

An-Najah National University
Faculty of Graduate studies

Evaluation of Solid Waste Management Practices in Nablus
District

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By
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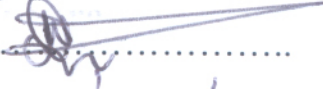
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Dedication

This work is cordially dedicated to the souls of my parents who devoted their life to their children.

Acknowledgement

I would like to express my thanks and appreciation to the faculty of graduated studies at An Najah National University.

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Abstract

This study is about the current solid waste management system in Nablus district and it covers the issue from three aspects. These are the management system, awareness of citizens, and solid waste composition.

Around 97% of the population in Nablus district are located within areas that have a solid waste collection system. There are great variations in the management system between the city and villages, and among different villages. The collection systems in villages vary from one to another by equipment used. 25 localities are using compacting trucks while 22 are using tractor. The service provider is local council in 9 localities, a contractor in 27 localities, and the joint service council in 13 localities. Amount of solid waste fee ranges between 5 NIS to 15 NIS. The fee is collected separately in 11 localities, with electricity bill in 35 localities, with water bill in 3 localities, with both bills in 2 localities. Ownership of the dumping sites also changes from locality to locality.

Insufficiency of existing labor and equipments, improper disposal of waste in dumping sites, and low fee collection rates, are the main problems in the existing management system. There is no separation of hazardous and medical waste in all localities. These practices increase threat to citizens and the environment.

There is a question about the necessity of unifying the solid waste management system in the district and in the Palestinian territories. This unification can be activated by initiative from the Ministry of Local Government, which is responsible for the local councils. There is a need for establishing sanitary disposal landfill. This should be done in parallel

with closing the illegal dumping sites, and increasing the recycling and composting where it is feasible.

The UNRWA has to take its full responsibility in refugee camps by disposing the generated solid waste. Currently, UNRWA is only collecting solid waste from the camps and disposing it in the nearest municipal containers.

Different citizens' attitudes toward solid waste management were revealed. Like, readiness of citizens to pay more for better collection system as their income increases, and the readiness of citizens living in separate houses to walk further to container than citizens living in apartments. There is a good indication about readiness of citizens to separate solid waste into five components for recycling purpose. On the other hand, there is a need to increase citizens awareness and care about solid waste management issues.

The weight composition percentage of the solid waste in Nablus district is 63% organic material, 8% plastics, 3% metals, 3% glass, 10% paper and cardboard, 3% textiles 10% others and inert materials. It is clear that the high portion of solid waste is organic material, as expected in developing countries. The variation in the composition between village and city is minor. The organic content is a bit higher in villages while the paper content is higher in the city.

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Abbreviations

DS	Dumping Sites
EIA	Environmental Impact Assessment
EQA	Environmental Quality Authority
Fig	Figure
GHG	Green House Gaz
JCSPD	Joint Councils for Services, Planning and Development
LGU	Local Government Unit
MLG	Ministry of Local Government
MSW	Municipal Solid Waste
NIMBY	Not In My Back Yard
NIS	New Israeli Sheqel
PCBS	Palestinian Central Bureau of Statistics
Pop	Population
SPSS	Statistical Package for Social Science
UNRWA	United Nations for Relief and Work Agency
UNEP	United Nation Environment Programme
WHO	World Health Organization

1

Chapter 1

Introduction

1.1 General

In the early centuries, management of solid waste was easily dealt with at the household level. (Mwanthi, 1997). Increasing population levels, rapid economic growth and rise in community living standard accelerate the generation rate of municipal solid waste (MSW). Improper management of MSW causes hazards to inhabitants (Sharholy, 2006).

Municipal solid waste is a heterogeneous mixture of paper, plastic, cloth, metal, glass, organic matter, etc. generated from households, commercial establishments, and markets. The proportion of different constituents of waste varies from season to season and place to place, depending on the lifestyle, food habits, standards of living, the extent of industrial and commercial activities in the area, etc (Katju, 2006).

Global MSW production in 1997 was 0.49 billion tons. The production of MSW is growing at 3.2–4.5% each year in developed countries, and at 2–3% per annum in developing countries. Based on these data, the problem of MSW management has earned increasing attention as a major hindrance to urbanization and economic development all over the world (Tong and Yuping, 2001).

The problem of solid waste is increasing with the increased population of the world.

According to the US Bureau of the census current population of the world had increased from 2.556 billion at the year 1950 to 6.525 billion in 2006 and expected to reach 8.5 billion by the year 2035. The percentage of

urban areas now is 50% and is expected to reach 60% by the year 2035 (United States Census Bureau, 2006).

1.1.1 Solid Waste Management

Solid waste is no longer regarded as something “to get rid of”, but has a potential value, both from environmental and economical point of view (Ljunggren, 1998).

Unfortunately, poor solid waste management practices are intensifying to crisis conditions in many developing countries. Limited opportunities for development of a sustainable solid waste management system exist because government budgets are limited and proper disposal of solid wastes is frequently perceived as representing only costs (McBean et al., 2005).

As a consequence, issues of solid waste management have been considered profoundly different from water supply. For example, because of the desirability of the product (the water supply), a willingness to pay exists on the part of the consumer. With solid wastes, most individuals’ willingness to incur expenditures for management extends only to ensuring that the wastes are out of sight (McBean et al., 2005).

Solid waste management is not only a technical problem but it is also strongly influenced by political, legal, socio-cultural, environmental and economic factors, as well as available resources. Moreover, these factors have interrelationships that are usually complex in waste management systems (Kum et al., 2005). Many cities in developing Asian countries face serious problems in managing their solid waste. The annual waste

generation increases in proportion to the rise in population and urbanization, and issues related to disposal have become challenging as more land is needed for the ultimate disposal of these solid wastes (Idris et al., 2004). MSW is normally pollution (Kansal et al., 1998).

When it comes to municipal solid waste management, the solution to addressing the poor quality of service in developing countries is a complex mixture of lack of resources, lack of expertise, lack of political will and inadequate legislation. There is no simple or single solution to this complex web of interlinked shortcomings. Needless to say, there will always be a service provider on hand to sell a quick solution to these problems, but these supposed solutions are invariably doomed to failure as they can only address one aspect of the problem. This discussion does not propose a solution that will single-handedly address this problem. Rather, it is suggested that an aspect that is often neglected is that of the competencies and abilities of those members of local, state and national government departments that are responsible for implementing and managing environmental legislation in developing countries (Fourie, 2006).

