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M.Sc. Program in Water and Environmental Science

M.SC. THESIS

ASSESSMENT OF CURRENT MUNICIPAL SOLID WASTE MANAGEMENT IN JENIN DISTRICT

التقييم الحالي لإدارة النفايات البلدية الصلبة في محافظة جنين

SUBMITTED BY:

MAY O. AL-BATNIJ

(1085300)

SUPERVISED BY:

DR. ISSAM AL-KHATIB

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MAY O. AL-BATNIJ

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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: 23-1-2013

Dedication

To my Parents, my husband Saa'd, my children Sara and Bashar, my brothers, and my sisters

with Love and Respect

Acknowledgment

I want to express my sincere gratitude thanks to God at first, my father and mother at second who courage me finishing master after marriage, and who dedicate their time for my children.

Also I want to express my valuable thanks for my dearest husband and my children for their patience and courage.

I would like to thank my brothers and their wives especially (Islam and Rania) and children, also my sisters especially (Aida) and their husbands and children.

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Finally I would like to thank everyone who contributed to complete this study and wish them all the best.

Abstract

This study entitled "Assessment of municipal solid waste management in Jenin district". It covers the issue from three aspects. Which are examine the current municipal solid waste management practices, Assess levels of services provided by municipalities for solid waste management and awareness of citizens, finally assess the environmental impacts of Zahrat Alfenjan sanitary landfill.

About 99% of the population in Jenin district is located within areas that have a solid waste collection system. There is a relationship between residence location (city, towns, villages and camp) and frequency of garbage collection, cleaning of streets. Joint serves council gets the highest percentage of solid waste service provider 86%, local councils 12%, and the other local councils 2%. Amount of solid waste fee is15 NIS/month. According to method of collecting the fee, 86.8% of people pay solid waste fee with electricity invoice, 6.3% with water invoice, 4.4% do not pay, 2.2% separately, and 0.3% have no service. The most used containers' volume is $1m^3$, its number (3470). The most vehicles used are compacting truck, its number (29).

The average of quantity of daily solid waste is 13000 Kg/locality/day. 34540 Kg/day is the Max quantity of daily solid waste from the city of Jenin, Min quantity of daily solid waste is 28 Kg from Zububa. The average daily quantity of solid waste from houses in Jenin district (3-4) Kg. The average waste generation per capita in Jenin city is (0.8) kg/capita/day.

Zahrat Alfenjan landfill receives around 700 tons/day, 200 tons out of the 700 tons only enter separation unit. Zahrat Alfenjan landfill operators separate cartoons, papers and plastic from

waste. Regarding environmental side there is pollution in the surrounding air in Zahrat Alfenjan landfill.

It is recommended, that there are a need to establish a monitoring and data base system for the solid waste sector, contains physical and chemical characteristics of waste to identify the better future collection and disposal alternatives. Public should be environmentally educated.

الملخص

هذه الدراسة بعنوان "تقييم إدارة النفايات البلدية الصلبة في محافظة جنين"، ولتقييم إدارة النفايات تم دراسة الممارسات الحالية في إدارة النفايات البلدية ، وتقييم مستويات الخدمات التي تقدمها البلديات للمواطنين ومدى الوعي لدى المواطنين حول هذا الجانب ، وأخيرا تقييم الآثار البيئية لمكب زهرة الفنجان.

في محافظة جنين تصل نسبة السكان الذين تصلهم خدمة جمع النفايات ٩٩%. يوجد هناك علاقة بين مكان سكن المواطنين(مدينة، بلدة، قرية، مخيم) وبين وتيرة جمع النفايات ونظافة الشوارع. ٨٦% من التجمعات السكنية في محافظة جنين يقوم مجلس الخدمات المشترك بتقديم خدمة جمع النفايات لهم، ١٢% من التجمعات مسؤولية الجمع تقع على عاتق المجالس المحلية، ٢% من التجمعات يقوم بخدمتها مجالس أخرى أو جهات خاصة. تبلغ قيمة الرسوم التي يدفعها المواطنين مقابل خدمة جمع النفايات ١٥ شيكل في الشهر، ٨٦,٨% من المواطنين يقومون بدفع هذه الرسوم مع فاتورة الكهرباء، ٦,٣% يدفعونها مع فاتورة الماء، ٤,٤ % من المواطنين لا يدفعونها، ٢,٢% يدفعونها بشكل منفصل عن الفواتير الأخرى، و٠,٣% لا توجد لديهم خدمة الجمع.

يبلغ متوسط كمية النفايات الصلبة اليومية في التجمعات السكانية في محافظة جنين ١٣٠٠٠ كجم / تجمع / يوم. وكانت الكمية الأكبر من النفايات تخرج من مدينة جنين وبلغت ٣٤٥٤٠ كجم / يوم، أما الكمية الأقل من النفايات فكانت من قرية

ازبوبا وهي ٢٨ كجم / يوم . أما المتوسط اليومي من النفايات الصلبة من المنازل في منطقة جنين (٣-٤) كجم / يوم. أما متوسط إنتاج الفرد من النفايات في مدينة جنين (٠,٨) كجم / فرد / يوم.

إن مكب زهرة الفنجان يستقبل جميع النفايات من المحافظات الشمالية بما فيها محافظ جنين، التي تبلغ حوالي ٧٠٠ طن / يوم، ٢٠٠ طن منها فقط يدخل إلى وحدة فصل النفايات في المكب، بحيث تقوم بفصل الكرتون و الورق والبلاستيك وبيعها إلى الجهات المعنية. وفيما يتعلق بالجانب البيئي وجد هناك تلوث في الهواء المحيط بمكب زهرة الفنجان.

ومن أهم التوصيات، هناك حاجة لإنشاء نظام مراقبة للمؤسسات المسؤولة عن قطاع النفايات الصبة، وإنشاء قاعدة بيانات لقطاع النفايات الصلبة، بحيث يحتوي على بيانات مستمرة متعلقة بالخصائص الفيزيائية والكيميائية للنفايات لبناء خطط مستقبلية لتسهيل عملية الجمع، واختيار البدائل المناسبة للتخلص من النفايات. وينبغي تثقيف الجمهور بيئيا.

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List of Abbreviations

ANU	An-Najah National University
ARIJ	Applied Research Institute of Jerusalem
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
EPA	Environmental Protection Agency
GDP	Gross Domestic Products
HAP	Hazardous Air Pollutant
ISWM	Integrated Solid Waste Management
JSWMC	Joint Service Waste Management Councils
JSC	Joint Serves Councils
LCA	Life-Cycle Assessment
LFG	Landfill Gases
LGU	Local Government Units
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NIS	New Israeli Shekels
NMOCs	Non-Methane Organic Compounds
PCBS	Palestinian Central Bureau of statistics
PSI	Palestinian standard institution
RH	Relative Humidity
SPSS	Statistical Package For Social Science
SW	Solid Waste
SWM	Solid Waste Management
Temp	Temperature
TKN	Total Kjeldahl Nitrogen

UNEP	United Nations Environment Programme
USA	United States of America
VOC	Volatile Organic Compounds
WB	West Bank
WESI	Water and Environmental Studies Institute
WHO	World Health Organization
ZAL	Zahrat Alfenjan Landfill

1. Chapter One: Introduction and Literature Review

1.1 Research outline

This research thesis consists of five chapters. Chapter one provides an introduction covering municipal solid waste management (MSWM), the main methods for the municipal waste treatment, the impacts of solid waste (SW) on environment, life-cycle assessment models (LCA) , solid waste management (SWM) in Palestine, characteristics of the study area, and objectives. Chapter two describes the methodology. Chapter three presents results and discusses the results, and chapter four presents the conclusion and recommendations.

1.2 Introduction

Today one of the most important issues that concerns human beings is the environment and its protection. Now the progress of human beings and the society is measured by their ability to control the environmental elements, SW one of these elements. Increase the population levels, rapid economic growth, rise in community living standard, increase their industry and agriculture progress, without following suitable ways for waste collection, transport and treatment. This has resulted in increasing SW quantities and consequently the pollution of the environmental elements including land, water, and air, and depletion the natural resources in different parts of the world. Therefore, SW management has become one of the necessary issues to protect health and public safety (World Bank, 2004; Saeed et al., 2009).

Municipal solid waste (MSW) is a heterogeneous mixture of organic matter, paper, plastic, glass, cloth, metal etc. generated from households, commercial establishments, and markets.

The proportion of different constituents of waste varies from place to place and season to season, depending on the lifestyle, food habits, standards of living, the extent of industrial and commercial activities in the area (Katju, 2006).

The problem of SW is increasing with the increased population of the world. According to the United States Bureau of the census current population of the world had increased from 2.556 billion at the year 1950 to 7.013 billion in 2012 and expected to reach 8.5 billion by the year 2035. (United States Census Bureau., 2012). The production of MSW is growing at 3.2–4.5% each year in developed countries, and at 2–3% in developing countries. According these data, the problem of MSWM has earned increasing attention as a major hindrance to urbanization and economic development all over the world (Kurt et al., 2001).

1.3 Municipal solid waste management:

With the rapid development and accelerating urbanization and the continued improvement of living standard, the output of the SW, particularly municipal waste, is constantly increasing. This causes environmental pollution and potentially affects people’s health, preventing the sustained development of cities and drawing public concern in all of societies. Proper waste treatment is therefore an urgent and important task for the continued development of cities (EPA, 2008; Hong et al., 2010).

MSW refers to waste generated from householders, individual, or organizations. In another word the term "SW" includes useless, unwanted, or discarded materials generated from society's normal activities. But now SW is no longer regarded as something “to get rid of”, but has a potential value, both from environmental and economical point of view. MSWM is one of the

major problems facing city planners all over the world. The problem is especially severe in most developing-country cities where increased urbanization, poor planning, and lack of adequate resources contribute to the poor state of MSWM (Opareh and Post, 2002; Al-khatib et al., 2007; ARIJ, 1996). Also SWM is one of the most challenging issues faced by developing countries that suffer from serious pollution problems caused by the generation of large waste quantities. also the collection of MSW has been identified as a major problem since in many areas municipal authorities are either unable or unwilling to provide waste collection services to all residents in their area. On average, up to 50% of residents lack collection services in urban areas of low and middle income countries (Parizeau et al., 2006).

MSWM is a technical issue, but it is also affected by political, legal, socio-cultural, environmental, economic factors and available resources. These factors have interrelationships that are usually complex in waste management systems (Abu Qdais, 2007; Kum et al., 2005).

All these issues need to be handling to reach a sustainable MSWM solution. It is usually not the environmental legislation itself that is the problem; there some developing countries have more refined legislation than developed countries. Rather, it is the lack of enforcement and/ or the availability of viable alternatives (Fourie, 2006). Also there are limited opportunities for the development of a sustainable SWM system as government budgets are limited and only the proper disposal of SW is perceived as representing a cost (McBean et al., 2005).

1.3.1 Waste management costs:

The financial aspect is important factor to reach to optimal management in the field of SW. In general, SWM costs are covered indirectly through taxes, permits and rates. The lack of

capacity within local authorities for billing and revenue generally results in a very low portion of revenue being collected and thus a low financial base to cover salaries and running costs associated with SWM. It is common to find old and broken down refuse collection vehicles and related equipment because the local authorities are unable to pay for the repair; this is not only as a result of lack of finances but also a poor choice of equipment in the first place, often by development agencies and national governments. The poor operation and maintenance therefore leads to local authorities only being able to service a small area of the urban centers, in most cases on the central business districts. Urban residents who do not receive a waste collection service are forced to either burn it or dump it in open spaces (Barton et al., 2008).

Municipalities in Palestine may spend more than 50% of their annual budget on waste collection and disposal. In part, these high cost are attributable to the costs of providing an adequate waste management service, but in part they are also attributable to poor management and inadequate community awareness of proper waste management practices (World Bank, 2004).

1.3.2 Waste production

The volume of waste produced in the world has been increasing considerably for many decades especially in rich countries as shown by the link between national gross domestic products (GDP) and waste generation per capita. The recent estimates suggest that the MSW alone generated globally exceeded 2 billion tons per year at the turn of the millennium (Giusti, 2009).

Urbanization induces a consumer based society; an increased concentration of people and industrial/commercial development implies an accumulation of waste. In developing countries 620,000 tons/day of SW (approximately 226 million tons/year) will be produced from the one billion people living in slums alone (on average 0.6 kg per capita per day). These slum dwellers

have no access to adequate water supply, sanitation or SW collection/disposal services. Even though per capita waste generation rates in developing countries are less than in higher-income countries, the capacity of the responsible local authorities to manage waste, from collection, to recycling or reuse and disposal is limited. Also the organic matter in SW in developing countries is much higher than that in the waste in developed countries, and organic matter can be converted into useful products to reduce the burden on existing landfills. Biomethanation is a potential route for energy recovery from MSW. But most of these countries do not take advantage of this organic waste (Kumar, et al. 2009; Barton, et al. 2008).

1.3.3 Classification of solid waste

SW in general consists of the highly heterogeneous mass of discarded materials from the urban community, as well as the more homogeneous accumulation of agricultural, industrial and mining wastes. Waste is anything discarded by an individual, household or organization. As a result, waste is a complex mixture of different substances. Wastes in general represent the interaction of human with his environment living in; several types of wastes are discarded depending on the types of human activities (Sufian and Bala, 2007).

The SW may be characterized by different classification systems. A number of the existing classification systems are simply based on material groups (e.g., paper, plastic, metal …etc).

Another way of classification as following are show the major SW categories:

1. Domestic SW: which is generated from the households and most of this waste is food waste.
2. Commercial SW: Including offices, restaurants, hotels, and public services, etc.

3. Industrial SW (non-hazardous, hazardous, and hospital wastes) :which is generated from processing and non processing industries.
4. Agricultural waste: This includes the waste that is generated from the agricultural activities such as leaves, plants, plastic pipes and the hazardous waste that is generated from using the fertilizers or pesticides.
5. Construction / demolition waste.

   (Al-Sa'ed, 2006).

The main constituents of urban SW are similar throughout the world, but the quantity generated, the density and the proportion of constituents vary widely from country to country, and from town to town within a country according to the level of economic development, geographic location, weather and social conditions. In general, it has been found that as the personal income rises, kitchen wastes decline but the paper, metals and glass wastes increase; the total weight generated increases but the density of the wastes declines (Sufian and Bala, 2007).

1.3.4 Solid waste disposal

The concept of environmental sustainability is now-a-days regarded as a key criterion to design waste management systems. In such a context, landfilling technologies are also contribute to environmental sustainability. Technological measures have been introduced to achieve a better control over liquid and gaseous emissions from landfills, in order to prevent groundwater pollution in the case of liquid emissions, and reduce greenhouse gases emissions, prevent fire hazards, odors and vegetation damages, in the case of gaseous emissions (Manfredi and Christensen ,2009).

The main methods for the municipal waste disposal are landfill, incineration, and composting. Sanitary land filling is the main method used in industrialized countries; the main purpose of landfill disposal of SW is to stabilize the waste and to make it hygienic through the use of natural metabolic pathways. Landfill leachate produced from these areas are, due to toxicity, classified as problematic wastewaters and represent a dangerous source of pollution for the environment due to its fertilizing and toxic effects (Yalcuk and Ugurlu, 2009).

Due to the effects of unwanted methane gas and leachate resulting from the landfill, the composting method is one of the least damaging alternatives because it enables us to recycle waste. Composted SW can be used as soil conditioner in agriculture and horticulture, and returns the carbon, nitrogen, phosphorus and other elements essential to the soil. However, heavy metals can limit the reuse of composted sludge for agricultural purposes (Hong et al., 2010).

Another method that has been used for the treatment of SW is incineration. It has received more attention due to its characteristics of energy recovery and reducing the volume of waste. However, the pollutant output of incineration is the emission of flue gas which consists of significant amounts of dioxin, furan, and fly ash into the atmosphere. Fly ash contains toxic metals such as lead, cadmium, copper, and zinc, as well as amounts of dioxin and furan (Hong et al., 2010).

The landfill classification according to United Nations Environment Programme (UNEP, 2005) is grouped into three general categories: 1. Open dumps 2. Controlled dumps 3. Sanitary landfills. Table 1.1 summarizes the main distinguishing characteristics of each of the three types (UNEP, 2005).

Table 1.1: Summary of the General Characteristics of Land Disposal methods (UNEP, 2005).

Criteria	Open Dump	Controlled Dump	Sanitary Landfill
Sitting of facility	Unplanned and often improperly sited	Hydro geologic conditions considered	Site chosen is based on environmental, community and cost factors
Capacity	Site capacity is not known	Planned capacity	Planned capacity
Cell planning	1.There is no cell planning. 2. The waste is indiscriminately dumped. 3. The working face/area is not controlled.	1. There is no cell planning, but the working face/area is minimized. 2. Disposal is only at designated areas.	1. Designed cell by cell development. 2. The working face/area is confined to the smallest area practical. 3. Disposal is only at designated cells.
Site preparation	Little or no site preparation	1. Grading of the bottom of the disposal site. 2. Drainage and surface water control along periphery of the site	Extensive site preparation.
Leachate management	No leachate management.	Partial leachate management.	Full leachate management
Gas management	No gas management	Partial or no gas management	Full gas management
Application of soil Cover	Occasional or no covering of waste.	Covering of waste implemented regularly but not necessarily daily.	Daily, intermediate and final soil cover applied
Compaction of waste	No compaction of waste	Compaction in some cases	Waste compaction
Access road maintenance	No proper maintenance of access road	Limited maintenance of access road	Full development and maintenance of access road
Fencing	No fence	With fencing	Secure fencing with gate
Waste inputs	No control over quantity and/or composition of incoming waste	Partial or no control of waste quantity, but waste accepted for disposal is limited to MSW	1. Full control over quantity and composition of incoming waste. 2. Special provisions for special types of

			wastes
Record keeping	No record keeping	Basic record keeping	Complete record of waste volumes, types, sources and site activities/events
Waste picking	Waste picking by scavengers	Controlled waste picking and trading	No on site waste picking and trading
Closure	No proper closure of site after cease of operations	Closure activities limited to covering with loose or partially compacted soil and replanting of vegetation	Full closure and post-closure management
Cost	Low initial cost, high long term cost	Low to moderate initial cost, high long term cost	Increased initial, operational and maintenance costs, moderate long term cost
Environmental and health impacts	High potential for fires and adverse environmental and health impacts	Lesser risk of adverse environmental and health impacts compared to an open dumpsite	Minimum risk of adverse environmental and health impacts

1.3.4.1 Open dumps

The open dump represents an old and unacceptable method, while the other methods have been modeled as well-designed landfills with relatively efficient environmental controls. Worldwide, open dump landfills have been recognized as unable to meet the sustainability target and are being replaced by more or less engineered landfilling systems (Manfredi and Christensen, 2009). Also open dumping is cheap and not requires planning, so open dumping is very common in developing countries which is have lack of knowledge and financial constraints (Sufian and Bala, 2007; UNEP, 2005).

Open dumpsites are known to pose a significant risk to public health and the environment. Open dump sites are non engineered landfill sites that spread over an area without lined their bases, wastes are dumped as such without segregation, the dumped SW gradually release its initial water and some of its decomposition by-products get into water moving through the waste deposit. Such liquid containing innumerable organic and inorganic compounds is called “leachate”. This leachate accumulates at the bottom of the landfill and percolates through the soil, which may result in continuous groundwater contamination; also these sites pollute the air, attract insects, vermin and other potential carriers of diseases, and devalue properties and a host of other negative impacts. These sites had not been designed systematically before being used for disposal of waste; also these sites are not equipped with a leachate collector (Mor et al. 2006; UNEP, 2005).

1.3.4.2 Controlled dumps

A controlled dump is a non-engineered disposal site where improvement is implemented on the operational and management aspects rather than on facility or structural requirements, which would otherwise require substantial investment. Controlled dumps evolved due to the need to close open dumpsites and replace them with improved disposal facilities, and in consideration of the financial constraints of Local Government Units (LGU). Controlled disposal of wastes may be established over existing wastes (from previous open dumping operations) or on new sites. But controlled dumps have less risk impact on environmental and health compared to an open dumpsite (UNEP, 2005).

1.3.4.3 Sanitary landfills

Sanitary landfills are sites where waste is isolated from the environment. Sanitary landfills method used to minimizes impacts to public health and the environment. Although it requires substantial financial resources, it is the most desirable and appropriate method of final waste disposal on land. Figure1.1 below shows a typical schematic of a sanitary landfill and its main components (UNEP, 2005).

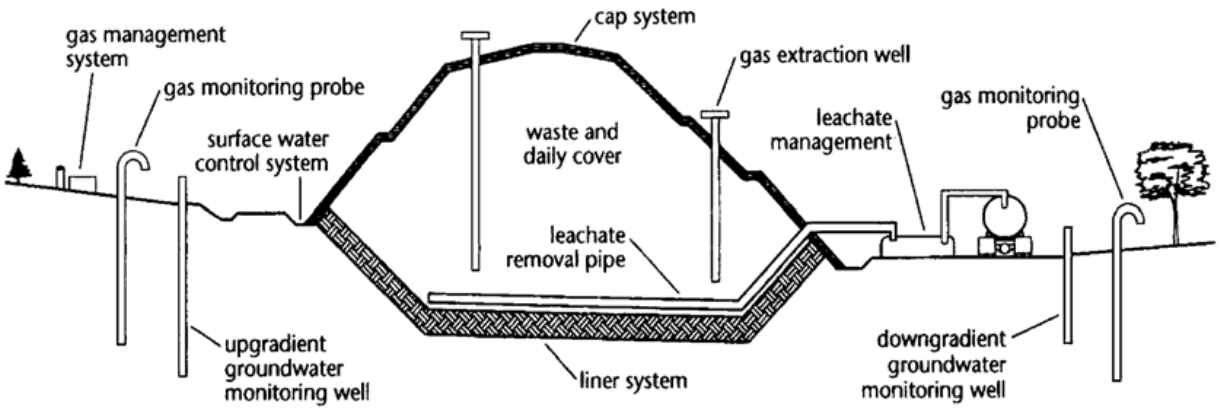

Figure1.1: Schematic of a Typical Sanitary Landfill (UNEP, 2005)

There are two basic types of sanitary landfills classified according to the method of landfilling operations employed. These are the: (a) Area Method, and; (b) Trench Method; other approaches are only modifications or a combination of these two types.

The area and trench methods are spreading and compaction of the waste in a confined area known as the cell. At the end of each day, a layer of soil is spread over the waste and then compacted. The compacted waste and soil cover constitute a cell. A series of adjoining cells, all of the same height, make up a lift. A completed sanitary landfill is made up of one or more lifts. The physical conditions of the particular site, and the amount and type of municipal SW to be handled are the main factors that determine the method (Area or Trench) to be selected. However, because the liners

and leachate collection systems must be in place prior to any waste disposal, the area method is now more commonly used (UNEP, 2005).

In most sites the area method was used, this method Suitable for the places in which the shallow groundwater, and where the volume of SW to be disposed of is very large. It is generally adopted on flat or gently sloping land. In this method, the waste is spread over the working face and compacted by a landfill compactor or bulldozer. After each day, a soil cover is applied and compacted (UNEP, 2005).

The trench method is best suited for areas where the groundwater is sufficiently deep to allow for the digging of trenches. After spreading and compaction of the waste, the soil excavated from the site is used as the daily cover material. A second trench parallel to the first one is then excavated and the excavated soil is used as daily cover for the second trench, as well as additional cover for the first trench. A space of at least 0.60m is provided to separate the trenches (UNEP, 2005).

1.4 Effects of waste management activities:

The most important way to limit the impact of MSW on the environment is by reducing the amount of waste that is generated. Failing this, waste must be either be recycled or reused. When these options are unsuitable, waste must be incinerated with energy recovery and only as a last resort, should landfills be utilized (Saeed et al .2009). However human activities have always generated waste. This was not a major issue when the human population was relatively small, but became a serious problem with urbanization and the growth of large conurbations. The characteristics of waste material evolved in line with changes in life style, and the number of new chemical substances present in the various waste streams increased dramatically. The long-term health effects of exposure to substances present in the waste, or produced at waste

disposal facilities are more difficult to measure, especially when their concentrations are very small and when there are other exposure pathways (e.g. food, soil). Nonetheless, lack of evidence can cause public concern. (Giusti, 2009).

Poor management of waste led to contamination of water, soil and atmosphere and to a major impact on public health. It is also caused general environmental impacts include: soil degradation, loss of aesthetic value, loss of recreational benefits, loss of wildlife and biodiversity, and destruction of natural habitats (Isaac et al. 2006).

Wastes from agriculture and industries can also cause serious health risks. Especially when industrial hazardous wastes collected with municipal wastes this action can expose people to chemical and radioactive hazards. Uncollected SW can also obstruct storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease. (Abul, 2010).

