Faculty of Graduate Studies
M.Sc. Program in Water and Environmental Engineering

M.Sc. Thesis

Municipal Solid Waste Management in Jericho and Ramallah Cities in the West Bank, Palestine

By:

Ammar J. Al-Khateeb

(1075379)

Supervised by:

Dr. Issam A. Al-Khatib

Birzeit, 2009

Municipal Solid Waste Management in Jericho and Ramallah Cities in the West Bank, Palestine

إدارة النفايات الصلبة في مدينتي رام الله و أريحا في الضفة الغربية، فلسطين

By:

Ammar J. Al-Khateeb

(1075379)

Supervised by:

Dr. Issam A. Al-Khatib

This thesis was submitted in partial fulfilment of the requirements for Master Degree in Water and Environmental Engineering from the Faculty of Graduate Studies at Birzeit University, Palestine.

Birzeit, 2009

Municipal Solid Waste Management in Jericho and Ramallah Cities in the West Bank, Palestine

إدارة النفايات الصلبة في مدينتي رام الله و أريحا في الضفة الغربية، فلسطين

By:

Ammar J. Al-Khateeb

(1075379)

This thesis was prepared under the supervision of Dr. Issam A. Al-Khatib and has been approved by all members of the examination committee

Dr. Issam Al-Khatib ……..

Chairman of the committee

Dr. Rashed Al-Sa'ed ……..

Member

Dr. Nidal Mahmoud ……..

Member

Date of Defense: 14th, November, 2009.

Dedication

To the candle that was burnt to light the road for us, to the soul of my father, Jalal Al Khateeb, God bless him, I dedicate this valuable work, since he is the first teacher I learnt from, he is the first one who established in me the confidence and critical thinking that enabled this work to be completed today.

Acknowledgments

I would like to thank my supervisor, Dr. Issam Al-Khatib guidance throughout this research project.

I would also like to thank Dr. Rashed Al-Sa'ed and Dr. Nidal Mahmoud for their helpful comments, and their willingness to share their time and advice.

I would like to thank concerned institutions for their assistance in completing the research and especially waste characteristics analysis, many thanks to all of my other people, friends and colleagues who were not mentioned here, and for their words of encouragement that have helped me and to achieve this research.

Special thanks to my beloved mother for her infinite care from kinder garden to graduate studies college and family for their listening when I needed someone to talk to and sincere appreciation for my wife Eng. Niveen Al-Abbasi for her endless support, patience and advice.

المستخلص

إن تزايد كميات النفايات الصلبة أصبحت قضية ملحة وهامة لبلديات المناطق الحضرية والريفية. تستخدم الإدارة المتكاملة للنفايات الصلبة (ISWM) بشكل واسع في جميع أنحاء العالم، وذلك للتعامل مع مثل هذه الزيادة السريعة والتباين و الإختلاف في التوزيع الفزيائي لمكونات النفايات. إن الإدارة المتكاملة للنفايات الصلبة بحاجة إلى إطار تشريعي قوي، فضلا عن تدابير تعزيز جانب المؤسسات المهنية من أجل تنفيذها بشكل فعال. في منطقة الدراسة (مدينتي أريحا ورام الله)، لا يوجد أساليب للحد و التقليل من انتاج النفايات، ولا لتدوير أوإعادة الاستخدام. ولا توجد منشآت لانتاج السماد الطبيعي (الدبال). تقيّم هذه الأطروحة النواحي الإقتصادية و الفنية لنظام إدارة النفايات الصلبة القائم. تم استخدام نوعين من الاستبيانات، الأولى على المستوى المؤسساتي، والثانية على المستوى المنزلي. تبين من النتائج أن إدارة النفايات الصلبة في منطقة الدراسة ليست قادرة على الاستمرار و التطور ذاتيا، وهي تعاني من انعدام التنسيق و ليس هناك استرجاع للتكلفة حيث ان نسبة الاسترجاع من المصاريف الحقيقية هي 67 % و 15 % لمدينتي أريحا و رام الله على التوالي، أظهر السكان نسبة اعتراض عالية لفصل النفايات في المصدر ،حيث أبدى 63 % و 92% من المستطلعين في مدينتي أريحا و رام الله ذلك على التوالي ، وأظهروا اهتماما عاليا حول مكان وحجم الحاويات. وعلاوة على ذلك ، فإن السكان غير راضين عن تنظيف الشوارع ؛ حيث يجري تنظيف 35 ٪ من الشوارع فقط .

أجريت الدراسة لكميات النفايات وتكوينها الفزيائي في موقعين من مواقع التخلص النهائي من النفايات الصلبة، حيث روعي ان يكون مصدر النفايات من مصادر تمتاز بدرجات متفاوتة من السمات الديموغرافية والاجتماعية والاقتصادية. كشفت هذه الدراسة أن تركيب النفايات البلدية الصلبة في المدينتين رام الله و اريحا على التوالي كان كالآتي: النفايات العضوية 40.15 % ، 41.63 % واللدائن (البلاستيك) 20.44 % ، 30.19 % والورق والكرتون 21.12 % ،10.58 %، والزجاج 4.39 % ، 2.02 % والمعادن 2.43 % ، 3.23 %.

توصي هذه الدراسة باعادة النظر في نظام الرسوم بالنسبة للنفايات الصلبة ، بالإضافة الى منهجية وطرق جمعها ، وينبغي أن يكون هناك برامج توعية و تعليم بيئي للمجمتع المحلي ، وينبغي تعزيز دور و كفاءة المؤسسات القائمة على ذلك ، وأخيرا دراسة الخواص الفيزيائية والكيميائية للنفايات يجب أن يكون ديناميكيا و مستمراً لتحديد أفضل وسائل الجمع والبدائل المتاحة للتخلص من النفايات مستقبلاً.

Abstract

Increasing amounts of municipal solid waste are becoming an issue for urban and rural municipalities. Integrated solid waste management (ISWM) is widely used throughout the world for coping with such rapid increase and variation in waste profile. Integrated solid waste management needs a strong legislative framework as well as reinforcement measures besides professional institutions for being implemented. In the study area (Ramallah and Jericho cities), no cleaner production methods are applied for waste reduction, no recycling and reuse alternatives, no composting plants exist. This thesis assesses the technical and economic status of existing system. Two types of questionnaires were used, the first for institutional and the second for household survey. It is found that the solid waste management in the study area is not self sustaining since the overall all cost recovery from actual expenditures is 67% and 15% for Jericho and Ramallah respectively, suffering from lack of coordination, primary collection methodology is different, in Jericho it is the curb side collection, while in Ramallah it is community bin collection, only 12 % and 2% of respondents in Jericho and Ramallah respectively had received environmental education. The residents showed high objection to waste segregation at source, 63% and 92% of respondents in Jericho and Ramallah cities respectively reported that, and they showed high concern about location and size of containers. Moreover, the residents are not satisfied about the street sweeping; only 35 % of the streets are being cleaned. A waste physical composition study was performed at two municipal solid waste disposal sites throughout the province with varying demographic and socioeconomic attributes. The results of the municipal solid waste composition survey showed the following results: the organics 40.15 % and 41.63 %, plastics 20.44% and 30.19% paper and cardboard 21.12% and 10.58%, glass 4.39% and 2.02% and metals 2.43% and 3.23% for Ramallah and Jericho respectively.

It is recommended to revise the cost tariff system for solid waste as well as the collection methodology and routes, the public should be environmentally educated, institutions should be strengthen and finally continuous physical and chemical characteristics of waste profile should be dynamically conducted to identify the better future collection and disposal alternatives.

Table of contents

List of Tables

List of Figures

List of Acronyms

ARIJ	Applied Research Institute - Jerusalem
CEI	Community Effect Index
ESWM	Ecological Solid Waste Management
EPA	Environmental Protection Agency
EQA	Environmental Quality Authority
FCA	Full Cost Accounting
GIS	Geographic Information System
ISWM	Integrated Solid Waste Management
JCSPD-JJRRV	Joint Council Service for Planning and Development for Jericho and Jordan River Rift Valley
JD	Jordanian Dinner
JICA	Japan International Cooperation Agency
JSC	Joint Service Council
LA	Local Authorities
LGUs	Local Government Units
MoEHE	Ministry of Education and Higher Education
MoLG	Ministry of Local Governorate
MoP	Ministry of Planning
MSW	Municipal Solid Waste
NGOs	None Governmental Organizations
NIS	New Israeli Shekel
oPT	Occupied Palestinian Territories
PCBS	Palestinian Census Bureau of Statistics
PNA	Palestinian National Authority
PRDP	Palestinian Reform and Development Plan
SPSS	Statistical Package for Social Sciences
UNDP	United Nations Development Programs
UNEP	United Nations Environmental Program
USD	United States Dollar
WHO	World Health Organization

1. Chapter One: Introduction

1.1 Research outline

This research thesis consists of four chapters. Chapter one provides an introduction covering the political, institutional arrangements, characteristics of the study area, literature review and objectives. Chapter two describes the methodology. Chapter three presents and discuss the results, and Chapter four presents the conclusions and recommendations.

1.2 Political situation and constraints

During the past four decades, Israeli occupation brought deterioration of the environment, infrastructure services, and the depletion of natural resources in the Palestinian lands. Management of solid waste throughout West Bank in occupied Palestinian Territories (oPT) has been ignored. Political restrictions, insufficient financial support and lack of expertise led to the situation where the solid waste is dumped without any proper management. Handling of solid waste in all stages, collection, transportation and disposal, is inadequate through out the West Bank. The major sources of solid waste in the West Bank are domestic waste, industrial waste, agricultural waste and medical waste. The current management of solid waste calls for immediate actions to minimize and control the expected severe environmental problems either to the groundwater, the soil or the air since the awareness of rapidly population increase and expected development in the industrial and agricultural sectors activate the hazardous situation (ARIJ, 1996). Since the establishing of Ministry of Environment (Environmental Quality Authority) in 1998, the Ministry had been managing an inherited vulnerable environmental situation that becomes serious problem in the occupied Palestinian Territories (oPT). Moreover, the continuing and uprising state of hostilities led to a significant decline in the Palestinian economy, with significant adverse impacts on solid waste management. Palestinian Authority is partially controlled the West Bank territory since

1995, its civil and institutional administration control are restricted and limited to areas A and B, while area C is considered under the Israeli control. On the other hand, areas A and B are described by their close location to residential areas; hence they are usually inappropriate for the purpose of solid waste disposal treatment facilities sites. The high costs of waste transport in some cases prohibit adequate solid waste management sustainable solutions (PMSP, 2006). For example, waste from the city of Ramallah, which can't reach the neighbouring Al-Bireh landfill due to restrictions of the Israeli military, is dumped in a wild dump site inside the boundary of Ramallah city posing serious health risks to residents. The city was invited to use the Israeli disposal facility in Abu Deis, but has forgone this option due to the high costs of transport and dumping fees. On the other hand, Al Bireh municipality can't reach its disposal site near Pesagoot colony on Saturdays, consequently Al Bireh municipality is using Ramallah wild dump site one day per week (Ramallah Municipality, 2009). Existing political situation is impeded and/or delayed the construction of new engineered landfill sites as well as other infrastructure utilities. As illustrated above the prosperity and sustainability of solid waste management is significantly affected by the political situations and uprising conflict.

1.3 Institutional and organizational arrangements

The Ministry of Local Government (MoLG) is the main coordinating leading ministry in line ministries of concern for solid waste management within the occupied Palestinian Territories (oPT), having overall responsibility and surveillance for the relevant functions of local government units (LGUs). The regional solid waste councils and municipalities are responsible for the construction of solid waste treatment facilities, under the supervision of the ministry of Local Government. The Ministry of Planning (MoP) is responsible for the overall planning and fund affording in coordination with other line ministries, while the Environmental Quality Authority (EQA) is responsible for licensing of sites, after getting

relevant approvals from Israeli side as per Osolo accord, environmental monitoring, provision of expertise and ensuring environmental protection. Palestinian Authority national policy, as presented in Palestinian Reform and Development Plan (PRDP) for 2008-2010, identified safety and security, good governance, increased national prosperity and enhanced quality of life, while the Palestinian environmental policy focuses on four dimensions: protection of public health, protection of natural resources, preservation of the rich cultural heritage and strengthening of environmental institutions, as per the PRDP 2008-2010, the Ministry of Planning (MoP) is planning to secure certain funds for the purpose of solid waste management as well as to enhance the capacity building of Environmental Quality Authority (EQA). From strategic planning point of view, the Palestinian Authority decided in coordination and consultation with World Bank to construct three regional landfill sites in the West Bank, northern, middle and southern West Bank, recently new talks and views are discussing the feasibility of fourth landfill site in the Jericho and Jordan River Rift Valley. These opinions are trying to cope up with any future expected outcomes for the peace process as returnees' migration. Due to the fact that the Jericho and Jordan River Rift Valley is considered as low density population area compared to other Palestinian areas (JCSPD, 2009), as per the census of 2007 it was estimated that population density in occupied Palestinian Territories (oPT) is 626 capita/km^2 , while it was 481 capita/km^2 in 1997. Moreover, the population density in Jericho and Jordan Rift Valley governorate is the lowest compared to others 71 capita/km^2 (PCBS, 2007). As MoLG delegated its authorities in the solid waste handling for the local councils, municipalities and joint service councils (JSC), the local government units are collecting, transfer and dumping the municipal solid waste.

1.4 Characteristics of the study area

The study area is divided into two locations, the first is Ramallah city and the second is Jericho city. Both cities are characterized by ancient vital historical cities. These two cities are representing two different natures in terms of topography and climate, but they are considered as the main Middle West Bank cities of the occupied Palestinian Territories. The following sections will introduce and summarize the geographical, meteorological, socio-economic and services conditions.

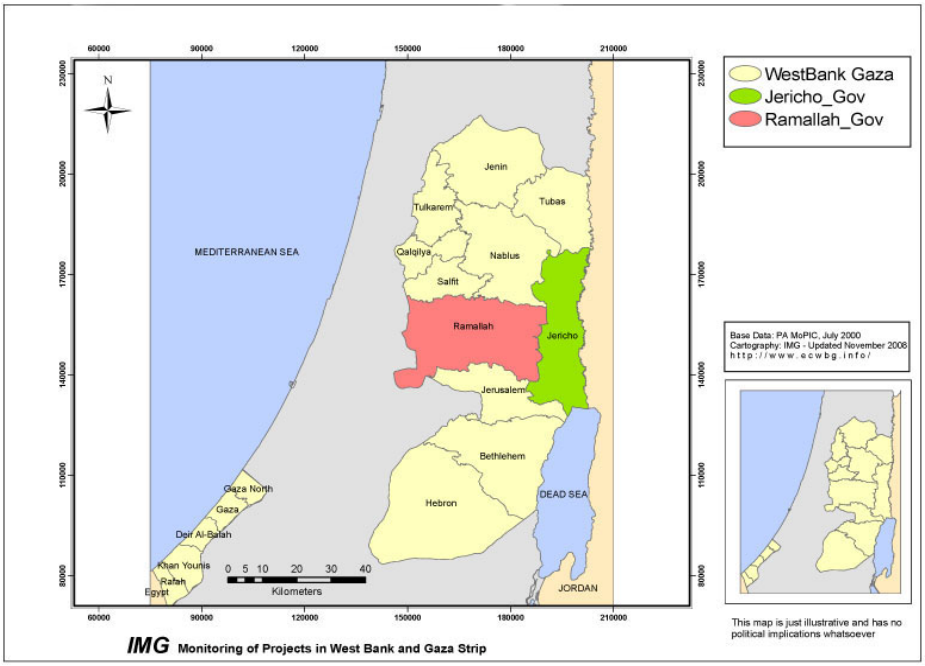

Figure1.1: Map of West Bank and Gaza Strip-occupied Palestinian Territories.
Source: International Management Group (2009), based data MoP (2000).

1.4.1 Ramallah city

1.4.1.1 Location

Ramallah is built on a mountain that oversees the Palestinian coastline on the West side. On the East and South side it is surrounded by mountains. Ramallah is about 10 miles north of Jerusalem, and is about 16 km away from the sea seen from its mountains. The ships docked at sea are visible from Ramallah on occasions. Due to the proximity of the sea to it, the air

coming to Ramallah from the West is humid, but the altitude of town from sea level which is about 830-880 meters makes this humidity less (Ramallah municipality, 2009). Nowadays, Ramallah city is considered as the temporary capital of the coming Palestinian state due to its proximity to historical capital of Palestine, Jerusalem.

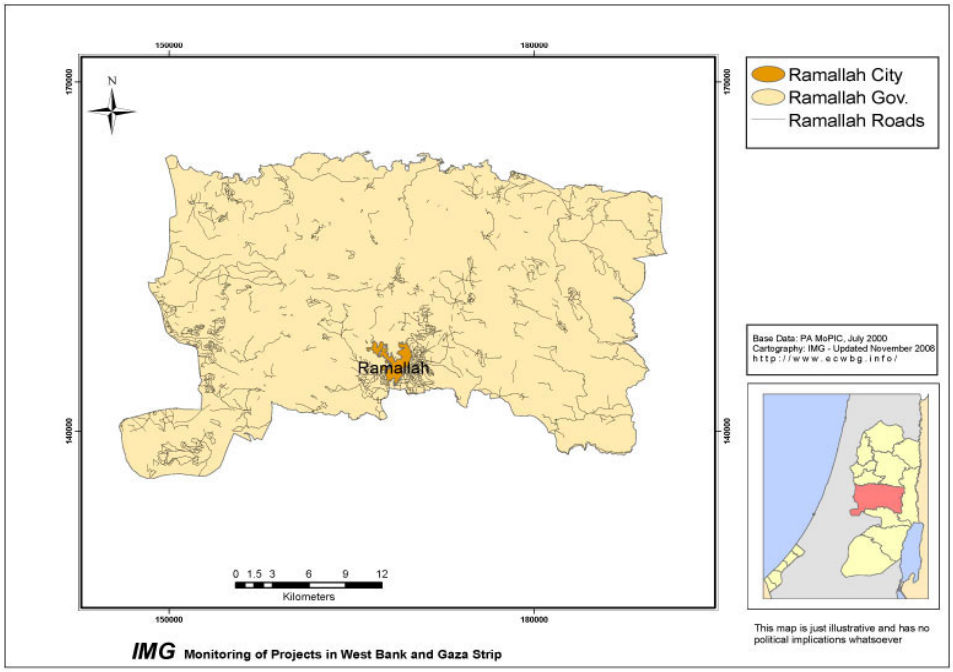

Figure1.2: Map of Ramallah Governorate-occupied Palestinian Territories.
Source: International Management Group (2009), based data MoP (2000).

1.4.1.2 Meteorological conditions

The climate in Ramallah is the Mediterranean climate. In winter, the town is subject to the harsh rainy south western winds and sometimes to the dry but cold north eastern winds. As for the average rain fall, it is around 20 inches or 500 ml a year. In general, the temperature in winter rarely drops to 32 F or 0 Celsius. During the summer, it hardly increased above 95 F or 35 Celsius. It can be said that the average annual temperature varies between 44-77 F or 5-25 Celsius. In April, the dessert winds blow, which are dry and dusty and mostly come from the south. These winds stop as the summer approaches. At the end of the summer and beginning of fall, warm winds blow into town and speed the end of the grape and fig season.

In general, the climate in Ramallah is refreshing in the summer and warm in winter which is considered as ideal for proactive life (Ramallah municipality, 2009).

1.4.1.3 Socio-economic conditions

Ramallah social life is widely varied due to availability of many cultural centres, parks, entertainment institutions, recreational places and hotels. Ramallah residents are working in commerce, private sector and public sector. The city has a plenty of light ad medium industry. The city is considered as a centre for Palestinian Authority ministries and many vital departments and international agencies. As per the census of 2007 the population of Ramallah city is about 27,460 and 8,477 housing units (PCBS, 2007), while the municipality is serving triple people of its original residents during the day light, since people are always visiting Ramallah city on daily basis. On the other hand, a large number of people have immigrated to other countries, especially to United States of America, those people has their strong relations with their families and homeland and send money back to be invested in economic activities. Ramallah city has developed at high rate where many new commercial centres and housing projects are constructed that encourages investors to start new business (ARIJ, 1996).

1.4.1.4 Infrastructure facilities

Ramallah municipality is managing and operating the infrastructure facilities in the city. The roads network inside the city is suffering from the absence of regular maintenance. The city is served by water distribution network, while approximately 70 % of the population are connected to sewage network (Ramallah municipality, 2009). The solid waste collection system is developing day by day, while Ramallah municipality is using wild dump site without any proper means of environmentally sound techniques. As stated by PRDP 2008-

2010 strategy, the Palestinian Authority is working on constructing a regional engineered sanitary landfill site for the Middle West Bank.

1.4.2 Jericho city

1.4.2.1 Location

Jericho is a green oasis in the Jordan Valley which lies 7 km west of the River Jordan, 10 Km north of the Dead Sea and 30 Km east of Jerusalem. It lies 250 meters below sea level and thus it is considered to be the lowest city in the world. The origin of the name "Jericho" is Semitic. To the Canaanites it meant "The Moon". In Syriac the name meant "Scent and odour". The city is called "The city of Palm" and "The Garden of God". Jericho is the oldest city in the world. The ruins of the oldest civilization discovered in Jericho are 10,000 years old (Jericho municipality, 2009).

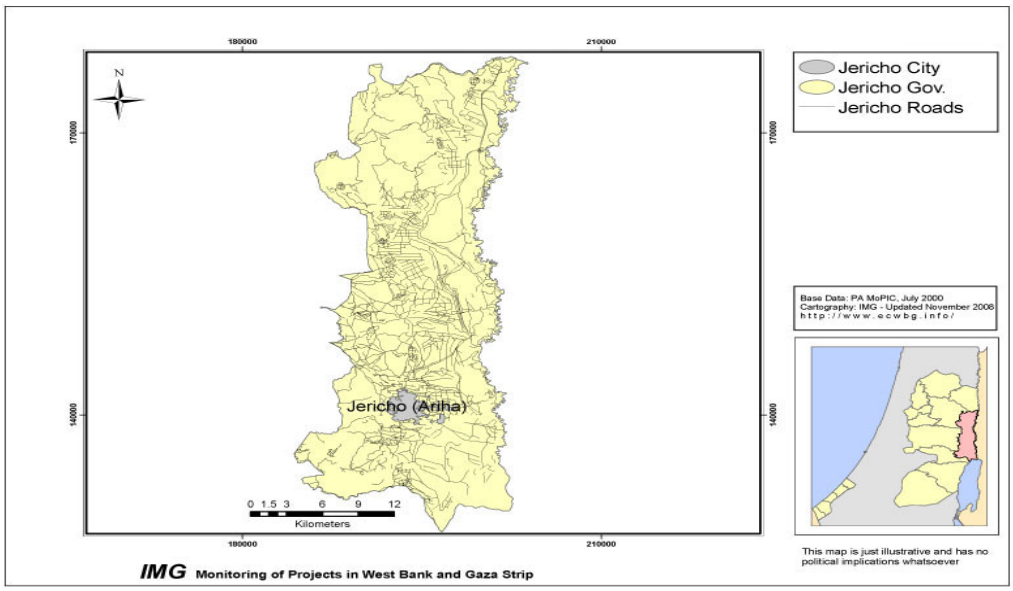

Figure1.3: Map of Jericho Governorate-occupied Palestinian Territories.
Source: International Management Group (2009), based data MoP (2000).

1.4.2.2 Meteorological conditions

The nice climate of the city is conducive to tourism both domestic and International. It is classified as arid which has hot summers and warm winters with very rare forests incidents

(ARIJ, 1995). The average temperature in January is 8.5 Celsius and the lowest average annual temperature is 17 Celsius. The average annual temperature is 23.5 Celsius and the highest average annual temperature is 30.5 Celsius , while it reaches in summer 44 Celsius (PCBS, 2006). The average annual amount of rainfall is 150 millimetres, and the average annual humidity is 52%. The amount of rainfall in the Jericho area is less than that of the surrounding mountains and the coastal regions, thus Jericho area relies entirely for drinking and irrigation on subterranean wells and springs such as the Ein Al-Sultan spring. The source of this water is situated in the distant mountains. Ein Al-Sultan spring is considered to be the main source for agriculture. It has an output of 680 cubic meters per hour, and a salinity of 600 fractions in one million. It provides a steady output throughout the year. It is used equally for drinking water and for irrigation (Jericho municipality, 2009).

1.4.2.3 Socio-economic conditions

In addition to its tourist sites, Jericho is considered to be an important area for agriculture. It is famous for its citrus fruits, dates, bananas, flowers and winter vegetables. The area within the municipality limits is about 45 square kilometres, and the population of the city of Jericho alone is 18,346 and 4,549 housing unit as per the census of 2007 (PCBS, 2007). There are a lot of important and beautiful historical places to visit in Jericho, such as Old Jericho, River Jordan where Jesus Christ was baptized, Mount of Temptation, Hisham Palace, Ein Al-Sultan (Elisha) spring, Sycamore tree, Monastery of Saint George (Wadi Kelt), Hasmoneans (Herod) Palace, Monastery of Dier hajlah, Kumran Caves, Dead Sea, and a lot more. The nice climate of the city is conducive to tourism both domestic and International. On the other hand, since 1994 Jericho is considered the only exist to Jordan for Palestinians since it has the Al limbi terminal to Jordan. So the municipality is paying services for ten thousands of people in

addition to its residents, but all passengers are paying services as municipality tax (JCSPD-JJRRV, 2008).

1.4.2.4 Infrastructure facilities

Jericho municipality is managing and operating the infrastructure facilities in the city. The roads network inside the city is suffering from the absence of regular maintenance. The city is covered by water distribution network, while no sewage network in the city (Jericho municipality, 2009). The solid waste management is under the responsibility of the Joint Council for Services and Development for Jericho and Jordan River Rift Valley (JCSPD-JJRRV). Jericho solid waste is collected by the JCS and dumped to recently constructed sanitary landfill. The solid waste management in Jericho is developing day by day (JCSPD-JJRRV, 2008).

1.4.3 Population

Population size is always a relevant factor in estimating majority of municipal services. Municipal Solid waste total generations are mainly dependent on per capita generation. For proper solid waste management plan and sustainability, it is mandatory to predict in some manner the future population based on statistics. The following table 1.1 illustrates the population growth rate in Palestinian occupied Territories (PCBS, 2000).

Table 1.1: Population growth rate

Year	Growth rate
2005	4.52
2010	4.05
2015	2.83
2020	2.51
2025	2.21

Source: PCBS, (2000).

After performing simple calculations based on the above growth rates, the following table 1.2 summarizes the populations' projects for Ramallah and Jericho cities.

Table 1.2: Population projections

Population/Year	2007	2009	2010	2015	2020	2025
Ramallah city	27,460	29,998	31,354	38,239	43,965	49,767
Jericho city	18,346	20,042	20,948	25,548	29,373	33,249

1.5 Solid waste characterization

Municipal Solid Waste (MSW) includes domestic solid waste from households, refuse from commercial offices and business holding, refuse from community holdings such as schools, colleges, mosques, churches and clubs, trash swept from streets and residue from all types of sanitary facilities in the form human excreta, toilet papers and the like (Alam et al., 2007).

A mandatory fundamental step prior a successful implementation of any solid waste management plan is the availability of information on the characteristics and quantities of solid waste generated (Abu Qadais, 2007). Solid waste types and generation analysed by local surveys and estimates indicate that household waste accounts to 45-50% of the total solid waste, with the construction and industrial sectors together constituting 20-25% and remaining types (e.g. commercial, institutional) 25-30% (Al-Hmaidi, 2002). The majority of waste is organic material, mostly in the form of food waste. Also, plastic bags are used and disposed frequently. Paper makes up a relatively small portion, much of which is cardboard and newspapers. As far as solid waste generation, the estimates are as follows: in refugee camps: 0.5-0.8 kg/capita; in rural areas: 0.4-0.6 kg/day; in towns/villages: 0.6-0.8 kg/day; in cities: 0.9-1.2 kg/day. It is difficult to obtain adequate population data for calculating overall levels of solid waste generation. Nevertheless, it is estimated that the total annual solid waste

generation for the West Bank altogether is likely to approach 500,000 tons (Al-Hmaidi, 2002).

In India, it is estimated that the Indian cities are generating 42 million metric tonnes annually, the per capita waste generation ranges between 0.2 – 0.6 kg/day. On the other hand, the socio-economic conditions, developing urbanization and economic growth are affecting the per capita waste generation per day by about 1.3% (3iNetwork, 2006 cited in Zia; Devadas, 2008). In Iran, Rasht city, the collected data showed that the per capita waste generation is about 0.8 kg/day (OWRCMR, 2007 cited in Alavi Moghadam et al., 2009). In Turkey, the solid waste generation rate is between 1.32-1.34 kg/day (SIS, 2004 cited in Tinmaz and Demir, 2006). In Bangladesh, studies showed that the per capita waste generation is about 0.36 kg/day (Alam et al., 2007) , while in Cambodia is about 0.34 kg per capita per day (Parizeau et al., 2006). In Philippines per capita generation waste is about 0.31 kg/day (Bennagen et al., 2002). As it was viewed latter, it is well documented in the literature that solid waste per capita generation rates and solid waste physical characteristics distribution vary across the world, and even across the developing world. Solid waste per capita generation is affected by the income and location, it seems that residents with higher income will consume more goods that leads to more production of waste, this is can not be generalized since previous studies had not use the same scale for the income and even the level of income is varied from country to country and it is even fluctuating within the same country from place to another. For example in a study in Abu Dhabi City, United Arab Emirates, it is found a strong positive correlation between household generation and self property rental rates (Abu Qadais et al., 1997 cited in Parizeau et al., 2006). The household location is affecting the per capita generation rate, urban or rural. Some times some households have their own business, meaning in rural areas some people have animals and

they used food waste to feed their animals (Parizeau et al., 2006). Other studies have shown that there is a relationship between waste generation and household size, the per capita waste generation decreases as the household members' increases, possibly due to economies scale in the consumption of goods and packaging (Abu Qadais et al., 1997 and Bolaane and Ali, 2004 cited in Parizeau et al., 2006). Solid waste nature, classification, distribution and quantity are affected by source, socio-economic aspects, income, lifestyle, seasonal migration and the degree of urbanization. More over, components of municipal solid waste are a critical factor in particular management decision process (Buenrostro and Bocco, 2003). Special studies shall be performed to assess the actual distribution of solid waste characterization. Waste characterization can be determined by field-scale analyses of wastes through collection of representative samples from the different districts of the study area. Mixing of samples from different sources isn't recommended since the type and content of solid waste is significantly affected by the socio-economic aspects (Tinmaz and Demir, 2006). In developing countries the organic fraction in the solid waste generation is high and may reach up to 60%. Solid waste characterization and quantification is very helpful and economically feasible, since the method of handling, storage and processing of solid wastes at the source plays an important role in public health, aesthetics and the efficiency of the municipal solid waste system (Alavi Moghadam et al., 2009). Moreover, it will help in determination of capacities and number of collection vehicles, potentials for recycling and recovery alternatives (Parizeau et al., 2006).