It is usually not the environmental legislation itself that is at the heart of the problem. Indeed, some developing countries may well have more refined and visionary legislation than many developed countries. What use is world-class environmental legislation, when it is impossible to enforce of all waste, including medical waste, without first ensuring viable alternatives are in place. The inevitable result is the disastrous situation that now exists in many developing countries. Lack of

enforcement of legislation also places unfair responsibility and pressure on municipal officers (Fourie, 2006).

1.1.2 Classification of Solid Waste

Solid waste 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. The principal sources of solid wastes are residences, commercial establishments, institutions, industrial and agricultural activities. Domestic, commercial, and light industrial wastes are considered together as urban wastes. The main constituents of urban solid wastes 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 (Sufian and Bala, 2006).

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, 2006).

The solid waste 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., Siegel et al., 1990). Table 1-1 gives an overview of existing classification systems for solid waste:

Table 1-1* : Overview of existing classification systems for solid waste

Author	Basis for differentiation	Parameters used for differentiation
Turczynski (1988)	Waste type	Density, shear parameters, liquid/plastic limit, permeability
Siegel et al. (1990)	Material groups	Part of composition
Landva and Clark (1990)	Organic, inorganic materials	Degradability (easily, slowly, non) Shape (hollow, platy, elongated, bulky)
Grisolia et al. (1995)	Degradable, inert, deformable material groups	Strength, deformability, degradability
Kölsch (1996)	Material groups	Size, dimension
Manassero et al. (1997)	Soil-like, other	Index properties

*Dixon and Langer (2006)

Due to the large variety of materials present in waste, a practical approach is to identify major groups of materials. For example, an American waste composition survey done by the Department of Environmental Quality (1998) used the following main groups: organic, paper, –wood, polymer/plastics, metal (Fe/non-Fe), soil-like, –ceramic, glass, inert and rubber. Waste composition is defined by measuring the mass percentage of each material group present in a sample (Dixon and Langer, 2006).

Figure 1-1 shows the details of the Landva and Clark classification.

Organic		Inorganic	
<u>Putrescible</u>	<u>Non-putrescible</u>	<u>Degradable</u>	<u>Non-degradable</u>
Food waste	Paper	Metals	Glass
Garden waste	Wood		Ceramics
Material	Organic		Concrete
contaminated	Sludge		Masonry
by such waste			
	Leather		Rubble
	Plastic, Rubber		Tailings
	Paint, Oil, Grease,		Slimes
	Chemicals		Ash
	Textiles		Mineral soil

* Dixon and Langer (2006)

Fig. 1-1: Waste classification (after Landva and Clark)

1.1.3 Solid Waste Disposal

Several disposal methods are being used in various parts of the world and the most prominent of these are: open dumping, sanitary landfilling, incineration and composting. Sanitary landfilling is the main method used in industrialized countries and open dumping is very common in developing countries (Sufian and Bala, 2006). This is because open dumping is cheap and requires no planning. Generally, the low-lying areas and outskirts of the towns and cities are used for MSW dumping (Sufian and Bala, 2006).

Special wastes are those that need special handling, treatment, and disposal because of their hazardous potential or large volumes. Ideally, these wastes should not enter the municipal solid waste stream, but quite frequently they do, particularly in developing countries (UNEP, 2006).

Special wastes can cause significant health and environmental impacts when managed inadequately. Those who come into direct contact with the wastes, such as waste pickers, are at great health risk. Toxic components of these wastes can enter the environment, poisoning water bodies. Hazardous materials can also degrade MSW equipment (UNEP, 2006).

1.1.4 Landfill classification

The landfills according to UNEP (UNEP, 2006) are grouped into three general categories:

1. Open dumps
2. Controlled dumps
3. Sanitary landfills

Obviously, these three types of landfills are points on a continuum, with facilities in developing countries most often falling somewhere between open dumps and controlled dumps. Table 1-2 summarizes the main distinguishing characteristics of each of the three types.

1.1.5 Strategic Planning Issues of SWM

Planning of Solid Waste Management (SWM) has to address several interdependent issues such as public health, the environment, the economic potential from the solid waste 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 factors. Experimentation with an actually existing urban solid waste management system containing economic, social, technological, environmental and political elements may be costly and time consuming or totally unrealistic (Sufian and Bala, 2006).

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Table 1-2: Key Characteristics of Municipal solid waste landfill

Type	Characteristics	Advantages	Disadvantages
Open Dump	<ul style="list-style-type: none"> • Poorly Sited • Unknown Capacity • No cell planning • Little or no site reparation • No leachate management • No gas management • Only occasional cover • No compaction of waste • No fence • No record keeping Waste picking and trading 	<ul style="list-style-type: none"> • Easy access • Extended lifetime • Low initial cost • Low initial cost • Low initial cost • Low initial cost • Low initial cost • Aerobic decomposition • Access to waste pickers • Low initial cost • Materials recovery, income 	<ul style="list-style-type: none"> • Environmental Contamination • Overuse, many noxious sites • Environmental Contamination • Unsightly, needs remediation • GW and SW Contamination • Risk of explosions and GHG • Vectors/ diseases, Unsightly • Shorter lifetime, little • Indiscriminate use, vermin • No record of landfill content • Least efficient for recovery
Controlled dump	<ul style="list-style-type: none"> • Sited with respect to hydro- geology • Planned capacity • No cell planning • Grading, drainage in site preparation • Partial leachate management • Partial or no gas management • Regular (not usual daily) cover • Compaction in some cases • Fence • Basic record keeping • Controlled waste picking and trading 	<ul style="list-style-type: none"> • Less event of contamination • Permits long term planning • Low initial cost • Easier rainfall, runoff, reduced risk • Moderate cost, reduced risk • Moderate cost, reduced risk • Moderate cost, reduced risk • Extended lifetime • Controlled access and use • Valuable information • Materials recovery, income, low risk to pickers 	<ul style="list-style-type: none"> • Perhaps less accessible • None • Environmental Contamination • Cost • Cost • Cost • Cost, slower decomposition • Cost • Cost, maintenance • Cost Harassment, possible displacement of pickers and buyers, loss of recyclable

Type	Characteristics	Advantages	Disadvantages
Sanitary Landfill	<ul style="list-style-type: none"> • Site based on Environmental risk assessment • Planned capacity • Designed cell development • Extensive site preparation • Full leachate management • Full gas management • Daily and final cover • Compaction • Fence and gate • Record volume, type and source • No waste picking 	<ul style="list-style-type: none"> • Minimized Environmental risk • Permits long term-planning • Minimized Environmental risk • Reduced risk at and from site • Reduced risk from leachate • Reduced risk from gas • Vector control, aesthetics • Extended lifetime • Secure access, gate records • Valuable information • Eliminate risk to pickers 	<ul style="list-style-type: none"> • Access, longer siting process • None • Cost • Cost, preparation time • Cost • Cost • Cost, slower decomposition • Cost • Cost, maintenance, staff • Cost, equipment • Displacement of pickers and buyers, loss of recyclable resources

Adopted from Tchobanglous, G. H. Theisin, and R. Eliassen. **Solid wastes: Engineering principles and management Issues**. New York, McGraw-Hill 1977 and Burner, D.R. and D.G. Keller. **Sanitary Landfill Design and Operations**. Washington: US EPA, Publication SW-65ts, 1972.