Pollution is not directly transferred from land to people, except in the case of dusts and direct contact with toxic materials. Pollutants deposited on land usually enter the human body through the medium of contaminated crops, animals, food products, or water. Land pollution can also damage terrestrial ecosystems, resulting in the deterioration of the conservation on and amenity value of the environment (Davoli, et al.2010).

Table 1.2: Simplified summary of the main known emissions and environmental impacts of waste management activities associated with MSW

Activity	Water	Air	soil	Landscape	Climate
Land filling	Leachate (heavy metals, synthetic organic compounds)	CO_2, CH_4, odour, noise, VOCs	Heavy metals, synthetic organic compounds	Visual effect, vermin	Worst option for greenhouse gases emission
Incineration	Fall-out of atmospheric pollutants	SO_2, NOx, N_2O, HCl, HF, CO, CO_2, dioxins, furans, PAHs, VOCs, odour, noise	Fly ash, slags	Visual effect	Greenhouse gases
Composting	Leachate	CO_2, CH_4, VOCs, dust, odour, bioaerosols	Minor impact	Some visual effect	Small emissions of greenhouse gases
Land spreading	Bacteria, viruses, heavy metals	Bioaerosols, dust, odour	Bacteria, viruses, heavy metals, PAHs, PCBs	Vermin, insects	Small emissions of greenhouse gases.
Recycling	Wastewater	Dust, noise	Land filling of residues	_____	Minor emissions
Waste transportation	Spills	CO_2, SO_2, NOx, dust, odour, noise, spills	Spills		Significant contribution of CO_2

CO_2 = carbon dioxide; CH_4 = methane; VOCs = volatile organic compounds; SO_2 = sulphur dioxide; NOx = nitrogen oxides; N_2O = nitrous oxide; HCl = hydrochloric acid; HF = hydrofluoric acid, CO = carbon monoxide; and PAHs = polycyclic aromatic hydrocarbons. a Assuming no energy recovery (Giusti, 2009).

1.5 Impacts on Environmental factors

1.5.1 Impacts on water

Wastes dumped near a water sources (surface water and ground water) cause a contamination of these water body. Direct dumping of untreated wastes in rivers, seas, and lakes, result the accumulation of toxic substances in the food chain through the plants and animals that feed on it. This clearly shows how waste disposal seriously affects the health of residents located closer to dumpsites (Davoli, 2010; Abul, 2010).

1.5.2 Impacts on air

Landfills are identified as a hazardous air pollutant (HAP) source, and there is an increased attention from the residential for toxicological aspects due to MSW land filling. Problems for nearby residents come mainly from the fact that they are exposed to landfill Gases (LFG) emissions. Several HAPs are present in LFG, and some of these are carcinogenic. There are also emissions from landfill flares such as dioxins/furans which causes carcinogenic effects. All combustion systems, through pyrolysis or thermal decomposition, can initiate reactions that lead to the formation of polycyclic aromatic hydrocarbons (PAHs) and other trace species. (Davoli, 2010).

1.5.3 Impacts on soil

Currently wide range of waste materials (sewage sludge, industrial waste) is increasingly spread on agricultural land as soil amendments. These surely produce a number of positive effects on soil quality, but also raise concern about potential short-term (e.g. pathogen survival) and long-term effects (e.g. accumulation of heavy metals), also the leachate resulting from dumping SW can lead the same effects (Giusti, 2009).

1.5.4 Impacts on humans

The health impacts and safety performance of the waste management is vary significantly across the world, with major differences between developed and developing countries. In developed countries, workers protection and safety measures have substantially reduced the likelihood of fatal or major accidents. In developing countries, the main issue is associated with infections and injuries from unregulated recycling (scavenging) in open dumps (Giusti, 2009).

Health issues are associated with every step of the handling, treatment and disposal of waste, both directly (via recovery and recycling activities or other occupations in the waste management industry, by exposure to hazardous substances in the waste or to emissions from incinerators and landfill sites, vermin, odours and noise) or indirectly (e.g. via ingestion of contaminated water, soil and food).

The main pathways of exposure are:

1. Inhalation (especially due to emissions from incinerators and landfills).
2. Consumption of water (in the case of water supplies contaminated with landfill leachate).
3. The foodchain (especially consumption of food contaminated with bacteria and viruses from land spreading of sewage and manure, and food enriched with persistent organic chemicals that may be released from incinerators) (Giusti, 2009).

Human exposure to substances released at waste management facilities can be

(i) Acute in case of a serious accident causing short term exposure to high levels of potentially hazardous substances, ionizing radiation, bioaerosols, dusts.

(ii) Chronic, when it involves long-term exposure to low concentrations of these substances or radiation (Giusti, 2009).

1.6 Difficulties of measuring environmental impact

In most cases, study of the environmental impacts need to investigate the occurrence of clinical effects in a population that may have been affected by emissions slightly above natural background levels. This task becomes particularly difficult at sites where sanitary landfills, incinerators, or other waste management facilities are built with the best available technology, and are operated according to guidelines and in full compliance with legislation. Other potential limitations of measuring environmental impact include: lack of data or poor quality of some of the original data, insufficient data on emissions, no data on direct exposure to emissions from waste management facilities (Giusti, 2009).

1.7 Main pollutants from the landfill site

1.7.1 Leachate

Leachate is the liquid that drains or 'leaches' from a landfill, it varies widely in composition regarding the age of the landfill and the type of waste that it contains. It can usually contain both dissolved and suspended material (Mor et al., 2006).

Landfill leachate contains organic with different biodegradation such as alcohols, acids, aldehydes, short chain sugars etc, inorganic pollutants in high rates, such as ammonia, sulfate and cationic metals, and heavy metals such as Cd, Cr, Cu, Fe, Ni, Pb, Zn, etc. If they are not collected carefully and not discharged safely, it may become a potential pollution source which threats soil, surface water and groundwater. Therefore, landfill leachate is recognized as an

important environmental problem by modern societies (Atmaca 2009; Yalcuk and Ugurlu 2009).

Heavy metal pollution is one of the major environmental impacts of landfill. Heavy metals are the most toxic contaminants in both landfill site and landfill leachate . The highest heavy metal concentrations were observed during the acid formation phase of waste stabilization when pH values were low. However, they could be removed from solution as sulfide minerals if sufficient sulfur was available under reducing condition (Long et al. 2009).

The chemicals within the leachate vary over time depending on the physical, chemical, and biological activities occurring within the landfill. Physico-chemical characteristics of the leachate depend primarily upon the waste composition, local rainfall regime that regulates moisture level, geology, and landfill age. Leachate flows are delayed until field capacity is reached, although for leachate to be developed, field capacity need to be reached only in localized regions of the waste. Field capacity is generally reached after 1 to 2 years when lateral development of waste placement is utilized, and longer if vertical development is used (Mor et al., 2006; Al-Sa'ed, 2006; Gotvajn et al., 2009).

1.7.1.1 Young Leachate

In the first few years, young leachate tend to be acidic due to presence of volatile fatty acids and are derived from processes such as the complex biodegradation of organics (cellulose) and simple dissolved organics (organic acid). Young leachate are characterized also by high Biological oxygen demand ($BOD_{5)}$ and Cemical oxygen demand (COD) values (Yalcuk and Ugurlu 2009). The results of these actions are generally in the ranges indicated in table 1.3.

Table 1.3: Typical chemical concentrations in young landfill leachate

Parameter	Leachate Concentration (mg/L)
COD	20,000-40,000
BOD_5	10,000-20,000
TOC	9,000-15,000
Volatile fatty acids	9,000-25,000
NH_3-N	1,000-2,000
Org-N	500-1,000
NO_3-N	0

(Source: Al-Sa'ed, 2006)

1.7.1.2 Old Leachate:

After 4 to 5 years, the changes occur as a result of depletion of the readily biodegradable organics and the production of gases. In old sanitary landfills, amount of organic materials having high molecular weight in leachate is high. The poorly biodegradable organics remain. Typical chemical concentrations are provided in table 1.4 (Al-Sa'ed 2006; Atmaca 2009).

Table 1.4: Typical chemical concentrations in older landfill leachate

Parameter	Leachate Concentration (mg/L)
COD	500-3,000
BOD_5	50-100
TOC	100-1,000
Volatile fatty acids	50-100

(Al-Sa'ed, 2006)

1.7.2 Landfill gases

LFG is a mixture of gases produced as waste decays in landfills. Because of their high vapor pressures and low solubility, many toxic volatile organic compounds (VOCs) are observed in

landfill gas. There can be more than 200 types of gas produced by landfills but the main components of LFG are methane (CH_4) and carbon dioxide (CO_2) which are colorless and odour less gases. Methane is a flammable gas and is explosive in concentrations between 5% and 15% of the total volume of air. When LFG concentrations are very high, they can also cause suffocation by reducing the amount of oxygen in the air. Other gases present can include a range of sulfide gases (e.g. hydrogen sulphide: may be decisive for the odour nuisance from the landfill). These gases that create the 'rotten rubbish' smell of landfill gases (Al-Sa'ed 2006; EPA 2008) .

LFG also contains various trace gases such as water vapor, ammonia, and hundreds of toxic contaminants known as Non-Methane Organic Compounds (NMOCs), NMOCs include such toxic compounds as benzene, toluene, chloroform, vinyl chloride, carbon tetrachloride, and 1,1,1 trichloroethane, which, although less than 1% by weight, are hazardous, as well as inorganic toxic contaminants like mercury as vapor-phase mercury (Hg) (primarily in its elemental form, Hg^0). Sometimes even radioactive contaminants like tritium are also produced (Ewall, 2008; Kim, 2002; Cooper et al., 1992) .

A number of environmental parameters influence the production rate and the composition of landfill gas. The main factors are waste composition, density of waste, waste age (time since placement), pH, moisture content, availability of nutrients, leachate flow, and soil type. Usually, gas production begins within a year of waste placement and may continue for as long as 50 years after landfill closure (Al-Sa'ed 2006; Cooper et al.,1992).

1.7.2.1 Landfill gases problems

LFG emissions potentially impact environmental quality in several ways. NMOC emissions from MSW landfills are include several suspected or known carcinogens (for example, benzene and vinyl chloride). Noncarcinogenic health risks have been identified for other NMOCs in LFG. Photocatalyzed reactions between volatile organic compounds emitted from landfills and nitrogen oxides can increase tropospheric ozone levels, resulting in adverse health and vegetation effects. Odor nuisances are common LFG impacts on local environments, while methane emissions have global impacts (Cooper et al.,1992).

The existence of CH_4, CO_2, and chlorinated compounds can cause fire and explosion at landfills and buildings at or in neighborhood of landfills, damage to vegetation, and odour problems (Al-Sa'ed 2006). Methane gas is lighter than air and as it rises in confined spaces it displaces oxygen. This means that methane can create a risk of suffocation in enclosed spaces. Methane is 20 to 25 times more effective on a molar basis than carbon dioxide at infrared energy absorption, contributing significantly to the greenhouse effect. In addition, methane indirectly increases levels of water vapor which may enhance warming effects. Methane also represents a fire and explosion hazard due to accumulation in nearby structures. There are trace amounts of other gases. These trace amounts combined are generally less than one percent of the total gas. Some of these trace gases have an unpleasant smell. These gases originate in the wastes that are in the landfill. The trace amounts of other gases when released to the environment are not at levels that may be harmful (EPA 2008; Cooper et al.1992).

1.7.3 Remedial methods

To remove the majority of pollutants, biological methods are usually preferred over physicochemical ones; these systems ensure a high BOD removal efficiency, even though

application of biological treatment alone is not an option due to the leachate characteristics. Biological treatment processes are effective for young or freshly produced leachate, but are ineffective for leachate from older landfills (>10 years old). In contrast, physical–chemical methods which are not favored for young leachate treatment, are advised for older leachate. Furthermore, neither biological nor chemical treatment separately achieves high treatment efficiencies (Atmaca 2009; Ghafari et al.2009).

There are two reasons for the low removal efficiency of each treatment system:

1. Significant presence of high-molecular weight organics that are difficult to remove and
2. Inhibitory effects of organics, inorganic salts and metals to activated sludge microorganisms.

These are the reasons, why combination of several treatment methods is usually applied. Combined treatment systems including many processes such as aerobic–anaerobic decomposition, chemical oxidation, coagulation–flocculation and adsorption are used instead of single process treatment systems.

It is common practice to mix the leachate with municipal wastewater and treat them jointly in conventional wastewater treatment plant, but this may cause problems because of the presence of harmful constituents, including ammonium nitrogen, which is usually present in high concentrations in mid to old-age landfills. Its high concentrations could cause difficulties to conventional aerobic activated sludge processes, due to the ammonia toxicity. (Gotvajn et al., 2009; Atmaca 2009).

1.8 Strategic planning issues of SWM

SWM Planning has to address several interdependent issues such as public health, the environment, the economic potential from the SW generated, and present and future costs to society. The SWM is a complex, dynamic and multi-faceted system depending not only on available technology but also upon economic and social factor (Sufian and Bala, 2007).

One of the greatest challenges that organizations face today is to figure out how to diversify the treatment options, increase the reliability of infrastructure systems, and leverage the redistribution of waste streams among incineration, composting, recycling, and other facilities to their competitive advantage region wide. Systems analysis plays an important role for regionalization assessment of integrated solid waste management (ISWM) systems. Recent research programs of planning SWM system emphasize the inclusion of both socioeconomic and environmental considerations that have to be evaluated simultaneously to provide decision makers with a set of total solutions regarding waste recycling, facilities sitting, and system operation (Chang and Davila, 2007).

1.9 Life-cycle assessment (LCA)

There are different tools for inventory and assessment environmental impacts of waste management's systems and supporting decision making such as environmental impact assessment (EIA), substance flow analysis (SFA) and LCA (Wittmaier et al., 2009).

LCA is an effective tool to evaluate the environmental burdens associated with a product, process, or activity by identifying, quantifying and assessing the impact of the utilized energy, materials and the wastes released to the environment. LCA models are becoming the principal decision support tools of waste management systems (Kirkeby et al., 2007; Christensen et al.,

2007).Today, the LCA applications are used as the basis of eco-labeling program, strategic planning, marketing, consumer education, process improvement and product design throughout the world (Hong et al., 2010).

To obtain energy from waste requires an investigation of the environmental performance and costs of alternative waste conversion methods. LCA is applied in waste-to energy conversion to compare the environmental consequences of each option. LCA for waste management has importance in comparing the many parameters within the different treatment options and generation of by-products (Christensen et al., 2007; Khoo, 2009).

LCA models usually include an inventory model (LCI) and an assessment model (LCIA). The life-cycle-inventory model (LCI) gives a detailed about of all resource consumptions and emissions for the waste management system, and provides a detailed for any up-stream or down-stream activities associated with the waste management system. The up-stream activities may be production of electricity or materials used in the waste management system and the down-stream activities may be material and energy recovered by the waste management system substituting for virgin production of materials and energy (Kirkeby et al, 2007).

The life-cycle impact assessment model (LCIA) translates and aggregates, according to unified standardized methods, LCI provided all of the detailed information about resource consumptions of concern and the main environmental impact categories (global warming, acidification, etc.). The significance of the aggregated data relative to each other and to all combined activities in society can be obtained by normalizing with average impacts caused by one average person. Thereby the data change their units to person-equivalents. Weighting of

normalized results can be made to identify the importance of environmental impacts or resource consumptions, but consensus on weighting factors has not yet been reached (Kirkeby et al., 2007). Identification and quantification of the potential environmental impacts of different waste management technologies is the one of the benefits of LCA. This can help minimize the risks of making the wrong decisions that may result in creating other types of environmental burdens downstream or upstream the material cycle (Khoo, 2009).

1.10 Problems of MSWM

In most developing countries, SWM is undertaken by the local authority, and the service includes waste collection (either from households or communal collection points) to final disposal. However, the low financial base and human resource capacity of these local authorities means that in most cases these authorities are only able to provide a limited service. The characteristics of the waste in developing countries (often high in organics and not suitable for waste to energy plants), so it's highly suitable for composting and anaerobic digestion (Barton et al., 2008).

The following deficiencies have been observed in the SWM system in many developing countries:

1. Lack of suitable technical, managerial and logistical infrastructure.
2. Insufficient budget for SWM sector.
3. Dustbins are not emptied regularly.
4. Sweeping and collection implements are poorly designed.
5. Many of plastic or metallic containers are in broken or bad condition in many places.
6. Scattered waste causes choking of drains.

7. Number of containers available is much less than the required containers.

8. Most of municipalities suffer from a lack in the labor force and equipment and vehicles, and the lack of regular maintenance for this equipment.

9. Transfer capacity of the waste less than quantities of waste generated daily.

10. There is no sufficient information on the number of clean workers and equipment and the quantity and quality of waste.

11. There are no studies to assess the environmental impact of SWM.

12. Collection process is usually randomly.

13. Correctional system that does not exist and the improvement is only when you receive complaints.

14. In most cases are disposed of waste in open places in the streets, making them susceptible to combustion and volatility in the air and often throw the waste is defined by a fence does not have the necessary mechanisms to collect and compress waste.

15. In most cases, medical waste and hazardous industrial waste mixed with municipal waste in final disposal site.

16. Deficiency in the presence of specialized labor in waste management.

17. Lack of environmental awareness and cooperation among the citizens.

18. There is no a comprehensive plan for SWM.

19. Difference in the level of service between the organization areas and random housing areas because of the difficulty of collecting waste in it.

20. No benefits from recyclable materials.

21. Not to give the subject of SWM attention required in the media.

(Kumar, et al. 2009; Rahma, 2005).

1.11 Solid waste management in Palestine

In every country there is a need for clear policies on SWM in order to properly select the most appropriate system for SW collection and disposal in a particular local condition and ensure public health protection, environmental safety, and provide an acceptable urban environment for living.

There is a growing concern to enhance the SWM in developing countries, the reasons for SWM elements (such as collection, storage, transforming, and sanitary disposal and the technology of waste land filling are well accepted and understood in developed countries. Regulated programs for the disposal of SW have been established in developed countries, while developing countries have generally continued to use conventional methods such as open dumps. In general, there is a lack of organization and planning in waste management due to insufficient information about regulations and due to financial restrictions in many developing countries. In most developed countries, workable legislation, regulations, and action plans are now in place. However, waste disposal in developing countries is still largely random and uncontrolled, and large quantities of waste go uncollected. (Al-Sa'ed 2006; Al-Khatib et al. 2007)

Palestine such as the other developing countries suffers from poverty, lack of education and adherence to customs that do not easily fit into the modern world, these are mainly the reasons that make it difficult for developing countries to upgrade their policies and practices for disposal of SW. Also it has difficult to establish sanitary landfills because of limited land availability and high levels of environment sensitivity. Local municipal will continue to be responsible for the collection and transport of MSW in most localities in Palestine and regional councils will take on responsibility for the management of the final disposal site (Al-Khatib et al., 2007)

The political situation in Palestine is also one of the main factors that have negative impacts on improvements in the sanitary disposal of SW. Several bad habits related to the handling of residential waste are common among Palestinians, such as thrown the SW randomly outside the dumps sites, at the sides of streets, and around the garbage containers, which aggravate the problems of MSWM. This leads to the accumulation of waste between collection periods, resulting in negative health and environmental impacts, such as the spread of unpleasant odors (especially in the summer), insects, and rodents (which are diseases vectors). It is common to see leachate dripping from waste collection containers during these accumulation periods. It is also common to see scattered garbage around full containers. (Al-Khatib et al. 2007; Al Sa'di, 2009)

According to the strategy of the Palestinian ministry of environment, regional Joint service waste management councils (JSWMC) to be established in the northern, central and southern parts of the West Bank (WB). Each council will serve a number of municipalities and will lead to the closure of the random dumping sites that exceeds 1000 sites in Palestine. The trend of establishing the JSWMC receives support from all local councils in the WB and Gaza and several councils have been established and others are planned. In each area where the councils have been formed, the number of open random dumping sites has dramatically dropped. However, sitting the new sanitary land fill sites is very difficult as it has to be approved by the Israeli side (World Bank, 2004).

1.12 Characteristics of the study area (Jenin Governorate)

1.12.1 Location

Jenin district is located in the northern part of the WB in Palestine as shown in figure 1.2. It is abounded by the Nablus and Tulkarem districts from the south and south east and by the 1948 cease-fire line from other directions of the district. Its occupies approximately 9.63% of (Gaza Strip and WB) (ARIJ, 1996). The area of Jenin district is 592 km² located between 90-750 m above sea level. The population of the district is around 274001 persons (PCBS, 2010). Because of the soil fertility and availability of water in the area, the Jenin district is considered one of the best agricultural areas in Palestine.

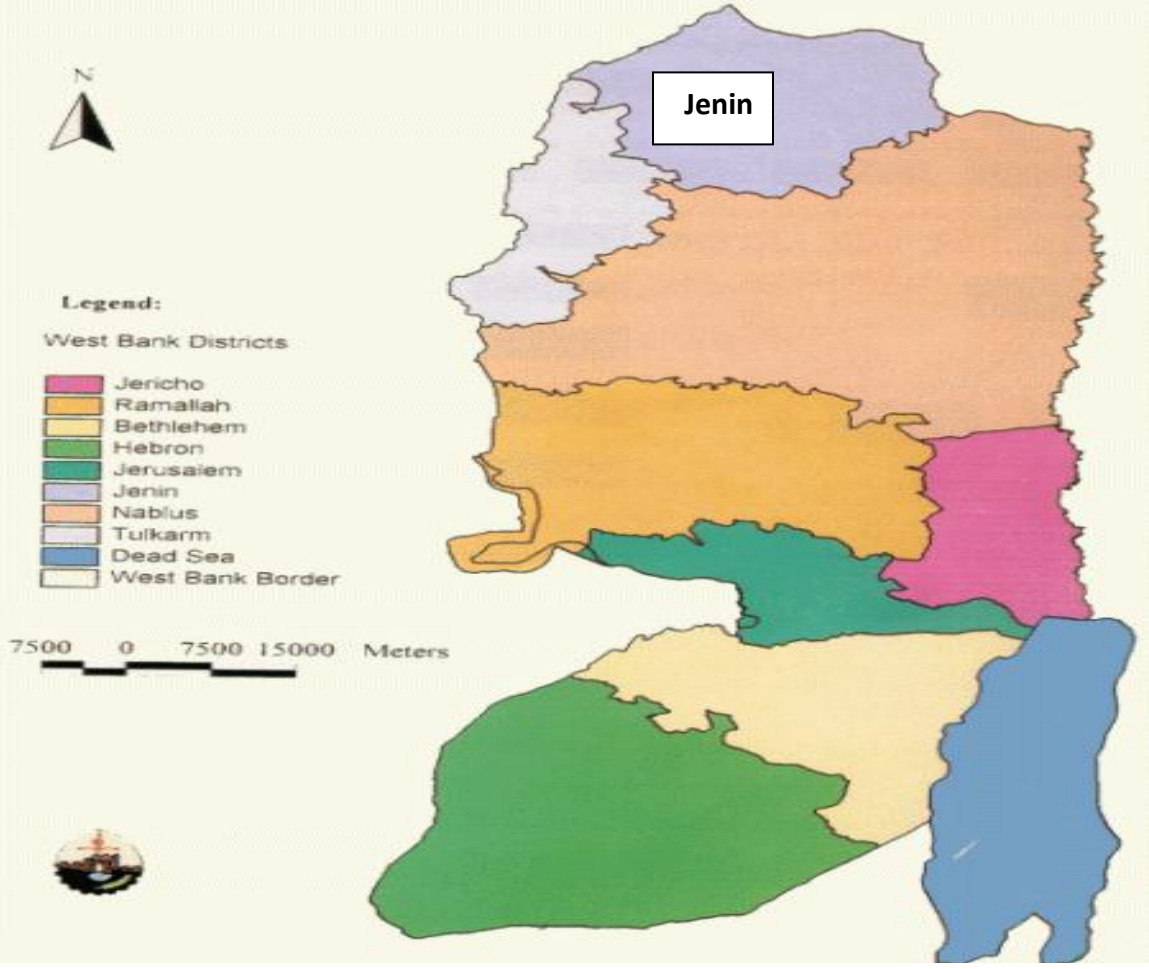

Figure 1.2: Location of Jenin district in the West Bank (Abu-Awwad, 2008).

1.12.2 Population

Population size is important factor in estimating majority of municipal services. Municipal SW total generations are mainly dependent on per capita generation. For proper SWM plan and sustainability, it is mandatory to predict in some manner the future population based on statistics. Table 1.5 summarizes the populations' projections for Jenin district.