In India, based on investigations performed by NEERI (1996) and Kanpur Municipal Corporation (1999), the percent distribution of solid waste are showing paper 4%, biodegradable 44.3%, inert (dust, ash, etc.) 39.2%, metals 0.01%, textiles 4.9%, plastics, leather and rubber 7.6%, others (stones, wood, etc.) 0.1% (NEERI, 1996 cited in Zia and

Devadas, 2008). In Iran, as per the recycling organization of Rasht municipality, 2007 the physical analysis of MSW showed the following distribution: food wastes 80.2%, paper and cardboard 8.7%, metals 0.7%, textiles 0.4%, glass 0.2%, rubber and plastics 9%, wood 0.4% and others 0.4%, as it is noticed the organic faction is high and this mainly due to the amount of unprocessed foods in the daily diet of inhabitants (Alavi Moghadam et al., 2009). In Turkey, the characterization percent profile of solid waste is showing cardboard 2.4%, food and yard 54.2%, metals 3%, glass 6.3%, nylon 9.4%, textile 1.9% and ash and others 5.9% (Tinmaz and Demir, 2006). In Philippines studies showed that the solid waste composition as the following: food wastes 36%, papers and cardboard 12%, plastics 11%, textiles 3%, rubber and leather 3%, wood and yard wastes 12%, metals 8%, glass 6% and others 9% (JICA, 1992 cited in by Bennagen et al., 2002). In Bangladesh, the composition of mixed MSW for Habibganj city illustrated that the percentages of food wastes 50%, fine dust 9.6%, plastics 10.3%, stones, bricks and earthward 14.3%, paper 6%, metals 1.5%, leather 2% and others 1.8% (Alam et al., 2007). In Jordan capital, Amman city, the typical physical percentage distribution of the MSW is food wastes 54.4 %, paper and cardboard 14%, plastics 13.2%, metals 2.4%, glass 2.8% and others 13.2% (MOGA, 2001 cited in Abu Qadais, 2007).

1.6 Solid waste management

Urban development is considered as a key element for the design of most infrastructures facilities, since urbanization will be reflected to different design parameters as well as to settle a planning mechanism for the involvement of concerned institutions. Solid waste collection and disposal is deemed to a perquisite mandatory service for the construction of sanitary systems. Distinctive approach shall be followed in urbanization management, especially in the identification of causes and their impacts of urbanization process and their driven forces (Chang et al., 2007). The Waste hierarchy is a key element of integrated solid

waste management (ISWM) and is widely applied in industrialized countries. It is based on environmental principles. This hierarchy is an open system and faces a lot of criticism in the order that has been given to follow. Recently, it has given way to a closed-loop concept called ‘‘zero waste’’ started at Canberra, Australia, and aims to eliminate rather than ‘‘manage’’ waste; it is a whole system approach that aims for a massive change in the way materials flow through society-resulting in no waste and is both an end of pipe solution, which encourages waste diversion through recycling and resource recovery, and a guiding design philosophy for eliminating waste at source and at all points down the supply chain (Act Government, 1996 cited in Zia and Devadas, 2008). Waste reduction is accomplished by changing behaviour (consumption patterns) so that new habits or practices are developed that generate less waste (Green Solutions, 2007). Preventive measures cover prevention, reduction at source and the reuse of products, while waste minimization additionally includes the waste management measures of quality improvements and recycling (Salhofer et al., 2008). Usually more than 60% of solid waste management cost is allocated for the purpose of collection and transportation, accordingly careful analysis and understanding of this vital section of solid waste management should be performed to ensure the effective timing of collection and transportation and using compatible collection vehicles in terms of technology and size (Jalilzadeh and Parvaresh, 2005). Modification of collection and transport of solid waste shall be kept as dynamic process for coping with any unforeseeable emergency conditions (Haskoning, 1994). However, due to the social benefits of the solid waste program, it is desirable to obtain balanced assignments of collection trips unloading their cargo at the disposal facilities. A heuristic approach, incorporating an auction algorithm and a dynamic penalty method, is designed to acquire a good solution (Li et al., 2006).

1.7 Perception and willingness of household towards solid waste management

Ecological Solid Waste Management (ESWM) is identified as one of the best means to tackle the issue from the environmental and socio-economic point of view. The understanding of public concerns toward ESWM is very essential for the community support for any proposed solid waste management programs. Considering the public preferences in ESWM will maximize the welfare of residents towards management plans, especially regarding waste segregation and recycling activities (Suranga and Gunaratne, 2007). Attitudes and behaviour to waste management can be measured quantitatively and qualitatively in terms of reasons for practicing source segregation, role of household in waste segregation, practicing recycling alternatives (i.e. compost), resource recovery practices, willingness to pay garbage fee, difficulties in solid waste management and responsibility of garbage collection. A baseline information on waste management related concerns and attitudes is compulsory for effective waste management and decision making at local and national levels (Bennagen et al., 2002). Public preferences and concerns are varied as per residents' socio- economic characteristics, age, gender, income, education and illiteracy, life style, nature of occupation, environmental and health awareness and location (Parizeau et al., 2006). The residents' perception may be influenced by incentives, presence of children in household and information through direct media (Vicente and Reis, 2008). On other hand, the existing situations affect significantly the public concerns and perception, that is, existing services that are delivered by the institutions managing the solid waste sector. The institutional behaviour is very important in the solid waste management since these institutions are in contact with local residents on daily basis, while people are directly affected by the delivered services, meaning better quality of services and incentives by institutions will yield better cooperation and integration of the community in the program enhancement (Refsgaard and Magnussen, 2009).

1.8 Environmental economy

"Environmental Economics undertakes theoretical or empirical studies of the economic effects of national or local environmental policies around the world. Particular issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming" (NBER, 2007). In recent years the environmental awareness and concern is become one of the most significant issues worldwide, especially in developing countries. Locally, valuable efforts are paid to enhance the environmental status and conditions through setting environmental policy and strategy. In the occupied Palestinian Territories, the environmental enhancement and prosperity can't be separated from the escalating political situation. Social life, economy and environment are basic requirements for sustainability and prosperity. Proper solid waste management is a core concept for the environmental enhancement; it is reported by Palestinian Central Bureau of Statistics (PCBS, 2008) through the residential environmental survey that more than 2.8 thousands ton are produced on daily basis without proper environmentally sound management techniques. On the other hand, 95% of economical establishments in the Palestinian occupied Territories are not performing source separation for the produced solid waste (PCBS, 2008). The willingness and the degree of attention paid to sustainable environment vary from country to country and it is related to the economic status. The are several factors responsible for poor and inadequate performance in developing economics, these factors are, and not limited to, urbanization and population growth that leads to the number of areas to be served and increasing of waste quantities, inadequate financial and human resources, inappropriate technologies used in all waste handling processes, societal and management apathy and absence of cost effectiveness and recovery principles (Shekdar, 2009). Understanding the costs of each MSW activity often will be necessary for compiling

the costs of the entire system and helps you evaluate whether to provide a service yourself or contract out for it. Understanding the full costs of each path is an essential first step in discussing whether to shift the flows of MSW one way or another. No single solid waste management approach is perfect since many communities have discovered that integrated solid waste management (i.e., using a mix of solid waste management approaches) can minimize costs and environmental effects and maximize recovery and conservation of energy and materials. Communities using integrated solid waste management can use Full Cost Accounting (FCA) to communicate the costs of different MSW approaches (EPA, 1997). It was proposed that the associated costs within the FCA can be classified into the following categories; up-front costs that cover the initial investments and expenses necessary to implement solid waste services, operating costs that include the expenses of daily basis management, external costs that could be result from environmental damages and human health programs that might arise from solid waste collection and disposal, and back end costs that related to expenses of taking proper care of treatment facilities and other solid waste services provision at the aftercare or decommissioning (EPA, 1997 cited in Abdrabo, 2008).

1.9 Landfill selection

Landfill selection in an urban area is a critical issue in the urban planning process because of its enormous impact on the economy, ecology, and the environmental health of the region. Landfill site selection can generally be divided into two main steps: the identification of potential sites through preliminary screening, and the evaluation of their suitability based on environmental impact assessment, economic feasibility, engineering design, and cost comparison since an inappropriate waste facility may adversely affect the surrounding environment and other economic and socio-cultural aspects (Chang et al., 2007). The construction of landfill is complex and difficult, due to residents' opposition and

environmental contamination that needs high investment costs in order to create environmentally sound treatment facility. Landfills have a lot of variables; each variable has its impact indicators, so a theoretical framework is needed in order to identify the important significant factors and interactions that contribute and establish the cause effect relationships in order to assess the contamination probability (Zeiss, 1995 cited in Zamorano et al., 2008). Land is among invaluable and finite resources that must be used wisely due to actual situation of sacristy and depletion of natural resources (Javaheri et al., 2006). For techno-economic reasons, landfilling is the most appropriate option for small-middle sized cities. Landfill capacity and life time is an essential design parameter; organized waste management plan should be prepared including expected waste quantities and nature that will be dumped (Chattopadhyay et al., 2009).

1.10 Solid waste status and challenges in the West Bank

Currently, dumping in open areas and burning are the most common methods of disposal throughout the West Bank. Evidence also shows that much of the solid waste generated by settlements is being disposed of on Palestinian land. Most disposal sites are unplanned and unmanned open dumps with little consideration being given to their proximity to people, agriculture, or water resources. Often, the solid waste is burned at these sites causing serious air pollution. The current management of solid waste may lead to contamination of groundwater and soil, air pollution and most of all public health hazards. The rapid population increase and the expected development in the industrial and agricultural sectors are likely to aggravate the situation. The main operational conditions and problems facing solid waste management in the West Bank include and not limited to lack of proper infrastructure for disposal and transfer of solid waste, shortage and poor technical conditions of equipment used for collection, transfer and disposal of solid waste, disruption of normal

solid waste transportation routes due to movement restrictions, open burning of waste, setting up of emergency dumpsites within the urban areas causing negative environmental and health impacts, limited access to maintenance equipment and spare parts due to delays, transport difficulties and current import restrictions, high increase of operational costs, adding a further financial burden on local entities (UNEP, 2003). 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. 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 (Tulkarem 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, 2007). Japan international cooperation agency (JICA) started working on the capacity development on solid waste management in Jericho and Jordan River Rift Valley area and the project is still ongoing (JCSPD-JJRRV, 2009). Nowadays, three major projects are on going, the first is the solid waste collection equipments for the West Bank funded through the European Commission with total budget of about 7 M€, the second is solid waste equipments for the West Bank funded through Japan and the third project is construction of

regional landfill sites for northern, middle and southern West Bank of occupied Palestinian Territories (oPT) funded by World Bank (MoLG, 2008).

1.11 Research objectives

1. To estimate the volume of municipal solid waste generated at the Jericho and Ramallah cities as well as their respective physical percent distribution;
2. To assess the level of services; to analyze the current practices and methods of solid waste management and to analyze the institutional (technical, operational and financial) and legislative framework;
3. To study the socio- demographic characteristics of the study population, attitudes and concerns and willingness to be integrated in different aspects of solid waste management;
4. To evaluate the satisfaction and awareness of the citizens with the level of service provided, and
5. To propose an integrated management system which is environmentally sound and economically feasible for dealing with the solid waste problem at the Jericho and Ramallah cities.

2. Chapter Two: Research Methodology

2.1 Introduction

The proposed study area for research is Ramallah and Jericho cities in West Bank in the occupied Palestinian Authority (oPT). Survey research method was used to collect the data at both institutional and households' levels. The study area was divided into two zones, Jericho and Ramallah, for technical and administrative purposes. On the other hand, the institutional level entities, JCSPD-JJRRV, both municipalities Ramallah and Jericho, and other Palestinian entities were collaborated in process of assessment. Two questionnaires were used, the first was semi-structured and used for the stakeholder level; particularly for municipalities and the second is structured and was used for household level.

2.2 The stakeholder survey

The stakeholder survey questionnaire was designed to measure and evaluate the technical, operational and financial capacities of the institutions involved in the solid waste handling in the study area, the questionnaire was adopted from the World Health Organization (WHO, 1996), then modified and customized for the purpose of the study. This questionnaire (Annex 01) included data on institutions itself and their functionality, number of employees and their classification, equipments owned and contracted by local authorities for solid waste collection, quantities and physical characteristics of solid waste, served areas by solid waste collection service, possession of maintenance workshop, economic incentives, residents cooperation, safety procedures, financial burden, data on expenditures and revenues, obstacles and challenges which are facing them during solid waste handling and their willing to apply new techniques towards solid waste enhancement. Several personnel meetings were held with respective municipalities and Joint Service Council for discussing the institutional questionnaire. The period of surveying assessment took about one month, in during several

correspondences were addressed, eventually the data were collected from concerned institutions in the two cites, analyzed and results are presented in the next chapter.

Deep interviews and meetings is another research method was used with decision making stakeholders in this regard who care involved in the solid waste management in the area, in order identify the opportunities, weaknesses and threats which are considered important. These kinds of interviews were mainly held with Palestinians entities, such as Environmental Quality Authority (EQA), Ministry of Education and Higher Education (MoEHE) and Ministry of Local Government. These interviews were dependent on prepared list of questions focused on how such entities can be integrated in solid waste management, for instance, in the strategic planning and legislative framework, the public awareness and targeted programs for pushing people to cooperate in such fields of solid waste enhancement.

2.3 The household survey

Based on institutional survey results, the household survey was designed and it was focused on general information about the location including demographic characteristics and socio-economic, solid waste management in the study area, environmental concerns, sensitization concerns and recycling and reuse. This questionnaire was designed to examine households' satisfaction about the existing solid waste management services, awareness and attitude toward willingness of be incorporated in the integrated solid waste management, especially, waste recycling, source separation, willing to buy recyclable products, keenness to pay for the solid waste services as well as the information about the gender, marital status, family size, educational level, income and occupation were assessed.

For this purpose the study area was divided into two stratums Jericho and Ramallah, then each stratum was divided into several wards that mainly dependent on geographical location. The following table 2.1 introduces the stratums and wards.

Table 2.1: Study area stratums and wards

Wards / Stratum	**Stratum 1: Ramallah**	**Stratum 2: Jericho**
Ward 1	Al Masyoun	Ketf Al Wad
Ward 2	Ein Minjed	Al Khedeiwi
Ward 3	Old City	Al Yarmouk Residentail
Ward 4	Al Teera	Palestine street
Ward 5	Ein Musbah	Yaffa Street
Ward 6	Baten Al Hawa	Qaser Hisham Street
Ward 7	Industrial Zone	Al Maghtas

2.3.1 Estimation of sample size and distribution

The household survey as aforementioned has assessed the satisfaction of community towards existing solid waste management service and examined their attitudes and cooperation in the view of integrated solid waste management. The collected data is categorical including mutually exclusive categories as presented in Annex 02. Measured variables are two categories, binary-dichotomous, or more than two categories, nominal or ordinal. The survey was assumed to be normal distribution, while the confidence level 95%. The sample size has been estimated as per the following formula.

$$n = \frac{N \times Z^2 \times p\,(1-p)}{Nd^2 + Z^2 \times p\,(1-p)}$$

n: requested sample size.

N: total number of household (sample frame)

p: proportional of successes (assumed to be 50%)

d: allowable margin of error(assumed to be 5%)

Z: standardization value correspondent to 95% CI (1.96)

This equation was used since the community, sampling frame is known and population is estimated. As per PCBS census 2007 the population of Jericho city is about 18,346 with average family size 5.2, the expected population number in 2009 is about 20,000 as per table 1.2. The average number of households is 3,845 household. In Ramallah, the population as per PCBS census 2007 is about 27,460 with average family size of 4.5, the expected population number in 2009 is about 30,000 as per table 1.2. The average number of households is 6,666 household. Total numbers of households are 10,511. The following table 2.2 summarizes the total sample size distributed on two stratums.

Table 2.2: Sample size per stratum

Total sample size	370
Stratum 1: Ramallah	235
Stratum 2: Jericho	135

The sample was distributed on seven wards, the number of households per ward was determined in consulting with respective authorities in order to reflect the actual size of served population. The survey was conducted from a known place in each ward, and then systematic sampling was performed. Figure 2.1 illustrates the survey execution methodology. Analysis of data was performed using Statistical Package for Social Sciences (SPSS)

computer program version 13. Appropriate test of significance (Chi-square) was used to determine the relationships between variables.

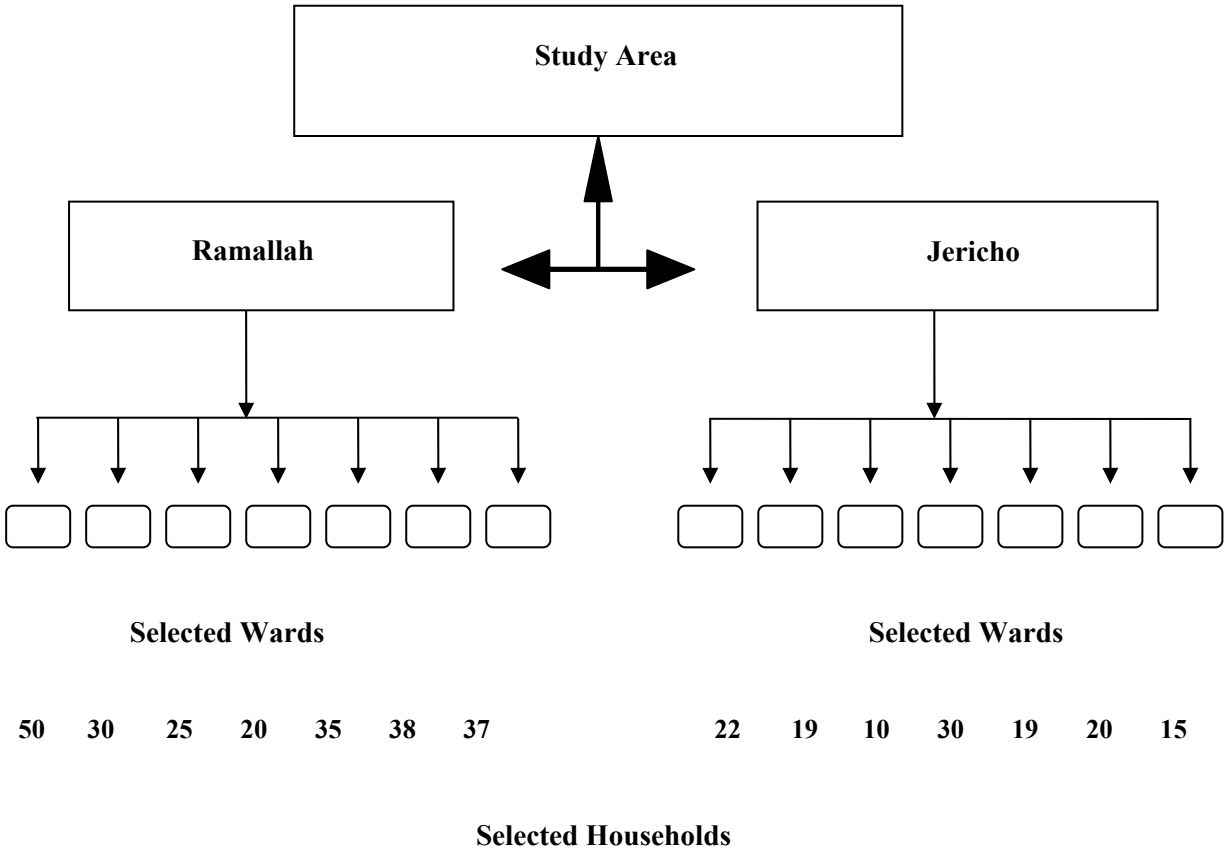

Figure 2.1: Flowchart showing selected households of systematic random sampling

2.4 Solid waste quantification

Based on institutional questionnaire results, Ramallah city has a dump site without any environmental precaution measures as well as the site isn't equipped with Weigh Bridge. On the other hand, Jericho landfill site has environmental precaution measures and it is equipped with several disposal machineries including the Weigh Bridge. Since the household solid waste generation and quantification is beyond the research objectives, the quantity of solid waste was measured and quantified at Jericho landfill site, Ramallah quantity of solid waste was estimated based on municipality records since the site work wasn't possible due to

logistics obstacles, while in Jericho the quantification was estimated using the weigh bridge existing in the site.

Figure 2.2: Weighing refuse compactor on the weighbridge at Jericho landfill site

2.5 Solid waste characterization

They are many methods for household waste composition studies and component analysis, there is no standard method throughout the world, meaning within one small country it is possible to have several methods used in parallel, but if characterization and quantification of municipal solid waste stream were carried out and interpreted consistently, comparisons and cause-effect discussions could be achievable (Dahle`n, 2008).

2.5.1 Procedure of solid waste characterization

Samples were taken from the two cities (from Ramallah dumping site, and Jericho sanitary landfill), samples were taken from each site distributed on the week days to cover the consumption patterns and variations in week days. The procedure of the sampling was done

according to World Health Organization (WHO) method (WHO, 1988). A sample of 0.5 m^3 volume (in a tank with 1m height x 0.5 m width x 1 m length) of solid waste was screened each time over the mesh screen for segregation into its different components. Common sense and random sampling was used in selecting the sample. The samples were qualitatively and quantitatively analyzed in screening equipment 1.5 m width by 3 m long. The screening surface is 10 mm x 10 mm mesh size surface that used as go gages. This means that any solid waste less than 10 mm in diameter can pass through the screening surface. The tank was shaken three times without any pressing force on it. Then the tank content was disposed on the screening surface and manually separated. Each sample was sorted into eight main components: (1) Organic and food wastes (compostable); (2) Plastics; (3) Paper and cardboard; (4) Glass; (5) Metals; (6) Textiles; (7) other waste (leather, wood, ashes, etc); and (8) Waste less than 10 mm size. The following figure 2.3 illustrates the classification process.

2.5.2 Execution of solid waste characterization

The process of characterization began directly after the discharge of waste into the disposal site in order to minimize the errors due to the loss of humidity, and then to ensure the homogeneity of the sample, the discharged load was separated and sorted using the tank of 0.5 m^3. The tank was shaken three times without any force erected on it. Then tank was weighted in order to determine the density of the solid waste sample. Then the content of the tank was separated and sorted on the plastic sheet manually into the eight categories aforementioned above. Each category of solid waste was put in separate bin, identified and marked for this purpose. Then the remaining wastes on the plastic sheet were screened over mesh screen of 10 mm x 10 mm, the passing wastes from the screen were a mixture of organic materials, inert materials, seeds and soil. The remaining on the screen was re-separated again. It is very important to underline that the characterization process was

executed with continuous supervision as well as all necessary safety protective measures were taken such as wearing gloves and muzzles .

2.6 Observation

Another research tool was used during the research process was observation, since it is good at explaining what is going on, reports the significant social behaviours and underlines the most important and sudden activities that were not planned to be assessed.

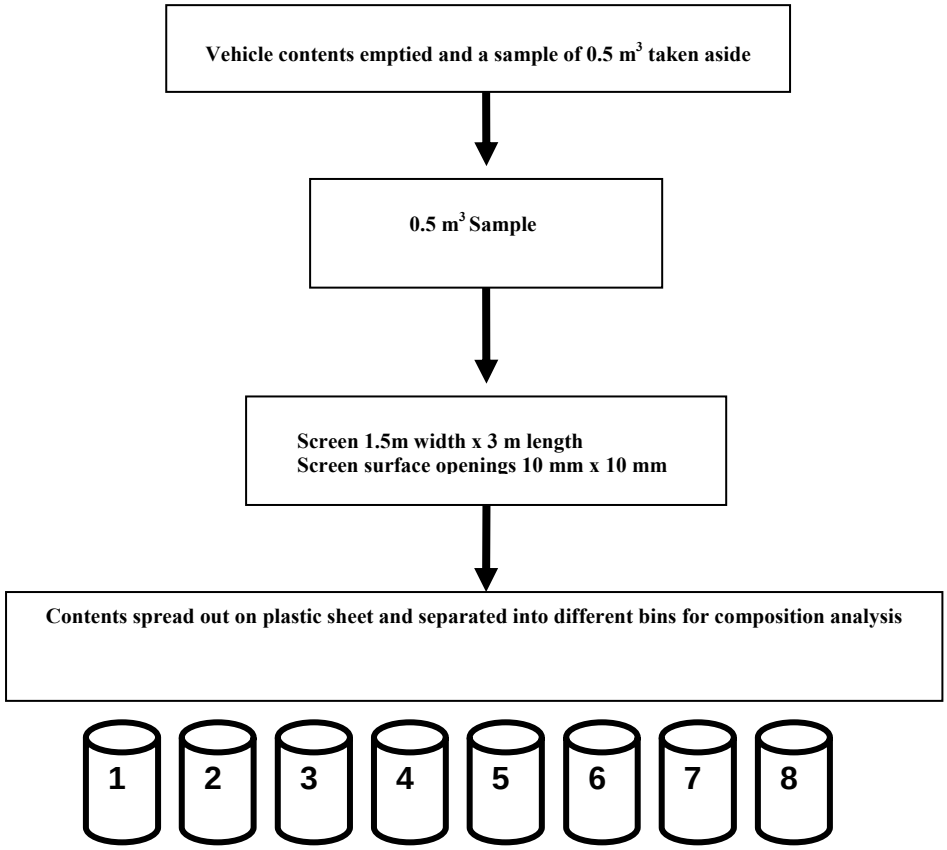

Figure 2.3- Sampling procedure for composition analysis of vehicles arriving at dumpsite /landfill

Step 1: Filling the tank by wastes-Jericho

Step 2: Shaking the tank-Jericho

Step 3: Separation of waste into eight fractions- Jericho

Step 4 : Screening -Jericho

Step 5: Weighting municipal waste characterized fractions- Jericho

Step 6: Weighting for density-Ramallah

Step 7: Separation of waste into eight fractions-Ramallah

Step 8: Screening-Ramallah

Figure 2.4: Steps of municipal solid waste characterization in the study area

3. Chapter Three: Research results and discussions

3.1 Legislative framework

Local authorities (LAs) including municipalities and village councils are directly responsible for solid waste management (SWM) services in occupied Palestinian Territories (oPT). The Ministry of Local Government (MoLG) supports and coordinates local authorities in various ways. The Local Authorities Law (1997) of the Palestinian National Authority (PNA) allows small-scale local authorities such as village councils to organize an association, the Joint Service Council (JSC), for the provision of public services. On the other hand, the Palestinian Environmental Law was issued in 1999, which was approved by Palestinian Legislative Council, is consisting of 82 articles that covering the environmental conditions in general, it is by the law that the Ministry of Environment is responsible to formulate and implement a comprehensive national strategy and plans for the solid waste management. Besides, the law is discussing some fields of solid waste management such as solid waste minimization through recycling and reuse, and polluter paying principle, but the law is not detailed and not active in many fields of concern along the country (EQA, 2009). It was noticed that after 10 years of issuing the Palestinian Environmental Law, there is no actions plans that translating the law into applicable practical mechanisms on ground. Despite of intensive efforts exerted for the development of the solid waste sector, the solid waste management is still suffering from apathy in coordination and conflicts in responsibilities and duties between concerned institutions, lack of continuous compliance monitoring, absence of national plans, existing of gaps in the legislative and law in this regard that lead to deterioration in the implementation and donation mechanisms (EQA, 2008). As illustrated in Environmental Law for the year 1999, it was agreed on preparation of national strategy medium plan for solid waste management that determines the priorities, needs, institutional involvement and it will be the reference for all concerned institutions.

It was found that Ministry of Education and Higher Education (MoEHE), curriculums center integrated the public health subjects into the education process since 2002, now it is found that from the seventh grade to tenth grade there are variety of topics in this regard that are taught to students at schools such principles of keeping clean towns and cities, waste minimization through introducing the recovery and reuse techniques as well as maintaining public healthy hygiene , as it is declared by the ministry, these materials are going to be updated in order to enhance the public awareness regarding the environment in general and solid waste in particular. Some campaigns are held yearly in the schools, such as a day for cleaning the school, streets around the school, and child is a friend for the environment principle is being strongly introduced. During reviewing the material in the text books, it was found that all basic principles for the solid waste management are gradually taught to students along their studying period.

3.2 Municipal solid waste management (MSWM) in the study area

3.2.1 Entitled authorities for MSWM in the study area

As per the local authorities law, the local entities such as municipalities and joint service councils are responsible for the solid waste management in their area of responsibility. The solid waste management in all stages; storage, collection and disposal are carried out in Ramallah city by the Ramallah municipality. The municipality is delivering the service to residential, commercial, institutional and industrial facilities. Moreover, the municipality is performing the streets sweepings as well as other related tasks related to cleaning and removal of wastes from the public facilities. On the other hand, the responsibility is shared between the municipality and the joint council service for planning and development in the Jericho and Jordan River Rift Valley (JCSPD-JJRRV) in Jericho city. The JCSPD is performing the collection of wastes from distributed containers throughout the residential and

commercial premises (secondary collection) of the wastes to Jericho sanitary landfill. Jericho municipality is performing the primary collection from houses to the nearest container by individual workers, streets sweeping, collection form the industrial facilities as well as other fields of concern. It is important to underline here that the local government units (LGUs) in Jericho and Jordan River Rift Valley governorate delegated their solid waste service to the JCSPD-JJRRV.