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 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 siting, and system operation (Chang and Davila, 2006).

1.2 Solid Waste Management in Palestine

1.2.1 Palestine

Palestine is located at the south western part of Asia, between 34° 15' and 35° 40' East longitude lines, and latitude lines 29° 30' and 33° 15' North. Historical Palestine is bordered by Lebanon, Syria, Jordan and Egypt, it amounts to 27,009 km², while the Palestinian Territory amounts 5,655 km² in the West Bank and 365 km² in Gaza Strip (Palestinian Central Bureau of Statistics, 2004).

The Palestinian Territories are divided into 16 governorates as [shown in table 1-3](#). According to Palestinian Bureau of Statistics, 2005 the natural increase is shown in table 1-4.

Palestine climate is affected by three factors: First is the mountain series extended from North to South parallel to the coast, second is Sina and North Africa Desert, and the third is Syrian Desert. Jordan River is the

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longest Palestinian river, this river is an internal one, and its water poured in the Dead Sea (Palestinian Central Bureau of Statistics, 1999).

Table 1-3*: Enrolment and area of Palestinian Governorates in 1997

No	Governorate	Enrolment 1997	Governorate area (Km ²)
1	Jenin	195,299	583
2	Tubas	35,216	402
3	Tulkarm	129,030	246
4	Nablus	251,392	605
5	Qalqiliya	69,268	166
6	Salfit	46,688	204
7	Ramallah & Al Bireh	205,448	855
8	Jericho	31,501	593
9	Jerusalem	113,896	345
10	Beithlehem	132,090	659
11	Hebron	390,272	997
	Total West Bank	1,600,100	5,655
12	North Gaza	179,690	61
13	Gaza	359,941	74
14	Deir Al-Balah	144,890	58
15	Khan Yunis	196,662	108
16	Rafah	120,386	64
	Total Gaza Strip	1,001,569	365
	Palestinian Territory	2,601,669	6,020

Palestinian Central Bureau of Statistics: **Population, Housing and establishment Census-1997, Final Results- Population Report – Palestinian Territory, First Part**. Ramallah- Palestine 1999.

Table 1-4 *: Estimated Population Natural Growth Rates in the Palestinian Territory, 1997-2006

Year	West Bank	Gaza Strip	Palestinian Territory
1997	3.6	4.1	3.8
1998	3.6	4.1	3.7
1999	3.5	4.0	3.7
2000	3.4	4.0	3.6
2001	3.4	4.0	3.6
2002	3.3	4.0	3.5
2003	3.2	3.9	3.4
2004	3.1	3.9	3.4
2005	3.0	3.8	3.3
2006	3.0	3.8	3.3

* Palestinian Central Bureau of Statistics: **Statistical Abstract of Palestine, No “6”**. Ramallah – Palestine, 2005.

1.2.2 Joint Councils for Services, Planning and Development (JCSPD):

The ministry of local government in cooperation with international development agencies has focused on merging some local government units (LGU) together. By grouping small governmental units together into a JCSPD a stronger institutional framework is formed which among other things will build the capacity of the member of the local government units (LGU) and enhance their ability to manage sustainable development in their communities (Ministry of Local Government, 2004).

Table 1- 5*: Distribution of Joint Councils for Service, Planning and Development in Districts

District	No of JCSPD	No of LGU
Jerusalem	6	54
Ramallah & al Bireh	14	68
Jericho	6	33
Beithlehem	6	49
Hebron	7	79
Nablus	5	41
Tulkarm	4	46
Jenin	6	125
Salfit	3	18
Tubas	3	22
Qalqiliya	4	49
Gaza Strip	6	43
Total	70	627

* Ministry of Local Government:, 2004

Note: The total number of LGUs in West Bank and Gaza is 497. However the total number of LGUs forming JCSPD is 627. This discrepancy is due to some LGUs being members of more than one JCSPD.

One of the main aims of the JCSPD is to improve the level of services in rural areas. Currently there is an imbalance between rural and urban areas as shown in table 1-6 (Ministry of Local Government, 2004):

Table 1-6 * Level of Services in Rural and Urban areas in Palestine

LGUs Service	Municipalities	Village Councils	Project Committy
Water	93%	79%	48%
Electricity	100%	95%	71%
Solid Waste Collection	100%	84%	45%

*Ministry of Local Government: **Joint Councils for services, planning and development**. Ramallah, Palestine, 2004)

1.2.3 Solid Waste Problem Identification

Palestine faces the problem of solid waste material, which is becoming more and more difficult. This is due to

- (1) Ever-increasing population and the change in people's habits.
- (2) Low environmental awareness of the citizens.
- (3) Low level of services presented by local municipalities.
- (4) Poor mechanical equipment.
- (5) Lack of funds.
- (6) Lack of effective enforcement.
- (7) Pressure and restriction by Israel

All of these have resulted in poor management practices of solid waste material and higher potential of pollution (UNEP, 2003).

According to household environmental survey done by PCBS 14.5% of households in North West Bank are exposed to bad smells sometimes and very often because of the dumping sites. Also 41% of the households in North West Bank are exposed to smokes sometimes and very often due to burning of waste (Palestinian Central Bureau of statistics, 2005).

There are many inconsistencies in the design and management of landfills (dumping sites) throughout Palestine, and many operate with vague, subjective or ineffective controls on hazardous waste disposal. Current international approaches to the landfill disposal of hazardous wastes are out of alignment with all of the Palestinian cities (United Nations Environment Programme, 2003).