Table 1.5: Population projections

Population/Year	2007	2009	2010	2012	2014	2016
Jenin district	٢٥٣،٥٥٨	٢٦٧،٠٢٧	٢٧٤،٠٠١	٢٨٨،٥١١	٣٠٣،٥٦٥	٣١٨،٩٥٨

Jenin district localities are 80 communities as follows: 13 Municipalities, 32 village councils, 34 project communities, and 1 refugee camps. And it has 77 Local Authorities as follows:
12 Municipality, 30 Village Council, 34 Project Committee, 1 Camp Director (PCBS, 2010).

1.12.3 Topography

The highest point in the Jenin district is Jabel Hureish, 3.5 Km east of the Jaba'a village, its height 750m above sea level. while the lowest elevation is 90m above sea level at El Mukhabba area, south of Muqebila village at the Israeli border (ARIJ, 1996).

1.12.4 Soil

The Jenin district is well-Known for its fertile agricultural land, which can be divided into four major soil associations:

1. Terra Rossa, Brown Rendzinas and Pale Rendzinas.
2. Brown Rendzinas and Pale Rendzinas.
3. Pale Rendzinas.
4. Grumusols.

1.12.5 Vegetation and Land use

The land use patterns in this district are greatly influenced by the topography, climate and political over land and natural resources. The land use patterns are classified into ten main categories: Palestinian built up areas, Israeli settlements, closed military areas and bases, nature reserves, forests, cultivated areas, industrial areas, dumping sites, quarries and roads.

1.12.6 Hydrology

1.12.6.1 Water Resources (Springs and well)

Groundwater is the main source of water in the Jenin area, it is represented by both springs and wells.

Springs: there are 42 springs in the Jenin district, these springs are mostly used for low-scale agricultural and domestic purposes.

Wells: there are 63 wells in the Jenin district, they are used for both irrigation and domestic purposes.

1.12.6.2 Precipitation

The mean annual ran-fall in Jenin district is 336.5 mm. The western parts enjoy greater amounts of rainfall. The rainy season in Jenin district starts in the middle of October to the end of April. Snowfall is rare in the Jenin district (Metrological general directorate, 2010).

1.12.7 Climate

The climate of Jenin district is governed by its position on the eastern Mediterranean. Winter is moderate and rainy, while summer is hot and dry. Monthly distribution of meteorological conditions in Jenin district during the year 2010 is shown in Table 1.6.

Table 1.6: Monthly distribution of meteorological conditions in Jenin district during the year 2010

Element / Month	Mean Temp. (C°)	Mean Wind Speed (Km/h)	Mean Atmospheric Pressure (mbar)	Mean Sunshine Duration (h/ day)	Mean Relative Humidity %	Total Rainfall (mm)	Total Evaporation (mm)
January	14.3	6.6	1001.3	5.8	75	70.9	76.0
February	14.7	6.9	994.5	5.1	73	125.3	80.8
March	17.2	6.8	998.3	7.6	69	16.4	126.2
April	19.8	7.5	996.4	9.4	62	0.4	173.1
May	23.1	8.2	994.9	10.1	60	1.0	236.0
June	26.1	8.8	992.9	11.6	57	1.1	276.7
July	27.7	8.4	991.4	11.6	66	0.0	271.4
August	29.9	7.7	990.9	10.8	63	0.0	266.9
September	27.9	6.7	994.5	9.5	63	0.0	221.3
October	25.1	5.4	997.0	8.3	60	4.5	170.7
November	21.1	3.6	999.0	7.4	57	0.0	121.3
December	15.2	3.1	998.7	5.8	65	116.9	82.3
Annual Mean	21.8	6.6	995.8	8.6	64	336.5	2102.7

Source: Metrological general directorate, 2010

1.12.7.1 Temperature

In summer, the temperature is moderate as a result of the influence of the Mediterranean winds that reach Jenin district due to the absence of the highlands between Jenin district and Mediterranean Sea. The average maximum temperature in year 2010 is 28.0ºC, the average minimum is 17.4 ºC (Metrological general directorate, 2010).

1.12.7.2 Humidity

The mean annual relative humidity (RH) in the Jenin district in year 2010 is 64.0%.The mean annual RH at Bait Qad weather station is 65.7% during winter. In summer, the mean annual humidity is 62.0% (Metrological general directorate, 2010).

1.12.7.3 Wind

Wind direction above Jenin district is between southwest and northwest, more northerly during the summer, with daily speed about 6.6km\h (Metrological general directorate, 2010).

1.13 Joint services council

Waste management costs in Palestine are high relative to the budgets available. New institutional arrangements are being implement in ways that are affordable at the municipal level. Accordingly, the strategy for the final treatment and disposal of MSW is to replace individual municipal responsibility for waste disposal with a regionalized responsibility managed by JSWMC where each council serves a number of neighboring municipalities and villages.

The Jenin district is known for its agricultural lands and beautiful scenery. However, SW is threatening its nature, water resources and public health. Also the growth in population and changes in consumer habits have led to an appreciable increase in the quantity of SW and differences in its composition. All of these reasons led established sanitary landfill.

In 1998 started a comprehensive approach to improve SWM services in the WB through the SWM project in Palestine. The joint Services Council (JSC) in the Jenin district is the first council established in the WB. The joint council was approved by the minister of local government affairs in Palestine. It's managed by the board of directors component of 20 local agencies (15 municipalities, and 5 village councils). JSC for Jenin district in terms of management of the Zahrat Al- Fenjan sanitary landfill, which is replaced all the 85 existing random dump sites in the district (see figure 1.3), also the JSC had prepared the technical designs for the landfill .Among the duties of this joint council is the construction and management of sanitary landfill in the Jenin district to reduce the number of final disposal sites and to solve the waste management problems facing the municipalities of Jenin district regarding SW, also this JSC established to reduce the cost of the SW collection and disposal service by opening new access roads to disposal sites to reduce the transportation distance and to achieve cost recovery for the service of waste disposal this made MSWM more effective and focused capacity building. Also the most important objectives of JSC are reduced number of pollution sources, make districts cleaner and modern as a tourist area, higher quality of staff (qualified personnel concentrated within joint service councils , not distributed through a larger number of municipalities), and increasing the community awareness regarding the following issues:

- Hazards of waste burning and random dumping.

- Health risks associated with improper waste management.
- Dangers facing water resources due to improper waste management.
- Waste minimization and recycling.
- Hazardous waste risks and the necessity of proper management.
- Landscape keeping the environment inside and outside closed dumpsites clean.

(JSC, 2009; World Bank, 2004).

Figure 1.3: Dumpsite before closed Dumpsite after closed

(Source: JSC, 2009)

1.14 Zahrat Al-Fenjan Landfill

Zahrat Al-Fenjan landfill (ZAL) is the first sanitary landfill in Palestine, it has been constructed in Jenin district since 2000 to serve the northern WB. The project cost 14 million dollar (9 million dollar loan from the World Bank, 3.75 million dollar from the European Union, 1.25 million dollar contribution from the local authorities). ZAL site is located17 Km to the south of Jenin city and 25 Km to the west of Tubas, 24 km north of Nablus through jenin-Nablus road, 24 km east of Tulkarem and 50 km northeast of Qalqilyia, in Wadi Ali between Arrabeh and

A'jja, which is now called Zahret Al-Finjan. Figure 1.4 illustrates the location of ZFL. Lands that have been purchased for the project about 240 dunums, the area for the cells which are ready to use about 95 dunums, these cells will serve the northern provinces for a period of 15 years during the first stage, and then will expand the cells in the remaining territories. The capacity of cells is 2.25 million tons (JSC, 2009).

The site include the following facilities:

- Access road, administration building and security fencing.
- Weighbridge and reception area.
- Waste deposition area, which was prepared and lined prior to filling.
- Leachate collection.
- Passive gas venting system.
- Vehicle wheel washing facility.
- Recycling pilot plant.

ZAL receive all domestic waste generated in the served area (Jenin, Tubas, Tulkarm, 90% of Qalqiliya, and 80% of Nablus). SW are collected by the JSC and municipalities and transported to ZAL by the JSC and municipal trucks.

The landfill received in 2009 about 374 tons of waste daily from served areas , this amount raised to 744 ton/day in 2011.

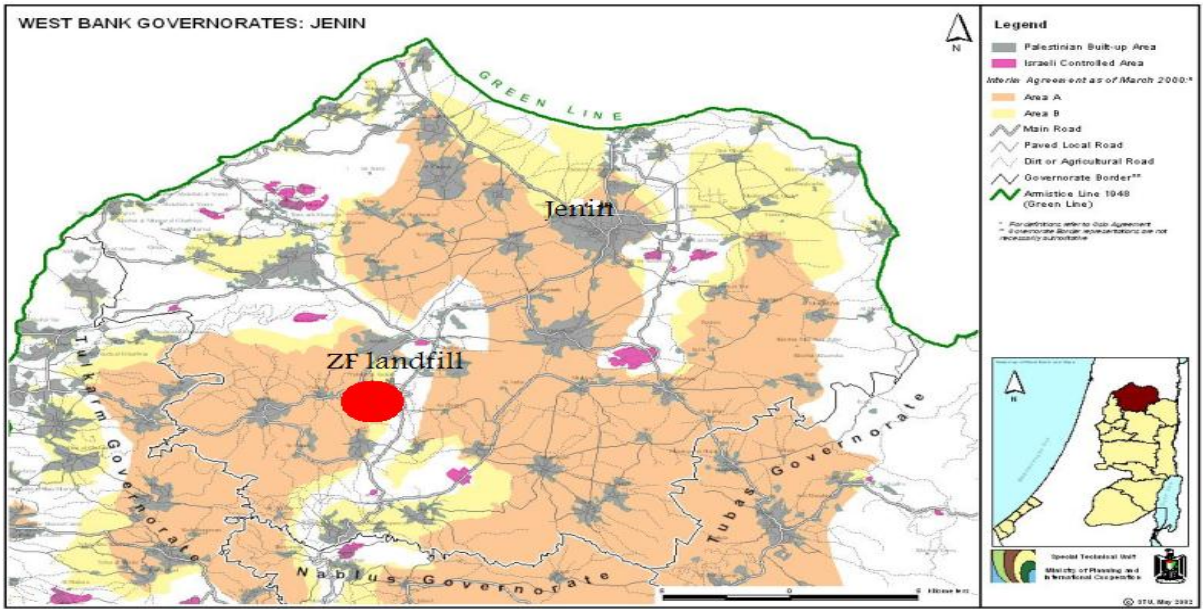

Figure 1.4: Location of ZFL in Jenin district (Source: JSC, 2009).

1.15 Objectives

Proper planning is the basis for any developmental process, which has many areas, including environmental planning, which deals with the development of policies and standards to manage and regulate all environmental components for the environmental balance. Palestine is a developing country, which still suffers from several environmental problems, including SW dumping in a random way such as unsanitary landfills or incineration without taking into account the minimum safety reasons. The main goal of this research study is to assess SWM in Jenin district.

In order to achieve those goals, the following objectives should be accomplished:

1. Examine the current MSWM practices in Jenin Governorate.
2. Assess levels of services provided by municipalities for MSWM.

Jenin district was taken as a study area for important reason, which is; Jenin is the only district in Palestine where there is a sanitary landfill. So we must study the effects of this landfill on the environment to determine the efficiency of it , and to decide to apply this model on other districts.

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2. Chapter Two: Methodology

Survey research method was used to collect the data at both institutional and households' levels. Special questionnaires were designed to collect information about the current management system in all localities of the district. The questionnaires were adopted from published research then modified and customized for the purpose of the study. Two questionnaires were used for the purpose of this study, the first was structured and used for data collection from stakeholders; particularly for municipalities and the second was structured and used for data collection from households.

Data collection was performed during summer, 2012. Pilot tests to examine the validity of the questionnaires were performed. For this purpose, three municipalities and ten households were interviewed. Minor corrections were done on the questionnaires after the pilot tests, the questionnaires were finalized.

The following sections discuss in detail the methods used to achieve the study.

2.1 The stakeholder survey

This questionnaire was distributed to the key person of the local councils. The key person was either the head of the local council, one of the members, or the local council engineer, often all together answer the questionnaire. The questionnaire was distributed to four municipalities which are (Qabatiya, Arraba, Jaba', Silat al Harithiya,) and four villages councils (Kafr Dan, Aja, Al Jalama , Zububa) and to the Joint Services Council in Jenin district which is responsible for waste management in the rest of the municipalities and village councils remaining and the Jenin refugee camp. In Jenin JSC several meetings were conducted with the person in charge of the SWM, in addition to meetings with the accountant and engineer of the JSC. During these interviews have been filled special questionnaire to identify comprehensive information about ZAL (see appendix D). The data collected was the base for documenting the current management system in Jenin district localities.

The stakeholder survey questionnaire was designed to measure and evaluate the technical, operational and financial capacities of the institutions involved in the SW handling in the study area. This questionnaire (Appendix B) included data on institutions itself, information relating to the laws and regulations, financial matters, number of employees and their classification, equipments owned and contracted by local authorities for SW collection, quantities and physical characteristics of SW, temporary storage of waste and vehicles used to transport, served areas by SW collection service, possession of maintenance workshop, residents cooperation, safety procedures, obstacles and challenges which are facing them during SW handling and their willing to apply new techniques towards SW enhancement. Several

personnel meetings were held with respective municipalities and JSC for discussing the institutional questionnaire.

2.2 The household survey

It was necessary to find the interaction of the citizens with the SW issues. This includes the awareness, concerns, satisfaction and interest. Also we should know the main problems in the current management system as seen by the citizen. A special questionnaire was designed for this purpose. The questionnaire includes questions about the geographic location, income, family size. It is to check if there is relation between these independent variables and the other studied variables. In providing any comprehensive SW system it is very important to find the trends of citizens. Trends will be in different aspects as the affordable SW fee, maximum walking distance to the container, readiness to participate in awareness campaigns.

The household survey was focused on SWM in the study area, environmental concerns, sensitization concerns and recycling and reuse. This questionnaire was designed to examine households' satisfaction about the existing SWM services, awareness and attitude toward willingness of be incorporated in the integrated SWM, especially, waste recycling, source separation, willing to buy recyclable products, keenness to pay for the SW services as well as the information about the gender, marital status, family size, educational level, income and occupation were assessed.

The questionnaire was distributed to a representative sample of 320 households. Each locality received a number of questionnaires in proportion to its population to the total population of the district see table 2.1 and for more details in (Appendix C). These questionnaires were collected and analyzed using SPSS program (Statistical Package for Social Science).

Table 2.1shows the percentage of questionnaire distributed in the three locality types. This matches with the percentage of population in these locality types.

Table 2.1: Distribution of households surveyed according to locality type:

Locality Type	number of questionnaires	Percent %
City	34	10.63
Town	79	24.68
Village	194	60.63
Refugee camp	13	4.06
Total	320	100%

2.2.1 Estimation of sample size and distribution

The survey was assumed to be normal distribution. The computation of the sample size was made utilizing statistical equations in accordance with Cochran (1977); Kalton (1983); Kish (1995); and Moore and McCabe (1999). A confidence level of 95% and a margin of error of 5% were considered to be appropriate, and by utilizing a value of 75% for the response distribution, the minimum required sample size may be computed with the following equation:

$$n = \left(\frac{z}{m}\right)^2 p(1-p)$$

where,

n: requested sample size.

Z: standardization value correspondent to 95% confidence level (1.96).

m: margin of error (e.g. 0.05= + or – 5%)

p: response distribution (the estimated value for the proportion of a sample that will respond a given way to a survey question e.g. recommended 70% unless you expect what the results will be).

Using our factors, and solving for the sample size equation, we found that 323 questionnaires are needed. However, using the finite population correction factor, which is routinely used in calculating sample sizes for simple random samples, the sample size equation solving for n' (new sample size) is:

$$n' = \frac{n}{1 + \frac{n}{N}}$$

where,

n: sample size based on the calculations above.

N: population size.

Calculating the new sample size for 273,576 person, n′ was found to be 320questionnaires.

The average MSW generation rate per-capita was then calculated for each residential area by dividing the average daily amount of waste collected (obtained from the municipalities through the surveys) by the population size of that area, which was obtained from the Palestinian Central Bureau of Statistics (PCBS, 2010)

2.3 Collection data of leachate and gas samples

The Water and Environmental Studies Institute (WESI) in An-Najah National University (ANU) collected information about the quality of leachate in ZAL between the years 2010 to 2012 and analyzed these samples. Two samples in 2010, two samples in 2011 and a sample in 2012. See tables in (Appendix E). Poison control and chemical- biological center in (ANU) was

also provided me data related to examine air pollutants in the landfill area in six different locations in 2012. See tables in (Appendix F) (JSC, 2012).

3. Chapter Three: Results and Discussion

3.1 Existing system for SWM in Jenin District

Were studied this aspect by the information that has been collected from a stakeholder questionnaire. The questionnaire revealed important facts about the current SWM system in the localities of Jenin district. The most important results will be handled in the coming sections. The first one is laws and regulations, financial issues, collection system includes (SW workers, equipments, and amount, frequency of waste collection), and disposal system.

3.1.1 Localities distribution based on the responsible of waste collection service

The questionnaire was distributed to four municipalities are (Qabatiya, Arraba, Jaba', Silat al Harithiya,) and four villages councils (Kafr Dan, Aja, Al Jalama , Zububa) and to the JSC in

Jenin district which is responsible for waste management in the rest of the municipalities and village councils remaining and the Jenin refugee camp.

Table 3.1: Localities distribution in Jenin district based on the responsible of waste collection service.

localities	Name of localities	Number of Localities	Total Population	Population %
Municipalities	Qabatiya, Arraba, Jaba', Silat al Harithiya	4	50216	18.33
Village local councils	Kafr Dan, Aja, Al Jalama , Zububa	4	15022	5.48
JSC	The rest of localities	63	208699	76.19
Total		71	273937	100%

3.1.2 Laws and regulations

75% of the councils in Jenin district said existence of strict regulations related to management of SW. Responsible authorities impose specific regulations dealing with SW, 62.5 % of councils approve this result. There is a specific formal authority that follow up the SW issue with the councils in Jenin. Depending on our results sometimes the formal authorities put penalties in case anyone did not follow the regulations of SWM.

Table 3.2: Summary results of laws and regulation questions

	Laws and regulations	Yes%	Sometimes%	No%	Total%
1	Presence of strict regulations related to management of SW.	75	____	25	100
2	Does responsible authorities impose specific regulations dealing with SW.	62.5	____	37.5	100

3	Is there is a specific formal authority that follow up the SW issue.	62.5	____	37.5	100
4	In case there is such authorities, are there any penalties in case you did not follow these regulations.	12.5	62.5	25	100
5	Is there is necessity for regulations dealing with SW management.	100	____	____	100

3.1.3 Financial issues

Percentage of citizens committed for payment of SW fee is 100% in all localities except Jaba' which is 15%. The reason for this commitment is that the fee of SW attached with the electricity prepayment bill. SW fee are collected on each house except for Jaba' where it is collected on each person. SW fee is about 15 New Israeli Shekels (NIS)/month. SWM percentage of the total annual budget is 11%, which is inappropriate because 50% of councils answered no. The monthly cost of SWM average is 18800 NIS.

3.1.4 Collection system

Recorded results were about the collection system in the localities in Jenin district. These results were bout the amount and frequency of waste collection as well as the equipment used for collection, disposal System. In this study we deal with the following items:

3.1.4.1 Staff of the SWM sector

Councils in Jenin district can't find labor for SW easily for many reasons such as, social shyness, and refusing the jobs because of the low salaries. The percentage of the councils who answer no is 62.5%.

Table3.3: Available staff in Jenin district for SWM sector:

Job Title for workers	Number	Work hours	Average month salary
Manager	18	6	2800
Foreman	14	6	2400
Workers collection waste	66	6	1900
Workers sweep the streets	63	6	1800
Driver	44	6	2300
Total	205		

Current workers numbers in Jenin district councils for SWM section is enough. Average monthly salary of SW labor is 1857 NIS. Laborers in SW section work 6 days a week. There are two shift-type of the working in SW councils, which are 66.7% of morning, and 33.3% morning and evening. In holidays, 77% of the same workers as overtime collect waste in these councils, 33% don't collect SW. 22.2% of laborers always wear protective clothes during work, 44.5% of laborers sometimes wear protective clothes during work, and 33.3% never wear protective clothes. The average of councils that vaccinate their workers against diseases is 22.2% which is a very low percentage. 88.9% of workers are aware for safety issues and methodology of dealing with SW, which is a very good percentage.

93% of workers get appropriate training that suit their work and dealing with SW and expected danger, which presents good development in our councils that care about its workers. 95% of councils sometimes apply safety and health regulations which are followed by competent authorities on its workers.

3.1.4.2 Equipments

Currently there is no urban door-to –door collection. Bin collection system is commonly used in Jenin district, which depends on equipments shown in table 3.4. Regarding to containers, the total number of containers in Jenin district is (5886) which gives a ratio of (47) citizens / container. The

number of these containers is sufficient that 95% of the councils agree with this sufficiency of numbers. 90.1% of the containers sometimes fits the volume of domestic SW. The volume of containers in some regain of the district unfit the volume of domestic waste, for that people put their waste around the containers. 95.8% of these containers don't have a specific location for it in the streets. 97.2% of containers have a cover, which is healthy and decrease the waste bad odors. But this doesn't forbid bad odors, rodents, insects to be near SW containers. For that 75% of citizens sometime complain.

Classifications of equipments:

- Containers of (250. 360, 600) cm^3 and containers of 1 m^3 size: They are the most common type of containers and are located in almost all parts of the district. Most of them were imported or come as aids to Palestinian from different donors. They are emptied by compacting trucks.
- Containers of 4 m^3. They are located in dense areas as they are filled quite rapidly. They are kept in their location for 2-3 days and then removed by roll off or lifting trucks
- Containers of size 30 m^3: which are used in commercial center and removed once or twice a day.
- Special containers for hospitals and medical centers: Jenin district not have medical waste containers, the medical waste were disposal inside municipal containers.
- Wheelbarrows: usually driven by labor and used for collecting garbage from small plastic containers in front of houses.
- Compacting Trucks: that collects the containers and compact it 2-3 times denser.
- Transporting Truck: that carry the containers.

Table3.4 : Existing Equipments in Jenin district for SW in year 2012.

No	Item	Number
1	Plastic barrels	240
2	Containers 250 cm^3	1365
3	Containers 360 cm^3	635 [1]
4	Containers 600 cm^3	60 [1]
5	Containers 1 m^3	3470 [2]
6	Containers 4 m^3	100
7	Containers 30 m^3	16
8	Special containers for hospitals and medical centers	---
9	Wheelbarrows	14
10	Tractor	3
11	Compacting Truck	29
12	Transporting Truck	5

Notes: [1] Metallic (60), [2] Metallic (2470), the rest containers are plastic.

95.8% of citizens are not provided with containers to separate SW into different components except Al Jalama rural. The reasons why there aren't such containers are, financially, there isn't special location for these containers, and citizens did not respond to the idea of separating waste from the source. Al Jalama rural use three different colors (green, yellow and brown) of containers to separate waste. Regarding to vehicles, the total number of trucks is (51) which gives a ratio of (5371) citizen / vehicles. Moreover, the population served vehicle varies from 2,000 to 2,300 in Ramallah and Jericho respectively while it varies in Jordan from 11, 320 to 15,580 (Al-Khateeb, 2009).

Table 3.5: Number of vehicles in use and that needed in Jenin district.

Vehicles Used	Municipal councils		villages councils		JSC
	Used	Needed	Used	Needed	
Wheelbarrows	12	___	2	___	____
Tractor	3	1		1	____
Compacting Truck	4	3	2	2	23
Truck	1	2	2	2	2

Different Vehicles	___	___	___	___	___
Total	20	6	6	5	25
Total used	51				
Total needed	11				

Two factors affect the number of SW vehicles; first 97.2% Quantity of SW, second 2.8% served area. 75% of SW vehicles have a cover. SW vehicles are gotten 100% periodic maintenance. 87.5 % of SW vehicles path was set according to study and 12.5% randomly. This save fuel which save a lot of money.

3.1.4.3 Amount and frequency of waste collection:

All localities in Jenin district have SW collection system. SW collection service covers 99% of population of localities. But there, very small rural (khirbah) that population density is low, and they do not have any collection. The results of the study will be presented for the localities that have SW collection system.

The average of quantity of daily SW is 13000 Kg/locality/day. 34540 Kg/day is the Max quantity of daily SW from the city of Jenin, Min quantity of daily SW is 28 Kg/day from Zububa.

The frequency of collection waste in each locality depends on the area of locality and the amount of waste which is depending on the population for each locality. 80% of SW vehicles are loaded mechanical, 20% manual. 100% of industrial waste and medical waste are collected with domestic waste in the same vehicles.