3.2.2 Environmental awareness and incentives

In general the planning, funds allocation and staff recruitment are the responsibility of Ramallah municipality and JCSPD-JJRRV in the study area. It was concluded that the training of solid waste management team as well as the public environmental awareness are performed by Ramallah municipality, JCSPD, none governmental organizations (NGOs), Japan International Cooperation Agency (JICA) and United Nations Development Programs (UNDP). It was figured out that the responsible authority in Ramallah is conducting environmental awareness activities through the environmental awareness unit in the municipality which coordinates with international and local organizations. In Jericho, it was obviously noticed that these activities are more concentrated and effectively developed. For instance, the JCSPD conducted more than 250 community meetings with residents in the governorate and not only in the city itself, in addition to issuing newsletters, leaflets, booklets, documentary and educational films and posters. Moreover, it was noticed that some economic incentives were issued such as people who has the special bags that sold with environmental headlines, will have discounts on goods prices from special shops and markets in the city of Jericho. In Ramallah city it was found that there are neither economic incentives nor regular public awareness campaigns in the concern of solid waste management. Besides, the absence and lack of environmental and economic incentives is explaining the problems

and hurdles that facing the municipality, especially burning the community containers, it was reported by Ramallah municipality that 15% of the containers were burnt yearly, while 10% of containers wheels are stolen as well as 10% of the community containers were surrounded by wastes while they are not full. These poor conditions of the containers delay the process of unloading into the collection vehicles and accordingly affect the collection efficiency. In addition, movement of containers without wheels requires extra effort and handling by workers that may lead to injuries in some cases.

3.2.3 Storage and collection in the municipal solid waste management

In Ramallah city the community bin (container) collection system is the main common practise used in the solid waste collection and storage, while in Jericho the primary collection is curb side collection, in which the residents put their wastes on the curbs, then the municipality workers collect the waste in wheeled carts and take them to the nearest container in the area. Then, the JCSPD collection vehicle collects the waste from the containers. It was found and observed that the residents deposit their waste into closet community containers located at streets edges and corners in Ramallah city, while some of them seen in Jericho. Waste separation at source is minimal, in Ramallah city it is found that there are two private companies, the first collects cardboard from some specific metal mashes containers in the several locations in the city, while the other company is collecting papers from some institutions including the municipality of Ramallah. In Jericho city, it was found that there is no waste source segregation. In the waste stream, biodegradable are existed along with the recyclable items such as plastics, metals, glass and other materials. The waste stream in Ramallah city isn't only containing the domestic and commercial fractions, but it also includes industrial as well as the medical waste and unfortunately all the solid waste fractions are being dumped in the same dump site without any proper environmental disposal

precaution measures. In Jericho city, recently the medical wastes are disposed into depots in the sanitary landfill, while other waste streams are dumped in the sanitary landfill. Regardless the poor dumping conditions, it is found that in Ramallah the workers who works in the solid waste collection are advised to use protective measures, but they are not forced to do so, consequently they are vaccinated from time to time. In Jericho the provision of safety clothes and equipments is obligatory in addition to vocational health requirements, but it is observed that few of them are used them.

Household wastes are generally accumulated in small containers and then disposed into community containers. These containers are varied from house to house in shape, type and size. These individual containers are most probably made of plastic bins and bags. Community containers are varied upon location and served population. In Ramallah city there are 784 containers which 357 of them are evacuated on daily basis, while 427 are evacuated day after day, while in Jericho city there are about 220 containers, the collection frequency in 6 days per a week. In both cities the promoted containers are made of steel with different sizes varied between 1.1 to 10 m^3. The containers types are either normal or roll-on-roll-off. The waste collection service is served more than 90% of residential and commercial areas in the both cites. Different types of vehicles are used in the collection process varying from handcarts which mainly used in street cleaning by scavengers, refuse compactors, ordinary trucks with tipping mechanism, hook lift trucks and grapple cranes. The common used vehicles are refuse compactors with different sizes varying from 5 m^3 to 19 m^3. Most of them are more than 10 years in service that leads to conclude that they need regular costly maintenance, in other words they are outlived their normal life . It is apparently noticed that in Ramallah there is no routing system for collection service that means daily duplication and redundancy of handling tasks, while in Jericho the solid waste removal is programmed, even

the JCSPD conducted the survey of motion that lead to accurate status of containers, best collection path and regular routes updates as per the season and status of containers and each vehicle is provided by daily program for the collection service. It is observed throughout the study area that majority of community containers are without covers which means undesired visual seen as well as presence of insects, flies and other domestic animals.

Table 3.1: Equipments used solid waste collection and disposal

Ramallah					**Jericho**				
Equipment / Vehicle type	**No**	**Capacity (M^3)**	**Condition**	**Age (Yr)**	**Equipment / Vehicle type**	**No**	**Capacity (M^3)**	**Condition**	**Age (Yr)**
Compactor	2	19	Good	< 2	Compactor	1	8	Good	>5
Compactor	3	12	Fair	>10	Compactor	1	8	Fair	>10
Compactor	3	8	Bad	>10	Compactor	3	5	Bad	>10
Grapple crane	1	13	Good	<2	Grapple crane	1	13	Good	<2
Hook lift truck	3	10	Fair	>10	Hook lift truck	3	10	Fair	>10
Hook lift truck	1	10	Good	<2	Open tipping truck	1	4	Fair	>10
Wheel loader	1	-	Good	<2	Track tractor	1	-	Good	<2
					Backhoe loader	1	-	Good	<2
					Landfill compactor	1	-	Good	<2
					Weigh bridge	1	-	Good	<2

Both Ramallah municipality and joint council service have no specified standardization policy regarding the collection vehicles, each entity is utilising the international financial aid in order to have comprehensive collection equipments for the proper functioning and enhancement of solid waste management. It was found that Ramallah municipality had its

own maintenance workshop for the vehicles, while the JCSPD in Jericho has a yearly contract with Jericho municipality for all maintenance tasks including purchasing and supplying of spare parts. It was recognized that the consumable spare parts are existed in the stock, while some times serious difficulties regarding the importing of spare parts which are not available in the local market due to import restrictions put by the political constraints by Israelis.

3.2.4 Disposal systems

The traditional method of municipally solid waste disposal throughout the occupied Palestinian Territories (oPT) until 2005 was open dumping with partial combustion, the first sanitary landfill in the West Bank was in Jenin, the second in Jericho and nowadays the third are being constructed in the south West Bank. In Ramallah city the disposal site is open dumping with occasional soil cover and the wastes are usually burned. No environmental protective measures. Moreover, the site is very close to the city and even it is considered part of the city, it is located 1.5 km far from the city center in the western southern part. All types of wastes are dumped together; medical, domestic, commercial or industrial. The site is only equipped with wheel loader. The existing situation of the dumpsite is lead to uncontrolled release of leachate that possibly migrated to the groundwater as well as the uncontrolled release of landfill gases which cause odour and other public health problems. In Jericho Japan International Cooperation Agency (JICA) funded the construction of engineered sanitary landfill. The landfill is provided with environmental protective measures that minimize from the environmental adverse impacts. The base sealing system is consisted of three layers, the first is 50 cm of clay, second is HDPE sheet and the upper layer of 50 cm clay. A leachate collection system is available as well as gas extraction pipes. The site is equipped with weighbridge, landfill compactor, track tractor as well as loader. The landfill has ground water

monitoring wells adjacent to the site, leachate collection pond as well as special depots for medical wastes. The site is located in the east side of the city on average distance 5-15 km from the city. The only negative aspect that can be recorded on this site, its area is relatively small, which means that the remaining life time of site is not too long and it may be not more than 3 years. The following table 3.2 illustrates the characteristics of the disposal sites in the study area. The presented data is collected through institutional questionnaires.

Table 3.2: Disposal sites characteristics in the study area

No	Site name	Type	Age (years)	Site Area (dunums)	Population served (in 1000)	Solid waste received per day (ton/day)
1	Ramallah	Dump site	33	70	30	100
2	Jericho	Sanitary Landfill	2	26	20	33

3.2.5 Cost and tariff setting

As aforementioned above the responsibility of waste management in Jericho city is shared between the JCSDP and the municipality, while in Ramallah it is under the full control of the municipality. For the estimation of solid waste management service provision cost, full cost accounting (FCA) was used in the questionnaires, that is, the questionnaire was designed to identify these costs. The major categories of costs that were involved are up-front costs that cover the initial investment and expenses necessary to implement solid waste services, operation costs that include the expenses of managing solid waste on daily basis, external costs that related to environmental damages and human health problems that could arise from waste collection and disposal and back-end costs that mainly connected to expenditures to properly to conclude operations and taking care of disposal facilities at the end of their life time. All these costs are discussed in table 3.3.

In the two cities it was concluded that there is no attention is given for the environmental costs, no aftercare costs are considered. Both cities are mainly dependent on the donation from the government as well as from international community, but the JCSPD is considering the depreciation value of the equipments since the year 2007, the approximate depreciation value of the equipments for the past two years is about 0.7 M NIS and it was considered in the table 3.3 above as indirect costs. Even more, the two municipalities are suffering from lack of coordination between departments, since there is no computerized monitoring system as well as accurate data records in several fields of concern such as needed equipments and financial monitoring system that cares about the expenditures and revenues of solid waste services as separately from other departments. In Jericho the JCSPD is performing record keeping as well as updating of management options where needed as per the requirements of the service. Usually up fronts costs or capital/investment costs should be distributed on the life time of the equipments and/or supplies, means depreciation value should be recovered per years of service. Accordingly, since there is no considering for such costs in Ramallah financial records, the reported up fronts costs for the two years 2007 and 2008 was considered totally (2.3 M NIS).

Table 3.3: Full cost accounting of the solid waste management in the study area (2007 and 2008)

No	Cost type	Ramallah city		Jericho city	
1	Up-front costs : Equipments/ vehicles, materials supplies and disposal site preparation and construction	The municipality is not allocating any budgets, but the municipality reported these costs as direct expenses upon actual needs.	The related paid expenses on these costs are about 2.3 M NIS.	The municipality and JCSPD are not allocating budgets for these costs since they are dependent on government and international donation.	
2	Operating costs: Remuneration, operational including spare parts, maintenance, fuelling and insurance and indirect costs.	The municipality is not allocating any budgets, but the municipality reported these costs as direct expenses upon actual needs.	The related paid expenses on these costs are about 12.1 M NIS.	The municipality and JCSPD are not allocating any budgets, but the municipality reported these costs as direct expenses upon actual needs.	The related paid expenses on these costs reported by both the municipality and JCSPD are about 4.5 M NIS.
3	External costs: related to environmental damages and human health	Not considered in the municipality accounts	No budgets are allocated to these fields.		
4	Back-end costs: expenditures to properly to conclude operations and taking care of disposal facilities at the end of their life time	Not considered in the municipality accounts		Not considered in the municipality or JCSPD accounts	No budgets are allocated to these fields.

The following table 3.4 and figure 3.1 illustrate the expenditures and the recovered revenues during the last two years 2007 and 2008.

Table 3.4: Expenditures and budgeted/ actual revenues for SWM in the study area (2007 and 2008)

Expenditures (M NIS)		Revenues (M NIS)			
Actual		Budgeted		Actual	
Ramallah	Jericho	Ramallah	Jericho	Ramallah	Jericho
14.4	4.5	8	4	2.2	3

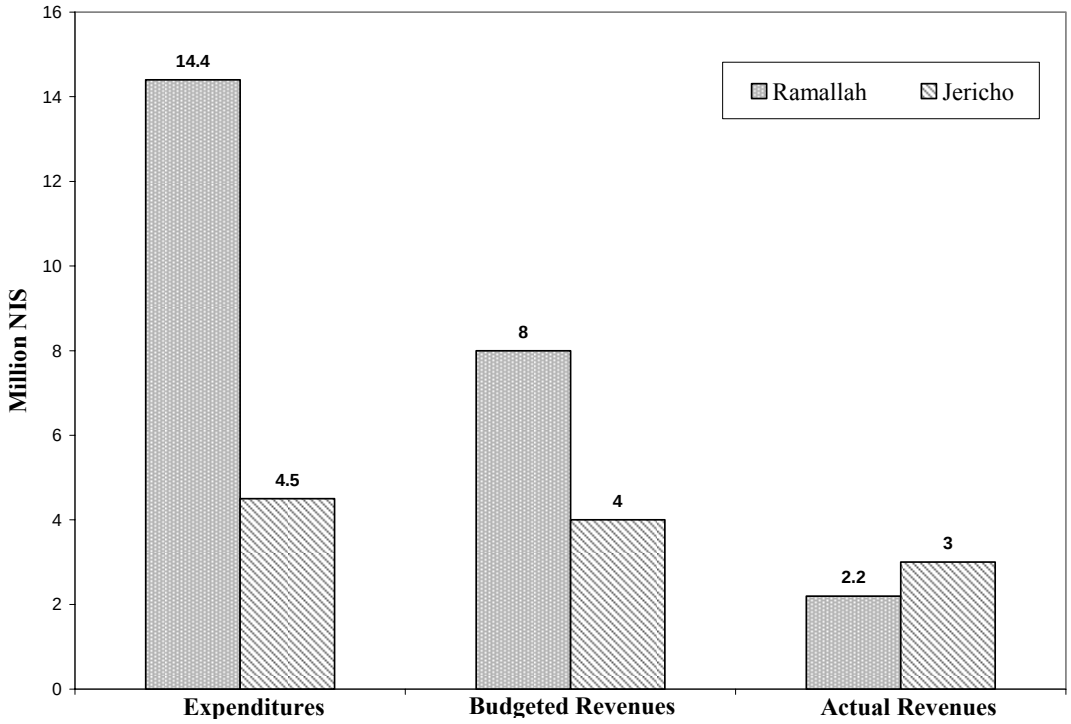

Figure 3.1: Expenditures and budgeted/ actual revenues for SWM in the study area (2007 and 2008)

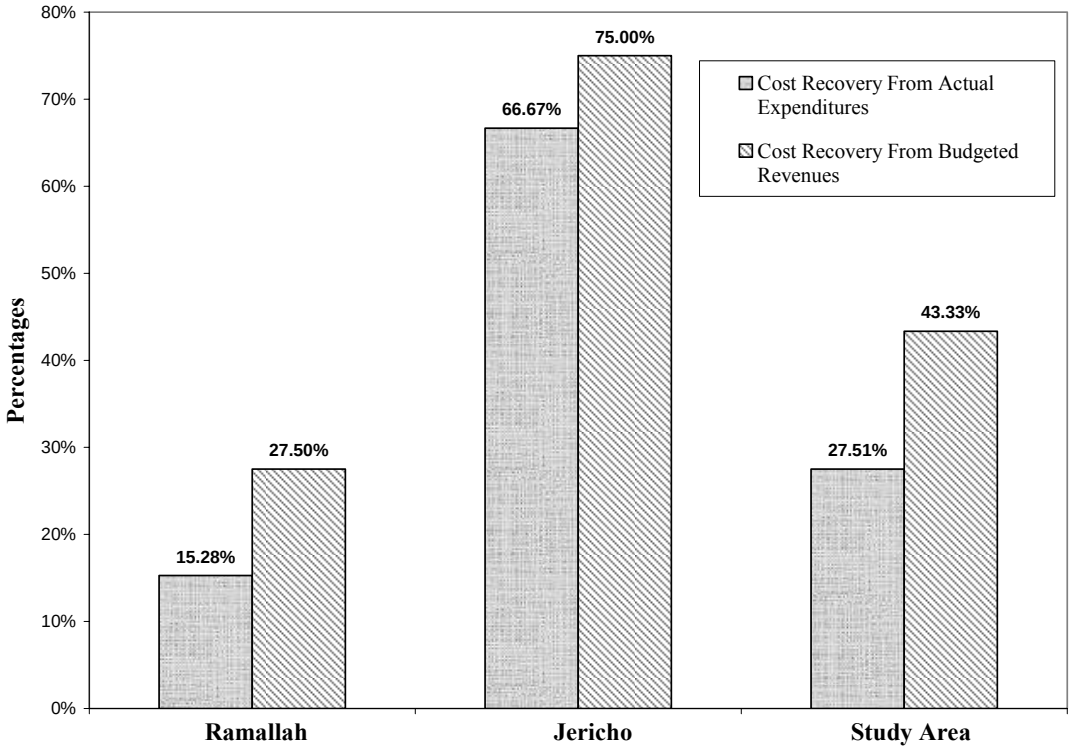

Figure 3.2: Percentages of Cost Recovery from Actual Expenditures and Actual Revenues (2007-2008)

The analysis of the financial status of the solid waste management in the two cities shows that the current practices of cost recovery are vulnerable and poor. As it is shown in figure 3.2, the recovery cost in Jericho is better than in Ramallah. It was, also, concluded that the budgeted revenues are less than the actual expenditures. Moreover, the cost recovery from the actual expenditures is 15.28% and 66.67% for Ramallah and Jericho respectively, while the cost recovery from the budgeted revenues is 27.5 % and 75 % for Ramallah and Jericho respectively. On the other hand, it was found that the overall cost recovery for the two cities are 27.51 % from the actual expenditures and 43.33% from budgeted revenues. In Jordan it is estimated that the cost recovery of solid waste management is varying from 40% to 55% (Abu Qadais et al., 2007).

The low cost recovery may be attributed to the following reasons:-

1. Tariff of MSW service: the fees system applied in the solid waste management are different in the two cities. In Ramallah the residential tariff is 36 JD/year per apartment or house consists of 1-3 rooms and an extra 12 JD/year for each extra room. In Jericho the residential tariff is 24 JD/year per apartment of house consists 1-3 rooms, 32 JD/year 3- 5 rooms and 48 JD/year for the apartment or house more than 5 rooms, while the JCSPD in the city is collecting the fees from the municipality of Jericho for the secondary collection and disposal of wastes, the tariff is 32 JD/year for single family and 52 JD/year for complex family. This apparently explained the deficiencies in the cost recovery system since the rooms or apartment fees system does not create incentives to minimize the waste production. Moreover, the higher fees on the level of JCSPD in Jericho create more reliable system than in the level of municipalities. On the other hand, the methodology of fees collection is better on the level of JCSPD since the council is working with local authorities and not with

residents directly, even the cost is paid in advance by Jericho municipality to the JCSPD as maintenance works for the equipments and vehicles of JCSPD, that's contributing the explanation of higher cost recovery in Jericho since majority of tasks are carried by JCSPD. While the fees collection, on residents and commercial levels, in Ramallah and Jericho are collected separately, since the electricity services is provided by private company as wells as the water supply in Ramallah, but the water supply in Jericho is under the responsibility of the municipality. The two municipalities in the study area are making economic incentives for the residents through making discounts for those who pay at the beginning of the year. Besides, the commercial sector including crafts and trades has special tariff system per type of craft. It was, also, obvious here that the quantity of waste is not minimised since the fees are lump sum per year.

2. Government institutions: no fees are collected from the government offices, they are considered big producer for solid wastes since the have a lot of customers and residents coming from all the country cities and town to follow up their official requests and papers.

3. The existing financial systems in the two municipalities are mixed with other sectors and departments, that is, there is no dependant financial department concerned with solid waste management separately.

4. Both cities have high number of workers that involved in primary collection in Jericho and road sweeping in Ramallah and Jericho cities. There are 40 workers in Jericho and 40 workers in Ramallah for this purpose, while the two street sweepers' equipments in the two municipalities are not working and in poor technical

conditions. This much affects the running cost as well as the delivered services, especially to public conditions of streets.

5. There is no sewage collection network in Jericho, while in Ramallah more 60% of the city is connected to the service. This extremely affects the financial burden on residents in Ramallah city and especially in Jericho, since residents are obligated to pump out the sewage from the septic tanks.
6. The two cities have great number of visitors per day that may reach up to triple original residents, but in two different purposes, in Ramallah people come to follow up their official tasks with government bodies that are not charged for any costs, but in Jericho people come to travel to Jordan, but all of them paid for the terminal departure station.

3.2.6 Problems encountered in the solid waste management in the study area

Part of the management aspect is enhanced by the construction of JCSPD in Jericho, but the municipality is still weak in this regard as the situation in Ramallah municipality. It is obviously observed and concluded that the two municipalities, Ramallah and Jericho, are suffering from the lack of making financial and administrative independent divisions as well as the insufficient financial resources, especially the systems are not self sustaining. Rapid urbanization and daily migration to the two cities from all other cities in the West Bank is outstripping the service capacity. Moreover, the two municipalities are indeed suffering from the absence of enforcement measures and capabilities that forcing the residents to pay their contribution to solid waste management in their areas. The two municipalities still have neither enough and qualified neither technical and administrative personnel nor adequate planning for the waste management. On the other hand, the two municipalities are facing problems with poor response to waste minimization as well as public cooperation, they are

not controlling the hazardous wastes either medical or industrial in Ramallah or industrial or agrochemical in Jericho. Finally, the lack of qualified private sector contractors is considered another important factor that affects the solid waste management enhancement as well as the absence of standby disposal facilities sites especially Ramallah site is outlived its normal life and Jericho is relatively of small absorption capacity.

3.2.7 Solid waste management performance indicators in the study area

Solid waste management performance is evaluated in terms of its efficiency, amount of money spent per ton of solid waste collected and disposed. Accordingly, it is essentially to be able to measure the effectiveness of the system in terms of tasks performance and residents level of satisfaction. In order to measure the adequacy of solid waste collection service in the two cities, the community effect index (CEI) was estimated for each city (Vesilind and Rimer, 1981 cited in Abu Qadais, 2007). CEI can be estimated based on the cleanliness of the streets by giving cautious rating for each street that starts by 100 for a very clean street with no existence of garbage or even litter as well as very clean surface to end with zero for extremely unclean street full of trash and garbage. Vesilind and Rimer suggested to deduct 10 points due to uncertain conditions resulted from the existence of abandoned vehicles. CEI can be calculated by the following formula:

$$CEI = \sum_{i=1}^{N} \frac{(S-P)}{N}$$

Where S is the street cleanliness rating given based on the inspection process during the household survey, P is the presence of special conditions lead to deduct 10 points from street rating for each condition and N is the total number of streets.

The following table 3.5 illustrates the solid waste management performance indicators in the two cities, Ramallah and Jericho.

Table 3.5: Solid waste management performance indicators in Ramallah and Jericho cities

Indicator	Unit	City	
		Ramallah	Jericho
Community effect index	-	65	55
Population served	Persons	30,000	20,000
Population served per staff	Persons	341	364
Population served per collection vehicle/equipment	Persons	2,300	2,000
Average daily number of containers served per collection vehicle	No	43	22
Average cost of solid waste management (collection and disposal)	NIS/ton	200	185
Average annual cost of solid waste management (collection and disposal)	NIS/person	240	200
Average daily solid waste collected by worker	Kg/day	1,430	660
Ratio of worker to remaining staff	-	4	10
Overall cost recovery from actual expenditures	%	15.28	66.67

It was concluded that the cost/ton of solid waste management in the study area is varied and not the same in the two cities, it is shown above the table that the cost in Ramallah is 200 NIS/ton (53$/ton) that only covers the storage, collection and dumping without proper environmentally sound techniques, while in Jericho it is 185 NIS/ton (49$/ton) that includes storage, collection and disposal in the sanitary landfill. This is mainly due to the higher running cost in Ramallah due to mountainous topography that requires higher fuel consumption and consumable parts. As it is aforementioned the routes of collection are not regulated in Ramallah, while it is organized in Jericho as declared by respective institutions. During the house hold questionnaire, a comprehensive effort was given to examine the cleanness of the streets in the two cities, the seven wards surveyed in each city were carefully visually inspected, a cautious rating was given to each street that was visited, then an overall score was given to each ward, then average was calculated for each city. It was estimated that CEI are 55 and 65 for Jericho and Ramallah respectively. It was noticed through visual inspection that garbage are scattered around some containers, animal manure, especially in

Jericho as well as trees leaves. On the other hand, the streets sweeping is not mechanized and it is performed by municipality workers in both cities. Littering throwing is significantly noticed in Jericho since no streets bins are installed in the streets. Moreover, as per the visits to houses, it was declared and observed that neither the municipality workers nor the collection workers clean the places around the containers. Besides, waste transportation using open trucks such as hook lift or trucks with tipping mechanism results a lot of littering especially in the areas close the disposal facility. Finally, the streets sweeping and aesthetic seen are strongly affected by the poor technical conditions of streets since majority of them have rut depths and cracks due to regular infrastructure utilities installation in the absence of programmed planning as well as the lack of sidewalks that strongly observed in Jericho. In Jordan the CEI was estimated for three cities and it was found that it varies from 47 to 80 (Abu Qadais et al., 2007). It was reported in Jordan, also, than the cost per ton collected and transported is varying from 20 USD to 30 USD(Abu Qadais et al., 2007), while in Pakistan the solid waste management cost per ton in varies from 7 USD to 22 USD (PEPA, 2005). The cost per ton is different from place to another due to nature of the served area and costs associated in operating the service such as fuel costs are varying from country to another. The population served per staff was found 341 and 364 in the study area, while in Pakistan it varies from 282 to 1613 (PEPA, 2005), while in Jordan it varies from 630 to 867 (Abu Qadais et al., 2007). In addition, it was found that the waste collected by the each worker is varying from 660 kg/d to 1430 kg/d in study area, in Jordan it was found by (Abu Qadais et al., 2007) that it varies from 518 to 650 kg/d, while in Pakistan it varies from 64 to 380 kg/d. The average daily number of containers served per collection vehicle is varying from 22 -43 in the study area, while in Jordan it varies from 31-42 (Abu Qadais et al., 2007). Moreover, the population served vehicle varies from 2,000 to 2,300 in the study area, while it varies in Jordan from 11, 320 to 15,580 (Abu Qadais et al., 2007).

3.3 Community survey

3.3.1 Demographics of the study area

According to the household survey, the average family size was 5.47 and 5.67 in Ramallah and Jericho respectively. Table 3.6 shows the surveyed sample distribution based demographics and socio-economic characteristics per study area. About 43.5% of the respondents were males and 56.5 % were females. The most common occupations in the study area include employees either in public sector or private sector, merchants, famers and workers. It was obviously noticed that most of the surveyed housewives are not employed. The average monthly income was varying along the study area, but this is mainly due to unreliability of the income data in this case due to reluctance of respondents to answer this survey question. More than 60 % of the respondents own their houses, while about 40 % are renting for living. It was also, concluded that more than 76.5 % of the respondents are married, and while 13 % and 7.8 % is single and widower respectively. Besides, more than 50 % of have either diploma or university degree, while only about 36 % had only completed their secondary education.

Table 3.7 shows the most factors that considered problems in study area cities, it was concluded that water problems in Ramallah city has the high concern of the residents, that is, 38% of the respondents in Ramallah city had shown that, besides they represents about 24 % of the study area, while in Jericho the solid waste management has been recorded the highest percentage with 40% of respondents in Jericho that represents 14.6 % of the study area.

Table 3.6: Sample distribution based on demographics and socio-economic characteristics in the study area

Independent Group	Number of respondents (percentage in parentheses)						Total
Gender	**Male**			**Female**			370 (100)
	161 (43.5)			209 (56.5)			
Housing Ownership	**Rent**			**Owner**			370 (100)
	143 (38.6)			227 (61.4)			
Marital Status	**Single**	**Married**		**Divorced**		**Widower**	370 (100)
	48 (13)	283 (76.5)		10 (2.7)		29 (7.8)	
Monthly Family Income (NIS)	**> 1500**	**1500-3500**		**3500-5500**	**< 5500**	**No answer**	370 (100)
	36 (9.73)	199 (53.78)		113 (30.54)	13 (3.51)	9 (2.43)	
Education	**Secondary**	**Diploma**		**University**		**Other**	370 (100)
	132 (35.7)	95 (25.7)		96 (25.9)		47 (12.7)	
Housing	**Villa**			**Apartment**		**House**	370 (100)
	32 (8.7)			174 (47)		164 (44.3)	
Occupation	**Public Sec. Employee**	**Private Sec. Employee**	**Merchant**	**Doctor**	**Farmers & Workers**	**Other**	370 (100)
	50 (13.5)	77 (20.8)	79 (21.4)	10 (2.7)	21 (5.7)	133 (35.9)	

Table 3.7: Factors considered problems in the study area

City		Factors Considered Problems per City							Total
		Security	**Water**	**SWM**	**Waste water**	**Noise**	**Traffic**	**Health**	
Ramallah	**Count**	5	89	79	42	16	4	0	235
	% within city	2.13	37.87	33.62	17.87	6.81	1.70	0.00	100.00
	% of Total	1.36	24.12	21.41	11.38	4.34	1.08	0.00	63.69
Jericho	**Count**	5	21	54	41	6	3	4	134
	% within city	3.73	15.67	40.30	30.60	4.48	2.24	2.99	100.00
	% of Total	1.36	5.69	14.63	11.11	1.63	0.81	1.08	36.31
Total	**Count**	10	110	133	83	22	7	4	369
	% of Total	**2.71**	**29.81**	**36.04**	**22.49**	**5.96**	**1.90**	**1.08**	**100.00**

3.3.2 Solid waste collection

In the household questionnaire, an about of twelve main questions were used to measure the satisfaction and status of the solid waste collection in the study area, especially the collection methodology is different in both cites of the study area. It was concluded from the household questionnaire that about 40 % of respondents in Ramallah city said that the community container is emptied on daily basis, while 54% said that it is emptied three times a week, this apparently matched the real case as illustrated by the municipality via the institutional questionnaire. In Jericho about 64% of the respondents said that the community container is emptied on daily basis that strongly support the information form join service council. Meanwhile this percentage is not relatively high because the collection system in Jericho is curb side collection, that is, the containers are not spread in front of each house.