The improper handling of solid waste in Palestine is a major cause of deterioration of water quality, land degradation, air pollution, pollution of the Gaza shoreline and the coastal marine environment and aesthetic distortion of the visual environment. The risks from leachate from non-sanitary hazardous waste dumps should not be underestimated. Also public health risks related to direct exposure to hazardous or infectious waste are serious (Ministry of environmental affairs, 2000).

According to UNEP, 2003, desk study on the environment in the occupied Palestinian Territories, approximately 67% of the West Bank population and 95% of Gaza population is served by a municipal collection system. However, no sanitary landfill exists in the West Bank, except Zahrat Al Finjan landfill in Jenin area which is under construction.

There were 500 illegal dumping sites in Israel. Up to 2005, half of these have been closed including the 77 large dumping sites. The current tipping fee in the legal sites for the solid waste ranges between 7 to 8 \$ per ton (Nissaim et al., 2005).

In Palestinian Territory and in the year 2001 the daily quantity of solid waste reaching dumping sites is 3,696 tons including 2,506 tons in the West Bank, and 1,190 tons in Gaza (Palestinian Central Bureau of

statistics, 2002). While the results of household environmental survey in 2005 showed the daily quantity of solid waste generated in the Palestinian Territory was 2,728 tons (Palestinian Central Bureau of statistics, 2005).

In the year 2005 the average household daily production of household waste in the Palestinian Territory was estimated to be 4.6 kg, and the average per capita daily production of household waste is estimated at 0.7 kg (Palestinian Central Bureau of statistics, 2005).

Comparison with Israel where 5.7 million tons of solid waste were produced in 2002 and the generation rate reaches 1.8 Kg /capita, and the household waste is increasing at a rate of 4-5% (Nissaim et al., 2005).

1.2.4 Dumping Sites in the Palestinian Territory 2001

In 1998, the number of dumping sites in the Palestinian territory was 175 of which 171 lie in the West Bank. In 2001, the number decreased to 137 of which 133 lie in West Bank. No change in the number of sites of Gaza Strip during the period, which remained 4 dumping sites (Palestinian Central Bureau of statistics, 2002).

Burning solid waste as a way of treatment is the most common in 116 dumping sites in the West Bank. Solid waste is buried in 17 dumping sites in the Palestinian Territory including 13 on the West bank and the four of Gaza Strip (Palestinian Central Bureau of statistics, 2002). The waste burning is the most important source of smoke for 33.0% of households that are exposed to smoke in the Palestinian Territory (Palestinian Central Bureau of statistics, 2002).

Table 1- 7 * Change in Distribution of dumping sites between 1998 and 2001

District	No of DS 1998	No of DS 2001	Quantity in 2001 tons/day
Palestinian Territory	175	137	3,696
West Bank	171	133	2,506
Jenin	33	23	215
Tubas	1	1	40
Tulkarm	17	15	198
Nablus	17	16	241
Qalqiliya	4	3	433
Salfit	11	9	32
Ramallah	41	32	469
Jericho	5	4	31
Jerusalem	16	9	148
Bethlehem	8	4	47
Hebron	18	17	652
Gaza Strip	4		1,190
North Gaza	1	1	150
Gaza	1	1	650
Deir Al –Balah	1	1	260
Khan Yunis	0	0	0
Rafah	1	1	130

*(PCBS, 2001)

The general notes about these dumping sites are:

- There is little or no control on what is dumped at these facilities
- Open burning is a common practice.
- No cover is applied.
- Dumping encroaches onto farmlands.
- No equipment to manage the incoming waste.
- Sitting of the dump is arbitrary.
- Unsafe practices (Unsafe slopes, no personal protection equipment...)

1.2.5 Legal and Institutional Framework

Prior to May 1994, management of local services including solid waste was under Israeli Civil administration. Prior to Israeli occupation of 1967, health laws based upon Jordanian health requirement were utilized in Palestine; with British and Egyptian law applied in Gaza strip (Hickman and Krueger, 2004).

The legal framework in Palestine provides a broadly effective basis for solid waste management, but requires implementing instructions in order to be fully implemented. There are positive aspects to the structural framework for solid waste management in Palestine (Hickman and Krueger, 2004).

The scope of the Palestinian law is affected by the territorial status of Palestine, which is currently divided into three areas (A, B and C), according to the degree of Palestinian control. Only area A is under full Palestinian control; Area B under joint Israeli-Palestinian control and area C under Israeli control (Hickman and Krueger, 2004).

The presence of Israeli colonies which dispose off their wastes in an uncontrolled manner on Palestinian Territory further complicates the applicability of Palestinian law and institutions.

Law No. 7 of 1999 entitled “Environmental Law” contains certain provisions related to solid waste management. The most important features of the law related to solid waste are (Hickman and Krueger, 2004):

- **Master Plan:** clause 7 requires EQA to prepare the Master Plan for solid waste management in coordination with other concerned agencies. The Plan is to provide locations and techniques for disposal.

- **Role of Councils:** Clause 7 requires that Local Councils to implement the solid waste Plan.
- **Recycling:** Clause 8 calls for promotion of recycling and reuse.
- **Technical Requirements:** Clause 9 authorizes EQA to develop or specify technical requirements for disposal facilities.
- **Hazardous Waste:** A broad definition of hazardous waste is provided in the Law. There is a need to develop regulations and a criterion to better define the limits of hazardous waste. The definition includes medical waste. Normally medical waste is not considered hazardous in the sense that it has chemical or radioactive concerns. The solid waste rules also address medical waste and allow them in sanitary landfills. The regulations should specify the criteria for accepting treated medical waste at sanitary landfills in order to prevent any conflict with the Law.
- **Clause 11-13** of the law mandate EQA develop a list of hazardous waste as well as regulation for its storage, treatment and disposal.
- **Permitting:** Clause 23 prohibits waste burning or dumping except at locations approved by EQA and according to its requirements. Therefore, EQA would need to develop a registration or list of approved sites. Clauses 46-48 specifically address permitting and burning.
- **Other Media:** The law contains provisions for air, water and noise (Clauses 19-30) that would be relevant in approval of solid waste facilities.

- **EIA:** Clause 45 authorizes EQA to require EIA for regulated activities according to rules to be published under this clause. According to the EIA policy an EIA will be required for solid waste facilities.
- **Inception and Enforcement:** Clause 49 authorizes inspection and enforcement. Authorized penalty levels for enforcement are not provided in the Law.