3.1.5 Disposal system

The best way to disposal of the waste is by dumped in sanitary landfill. So, in Europe, sanitary land filling is the main disposal method. In 1999, 57% of MSW was send to landfill. In 2000, about 18% of MSW was incinerated and 25% recycled in western Europe, whereas incineration and recycling accounted for 6% and 9%, respectively, in central and eastern Europe. In 2006 the United States of America (USA) land filled 54% of MSW, incinerated 14%, and recovered, recycled or composted the remaining 32% (Giusti, 2009).

Table 3.6: Methods of MSWM in foreign countries (Source: UNEP, 2008)

Countries	Land filling %	Incineration %	Composting %	Recycling %
USA	65	10	2	23
UK	85	8	2	5
Japan	15	60	5	20
Spain	65	5	17	13

Jenin district is the only district in Palestine which established sanitary landfill, in addition it closed 85 dumping sites, also expressed an interest in the field of recycling but not to large proportions. All waste produced from Jenin district are sent to ZAL directly or sent to the transfer stations and then sent to the landfill without being separated.

This waste is generated from the following sources:

1. Residential waste (homes, parks, etc).

2. Commercial waste (hotels, office, shops, restaurant, slaughterhouse, etc).

3. Industrial waste (manufacturing, trades and crafts).

4. Medical waste (hospital, Medical clinic, etc).

5. Institutional waste (schools, universities, governmental offices, Private offices).

6. Agricultural waste (animal farm wastes, plant nurseries, olive mills).

3.1.5.1 Transfer stations

There are five transfer station in Jenin district as table below. 98.6% of transfer stations are located far from residential areas, there are paved roads reaching those transfer stations in all localities. SW vehicle path was set according first a study 87.5%, second randomly 12.5% . All waste from all transfer stations are sent to ZAL.

Table3.7: Transfer stations in Jenin district.

No.	Transfer station	Area[1]	Served area	WQ[2]	Distance to landfill (Km)	Vehicles and equipment	number of trips (daily)
1	Jenin west Villages transfer station	1	Jenin west villages	37	25	one vehicle trailer (3) containers (32 m^3)	2 trip the trailer carrying two container in each trip
2	Tubas transfer station	2	Tubas Governorate	39	34	one vehicle trailer (5) containers (32 m^3)	2-3 trip the trailer carrying two container in each trip
3	Al-Sayrafi transfer station	4	Nablus city and Nablus Camps (Balata	154	32 km through maythaloun-Serees road	three vehicles trailer (8) containers (32 m^3)	5trip daily to ZF Landfill (each trailer making two trip and

			camp, A'skar camp, Bayit Al-ma' camp)				carrying two containers in each trip)
4	Tulkarm	3	Tulkarm		_	one vehicles trailer (2) containers (32 m^3)	4 trip the trailer carrying two container in each trip
5	Qalqiliya	2	Qalqiliya		50	one vehicles trailer (2) containers (32 m^3)	3 trip the trailer carrying two container in each trip

[1]Area in dunum
[2]WQ: waste quantity (ton/day)

3.2 Zahret Al-Finjan Landfill

The operation in the landfill started in 2007, ZAL is located in Jenin district in the northern part of WB. Studies and designs for ZAL were originally made for Jenin and Tubas districts, where the lifetime of the landfill was estimated at 30 years, with a capacity of 2.25 million ton of SW. The coverage area of ZAL services has now been extended to include Nablus, Tulkarem, and Qalqiliya districts. This will decrease the lifetime of the landfill to 10-15 years.

Figure 3.1: The site of ZAL before starting work, (Source: JSC,2009).

Figure 3.2: Lining of ZA L, (Source: JSC,2009).

3.2.1 Solid waste quantities

The quantities of SW entered ZAL have being measured by weighbridge at the entrance of the landfill as shown in figure 3.4. The landfill received about 374 ton/day of wastes in 2009 from served areas, this amount raised to 744 ton/day in 2011. This is cause reduce the life landfill to about 10 years. The number of the citizens which benefit from this project in the northern districts increased from 800,000 to 1 million (JSC, 2012).

Table3.8: Population growth in served districts by ZAL and the quantities of waste generated.

District	Population 2009	Population 2010	Population 2011
Jenin	267027	٢٧٤٠٠١	٢٨١١٥٦
Tubas	52950	٥٤٧٦٥	٥٦٦٤٢
Tulkarm	162668	١٦٥٧٩١	١٦٨٩٧٣
Qalqiliya[1]	85452	87702	90011
Nablus[2]	265911	272094	278418
Total Population	834008	854353	875200
Total amount of waste (ton)	134761.60	182400.12	200778.49
Waste (ton /day)	374	507	744

(Source: PCBS, 2010; JSC, 2012)

[1]: 90% of Population in Qalqiliya district. [2]: 80% of Population in Nablus district.

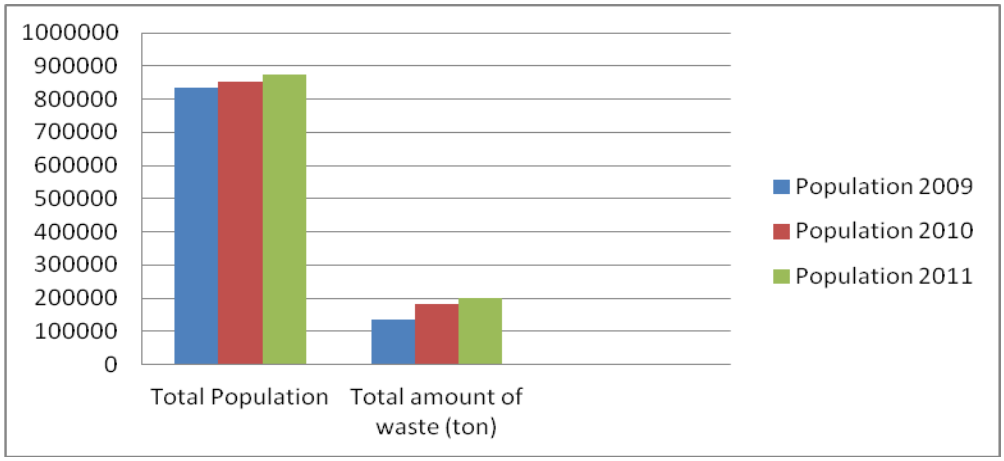

Figure 3.3: Increments of SW due to population increasing

Figure3.4: weighbridge at the entrance of ZAL

3.2.2 Solid waste fee

Eight councils collect waste by themselves which are four municipalities councils (Qabatiya, Arraba, Jaba', Silat al Harithiya,) and four villages councils (Kafr Dan, Aja, Al Jalama , Zububa) pay 30 NIS/ton. JSC collects waste to the rest councils (63), these councils pay 100 NIS/ton for collecting waste, and pay 170 NIS for street sweepings to JSC. The next table shows the outstanding debts on the councils. As the table shows, the debt increased from 2008 to 2011 by (1,685386 NIS), this amount is too large, and to solve this problem the councils linking waste bill with the prepaid electricity bill at the beginning of 2012.

Table 3.9: Debt owed on councils

	2008	2009	2010	2011
Fee (NIS)	529488	6967657	9344776	13594439
Paid (NIS)	421481	6111851	7763936	11801046
Dept (NIS)	108007	855806	1580840	1793393

3.2.3 Components of solid waste

As shown in the table 3.10 ZAL has high organic percent of waste, while it was noticed that papers and plastic forms the second and third fractions of percentage of waste. Metals, glass and textiles forms the lowest fractions of percentage of waste.

Table 3.10: Mean components of SW in ZAL

	Residential	Agricultural	Commercial
Organics %	50	80	25
Paper %	20	6	55
Plastic %	6	4	10
Metals %	10	—	—
Glass %	4	—	—
Textiles %	4	—	—
Other waste %	6	10	10
Total	100	100	100

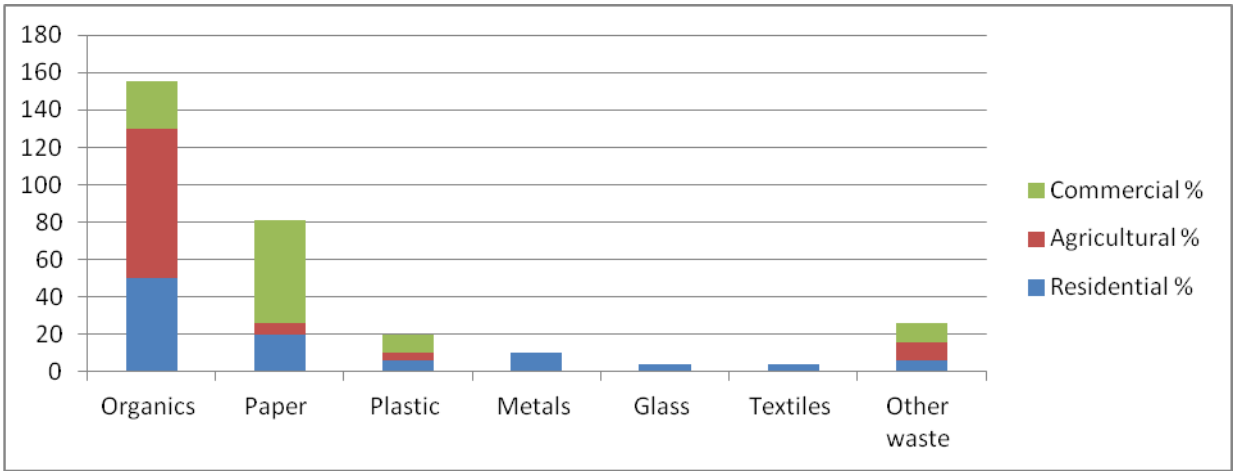

Figure 3.5 : Mean components of SW in ZAL

Table 3.11: Composition of SW stream in four countries

Countries	Organic	Paper, %	Plastic,%	Glass,%	Metals%	Others, %

	Matter, %					
USA	23	37.4	10.7	5.5	7.8	15.6
Israeli settlements	43	22	14	3	3	15
Jordan	63	١١	16.8	2.1	2.1	5
Palestinian territory	59	15	12	4	4	6
Indonesia	62	6	10	9	8	4
Iran	80	8.7	9	0.2	0.7	

(Source: UNEP, 2008)

In Jordan, the organic fraction reaches 63 % by weight, and this much affecting the density.

In developing countries the organic fraction in the SW generation is high. SW characterization and quantification is very helpful and economically feasible, since the method of handling, storage and processing of SW at the source plays an important role in public health, aesthetics and the efficiency of the municipal SW system. 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 (Moghadam et al., 2009).

There are restrictions presented in the site to forbid the fractions which are shown in figure 3.6 from entering the landfill.

Figure 3.6: waste that are not allowed to enter ZAL

3.2.4 Waste separation, reuse, and recycle

The reuse and recycling system for the ZAL will help extend the lifetime of the landfill, by extracting of the reusable and recyclable wastes from municipal wastes such as, organic waste, papers, plastic, etc. Reusable and recyclable materials can be sold, which decrease the cost of waste disposal. In addition, natural resources can be conserved by reusing and recycling the separated waste, which will be an important step towards ISWM of ZAL.

ZAL reuse only tires from the whole waste. They reuse it as barriers to protect soil from erosion, and for planting flowers to beautifies nature landscape and beautifies sight of the streets.

ZAL receives around 700 tons/day, 200 tons out of the 700 tons only enter separation unit. ZAL operators separate cartoons and papers from waste , they sell it to an Israeli factory in "Al-Hudayrah". Plastic is separated from waste, smashed, then sold to the local factories. They dump glass with other waste that no one asks for it.

Regarding medical waste, it is also dumped with other waste because it's not separated from its source. Medical waste needs special containers, and special treatment in landfill, ZAL has special containers for it, but they didn't give them to the councils.

Figure 3.7: waste that are reuse and recycle in ZAL

3.2.5 Environmental control

In most situations, regulations are established that require the inclusion of environmental controls in the design and operation of a landfill in order to protect the public health and the environment from potential negative impacts of landfills. The most commonly used types of environmental controls include impermeable barriers (liners), leachate collection and treatment systems, landfill gas management systems, and cover systems. Environmental controls are necessary to protect the environment during landfill operation and during the closure and post-closure periods. These practices are described in the following sections.

Lining layers in ZAL:

1. Gravel: as filter.
2. Geotextile: to distribute pressure.
3. High density poly ethylene(HDPE) and geosynthetic clay liners: to prevent leaking.

Waste is spread and compacted diagonally in the operating area, waste is placed in layers on top of each other and then compactors walk on top of the layers 3 - 5 times to reduced the volume of waste, this is process produce a cell. Each cell covered with 15 cm-soil, at the end of the day all side-by-side makes layer, which's covered 25 cm-soil. Figure 3.8 shows daily cell shape The benefits of the soil cover are to reduce bad odors and prevent waste scattering. There is a fence around the landfill to hinder light waste from flying away and prevent animals to enter it. In addition, they use Insecticides .

To reduce the amount of dust generation operators use trucks to spray water on the roads access roads should be paved . Dust is generated at a landfill site by two main sources: 1) collection vehicles and heavy equipment moving over dry dirt roads, and 2) the wind. Dust can also be

generated during the discharge, placement, and compaction of unusually dry materials or during the excavation and movement of dry soils.

Rainwater is collected separately away of the leachate to keep it clean and pure incase the earth absorbed it with ground water.

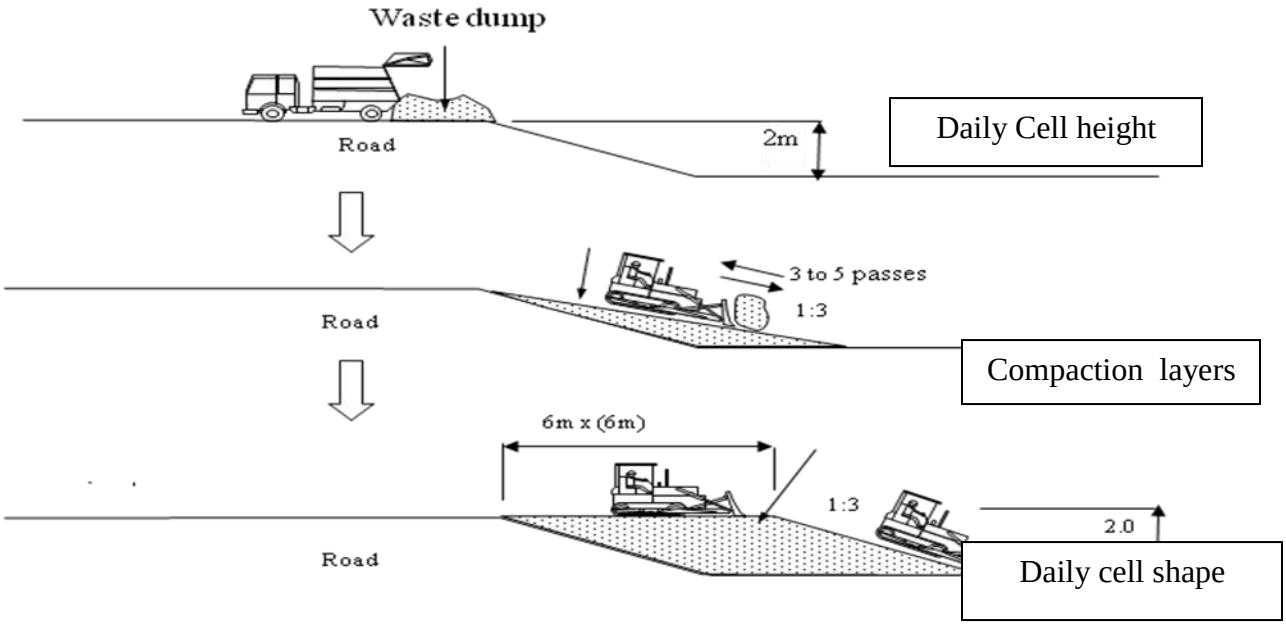

Figure 3.8: Daily cell shape


Figure 3.9: Control on waste scattered

Figure 3.10: Control on dust


Figure 3.11: Control on insects

Figure 3.12: Control on rainwater

3.2.6 Leachate system

When biodegradable waste, such as food, paper… etc, is disposed of to the oxygen-free (anaerobic) conditions of a landfill, breakdown by bacteria produces gas and soluble chemicals. The soluble chemicals combine with liquids in waste (e.g. rainwater) to form landfill leachate. The amount of leachate produced is directly linked to the amount of precipitation around the landfill.

Leachate is a potential hazardous waste from landfill sites. If not dealt properly it can cause groundwater pollution, health problems and affect the environment. It is important that leachate has to be treated and contained to prevent these occurrences. Leachate treatment options are on-site treatment plant, discharge or transport to off-site treatment plant, recirculation through the landfill body and evaporation (natural or forced). Leachate treatment processes include biological, physical and chemical processes. ZAL developed leachate collection and treatment systems involves the following design steps:

1) Selection of the type of bottom liner to be applied. Figure 3.13

2) Preparation of a grading plan (i.e., channels, pipelines, and others). Figure 3.13

3) design of the system for the collection, removal, and storage of the leachate. To storage leachate there are two ponds for leachate, the first one fig 3.14 is already used in the first stage. Its volume is 3000 m^3, its depth is 3 m, its area is 1100 m^2. The second pond still in progress for use in the second stage. Its volume 20000 m^3, its depth is 3 m, its area 5500 m^2.

4) Recirculation leachate on landfill waste and evaporation, figure3.15

Quantity and quality of leachate, the quantity of the leachate can be estimated based on a water balance performed on the landfill system. The quality of the leachate from a landfill depends primarily on the type of waste placed in the fill, degree of compaction, depth of fill, and age of the waste. For example, leachate produced during the first phase of decomposition of MSW characteristically has an acidic pH resulting from a high concentration of organic acids. Some characteristics of leachate from municipal SW are presented in Table 3.12. The range of values given in the table reflects leachate generated during the acid and methanogenic phases of decomposition.

Figure 3.13: Leachate collection

Figure 3.14: Leachate collection pond

Figure 3.15: Recycling leachate and evaporation

3.2.6.1 Results of leachate samples from ZAL:

All samples taken from ZAL prove that leachate is in its initial stage which is less than five years (young leachate). Proof of this is that the values of pH an all samples between (4.5-9), see table 3.13. Most important indicator to biodegradable waste is BOD_5/COD ratio. Higher BOD_5/COD ratio indicates presence of easily biodegradable materials, while low BOD_5/COD ratio indicates presence of difficult to biodegrade materials. From our data the best ratio in sample four which is the highest value also it has maximum value in range.

The highest values of the Carbonate, chloride and sodium parameters were found in the fourth sample higher than the highest range of values. Also sample four had highest value of TDS and TSS parameters, but within the range. Sample five had higher value of nitrate (81 mg/l) which is higher than the highest range of values. Cd, Pb, Cr, Mn metals are not existed in first for samples, but it was found in sample five within the range.

Although there is some increase in the concentration of some samples for the required range, but it does not affect the environment directly because there is a good leachate pond lining in ZAL, which don't allow for these materials to leak into the ground and contaminate groundwater.

Concentration of total Kjeldahl nitrogen (TKN) increase with time, and this increase still in range of values set by EPA for characteristics of leachate. Also concentration of Nitrate increase with time.

Nitrogen levels are very useful as indicators of the age of the leachate. Ammonia nitrogen and organic nitrogen are produced by the decomposition of organics and are stable in the anaerobic environment and does not decrease with landfill ages; nitrate nitrogen is consumed in the anoxic environment (Al-Sa'ed 2006; Yalcuk and Ugurlu 2009).

Table 3.12: Result of leachate samples from ZAL (five samples from landfill pool), compared them with characteristics of leachate from EPA.

Parameter	Unit	Sample (1) 2010	Sample (2) 2010	Sample (3) 2011	Sample (4) 2011	Sample (5) 2012	Range of Values (EPA, 1987)
pH	---	8.3	8.5	7.65	8.2	7.85	4.5 - 9
Turbidity	NTU	11.7	11.9	14.3	29	21.6	___
Carbonate ($CaCO_3$)	mg/L	600	660	7000	13600	8000	300 - 11,500
Conductivity	Ms/cm	15.10	15.45	17580	28900	20900	___
Total Dissolved Solids TDS	mg/L	7732	7804	12292	23142	12970	0 - 42,300
Sulfate ($SO4^{-2}$)	mg/L	12.50	11.7	18.3	15.7	25	20 - 1,750
Ammonium (NH_4^+)	mg/L	588	622	1086	1900	960	30 - 3,000
Calcium (Ca)	mg/L	65	80	220	280	280	10 - 2,500
Magnesium (Mg)	mg/L	154	121	138	194	190	40 - 1,150
Chloride (Cl)	mg/L	2600	2900	3800	9000	3990	100 - 5,000
Cadmium (Cd)	mg/L	0.00	0.00	0.0	0.0	0.03	___
Lead (Pb)	mg/L	0.00	0.00	0.0	0.0	0.0	8 - 1,020
Chrome (Cr)	mg/L	0.00	0.00	0.0	0.0	0.09	___
Copper (Cu)	mg/L	0.10	0.4	0.0	0.0	0.05	4 - 1,400
Iron (Fe)	mg/L	0.54	0.1	6.4	3.3	1.57	3 - 2,100
Manganese (Mn)	mg/L	0.00	0.00	0.0	0.0	0.12	0.03 - 65
Sodium (Na)	mg/L	1660	1940	1820	4700	2450	50 - 4,000
Zinc (Zn)	mg/L	0.50	0.37	0.5	0.2	0.41	0.03 - 120
Nitrate (NO_3^-)	mg/L	24	23	32	34	81	0.1 - 50
Total Kjeldahl	mg/L	889	980	1391	2700	1703	50 - 5,000

nitrogen (TKN)							
BOD	mg/L	210	193	989	4050	962	20 - 40,000
COD	mg/L	3200	1600	3680	6080	4240	500 - 60,000
Total Suspended Solids TSS at 105 ºC	mg/L	104	103	220	348	154	6 - 2,700
BOD5/COD		0.066	0.12	0.27	0.67	0.23	0.04 - 0.67

3.2.7 Gas system

Landfill gas "biogas" is one of the products generated as a consequence of the biological degradation of the waste organic fraction placed in the landfill. Typically, the composition of landfill gas is methane CH_4 40% - 60%, Carbon dioxide CO_2 40% - 50%, Nitrogen N_2 3% - 20%, Oxygen O_2 1%, and traces of sulphides and volatilised organic acids. Traces of other compounds may include benzene, toluene, sulphur dioxide, methylene chloride, and others in concentrations of up to 50 ppm (Paul, 2009).

The quality of gas depends mainly on the type of SW. The quantity of gas generated depends on waste volume, waste composition, and time since deposition of waste in the landfill. The quality and quantity of landfill gas both vary with time. Immediately after disposal waste aerobic degradation. The main constituents of the landfill gas during this stage are carbon dioxide (CO_2) and water vapor. The change from aerobic to anaerobic degradation produce methane and carbon dioxide under anaerobic conditions proceeds as a series of phases.

Since methane gas has the potential to burn or explode, it has to be removed from the landfill. To do this, a series of pipes are embedded within the landfill to collect the methane gas. This

gas, once collected, can be either naturally vented or control-burned. Aside from being a flammable gas, methane released to the atmosphere greatly contributes to the depletion of the ozone layer since it has approximately 15 to 20 times the global warming potential of carbon dioxide.

Methane gas needs five years or more to be gathered in huge mounts since operating the landfill for the first time. Till this moment methane gas does not gather at all in ZAL, because the landfill started working five years ago or less.

The main cause of global warming is the increasing amount of greenhouse gases (CO_2 and CH_4) in the atmosphere. The main contribution to the greenhouse effect in the EU is from methane released from landfills where biodegradable waste undergoes anaerobic decomposition. Given the high proportion of waste traditionally landfilled in. According to Giusti, (2009), the estimated overall positive greenhouse gases flux in the EU in 2000 was 50 kg of CO_2 equivalent per ton of waste, the estimate for 2020 is a negative flux of about 200 kg of CO_2 equivalent per ton of waste. Even larger negative fluxes were estimated assuming different scenarios (e.g. more recycling, more incineration with energy recovery, more biological treatment).

Although most municipal wastes in developing countries have a high concentration of organic matter, the wastes usually are not adequately covered and thus the gases readily escape. In addition, there are several factors that affect the amount and rate of gas production in a SW disposal site. Some of these factors include:

- Waste composition (i.e., concentration of carbon, nutrients, and inhibitors) and moisture content;

• Degree of pre-treatment (size reduction, recycling, composting, baling);

• Type and degree of compaction, method of operation of the landfill site, type and thickness of cover material;

• Quantity of refuse, geometry, and hydro geologic properties of the landfill; and

• Climatic conditions (temperature, precipitation, evaporation, insulation) (Paul, 2009).