Table 3.8: Frequency of collection from community container

How Many Times the Community Container Emptied							Total
City		Once per week	Twice per week	3 times per week	Daily	Other	
Ramallah	Count	2	11	127	93	2	235
	% within city	0.85	4.68	54.04	39.57	0.85	100.00
	% of Total	0.57	3.12	35.98	26.35	0.57	66.57
Jericho	Count	4	8	20	76	10	118
	% within city	3.39	6.78	16.95	64.41	8.47	100.00
	% of Total	1.13	2.27	5.67	21.53	2.83	33.43
Total	Count	6	19	147	169	12	353
	% of Total	**1.70**	**5.38**	**41.64**	**47.88**	**3.40**	**100.00**

The respondents' views about the status of community container showed that the community container is either always full or full with garbage around in Ramallah city. About 34% of respondents in Ramallah said that the community container is always full and 41% of them said that it is full with garbage around, that means about 75% of respondents in Ramallah city said that the community container is most probably full. In Jericho, 27% of the respondents said that the community container is always full, while 22% said that it full with garbage around, that, also means about 49% of the respondents in Jericho said the community container is always full. Table 3.9 shows these results distributed on the study area.

Table 3.9: Visual status of community container

How Do You Find the Status of Community Container						Total
City		Half full	Always full	Full with garbage around	Empty	
Ramallah	Count	57	81	97	0	235
	% within city	24.26	34.47	41.28	0.00	100.00
	% of Total	16.01	22.75	27.25	0.00	66.01
Jericho	Count	33	33	27	28	121
	% within city	27.27	27.27	22.31	23.14	100.00
	% of Total	9.27	9.27	7.58	7.87	33.99
Total	Count	90	114	124	28	356
	% of Total	**25.28**	**32.02**	**34.83**	**7.87**	**100.00**

On the other hand, about 47% of the respondents in Ramallah city said that the collection and transportation from the community container is average and about 23% of them said that it is acceptable, while 15% said it is bad. Only 0.43 % said that the collection and transportation from the community container is very good and 15% said it is good. In Jericho, about 19% of the respondents said that it is average and 16% said it is acceptable. 11% of them said that the collection and transportation from the community container is bad, while 19% of them said that the service is very good and 36% said it is good, meaning 55% of the respondents said that the service is at least good. This dissatisfaction and satisfaction of the residents in Ramallah and Jericho respectively can be explained by the age of the service in both cities. In Ramallah the service is old established, while in Jericho is young service, this is affected the views of the respondents since in Ramallah they didn't feel the difference compared to absence of the service, while in Jericho the comparison is easily established. Table 3.10 shows the different results of respondents regarding the collection and transportation from the community container. Moreover, it is concluded that about 66% of the respondents in Ramallah city said that the relation of the collection team with residents is acceptable, while about 15 % said it is respected. In Jericho 31% of the respondents said that the relation is acceptable and about 59% said it is respected. Only 19% and 10% of the respondents in Ramallah and Jericho respectively said that the relation is bad.

Table 3.10: Collection and transportation from community container

City		Collection and Transportation From the Community Container					Total
		Very good	Good	Average	Acceptable	Bad	
Ramallah	Count	1	35	111	53	35	235
	% within City	0.43	14.89	47.23	22.55	14.89	100.00
	% of Total	0.28	9.64	30.58	14.60	9.64	64.74
Jericho	Count	24	46	24	20	14	128
	% within City	18.75	35.94	18.75	15.63	10.94	100.00
	% of Total	6.61	12.67	6.61	5.51	3.86	35.26
Total	Count	25	81	135	73	49	363
	% of Total	**6.89**	**22.31**	**37.19**	**20.11**	**13.50**	**100.00**

Table 3.11: Evaluation of the collection team relation with residents

City		Evaluation of the Collection Team Relation with Residents			Total
		Respected	Acceptable	Bad	
Ramallah	Count	36	154	45	235
	% within City	15.32	65.53	19.15	100.00
Jericho	Count	79	42	14	135
	% within City	58.52	31.11	10.37	100.00
Total	Count	115	196	59	370
	% within City	**31.08**	**52.97**	**15.95**	**100.00**

The respondents were asked about the status of the community container in terms of age, technical status, size and location. The answers were as shown in table 3.12 that obviously illustrates that size of the community container is inadequate since about 78 % and 62% of the respondents in Ramallah and Jericho respectively declared that, as well as the location of the container is not considered suitable for majority of 66% of respondents in Ramallah, while in Jericho 57% considered the location is suitable. On the other hand, about 58% of the respondents in both cities said that the container is not exhausted and 52% of them in Ramallah said it is good, while in Jericho about 49 % said that is also good. From above it can be concluded that the residents are satisfied from the technical status of the containers but they have high concern about their size and location.

Table 3.12: Status of community containers

Status of community container		Ramallah			Jericho		
		Yes	No	Total	Yes	No	Total
Old and exhausted	**Count**	96	137	233	45	63	108
	%	41.20	58.80	100	41.67	58.33	100
Good	**Count**	122	111	233	49	52	101
	%	52.36	47.64	100	48.51	51.49	100
Adequate size	**Count**	52	181	233	42	67	109
	%	22.32	77.68	100	38.53	61.47	100
Location suitable	**Count**	79	154	233	60	46	106
	%	33.91	66.09	100	56.60	43.40	100

3.3.3 Environmental concerns and awareness

The survey examined the environmental concerns of the residents through their observation of healthy hygiene in the study area around the containers, disposal facilities and cleanliness of the streets sweeping. Besides, the survey, also, examined the knowledge and practise of the residents towards environmental public awareness campaigns. Tables 3.13, 3.14 and 3.15 introduce these results.

Table 3.13: Residents observation around containers and disposal facilities

Residents observation around containers and disposal facilities		Ramallah			Jericho		
		Yes	No	Total	Yes	No	Total
Leachate	**Count**	201	33	234	42	69	111
	%	85.90	14.10	100	37.84	62.16	100
Bad odor	**Count**	230	4	234	78	34	112
	%	98.29	1.71	100	69.64	30.36	100
Insects	**Count**	233	1	234	45	66	111
	%	99.57	0.43	100	40.54	59.46	100
Burning	**Count**	78	156	234	33	79	112
	%	33.33	66.67	100	29.46	70.54	100
Domestic animals	**Count**	227	7	234	67	45	112
	%	97.01	2.99	100	59.82	40.18	100
Rats	**Count**	184	50	234	5	106	111
	%	78.63	21.37	100	4.50	95.50	100
Scavengers	**Count**	118	115	233	3	108	111
	%	50.64	49.36	100	2.70	97.30	100

In Ramallah city 234 of residents responded to this question, while 111 only responded to this question Jericho, that is, 99.5 % and 82.2 % of proposed sample were responded in Ramallah and Jericho respectively. It was obviously noticed that the answers of the respondents in both

cities are different, this due to the different collection methodology, since the residents are not in contact with community containers on daily basis in Jericho (curb collection), while in Ramallah it community bin collection which explains observation of much leachate, domestic animals, rats and scavengers in Ramallah than in Jericho. The results showed, also, that majority of the respondents said that there is bad odour which is apparently agree with real conditions of the containers since the containers are not covered, besides the disposal facility is Ramallah is very close to the city and it is western southern side that means with direction of the wind.

Table 3.14: Residents evaluation of roads sweeping

Evaluation of Road Sweeping							Total
City		No road sweeping	Good	Average	Acceptable	Bad	
Ramallah	Count	143	28	40	9	15	235
	% within City	60.85	11.91	17.02	3.83	6.38	100.00
	% of Total	38.65	7.57	10.81	2.43	4.05	63.51
Jericho	Count	35	15	17	13	55	135
	% within City	25.93	11.11	12.59	9.63	40.74	100.00
	% of Total	9.46	4.05	4.59	3.51	14.86	36.49
Total	Count	178	43	57	22	70	370
	% of Total	**48.11**	**11.62**	**15.41**	**5.95**	**18.92**	**100.00**

It was concluded that both respondents in the two cities of the study area showed their dissatisfaction against the sweeping services since about 67% of total respondents said that either no road sweeping or it is bad. This truly matched the actual situation on ground as well as the estimated of community effect index as it was investigated with the municipality of Ramallah; it was found that 35% of the streets are swept.

Table 3.15: Residents received public awareness campaigns

Residents Received Public Awareness Campaigns				Total
City		Yes	No	
Ramallah	Count	3	232	235
	% within City	1.28	98.72	100.00
	% of Total	0.81	62.70	63.51
Jericho	Count	16	119	135
	% within City	11.85	88.15	100.00
	% of Total	4.32	32.16	36.49
Total	Count	19	351	370
	% of Total	**5.14**	**94.86**	**100.00**

It was also concluded that only 1.3 % of respondents in Ramallah had received public awareness campaigns, while 12% of the respondents in Jericho received public awareness campaigns before, it was noticed that the overall percentage of respondents who had public awareness campaigns is about 5%. Those respondents who received the public awareness campaigns had got the message how to deal with solid wastes, dangers of wastes and the importance of wastes separation at source as well as keeping the healthy hygiene. These results are totally agreed with results of the institutional questionnaire.

3.3.4 Reuse and recycling concerns

This section in the household questionnaire was designed to measure the practises and willingness of residents toward reuse and recycling as well as source separation. Table 3.16 introduces the results of a question for the reuse or sell or receive of several solid waste stream fractions. It was concluded that about 65 % and 50% of the respondents said that they reuse or sell or receive plastic and glass bottles in Ramallah and Jericho respectively. On the other hand, none of the respondents in Ramallah is reusing or selling or receiving cans and metals, while in Jericho about 40 % of the respondents (15 % of the study area) are either reusing or selling or receiving them. The table 3.16 gives the complete results of this question in relation of other fractions of municipal solid waste.

On the other hand, about 78.5 % of the respondents in the study area said that they get rid of food wastes along with other wastes streams, while 3.8 % are doing composting. Moreover, it was reported that none of respondents in Ramallah city are burning these food wastes, while in Jericho 45% of the respondents are burning these wastes that represents about 16.5 % of the study area respondents. The variations in the ways of the disposing the food wastes in the two cities could be attributed to collection methodology, nature of living premises and availability of other uses for these wastes. Since Jericho has agricultural activities and majority of living premises are detached houses (70% as per the household questionnaire).

Table 3.16: Residents behavior regarding recyclable and reusable materials

Did You Reuse or Sell or Receive any of the Following							
City		Ramallah			Jericho		
		Yes	No	Total	Yes	No	Total
Plastic bottles	Count	158	77	235	81	54	135
	%	67.23	32.77	100	60	40	100
Glass bottles	Count	138	97	235	47	88	135
	%	58.72	41.28	100	34.81	65.19	100
Cans	Count	0	235	235	33	100	133
	%	0	100	100	24.81	75.19	100
Plastics	Count	3	232	235	24	109	133
	%	1.28	98.72	100	18.05	81.95	100
Metals	Count	0	235	235	20	113	133
	%	0	100	100	15.04	84.96	100
Shoes	Count	5	230	235	50	84	134
	%	2.13	97.87	100	37.31	62.69	100
Clothes	Count	15	220	235	90	44	134
	%	6.38	93.62	100	67.16	32.84	100
Old furniture	Count	60	175	235	15	117	132
	%	25.53	74.47	100	11.36	88.64	100

Table 3.17: Food wastes disposal methods

What You Do With Your Food Wastes							Total
City		Compost	Send it to Garden	Send it with Other Wastes	Burning	Other uses	
Ramallah	Count	3	0	232	0	0	235
	% within City	1.28	0.00	98.72	0.00	0.00	100.00
	% of Total	0.82	0.00	63.04	0.00	0.00	63.86
Jericho	Count	11	3	57	61	1	133
	% within City	8.27	2.26	42.86	45.86	0.75	100.00
	% of Total	2.99	0.82	15.49	16.58	0.27	36.14
Total	Count	14	3	289	61	1	368
	% of Total	**3.80**	**0.82**	**78.53**	**16.58**	**0.27**	**100.00**

The respondents showed high objection towards source separation for foods wastes from other wastes. More than 80% of respondents in the study area refused to perform separation for food wastes from other wastes. This much noticed in Ramallah than in Jericho since around 92% and 63%of respondents in Ramallah and Jericho respectively showed their objection to perform source separation for food wastes. This is can be explained by the insufficient public awareness campaigns as well as the absence of environmental education for residents. The respondents who have the will to separate are about 18%, their concerns for this are mainly for reuse and recycling, gardens fertilizers, minimising wastes volumes and for better health hygiene.

Table 3.18: Respondents views regarding source separation of food wastes

Do You Have the Will to Separate the Food Wastes From Other Wastes				**Total**
City		**Yes**	**No**	
Ramallah	**Count**	18	217	235
	% within City	7.66	92.34	100.00
	% of Total	4.86	58.65	63.51
Jericho	**Count**	50	85	135
	% within City	37.04	62.96	100.00
	% of Total	13.51	22.97	36.49
Total	**Count**	68	302	370
	% of Total	**18.38**	**81.62**	**100.00**

As per table 3.19, it is well known that residential premises generates the biggest amount of food wastes, they are representing more 40% of the waste stream as per the respondents' views.

Table 3.19: Respondents views regarding waste stream fractions

Solid waste fraction		Respondents views regarding waste stream fractions			
		Too much	Much	Not much	Little
Paper and cartoon	Count	3	9	13	345
	%	0.81	2.43	3.51	93.24
Plastic	Count	7	5	13	345
	%	1.89	1.35	3.51	93.24
Food wastes	Count	58	95	209	8
	%	15.68	25.68	56.49	2.16
Glass	Count	1	4	5	359
	%	0.27	1.08	1.36	97.29
Metals	Count	4	5	4	356
	%	1.08	1.36	1.08	96.48

Respondents concerns regarding the rejection of food wastes separation were located between four answers, no use for it, complex process, due to diseases and because of insufficient time. About 52% of the respondents said that they have no use for it, while about 29 % said that they have no times and 14.5 % and 5% said that it is complex process and they afraid of diseases respectively. On the other hand, 53 % of the respondents said that the solid waste management situation in the study area is getting worst, while about 30 % of them said that no change. It is important to underline that 57 % and 46% of the respondents in Ramallah and Jericho respectively said that it is getting worst, while 3.4 % and 42 % of the respondents in Ramallah and Jericho respectively said it is better. Table 3.21 introduces these results for the respondents' views regarding solid waste management in the study area

Table 3.20: Respondents concerns for not performing food wastes separation

Why You Don't Want to Separate						Total
City		No use for it	Complex process	Because of diseases	No time	
Ramallah	Count	127	15	8	68	218
	% within City	58.26	6.88	3.67	31.19	100.00
	% of Total	41.78	4.93	2.63	22.37	71.71
Jericho	Count	31	29	7	19	86
	% within City	36.05	33.72	8.14	22.09	100.00
	% of Total	10.20	9.54	2.30	6.25	28.29
Total	Count	158	44	15	87	304
	% of Total	**51.97**	**14.47**	**4.93**	**28.62**	**100.00**

Table 3.21: Respondents views regarding solid waste management evaluation in the study area

How Do You Evaluate The Solid Waste Management in Your City					Total
City		Better	Getting worst	No change	
Ramallah	Count	8	134	93	235
	% within City	3.40	57.02	39.57	100.00
	% of Total	2.19	36.61	25.41	64.21
Jericho	Count	55	60	16	131
	% within City	41.98	45.80	12.21	100.00
	% of Total	15.03	16.39	4.37	35.79
Total	Count	63	194	109	366
	% of Total	**17.21**	**53.01**	**29.78**	**100.00**

Table 3.22: Respondents views regarding the reasons of solid waste management deterioration in the study area

Reasons Contributing the Deterioration of the Solid Waste Management in the Study Area						
City		Too much	Much	Little	Very little	No relation
Responsible entities	Count	164	29	1	0	4
	%	82.83	14.65	0.51	0.00	2.02
Financial resources	Count	26	43	38	62	29
	%	13.13	21.72	19.19	31.31	14.65
No cooperation from residents	Count	14	13	69	62	40
	%	7.07	6.57	34.85	31.31	20.20
No public awareness	Count	12	19	60	66	41
	%	6.06	9.60	30.30	33.33	20.71
Human and technical resources	Count	2	2	60	73	61
	%	1.01	1.01	30.30	36.87	30.81
Political problems	Count	2	5	10	17	164
	%	1.01	2.53	5.05	8.59	82.83

It was obviously noticed that about 97% of the respondents who said that the solid waste management is getting worst are referring to responsible entities as a reason for that, 35 % of them is referring that to vulnerable financial resources, while almost 28% said it is because of lack of residents cooperation and absence of public awareness campaigns. Other causes are shown in table 3.22, but it can be strongly noticed that political constraints is almost ignored by the residents and this is leading to the conclusion that the residents is not caring about reasons behind the service weakness and deterioration but he evaluates the visual delivered services and efficiency of entities.

3.3.5 Variation in citizens' response based on independent variable groups

This section shows the variations in citizens' response based on five independent variable; gender, education, occupation, marital status and monthly income. The dependent variables are six; evaluation of solid waste collection and transport from the community bin, evaluation of solid waste team relation with residents, evaluation of roads sweeping, disposal of food wastes, willingness of source separation and the evaluation of solid waste management. The Chi square test revealed that six dependent groups shown in table 3.23 had significant relationship with gender ($p < 0.05$).

Table 3.23: Variations in citizens' response based on gender

Dependent Variable (Question)	**Answer**	**Percentage of respondents (%)**		
		Gender		**Total**
		Male	**Female**	
How do you evaluate the collection and transportation from the community container	Very good	1.3	11.3	6.9
	Good	21.3	23.2	22.3
	Average	42.5	33.0	37.2
	Acceptable	21.3	19.2	20.1
	Bad	13.8	13.3	13.5
			Total	**100**
How do you evaluate the collection team relation with residents	Respected	24.2	36.4	31.1
	Acceptable	59.0	48.3	53.0
	Bad	16.8	15.3	15.9
			Total	**100**
How do you evaluate the road sweeping	No sweeping	54.0	43.5	48.1
	Good	13.0	10.5	11.6
	Average	15.5	15.3	15.4
	Acceptable	5.6	6.2	6.0
	Bad	11.8	24.4	18.9
			Total	**100**
What you do with your food wastes	Compost	4.3	3.4	3.8
	Send it to garden	0.0	1.4	0.8
	Send it with other wastes	87.6	71.5	78.5
	Burning	8.1	23.2	16.6
	Other uses	0.0	0.5	0.3
			Total	**100**
Do you have the will to separate the food wastes from other wastes	Yes	11.2	23.9	18.4
	No	88.8	76.1	81.6
			Total	**100**
How do you evaluate the solid waste management	Better	8.1	24.3	17.2
	Getting worst	58.8	48.5	53.0
	No change	33.1	27.2	29.8
			Total	**100**

On the other hand, the analysis revealed that five out of six dependent groups as shown on table 3.24 had significant relationship with level of education ($p<0.05$).

Table 3.24: Variations in citizens' response based on education

Dependent Variable (Question)	Answer	Percentage of respondents (%)				
		Education level				Total
		University	Diploma	Secondary	Other	
How do you evaluate the collection and transportation from the community container	Very good	8.5	2.1	5.3	15.9	6.9
	Good	21.5	13.8	27.4	31.8	22.3
	Average	35.4	50.0	36.8	15.9	37.2
	Acceptable	19.2	21.3	21.1	18.2	20.1
	Bad	15.4	12.8	9.5	18.2	13.5
					Total	**100**
How do you evaluate the collection team relation with residents	Respected	36.4	16.8	36.5	34.0	31.1
	Acceptable	50.0	65.3	52.1	38.3	53.0
	Bad	13.6	17.9	11.5	27.7	15.9
					Total	**100**
How do you evaluate the road sweeping	No sweeping	38.6	64.2	50.0	38.3	48.1
	Good	6.8	9.5	15.6	21.3	11.6
	Average	18.2	14.7	15.6	8.5	15.4
	Acceptable	9.1	3.2	4.2	6.4	6.0
	Bad	27.3	8.4	14.6	25.5	18.9
					Total	**100**
What you do with your food wastes	Compost	4.5	1.1	2.1	11.1	3.8
	Send it to garden	0.0	0.0	1.0	4.4	0.8
	Send it with other wastes	71.2	94.7	85.4	51.1	78.5
	Burning	23.5	4.2	11.5	33.3	16.6
	Other uses	0.8	0.0	0.0	0.0	0.3
					Total	**100**
How do you evaluate the solid waste management	Better	16.9	6.3	20.2	34.0	17.2
	Getting worst	47.7	62.1	53.2	48.9	53.0
	No change	35.4	31.6	26.6	17.0	29.8
					Total	**100**

Moreover, the analysis revealed that five out of six dependent groups as shown on table 3.25 had significant relationship with occupation type ($p<0.05$). Only two out of six dependent groups as shown in table 3.26 hand significant relationship with marital status ($p<0.05$), while four out of six dependent groups had significant relationship with monthly income ($p<0.05$) as shown in table 3.27.

Table 3.25: Variations in citizens' response based on occupation

Dependent Variable (Question)	Answer	Percentage of respondents (%)							
		Occupation type							Total
		Public Sector	Private Sector	Merc-hant	Dr.	Farmer	Wor-kers	Other	
How do you evaluate the collection and transportation from the community container	Very good	4.2	4.0	1.3	0.0	0.0	0.0	14.5	6.9
	Good	20.8	26.7	15.2	30.0	0.0	27.8	23.7	22.3
	Average	39.6	28.0	49.4	60.0	0.0	50.0	31.3	37.2
	Acceptable	27.1	25.3	17.7	10.0	50.0	5.6	18.3	20.1
	Bad	8.3	16.0	16.5	0.0	50.0	16.7	12.2	13.5
								Total	**100**
How do you evaluate the collection team relation with residents	Respected	26.0	39.0	17.7	20.0	50.0	31.6	36.8	31.1
	Acceptable	68.0	45.5	57.0	70.0	50.0	57.9	47.4	53.0
	Bad	6.0	15.6	25.3	10.0	0.0	10.5	15.8	15.9
								Total	**100**
What you do with your food wastes	Compost	6.0	1.3	2.5	0.0	50.0	15.8	3.1	3.8
	Send it to garden	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.8
	Send it with other wastes	72.0	81.8	93.7	100	0.0	63.2	71.8	78.5
	Burning	22.0	16.9	3.8	0.0	50.0	21.1	22.1	16.6
	Other uses	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.3
								Total	**100**
Do you have the will to separate the food wastes from other wastes	Yes	18.0	18.2	8.9	0.0	0.0	15.8	26.3	18.4
	No	82.0	81.8	91.1	100	100	84.2	73.7	81.6
								Total	**100**
How do you evaluate the solid waste management	Better	24.0	15.8	3.8	10.0	0.0	11.1	25.2	17.2
	Getting worst	58.0	63.2	55.7	60.0	100.0	55.6	42.0	53.0
	No change	18.0	21.1	40.5	30.0	0.0	33.3	32.8	29.8
								Total	**100**

Table 3.26: Variations in citizens' response based on marital status

Dependent Variable (Question)	Answer	Percentage of respondents (%)				
		Education level				Total
		Single	Married	Widower	Divorced	
How do you evaluate the collection team relation with residents	Respected	33.3	31.3	20.7	44.4	31.1
	Acceptable	64.6	49.6	69.0	44.4	53.0
	Bad	2.1	19.0	10.3	11.1	15.9
					Total	**100**
What you do with your food wastes	Compost	0.0	3.9	10.3	0.0	3.8
	Send it to garden	0.0	0.7	0.0	11.1	0.8
	Send it with other wastes	81.3	79.4	79.3	33.3	78.5
	Burning	18.8	15.6	10.3	55.6	16.6
	Other uses	0.0	0.4	0.0	0.0	0.3
					Total	**100**

Table 3.27: Variations in citizens' response based on monthly income

Dependent Variable (Question)	Answer	Percentage of respondents (%)					
		Monthly Income (NIS)					Total
		> 1500	1500-3500	3500-5500	< 5500	No answer	
How do you evaluate the collection and transportation from the community container	Very good	25.7	6.7	2.7	0.0	0.0	6.9
	Good	31.4	15.9	26.8	50.0	33.3	22.3
	Average	20.0	38.5	42.0	25.0	33.3	37.2
	Acceptable	11.4	24.1	17.9	8.3	11.1	20.1
	Bad	11.4	14.9	10.7	16.7	22.2	13.5
						Total	**100**
What you do with your food wastes	Compost	5.7	2.5	3.5	15.4	11.1	3.8
	Send it to garden	0.0	0.5	1.8	0.0	0.0	0.8
	Send it with other wastes	48.6	82.3	82.3	84.6	55.6	78.5
	Burning	45.7	14.1	12.4	0.0	33.3	16.6
	Other uses	0.0	0.5	0.0	0.0	0.0	0.3
						Total	**100**
Do you have the will to separate the food wastes from other wastes	Yes	41.7	14.1	15.9	15.4	55.6	18.4
	No	58.3	85.9	84.1	84.6	44.4	81.6
						Total	**100**
How do you evaluate the solid waste management	Better	36.1	16.2	13.4	0.0	37.5	17.2
	Getting worst	44.4	51.8	56.3	61.5	62.5	53.0
	No change	19.4	32.0	30.4	38.5	0.0	29.8
						Total	**100**

3.4 Solid waste quantification and characterization

3.4.1 Solid waste quantification in the study area

3.4.1.1 Per capita generation

The calculation of per capita solid waste generation is beyond the research objectives, but it was found that the per capita generation of solid waste in Ramallah had been never calculated, while in Jericho it was calculated recently two times by the Joint Council Services for Planning and Development in Jericho and Jordan Rift Valley, the first in 2006 and it was 0.80 kg per capita per day and the second in 2009 and it was 0.78 kg per capita per day.

3.4.1.2 Municipal solid waste quantification

As per the institutional questionnaire, the estimated average daily solid waste quantity produced is 100 and 33 ton per day in Ramallah and Jericho respectively.

The solid waste quantification in the study area was calculated based on weighing the waste vehicles entering the disposal facility in Jericho, while Ramallah it was based on the information from institutional questionnaire. This is due to logistics problems with municipality cooperation. Annex 03 illustrates the quantity entered Jericho landfill site for a period of one week during July, 2009. It is found that the average daily generation of solid waste at Jericho landfill site is about 23 ton per day, but this amount can't be considered for long term periods, since it doesn't consider the seasonal variation, those fit with the design life time of the disposal facility and/or the technology for sorting or separation alternatives. On the other hand, the estimated volume excludes the quantity that disposed locally at household either as compost for gardens and as animal feed or it is burned in few cases. Usually the solid waste quantification and characterization are very important for choosing proper disposal technology as well as the economic of value of such wastes based on

projected estimates. Based on these results the annual solid waste quantity produced at Jericho landfill site is about 8,400 ton per year.

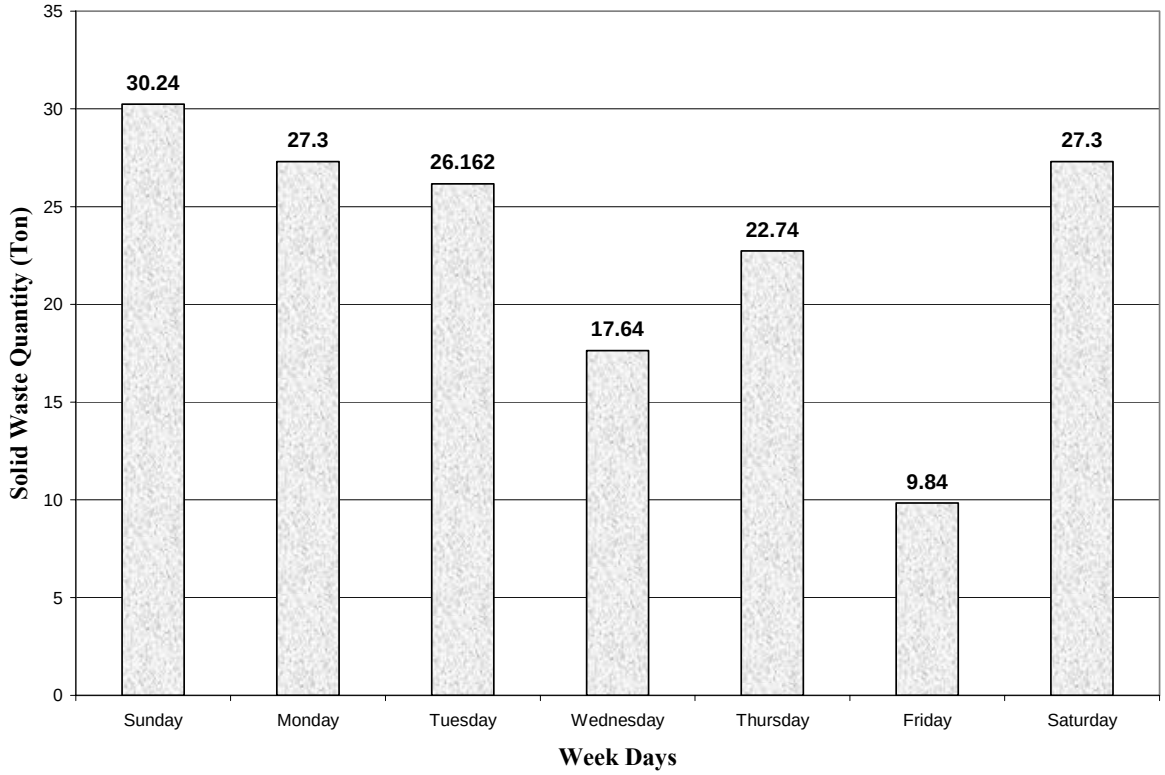

Figure 3.3: Daily solid waste generation at Jericho landfill site

It is documented in the literature that in India, it is estimated that the Indian cities are generating 42 million metric tonnes annually, the per capita waste generation ranges between 0.2 – 0.6 kg/day. On the other hand, the socio-economic conditions, developing urbanization and economic growth are affecting the per capita waste generation per day by about 1.3% (3iNetwork, 2006 cited in Zia; Devadas, 2008). In Iran, Rasht city, the collected data showed that the per capita waste generation is about 0.8 kg/day (OWRCMR, 2007 cited in Alavi Moghadam et al., 2009). In Turkey, the solid waste generation rate is between 1.32-1.34 kg/day (SIS, 2004 cited in Tinmaz and Demir, 2006). In Bangladesh, studies showed that the per capita waste generation is about 0.36 kg/day (Alam et al., 2007) , while in Cambodia is

about 0.34 kg per capita per day (Parizeau et al., 2006). In Philippines per capita generation waste is about 0.31 kg/day (Bennagen et al., 2002). As it was viewed latter, it is well documented in the literature that solid waste per capita generation rates and solid waste physical characteristics distribution vary across the world, and even across the developing world. Solid waste per capita generation is affected by the income and location, it seems that residents with higher income will consume more goods that leads to more production of waste, this is can not be generalized since previous studies had not use the same scale for the income and even the level of income is varied from country to country and it is even fluctuating within the same country from place to another. For example in a study in Abu Dhabi City, United Arab Emirates, it is found a strong positive correlation between household generation and self property rental rates (Abu Qadais et al., 1997 cited in Parizeau et al., 2006). The household location is affecting the per capita generation rate, urban or rural. Some times some households have their own business, meaning in rural areas some people have animals and they used food waste to feed their animals (Parizeau et al., 2006). Other studies have shown that there is a relationship between waste generation and household size, the per capita waste generation decreases as the household members' increases, possibly due to economies scale in the consumption of goods and packaging (Abu Qadais et al., 1997 and Bolaane and Ali, 2004 cited in Parizeau et al., 2006).