1.2.6 Proposed Global Solutions for Solid Waste Disposal

Environmental Quality Authority identified several projects and prioritized them for implementation in the West Bank (Center for Engineering and Planning, 2001):

- Construction of three landfills in Jenin, Ramallah , and Hebron.
- Construction of sanitary landfill site for hazardous waste.
- Feasibility study for slurry management and reuse
- Feasibility of composting in reducing solid waste quantities

The priority was given to the construction of waste facilities, waste reduction and waste recycling. The missing is a comprehensive national solid waste management plan. The plan should be comprehensive and should integrate all aspects of solid waste management and should cover all areas under the control of the Palestinian authority. In the absence of such a plan, the solid waste services will become more expensive (Center for Engineering and Planning, 2001).

If composting at the village level is adopted, the total quantities of waste requiring landfilling would be reduced, thereby making the site of landfills and required investment smaller. The need for transfer stations would

become more critical if the approach of three landfills was adopted on a national basis (Center for Engineering and Planning, 2001).

1.3 Study Area Framework and Characteristics

In this part we will handle the specific characteristics of Nablus area.

1.3.1 Geographical and Historical Background

Nablus District is one of the districts in Palestine. According to 1997 statistics Nablus has 72 localities populated by 251,392 inhabitants (Nowadays estimated at about 336,000).

Nablus city which is the main city in the District encounters within its boundaries about 170 thousand inhabitants according to 2006 projections (including the refugee camps). The total area of Nablus District is about 605 km² (Palestinian Central Bureau of Statistics, 1999).

The city of Nablus is one of the oldest in the world and has been a place of habitation for 4000 years (El-Masri 1996). Located 65 km north of Jerusalem, Nablus is considered the main business and residential center of the northern West Bank.

Its prime location also enhances its position in any future development plans, as it is located at the crossroads of the Jerusalem Jenin road running north to south, and the Tulkarm – Jordan Valley road running east to west (Arafat et al., 2006).

1.3.2 Localities and population

The existing localities in Nablus District are shown in Table A-1 of the appendix according to 1997 statistics compiled with the natural increase.

The table shows that there are 72 localities in Nablus of total population of 336,380 inhabitants in 2006.

1.3.3 Metrological data

For Nablus the monthly mean of air temperature and the Evaporation quantity varies between months according to table 1-8:

Table 1-8* : Monthly mean temperature and evaporation quantities for Nablus

Month	Temperature °C	Evaporation (mm)	Relative humidity
January	10.1	49.6	67
February	11.4	67.2	71
March	13.4	99.2	57
April	16.8	149.1	50
May	20.0	202.7	54
June	21.9	225.9	60
July	23.4	237.9	59
August	23.5	218.2	65
September	22.7	177.6	61
October	20.7	131.1	57
November	16.5	74.4	60
December	11.0	48.6	61
Average / Total	17.6	1,681	60.2

*(PCBS, 2005)

The annual average rainfall for Nablus is 663.5 mm. In the year 2005 the annual rain was 790.5 mm, and the average relative humidity is 60.2 (PCBS, 2005).

1.3.4 Joint Service Councils for Nablus

The ministry of local government in cooperation with international development agencies has focused on merging some local government units (LGU) together. The Joint Service Councils (JSC) in Nablus district is according to table 1-9.

1.4 Aim of the Study

The study aims at analyzing the current practices of solid waste management in Nablus district. This will be done in three aspects:

(1) Evaluation of current practices in solid waste collection and disposal in city, villages and camps

(2) Evaluation of the satisfaction and awareness of the citizen with the level of service provided.- It is also to figure out the main issues of interest for the citizens about the solid waste.

(3) Finding the composition of the solid waste in both city and villages.

Another main purpose of the study is finding out the most important problems concerning solid waste collection, transfer and disposal. Finding the main advantages and disadvantages of the current solid waste management system is also one of the aims of the study.

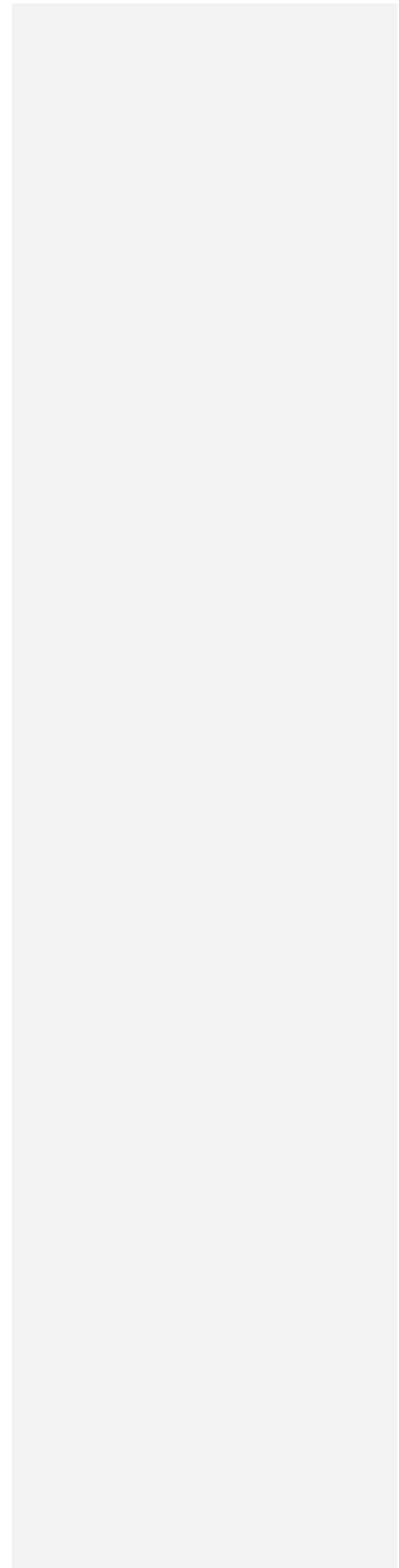
The main purpose at the end is to propose a comprehensive practical management system which is environmentally sound and economically feasible for dealing with the solid waste problem in Nablus district.