Table 3.13:Comparison between gas samples results from ZAL and Palestinian standards (Source: PSI, 2010).

Test	First location	Second location	Third location	Fourth location	Fifth location	Sixth location	PSI standards
NH_3 (ppm)	1.09	0.74	0.58	1.38	0.19	0.44	___
HCN (ppm)	0.010	0.00	0.086	0.09	0.00	0.25	___
SO_2 (%)	0.00	0.00	0.00	0.00	0.00	0.00	$(0.04\text{-}0.14)*10^{-3}$
H_2S (ppm)	0.025	0.043	0.058	0.052	0.052	0.32	$(0.01\text{-}0.03)*10^{-3}$
Temp. (ºC)	23.6	23.75	21.08	19.89	21.24	17.39	___
TVOC (ppb)	0.143	0.00	1.86	2.8	0.8	2.5	___
CO_2 (ppm)	406.21	436.82	364.64	366	458.5	1034.4	___
O_3 (ppm)	0.00	0.00	0.00	0.00	0.00	0.00	$(0.08\text{-}0.21)*10^{-3}$
NO_2 (ppm)	0.00	0.00	0.00	0.00	0.00	0.00	$(0.05\text{-}0.21)*10^{-3}$
CO (ppm)	2.11	1.82	0.43	0.75	0.8	0.7	0.009-0.026
(%R.H)	34	32.17	49.55	52.74	48.78	59.36	___

PM 1 (mg/m^3)	0.010	0.017	0.030	0.015	0.003	0.010	___
PM 2.5 (mg/m^3)	0.075	0.075	0.087	0.099	0.032	0.148	___
PM 7 (mg/m^3)	0.101	0.099	0.168	0.138	0.100	0.372	___
PM_{10} (mg/m^3)	0.268	0.259	0.304	0.297	0.166	0.429	0.07- 0.12
TSP (mg/m^3)	0.351	0.349	0.412	0.377	0.184	0.711	0.075- 0.26

PM: Particulate Matter

In order to measure the air pollution in ZAL, six locations were tested around the site, and the results were: Regarding SO_2, O_3, NO_2, and CH_4: no existence. H_2S was exist in location no. six and it was higher than the allowed range by PSI. CO was found in all locations and had values higher than what allowed by PSI. Among all gases CO_2 had the highest concentrations, which proof that microorganism is active. There is no gas collection system in ZAL, which allow all gases to fly away in the air. As mentioned before, there are some not allowed concentrations for some gases which cause air pollution.

3.2.8 Closure of the landfill:

The landfill operations end only after it is closed properly, part of the landfill can be closed while continuing to run the other part; it's called partial closure. The way of closing the landfill must help achievement the purpose of using it after closure which determined already in the design stage. The most important requirements for closure of the landfill or any part of it is to prevent the detection of waste and reduce the chance of rainwater leak into dump waste in it.

3.3 Demographics of the study area

Opinions of citizens are very important . A special questionnaire was designed to know public awareness. The questionnaire is designed to measure the awareness and concerns of citizens about SW issues. This is assessed by asking the citizen about some existing practices for SWM and his readiness to participate in SW campaigns. The response of the citizen for suggesting proposals to improve SWM system will be detected. In this part we are going to present the results collected through the questionnaire.

The samples were included 320 households interviewed, it was comprehensive because it included the next dependent factors. About 60% of the respondents were live in villages, 25% in the towns, 10% live in the city, only 4% live in refugee camps. The large number of household who being interviewed were males 83.5%, females were 13.5%. The average family size was 6 persons. Most of them live in separate houses 88%, the others live in apartment 12%. The majority of respondents work as employee 45%, the minority of them are unemployed 9%. Regarding income, most households receive a monthly income of 1500-3000 NIS 52%, and only 2% received over 6000 NIS. 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. The large percentage of respondents education level were graduated 38%, and the less percentage 2.6% was for uneducated.

Figures below shows the surveyed sample distribution based on demographics and socio-economic characteristics per study area.

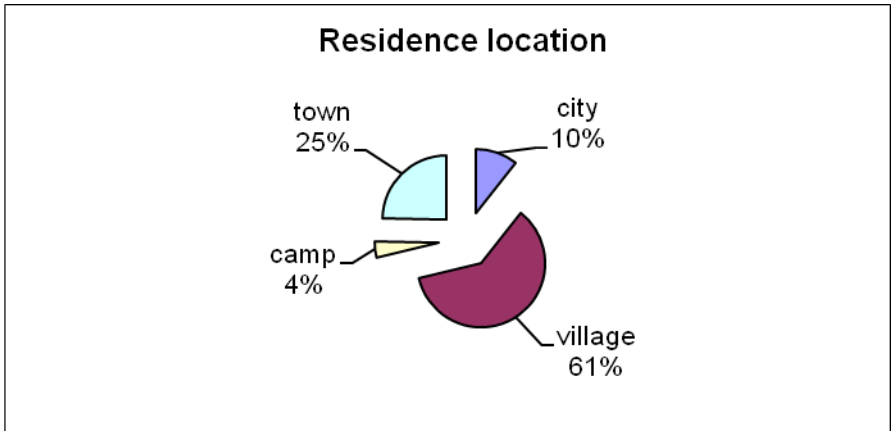

Figure 3.16: Sample distribution according to residence location

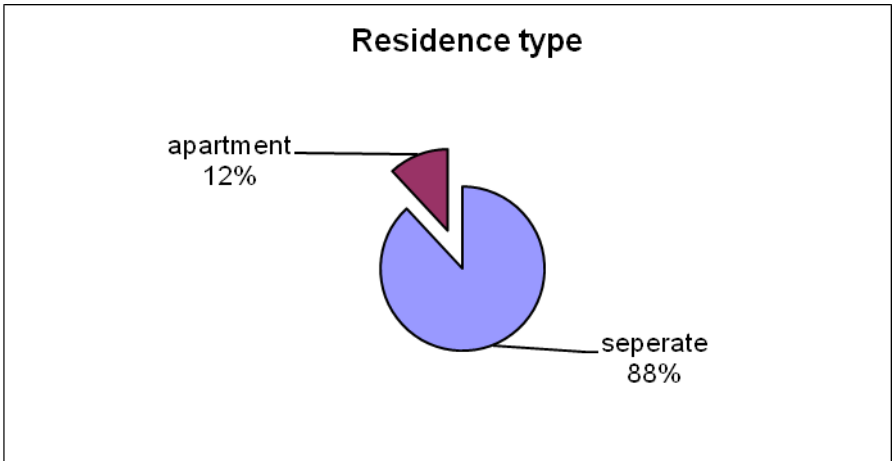

Figure 3.17: Sample distribution according to residence type

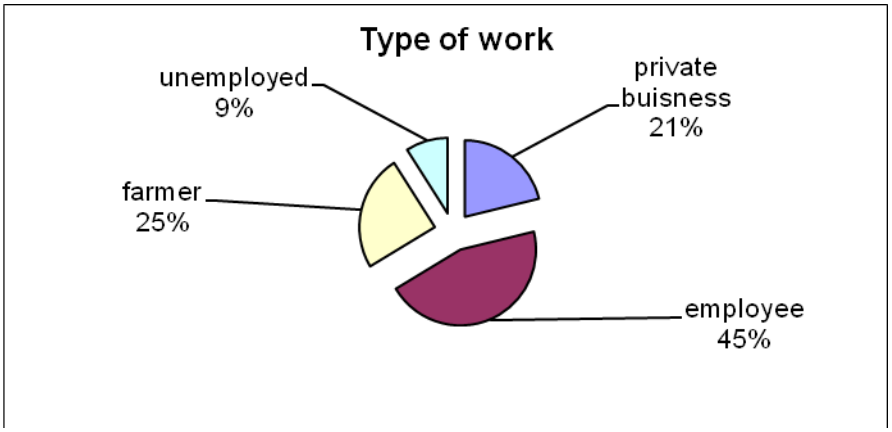

Figure 3.18: Sample distribution according to residence type of work

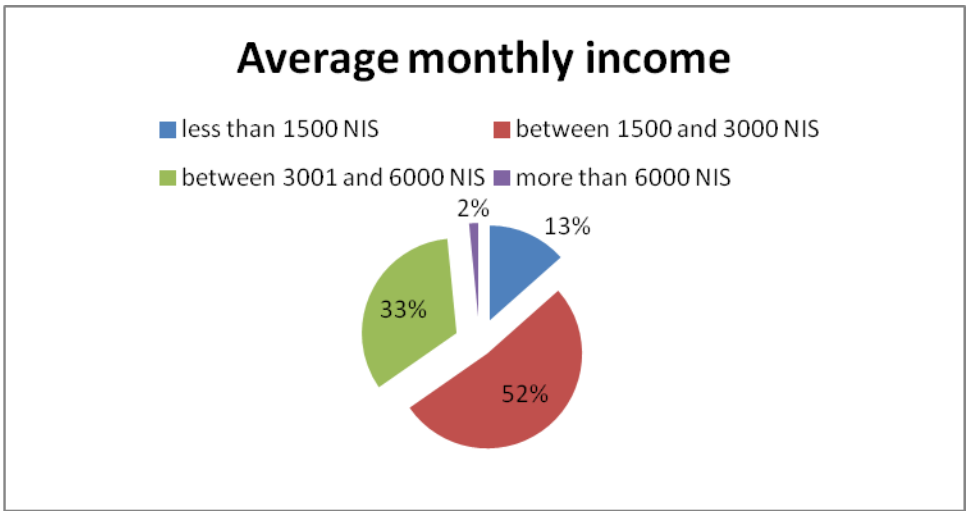

Figure 3.19: Average monthly income of the surveyed sample

Fig 3.20 shows the most factors that considered problems in the study area, SWM problems come in the fourth level between the most severe problems in the respondents locality. The most severe one is safety and security, then water problems, after that is sewerage system problems.

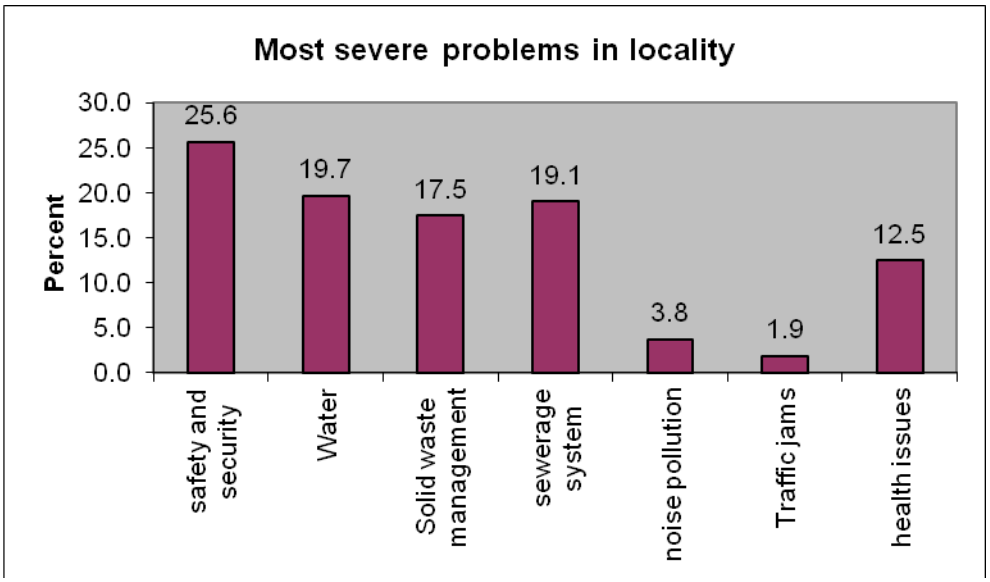

Figure 3.20: Most severe problems in locality

3.4 Citizens opinion of services provided by councils for MSW management

3.4.1 Collection system

In the household questionnaire, about seventeen main questions were used to measure the satisfaction and status of the SW collection in the study area.

3.4.1.1 Service provider

JSC gets the highest percentage of SW service provider 86%, local councils 12%, another local councils 2%. About 99% of the population in Jenin district are located within areas that have a SW collection system .According to the residents of these localities and from field observations, the presence of SW collection has been the cause of reducing serious health and environmental problems, such as the spread of open dumps that support large populations of rats, flies and cockroaches that frequently invade nearby dwellings in addition to odor problems. Except in the very small rural (khirbah) where there is absence of SW collection because its population number is very small (just 2-3 houses).

Figure 3.21 summarizes the distribution of localities according to the SW service provider

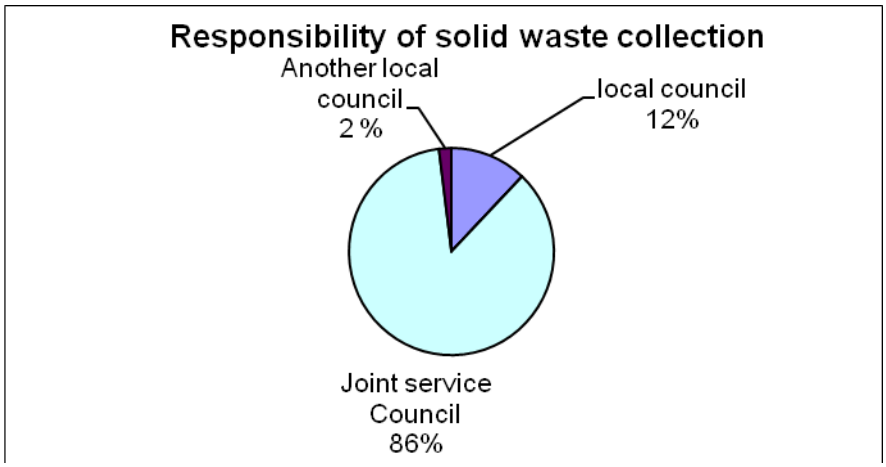

Figure 3.21: Distribution of localities according to the SW service provider

In Palestine the number of localities that do not have SW collection service localities had decreased from 99 localities during 2008 to 79 localities during 2010 all in the WB, with a population of 39,642 represent 1% of the population of the Palestinian territories. While it was 166 localities during 2005 and 193 localities during 2003 that do not have SW collection service. The local authority collects SW in 359 localities that have SW collection service in the Palestinian Territory with a population of 3,390,200 (83.7% of the population of the Palestinian Territory) (PCBS, 20١١).

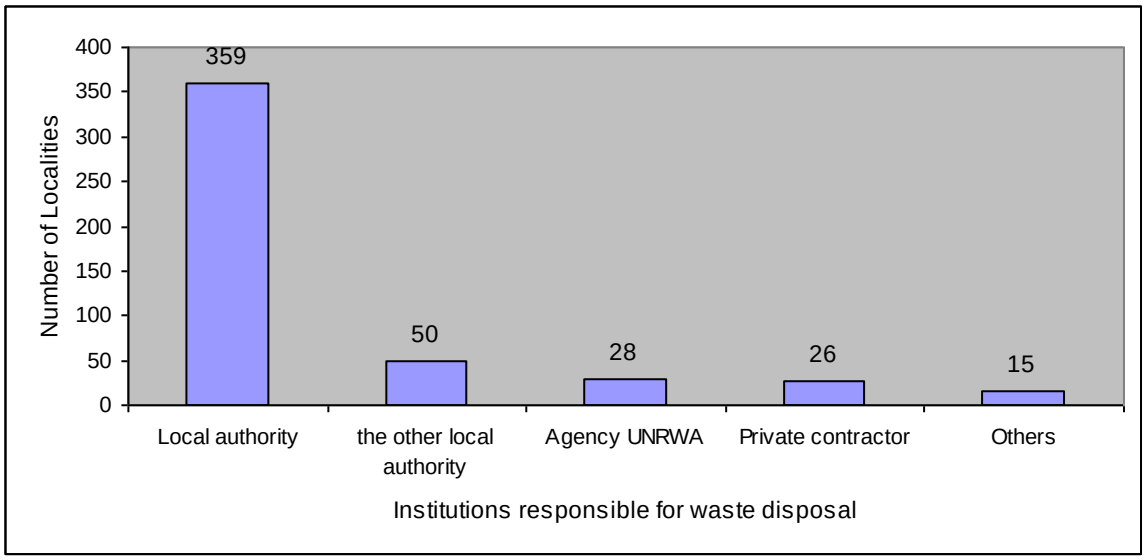

Figure 3.22: Distribution of population in the Palestinian territories according to Institutions responsible for waste disposal 2010.(Source: PCBS, 20١١).

3.4.1.2 SW fee system

We are going to present the amount of the SW fee, frequency of collecting fee (monthly or yearly), method of collecting fee. SW fee system changes from city, town to village. Houses vary from institution, Commercial and industrial sectors in Jenin city and towns. Houses pay 15 NIS/ month, the other sector pay according to tax tariff system. On the other hand in villages houses and other sectors pay 15 NIS/month.

According to method of collected the fee, 86.8% of people pay SW fee with electricity invoice, 6.3% with water invoice, 4.4% do not pay, 2.2% separately, and 0.3% no service. Regarding maximum affordable monthly SW fee for improving waste collection 57.3% of people can pay between 11 and 20 NIS, 36.3% can pay less than 10 NIS, 5.7% can pay between 21 and 30 NIS.

3.4.1.3 SW generation

The average daily quantity of SW from houses in Jenin district (3-4) Kg/day. It is close to the average Palestinian household (4.6) kg/day of SW in WB and Gaza Strip (Al Sa'di, 2009). The average waste generation per capita in Jenin city (0.8) kg/capita/day in year 2012. It is close to the average waste generation per capita in Palestine cities (0.9 – 1.2) kg / capita/ Day (ARIJ, 2006).

Table 3.14: Rate of waste production in some developing and developed countries (Source: UNEP, 2008)

Developing countries	Municipal waste Kg/Capita/day	developed countries	Municipal waste Kg/Capita/day
Kuwait	1.8	USA	1.98
Bahrain	1.6	Canada	1.65
Saudi Arabia	1.3	Denmark	1.32
Egypt	1.2	Japan	1.26
Jordan	0.9	Netherlands	1.04
Syria	0.5	France	0.9
Yemen	0.45	Germany	0.8
Morocco	0.33	Finland	0.47

We can note through the above table that in developing countries maximum SW generation is in Kuwait. It is estimated that the Kuwaiti cities are generating 1.8 Kg/capita/day, and minimum SW generation is in Morocco. It is estimated that the citizen is generating 0.33 Kg/capita/day. On the other hand, the socio-economic conditions, developing urbanization and economic growth are affecting the per capita waste generation per day. These are the results that cause the

increasing of waste generation per capita per day in developed countries as shown in the table 3.15. For examples in USA the generation rate is 1.98Kg /capita/day.

Through the study of previous literature, we can document that SW per capita generation rates and SW physical characteristics distribution vary across the world, and even across the developing world. SW 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.

3.4.1.4 Frequency of waste collection

About 64% of people says that the SW is collected twice a week in their localities, 16.4% three time a week, 9.3% daily, 9.6% others. 50.2% of residents are mostly satisfied with SW collection frequency, 21.5% are always satisfied, 18.6% are sometimes satisfied, 9.8% are rarely satisfied. It was concluded from the household questionnaire that around 70% of citizens are satisfied with waste collection frequency, this apparently matched the real case as illustrated by the municipality via the institutional questionnaire, which is say that the frequency of collection waste in each locality depends on the area of locality and the amount of waste which is depend on the population for each locality.

Table 3.16 shows that 100% of people in Jenin camp said that SW is collected daily, Table 3.17 shows that 100% of the camp citizens are always and mostly satisfied with SW collection frequency. In the towns, villages and Jenin city the percentage between 63-88% of people said that SW is collected twice a week in their localities, no notable differences between the three zones.

From the cross tabulation there is a statistically significant relationship between residence location and (frequency of garbage collection, satisfaction with SW collection frequency). Also there is a statistically significant relationship between frequency of garbage collection and (type of work, education level) at significance level of 0.05. And there is a statistically significant relationship between satisfaction with SW collection frequency and type of work at significance level of 0.05.

Table 3.15: Residence location versus frequency of waste collection (count and percentage)

Residence location	**Frequency of waste collection**					**Total**
	daily	twice a week	three time a week	it is not collected	other	
Town, count	3	51	17	0	8	79
%	3.79	64.56	21.52	0	10.13	100
Village, count	13	117	34	2	18	184
%	7.07	63.58	18.48	1.09	9.78	100
Camp, count	13	0	0	0	0	13
%	100	0	0	0	0	100
City, count	0	30	0	0	4	34
%	0	88.24	0	0	11.76	100
Total, count	29	198	51	2	30	310
%	9.35	63.87	16.45	0.65	9.68	100

Table 3.16: Residence location versus frequency of satisfied with SW collection (count and percentage)

Residence location	Are you satisfied with SW collection frequency				Total
	always	mostly	sometimes	rarely	
Town, count	14	49	11	5	79
%	17.72	62.02	13.94	6.32	100
Village, count	38	86	44	23	191
%	19.89	45.03	23.04	12.04	100
Camp, count	5	8	0	0	13
%	38.46	61.54	0	0	100
City, count	11	15	4	3	33
%	33.33	45.45	12.12	9.09	100
Total, count	68	158	59	31	316
%	21.52	50	18.67	9.81	100

3.4.1.5 Equipments of collection system

The respondents were asked about the status of the community container in terms of number, size, mechanical status and location. As shown in table 3.18 the answers were obviously illustrates that most citizens of Jenin district fine with numbers of containers in their locality, 66.1% agreed that numbers suit SW quantity. On the other side 30.1% said don't fit, the rest 3.8% don't have containers in their locality. Regarding containers size, 66.8% of people agreed that containers size suits SW quantity for the served area, 29.4 % of people assure that the containers size doesn't suit SW quantity, for that they put their waste around the containers.

As well as the mechanical status of the containers is considered good for 57.4% of respondents, and 40.4% considered the mechanical status bad. On the other hand, about 68.2% of the

respondents said that the containers are not having a specific location in the street. From above it can be concluded that the most residents are satisfied from the number, size and mechanical status of the containers but they have high concerns about their locations.

Table3.17: Status of community containers

Status of community container	Yes %	No %	No containers %	Count, Total %
Number	66.1	30.1	3.8	319, 100
Size	66.8	29.4	3.8	317, 100
Mechanical condition	57.4	40.4	2.2	319, 100
Location suitable	31.8	68.2	--	318, 100

The maximum walking distance to the container: The concerns of citizens about distance to the nearest SW container, 77.1% of citizens are walking less than 75 m to the nearest container, 17.6% between 76 - 150 m, 3.8% more than 150 m. According to World Health Organization (WHO) the recommended distance between the containers is 150m (WHO,1988). And the recommended walking distance to the container is 75m.

The question was: what is the maximum distance you are ready to walk to the container? The citizens had to choose one answer out of four. The answers were: less than 30m, 31-60m, 61-90m, 91-120m, and more than 120m. The results were analyzed depend on the residence location, type of work, and average monthly income. 49.5% of people are willing to walk less than 30m to the container, 40.4% between 31 - 60 m, 6.3% between 61-90m, 0.6% between 91-120m, and 3.2% more than 120m.

Table 3.21 shows that 82.35% of the city citizens are ready to walk up less than 30m to the container. In the villages this percentage reaches 50.53% and in Jenin camp it reaches 92.31%. No notable differences between the three zones. On the contrary, 62% of citizens are willing to walk between 31-60m.

Table 3.18: Residence location versus maximum walking distance to the container (count and percentage)

residence location	Maximum distance, citizens are willing to walk to the container (m)					Total
	< 30m	31-60m	61-90m	91-120m	> 120m	
Town, count	21	49	5	1	3	79
%	26.6	62.01	6.33	1.27	3.79	100
Village, count	96	72	14	1	7	190
%	50.53	37.89	7.37	0.53	3.68	100
Camp, count	12	1	0	0	0	13
%	92.31	7.69	0	0	0	100
City, count	28	6	0	0	0	34
%	82.35	17.65	0	0	0	100
Total, count	157	128	19	2	10	316
%	49.68	40.51	6.01	0.63	3.17	100

From the cross tabulation there is a statistically significant relationship between residence location and distance willing to walk to the container. Also There is a statistically significant relationship between distance willing to walk to the nearest container and (type of work, average monthly income) at significance level of 0.05.

3.4.2 Evaluation of road sweeping

It was concluded that the respondents in the district of the study area showed their satisfaction about the sweeping services since only 13.2 % of total respondents said that it is bad, and 13.2 said no road sweeping. There is a statistically significant relationship between residence location and evaluation of the cleaning of streets.