3.4.2 Solid waste characterization

Solid waste characterization took place in both cites, in Jericho and Ramallah during July and August, 2009 respectively. The characterization survey lasted for one week in Jericho and 4 days in Ramallah. On the other hand, the following table 3.28 and the three figures 3.4, 3.5 and 3.6 illustrated the results of the municipal solid waste fractions in both cities and the study area.

Table 3.28: Mean physical composition of municipal solid waste in the study area

Municipal Solid Waste Fraction	Percent by Weight (%)		
	Ramallah	Jericho	Study Area
Organic and Food wastes	40.15%	41.63%	40.89%
Plastics	20.44%	30.19%	25.32%
Paper and cardboard	21.12%	10.58%	15.85%
Glass	4.39%	2.02%	3.20%
Metals	2.43%	3.23%	2.83%
Textiles	4.98%	6.71%	5.85%
Other Wastes	4.28%	4.42%	4.35%
Waste less than 10 mm diameter	2.21%	1.21%	1.71%
Density (Kg/m^3)	164.00	177.87	170.93
Per capita waste generation (Kg/d)	-	0.780	-
Estimated municipal solid waste quantity (Ton/yr)	36,000	8,400	44,400

As shown in the table above both cities had high organic percent of wastes, it is more than 40%, while it was noticed that plastics and papers in Ramallah are representing, also, more than 40% (20 % plastics and 21 % papers) while in Jericho it is about 30 % plastics and 10 % papers. This is explaining the slight difference in the density since Jericho had higher organic fraction, less paper and cartoon. Metals and glass are representing small fraction which is about 6% of the municipal stream in the study area.

In Irbid ,Jordan, the organic fraction reaches 77 % by weight and it is about 54 % in Amman, and this much affecting the density, since the corresponding density for these figures are above 240 kg/ m^3(Abu Qadais et al., 2007). In developing countries the organic fraction in the solid waste generation is high and may reach up to 60%. Solid waste characterization and quantification is very helpful and economically feasible, since the method of handling, storage and processing of solid wastes at the source plays an important role in public health, aesthetics and the efficiency of the municipal solid waste system (Alavi Moghadam et al., 2009). In southeast Asian nations studies showed that in Indonesia the composition of MSW is 62% organic wastes, 6% paper and cardboard, 10% plastics, 9 % glass, 8 % metals and 4 % others, while in Laos it is 46 % organic wastes, 7% paper and cardboard, 10% plastics, 8 %

glass, 12 % metals and 21% others, in Brunei it is 44% organic wastes, 22% paper and cardboard, 12 % plastics, 4% glass, 5 % metals and 13 % others (SWM in Asia, 2000-2007 cited in Yen et al., 2009). In India, based on investigations performed by NEERI (1996) and Kanpur Municipal Corporation (1999), the percent distribution of solid waste are showing paper 4%, biodegradable 44.3%, inert (dust, ash, etc.) 39.2%, metals 0.01%, textiles 4.9%, plastics, leather and rubber 7.6%, others (stones, wood, etc.) 0.1% (NEERI, 1996 cited in Zia; Devadas, 2008). In Iran, as per the recycling organization of Rasht municipality, 2007 the physical analysis of MSW showed the following distribution: food wastes 80.2%, paper and cardboard 8.7%, metals 0.7%, textiles 0.4%, glass 0.2%, rubber and plastics 9%, wood 0.4% and others 0.4%, as it is noticed the organic faction is high and this mainly due to the amount of unprocessed foods in the daily diet of inhabitants (Alavi Moghadam et al., 2009). In Turkey, the characterization percent profile of solid waste is showing cardboard 2.4%, food and yard 54.2%, metals 3%, glass 6.3%, nylon 9.4%, textile 1.9% and ash and others 5.9% (Tinmaz and Demir, 2006). In Philippines studies showed that the solid waste composition as the following: food wastes 36%, papers and cardboard 12%, plastics 11%, textiles 3%, rubber and leather 3%, wood and yard wastes 12%, metals 8%, glass 6% and others 9% (JICA, 1992 cited in by Bennagen et al., 2002). In Bangladesh, the composition of mixed MSW for Habibganj city illustrated that the percentages of food wastes 50%, fine dust 9.6%, plastics 10.3%, stones, bricks and earthward 14.3%, paper 6%, metals 1.5%, leather 2% and others 1.8% (Alam et al., 2007).

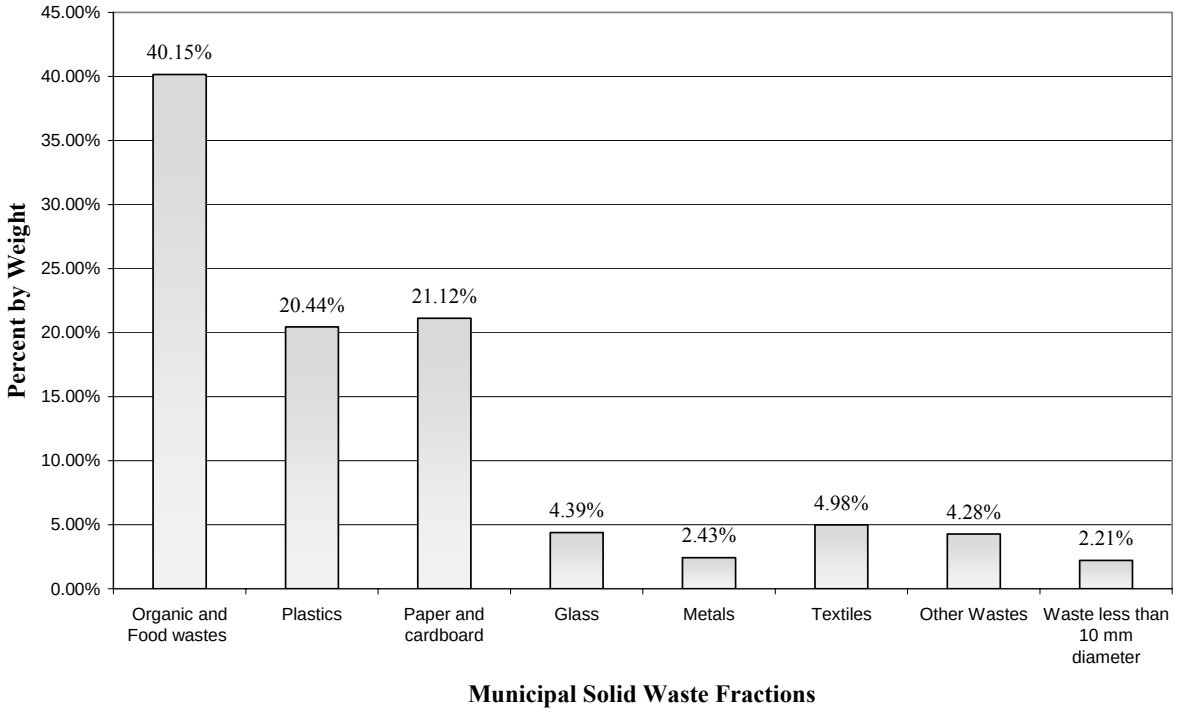

Figure 3.4: Municipal solid waste distribution percent by weight- Ramallah city

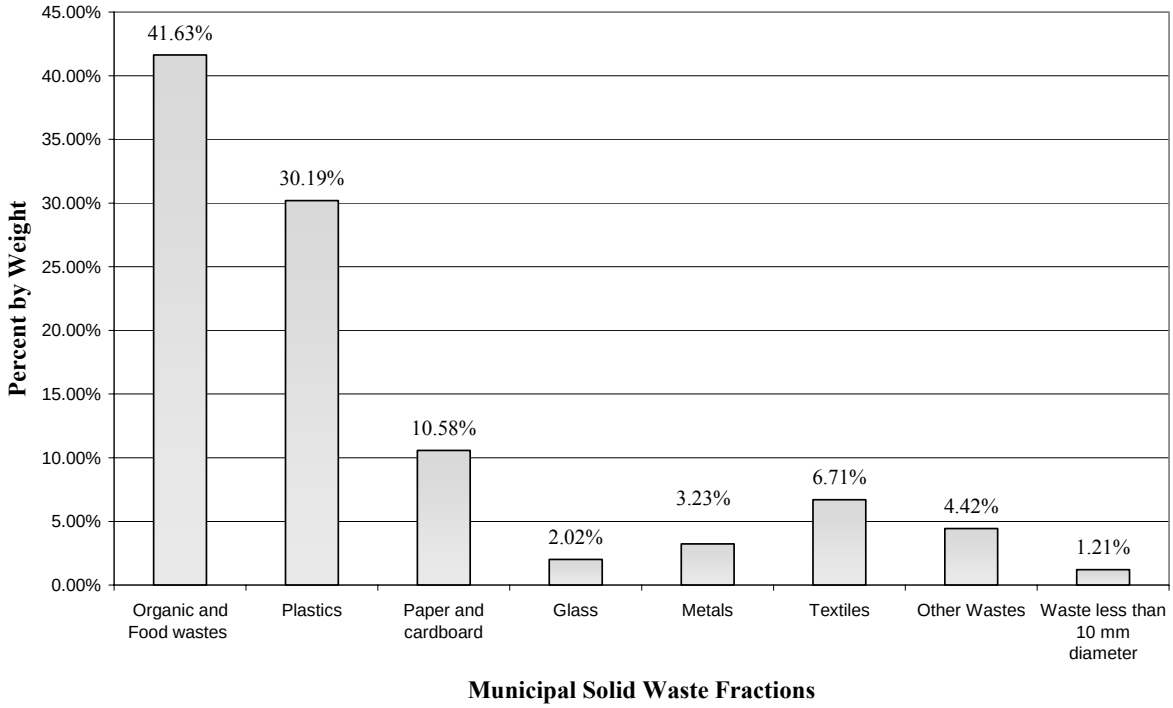

Figure 3.5: Municipal solid waste distribution percent by weight- Jericho city

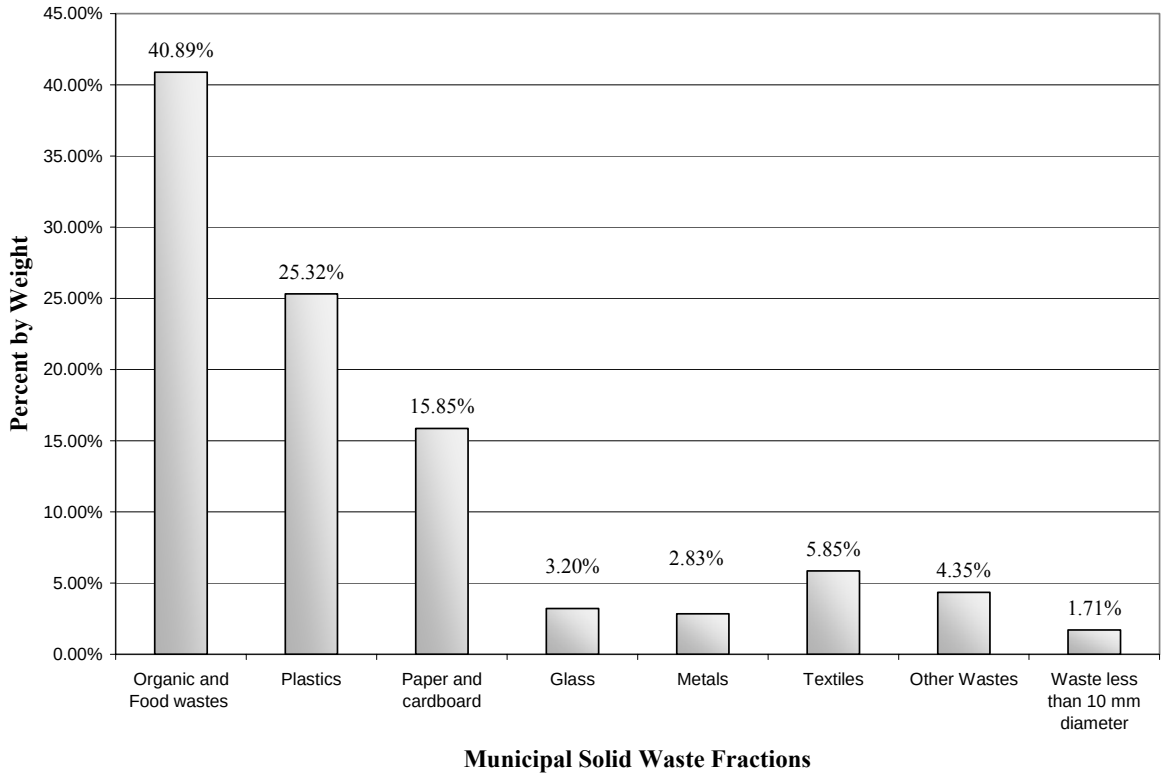

Figure 3.6: Municipal solid waste distribution percent by weight- Study Area

It is noticed above the recyclable fractions (metals, glass, paper and cardboard and plastics) are representing about 47 % of solid waste stream, the high percentage is coming from plastics and papers, while metals and glass are representing only 6%, this is coming from the fact that due to high potential value of metals, many scavengers are collecting the cans and other metals from the containers and homes. Valuable concerns shall be given to paper and plastic fractions as well as the organic and food wastes as a source for composting and soil enrichment, especially the study area has large areas for agriculture use.

The following table 3.29 illustrates the comparison between previous physical characterizations executed in the study area.

Table 3.29: Mean physical composition of municipal solid waste in the study area compared to previous studies

Municipal Solid Waste Fraction	Percent by Weight			
	Jericho 2006	Jericho 2009	Ramallah 2008	Ramallah 2009
Organic and Food wastes	60.00%	41.63%	42.30%	40.15%
Plastics	13.80%	30.19%	18.70%	20.44%
Paper and cardboard	11.60%	10.58%	27.90%	21.12%
Glass	2.80%	2.02%	1.60%	4.39%
Metals	4.90%	3.23%	1.80%	2.43%
Textiles	2.00%	6.71%	0.00%	4.98%
Other Wastes	4.90%	4.42%	7.70%	4.28%
Waste less than 10 mm diameter	0.00%	1.21%	0.00%	2.21%

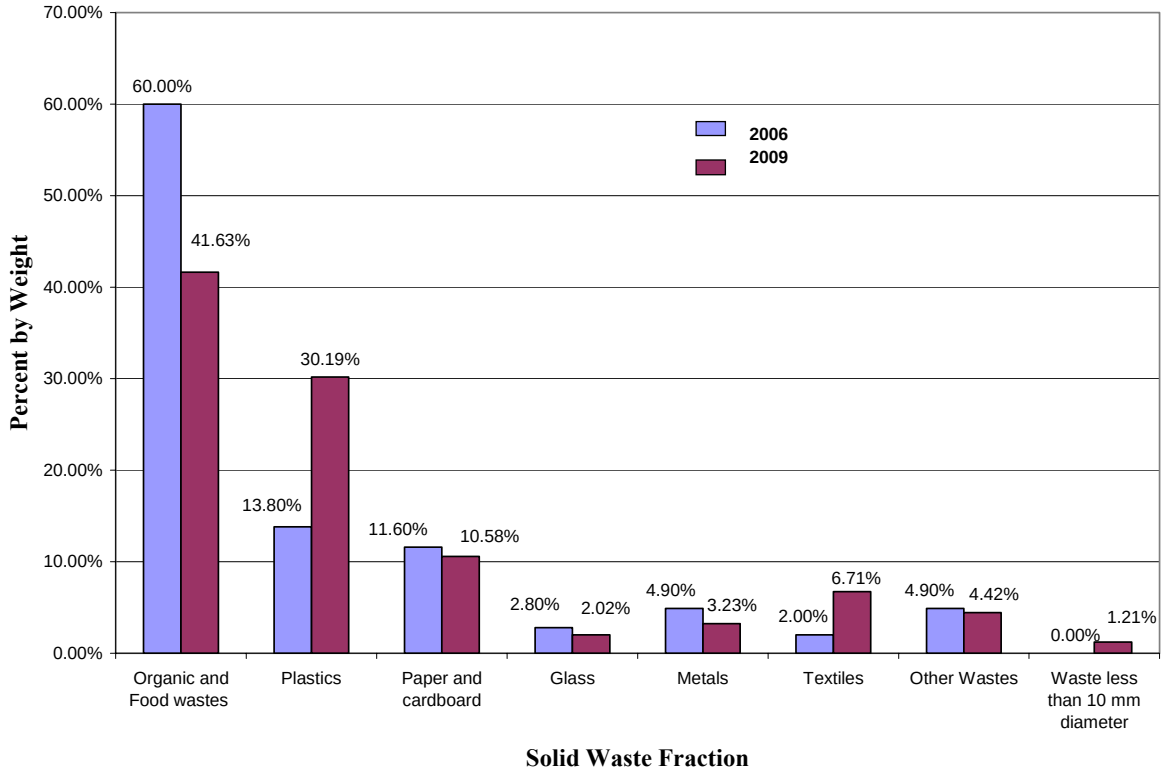

Figure 3.7: Municipal solid waste distribution percent by weight- comparison to previous studies-Jericho city

It is apparently noticed that during the past three years there is a decline trend in the percent of organics and increase in the percentage of plastics, other municipal solid waste fractions are not much deviated. This may be attributed to increase of the tourism in Jericho and high number of visitors those who are using many plastics derivatives like plastic bags, bottles and

fast food packages. Another reason that is considered a major source of plastics in Jericho is agricultural residues like nylon sheets.

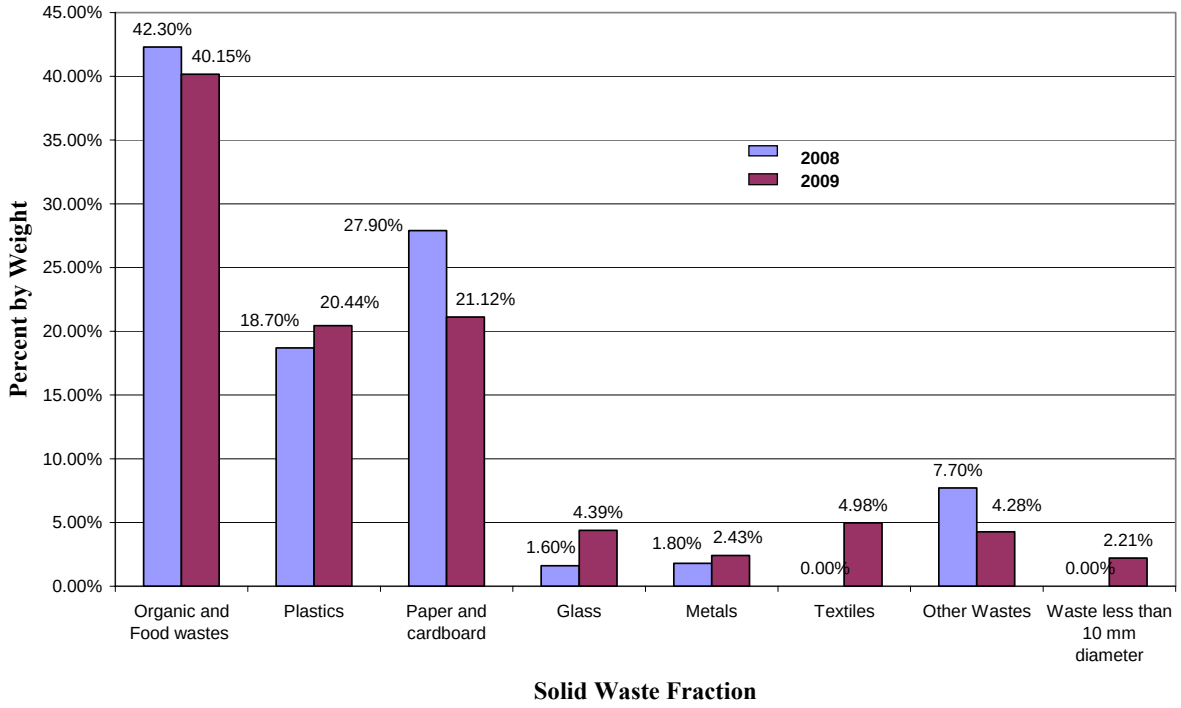

Figure 3.8: Municipal solid waste distribution percent by weight- comparison to previous studies-Ramallah city

In Ramallah there is no decline in the organic fraction, but it is noticed that also plastics fraction increased as well as the glass and textiles. The results are slightly different because the lag period is only one year.

4. Conclusions and Recommendations

This chapter presents the final conclusions with brief summary on the outputs of the research assessment, besides, it, also, presents several recommendations in order to enhance the solid waste management in the study area as well as propose an integrated solid waste management system.

4.1 Legislative framework and institutional involvement

Despite of intensive efforts exerted for the development of the solid waste sector in the occupied Palestinian Territories (oPT), the solid waste management is still suffering from apathy in coordination and conflicts in responsibilities and duties between concerned institutions, lack of continuous compliance monitoring, absence of national plans, existing of gaps in the legislative and law in this regard that lead to deterioration in the implementation and donation mechanisms. It is obviously observed and concluded that the two municipalities, Ramallah and Jericho, are suffering from the lack of making financial and administrative independent divisions as well as the insufficient financial resources, especially the systems are not self sustaining. Rapid urbanization and daily migration to the two cities from all other cities in the West Bank is outstripping the service capacity. Moreover, the two municipalities are indeed suffering from the absence of enforcement measures and capabilities that forcing the residents to pay their contribution to solid waste management in their areas. The two municipalities still have neither enough and qualified neither technical and administrative personnel nor adequate planning for the waste management. On the other hand, the two municipalities are facing problems with poor response to waste minimization as well as public cooperation, they are not controlling the hazardous wastes either medical or industrial in Ramallah or industrial or agrochemical in Jericho. Finally, the lack of qualified private sector contractors is considered another important factor that affects the solid waste

management enhancement as well as the absence of standby disposal facilities sites especially Ramallah site is outlived its normal life and Jericho is relatively of small absorption capacity. Consequently, it is recommended to change the technology-driven tradition of solid waste management to an integrated management perspective where the human dimension has a prominent place, adopting a new and comprehensive notion of policy and polycentric governance that includes the design of flexible and adaptive human-technology-environment systems, bridging the science-policy gap by defining a new role for science as an active participant in polycentric policy processes, rather than being an external observer and the process of solid waste management planning and decision making should be shared with the four main stakeholders in society: civil society, the private sector, NGOs and the relevant government entities. On the other hand, the key personnel in the involved institutions should be trained and educated to acquire particular experience for the enhancement of the solid waste management. Despite the escalating political situation that much adversely affect the prosperity of the solid waste management, the concepts of good governance are important aspects in this regard, through the provision of legal security, transparency, accountability and the freedom to express one's views.

4.2 Environmental awareness and incentives

As per the results of the institutional and household questionnaires, the study area in general are suffering from lack of conducting regular public awareness campaigns for the public participation and increasing their acceptance for the enhancement of the solid waste management area. It is reported via the results of the household questionnaire that only 5 % of the respondents had received public awareness campaigns. This is explaining the high percentage of objection for performing source separation that reaches 82% in the study area. Accordingly, increasing public participation by establishing and maintaining an effective

public and government communication system is highly recommended since it is two way process that identify what the public should do and how the government will perform towards public concerns and preferences. Civil society support for the service enhancement is very essential since it empowers the efficiency of proposed modifications of existing situation. It is recommended to inform and educate the public for any proposed changes to solid waste management practices relatively at earlier stage of planning process. The information and environmental education can be achieved through several methods, but it is preferable to use several of them on continuous long term basis, such as media through leaflets, posters, mural, notice boards, books, stories, games, videos, newspapers, radio and television. Events such as public meetings, community discussion focused groups and other printed shopping bags or tee-shirts with environmental messages are considered other important ways for public education and informing.

4.3 Storage and collection systems

Primary collection in Jericho is curb side collection, while in Ramallah is community bin collection system. Both municipalities have no standardization policy regarding solid waste collection vehicles and containers. Both municipalities are performing street sweeping by their own workers and not by sweepers, this much affected the cleanness of the streets, since the calculated CEI is 55 and 65 in Jericho and Ramallah respectively, as well as this much increase the running cost of streets cleaning. 67 % of the respondents in the household questionnaire said there is no road sweeping or it is considered bad. The results of the household questionnaire reported that the community containers are always full or partially full with garbage around, respondents showed high concern about the location and size of the community bins. Moreover, collection routes are not organized in Ramallah city, while in more organized in Jericho due to continuous efforts exerted by the JCSPD-JJRRV. It is

recommended to conduct survey motion for the collection vehicles, that identifies the best collection routes and it gives real status of the containers as well as using the geographic information system (GIS) facility for allocating the optimal routes planning and networking of waste collection and transportation. On other hand, the collection and transportation cost is considered the higher among other tasks, so cautious concern shall be given to this portion of management. (EPA, 1999) recommends cost cutting strategies for success of collection efficiency, these strategies are reducing collection frequency, automated collection, decreasing fleet size with dual collection, increasing employee productivity and contracting and competition. It is recommended to adapt some or all of these strategies in the study area on short term and long terms periods. Collection frequency always less is often the best, when it is applicable to reduce the collection frequency; it is always the best since daily collection is underutilized. So it is recommended to afford and adopt the following steps in order to minimize waste production and to utilize the waste as a source and not as only a cost burden on the residents and institutions:-

- Eliminate rather than manage (cleaner production principle): this can be achieved through public awareness rising, environmental education, changing the tariff system to weight billing system instead of flat fee system. By considering the (Pay –As-You- Throw) fee structure, the per capita waste generation studies should be performed in order to revise the tariff per house or apartment based on the number of people living in respective home or flat. The tariff for commercial and industrial premises should be revised, since it is unrealistic that big restaurant or hotel is charged like other crafts.
- Plan and implement for recycling and composting programmes that helps in reducing the need for several collection trips and it generates income for the solid waste enhancement.

- Study the containers locations and their corresponding capacities, since in both cities it is noticed that 1100 litre containers are frequently used, revision is needed to adopt new sizes and better distribution of containers.
- Adopt a standardization policy the type of vehicles and containers used for propose of collection, since many vehicles can't handle all containers types that lead to travel several kilometres in order to pick up the 2nd container. Moreover, the containers should be covered since it noticed caused bad aesthetic seen and it attracts insects and flies and usually it produces bad odours and attracts vermin and domestic animals.
- Educate the workers and the supervisors: the collection working staff should be educated for wearing the safety clothes and equipments, how to treat with loading and unloading of containers, clean around containers and maintain the public property in good status.
- Provide residents with bigger residential containers with tied covers for storage for more than one day.
- Schedule the number and time of collection trips: since it is known that the collection team is working for certain hours, so careful programming of collection trip time is highly recommended since it will minimize the cost of travelling through traffic congestion and avoid many probable accidents.

The second strategy is automation, the secondary collection in the study area is automated, but the primary collection is not in Jericho and in the field of roads sweeping that adds additional costs on the burden of the municipalities. So it is recommended to adopt the community bin principle in Jericho and to use road sweepers for the streets sweeping that increasing the efficiency of the system as well as minimizing the relevant costs. Another important factor that should be considered is the crew productivity, motivating employees by considering special pay structures, offering better training programmes and rewarding employees for safe work practise. Finally, the concerned entities should study the possibility

of considering privatisation option in the collection tasks that ensures fair competition since well designed competitive procurement procedure according to specified terms of reference is the key to obtain the most reasonable rates and highest quality service.

4.4 Waste quantification and characterization

The per capita waste generation is beyond research objectives, but it is found that it is calculated in Jericho and it was found 0.78 kg per capita per day, while in Ramallah it was never calculated. On other hand, based on institution records the total quantity entering the disposal facilities are 33 and 100 ton per day for Jericho and Ramallah respectively. In this regard the research calculated the waste quantities entering Jericho landfill site and it was 23 ton per day. In Ramallah the municipality has now no weighbridge in dumpsite, besides the municipality refused to program the weighing process using external weighbridge.