Table 1-9 * : Joint Service councils for Nablus District

No	Name of JSC	Participating LGU	Number of Participants
1	South Eastern Nablus	Beita , Odala, Awarta, Osarin, Za'atra,	5
2	East Nablus A	Beit Furik , Azmut, Deir Al Hatab, Salim, Beit Dajan, Rujeib, Kafr Qallil	7
3	East Nablus B	Aqraba , Qabalan , Yanun, Yatma, Jurish, Qusra, Talfit, Majdal Bani Fadil, Qaryut, Jalud, Duma	11
4	Huwwara	Huwwara , Jamma'in, Burin, Asira al Qibliya, Urif, Einabus, Zeita Jamma'in	6
5	North West Nablus	Sabastiya , Bizzariya, Burqa, Beit Imrin , Nisf Jubeil, Ijnisinya, Deir Sharaf, An Naqura	8
6	Al Aghwar Al Wusta	An Nassariya, Al ' Aqrabaniya, Beit Hasan, Ein Shibli, Frush Beit Dajan,	5

* According to interview with officials from MLG-Nablus

Chapter 2
Study Methodology



2.1 General

It is first to review the existing documents that deal with solid waste management issues in Palestine in general and especially in Nablus district. There were some studies done by local councils either to find donation for purchasing solid waste vehicles or for developing their dumping site. Nablus Municipality made a preliminary study on a proposed landfill site in Al Aghwar area.

Then it is to collect data. Special questionnaire was designed to collect information about the current management system in all localities of the district. 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. Sometimes the questionnaire was filled through a phone call with the key person. All the local councils were surveyed and one form was filled for each council. In case there was no solid waste management system the questionnaire was not filled. For Nablus municipality several meetings were conducted with the person in charge of the solid waste management, in addition to meetings with the accountant of the municipality. The data collected was the base for documenting the current management system in Nablus district localities. The researcher after that detected the variations between one locality and another. Also this helped in finding the main deficiencies in the current different management systems.

It was necessary to find the interaction of the citizens with the solid waste issues. This includes the awareness, concerns, satisfaction and interest. A special questionnaire was designed for this purpose. The questionnaire intends to clarify the above questions and trends. The questionnaire

includes data about the geographic location, income, number of family members. It is to check if there is relation between these independent variables and the other studied variables. The questionnaire was distributed to a representative sample of 1,068 households. Each locality received a number of questionnaires in proportion to its population to the total population of the district. These questionnaires were collected and analyzed using SPSS program (Statistical Package for Social Science).

The composition of the solid waste is very important in proposing any management system. Thirty samples were analyzed. The samples were chosen to cover the city and villages. For the camps the solid waste is collected with the city. Three sites were chosen for analysis, one that cover the city, the other covers some of the western localities and the third covers some of the eastern localities.

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

2.2 Household's Questionnaire

In providing any comprehensive solid waste system it is very important to find the trends of citizens. Trends will be in different aspects as the affordable solid waste fees, maximum walking distance to the container, readiness to participate in awareness campaigns. These dependent factors were analyzed with respect to independent factors as the locality type, house type, number of residents, and economic situation.

Special questionnaire was designed and distributed on a sample of citizens. It assesses knowledge and attitude of the citizens regarding the current management of solid waste. It detects the variation in attitudes and trends

between citizens of the city, camps and villages. It will also find the effect of demographic, geographic and economic conditions on the previously mentioned variables.

The satisfaction of citizens with the level of service provided was also assessed. This was correlated to effect of demographic, geographic and economic conditions on the variations if any.

The third target was finding the main problems in the current management system as seen by the citizen. Several questions in the questionnaire were guided toward this objective.

The forth target is to find out what solutions citizens propose to alleviate the problem of solid waste management. In fact some of the citizens ideas were important and worth discussing.

It was needed to know the number of population to be investigated. According to 1997 statistics, the number of households in Nablus Governorate is 42,886 (including the populations not served by solid waste system). The number of households in localities served by solid waste system is 41,883 households. It was assumed that the number of households had the same percentage of increase as the population. The gross percentage of increase will be the multiplication of the percentages of increase from 1997 to 2005 (in the West Bank) as follows:

Gross Percentage

$$=1.036*1.036*1.035*1.034*1.034*1.033*1.032*1.031*1.030$$

$$=1.34$$

Then the number of households had grown to 56,092 in 2006.

A sample was chosen to give a 95 % confidence level with a confidence interval of 3%. The required sample size was calculated according to the following formula (Kachigan, 1986):

$$ss = z^2 * p * (1-p) / E^2 \quad \text{where:}$$

ss: sample size to be taken.

z: z value (e.g. 1.96 for 95% confidence level), proportion of area under the normal curve above the indicated values of z.

P: percentage picking a choice, expressed as decimal (.5 used for sample size needed).

E= confidence interval, expressed as decimal, or maximum error for a given confidence level (e.g. 0.03 =+/-3).

Substituting in the above equation we get

$$\begin{aligned} ss &= 0.5 * 0.5 * (1.96 / 0.03)^2 \\ &= 1067.1 \end{aligned}$$

The above equation is for infinite population, for a finite population a correction factor shall be applied according to the following:

$$\text{New ss} = ss / (1 + (ss-1) / \text{pop})$$

Where pop is the population, the number of households which is 56,092 as calculated in table A-2

$$\begin{aligned} &= 1 / (1 + (1067.1-1) / 56092) \\ &= 1047 \end{aligned}$$

We use 1068 questionnaire. Which is larger than the required.

The sample chosen for the study was designed to cover all slices of society. The sample was taken from the city, camps and villages in proportion to their percentage. The sample consists of 1,068 households

as calculated previously. The distribution of selected households between different localities was done according to the relative population of each locality. Table A-2 in appendix shows also the number of samples applied to each locality.

For the city of Nablus and according to table A-2 the number of required questionnaires is 455. These questionnaires were distributed in all parts of the city.

Table 2-1 shows 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	434	40.6
Village	535	50.1
Refugee camp	99	9.3
Total	1,068	100.0

The data were analyzed using the SPSS software which makes it easy to correlate different variables with each other.

The questions were directed to find different aspects that may be arranged in categories. The first is related to the location of residence, type of locality (city or village camp), type of house (separate or apartment), and the average monthly income for the household residents.

The second group deals with the existing solid waste management system and includes questions about the current solid waste fee, and its collection frequency, and solid waste collection frequency.

A third group of question was directed to reflect the awareness of citizens with solid waste issues. This includes questions about the average weight of the daily house solid waste, meaning of solid waste, proposals from the citizen to enhance solid waste management.

A fourth group of questions measures the readiness of citizen to increase the solid waste fee and another measures the maximum distance that the citizen is ready to walk in order to throw the garbage.

A fifth group of questions that represents an exciting one. It reveals the social habit of who throw the garbage (father, mother or children). Other questions in this group reveal the readiness of citizens to separate the solid waste into five components (glass, plastics, metals, paper, and organics). A third is about the method the citizen is using to get rid of the food residuals. The last question in this group is about readiness of citizen to apply composting in his home.