Table 3.19: Evaluation of road sweeping

evaluation of the cleaning of road in your area is	Count	Valid Percent
good	109	34.4
moderate	124	39.1
bad	42	13.2
there is no cleaning	42	13.2
Total	317	100.0

Table 3.20: Residence location versus sanitary evaluation of the cleaning of streets (count and percentage)

Residence location	Evaluation of the cleaning of streets in your area is				Total
	good	moderate	bad	there is no cleaning	
Town, count %	24 30.37	44 55.69	9 11.39	2 2.53	79 100
Village, count %	61 31.94	65 34.03	26 13.61	39 20.42	191 100
Camp, count %	11 84.62	2 15.38	0 0	0 0	13 100
City, count %	12 36.36	13 39.39	7 21.21	1 3.03	33 100
Total, count %	108 34.18	124 39.24	42 13.29	42 13.29	316 100

3.5 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. Besides, the survey, also, examined the knowledge and practice of the residents towards environmental public awareness campaigns. Tables 3.22, 3,23, 3,24 introduce these results.

Table 3.21: Residents observation around containers

Residents observation around containers	Yes %	Sometimes %	No %	Total %
annoyed by noise when evacuating container	9.8	35.2	54.9	100
bad odor	34.4	53.5	12.1	100
rodents and insects	43.1	50.9	6.0	100
container evacuated periodically	50.5	43.2	6.3	100
container always clean	26.2	55.6	18.2	100
leachate	16.2	43.0	40.7	100
burning in or around the container	16.6	44.2	39.2	100

The results showed, that majority of the respondents said that they are not annoyed by noise when evacuating container, and there is not black leachate from the container. 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 47% of the containers are not covered, the speed and direction of wind also play a role in spreading the smell. About 43.1% of the respondents said that there are rodents and insects near the containers in most times. Although 50.5% said that the container evacuated periodically, which means no accumulation of waste.

Also about 68.2% of people said it is good sanitary conditions of SW container, 29.3% said it is bad sanitary conditions, 2.5% said there are no containers. There is a statistically significant relationship between residence location and Sanitary condition of SW containers, at significance level of 0.05.

Table 3.22: Residence location versus sanitary condition of SW containers (count and percentage)

Residence location	Sanitary condition of SW container			Total
	good	bad	there is no container	
Town, count	37	42	0	79
%	46.84	53.16	0	100
Village, count	140	46	8	194
%	72.17	23.71	4.12	100
Camp, count	13	0	0	13
%	100	0	0	100
City, count	28	6	0	34
%	82.35	17.65	0	100
Total, count	218	94	8	320
%	68.13	29.37	2.5	100

3.5.1 Residents received public awareness campaigns

Citizens have great environmental awareness since 93.8% of respondents are willing to participate in voluntary cleanness campaigns. Table 3.24 showed that the biggest role in spreading awareness among the public is media and later those responsible for collecting waste, and lowest role is for school. Hence, we have to highlight the importance of focusing on the culture of environmental awareness and educate it to students from an early age.

Table 3.23: Public awareness sources that residents receive

get knowledge from	Count	Valid Percent
school study	36	11.2
media	183	57.0

SW collecting authority	61	19.0
local council and citizens	40	12.8
Total	320	100.0

3.5.2 Residents willing to work in SWM sector

60.1% of residents willing to work in SW management sector, on contrary 39.9% of them are not willing to work because of social shyness (51.2%), fear of disease (20.5%), low salary (10.2%), bad odors (9.4%),other reasons (8.7%).

From the cross tabulation there is a statistically significant relationship between residence location and willing to work in SWM sector. Also There is a statistically significant relationship between willing to work in SWM sector and (type of work, average monthly income, education level) at significance level of 0.05.

Table 3.24: Residence location versus residents willing to work in SWM sector (count and percentage)

residence location	**Residents willing to work in SW management sector**		**Total**
	Yes	No	

Town, count	57	22	79
%	72.15	27.85	100
Village, count	105	89	194
%	54.12	45.88	100
Camp, count	13	0	13
%	100	0	100
City, count	17	17	34
%	50	50	100
Total, count	192	128	320
%	60	40	100

3.5.3 Reuse and recycling concerns

This section in survey of the household questionnaire was designed to measure the practices and willingness of residents toward reuse and recycling as well as source separation. About 90.7% of the respondents said that they are willing to use materials produced from recycling SW. Table 3.26 introduces the results of a question for the reuse or sell or receive of several SW stream fractions. It was concluded that about 70% of the respondents said that they reuse or sell or receive clothes in Jenin district. 39.7 % of the respondents is selling metals to hawkers. There is a statistically significant relationship between residence location and reuse some garbage to reduce the quantity of SW. Also There is a statistically significant relationship between reuse some garbage to reduce the quantity of SW and (average monthly income, education level) at significance level of 0.05.

Table 3.25 : Did You Reuse or Sell or Receive any of the Following

	Glass bottles,	**Clothes**	**Shoes**	**Old furniture**	**Metals**

	Plastic bottles				
Yes %	27.9	70.0	57.8	65.6	39.7
Sometimes %	69.5	---	---	---	54.0
No %	2.5	30.0	42.2	34.4	6.3
count	315	320	320	320	302
Total %	100	100	100	100	100.0

On the other hand, about 76.3% of citizens of Jenin district discard leftover food with other garbage, 21.5% of citizens feed their animals of leftover food, 9% of citizens reuse leftover food as organic fertilizer, 1.3% of citizens discard leftover food in other ways. Also, about 57.8% of citizens are willing to carry out composting of the leftover food in their gardens, the rest of the citizens 42.2% are not willing to carry out composting of the leftover food in their gardens. The reasons for that are: 36% say it is difficult process, 30.1% say they have no use of the product, 22.1% say they have no time, 11.8% say they are afraid of diseases. There is a statistically significant relationship between residence location and willing to carry out composting of the leftover food in their gardens. Also there is a statistically significant relationship between willing to carry out composting of the leftover food in their gardens and (type of work, average monthly income, education level) at significance level of 0.05.

3.6 Disposal system

Most of the residents (93.1%) are willing to carry out SW classification for free, 4.1% of residents are willing to carry out SW classification; but for little amount of money. There is a

statistically significant relationship between willing to carry out SW classification and (type of work, average monthly income, education level) at significance level of 0.05.

Moreover, it was reported that 55.6% of respondents wasn't burning wastes, while 16.6% of the respondents are burning wastes, the rest are sometimes burning waste.

78.4% of the respondents said that the SWM situation in the study area is getting better after setting up ZAL, while about 14.2 % of them said that no change. It is important to underline that 7.4 of the respondents in Jenin district said that it is getting worst.

4. Chapter four: Conclusions and Recommendations

As a conclusion, 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 SWM in the study area as well as propose an ISWM system.

4.1 Collection system

The main responsible for waste collection in Jenin district is the Joint Service Council. As well as, collection service include 99% of the district citizens except some small rural “khirab” which don’t affect SWM operation in the district. Councils in Jenin district can’t develop waste sector because the budget allocated to the sector very little. Also, accumulation of debt on citizens causes accumulation of debt on councils because they pay to JSC. To resolve this issue, councils attached waste fee with electricity bill.

Only bin collection system is applied in all Jenin district, meanwhile the other two systems (door-to-door) and (curb side collection) are not applied any more in the district.

It is hard for councils to find workers to work in waste collection sector due to a lack of social awareness among people. Despite this difficulty the number of workers in the district are enough, but most of these workers don’t have good healthcare.

Containers’ volume and number are fine in most localities. There is diversity in containers scattered in terms of capacity. Because the lack of special places for containers in streets, the waste separation system can’t be applied from its source. Most citizens are satisfied with the frequency of waste collection in the district.

Average daily quantity of SW from houses in Jenin district is close to the average Palestinian household. Also, the average waste generation per capita in Jenin city is close to the average waste generation per capita in other Palestinian cities.

Regarding street sweeping the district relays on its own workers not on sweepers, this has a role in how clean are the streets, and increase the cost of operating workforce in waste sector.

There are five transfer stations in Jenin district. This number helps to achieve better waste management through decreasing expenses of transferring waste to the landfill. Vehicles movement occurs according to a study for the containers locations and locations of collection stations.

4.2 Environmental awareness

Citizens' non respond to the idea of separating waste indicate a lack of environmental awareness of the importance of this work, and its result to reduce environmental pollution, and take advantage of the materials which are separated.

Citizens don't get public awareness campaigns by those responsible for waste, also they don't promote environmental awareness in schools. Therefore, we have to highlight the importance of focusing on the culture of environmental awareness and educate it to students from an early age.

Organic fraction is considered the biggest portion that required special attraction, that organic waste has the highest percentage among SW fractions. 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, magazines, phonebooks, shredded paper… etc. By recycling paper can be produced : toilet paper, egg cartons, newspaper, phonebooks …etc. Plastic is non-biodegradable that take long time to break down, so the increased quantities of plastic is considered a growing concern. There are many products can be recycled from plastics like bags, poly vinyl chloride (PVC) sewer pipes, garden furniture…etc.

As mentioned above, the three waste fractions; organics, papers and plastic are formulating the highest percentage of the waste sector, 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 health conditions.

4.3 Integrated SWM

The application of integrated SWM in the Arab world countries facing challenges and obstacles at the technical, financial and administrative fields, exception of a few of them. And increases the difficulty of the problem is the lack of information or statistical data or accurate documented inventory on the quantities of such waste produced in these countries. Figure 4.1 show the hierarchal order to reach the integrated management of SW. In some countries, initial attempts were made to estimate the quantities of hazardous wastes by linking them with their GDP and benefit from the global statistical.

If there is difficulty in applying the methods of proper and safe management of wastes (from the cradle to the grave) as fully integrated, in some regions, cities and municipalities. So must choose and employ some elements of the task and work to integrate and integrate gradually. Sanitary landfills are a principled and effective method able to provide an alternative to

integrated waste management system and comprehensive (ARIJ, 1996; World Bank, 2004;Barton,et al, 2008).

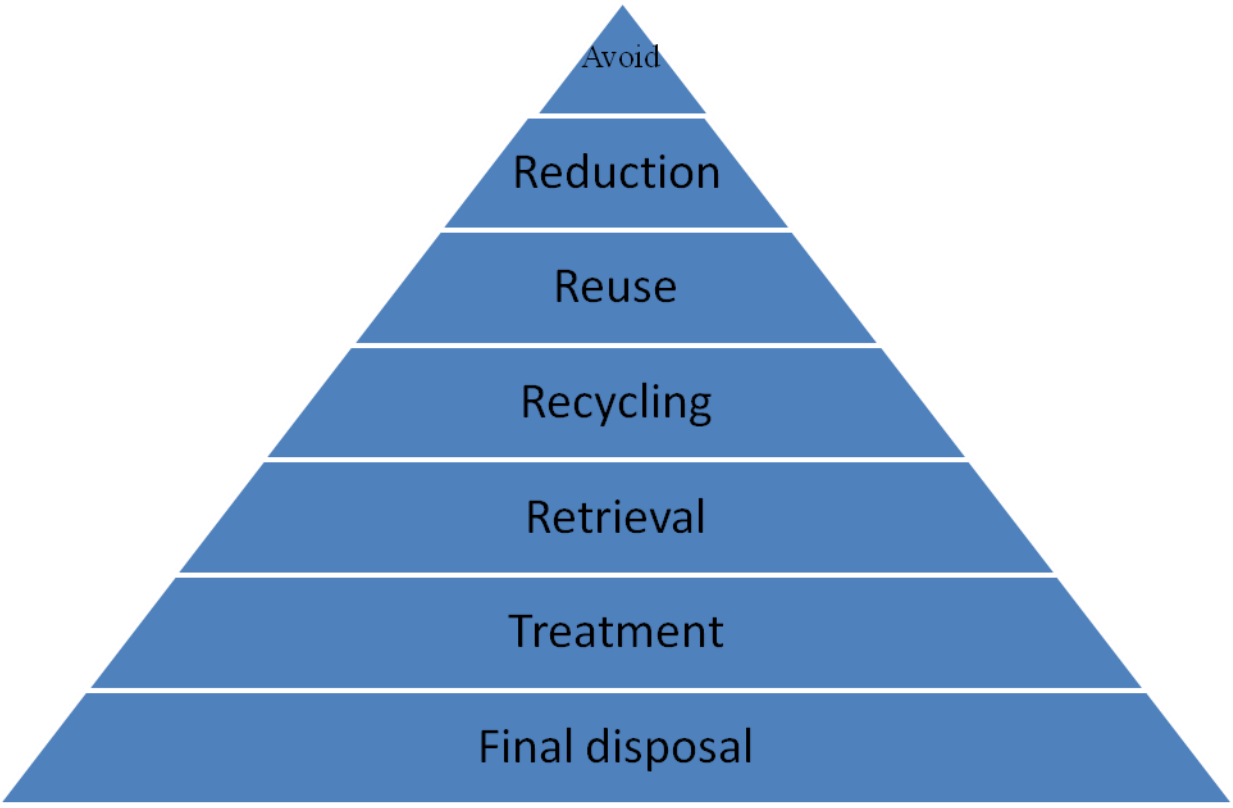

Figure 4.1 The hierarchal order to reach the integrated management of SW

4.4 The most important obstacles that hinder the councils from performing its role efficiently in Jenin district are:

The most financial and economical obstacles (from most important to less important):

1. Difficulty in getting foreign fund.
2. High cost of equipment, recycling,..
3. Lack of governmental support.
4. Low revenue of SWM.
5. Lack of efficient evaluation of SWM

The most technical and informational obstacles (from most important to less important):

1. Lack of external technical support.
2. Absence of modern equipments to deal with toxic materials from SW.
3. Absence of training and workshops.
4. Poor experience and capability of worker.
5. Absence of organized infrastructure for SWM.

The most physical obstacles (from most important to less important):

1. Unsuitable distribution of containers in areas.
2. Improper location of containers in streets.
3. Shortage in transfer station.

4.5 Recommendations

Based on the above conclusions and the whole study, many recommendations can be drawn.

1. There is a need for building regulatory System. This system should concern with developing SW laws and regulations. Also, there is a need to establish a monitoring and data base system for the SW sector.
2. Increased financial support for SWM sector.
3. Increased of technical support and training and workshops for the workers.
4. Construction suitable infrastructure to serve the SWM sector such as, allocated proper places to put containers in street, proper location to put containers for waste separation from houses.

5. Medical and industrial waste should be collected separately in special containers, also dispose it separately away of municipal waste.
6. 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.
7. Cleaner production principle: reducing waste rather than manage means waste reduction at source either for residential, commercial, industrial or agricultural. This is can be achieved through the application of fee structure.
8. Transfer the know-how to residents gradually for source separation after conducting relevant awareness rising and environmental education. Encourage source separation by conducting economic incentives through local markets and buying the recyclable materials from the residents.
9. Consider composting alternative since the organic fraction forms the highest percentage among SW and the study area includes large scale of agricultural lands.
10. Detailed and general terms should be placed regarding safety and professional health of everything related to work in SWM , and checking environmental requirements, health and safety of workers.
11. Need to clarify the execution of national plans more clearly than it is by special authorities, so clearly shows specialization of each authority, as well as clarify the roles between the Environmental Quality Authority and the Ministry of Local Government and activate their respective capabilities to carry out the planning process, each according to its competence

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INTERVIWES

1- Eng Hani shwahnah, Manager of ZAL, 5/2012

3- Eng. Mohammed Al Sa'di, the responsible Engineer of ZAL, 5/2012.

6. Appedices

Appendix A: Distribution of household survey

	Locality Name	Population	Locality Type	No. of questionnaires
1	Silat al Harithiya	10060	Town	12
2	Al Yamun	17493	Town	20
3	Barta'a Asharqiy	4459	Town	5
4	Jenin	41646	City	49
5	Birqin	6070	Town	7
6	Ya'bad	14564	Town	17
7	Qabatiya	20497	Town	24
8	Arraba	10592	Town	12
9	Kafr Ra'i	7863	Town	9
10	Meithalun	7426	Town	9
11	Jaba'	9067	Town	11
12	Silat adh Dhahr	6186	Town	7
13	Kafr Dan	5497	Rural	6
14	Zububa	2065	Rural	2
15	Rummana	3353	Rural	4
16	Ti'innik	1068	Rural	1
17	At Tayba	2301	Rural	3
18	Arabbuna	865	Rural	1
19	Al Jalama	2200	Rural	3
20	Anin	3941	Rural	5
21	Arrana	2131	Rural	3
22	Deir Ghazala	956	Rural	1
23	Faqqu'a	3702	Rural	4
24	Umm ar Rihan	395	Rural	1
25	Khirbet 'Abdallah alunes	147	Rural	0
26	Dhaher al Malih	211	Rural	0
27	Al 'Araqa	2307	Rural	3
28	Beit Qad	1545	Rural	2
29	Tura al Gharbiya	980	Rural	1
30	Tura ash Sharqiya	186	Rural	0
31	Al Hashimiya	1122	Rural	1
32	Nazlat ash Sheikh	752	Rural	1
33	At Tarem	394	Rural	0
34	Jalbun	2552	Rural	3
35	Aba	218	Rural	0
36	Kafr Qud	1220	Rural	1
37	Deir Abu Da'if	5949	Rural	7

38	Umm Dar	595	Rural	1
39	Al Khuljan	543	Rural	1
40	Wad ad Dabi'	439	Rural	1
41	Dhaher al 'Abed	388	Rural	1
42	Zabda	1008	Rural	1
43	Kufeirit	2569	Rural	3
44	Imreiha	452	Rural	1
45	Umm at Tut	1056	Rural	1
46	Ash Shuhada	1866	Rural	2
47	Jalqamus	2127	Rural	3
48	Al Mughayyir	2,584	Rural	3
49	Al Mutilla	315	Rural	0
50	Bir al Basha	1396	Rural	2
51	Telfit	254	Rural	0
52	Mirka	1720	Rural	2
53	Wadi Du'oq	131	Rural	0
54	Fahma al Jadida	394	Rural	1
55	Raba	3358	Rural	4
56	Al Mansura	185	Rural	0
57	Misliya	2550	Rural	3
58	Az Zababida	3913	Rural	5
59	Fahma	2654	Rural	3
60	Az Zawiya	822	Rural	1
61	Sir	794	Rural	1
62	Ajja	5260	Rural	6
63	Anza	2000	Rural	2
64	Sanur	4342	Rural	5
65	Ar Rama	1029	Rural	1
66	Al Judeida	5059	Rural	6
67	al 'Asa'asa	495	Rural	1
68	Al 'Attara	1238	Rural	1
69	Siris	5217	Rural	6
70	Al Fandaqumiya	3631	Rural	4
71	Jenin Camp	11573	Camps	13
	Total	**273937**		320

Appendix B: Stakeholder questionnaire

تحية طيبة وبعد،
يقوم البحث بإجراء دراسة لمتطلب رسالة الماجستير في تخصص علوم المياه والبيئة التابع لمعهد الدراسات البيئية والمائية في جامعة بيرزيت، وهي بعنوان (تقييم إدارة النفايات البلدية الصلبة في محافظة جنين). النتائج في هذا البحث تخص أغراض البحث العلمي، ونظمن لكم السرية التامة، وشكرا لحسن تعاونكم.

اليوم:	**التاريخ:**	**رقم الإستبانة:**

معلومات عامة عن المؤسسة:

V01	☐	اسم التجمع السكاني:.....
V02	☐	تصنيف المؤسسة: ١. بلدية ٢.مجلس قروي ٣. مخيم ٤. غير ذلك حدد.....
V03	☐	العنوان:
V04	☐	التلفون/ فاكس:
V05	☐	نسبة عدد السكان الذين تصلهم خدمة جمع النفايات.....%

معلومات تتعلق بالأنظمة والقوانين:

V06	☐	هل هنالك قوانين واضحة للمواطنين تتعلق بإدارة النفايات الصلبة في المحافظة: 1. نعم ٢. لا
V07	☐	هل تفرض الجهات المسئولة عن إدارة البيئة قوانين خاصة بالتعامل مع النفايات الصلبة الناتجة ؟ ١) نعم ٢) لا
V08	☐	هل توجد جهة رسمية تتابع موضوع إدارة المخلفات الصلبة معكم؟ ١) نعم دائما ٢) أحيانا ٣) لا
V09	☐	في حال وجود هذه الجهات هل هناك عقوبات معينة في حالة عدم التقيد بالتعليمات؟ ١) نعم دائما ٢) أحيانا ٣) لا
V10	☐	هل ترى ضرورة وجود قوانين خاصة بإدارة النفايات الصلبة؟ 1) نعم ٢) لا

معلومات تتعلق بالأمور المالية:

V١1	☐	ما هي النسبة المئوية للسكان الملتزمين بدفع الرسوم الخاصة بالنفايات الصلبة.....%
V12	☐	طريقة تحصيل رسوم جمع النفايات. ١.على كل فرد ٢. على كل منزل ٣. على كل عائلة
V13	☐	كم تبلغ قيمة هذه الرسوم من الأسرة بالشيكل.....في الشهر
V14	☐	كم تبلغ النسبة المئوية للميزانية المخصصة لقطاع إدارة النفايات الصلبة من الموازنة العامة السنوية؟.....%
V15	☐	كم تبلغ التكاليف الشهرية لقطاع إدارة النفايات الصلبة(موظفين، معدات، تخلص نهائي،...)؟.....شيكل
V16	☐	هل تشعر بأن الموازنة المخصصة لإدارة النفايات الصلبة مناسبة؟ ١. نعم ٢. أحيانا ٣. لا

العاملين في مجال إدارة النفايات:

V17	☐	هل تجدون عمال بسهولة للعمل في قسم النفايات عند الحاجة: ١. نعم ٢. لا
V18	☐	إذا كان الجواب لا فما هو السبب.....

V19	☐	عدد العاملين في مجال النفايات التابعين للتجمع السكاني	العدد	عدد ساعات العمل	الراتب الشهري
		إداري			
		مفتش			

		عامل جمع قمامة			
		عامل تكنيس شوارع			
		سائق			
		غير ذلك حدد			
		المجموع			
V20	☐	هل هذا العدد كافي: ١. نعم ٢. لا			
V21	☐	كم يبلغ متوسط أجور عمال النفايات في بلدتكم.....شيكل \شهر			
V22	☐	أيام عمل الموظفين في الأسبوع: ١. ٧ أيام ٢. ٦ أيام ٣. ٥ أيام ٤. ٤ أيام أو أقل			
V23	☐	فترة دوام العاملين في هذا المجال ١. فترة صباحية فقط ٢. فترة مسائية فقط ٣. الفترتين معا			
V24	☐	في أيام العطل الرسمية من يقوم بجمع النفايات: ١. نفس العمال بأجر إضافي ٢. التناوب في العمل ٣. لا تجمع			
V25	☐	يلبس العمال ملابس واقيه: ١. نعم دائما ٢. أحيانا ٣. لا			
V26	☐	يتم تلقيح العمال ضد الأمراض مثل التيفؤيد والكزاز وغيرها: ١. نعم دائما ٢. أحيانا ٣. لا			
V27	☐	يتم توعية العمال بمبادئ السلامة المهنية و آلية التعامل مع النفايات . ١. نعم ٢. لا			
V28	☐	يتم توفير التدريب المناسب للعمال بما يتناسب مع طبيعة عملهم وعلاقتهم بالنفايات و الأخطار الناشئة ؟ ١. نعم دائما ٢. أحيانا ٣. لا			
V29	☐	يتم تطبيق قوانين السلامة المهنية والصحية الموضوعة من قبل الجهات المختصة؟ ١. نعم دائما ٢. أحيانا ٣. لا			
V30	☐	إذا كان الجواب لا. أرجو توضيح السبب ؟			
V31	☐	هل يتوفر كتيب يشمل إرشادات وتعليمات للعاملين للوقاية و المعالجة في حالة حدوث حادث؟ ١. نعم دائما ٢. أحيانا ٣. لا			
التخزين المؤقت للنفايات والمركبات المستخدمة لجمع ونقل النفايات:					
V32	☐	عدد الحاويات الموزعة لجمع النفايات والتي تعود ملكيتها للمؤسسة: ١. أقل من ٥٠ حاوية ٢. ٥٠-١٠٠ حاوية ٣. ١٠١-٢٠٠ حاوية ٤. أكثر من ٢٠٠ حاوية			
V33	☐	هل هذا العدد كافي ويفي بالغرض: ١. نعم دائما ٢. أحيانا ٣. لا			
V34	☐	إذا كان الجواب لا فما المانع من زيادة عدد الحاويات:			

V35	☐	يوجد هناك مكان مخصص لوضع الحاويات في الشارع: ١. نعم ٢. لا
V36	☐	يوجد للحاويات أغطية: ١. كلها ٢. معظمها ٣. لا يوجد
V37	☐	حجم الحاويات الموجودة مناسب لحجم النفايات المنتجة من المنازل: ١. نعم دائما ٢. أحيانا ٣. لا
V38	☐	إذا كان الجواب لا فأين يضع المواطنون الفائض من النفايات: .....