Many plastics are non-biodegradable that take long time to break down, so the increased quantities of plastics is considered a growing concern and it can be recognized as an attractive market for investment and development, since recycling of wastes and especially plastics is not a new method because it has been successfully applied in many developing countries at those with small – medium scale production capacity. There are many products can be recycled from plastics like polyethylene bin liners, carrier bags, PVC sewer pipes, flooring and window frames, building insulation boards, video and compact disc cassettes, fencing and garden furniture, water butts, garden sheds and other variety of office accessories. Moreover, organic fraction is considered the biggest portion that required special attraction. These wastes should be used as feedstock for aerobic and anaerobic digestion (composting) that considered more cost-effective and environmentally friendly. Paper recycling is the process of manufacturing old paper products and turning them into new, reusable paper products. These can be recognized recycled paper products: newspaper,

shredded paper, phonebooks, cardboard, magazines, computer paper, envelopes, and construction papers. By recycling cardboard and other paper products millions of new products can be produced such as: egg cartons, paper towels, tissue, toilet paper, newspaper, phonebooks, paper bags, and notebooks. As it is aforementioned, the three waste fractions; organics, plastics and papers are formulating 80% of the waste stream, so if well prepared recycling program is established, the quantity of waste to dumped at the disposal facilities will be much less as well as high potential income will be generated in addition to better environmental and healthy conditions.

Waste reuse is preferably for recommended for plastics products since in this way uses less energy and fewer resources. Consequently, it can be recommended to produce long life plastics products. Economic incentives can encourage residents such markets can increase their returnable plastics crates. As well as the issue for glass and plastics bottles, they should be considered as returnable products.

It important to underline that quantification and characterization studies should be conducted on seasonal terms in order to reflex the actual quantity and physical distribution of waste components to build up clear strategies and future plans for integrated waste management.

4.5 Proposed integrated solid waste management system

The waste hierarchy is a key element of integrated solid waste management (ISWM) and is widely applied in industrialized countries; figure 4.1 introduces the waste hierarchy. No single solution completely answers the question of what to do with our waste. Every community or region has its own unique profile of solid waste. Community diversity and waste diversity are two reasons why no single approach to waste management has been accepted as the best method.

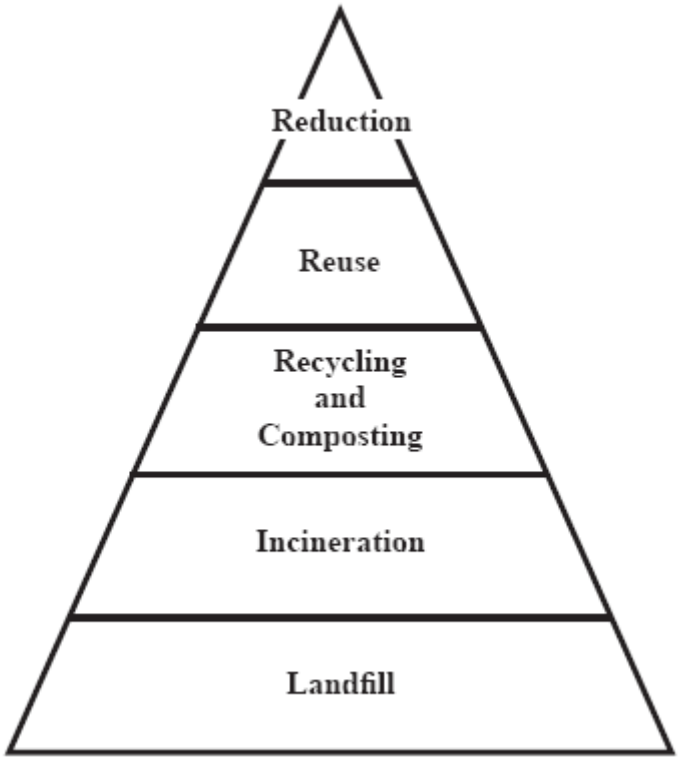

Figure 4.1: Hierarchy of ISWM

Integrated solid waste management needs a strong legislative framework as well as reinforcement measures besides professional institutions for the implementation of ISWM. In this regard figure 4.2 illustrates the main milestones and stations for the proposed ISWM. Finally, the following steps are summarizing the major proposed mechanism to enhance the solid waste management in the study area:-

1. Institutional strengthen through establishing independent financial system for the solid waste management ,inventory spare parts and supplies systems, capacity building of key personnel those involved in the system and appoint qualified experts for enhancement of the institutions.
2. Review the tariff system charged to residents and other crafts and considers the depreciation value of the equipments used.

3. Revise the collection routes consider the cost cutting strategies; reducing collection frequency, automated collection, decreasing fleet size with dual collection, increasing employee productivity and contracting and competition.
4. Adopt standardization policy for collection vehicles and community containers.
5. Secure disposal sites locations since Ramallah dump site is outlived and Jericho is relatively small of absorption capacity.
6. Secure certain funds for planning and inception and implementation phases of ISWM.

Then, after the good preparing of the institutions and their staff, ISWM can be introduced through:-

1. Plan and conduct public awareness rising and environmental education campaigns for residents in order to increase the public acceptance and their cooperation in the implementation of ISWM.
2. Cleaner production principle: eliminate waste rather than manage means waste reduction at source either for residential, commercial, industrial or agricultural. This is can be introduced through the application of (Pay –As-You- Throw) fee structure.
3. Consider recycling and reuse alternatives gradually, through government institutions, schools, big waste producers like hotels, restaurants and industrial facilities.
4. Develop and construct mechanized sorting plants at disposal facilities as preliminary step since many fractions can be sold as raw materials for the market, this will minimize the waste to be dumped as well as generate income for other branches of solid waste management enhancements.
5. Consider composting alternative since the organic fraction is above 40% and the study area includes large scale of lands for agricultural.
6. Transfer the know-how to residents gradually for source segregation after conducting relevant awareness rising and environmental education.

7. Encourage source separation by conducting economic incentives through local markets and buying the recyclable materials from the residents.
8. Construct engineered sanitary landfill sites.
9. Consider and involve the informal sector in the process of waste collection and recycling and reuse alternatives.
10. Develop a computerized monitoring system for record keeping and data verification as well as develop management plans and action plans.
11. Maintain continuous studies for solid waste profile; quantity and physical and chemical characterization in order to adopt corrective measures that always enhances the solid waste management.

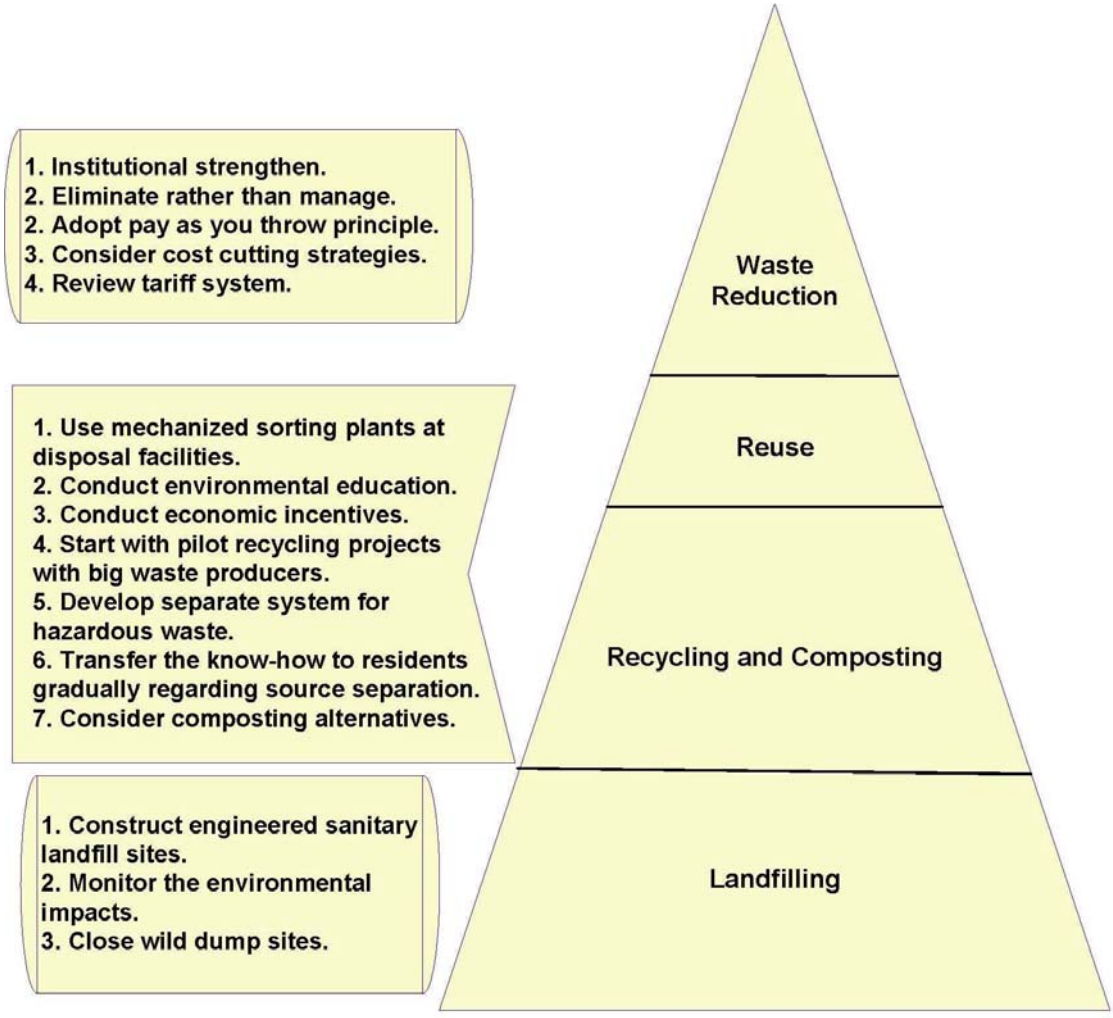

Figure 4.2: Proposed hierarchy of ISWM in the study area

5. References

Abdrabo, M., (2008). Assessment of economic viability of solid waste service provision in small settlements in developing countries: case study Rosetta, Egypt. Waste Management, 28(12), 2503-2511.

Abu Qadais, H.A., (2007). Techno-economic assessment of municipal solid waste management in Jordan. Waste Management, 27(11) 1666–1672.

Abu Qadais, H.A., Hamoda, M., F., Newham, J., (1997). Analysis of residential solid waste at generation sites. Waste Management, 15, 395-406.

Alam, J., B., Chowdhury, R., K., Uddin Ahmed, Z., Amin, A., S., M., Chawdhury, A., K., H., B., (2007). Sustainable approach of solid waste management of small urban area; case for HABIBGANJ municipality in Bangladesh. Iranian Journal of Environmental Health, Science and Engineering, 4(3), 181-190

Alavi Moghadam M.R., Mokhtarani N., Mokhtarani B.,(2009). Municipal solid waste management in Rasht city, Iran. Waste Management, 29(1),485-489

Al Baldawi, A., A., (2004). Methods of scientific research and statistical analysis using SPSS. 1st edition, Al Isra' University, Jordan.

Act Government (1996). A waste management strategy for Canberra- strategy of no waste by 2010. Office of the Commissioner for Sustainability and Environment, Canberra, Australia. http://www.environmentcommissioner.act.gov.au/publications/nowasteprogress, accessed on 15/06/2009.

Al-Hmaidi, M., (2002). The development of a strategic waste management plan for Palestine. Negotiations support unit, Ramallah, Palestine.

Al-Khatib, I.A., Arafat, H.A., Basheer, T., Shawahneh, H., Salahat, A., Eid, J., Ali, W., (2007). Trends and problems of solid waste management in developing countries: a case study in seven Palestinian districts. Waste Management, 27(12), 1910-1919.

Applied Research Institute-Jerusalem (ARIJ) (1996). Environment profile for the West Bank, Ramallah district, Volume 4.

Applied Research Institute-Jerusalem (ARIJ) (1995). Environment profile for the West Bank, Jericho district, Volume 2.

Bennagen, Ma. E. C., Nepomuceno, G., Cover, R., (2002). Solid waste segregation and recycling in metro Manila: household attitudes and behavior. Resources, Environmental and Economics Center for Studies, Inc. (REECS), Philippine.

Bolaane B., Ali, M., (2004). Sampling household waste at source: lessons learnt in Gaborone. Waste Management, 22, 142-148.

Buenrostro O., Bocco G., (2003). Solid waste management in municipalities in Mexico: goals and perspectives. Recourses Conservation and Recycling, 39(3), 251-263.

Chang, N.B., Parvathinathan, G., Breeden, J.B., (2007). Combining GIS with fuzzy multi criteria decision-making for landfill siting in a fast-growing urban region. Environment Management, 87(1), 139-153.

Chattopadhyay, S., Dutta, A., Ray, S., (2009). Municipal solid waste management in Kolkata-India. Waste Management, 29(4), 1449-1458.

Dahle`n, L., Anders, L., (2008). Review methods for household waste composition studies. Waste Management, 28(7), 1100-1112.

Environmental Protection Agency (EPA) (1999). Collection efficiency, strategies for success, USA.

Environmental Protection Agency (EPA) (1997). Full cost accounting for municipal solid waste management: A Hand Book, USA.

Environmental Quality Authority (EQA) (2009). Publications, Palestinian environmental law, http://www.mena.gov.ps/pub/index.htm, accessed on 21/03/2009.

Environmental Quality Authority (EQA) (2008). National strategy for solid waste management in Palestine, Ramallah, Palestine.

Green Solutions, (2007). Chelan county solid waste management plan, south Prairie, USA.

Royal Dutch Consulting Engineers and Architects (HASKONING) (1994). Guidelines, division of environment affairs.

Jalilzadeh, A., Parvaresh, A., (2005). Evaluation of chronological aspects of collection and transportation of municipal solid waste system in Urmia, Iran. Iranian Journal of Environmental Health, Science and Engineering, 2(4), 267-272.

Javaheri H., Nasrabadi, T., Jafarian, M.H., Rowshan, R., G., Khoshnam, H., (2006). Site selection of municipal solid waste landfills using analytical hierarchy process method in a geographical information technology environment in Giroft. Iranian Journal of Environmental Health, Science and Engineering, 3(3), 177-184.

Japan International Cooperation Agency (JICA) (1992). Metropolitan Manila development, Philippine.

Jericho Municipality (2009). City history, http://www.jericho-city.org, accessed on 15/02/2009.

Joint Council for Services, Planning and Development for Jericho and Jordan River Rift Valley (JCSPD-JJRRV) (2008). Progress report, Jericho, Palestine.

International Management Group (IMG) (2009). Damage assessment and reconstruction in the West Bank and Gaza Strip, http://www.ecwbg.info, accessed on 20/02/2009.

Lia, J.Q., Borensteinb, D., Mirchandani B., P., (2006).Truck scheduling for solid waste collection in the city of Porto Alegre, Brazil. Omega, 36(6), 1133-1149.

Ministry of Local Government (MoLG) (2008). Infrastructure facility program, procurement of solid waste equipments for the West Bank, Ramallah, Palestine.

Ministry of Planning (MoP) (2009). Palestinian Reform and Development Plan (PRDP) for 2008-2010, Ramallah, Palestine.

Municipality of Geater Amman (MoGA) (2001). Cleansing department documents.

National bureau of economic research (NBER) (2006).World web page http://www.nber.org/workinggroups/ee/ee.html, accessed on 15/02/2009.

NEERI, (1996). Strategy paper on solid waste management in India. National Environmental Engineering Research Institute, India.

Organization for waste recovery and composting of the municipality of Rasht (OWRCMR) (2007). Technical report, Iran.

Pakistan Environmental Protection Agency (PEPA) (2005). Guidelines for solid waste management, Pakistan.

Palestinian Central Bureau of Statistics (PCBS) (2007). Population census, Ramallah, Palestine.

Palestinian Central Bureau of Statistics (PCBS) (2008). Environmental survey for residential and economical establishments, Ramallah, Palestine.

Parizeau K., Maclaren V., Chanthy L., (2006). Waste characterization as an element of waste management planning: lessons learned from a study in Siem Reap, Cambodia. Recourses Conservation and Recycling 49(2), 110-128.

Palestinian Municipal Support Program (PMSP) (2006). Consulate general of Italy, solid waste management in Bethlehem governorate, Palestine.

Ramallah Municipality (2009). Location and climate, http://www.ramallah.ps, Ramallah, Palestine, accessed on 15/02/2009.

Refsgaard, K., Mangnussen, K., (2009). Household behavior and attitudes with respect to recycling food waste-experience from focus groups. Environmental Management, 90(1), 760-771.

Salhofer, S, Obersteiner, G, Schneider, F., Lebersorger, S., (2007). Potentials for the prevention of municipal solid waste. Waste Management, 28(2), 245-259.

Shekdar V., A., (2009). Sustainable solid waste management: an integrated approach for Asian Countries. Waste Management, 29(4), 1438-1448.

Suranga, M.S.S, Gunaratne, L.H.P, (2007). Analysis of public preferences for ecological solid waste management: a discrete choice experiment. Sri Lankan Journal of Applied Statistics, 8, 45-53.

Tinmaz E., Demir I., (2006). Research on solid waste management system: to improve existing situation in Corlu Town of Turkey, Waste Management, 26(3), 307-314.

United Nations Environmental Program (UNEP) (2003). Desk study on the environment in the occupied Palestinian Territories, 1, 58-188, Switzerland.

Vesilind, P., A., Rimer, A., E., (1981). Unit operations in resources recovery engineering. Prentice hall Inc.. Englewood Cliffs, NJ, USA.

Vicente, P., Reis, E., (2008). Factors influencing households' participation in recycling. Waste Management, 26(2), 140-146.

World Health Organization (WHO) (1988). Handling solid wastes in developing countries, a handbook Alexandria, Egypt.

World Health Organization (WHO) (1996). Guides for municipal solid waste management in Pacific Countries. Healthy cities, healthy islands document series, No.6, western Pacific region.

Yen, U., Ngoc, N., Schnitzer, H., (2009). Sustainable solutions for solid waste management in southeast Asian countries. Waste Management, 29(6), 1982-1995.

Zamorano, M., Molero, E., Hurtado, A., Grindlay, A., Ramos, A., (2008). Evaluation of a municipal landfill site in southern Spain with GIS-aided methodology. Journal of Hazardous Materials, 160(2-3), 473-481.

Zeiss, C., (1995). Analytical framework for waste facility siting. Journal of Urban Planning and Development, 121(4), 115-145.

Zia, H., Devadas, V., (2008). Urban solid waste management in Kanpur: opportunities and perspectives. Habitat International, 32(1), 58-73.

3iNetwork (2006). India infrastructure report: urban infrastructure, Oxford University press.

6. Annex 01: Institutional questionnaire

Introduction

This questionnaire designed to facilitate the assessment of the current situation of solid waste management service in Ramallah and Jericho cities. The information collected by this questionnaire for the two cities can be used to evaluate the status of the solid waste management sector in them. To enable an accurate assessment, it is important that all information requested in the questionnaire should be provided as completely and accurately as possible.

General Information

Name of responsible authority	
Address	
Telephone/Fax	
Population	
Department responsible for solid waste management	
Address	
Telephone/Fax	

Performance of solid waste service activities

Function/Activity	Carried out by			Remarks
	Own staff	Contractor	Others, specify	
Solid waste management service to domestic premises				
Solid waste management service to commercial/trade premises				
Solid waste management service to industrial premises				
Street sweeping				
Grass cutting				
Public toilet cleansing				
Removal of dead animals				
Removal of gardens/parks waste				
Removal of bulky waste e.g. ministries and other government bodies				
Removal of abandon vehicles				
Development/building plan approval				
Procurement of vehicles/equipment				
Maintenance of vehicles and equipment				
Recruitment of solid waste management staff				
Training of solid waste management staff				
Public education				
Others				

Current solid waste management system
This section will be as a basic orientation for the existing solid waste management system, please answer the following questions:-

- Is your solid waste management system has a legislative and framework background? If yes, please specify main milestones.

- Is your entity performing recycling, recovery and solid waste segregation? If yes, please specify.

- Is your entity conducting economic incentives, environmental awareness and public awareness campaigns for the residents? If any, please specify.

- How do you evaluate the role of your residents in the solid waste management, please describe their involvement.

- Is your entity conducting regular record keeping for technical and financial status of the system? If any, please specify fields of concern

- Is your entity has clear vision for the future needs and structured strategies? If any, please specify fields of concern

- Is your entity has internal safety measures and public health preservation? If any, please specify fields of concern

Planning and development

- Solid waste generation and characterization

If data on solid waste generation and characteristics are available, please answer the following questions and then complete the following table:

1. When the data was collected? ……
2. Is data collected by actual survey of estimation?.....

Solid waste characterization		**Solid waste generation**	
Component	**% by weight**	**Sector**	**Kg per capita per day**
Paper and cardboard		Domestic	
Plastic and rubber		Commercial	
Organic and food waste		Institutional	
Glass			
Metals			
Textile			
Other waste (wood, leather, ashes, etc.)			
Waste less than 10mm size			
Total			

Note: for more than one year, copy the table and insert relevant data

- Solid waste storage and collection

1. Does your entity have any policy regarding the storage? If yes, please specify

2. Type of storage container used (please tick appropriate space)

Type of Containers		Size(m^3)	Residential premise				Commercial premise			
			A	F	S	N	A	F	S	N
Individual Containers	Metal bin									
	Plastic bin									
	Plastic bag									
	Others									
Communal Containers	Metal bin									
	Concrete bin									
	Roll-on roll-off									
	Others									

A= almost exclusively used F= frequently used S= sometimes used N= never used

3. Collection coverage in last year 2008

Sector/ Activity	Percent of served fraction	Frequency of collection
Domestic (households)		
Commercial Collected by SW department		
Commercial Collected by SW department contractors'		
Commercial Collected by SW owner contractors'		
No collection service (done by owner , both residential and commercial)		

4. Total amounts collected by all parties in last year 2008

Waste type	Amount collected (1000kg)	
	Measured	Estimated
Domestic, institutional, commercial and trade waste		
Industrial waste		
Street/park cleansing waste		
Bulky waste		
Others		
Total		

5. Solid waste disposal: for the disposal method, please complete the following table:

Items	**Disposal site**		
	Site 1	**Site 2**	**Site 3**
Name of site			
Total area (ha)			
Year when disposal started			
Estimated life span remaining (year)			
Amount of waste deposited daily (tonne/day) (measured or estimated)			
Distance from collection area to the site (km)			
Disposal method (See notes below)			
Environmental protective measures	Yes / No	Yes / No	Yes / No
If yes, please specify			
Existence of animals on site	Yes / No	Yes / No	Yes / No
Existence of waste pickers or scavengers on site	Yes / No	Yes / No	Yes / No
If yes, how many scavengers			
Any separation or recycling activities at disposal site	Yes / No	Yes / No	Yes / No
If yes, please specify			
Existence of open burning on site	Yes / No	Yes / No	Yes / No

O = Open dumping

C = Controlled tipping (with occasional soil cover)

S = Sanitary landfill (with daily cover)

D = Dumping into water body (river/sea etc.)

Operation

- Contractual services

Service Component	Proportion of contractual service (last 3 years)			Number of contractors in last 3 years		
	2006	2007	2008	2006	2007	2008
Collection and transport						
Street sweeping						
Grass cutting						
Landfill operation						
Vehicle maintenance						
Others						

- Vehicles and Equipments

1. Is there any policy to standardize the vehicles and equipment used by the department? If so, please outline how this policy is being implemented.

2. Does the department have its own workshop to maintain and repair its vehicles and equipment? If so, how does the workshop purchase spare parts? What is the average time taken for the purchase? What is the policy on stock Maintenance?

3. Equipment for primary collection owned and contracted (i.e. collection of solid waste from households to communal bin or depot for subsequent collection by collection vehicles)

Equipment type	Number	Average capacity (Cu.m)
Wheel barrows (1 wheel)		
Push carts (2-4 wheels)		
Others		

Vehicle type	No.	Average Capacity Cu.m	No. of vehicle by condition (See note below)			No. of vehicle by age (year)			
			G	F	B	> 10	5-10	2-5	<2
Compactor vehicles									
Tipping truck with sliding cover									
Open truck with tipping mechanism									
Open truck without tipping mechanism									
Open truck with crane (grapple crane)									
Hook lift truck									
Vacuum truck									
Water tanker									
Tractor									
Vehicle for administration									
Others									

Note: G = Good condition, F = Fair condition, B = Bad condition

4. Machinery and equipments used in landfill, including machinery owned by both the Department and contractors

Machinery/equipment type	No.	No. of machinery by condition			No. of machinery by age (years)			
		G	F	B	>10	5-10	2-5	< 2
Bulldozers- track tractor								
Wheel loaders								
Track loaders								
Backhoe loader								
Landfill compactor								
Tractors								
Skid steer loader								
Weigh bridge								
Others								

Note: G = Good condition, F = Fair condition, B = Bad condition

5. Problems encountered in solid waste management service. Please tick appropriate spaces.

Problem	Very serious	Serious	Not so serious	No problem
Inadequate service coverage (some people not given service)				
Lack service qualities (not frequent enough, spill, etc.)				
Lack of authority to make financial and administrative decision				
Lack of financial resources				
Lack of trained personnel				
Lack of vehicles				
Lack of equipment				
Old vehicle/equipment frequent breakdown				
Difficult to obtain spare parts				
Lack of capability to maintain/repair vehicle/equipment				
No standardization of vehicle/equipment				
No proper institutional set-up for solid waste management service				
Lack of legislation				
Lack of enforcement measure and capability				
Lack of planning (short, medium and long term plan)				
Rapid urbanization outstripping service capacity				
Uncontrolled proliferation of squatter settlements				
Difficult to locate and acquire landfill site				
Difficult to obtain cover material				
Poor cooperation by Government agencies				
Poor public cooperation				
Uncontrolled use of packaging material				
Poor response to waste minimization (reuse/recycling)				
Lack of qualified private contractors				
Difficult to control contractual service				
Lack of control on hazardous waste				

Finance

- Revenue (NIS) of the authority where the Department responsible for solid waste management is located.

Revenue source	(2007)		(2008)	
	Budgeted	**Actual**	**Budgeted**	**Actual**
Property tax				
License				
Loan				
Grant by Government				
Foreign grant/aid				
User charge for solid waste management				
Please specify the tariff for solid waste collection and disposal				
Other user charge				
Penalty				
Others				
Total				

- Expenditure for solid waste management service (NIS)

Expenditure items	2007		2008	
	Budgeted	**Actual**	**Budgeted**	**Actual**
Remuneration				
Material & supplies				
Equipment/vehicle				
Operational and maintenance (spare parts, fueling, repairing, etc. …)				
Others				
Total for solid waste management				
Solid waste management expenditure as % of total expenditure of the authority				

Human Resources

Personnel for solid waste management service; In case where a person is responsible for other duties beside solid waste management, please put the number of such persons in parenthesis.

Type of personnel		Area of Work					
	A	**CT**	**S**	**G**	**FD**	**O**	**Total**
Administrator							
Health officer							
Public health inspector (PHI) or equivalent							
Assistant to PHI							
Engineer							
Technical assistant							
Technician							
Mechanic							
Mechanic's assistant							
Supervisor							
Driver							
Laborer							
Others							
Total							

A = Administration/supervision
CT = Collection and transportation
S = Street sweeping, G = grass cutting. If the same person carries out street sweeping and grass cutting, please indicate the number of persons in S column and write same in G column. FD = Final disposal, O = Others.

7. Annex 02: Household questionnaire

هذا الاستبيان الذي يهدف إلى تسهيل تقييم التصور والاستعداد للسكان من أجل التعاون في إدارة النفايات الصلبة في مدن رام الله وأريحا ، وتقييم ارتياح السكان لخدمات النفايات الصلبة الموجودة. المعلومات التي يتم جمعها من خلال هذا الاستبيان للمدينتين وسوف تستخدم للبحوث العلمية والأكاديمية وحدها.