The last group of questions indicates the condition of the current collection system represented by collection containers and the problems associated in addition to questions that indicate the satisfaction of the citizen with the current collection system.

Household's questionnaire is attached in the appendix..

2.3 Stakeholders questionnaire

In order to identify the existing collection and disposal system, a special questionnaire was designed. This questionnaire was directed to the stakeholders in the local councils. Sometimes the data were collected through direct personal interviews and in sometimes through the phone. In

all cases the study was explained so that the contacted party has full idea about the issues under study.

All the local councils were contacted to ensure comprehensiveness of data. The questionnaire included data about the locality and its population. It also includes data about the existing vehicles and equipment for solid waste collection system and the required ones. It also includes data about the frequency of solid waste collection.

The questionnaire includes also other miscellaneous questions; availability of solid waste workers, existence of collection containers, maintenance system, and the way in which the solid waste vehicle track was adopted.

Other category of questions deals with the financial aspects like the amount of solid waste fees, percentage collection, and methodology of collection.

Other category deals with data about the dumping site, its area, its ownership, method of disposal, and localities sharing the same dumping site.

The questionnaire that was distributed to the local councils is in annex A-2.

2.4 Analyzing composition of the solid waste

In order to get real data on the generated composition of solid waste a special sieve was designed and fabricated for this purpose. A total of 30 representative solid waste samples were taken and analyzed. Because of the heterogeneous nature of the solid waste, determination of the composition is not an easy task. Samples were taken from two dumping sites (Beit Imrin and Beita) in addition to the transfer station in Nablus.

Fourteen samples were taken from the city, eight samples were taken from the dumping site in Beita, and another eight samples were taken from dumping site in Beit Imrin.

The procedure of the sampling was done according to WHO method (WHO, 1988). A certain volume of solid waste was screened over the mesh screen for segregation into its different components. Common sense and random sampling was used in selecting the sample. A sample of size 0.5 m^3 was chosen each time for the purpose of segregation.

The 30 samples were qualitatively and quantitatively analyzed in screening equipment 1.5 m width by 3 m long. The screening surface is 10mm x 10 mm mesh size surface that used as go gages. This means that any solid waste less than 10 mm in diameter can pass through the screening surface. A 1m x 0.5 m x 1 m tank was filled with the solid waste sample. The tank was shaken three times without any pressing force on it. Then the tank content was disposed on the screening surface and manually separated into eight main components:

- (1) Organic and food wastes,
- (2) Plastic,
- (3) Paper and cardboard,
- (4) Glass,
- (5) Metals,
- (6) Textiles,
- (7) Other waste (leather, wood, ashes, etc), and
- (8) Waste less than 10 mm size.

Eight dustbins each of 80- liter capacity were used for the separation of the solid waste components. The empty weight of each dustbin was known. A special scale was brought to the sampling locations. The percentage of the solid waste components was computed. The total weight of the sample equals the summation of the weights of the eight components. The density of the whole sample was computed by dividing the total weight of the sample by 0.5. The sampling of the solid components has been performed during 4 days in July 2006 (2 days in the city and 1 day in each for the other two sites). The fieldwork started on 16th July and ended on 25th July 2006.

In addition, the density of each item was calculated using the equation:

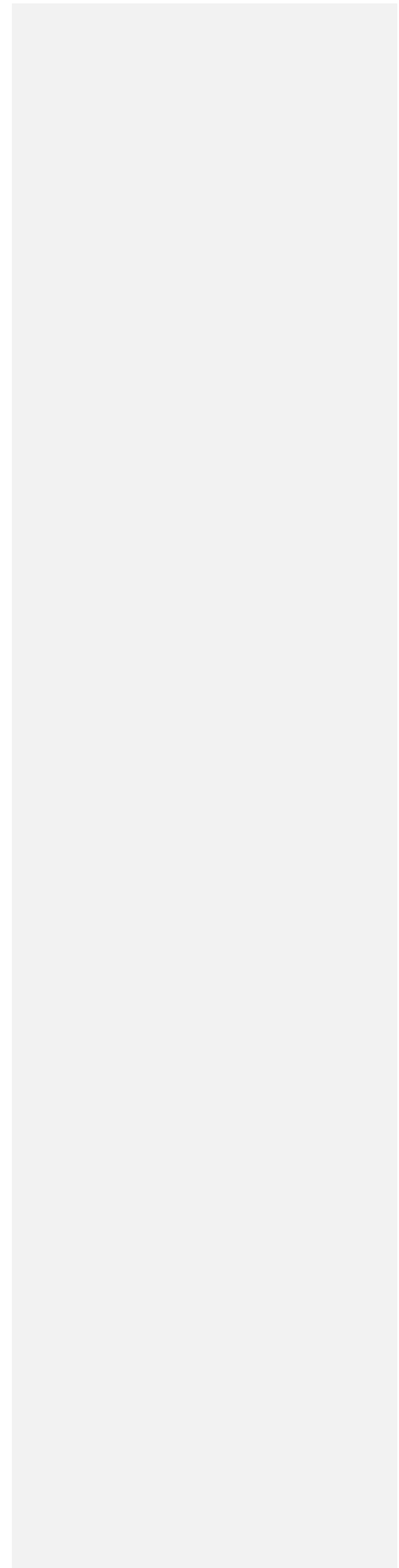
$$\text{Density} = \text{Weight} / \text{volume}$$

The density was calculated for the eight items.

The equipments used were: steel box with dimensions 1m x 1m x 0.5 m with four carrying hands, classification table covered with screen, whose openings are 1cm x 1cm, eight dust bins to fill in, and the shovels for carrying the solid waste materials for classification, hand gloves, and special balance (WHO, 1988).

Chapter 3

Results



3.1 Existing system for solid waste management in Nablus District

The questionnaire revealed important facts about the current solid waste management system in the localities of Nablus district. The most important results will be handled in the coming sections. The first one is presence or absence of a collection system in these localities. In case of the presence of a system main constituents of this system were recorded for analysis. These constituents deal with collection frequency, equipments, fees, service provider, etc.

3.1.1 Collection system

Recorded results were about the collection system in the localities surrounding Nablus city as well the city and the camps. These results were about the frequency of collection as well as the equipment used for collection. In this study we deal with the following items:

- (1) Equipments and labour,
- (2) Service provider, and
- (3) Main problems.