V39 ☐

نوع الحاويات التي تستخدم للتخزين المؤقت للنفايات الصلبة :	الحجم ($م^3$)	العدد	معدني- بلاستيكي
١. أكوام مفتوحة للهواء			
٢. حاويات سعة ١$م^3$			
٣. حاويات سعة 4$م^3$			
٤. حاويات سعة ٣٠$م^3$			
٥. حاويات باطون			
٦. براميل			
٧. أكياس بلاستيكية			
٨. غير ذلك، حدد ----------			

V40	☐	يتوفر للمواطنين حاويات مخصصة لفصل النفايات: ١. نعم ٢.في بعض المناطق ٣. لا
V41	☐	إذا كان الجواب لا فالسبب هو: ١. عدم قدرة المؤسسة على توفير حاويات مخصصة لفصل النفايات. ٢. عدم استجابة المواطنين لفكرة فصل النفايات من المصدر. ٣.عدم وجود مكان مخصص لوضع تلك الحاويات. ٤. غير ذلك حدد.....
V42	☐	هل يوجد حاويات مستخدمة في تخزين النفايات تعود ملكيتها للمواطنين: ١. نعم ٢. لا
V43	☐	هل يوجد نظام لصيانة الحاويات؟ ١) نعم ٢) لا
V44	☐	هل يوجد محطات ترحيل لنقل النفايات إليها قبل التخلص النهائي منها ١. نعم ٢. لا
V45	☐	إذا كان الجواب نعم فكم عددها.....
V46	☐	أين تقع محطات الترحيل لنقل النفايات إن وجدت:

		١. بين المنازل ٢. قريبه من المناطق السكنية ٣. بعيدة عن المناطق السكنية
V47	☐	هل يوجد طرق معبدة تصل إلى تلك المحطات: ١. نعم لكلها ٢. لمعظمها ٣. ولا لواحدة منها
V48	☐	هل يوجد حيوانات ضالة كالكلاب والقطط في أماكن تجميع النفايات المؤقتة (الحاويات) أو بالقرب منها؟ ١) نعم دائما ٢) أحيانا ٣) لا
V49	☐	هل تلاحظ وجود روائح كريهة أو حشرات أو قوارض بسبب النفايات الصلبة المجمعة في الحاويات قبل نقلها؟ ١) نعم دائما ٢) أحيانا ٣) لا
V50	☐	هل صدرت شكاوى من المجاورين للحاويات: ١) نعم دائما ٢) أحيانا ٣) لا
V51	☐	ما هي المعايير التي يتم من خلالها اختيار المركبات المستخدمة لنقل النفايات: ١. كمية النفايات ٢. عرض الطريق. ٣. حالة المرور ٤. الوضع المادي للمؤسسة ٥. كل ما ذكر ٦.غير ذلك حدد .....
V52	☐	ما هي المعايير التي يتم من خلالها اختيار عدد المركبات: ١. كمية النفايات ٢. مساحة المنطقة التي يتم فيها الجمع ٣. الوضع المادي للمؤسسة ٤. كل ما ذكر ٥. غير ذلك حدد.....
V53	☐	المركبات التي تنقل النفايات لها أغطيه: ١. كلها ٢. معظمها ٣. لا يوجد
V54	☐	تقوم المؤسسة بعمل صيانة دورية لمركبات نقل النفايات: ١. نعم ٢. لا
V55	☐	هل حصل تكسير للطرق ناتج عن حركة مركبات جمع النفايات؟ ١. نعم ٢. لا
V56	☐	كيف تم اعتماد خط سير سيارة النفايات أثناء عملية الجمع؟ ١. عشوائيا ٢. بناء على دراسة ٣. حسب كمية النفايات ٤. غير ذلك حدد.....

V57	☐	نوع المركبات المستخدمة لجمع ونقل النفايات	عدد	السعة($م^3$)	الحالة: (١)جيدة (٢) متوسطة (٣) سيئة	١) ملك ٢)مستأجرة
		١. عربات يدوية				
		٢. عربات تجر بواسطة حيوانات				
		٣. تراكتور				
		٤. شاحنات كبيرة				
		٥. شاحنات مخصصة لنقل النفايات				
		٦. سيارات ضاغطة				

		٧. غير ذلك حدد				
		٨. المجموع				
V٥٨	☐	نوع المركبات التي انتم بحاجة لها زيادة عن المتوفر لديكم لجمع ونقل النفايات	عدد	السعة(م^3)	الحالة: (١)جيدة (٢) متوسطة (٣) سيئة	١) ملك ٢)مستأجرة
		١. عربات يدوية				
		٢. عربات تجر بواسطة حيوانات				
		٣. تراكتور				
		٤. شاحنات كبيرة				
		٥. شاحنات مخصصة لنقل النفايات				
		٦. سيارات ضاغطة				
		٧. غير ذلك حدد				
		٨. المجموع				

نوع وحجم وتجميع النفايات:

V59	☐	كم تبلغ كمية النفايات التي تجمع يوميا ..... كغم
V٦٠	☐	كم مرة يتم جمع النفايات المنزلية في الأسبوع: ١. يوميا ٢. مرتين في الأسبوع ٣. مرة في الأسبوع ٤. غير ذلك
V٦١	☐	هل عدد هذه المرات كافي ١. نعم ٢. لا
V٦٢	☐	إذا كان الجواب لا فهل السبب: ١. نقص في عدد العمال ٢. نقص في عدد المركبات ٣. كلاهما ٤. غير ذلك حدد.....
V٦٣	☐	كم تبلغ النسبة المئوية للسكان المخدومين بجمع النفايات الصلبة في التجمع السكاني.....%
V٦٤	☐	يتم جمع النفايات بناء على: ١. كمياتها ٢. بشكل دوري ٣. بعد أن تتكدس وتسبب مشاكل ٤. غير ذلك حدد.....
V٦٥	☐	كيف يتم تحميل النفايات المجمعة في أماكن التجميع إلى سيارات النقل؟ ١) آليا ٢) يدويا
V٦٦	☐	هل يتم مراقبة آلية جمع ونقل النفايات؟ ١. نعم ٢. لا
V٦٧	☐	هل يتم جمع النفايات الصناعية والنفايات الطبية مع النفايات المنزلية: ١. نعم ٢. لا

V68	☐	هل يوجد للنفايات الصناعية والطبية مركبات خاصة لنقلها: ١. نعم ٢. لا
V69	☐	هل تقوم المستعمرات المجاورة للمحافظة بوضع نفاياتها داخل أراضي المحافظة: ١. نعم ٢. لا
V٧٠	☐	إذا كان الجواب نعم فهل تجمع من قبل المؤسسة: ١. نعم ٢. لا
V٧١	☐	إذا كان الجواب نعم فكم تبلغ كميتها: ..... طن/سنة
المعالجة و المعاملة والتخلص النهائي من النفايات:		
V٧٢	☐	هل يتم معالجة النفايات بعد جمعها و قبل التخلص النهائي منها ١. نعم دائما ٢ . أحيانا ٣. لا
V٧٣	☐	إذا كان الجواب نعم، ما هي طرق المعالجة المستخدمة ١. التنظيف ٢.الفصل و الفرز ٣. فصل المركبات الخطرة فقط ٤. تقليل الحجم ٥. التدوير ٦. إعادة الاستخدام ٧. غير ذلك، حدد ----------
V٧٤	☐	كيف يتم التخلص النهائي من النفايات الصلبة: ١. رميها بصورة عشوائية ٢.طمرها في مكبات خاصة ٣.مكبات عشوائية ٤. حرقها بصورة عشوائية ٥. حرقها بصورة منظمة ٦. غير ذلك حدد.....
V٧٥	☐	كيف يتم التخلص من النفايات في المناطق التي لا يتم فيها جمع النفايات: ١. طمر في الفناء الخلفي للمنزل ٢. وضعها في حفرة مفتوحة خلف المنزل ٣. رميها في مناطق عشوائية ٤. حرقها ٥. غبر ذلك حدد.....
V٧٦	☐	هل تقوم المؤسسة بتشجيع الناس على استخدام مواد صديقة للبيئة: ١. نعم ٢. لا
V٧٧	☐	إذا كان الجواب نعم فما هي الطريقة المستخدمة لذلك: ١. نشرات توعية ٢. ندوات ٣. من خلال وسائل الإعلام ٤. غير ذلك حدد.....

أهم العقبات التي تعيق إدارة النفايات الصلبة بشكل فعال:

V٧٨		ما هي أهم العقبات المتعلقة بالنواحي المالية والاقتصادية التي تمنع أو تعيق المؤسسة من القيام بدورها بشكل فعال:	١.نعم	٢.لا
V٧٨a	☐	عدم وجود دعم من قبل الدولة لقطاع إدارة النفايات الصلبة		
V٧٨b	☐	صعوبة الحصول على تمويل خارجي		
V٧٨c	☐	ارتفاع تكلفة كل من(المعدات، طرق المعالجة الآمنة، طرق تدوير النفايات)		
V٧٨d	☐	.ضعف العوائد المالية لإدارة النفايات الصلبة		

V٧٨e	☐	.عدم وجود تقييم فعال للأداء المالي لإدارة النفايات الصلبة		
V٧٩		ما هي أهم العقبات المتعلقة بالنواحي التقنية والمعلوماتية التي تمنع أو تعيق المؤسسة من القيام بدورها بشكل فعال:	١.نعم	٢.لا
V٧٩a	☐	خبرة وقدرة العمال محدودة في مجال معالجة النفايات الصلبة		
V٧٩b	☐	عدم الحصول على الدعم التقني الخارجي		
V٧٩c	☐	عدم وجود معدات وأجهزة حديثة لجمع ونقل ومعالجة والتحكم في المواد الضارة الناتجة عن النفايات الصلبة		
V٧٩d	☐	عدم وجود بنية تحتية منظمة لإدارة النفايات الصلبة		
V٧٩e	☐	نقص التدريب العملي وورش العمل		
V٨٠		ما هي أهم العقبات المتعلقة بالنواحي الفيزيائية التي تمنع أو تعيق المؤسسة من القيام بدورها بشكل فعال:	١. نعم	٢.لا
V8٠a	☐	عدم وجود أراضي كافية لعمل مكبات صحية وذلك بسبب الاحتلال الإسرائيلي		
V8٠b	☐	نقص في الطرق المعبدة التي تصل إلى مكبات النفايات		
V8٠c	☐	عدم وجود إدماج للحاويات في الشارع بحيث لا تؤثر على حركة السير		
V8٠d	☐	التوزيع المكاني للحاويات لا يأخذ بين الاعتبار المستوى المعيشي وكمية النفايات الناتجة في الاعتبار		
V8٠e	☐	نقص في محطات التجميع التي تحد من تكاليف النقل		
V8١	☐	ما هي اقتراحاتكم لتحسين وضع إدارة النفايات الصلبة في تجمعكم السكاني؟ ١. ٢. ٣.		

Appendix C: Household questionnaire

Institute for Water Studies
Collaborative Center of UNESCO-IHE Institute for Water Education
P. O. Box 14, Birzeit / West Bank / Palestine
Tel/Fax: +970 2 298 2120
Email: iws@birzeit.edu

جامعة بيرزيت
BIRZEIT UNIVERSITY
معهد الدراسات المائية

تحية طيبة وبعد،
يقوم البحث بإجراء دراسة لمتطلب رسالة الماجستير في تخصص علوم المياه والبيئة التابع لمعهد الدراسات البيئية والمائية في جامعة بيرزيت، وهي بعنوان (تقييم إدارة النفايات البلدية الصلبة في محافظة جنين). النتائج في هذا البحث تخص أغراض البحث العلمي، ونظمن لكم السرية التامة، وشكرا لحسن تعاونكم.

اليوم:	**التاريخ:**	**رقم الإستبانة:**

معلومات تتعلق بالمجيب عن الأسئلة:

V01	☐	اسم التجمع السكاني (اسم القرية أو المدينة) وليس الحي:.....
V02	☐	مكان سكن المجيب عن الأسئلة: ١. مدينة ٢. قرية ٣. مخيم ٤. بلدة
V03	☐	الجنس: ١. ذكر ٢. أنثى
V04	☐	المنزل: ١. مستقل ٢. شقة في عمارة
V05	☐	عدد المقيمين في المنزل.....
V06	☐	نظام العمل الحالي: ١. تعمل لحسابك الخاص ٢. موظف ٣. مزارع 4. عاطل عن العمل
V07	☐	معدل الدخل الشهري لجميع المقيمين في المنزل: ١. أقل من ١٥٠٠ شيكل ٢. ١٥٠٠-٣٠٠٠ شيكل ٣. ٣٠٠١-٦٠٠٠ شيكل ٤. أكثر من ٦٠٠٠ شيكل
V08	☐	ما اسم الجهة المسئولة عن جمع النفايات في منطقة سكنك؟.....
V09	☐	المستوى التعليمي للمجيب عن الأسئلة: ١. أمي ٢. ابتدائي ٣. إعدادي ٤. ثانوي ٥. تعليم عالي
V10	☐	ما هو من العوامل التالية تعتقد أنها أكبر مشكلة في مدينتك؟ ١. السلامة والأمن ٢. المياه ٣. إدارة النفايات الصلبة ٤. جمع المياه العادمة ٥. التلوث الضوضائي ٦.ازدحام المرور ٧.مشاكل صحية
V11	☐	بعد منزلك عن اقرب مكب أو أقرب محطة تجميع النفايات: ١. أقل من أو يساوي 200m ٢. أكثر من 200m

معلومات تتعلق بخدمة جمع النفايات في منطقة سكنك:		
V12	☐	كم تبلغ قيمة هذه الرسوم.....شيكل/شهر
V13	☐	كيف تدفع الرسوم؟ ١. بشكل منفصل ٢. مع فاتورة الماء ٣. مع فاتورة الكهرباء ٤.غير ذلك حدد.....
V14	☐	ما أعلى حد للرسوم تستطيع دفعها(بالشيكل) شهريا في حال تحسين خدمة جمع النفايات ونقلها؟ ١. أقل من ١٠ ٢. ١١-٢٠ ٣. ٢١-٣٠ ٤. ٣١-٤٠ ٥. أكثر من ٤٠
V15	☐	مسافة أقرب حاوية إلى المنزل (بالمتر): ١. أقل من ٧٥ متر ٢. ٧٦-١٥٠ ٣. أكثر من ١٥٠ ٤. لا يوجد حاوية
V16	☐	كم يقدر معدل وزن النفايات الصلبة من المنزل يوميا.....كغم
V17	☐	هل عدد الحاويات في منطقتك متناسب مع كمية النفايات المنتجة: ١. نعم ٢. لا ٣. لا يوجد حاويات
V18	☐	حجم الحاوية الموجودة مناسب لحجم النفايات المنتجة من المنازل المجاورة لها: ١. نعم ٢. أحياناً ٣. لا ٤. لا يوجد
V19	☐	إذا كان الجواب لا فأين يضع المواطنون الفائض من النفايات: .....
V20	☐	من الذي يقوم عادة بإلقاء النفايات في الحاوية أو غيرها: ١. الأب ٢. الأم ٣. الأبناء ٤.جميع ما ذكر ٥. غير ذلك حدد.....
V21	☐	ما هي المسافة بالمتر التي أنتم مستعدون لقطعها لإيصال النفايات إلى الحاوية: ١. أقل من ٣٠ ٢. ٣١-٦٠ ٣. ٦١-٩٠ ٤. ٩١ -١٢٠ ٥. أكثر من ١٢٠
V22	☐	أكثر مبلغ شهري مستعد لدفعه مقابل خدمة أخذ النفايات من المنزل.....شيكل
V23	☐	يتم جمع النفايات من قبل الجهة المسئولة في منطقتك: ١. يوميا ٢. مرتين في الأسبوع ٣. مرة في الأسبوع ٤. لا تجمع ٥. غير ذلك حدد.....
V24	☐	هل أنت راض عن وتيرة جمع النفايات: ١. دائماً ٢. غالبا ٣. أحياناً ٤. نادرا
V25	☐	هل أنت مستعد لدفع غرامة مالية إذا قمت بتلويث البيئة: ١. نعم ٢. لا
V26	☐	هل أنت مستعد للمشاركة في حملات تطوعية للنظافة: ١. نعم ٢. لا
V27	☐	إذا كان الجواب لا اذكر السبب.....
V28	☐	هل تقبل أن تعمل في وظيفة تتعلق بإدارة النفايات(جمع، نقل، معالجة...الخ) ١. نعم ٢. لا

V29	☐	إذا كان الجواب لا فالسبب هو: ١. تدني الراتب ٢. خجل اجتماعي ٣. خوفا من الأمراض ٤. الرائحة الكريهة ٥. غير ذلك حدد.....
V30	☐	كيف تقيم تكنيس وتنظيف الشوارع في منطقة سكنك؟ ١. جيد ٢. متوسط ٣.سيء ٤. لا وجود له
V31	☐	وضع الحاويات من ناحية ميكانيكية: ١. جيدة ٢. ليست جيدة ٣. لا يوجد حاوية
V32	☐	وضع الحاوية القريبة من ناحية صحية: ١. مقبولة ٢. غير مقبولة ٣. لا يوجد حاوية قريبة
V33	☐	يوجد هناك مكان مخصص لوضع الحاويات في الشارع: ١. نعم ٢. لا
V34	☐	يوجد للحاوية القريبة من منزلك غطاء: ١.نعم ٢. لا ٣. لا يوجد حاوية
V35	☐	هل لديك استعداد لفرز النفايات المنزلية الناتجة إلى خمسة أنواع رئيسية هي: الزجاج، البلاستيك ، المعادن ، الورق، المواد العضوية .وذلك إذا طلب منك ذلك من خلال توزيع أكياس ذات ألوان خاصة ليدل على نوع ما بداخلها من نفايات لأغراض الاستفادة من المخلفات: ١. نعم مجانا ٢. نعم مقابل أجر رمزي ٣. لا
V36	☐	إذا كان الجواب لا اذكر السبب.....
V37	☐	كيف تتخلص من بقايا الطعام: ١. توضع مع النفايات الأخرى ٢. إعادة استخدام كسماد عضوي ٣. تستخدم طعام للحيوانات ٤. غير ذلك حدد.....
V38	☐	هل لديك الاستعداد لإجراء عملية التذبيل في حديقة المنزل (تحويل بقايا الطعام ومخلفات الحديقة إلى سماد عضوي)في حال تدربكم على عمل ذلك: ١. نعم ٢. لا
V39	☐	إذا كان الجواب لا فالسبب هو: ١.ليس لدي أي استخدام لها ٢.عملية صعبة ٣.أخاف من الأمراض ٤.ليس لدي وقت لذلك
V40	☐	هل الحاوية المستخدمة لجمع النفايات عند منزلك: ١. ملك للجهة التي تجمع النفايات ٢. ملك خاص ٣. ملك لمجموعة مواطنين ٤.لا يوجد حاوية
V41	☐	المركبات التي تنقل النفايات من منطقة سكنك لها أغطيه: ١. كلها ٢. معظمها ٣. لا يوجد لها أغطية ٤. لا تصلك خدمة جمع النفايات
V42	☐	هل تعيد استخدام بعض النفايات مثل(العبوات الفارغة البلاستيكية أو الزجاجية) لتقلل من كمية النفايات الناتجة؟ 1. نعم ٢. أحيانا ٣. لا
V43	☐	إذا كان الجواب لا اذكر السبب:.....
V44	☐	هل تعرف مخاطر حرق البلاستيك ١. نعم ٢. لا

V45	☐	هل تقبل استخدام مواد ناتجة من إعادة تدوير النفايات الصلبة: ١. نعم ٢. لا		
V46	☐	هل تقوم ببيع النفايات المعدنية (حديد، نحاس، ألمونيوم) إلى الباعة المتجولين: ١. نعم ٢.أحيانا ٣. لا		
V47	☐	هل في أي وقت مضى أعدت استخدام، بعت، أعطيت هدايا أي مما يلي من الأشياء القديمة التالية؟	١. نعم	٢. لا
V47a	☐	ملابس		
V47b	☐	أحذية		
V47c	☐	أثاث قديم		
V47d	☐	أدوات كهربائية		
V47e	☐	غير ذلك حدد.....		
V48	☐	هل تقوم بتجفيف غصون الأشجار وسيقانها لغرض التدفئة: ١. نعم ٢. أحياناً ٣. كلا		
V49	☐	هل تقوم بحرق النفايات: ١. نعم ٢. أحياناً ٣. لا		
V50	☐	هل تقوم باستخدام النفايات للتدفئة (الورق، البلاستيك، مخلفات المطبخ...): ١. نعم ٢. أحياناً ٣. لا		

			١. نعم دائماً	٢. أحياناً	٣. لا
V51a	☐	هل توجد حاوية لجمع النفايات			
V51b	☐	هل بعد الحاوية مناسب			
V51c	☐	هل تتضايق من الإزعاج الصوتي عند تفريغ الحاوية			
V51d	☐	هل في معظم الأوقات تكون هنالك رائحة كريهة من الحاوية			
V51e	☐	هل في معظم الأوقات يوجد حشرات و قوارض بالقرب من الحاوية			
V51f	☐	هل يتم تفريغ الحاوية بشكل دوري			
V51g	☐	هل الحاوية دائماً تكون نظيفة			
V51h	☐	هل تتسرب مياه سوداء من الحاوية على الأرض			
V51i	☐	هل يحدث في بعض الأحيان حريق داخل أو حول الحاوية			

V52		أي من هذه العوامل التي قد تكون مساهمة في تدهور إدارة النفايات، وإلى أي درجة؟	١. كثير	٢. وسط	٣. قليل	٤. ليس له علاقة
V52a	☐	الجهات التنظيمية المسؤولة				
V52b	☐	الأمور المالية				
V52c	☐	لا يوجد تعاون من السكان				
V52d	☐	عدم وجود الوعي العام				
V52e	☐	القدرات البشرية والتقنية				
V52f	☐	الحالة السياسية				
V53	☐	هل المنتزهات والأماكن الترفيهية نظيفة: ١. نعم دائما ٢. أحيانا ٣. لا				
V54	☐	إذا كان الجواب لا فالسبب هو: ١. من المواطنين ٢. لا تصلها خدمة جمع النفايات ٣. غير ذلك حدد.....				
V5o	☐	ما هي الطريق الأفضل في رأيك للتخلص من النفايات: ١. فرزها لإعادة الاستخدام والتصنيع ٢. حرقها ٣. نقلها لاماكن بعيد عن السكان ٤. طمرها في مكبات صحية				
V56	☐	ما هو تقييمك لحالة إدارة النفايات الصلبة في منطقتك بعد إنشاء مكب زهرة الفنجان:١.تحسن الوضع ٢.صار أسوء ٣. لم يتغير				
V57	☐	في رأيك هل يؤثر المكب على صحة المجتمع: ١. نعم ٢. لا				
V58	☐	هل تنزعج من صوت المعدات التي تعمل في المكب: ١. نعم ٢. لا				
V59	☐	من أين تحصل على معلوماتك حول تحقيق سبل النظافة والإدارة المثلى لإدارة النفايات: ١. المدارس ٢. وسائل الإعلام ٣. المؤسسة التي تجمع النفايات في منطقتك ٤. غير ذلك حدد				
V60	☐	ما هي اقتراحاتك لتحسين إدارة النفايات الصلبة بالشكل الأمثل في منطقتك:				

Appendix D: Zahret AlFenjan Landfill

معلومات تتعلق بمكب زهرة الفنجان :

اسم المجيب عن الأسئلة:	المسمى الوظيف له:
اسم المشروع:	
العنوان:	الموقع الجغرافي:
التلفون/ فاكس:	
تاريخ إنشاء المكب:	تاريخ بدء العمل:
عدد أيام العمل السنوية:	
عدد الموظفين الكلي:	
عدد العاملين في مجال إدارة النفايات الصلبة:	
من هم أعضاء مجلس الخدمات المشترك:	
المحافظات التي يغطيها المكب:	
كم تبلغ النسبة المئوية للميزانية المخصصة لقطاع إدارة النفايات الصلبة من الموازنة العامة للدولة؟.....%	
كم بلغت التكلفة الكلية للمشروع:	
هل تحصلون على دعم خارجي: ١. نعم	٢. لا
المساحة الكلية للمكب:	المساحة المستغلة:

الأنظمة والقوانين:				
١	هل تفرض الجهات المسئولة عن إدارة البيئة قوانين خاصة بالتعامل مع النفايات الصلبة؟ ١) نعم ٢) لا			
٢	هل توجد جهة رسمية تتابع موضوع إدارة المخلفات الصلبة معكم؟ ١) نعم دائما ٢) أحيانا ٣) لا			
٣	في حال وجود هذه الجهات هل هناك عقوبات معينة في حالة عدم التقيد بالتعليمات؟ ١) نعم دائما ٢) أحيانا ٣) لا			
٤	يتم توعية العمال بمبادئ السلامة المهنية و آلية التعامل مع النفايات. ١. نعم ٢. لا			
٥	يلبس العمال ملابس واقيه: ١. نعم ٢. لا			
٦	يتم تلقيح العمال ضد الأمراض مثل اليفويد والكزاز وغيرها: ١. نعم ٢. لا			
٧	يتم توفير التدريب المناسب للعمال بما يتناسب مع طبيعة عملهم وعلاقتهم بالنفايات و الأخطار الناشئة ؟ 1 نعم ٢. لا			
٨	يتم تطبيق قوانين السلامة المهنية والصحية الموضوعة من قبل الجهات المختصة؟ ١. نعم ٢. لا			
٩	إذا كان الجواب لا. أرجو توضيح السبب ؟			
١٠	هل يتوفر كتيب يشمل إرشادات وتعليمات للعاملين للوقاية و المعالجة في حالة حدوث حادث؟ ١. نعم ٢. لا			
١١	هل أنتم ملتزمين بما تنص علية منظمة الصحة العالمية لمعالجة النفايات:			
١٢	هل يتم عقد ورشات عمل وندوات داخل أو خارج المكب لتوعية الناس وبيان أهمية المكبات الصحية لإدارة النفايات ؟			
موقع المكب:				
١٣	يوجد للمكب سياج وبوابات خاصة للدخول: ١. نعم ٢.لا			
١٤	هل تم استخدام المعايير التالية لاختيار الموقع:	نعم	لا	غير ذلك
	تم استخدام تقنية GIS لتحديد موقع المكب			
	الأرض بعيدة عن المحميات والمناطق الأثرية			
	بعيدة عن مصادر المياه السطحية والجوفية على الأقل ١كم			
	بعيدة عن المناطق السكنية على الأقل ١كم			
	سهولة وصول الخدمات (طرق، مياه، هاتف، كهرباء)			
	ثمن الأرض غير مرتفع			
	كمية الأمطار قليلة أقل من 450mm سنويا			
	ميلان الأرض أقل من ٥%			
	نوع التربة طينية			

	المساحة أكثر من ١٢٥ دونم			
	اتجاه الرياح مناسب بحيث لا تصل الرائحة للسكان القريبين من المكب			
	قريبة من محطات تجميع النفايات			
١٥	هل يوجد حيوانات ضالة كالكلاب والقطط في المكب؟ 1) نعم دائما ٢) أحيانا ٣) لا			
١٦	هل تلاحظ وجود روائح كريهة أو حشرات أو قوارض في المكب؟ 1) نعم دائما ٢) أحيانا ٣) لا			
١٧	هل صدرت شكاوى من المجاورين للمكب:1) نعم دائما ٢) أحيانا ٣) لا			
١٨	هل يتم فرز النفايات الصلبة التي تجمع إلى مكوناتها الرئيسية المختلفة(بلاستيك ،وراق،زجاج.....الخ)؟ ١) نعم دائما ٢) أحيانا ٣)لا			
١٩	هل يوجد مكبات أخرى:			
٢٠	كم يبلغ العمر الافتراضي للمكب:			
المعدات المستخدمة:				
٢١	أنواع المعدات المستخدمة:	عددها	وظيفتها	بحاجة الى زيادة
	١. فرد النفايات:			
	٢. ضغطها:			
	٣: طحنها:			
		المجموع		
٢٢	هل تقومون بعمل صيانة دورية للمعدات الموجودة لديكم: ١. نعم ٢. لا			

	حجم ونوع النفايات:									
٢٣	آلية توزين النفايات:									
٢٤	آلية جباية الرسوم من البلديات:									
٢٥	هل يوجد ديون مستحقة على البلديات:									
٢٦	النفايات الصلبة التي	كميتها (طن/ يوم)				كميتها (طن/ سنة)				طريقة المعالجة
		٢٠٠٨	٢٠٠٩	٢٠١٠	٢٠١١	٢٠٠٨	٢٠٠٩	٢٠١٠	٢٠١١	

	تستقبل:									
	مواد عضوية									
	ورق									
	بلاستيك									
	معادن									
	زجاج									
	نفايات طبية									
	نفايات صناعية									
	الإطارات غير ذلك حدد..... .									
٢٨	هل يتم استقبال النفايات الصناعية والنفايات الطبية مع النفايات المنزلية: ١. نعم ٢. لا									

٢٩	مكبات التجميع	موقعها	المساحة التي تخدمها	كمية النفايات (طن/يوم)	بعدها عن المكب (كم)	عدد السيارات	عدد الرحلات يوميا	تكاليف الوقود	تكاليف أخرى
	١.								
	٢.								
	٣.								
	٤.								

المعالجة و المعاملة والتخلص النهائي :

٣٠	هل يتم معالجة النفايات بعد وصولها و قبل التخلص النهائي منها؟ ١. نعم دائما ٢ . أحيانا ٣. لا
٣١	إذا كان الجواب نعم، ما هي طرق المعالجة المستخدمة ٢. التنظيف ٢.الفصل و الفرز ٣. فصل المركبات الخطرة فقط ٤. تقليل الحجم

	٥. التدوير ٦. إعادة الاستخدام ٧. غير ذلك، حدد ----------
٣٢	إذا كان الجواب لا فهل هنالك مشاريع مستقبلية لمعالجة وفرز وإعادة استخدام النفايات الصلبة: 1 . نعم ٢. لا
٣٣	هل يستخدم الحرق للتخلص من النفايات: منظم: كم مرة يتم الحرق في الأسبوع:

٣٤	أصناف النفايات التي يتم استقبالها	كميتها (طن/سنة)				طرق المعالجة
		٢٠٠٨	٢٠٠٩	٢٠١٠	٢٠١١	
	النفايات المنزلية					
	النفايات التجارية: (المكاتب، المطاعم، الفنادق...الخ)					
	نفايات صناعية:(خطيرة، غير خطيرة)					
	نفايات طبية:					
	النفايات الزراعية: الورق، غصون الأشجار، النباتات، الأسمدة والمبيدات...الخ)					
	النفايات الإنشائية					
	المجموع:					

٣٥	هل يوجد وحدة خاصة لمعالجة النفايات الطبية والصحية:
٣٦	هل يتم فصل النفايات الرطبة عن النفايات الجافة بعد وصولها:1 . نعم دائما ٢. أحيانا ٣. لا
٣٧	هل يوجد لديكم آليات خاصة لضغط النفايات لتقليل حجمها: ١. نعم ٢. لا
٣٨	كيف يتم التخلص من النفايات العضوية الناتجة بشكل نهائي ١. طمرها ٢.تحول إلى سماد ٣. تحرق تحدث عن آلية طمر النفايات بالتفصيل:
٣٩	هل يتم تجميع ومعالجة العصارة الناتجة من طمر النفايات الصلبة حفرة العصارة: حجمها عمقها: مساحتها: تبطين الحفرة: نوع الأنابيب:
٤٠	كم تبلغ كمية العصارة الناتجة سنويا.....

٤١	ما هي الإجراءات المتخذة للحد من كمية العصارة:
٤٢	هل تتم السيطرة على الغازات الناتجة وجمعها والاستفادة منها: ١. نعم ٢. لا
٤٣	إذا كان الجواب نعم فكم تبلغ كميتها وهل قمتم من قبل بتحويله إلى طاقة كهربائية: نوع أنابيب الغاز:
٤٤	هل يوجد لديكم أجهزة للكشف عن تسرب الغاز واذا حث تسرب فكيف تتم المعالجة:
٤٥	غاز الميثان يسبب انفجارات، كيف تسيطرون على هذه المشكلة:
٤٦	ما هو سمك طبقة النفايات: سمك طبقة التراب:
٤٧	هل يتم بيع النفايات أو جزء منها؟ 1 . نعم ٢. أحيانا ٣. لا
٤٨	إذا كان الجواب نعم، من يشتري هذه النفايات ١. أفراد مستقلين ٢. شركات أو مؤسسات خاصة ٣. شركات أو مؤسسات حكومية
٤٩	إذا كان الجواب نعم فما هي أنواع النفايات التي تباع:
٥٠	كيف يتم التعامل مع العبوات (الزجاجية أو البلاستيكية) في حال تم فصلها: ١. إعادة الاستخدام ٢. تباع لإعادة التدوير ٣. تبقى مع النفايات ولا يتم فصلها ٤. كل ما ذكر بنسب متفاوتة
٥١	كيف يتم التعامل مع المعادن مثل (الحديد، النحاس، الألمونيوم)
٥٢	كيف يتم التعامل مع البطاريات:
٥٣	كيف يتم التعامل مع الدهانات:
٥٤	هل يتم تجفيف غصون الأشجار وسيقانها للبيع بغرض التدفئة:1 . نعم ٢. أحيانا ٣. كلا
5٥	ما هي الإجراءات المتبعة لتقليل مضار النفايات الطبية والصناعية:
56	أي من الإجراءات التالية تتخذ لتقليل من تأثير النفايات الصلبة على البيئة:
	a. توعية السكان لتخفيف إنتاج النفايات الصلبة
	b. تقليل من مواقع طمر النفايات
	c. تقليل مصادر التلوث والتحكم فيها مثل (الغازات الناتجة، العصارة...الخ)
	d. الاستفادة قدر الإمكان من النفايات قبل التخلص النهائي منها
	e. استخدام طرق التخلص من النفايات وفق قوانين علمية ووفقا لشروط المنظمات العالمية للحفاظ على البيئة
	f. وضع خطط مستقبلية للسيطرة على إنتاج النفايات والتخلص منها

57	هل تقوم إدارة المكب بتشجيع الناس على استخدام مواد صديقة للبيئة: ١. نعم ٢. لا
58	إذا كان الجواب نعم فما هي الطريقة المستخدمة لذلك: ١. نشرات توعية ٢. ندوات ٣.من خلال وسائل الإعلام ٤. غير ذلك حدد.....
59	هل يوجد لدى إدارة المكب إستراتيجية بيئية وقائية متكاملة ١. نعم ٢. لا
60	هل تتبع إدارة المكب آلية التسلسل الهرمي لإدارة النفايات الصلبة (منع، تقليل، استرداد، حرق، مكبات صحية): ١. نعم ٢. لا
61	ما هي التأثيرات البيئية التي تم رصدها بعد عمل المكب:
62	هل حدثت انهيارات داخل المكب وأثرت على العمال:
63	كم تقدر المدة الزمنية التي سوف يخدمها المكب في ظل النمو السكاني وزيادة كمية النفايات:

أهم العقبات التي تعيق إدارة النفايات الصلبة بشكل فعال:			
64	ما هي أهم العقبات المتعلقة بالنواحي المالية والاقتصادية التي تمنع أو تعيق إدارة المكب من القيام بدورها بشكل فعال:	١.نعم	٢.لا
	عدم وجود دعم من قبل الدولة لقطاع إدارة النفايات الصلبة		
	صعوبة الحصول على تمويل خارجي		
	ارتفاع تكلفة كل من(المعدات، طرق المعالجة الآمنة، طرق تدوير النفايات)		
	ضعف العوائد المالية لإدارة النفايات الصلبة		
	عدم وجود تقييم فعال للأداء المالي لإدارة النفايات الصلبة		
65	ما هي أهم العقبات المتعلقة بالنواحي التقنية والمعلوماتية التي تمنع أو تعيق إدارة المكب من القيام بدورها بشكل فعال:	١.نعم	٢.لا
	خبرة وقدرة العمال محدودة في مجال معالجة النفايات الصلبة		
	عدم الحصول على الدعم التقني الخارجي		
	عدم وجود معدات وأجهزة حديثة لجمع ونقل ومعالجة والتحكم في المواد الضارة الناتجة عن النفايات الصلبة		
	عدم وجود بنية تحتية منظمة لإدارة النفايات الصلبة		
	نقص التدريب العملي وورش العمل		
٦٦	ما هي أهم العقبات المتعلقة بالنواحي الفيزيائية التي تمنع أو تعيق إدارة المكب من القيام بدورها بشكل فعال:	١. نعم	٢.لا
	عدم وجود أراضي كافية لعمل مكبات صحية وذلك بسبب الاحتلال الإسرائيلي		
	نقص في الطرق المعبدة التي تصل إلى مكبات النفايات		
	عدم وجود إدماج للحاويات في الشارع بحيث لا تؤثر على حركة السير		
	التوزيع المكاني للحاويات لا يأخذ بين الاعتبار المستوى المعيشي وكمية النفايات الناتجة		

	في الاعتبار		
	نقص في محطات التجميع التي تحد من تكاليف النقل		
67	ما هي اقتراحاتكم لتحسين وضع إدارة النفايات الصلبة في رأيكم؟		

Appendix E: Leachate Samples from ZAL

Sample one: Date 3/2/2010, Type of samples: leachate, Sample volume: 1.5 Liter, No. of samples:2, reference of testing: standard methods for examination of water and wastewater.

Table (1E): Sample analysis report for leachate sample No.1.

Parameter	Unit	Landfill	Landfill pool
pH	Unit	8.7	8.3
Turbidity	NTU	12.5	11.7
Carbonate (CaCO3)	mg/L	720	600
Conductivity	Ms/cm	21.10	15.10
TDS at 180 ºC	mg/L	9988	7732
Sulfate	mg/L	15	12.50
Ammonium	mg/L	1052	588
Ca	mg/L	71	65
Mg	mg/L	162	154
Cl	mg/L	3700	2600
Cd	mg/L	0.00	0.00
Pb	mg/L	0.00	0.00
Cr	mg/L	0.00	0.00
Cu	mg/L	0.16	0.10
Fe	mg/L	0.58	0.54
Mn	mg/L	0.00	0.00
Na	mg/L	1880	1660
Zn	mg/L	0.60	0.50
Nitrate	mg/L	27	24
Total Kjeldahl nitrogen	mg/L	1577	889
BOD	mg/L	270	210
COD	mg/L	3600	3200
TSS at 105 ºC	mg/L	180	104

Sample two: Date 22/3/2010, Type of samples: leachate, Sample volume: 1.5 Liter, No. of samples:1, reference of testing: standard methods for examination of water and wastewater.

Table (2E): Sample analysis report for leachate sample No.2.

Parameter	Unit	Landfill pool
pH	Unit	8.5
Turbidity	NTU	11.9
Carbonate (CaCO3)	mg/L	660
Conductivity	Ms/cm	15.45
TDS at 180 ºC	mg/L	7804
Sulfate	mg/L	11.7
Ammonium	mg/L	622
Ca	mg/L	80
Mg	mg/L	121
Cl	mg/L	2900
Cd	mg/L	0.00
Pb	mg/L	0.00
Cr	mg/L	0.00
Cu	mg/L	0.4
Fe	mg/L	0.1
Mn	mg/L	0.00
Na	mg/L	1940
Zn	mg/L	0.37
Nitrate	mg/L	23
Total Kjeldahl nitrogen	mg/L	980
BOD	mg/L	193
COD	mg/L	1600
TSS at 105 ºC	mg/L	103

Sample three: Date 18/1/2011, Type of samples: leachate and water, Sample volume: 1.5 Liter, No. of samples:2, reference of testing: standard methods for examination of water and wastewater.

Table (3E): Sample analysis report for leachate sample No.3.

Parameter	Unit	Rainwater collected around Landfill	Leachate
pH	Unit	7.8	7.65
Turbidity	NTU	6.8	14.3
Carbonate (CaCO3)	mg/L	500	7000
Conductivity	Ms/cm	1800	17580
TDS at 180 ºC	mg/L	1084	12292
Sulfate	mg/L	13.8	18.3
Ammonium	mg/L	48	1086
Ca	mg/L	82	220
Mg	mg/L	25	138
Cl	mg/L	350	3800
Cd	mg/L	0.0	0.0
Pb	mg/L	0.0	0.0
Cr	mg/L	0.0	0.0
Cu	mg/L	0.0	0.0
Fe	mg/L	0.7	6.4
Mn	mg/L	0.0	0.0
Na	mg/L	114	1820
Zn	mg/L	0.0	0.5
Nitrate	mg/L	47	32
Total Kjeldahl nitrogen	mg/L	140	1391
BOD	mg/L	291	989
COD	mg/L	480	3680
TSS at 105 ºC	mg/L	47	220

Sample four: Date 10/10/2011, Type of samples: leachate, Sample volume: 1.5 Liter, No. of samples:1, reference of testing: standard methods for examination of water and wastewater.
Table (4E): Sample analysis report for leachate sample No.4.

Parameter	Unit	Landfill pool
pH	Unit	8.2
Turbidity	NTU	29
Carbonate (CaCO3)	mg/L	13600
Conductivity	Ms/cm	28900
TDS at 180 ºC	mg/L	23142
Sulfate	mg/L	15.7
Ammonium	mg/L	1900
Ca	mg/L	280
Mg	mg/L	194
Cl	mg/L	9000
Cd	mg/L	0.0
Pb	mg/L	0.0
Cr	mg/L	0.0
Cu	mg/L	0.0
Fe	mg/L	3.3
Mn	mg/L	0.0
Na	mg/L	4700
Zn	mg/L	0.2
Nitrate	mg/L	34
Total Kjeldahl nitrogen	mg/L	2700
BOD	mg/L	4050
COD	mg/L	6080
TSS at 105 ºC	mg/L	348

Sample five: Date 30/1/2012,Type of samples: leachate, Sample volume: 2Liter, No. of samples:3, reference of testing: standard methods for examination of water and wastewater.
Table (5E): Sample analysis report for leachate sample No.5.

Parameter	Unit	Collected water	Landfill pool	Canal outside the landfill
pH	Unit	8.27	7.85	8.32
Turbidity	NTU	14.5	21.6	9.3
Carbonate (CaCO3)	mg/L	4000	8000	1500
Conductivity	Ms/cm	11400	20900	6840
TDS at 180 ºC	mg/L	6270	12970	3328
Sulfate	mg/L	19	25	10
Ammonium	mg/L	670	960	82
Ca	mg/L	160	280	49
Mg	mg/L	97	190	72
Cl	mg/L	2000	3990	1500
Cd	mg/L	0.0	0.03	0.0
Pb	mg/L	0.0	0.0	0.0
Cr	mg/L	0.03	0.09	0.03
Cu	mg/L	0.02	0.05	0.07
Fe	mg/L	0.53	1.57	0.83
Mn	mg/L	0.02	0.12	0.01
Na	mg/L	1400	2450	1000
Zn	mg/L	0.18	0.41	0.21
Nitrate	mg/L	41.5	81	38.6
Total Kjeldahl nitrogen	mg/L	883	1703	354
BOD	mg/L	318	962	162
COD	mg/L	760	4240	400
TSS at 105 ºC	mg/L	120	154	112

Appendix F: Gas Samples from ZAL

The tests were conducted in more than one location in the area and the vicinity of the landfill:

First location: The southern and eastern side of the leachate pond between the administration building and leachate pond. Date 31/3/2012, Type of samples: Gas.

Table (1F): Sample analysis report for Gas sample in first location.

Test	**min**	**max**	**average**
NH_3 (ppm)	0.4	1.7	1.09
HCN (ppm)	0.00	0.1	0.010
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.00	0.11	0.025
Temp. (ºC)	20.6	27.2	23.6
TVOC (ppb)	0.00	1.00	0.143
CO_2 (ppm)	365	456	406.21
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.2	5.1	2.11
R.H (%R.H)	29.9	40.4	34
PM 1 (mg/m^3)	0.002	0.030	0.010
PM 2.5 (mg/m^3)	0.019	0.090	0.075
PM 7 (mg/m^3)	0.068	0.118	0.101
PM 10 (mg/m^3)	0.083	0.312	0.268
TSP (mg/m^3)	0.104	0.432	0351

Second location: The northern and western side of the leachate pond exists beside the administration building. Date 31/3/2012, Type of samples: Gas.

Table (2F): Sample analysis report for Gas sample in second location.

Test	min	max	average
NH_3 (ppm)	0.4	1.00	0.74
HCN (ppm)	0.00	0.00	0.00
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.00	0.09	0.043
Temp. (ºC)	21.2	25.3	23.75
TVOC (ppb)	0.00	0.00	0.00
CO_2 (ppm)	419	454	436.82
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.2	2.8	1.82
R.H (%R.H)	28.6	35.9	32.17
PM 1 (mg/m^3)	0.001	0.029	0.017
PM 2.5 (mg/m^3)	0.018	0.088	0.075
PM 7 (mg/m^3)	0.066	0.115	0.099
PM 10 (mg/m^3)	0.079	0.308	0.259
TSP (mg/m^3)	0.100	0.429	0.349

Third location: Top middle of the landfill. Date 31/3/2012, Type of samples: Gas.
Table (3F): Sample analysis report for Gas sample in third location.

Test	min	max	average
NH_3 (ppm)	0.5	0.7	0.58
HCN (ppm)	0.00	0.1	0.086
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.02	0.12	0.058
Temp. (ºC)	19.5	21.4	21.08
TVOC (ppb)	1.00	2.00	1.86
CO_2 (ppm)	359	424	364.64
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.2	1.2	0.43
R.H (%R.H)	40.7	51.5	49.55
PM 1 (mg/m^3)	0.004	0.070	0.030
PM 2.5 (mg/m^3)	0.021	0.132	0.087
PM 7 (mg/m^3)	0.078	0.209	0.168
PM 10 (mg/m^3)	0.116	0.488	0.304
TSP (mg/m^3)	0.141	0.690	0.412

Fourth location: The eastern side of the landfill beside the leachate ponds on side of the landfill next to main street. Date 31/3/2012, Type of samples: Gas.

Table (4F): Sample analysis report for Gas sample in fourth location.

Test	min	max	average
NH_3 (ppm)	1.1	1.8	1.38
HCN (ppm)	0.00	0.1	0.09
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.02	0.08	0.052
Temp. (ºC)	19.2	20.6	19.89
TVOC (ppb)	2.00	3.00	2.8
CO_2 (ppm)	353	380	366
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.4	1.1	0.75
R.H (%R.H)	51.00	55.3	52.74
PM 1 (mg/m^3)	0.002	0.021	0.015
PM 2.5 (mg/m^3)	0.015	0.111	0.099
PM 7 (mg/m^3)	0.063	0.177	0.138
PM 10 (mg/m^3)	0.072	0.443	0.297
TSP (mg/m^3)	0.089	0.575	0.377

Fifth location: The western side of the landfill. Date 31/3/2012, Type of samples: Gas.
Table (5F): Sample analysis report for Gas sample in fifth location.

Test	min	max	average
NH_3 (ppm)	0.00	0.3	0.19
HCN (ppm)	0.00	0.00	0.00
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.01	0.13	0.052
Temp. (ºC)	19.5	22.4	21.24
TVOC (ppb)	0.00	1.00	0.8
CO_2 (ppm)	422	563	458.5
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.1	3.5	0.8
R.H (%R.H)	37.4	52.7	48.78
PM 1 (mg/m^3)	0.001	0.006	0.003
PM 2.5 (mg/m^3)	0.013	0.045	0.032
PM 7 (mg/m^3)	0.052	0.121	0.100
PM 10 (mg/m^3)	0.083	0.243	0.166
TSP (mg/m^3)	0.097	0.294	0.184

Sixth location: Foot dump area and covered with wheels ready for planting along the street entrance leading to the middle of the landfill. Date 31/3/2012, Type of samples: Gas.

Table (6F): Sample analysis report for Gas sample in sixth location.

Test	min	max	average
NH_3 (ppm)	0.3	0.7	0.44
HCN (ppm)	0.00	1.4	0.25
SO_2 (%)	0.00	0.00	0.00
H_2S (ppm)	0.03	1.75	0.32
Temp. (ºC)	16.7	18.1	17.39
TVOC (ppb)	2.00	5.00	2.5
CO_2 (ppm)	339	5102	1034.4
O_3 (ppm)	0.00	0.00	0.00
NO_2 (ppm)	0.00	0.00	0.00
CO (ppm)	0.4	1.00	0.7
R.H (%R.H)	57.2	62.2	59.36
PM 1 (mg/m^3)	0.005	0.088	0.010
PM 2.5 (mg/m^3)	0.010	0.301	0.148
PM 7 (mg/m^3)	0.057	0.418	0.372
PM 10 (mg/m^3)	0.198	0.540	0.429
TSP (mg/m^3)	0.213	0.929	0.711