ID- رقم الاستمارة المتسلسل في العينة: ☐☐☐		
معلومات عامة		
V01	☐☐	**المدينة :** 1) رام الله (2) أريحا
V02	☐☐	**الشارع :**.....
V03	☐☐	**نظافةالشارع**:. .....(خاص بالباحث)
V04	☐☐	**المسكن:** 1) فيلا 2) شقة 3)) منزل مستقل.
V05	☐☐	**هل أنت المالك أو المستأجر في هذا البيت:** 1) مالك 2) المستأجر
V06	☐☐	**العمر** .....سنة.
V07	☐☐	**النوع الاجتماعي؟** 1) ذكر 2) انثى
V08	☐☐	**التعليم :** 1) الثانوية 2) دبلوم 3) جامعة 4) أخرى ، حدد.....
V09	☐☐	**الوظيفة :** 1) موظف في القطاع العام 2)) موظف في القطاع الخاص 3) القطاع التجاري 4)الطب 5) مزارع 6) عامل 7) غيرها .....
V10	☐☐	**الوضع الاجتماعي**: 1) أعزب 2) متزوج 3) أرمل - ة 4) مطلق
V11	☐☐	**كم عدد الأشخاص الذين يعيشون حاليا في هذا المنزل**.....
V12	☐☐	**ويمكن لك أن تخبرنا من فضلك أين يقع الدخل الشهري الخاص بك؟**) أقل من 1.500 شيكل 2) بين 1.500 إلى 3.500 شيكل 3) بين 3.500 إلى 5.500 شيكل 4) أكثر من 5.500 شيكل 5) لن اقول لكم
V13	☐☐	**ما هو من العوامل التالية تعتقد أنها أكبر مشكلة في مدينتك؟** 1) السلامة والأمن 2) المياه 3) إدارة النفايات الصلبة 4) جمع المياه العادمة 5) التلوث الضوضائي 6) ازدحام المرور7) مشاكل صحية
جمع النفايات الصلبة		
	☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐	**أي نوع من النفايات الصلبة ينتج من بيتك ، وإلى أي مدى؟** V14 الورق والكرتون: الكثير جدا 1، الكثير 2، ليس كثيرا 3، قليل 4 V15 البلاستيك: الكثير جدا 1، الكثير 2، ليس كثيرا 3، قليل 4 V16 النفايات الغذائية: الكثير جدا 1، الكثير 2، ليس كثيرا 3، قليل 4 V17 زجاج: الكثير جدا 1، الكثير 2، ليس كثيرا 3، قليل 4 V18 معادن: الكثير جدا 1، الكثير 2، ليس كثيرا 3، قليل 4 V19 اخرى ، حدد.....
V20	☐☐	**كل كم تقريبا تفرغ حاوية (سطل) المنزل ؟** مرة واحدة في اليوم 2) مرة واحدة في اليومين 3) مرة واحدة كل ثلاثة أيام 4) أخرى ، حدد.....
V21	☐☐	**كم تدفع سنويا لخدمة النفايات ؟.....** شيكل
V22	☐☐	**إذا كنت تتخلص من النفايات بارسالها الى الحاوية العامة ، ما هي المسافة التي تمشيها بتقديرك من منزلك الى الحاوية؟** 1) 50 م أو أقل 2) 51- 100 م 3) 101-150 م 4) أكثر من151- 200 م 5) أكثر من 200
V23	☐☐	**كل كم تقريبا تفرغ الحاوية العامة؟** 1) مرة في الأسبوع 2) مرتين في الأسبوع 3) ثلاث مرات في الأسبوع 4) يوميا 5) غير ذلك ، حدد.....
V24	☐☐	**كيف تجد وضع الحاوية العامة؟** 1) نصف ممتلئة 2) دائما ممتلئة 3) ممتلئة و النفايات متناثرة 4) فارغة
V25	☐☐	**ما هو تقييمكم لجمع ونقل النفايات من الحاويات العامة ؟** 1) جيد جدا 2) جيد 3) متوسط 4) مقبول 5) سيئ
V26	☐☐	**كيف تصف و تقيم تعاون فريق عمل جمع النفايات مع السكان؟** 1) محترم 2) مقبول 3) سيئ

V27	☐☐	**لو توفر شخص أو جمعية لنقل كل ما تنتجونه من النفايات من المنزل الى الحاوية العامة ، كم سوف تكون على استعداد للدفع مقابل هذه الخدمة في الشهر**..... ..... شيكل
	☐☐☐ ☐☐☐ ☐☐	**كيف تقيم حالة الحاوية العامة من حولك؟** V28 قديمة وبالية ومهترئة نعم لا V29 في حالة جيدة نعم لا V30 الحجم كافي نعم لا V31 الموقع مناسب نعم لا
		الاهتمامات البيئية
	☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐ ☐	**هل لاحظت في أي وقت مضى وجود ما يلي في وحول حاويات النفايات أومواقع التخلص من النفايات؟** V32 المياه السوداء من الحاوية العامة نعم لا V33 توجد رائحة كريهة نعم لا V34 يوجد البعوض و الذباب فيها وحولها نعم لا V35 الحرائق نعم لا V36 الحيوانات المنزلية نعم لا V37 الجرذان نعم لا V38 الزبالون نعم لا V39 أخرى ، تحدد.....
V40	☐☐	**كيف تقيم تكنيس وتنظيف الشوارع في المدينة؟** 1) لا وجود له 2) جيد 3) متوسط 4) مقبول 5) سيئ
		التوعية البيئية
V41	☐☐	**هل تلقيت أي من التوعية / التثقيف بشأن إدارة النفايات الصلبة:** 1) نعم 2) لا
	☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐	**اذا كانت الاجابة نعم، من خلال اي من وسائل الاعلام ؟** V42 الراديو نعم لا V43 التلفزيون نعم لا V44 اجتماع نعم لا V45 المدرسة نعم لا V46 الملصقات نعم لا V47 أخرى ، تحدد.....
V48	☐☐	**كم مرة:** .....
	☐☐☐ ☐☐☐ ☐☐☐ ☐	**من الذي نظم هذه البرامج للتوعية؟** V49 البلدية نعم لا V50 مجلس الخدمات المشترك نعم لا V51 جهات أكاديمية نعم لا V52 المنظمات غير الحكومية نعم لا V53 أخرى ، تحدد.....
V54		**ماذا كانت الرسالة الرئيسية من التوعية ؟** ....
		إعادة التدوير وإعادة الاستخدام للنفايات الصلبة
	☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐	**هل في أي وقت مضى اعدت استخدام، بعت، أعطيت هدايا أو أخذت هدايا أي مما يلي من الأشياء القديمة؟** V55 العبوات البلاستيكية نعم لا V56 العبوات الزجاجية نعم لا

	□□□	V57 العلب الخاصة بالمعلبات نعم لا V58 البلاستيك نعم لا V59 المعادن نعم لا V60 أحذية نعم لا V61 الملابس نعم لا V62 الأثاث القديم نعم لا V63 أخرى ، تحدد.....
V64	□□	**ماذا تفعل مع النفايات الغذائية وبقايا أوراق الاشجار الصادرة عن منزلك؟** 1) تعمل سماد طبيعي 2) ترسلها مباشرة إلى حديقة المنزل 3) تتخلص منها مع النفايات الأخرى 4) تحرقها
V65	□□	**هل عندك الرغبة لفصل النفايات الغذائية من النفايات الاخرى؟** 1) نعم : اذهب إلى سؤال 66 2) لا : اذهب إلى سؤال 67
V66		**لماذا تريد أن تفصل؟** ....
V67	□□	**لماذا تريد ألا تفصل؟** 1) ليس لدي أي استخدام لها 2) عملية صعبة 3) أخاف من الامراض 4) ليس لدي وقت لذلك
V68	□□	**ما هو تقييمك لحالة إدارة النفايات الصلبة في مدينتك؟** 1) قد تحسن ، فتوجه إلى السؤال رقم 69 2) إلى أسوأ ، ، فتوجه إلى السؤال رقم 75-70 3) لم يتغير
V69		**كيف تحسن الوضع؟** ....
	□□□ □□□ □□□ □□□	**أي من هذه العوامل التي قد تكون مساهمة في تدهور إدارة النفايات ، وإلى أي درجة؟** V70 الجهات التنظيمية المسؤولة 1 2 3 4 5 V71 الامورالمالية 1 2 3 4 5 V72 لا يوجد تعاون من السكان 1 2 3 4 5 V73 عدم وجود الوعي العام 1 2 3 4 5 V74 القدراتالبشرية والتقنية 1 2 3 4 5 V75 الحالة السياسية 1 2 3 4 5 كثير جدا كثير قليل قليل جدا ليس له علاقة

This questionnaire designed to facilitate the assessment of perception and willingness of residents towards solid waste management service in Ramallah and Jericho cities and to evaluate the satisfaction of residents for the solid waste existing services. The information collected by this questionnaire for the two cities will be used for academic and scientific research only.

ID of the questionnaire in the sample: ☐☐☐		
General Information		
V01	☐☐	**City:** 1) Ramallah 2) Jericho
V02	☐☐	**Street:**……..
V03	☐☐	**Cleanliness of the street** ……
V04	☐☐	**Dwelling** : 1) Villa 2) Apartment 3) House
V05	☐☐	**Could you please tell me if you are the proprietor or tenant in this house?** 1) Proprietor 2) Tenant
V06	☐☐	**Age:** ……..years
V07	☐☐	**Gender:** 1) Male 2) Female
V08	☐☐	**Education:** 1) Secondary 2) Diploma 3) University 4) other……
V09	☐☐	**Occupation:** 1) Employee public sector 2) Employee private sector 3) commercial sector 4) Doctor 5) Farmer 7) Worker 8) other, specify……..
V10	☐☐	**Marital status:** 1) Single 2) Married 3) Widow 4) Divorced
V11	☐☐	**How many persons are currently living in this house** ……
V12	☐☐	**Could you please tell me where your monthly earnings fall?** 1) Less than 1,500 NIS 2) Between 1,500 NIS to 3,500 NIS 3) Between 3,500 NIS to 5,500 NIS 4) More than 5,500 NIS 5) Won't tell you
Solid Waste Collection		
V13	☐☐	**Which of the following factors do think are a problem in your city?** 1) Safety and security 2) Water potable 3) Solid waste management 4) Wastewater collection 5) Noise pollution 6) Traffic congestion 7) Health problems
	☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐	**What type of solid waste comes out of your household and to what extent?** Too much / Much / Quite / Not much V14 Paper and Cartoon 1 2 3 4 V15 Plastics (bottles / bags) 1 2 3 4 V16 Food waste 1 2 3 4 V17 Glass 1 2 3 4 V18 Metals 1 2 3 4 V19 Other, Specify ……
V20	☐☐	**How often the house waste container emptied?** 1) Once a day 2) Once in 2 days 3) Once in 3 days 4) Other, specify …….
V21	☐☐	**How much you pay for the solid waste service yearly?**.....NIS
V22	☐☐	**If your waste in transferred to public bin, how far do you estimate the distance from your house?** 1. Less than 50 m. 2. 51-100 m. 3. 101-150 m.

		4. 151-200 m. 5. More than 20 m
V23	☐☐	**How often is the public container near you emptied?** 1. Once a week 2. Twice a week 3. Thrice a week 4. Daily basis 5. Other, specify……..
V24	☐☐	**How do usually meet the public bin?** 1. Half full 2. Always full 3. Always overfull 4. Empty
V25	☐☐	**How do you evaluate the collection and the transportation process of waste at the public container?** 1. Very good 2. Good 3. Average 4. Fair 5. Bad
V26	☐☐	**How do you describe the attitude of the waste collection team to the public?** 1. Respectful 2. Fair Disrespectful
V27	☐☐	**If you had someone or association to remove all your waste from the home to public bin, how much would you be prepared to pay in a month.....NIS**
	☐☐ ☐☐ ☐☐ ☐☐	V28 Rusting Yes No V29 In good status Yes No V30 Adequate size Yes No V31 Well places in street Yes No
		Environmental Concerns
	☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐	**Do you ever notice the presence of the following in and around the waste bin or waste dump?** V32 Dark flowing water Yes No V33 Odor Yes No V34 Mosquitoes flies Yes No V35 Fire Yes No V36 Domestic animals Yes No V37 Rats Yes No V38 Scavengers Yes No V39 Other, specify …….
V40	☐☐	How do you rate street sweeping in the city? 1. No existence 2. Good 3. Average 4. Fair 5. Bad

Sensitization Concerns		
V41	☐☐	**How ever had any sensitization / education on waste management?** 1. Yes 2. No
	☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐	If yes, through what media/way? V42 Radio Yes No V43 TV Yes No V44 Meeting Yes No V45 School Yes No V46 Posters Yes No V47 Other, specify ……
V48	☐☐	**How often?.....**
		Who organized it? V49 The municipality Yes No V50 Joint service council Yes No V51 Academic Yes No V52 NGO Yes No V53 Other, specify ……
V54		**What was the main message?** …… …… ……
Recycling and Reuse		
	☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐	**Do you ever reuse, sell, give as presents, or receive as gifts any of the following old things?** V54 Plastic bottles Yes No V55 Glass bottles Yes No V56 Tins/cans Yes No V57 Plastics Yes No V58 Bags Yes No V59 Metals Yes No V60 Shoes Yes No V61 Clothes Yes No V62 Old furniture Yes No V63 Other, specify ……
V64	☐☐	**What do you do with the food wastes, leaves and trimmings that come out of your house?** 1. Make compost 2. Apply directly to farm/garden 3. Throw away with other wastes 4. Burn
V65	☐☐	Would you like to separate decomposable, food/ vegetables waste from non - decomposable manufactured waste? 1. Yes, go to question 66 2. No, go to question 67
V66		**Why do you like to separate?** …… ……
V67	☐☐	Why you wouldn't like to separate? 1. I have no use 2. Difficult exercise 3. Because of diseases 4. I have no time

V68	☐☐	**How do you evaluate the state of solid waste management in your city?** 1. Has improved, go to question 69 2. Getting worst, go to question 70-75 3. Not changed
V69		**How has the situation improved?** …… …… ……
	☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐	**Which of these may be contributory factor to waste management deterioration, and to what degree?**

		Extreme	Very	Quite	Very little	Not at all
V70	Organizational	1	2	3	4	5
V71	Finance related	1	2	3	4	5
V72	No cooperation	1	2	3	4	5
V73	Lack of public awareness	1	2	3	4	5
V74	Technical-human know-how	1	2	3	4	5
V75	Political situation	1	2	3	4	5

8. Annex 03: Solid waste characterization data sheets

Ramallah: Solid waste characterization data sheet (Saturday 08/08/2009)

Sample no.	Sample Description	Gross Weight(Kg)	Sample weight (kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**103.5**	**57.5**	**115**		Source: Ramallah Al Tahta-Arab Bank, hook lift
1.1	Organic and food wastes	31.4	27.4		47.90%	
1.2	Plastics	10.3	6.3		11.01%	
1.3	Paper and cardboard	13.1	9.1		15.91%	
1.4	Glass	4.8	2.8		4.90%	
1.5	Metals	4.3	2.3		4.02%	
1.6	Textiles	3.5	1.5		2.62%	
1.7	waste (leather, wood, ashes, etc)	7	5		8.74%	
1.8	Waste less than 10 mm size	4.8	2.8		4.90%	
			57.2	**114.4**	**100.00%**	
2	Random Sample	**132.8**	**86.8**	**173.6**		Source: Ramallah Al Tirah, compactor
2.1	Organic and food wastes	26.1	24.1		27.80%	
2.2	Plastics	33.7	21.7		25.03%	
2.3	Paper and cardboard	27.7	21.7		25.03%	
2.4	Glass	4.9	2.9		3.34%	
2.5	Metals	3.3	1.3		1.50%	
2.6	Textiles	13.4	9.4		10.84%	
2.7	waste (leather, wood, ashes, etc)	6.1	4.1		4.73%	
2.8	Waste less than 10 mm size	3.5	1.5		1.73%	
			86.7	**173.4**	**100.00%**	
3	Random Sample	**125.5**	**79.5**	**159**		Source: Ramallah City Center+Al Masayef, compactor
3.1	Organic and food wastes	33.2	29.2		36.87%	
3.2	Plastics	28.1	18.1		22.85%	
3.3	Paper and cardboard	11.3	7.3		9.22%	
3.4	Glass	9.2	7.2		9.09%	
3.5	Metals	4.4	2.4		3.03%	
3.6	Textiles	15.9	11.9		15.03%	
3.7	waste (leather, wood, ashes, etc)	2.3	0.3		0.38%	
3.8	Waste less than 10 mm size	4.8	2.8		3.54%	
			79.2	**158.4**	**100.00%**	

4	Random Sample	**153.4**	**107.4**	**214.8**		Source: Ramallah Ein Musbah, compactor
4.1	Organic and food wastes	52.5	48.5		45.67%	
4.2	Plastics	34.4	22.4		21.09%	
4.3	Paper and cardboard	19.4	13.4		12.62%	
4.4	Glass	3.9	1.9		1.79%	
4.5	Metals	5.4	3.4		3.20%	
4.6	Textiles	3.5	1.5		1.41%	
4.7	waste (leather, wood, ashes, etc)	15.4	13.4		12.62%	
4.8	Waste less than 10 mm size	3.7	1.7		1.60%	
			106.2	**212.4**	**100.00%**	
5	Random Sample	**122.1**	**76.1**	**152.2**		Source: Ramallah Ein Munjed, compactor
5.1	Organic and food wastes	29.1	27.1		35.70%	
5.2	Plastics	32.6	20.6		27.14%	
5.3	Paper and cardboard	25.7	17.7		23.32%	
5.4	Glass	5	3		3.95%	
5.5	Metals	3.6	1.6		2.11%	
5.6	Textiles	2.7	0.7		0.92%	
5.7	waste (leather, wood, ashes, etc)	6.2	4.2		5.53%	
5.8	Waste less than 10 mm size	3	1		1.32%	
			75.9	**151.8**	**100.00%**	
Total Avg.	**Sample**		**75.02**	**150.04**		
	Organic and food wastes				**38.79%**	
	Plastics				**21.43%**	
	Paper and cardboard				**17.22%**	
	Glass				**4.61%**	
	Metals				**2.77%**	
	Textiles				**6.16%**	
	waste (leather, wood, ashes, etc)				**6.40%**	
	Waste less than 10 mm size				**2.62%**	

Solid waste characterization data sheet (Sunday:09/08/2009)

Sample no.	Sample Description	Gross Weight(Kg)	Sample weight (kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**108.8**	**62.8**	**125.6**		Al Nuzha St, Hook lift
1.1	Organic and food wastes	35.1	31.1		50.41%	
1.2	Plastics	17.5	9.5		15.40%	
1.3	Paper and cardboard	21.8	13.8		22.37%	
1.4	Glass	5.3	3.3		5.35%	
1.5	Metals	4.4	2.4		3.89%	
1.6	Textiles	2.3	0.3		0.49%	
1.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
1.8	Waste less than 10 mm size	3.3	1.3		2.11%	
			61.7	**123.4**	**100.00%**	
2	Random Sample	**69.4**	**23.4**	**46.8**		Al Nahda St-Bravo-Hook lift
2.1	Organic and food wastes	5.6	3.6		15.72%	
2.2	Plastics	8.8	4.8		20.96%	
2.3	Paper and cardboard	21.7	11.7		51.09%	
2.4	Glass	2.9	0.9		3.93%	
2.5	Metals	2.9	0.9		3.93%	
2.6	Textiles	2.2	0.2		0.87%	
2.7	waste (leather, wood, ashes, etc)	2.3	0.3		1.31%	
2.8	Waste less than 10 mm size	2.5	0.5		2.18%	
			22.9	**45.8**	**100.00%**	
3	Random Sample	**130.1**	**84.1**	**168.2**		Industrial Zone, compactor
3.1	Organic and food wastes	30.9	28.9		34.74%	
3.2	Plastics	29.1	17.1		20.55%	
3.3	Paper and cardboard	23.6	15.6		18.75%	
3.4	Glass	3	1		1.20%	
3.5	Metals	3.5	1.5		1.80%	
3.6	Textiles	13.8	11.8		14.18%	
3.7	waste (leather, wood, ashes, etc)	7.3	5.3		6.37%	
3.8	Waste less than 10 mm size	4	2		2.40%	
			83.2	**166.4**	**100.00%**	

4	Random Sample	**129.8**	**83.8**	**167.6**		Al masyoun-compactor
4.1	Organic and food wastes	41.6	37.6		45.30%	
4.2	Plastics	33.1	19.1		23.01%	
4.3	Paper and cardboard	14.7	10.7		12.89%	
4.4	Glass	3.8	1.8		2.17%	
4.5	Metals	3.9	1.9		2.29%	
4.6	Textiles	4.4	2.4		2.89%	
4.7	waste (leather, wood, ashes, etc)	9.7	7.7		9.28%	
4.8	Waste less than 10 mm size	3.8	1.8		2.17%	
			83	**166**	**100.00%**	
5	Random Sample	**122.3**	**76.3**	**152.6**		Al Tirah-compactor
5.1	Organic and food wastes	29.5	27.5		36.33%	
5.2	Plastics	30.9	18.9		24.97%	
5.3	Paper and cardboard	21.7	15.7		20.74%	
5.4	Glass	3.4	1.4		1.85%	
5.5	Metals	4.4	2.4		3.17%	
5.6	Textiles	2.7	0.7		0.92%	
5.7	waste (leather, wood, ashes, etc)	8.8	6.8		8.98%	
5.8	Waste less than 10 mm size	4.3	2.3		3.04%	
			75.7	**151.4**	**100.00%**	
6	Random Sample	**124.8**	**78.8**	**157.6**		Al Masayef-Wast Al Balad-compactor
6.1	Organic and food wastes	31.9	27.9		35.59%	
6.2	Plastics	30.6	18.6		23.72%	
6.3	Paper and cardboard	28.5	18.5		23.60%	
6.4	Glass	3.4	1.4		1.79%	
6.5	Metals	5.8	3.8		4.85%	
6.6	Textiles	5.6	3.6		4.59%	
6.7	waste (leather, wood, ashes, etc)	5.8	3.8		4.85%	
6.8	Waste less than 10 mm size	2.8	0.8		1.02%	
			78.4	**156.8**	**100.00%**	
Total Avg.	Sample			**152.8**		
	Organic and food wastes				**36.35%**	
	Plastics				**21.44%**	
	Paper and cardboard				**24.91%**	
	Glass				**2.71%**	
	Metals				**3.32%**	
	Textiles				**3.99%**	

	waste (leather, wood, ashes, etc)				**5.13%**	
	Waste less than 10 mm size				**2.15%**	

Solid waste characterization data sheet (Monday:10/08/2009)

Sample no.	Sample Description	Gross Weight(Kg)	Sample weight (kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**149.5**	**103.5**	**207**		Al Sahel St-old city-hook lift
1.1	Organic and food wastes	70.9	62.9		61.01%	
1.2	Plastics	24.3	16.3		15.81%	
1.3	Paper and cardboard	17.7	11.7		11.35%	
1.4	Glass	4.6	2.6		2.52%	
1.5	Metals	2.9	0.9		0.87%	
1.6	Textiles	5.7	3.7		3.59%	
1.7	waste (leather, wood, ashes, etc)	2.9	0.9		0.87%	
1.8	Waste less than 10 mm size	6.1	4.1		3.98%	
			103.1	**206.2**	**100.00%**	
2	Random Sample	**162.4**	**116.4**	**232.8**		City Center
2.1	Organic and food wastes	57.1	53.1		45.70%	
2.2	Plastics	37.8	27.8		23.92%	
2.3	Paper and cardboard	12.8	8.8		7.57%	
2.4	Glass	3.2	1.2		1.03%	
2.5	Metals	2.7	0.7		0.60%	
2.6	Textiles	24.4	20.4		17.56%	
2.7	waste (leather, wood, ashes, etc)	5.4	3.4		2.93%	
2.8	Waste less than 10 mm size	2.8	0.8		0.69%	
			116.2	**232.4**	**100.00%**	
3	Random Sample	**130.6**	**84.6**	**169.2**		Al Masayef + Qadoura
3.1	Organic and food wastes	41	37		43.79%	
3.2	Plastics	20.7	12.7		15.03%	
3.3	Paper and cardboard	33.9	25.9		30.65%	
3.4	Glass	6.4	4.4		5.21%	
3.5	Metals	2.6	0.6		0.71%	
3.6	Textiles	4.1	2.1		2.49%	
3.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
3.8	Waste less than 10 mm size	3.8	1.8		2.13%	
			84.5	**169**	**100.00%**	
4	Random Sample	**166.8**	**120.8**	**241.6**		Ein Minjed
4.1	Organic and food	61	55		45.64%	

	wastes					
4.2	Plastics	23.6	15.6		12.95%	
4.3	Paper and cardboard	26.9	20.9		17.34%	
4.4	Glass	25	21		17.43%	
4.5	Metals	4.1	2.1		1.74%	
4.6	Textiles	4	2		1.66%	
4.7	waste (leather, wood, ashes, etc)	3.4	1.4		1.16%	
4.8	Waste less than 10 mm size	4.5	2.5		2.07%	
			120.5	**241**	**100.00%**	
5	Random Sample	**139**	**93**	**186**		Al Tirah
5.1	Organic and food wastes	42.5	38.5		41.71%	
5.2	Plastics	28.9	20.9		22.64%	
5.3	Paper and cardboard	22.8	16.8		18.20%	
5.4	Glass	7.9	5.9		6.39%	
5.5	Metals	4.1	2.1		2.28%	
5.6	Textiles	7.8	5.8		6.28%	
5.7	waste (leather, wood, ashes, etc)	2.5	0.5		0.54%	
5.8	Waste less than 10 mm size	3.8	1.8		1.95%	
			92.3	**184.6**	**100.00%**	
6	Random Sample	**124**	**78**	**156**		Industrial Zone
6.1	Organic and food wastes	40.5	36.5		47.00%	
6.2	Plastics	23.16	15.16		19.52%	
6.3	Paper and cardboard	29.4	19.4		24.98%	
6.4	Glass	3.6	1.6		2.06%	
6.5	Metals	6	4		5.15%	
6.6	Textiles	0	0		0.00%	
6.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
6.8	Waste less than 10 mm size	3	1		1.29%	
			77.66	**155.32**	**100.00%**	
Total Avg.	**Sample**			**198.09**		
	Organic and food wastes				**47.47%**	
	Plastics				**18.31%**	
	Paper and cardboard				**18.35%**	
	Glass				**5.77%**	
	Metals				**1.89%**	
	Textiles				**5.26%**	
	waste (leather, wood, ashes, etc)				**0.92%**	
	Waste less than 10 mm size				**2.02%**	
					100.00%	

Solid waste characterization data sheet (Tuesday:11/08/2009)

Sample no.	Sample Description	Gross Weight(Kg)	Sample weight (kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**131.5**	**85.5**	**171**		Industrial Zone
1.1	Organic and food wastes	51.2	47.2		55.73%	
1.2	Plastics	23.2	15.2		17.95%	
1.3	Paper and cardboard	17.6	11.6		13.70%	
1.4	Glass	3.5	1.5		1.77%	
1.5	Metals	3.8	1.8		2.13%	
1.6	Textiles	4.3	2.3		2.72%	
1.7	waste (leather, wood, ashes, etc)	4.7	2.7		3.19%	
1.8	Waste less than 10 mm size	4.4	2.4		2.83%	
			84.7	**169.4**	**100.00%**	
2	Random Sample	**152.8**	**106.8**	**213.6**		Baten Al Hawa
2.1	Organic and food wastes	60.2	56.2		52.92%	
2.2	Plastics	31.8	19.8		18.64%	
2.3	Paper and cardboard	13.1	9.1		8.57%	
2.4	Glass	8.5	6.5		6.12%	
2.5	Metals	4.5	2.5		2.35%	
2.6	Textiles	5.2	3.2		3.01%	
2.7	waste (leather, wood, ashes, etc)	9.1	7.1		6.69%	
2.8	Waste less than 10 mm size	3.8	1.8		1.69%	
			106.2	**212.4**	**100.00%**	
3	Random Sample	**94.7**	**48.7**	**97.4**		Al Masyoun Bravo
3.1	Organic and food wastes	19.5	17.5		36.08%	
3.2	Plastics	21.9	13.9		28.66%	
3.3	Paper and cardboard	22.6	14.6		30.10%	
3.4	Glass	2.1	0.1		0.21%	
3.5	Metals	2.4	0.4		0.82%	
3.6	Textiles	2.5	0.5		1.03%	
3.7	waste (leather, wood, ashes, etc)	2.1	0.1		0.21%	
3.8	Waste less than 10 mm size	3.4	1.4		2.89%	
			48.5	**97**	**100.00%**	
4	Random Sample	**135.4**	**89.4**	**178.8**		Ein Minjed
4.1	Organic and food wastes	38.2	34.2		38.60%	

4.2	Plastics	22.7	12.7		14.33%	
4.3	Paper and cardboard	23.9	15.9		17.95%	
4.4	Glass	15.2	13.2		14.90%	
4.5	Metals	3.5	1.5		1.69%	
4.6	Textiles	6	4		4.51%	
4.7	waste (leather, wood, ashes, etc)	7	5		5.64%	
4.8	Waste less than 10 mm size	4.1	2.1		2.37%	
			88.6	**177.2**	**100.00%**	
5	Random Sample	**118.2**	**72.2**	**144.4**		Al Masayef
5.1	Organic and food wastes	6.8	4.8		6.67%	
5.2	Plastics	39.9	23.9		33.19%	
5.3	Paper and cardboard	50.6	38.6		53.61%	
5.4	Glass	3.1	1.1		1.53%	
5.5	Metals	3.2	1.2		1.67%	
5.6	Textiles	3.5	1.5		2.08%	
5.7	waste (leather, wood, ashes, etc)	2.1	0.1		0.14%	
5.8	Waste less than 10 mm size	2.8	0.8		1.11%	
			72	**144**	**100.00%**	
6	Random Sample	**111.4**	**65.4**	**130.8**		Industrial Zone
6.1	Organic and food wastes	26.8	24.8		38.04%	
6.2	Plastics	11	7		10.74%	
6.3	Paper and cardboard	21.1	13.1		20.09%	
6.4	Glass	3.4	1.4		2.15%	
6.5	Metals	3.1	1.1		1.69%	
6.6	Textiles	12.9	8.9		13.65%	
6.7	waste (leather, wood, ashes, etc)	9.9	7.9		12.12%	
6.8	Waste less than 10 mm size	3	1		1.53%	
			65.2	**130.4**	**100.00%**	
Total Avg.	**Sample**			**155.07**		
	Organic and food wastes				**38.01%**	
	Plastics				**20.59%**	
	Paper and cardboard				**24.00%**	
	Glass				**4.45%**	
	Metals				**1.73%**	
	Textiles				**4.50%**	
	waste (leather, wood, ashes, etc)				**4.66%**	
	Waste less than 10 mm size				**2.07%**	

Jericho: Solid waste characterization data sheet (Sunday :05/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**139.6**	**93.6**	**187.2**		Al Khidewi Area
1.1	Organic and food wastes	64.5	54.5		58.35%	
1.2	Plastics	30	24		25.70%	
1.3	Paper and cardboard	3.7	1.7		1.82%	
1.4	Glass	0	0		0.00%	
1.5	Metals	0	0		0.00%	
1.6	Textiles	0	0		0.00%	
1.7	waste (leather, wood, ashes, etc)	13	11		11.78%	
1.8	Waste less than 10 mm size	4.2	2.2		2.36%	
			93.4	**186.8**	**100.00%**	
2	Random Sample	**142.5**	**96.5**	**193**		Police Colleage
2.1	Organic and food wastes	20.2	18.2		18.94%	
2.2	Plastics	10.5	8.5		8.84%	
2.3	Paper and cardboard	7.6	5.6		5.83%	
2.4	Glass	9.4	7.4		7.70%	
2.5	Metals	9.2	7.2		7.49%	
2.6	Textiles	40.7	30.7		31.95%	
2.7	waste (leather, wood, ashes, etc)	20.2	16.2		16.86%	
2.8	Waste less than 10 mm size	4.3	2.3		2.39%	
			96.1	**192.2**	**100.00%**	
3	Random Sample	**145.2**	**99.2**	**198.4**		Harat Al Arab
3.1	Organic and food wastes	35.9	31.9		32.25%	
3.2	Plastics	30	26		26.29%	
3.3	Paper and cardboard	14.3	12.3		12.44%	
3.4	Glass	0	0		0.00%	
3.5	Metals	3.5	1.5		1.52%	
3.6	Textiles	30.2	24.2		24.47%	
3.7	waste (leather, wood, ashes, etc)	4.1	2.1		2.12%	
3.8	Waste less than 10 mm size	2.9	0.9		0.91%	
			98.9	**197.8**	**100.00%**	

4	Random Sample	**88.9**	**42.9**	**85.8**		Ketf Al Wad
4.1	Organic and food wastes	10.5	8.5		20.14%	
4.2	Plastics	14.2	12.2		28.91%	
4.3	Paper and cardboard	13.9	11.9		28.20%	
4.4	Glass	0	0		0.00%	
4.5	Metals	5.1	3.1		7.35%	
4.6	Textiles	5.5	3.5		8.29%	
4.7	waste (leather, wood, ashes, etc)	3.6	1.6		3.79%	
4.8	Waste less than 10 mm size	3.4	1.4		3.32%	
			42.2	**84.4**	**100.00%**	
5	Random Sample	**138.1**	**92.1**	**184.2**		Ketf Al Wad
5.1	Organic and food wastes	32.9	28.9		31.58%	
5.2	Plastics	44.5	38.5		42.08%	
5.3	Paper and cardboard	8.1	6.1		6.67%	
5.4	Glass	8.9	6.9		7.54%	
5.5	Metals	6.7	4.7		5.14%	
5.6	Textiles	6.4	4.4		4.81%	
5.7	waste (leather, wood, ashes, etc)	3.1	1.1		1.20%	
5.8	Waste less than 10 mm size	2.9	0.9		0.98%	
			91.5	**183**	**100.00%**	
Total Avg.	Sample		**84.42**	**168.84**		Total amount Characterized in day1 is 431.1 kg
	Organic and food wastes				**32.25%**	
	Plastics				**26.36%**	
	Paper and cardboard				**10.99%**	
	Glass				**3.05%**	
	Metals				**4.30%**	
	Textiles				**13.90%**	
	waste (leather, wood, ashes, etc)				**7.15%**	
	Waste less than 10 mm size				**1.99%**	

Solid waste characterization data sheet (Monday:06/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**140.2**	**94.2**	**188.4**		Al Khidewi Area
1.1	Organic and food wastes	40.4	36.4		38.89%	
1.2	Plastics	32.2	28.2		30.13%	
1.3	Paper and cardboard	15.5	13.5		14.42%	
1.4	Glass	0	0		0.00%	
1.5	Metals	3.6	1.6		1.71%	
1.6	Textiles	12.3	10.3		11.00%	
1.7	waste (leather, wood, ashes, etc)	4.1	2.1		2.24%	
1.8	Waste less than 10 mm size	3.5	1.5		1.60%	
			93.6	**187.2**	**100.00%**	
2	Random Sample	**136.7**	**90.7**	**181.4**		Police Colleage
2.1	Organic and food wastes	14.3	12.3		13.65%	
2.2	Plastics	12.4	10.4		11.54%	
2.3	Paper and cardboard	19.9	15.9		17.65%	
2.4	Glass	11.3	9.3		10.32%	
2.5	Metals	11.4	9.4		10.43%	
2.6	Textiles	8.5	6.5		7.21%	
2.7	waste (leather, wood, ashes, etc)	31.8	25.8		28.63%	
2.8	Waste less than 10 mm size	2.5	0.5		0.55%	
			90.1	**180.2**	**100.00%**	
3	Random Sample	**133.8**	**87.8**	**175.6**		Harat Al Arab
3.1	Organic and food wastes	37.2	33.2		38.07%	
3.2	Plastics	32.3	28.3		32.45%	
3.3	Paper and cardboard	12.5	10.5		12.04%	
3.4	Glass	0	0		0.00%	
3.5	Metals	0	0		0.00%	
3.6	Textiles	0	0		0.00%	
3.7	waste (leather, wood, ashes, etc)	16.3	14.3		16.40%	
3.8	Waste less than 10 mm size	2.9	0.9		1.03%	
			87.2	**174.4**	**100.00%**	
4	Random Sample	**112.2**	**66.2**	**132.4**		Amn and Hemaia
4.1	Organic and food wastes	13.5	11.5		17.67%	
4.2	Plastics	14.9	12.9		19.82%	
4.3	Paper and cardboard	16.8	14.8		22.73%	

4.4	Glass	0	0		0.00%	
4.5	Metals	27.3	25.3		38.86%	
4.6	Textiles	0	0		0.00%	
4.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
4.8	Waste less than 10 mm size	2.6	0.6		0.92%	
			65.1	**130.2**	**100.00%**	
5	Random Sample	**129.5**	**83.5**	**167**		Harat Al Arab
5.1	Organic and food wastes	32.6	30.6		36.78%	
5.2	Plastics	43.5	39.5		47.48%	
5.3	Paper and cardboard	6.1	4.1		4.93%	
5.4	Glass	0	0		0.00%	
5.5	Metals	0	0		0.00%	
5.6	Textiles	9.8	7.8		9.38%	
5.7	waste (leather, wood, ashes, etc)	2.8	0.8		0.96%	
5.8	Waste less than 10 mm size	2.4	0.4		0.48%	
			83.2	**166.4**	**100.00%**	
Total Avg.	Sample		**83.84**	**167.68**		437.2
	Organic and food wastes				**29.01%**	
	Plastics				**28.28%**	
	Paper and cardboard				**14.35%**	
	Glass				**2.06%**	
	Metals				**10.20%**	
	Textiles				**5.52%**	
	waste (leather, wood, ashes, etc)				**9.65%**	
	Waste less than 10 mm size				**0.92%**	

Solid waste characterization data sheet (Tuesday :07/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**154.4**	**108.4**	**216.8**		Al Khidewi Area
1.1	Organic and food wastes	60.5	54.5		50.70%	
1.2	Plastics	19.7	15.7		14.60%	
1.3	Paper and cardboard	12.3	10.3		9.58%	
1.4	Glass	11.9	9.9		9.21%	
1.5	Metals	3.1	1.1		1.02%	
1.6	Textiles	11.2	9.2		8.56%	
1.7	waste (leather, wood, ashes, etc)	7.5	5.5		5.12%	
1.8	Waste less than 10 mm size	3.3	1.3		1.21%	
			107.5	**215**	**100.00%**	
2	Random Sample	**135.8**	**89.8**	**179.6**		Al Khidewi Area
2.1	Organic and food wastes	60.4	54.4		61.12%	
2.2	Plastics	22.3	18.3		20.56%	
2.3	Paper and cardboard	5.7	3.7		4.16%	
2.4	Glass	0	0		0.00%	
2.5	Metals	0	0		0.00%	
2.6	Textiles	9.5	7.5		8.43%	
2.7	waste (leather, wood, ashes, etc)	5.4	3.4		3.82%	
2.8	Waste less than 10 mm size	3.7	1.7		1.91%	
			89	**178**	**100.00%**	
3	Random Sample	**121.5**	**75.5**	**151**		Intercontental
3.1	Organic and food wastes	41.3	37.3		49.87%	
3.2	Plastics	30.3	26.3		35.16%	
3.3	Paper and cardboard	8	6		8.02%	
3.4	Glass	0	0		0.00%	
3.5	Metals	4.1	2.1		2.81%	
3.6	Textiles	2.4	0.4		0.53%	
3.7	waste (leather, wood, ashes, etc)	3.8	1.8		2.41%	
3.8	Waste less than 10 mm size	2.9	0.9		1.20%	
			74.8	**149.6**	**100.00%**	
4	Random Sample	**132.9**	**86.9**	**173.8**		Harat Al Arab
4.1	Organic and food wastes	22.5	20.5		23.64%	
4.2	Plastics	34.9	30.9		35.64%	
4.3	Paper and cardboard	6.7	4.7		5.42%	

4.4	Glass	0	0		0.00%	
4.5	Metals	4.7	2.7		3.11%	
4.6	Textiles	21.8	17.8		20.53%	
4.7	waste (leather, wood, ashes, etc)	11.3	9.3		10.73%	
4.8	Waste less than 10 mm size	2.8	0.8		0.92%	
			86.7	**173.4**	**100.00%**	
5	Random Sample	**110.6**	**64.6**	**129.2**		Jericho Village
5.1	Organic and food wastes	32.8	30.8		47.98%	
5.2	Plastics	22.2	18.2		28.35%	
5.3	Paper and cardboard	11.9	9.9		15.42%	
5.4	Glass	3.9	1.9		2.96%	
5.5	Metals	2.5	0.5		0.78%	
5.6	Textiles	4.3	2.3		3.58%	
5.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
5.8	Waste less than 10 mm size	2.6	0.6		0.93%	
			64.2	**128.4**	**100.00%**	
Total Avg.	Sample		**84.44**	**168.88**		422.2
	Organic and food wastes				**46.66%**	
	Plastics				**26.86%**	
	Paper and cardboard				**8.52%**	
	Glass				**2.43%**	
	Metals				**1.54%**	
	Textiles				**8.33%**	
	waste (leather, wood, ashes, etc)				**4.41%**	
	Waste less than 10 mm size				**1.24%**	

Solid waste characterization data sheet (Wednesday :08/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**156.9**	**110.9**	**221.8**		Harat Al Arab
1.1	Organic and food wastes	56.6	50.6		46.00%	
1.2	Plastics	54.2	48.2		43.82%	
1.3	Paper and cardboard	11.9	9.9		9.00%	
1.4	Glass	0	0		0.00%	
1.5	Metals	0	0		0.00%	
1.6	Textiles	0	0		0.00%	
1.7	waste (leather, wood, ashes, etc)	2.5	0.5		0.45%	
1.8	Waste less than 10 mm size	2.8	0.8		0.73%	
			110	**220**	**100.00%**	
2	Random Sample	**143.9**	**97.9**	**195.8**		Al Khidewi Area
2.1	Organic and food wastes	37.9	33.9		34.80%	
2.2	Plastics	43.2	37.2		38.19%	
2.3	Paper and cardboard	5.9	3.9		4.00%	
2.4	Glass	0	0		0.00%	
2.5	Metals	0	0		0.00%	
2.6	Textiles	25.3	21.3		21.87%	
2.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
2.8	Waste less than 10 mm size	3.1	1.1		1.13%	
			97.4	**194.8**	**100.00%**	
3	Random Sample	**131.9**	**85.9**	**171.8**		Intercontental
3.1	Organic and food wastes	49.4	45.4		53.54%	
3.2	Plastics	30.6	26.6		31.37%	
3.3	Paper and cardboard	8.2	6.2		7.31%	
3.4	Glass	3.1	1.1		1.30%	
3.5	Metals	4.3	2.3		2.71%	
3.6	Textiles	2.7	0.7		0.83%	
3.7	waste (leather, wood, ashes, etc)	3.6	1.6		1.89%	
3.8	Waste less than 10 mm size	2.9	0.9		1.06%	
			84.8	**169.6**	**100.00%**	
4	Random Sample	**154**	**108**	**216**		Ketf Al Wad
4.1	Organic and food wastes	52.3	50.3		46.79%	
4.2	Plastics	49.8	45.8		42.60%	
4.3	Paper and cardboard	11.9	9.9		9.21%	
4.4	Glass	0	0		0.00%	

4.5	Metals	0	0		0.00%	
4.6	Textiles	0	0		0.00%	
4.7	waste (leather, wood, ashes, etc)	2.6	0.6		0.56%	
4.8	Waste less than 10 mm size	2.9	0.9		0.84%	
			107.5	**215**	**100.00%**	
5	Random Sample	**118.7**	**72.7**	**145.4**		Jericho Village
5.1	Organic and food wastes	37.9	33.9		47.15%	
5.2	Plastics	26.4	22.4		31.15%	
5.3	Paper and cardboard	12.3	10.3		14.33%	
5.4	Glass	3.9	1.9		2.64%	
5.5	Metals	2.5	0.5		0.70%	
5.6	Textiles	4.3	2.3		3.20%	
5.7	waste (leather, wood, ashes, etc)	0	0		0.00%	
5.8	Waste less than 10 mm size	2.6	0.6		0.83%	
			71.9	**143.8**	**100.00%**	
Total Avg.	Sample		**94.32**	**188.64**		471.6
	Organic and food wastes				**45.66%**	
	Plastics				**37.43%**	
	Paper and cardboard				**8.77%**	
	Glass				**0.79%**	
	Metals				**0.68%**	
	Textiles				**5.18%**	
	waste (leather, wood, ashes, etc)				**0.58%**	
	Waste less than 10 mm size				**0.92%**	

Solid waste characterization data sheet (Thursday:09/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**131.4**	**85.4**	**170.8**		Ketf Al Wad
1.1	Organic and food wastes	50.9	44.9		52.76%	
1.2	Plastics	36.8	28.8		33.84%	
1.3	Paper and cardboard	12.1	10.1		11.87%	
1.4	Glass	0	0		0.00%	
1.5	Metals	0	0		0.00%	
1.6	Textiles	0	0		0.00%	
1.7	waste (leather, wood, ashes, etc)	2.7	0.7		0.82%	
1.8	Waste less than 10 mm size	2.6	0.6		0.71%	
			85.1	**170.2**	**100.00%**	
2	Random Sample	**135.6**	**89.6**	**179.2**		Al Khidewi Area
2.1	Organic and food wastes	46.2	42.2		47.36%	
2.2	Plastics	36.6	30.6		34.34%	
2.3	Paper and cardboard	7.3	5.3		5.95%	
2.4	Glass	5.6	3.6		4.04%	
2.5	Metals	3.3	1.3		1.46%	
2.6	Textiles	6.8	4.8		5.39%	
2.7	waste (leather, wood, ashes, etc)	2.7	0.7		0.79%	
2.8	Waste less than 10 mm size	2.6	0.6		0.67%	
			89.1	**178.2**	**100.00%**	
3	Random Sample	**127.3**	**81.3**	**162.6**		Intercontental
3.1	Organic and food wastes	46.3	42.3		52.48%	
3.2	Plastics	26.8	22.8		28.29%	
3.3	Paper and cardboard	9.3	7.3		9.06%	
3.4	Glass	4.3	2.3		2.85%	
3.5	Metals	4.1	2.1		2.61%	
3.6	Textiles	3.1	1.1		1.36%	
3.7	waste (leather, wood, ashes, etc)	3.1	1.1		1.36%	
3.8	Waste less than 10 mm size	3.6	1.6		1.99%	
			80.6	**161.2**	**100.00%**	
4	Random Sample	**136.1**	**90.1**	**180.2**		Ketf Al Wad
4.1	Organic and food wastes	50.3	44.3		49.33%	
4.2	Plastics	42.1	34.1		37.97%	
4.3	Paper and cardboard	11.2	9.2		10.24%	
4.4	Glass	2.5	0.5		0.56%	
4.5	Metals	0	0		0.00%	
4.6	Textiles	0	0		0.00%	
4.7	waste (leather, wood, ashes, etc)	2.5	0.5		0.56%	

4.8	Waste less than 10 mm size	3.2	1.2		1.34%	
			89.8	**179.6**	**100.00%**	
5	Random Sample	**129.4**	**83.4**	**166.8**		Jericho Village
5.1	Organic and food wastes	41.9	37.9		45.77%	
5.2	Plastics	27.4	23.4		28.26%	
5.3	Paper and cardboard	14.3	12.3		14.86%	
5.4	Glass	5.1	3.1		3.74%	
5.5	Metals	3.9	1.9		2.29%	
5.6	Textiles	4.6	2.6		3.14%	
5.7	waste (leather, wood, ashes, etc)	3.9	0		0.00%	
5.8	Waste less than 10 mm size	3.6	1.6		1.93%	
			82.8	**165.6**	**100.00%**	
Total Avg.	Sample		**85.48**	**170.96**		440.4
	Organic and food wastes				**49.54%**	
	Plastics				**32.54%**	
	Paper and cardboard				**10.39%**	
	Glass				**2.24%**	
	Metals				**1.27%**	
	Textiles				**1.98%**	
	waste (leather, wood, ashes, etc)				**0.71%**	
	Waste less than 10 mm size				**1.33%**	

Solid waste characterization data sheet (Saturday:11/07/2009)

Sample no.	Sample Description	Gross Weight (Kg)	Sample Weight (Kg)	Sample Density (kg/m3)	Percent by Weight	Remarks
1	Random Sample	**167.6**	**121.6**	**243.2**		City center
1.1	Organic and food wastes	66.9	56.9		46.99%	
1.2	Plastics	39.1	33.1		27.33%	
1.3	Paper and cardboard	13.3	11.3		9.33%	
1.4	Glass	3	1		0.83%	
1.5	Metals	3.2	1.2		0.99%	
1.6	Textiles	18.3	14.3		11.81%	
1.7	waste (leather, wood, ashes, etc)	4.1	2.1		1.73%	
1.8	Waste less than 10 mm size	3.2	1.2		0.99%	
			121.1	**242.2**	**100.00%**	
2	Random Sample	**141.8**	**95.8**	**191.6**		Al Khidewi Area
2.1	Organic and food wastes	42.8	38.8		40.76%	
2.2	Plastics	33.9	29.9		31.41%	
2.3	Paper and cardboard	10.3	8.3		8.72%	
2.4	Glass	0	0		0.00%	
2.5	Metals	0	0		0.00%	
2.6	Textiles	11.7	9.7		10.19%	
2.7	waste (leather, wood, ashes, etc)	9.6	7.6		7.98%	
2.8	Waste less than 10 mm size	2.9	0.9		0.95%	
			95.2	**190.4**	**100.00%**	
3	Random Sample	**139.6**	**93.6**	**187.2**		Intercontental
3.1	Organic and food wastes	51.6	47.6		51.29%	
3.2	Plastics	30.7	26.7		28.77%	
3.3	Paper and cardboard	11.4	9.4		10.13%	
3.4	Glass	4.9	2.9		3.13%	
3.5	Metals	4.8	2.8		3.02%	
3.6	Textiles	3.3	1.3		1.40%	
3.7	waste (leather, wood, ashes, etc)	3.5	1.5		1.62%	
3.8	Waste less than 10 mm size	2.6	0.6		0.65%	
			92.8	**185.6**	**100.00%**	
4	Random Sample	**150.1**	**104.1**	**208.2**		Harat Al Arab
4.1	Organic and food wastes	54.3	48.3		46.67%	
4.2	Plastics	40.5	34.5		33.33%	
4.3	Paper and cardboard	12.6	10.6		10.24%	
4.4	Glass	0	0		0.00%	
4.5	Metals	0	0		0.00%	
4.6	Textiles	14.3	0		0.00%	
4.7	waste (leather, wood, ashes, etc)	11.2	9.2		8.89%	

4.8	Waste less than 10 mm size	2.9	0.9		0.87%	
			103.5	**207**	**100.00%**	
5	Random Sample	**139.1**	**93.1**	**186.2**		Jericho Village
5.1	Organic and food wastes	48.3	44.3		47.69%	
5.2	Plastics	29.6	25.6		27.56%	
5.3	Paper and cardboard	14.8	12.8		13.78%	
5.4	Glass	5.4	3.4		3.66%	
5.5	Metals	4.7	2.7		2.91%	
5.6	Textiles	5.2	3.2		3.44%	
5.7	waste (leather, wood, ashes, etc)	4.6	0		0.00%	
5.8	Waste less than 10 mm size	2.9	0.9		0.97%	
			92.9	**185.8**	**100.00%**	
Total Avg.	Sample		**101.1**	**202.2**		505.5
	Organic and food wastes				**46.68%**	
	Plastics				**29.68%**	
	Paper and cardboard				**10.44%**	
	Glass				**1.52%**	
	Metals				**1.38%**	
	Textiles				**5.37%**	
	waste (leather, wood, ashes, etc)				**4.04%**	
	Waste less than 10 mm size				**0.88%**	

Solid waste quantification at Jericho landfill site

No.	Date	Vehicle Plate No.	Vehicle Type	Vehicle Capacity (m^3)	Weight of Loaded Vehicle (kg)	Weight of Empty Vehicle (kg)	Solid Waste Amount (kg)
1	05/07/2009	6070	Nissan	8	14840	9860	4980
	05/07/2009	6070	Nissan	8	11780	9820	1960
	05/07/2009	6014	Mercedes	8	11160	10140	1020
	05/07/2009	8047	Volvo	10	13340	11420	1920
	05/07/2009	6014	Mercedes	8	10880	10220	660
	05/07/2009	6072	Nissan	4	8260	7520	740
	05/07/2009	6014	Mercedes	8	11560	10220	1340
	05/07/2009	6072	Nissan	4	7960	7520	440
	05/07/2009	8047	Volvo	10	13440	11460	1980
	05/07/2009	6014	Mercedes	8	11220	9760	1460
	05/07/2009	6072	Nissan	4	8020	7520	500
	05/07/2009	6014	Mercedes	8	10680	9760	920
	05/07/2009	6072	Nissan	4	7940	7520	420
	05/07/2009	6014	Mercedes	8	10760	9760	1000
	05/07/2009	8047	Volvo	10	13020	11820	1200
	05/07/2009	6072	Nissan	4	7840	7520	320
	05/07/2009	6072	Nissan	4	7820	7520	300
	05/07/2009	6014	Mercedes	8	12140	10140	2000
	05/07/2009	6072	Nissan	4	8800	7520	1280
	05/07/2009	8340	Issuzu	5	8400	5020	3380
	05/07/2009	6014	Mercedes	8	11880	10140	1740
	05/07/2009	6072	Nissan	4	8200	7520	680
						Subtotal 1st Day	**30,240**
2	06/07/2009	6077	Nissan	8	14120	9820	4300
	06/07/2009	6077	Nissan	8	11840	9820	2020
	06/07/2009	8047	Volvo	10	12980	11300	1680
	06/07/2009	6072	Nissan	4	8960	7520	1440
	06/07/2009	6014	Mercedes	8	10720	10340	380
	06/07/2009	6072	Nissan	4	8360	7520	840
	06/07/2009	6072	Nissan	4	7860	7520	340
	06/07/2009	6014	Mercedes	8	11060	10340	720
	06/07/2009	8047	Volvo	10	13060	11300	1760
	06/07/2009	6072	Nissan	4	7880	7520	360
	06/07/2009	6014	Mercedes	8	11400	10340	1060
	06/07/2009	2403	Tractor	5	6780	5740	1040
	06/07/2009	6072	Nissan	4	7780	7520	260
	06/07/2009	6014	Mercedes	8	10900	10340	560
	06/07/2009	8047	Volvo	10	12420	11300	1120
	06/07/2009	6073	Nissan	10	11860	9820	2040
	06/07/2009	6014	Mercedes	8	11160	10340	820
	06/07/2009	6072	Nissan	4	7740	7520	220
	06/07/2009	6072	Nissan	4	7840	7520	320
	06/07/2009	6072	Nissan	4	8300	7520	780
	06/07/2009	6073	Nissan	10	13080	9820	3260
	06/07/2009	2403	Tractor	5	7720	5740	1980
						Subtotal 2nd Day	**27,300**

No.	Date	Vehicle Plate No.	Vehicle Type	Vehicle Capacity (m^3)	Weight of Loaded Vehicle (kg)	Weight of Empty Vehicle (kg)	Solid Waste Amount (kg)
3	07/07/2009	6070	Nissan	8	14680	9820	4860
	07/07/2009	6070	Nissan	8	11400	9820	1580
	07/07/2009	8047	Volvo	10	12760	11320	1440
	07/07/2009	6072	Nissan	4	7900	7520	380
	07/07/2009	6072	Nissan	4	8160	7520	640
	07/07/2009	8047	Volvo	10	12320	11460	860
	07/07/2009	6014	Mercedes	8	12040	10180	1860
	07/07/2009	6072	Nissan	4	8280	7520	760
	07/07/2009	6014	Mercedes	8	10060	9760	300
	07/07/2009	6014	Mercedes	8	10400	9760	640
	07/07/2009	8047	Volvo	10	12840	11480	1360
	07/07/2009	6072	Nissan	4	7880	7520	360
	07/07/2009	2403	Tractor	5	6520	5740	780
	07/07/2009	6014	Mercedes	8	10940	9760	1180
	07/07/2009	6073	Nissan	10	10640	9480	1160
	07/07/2009	6072	Nissan	4	8420	7520	900
	07/07/2009	6014	Mercedes	8	11800	10180	1620
	07/07/2009	6014	Mercedes	8	11180	10118	1062
	07/07/2009	6073	Nissan	10	10980	9480	1500
	07/07/2009	6014	Mercedes	8	10980	10180	800
	07/07/2009	8340	Issuzu	5	5680	5020	660
	07/07/2009	6073	Nissan	10	10940	9480	1460
						Subtotal 3rd Day	**26,162**
4	08/07/2009	6070	Nissan	8	14000	9820	4180
	08/07/2009	6070	Nissan	8	11400	9820	1580
	08/07/2009	6072	Nissan	4	8320	7520	800
	08/07/2009	6072	Nissan	4	8000	7520	480
	08/07/2009	6014	Mercedes	8	11100	10180	920
	08/07/2009	6014	Mercedes	8	10720	10300	420
	08/07/2009	6072	Nissan	4	8020	7520	500
	08/07/2009	6014	Mercedes	8	10820	10300	520
	08/07/2009	6072	Nissan	4	7660	7520	140
	08/07/2009	8047	Volvo	10	14000	11440	2560
	08/07/2009	6014	Mercedes	8	10940	10300	640
	08/07/2009	6072	Nissan	4	7980	7520	460
	08/07/2009	2403	Tractor	5	6540	5740	800
	08/07/2009	6072	Nissan	4	7660	7520	140
	08/07/2009	8043	Issuzu	5	6520	4960	1560
	08/07/2009	6014	Mercedes	8	10620	10300	320
	08/07/2009	6072	Nissan	4	8060	7520	540
	08/07/2009	6014	Mercedes	8	10780	9700	1080
						Subtotal 4th Day	**17,640**

No.	Date	Vehicle Plate No.	Vehicle Type	Vehicle Capacity (m3)	Weight of Loaded Vehicle (kg)	Weight of Empty Vehicle (kg)	Solid Waste Amount (kg)
5	09/07/2009	6070	Nissan	8	14740	9860	4880
	09/07/2009	6070	Nissan	8	11860	9860	2000
	09/07/2009	6014	Mercedes	8	10680	9680	1000
	09/07/2009	6014	Mercedes	8	10400	9680	720
	09/07/2009	6014	Mercedes	8	11200	9680	1520
	09/07/2009	8047	Volvo	10	13800	11460	2340
	09/07/2009	6072	Nissan	4	7740	7520	220
	09/07/2009	6014	Mercedes	8	10720	10140	580
	09/07/2009	6072	Nissan	4	8000	7520	480
	09/07/2009	6014	Mercedes	8	10740	10140	600
	09/07/2009	8047	Volvo	10	12440	11460	980
	09/07/2009	6072	Nissan	4	7880	7520	360
	09/07/2009	6014	Mercedes	8	10760	10180	580
	09/07/2009	8047	Volvo	10	12280	11460	820
	09/07/2009	6072	Nissan	4	7880	7520	360
	09/07/2009	6014	Mercedes	8	11740	10140	1600
	09/07/2009	6072	Nissan	4	7700	7520	180
	09/07/2009	6072	Nissan	4	7760	7520	240
	09/07/2009	6014	Mercedes	8	10880	10140	740
	09/07/2009	8223	Tractor	5	5960	5540	420
	09/07/2009	2403	Tractor	5	7560	5800	1760
	09/07/2009	6072	Nissan	4	7880	7520	360
						Subtotal 5th Day	**22,740**
6	10/07/2009	6077	Nissan	8	15360	9820	5540
	10/07/2009	6077	Nissan	8	12680	9820	2860
	10/07/2009	6072	Nissan	4	7820	7520	300
	10/07/2009	6072	Nissan	4	8660	7520	1140
						Subtotal 6th Day	**9840**

No.	Date	Vehicle Plate No.	Vehicle Type	Vehicle Capacity (m3)	Weight of Loaded Vehicle (kg)	Weight of Empty Vehicle (kg)	Solid Waste Amount (kg)
7	11/07/2009	6070	Nissan	8	14540	9880	4660
	11/07/2009	6070	Nissan	8	11740	9880	1860
	11/07/2009	8047	Volvo	10	12200	11140	1060
	11/07/2009	6014	Mercedes	8	12060	10260	1800
	11/07/2009	6014	Mercedes	8	11340	10140	1200
	11/07/2009	6072	Nissan	4	7880	7520	360
	11/07/2009	6014	Mercedes	8	11480	10400	1080
	11/07/2009	6072	Nissan	4	8440	7520	920
	11/07/2009	8047	Volvo	10	13440	11140	2300
	11/07/2009	6014	Mercedes	8	12240	10240	2000
	11/07/2009	6072	Nissan	4	8200	7520	680
	11/07/2009	6014	Mercedes	8	11360	10360	1000
	11/07/2009	2403	Tractor	5	6700	5740	960
	11/07/2009	6072	Nissan	4	7860	7520	340
	11/07/2009	8047	Volvo	10	13040	11140	1900
	11/07/2009	6014	Mercedes	8	11680	10360	1320
	11/07/2009	6072	Nissan	4	8020	7520	500
	11/07/2009	8047	Volvo	10	12800	11460	1340
	11/07/2009	6072	Nissan	4	7840	7520	320
	11/07/2009	6072	Nissan	4	7740	7520	220
	11/07/2009	6072	Nissan	4	7820	7520	300
	11/07/2009	2403	Tractor	5	6920	5740	1180
Subtotal 7th Day							**27,300**
Grand Total Per Week (kg)							**161,222**
Grand Total Per Week (Ton)							**161.222**
Average Per Day (Ton)							**23**
Average Yearly (Ton)							**8,400**