Nineteen localities out of 72 localities in Nablus district have no collection system at all. This represents 26% of the localities. But most of these localities have very small enrolment. The enrolment of the localities that are not served is 8,645 according to the projection for the year 2006. This represents 2.6% of the whole enrolment in Nablus District.

Table A-3 in Appendix shows the localities that have no solid waste collection system and enrolment of each one. Fig 3-1 shows the localities that have and those which do not have collection system.

One of the main localities that have no solid waste system is Kafr Qallil, where the population density is high. Other examples include some localities in Al Ghour area. But there, the population density is low, and they do not have any collection system. An-Nassariya, Al-A'qrabaniya, and Beit Hasan are some of these localities. According to the citizens there, absence of solid waste collection has created a serious problem in disposal of the waste.

The results of the study will be presented for the localities that have solid waste collection system. For sake of simplicity we can distinguish between the collection system in the city, in the refugee camps and in the surrounding villages.

3.1.1.1 Equipments and labor

Equipment and labor used in the city

There is currently no urban door-to-door collection. The collection system depends on equipments shown in table 3-1.

- Table 3-1 shows that the municipality has the following equipments: Steel Containers sized of 6,8,10 m³. 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 1 m³ size. They are the most common type of containers and are located in almost all parts of the city. In the past they were imported or come as aids to Palestinian from different donors. Nowadays they are manufactured locally. They are emptied by compacting trucks.

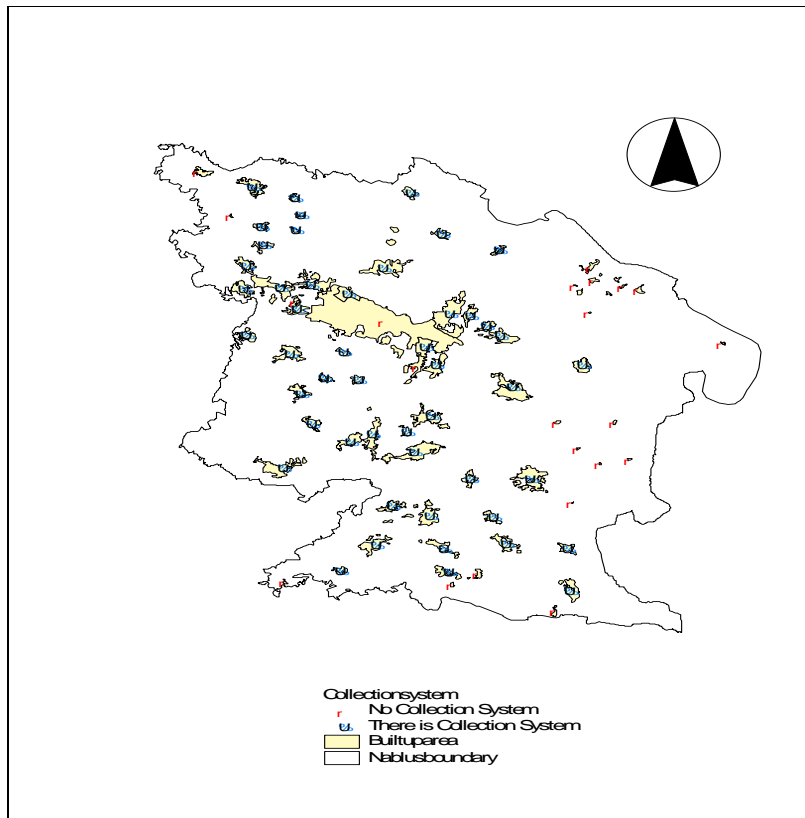


Fig 3-1: Existence of solid waste collection system in Nablus localities

- Steel containers of size 30 m^3 which are used in commercial center and removed once or twice a day.
- Rubbish carts: usually driven by labor and used for collecting garbage in front of houses and for collecting street littering.
- Compressors of solid waste which decreases its volume by 3-4 times.
- Special Containers for hospital and medical centers. The medical waste is collected inside these containers. There were 10 special containers around 0.6 m^3 each. Only 4 are working and the other 6 were damaged.

Table 3-1* : Existing Equipments in Nablus Municipality for solid waste in year 2006

No	Item	Number
1	Containers 1 m ³	1450
2	Containers 6 m ³	7
3	Containers 8 m ³	62
4	Containers 10 m ³	77
5	Containers 30 m ³	5
6	Compressor of Solid Waste	4 ^a
7	Rubbish carts wheel	90
8	Special containers for hospitals and medical centers	10 ^b
9	Compacting Trucks	8
10	Transporting Trucks	7
11	Large Tipper with Tractor	0
12	Sterilizing vehicle	1 ^c
13	Medical Incinerator	0
14	Medical waste Truck	1
15	Tractor	1

* (Halawah, 2006)

Notes:

^a Only one is working

^b Only 4 working and 6 are damaged

^c Not working

- Compacting Trucks that collects the containers and compact it 2-3 times denser.
- Transporting trucks that carry the large containers: 6,8,10, and 30 m³.
- Large tipper with tractor that carry the bulky items. There were one tipper truck, but now it is out of duty (not working).

- Medical Incinerator which is used for incinerating the medical waste. There was one incinerator and was a gift from the Spanish government. Unfortunately now it is not working.
- Medical Rubbish truck that collects the medical waste from hospitals and other health centers. There was one truck devoted for this issue.
- The total number of containers is 1601 which gives a ratio of 106 citizens / container.
- The total number of trucks is 15 which gives a ratio of 11,326 citizen / truck. This percentage compares with the figure of the MLG of providing a compacting truck for each 13,000 citizens (The Japanese grant).

A total of 240 laborers are working in the municipality for the health section. This figure also include in addition to labor that collects, the foremen, the administrative staff and also the technical staff.

Table 3-2 summarizes the available staff for the solid waste sector.

Table 3-2* : Available staff in Nablus Municipality for solid waste sector

No	Item	Number
1	Manager (Doctor)	1
2	Health Inspector	1
3	Driver	15
4	Foreman	27
5	Laborer (Cleaner men)	196
	Total	240

* (Halawah, 2006)

There is also additional supporting staff that works for other sectors like accountants, secretary, and administrative staff of municipality.

Table 3-3 shows distribution of the foremen according to their duties.

Table 3-3 *: Distribution of SW foremen in Nablus Municipality

No	Work Location	No. of Foremen
1	Mountain areas and peripherals	11
2	Central Vegetable market	1
3	Eastern city center	1
4	Eastern solid waste dumping site	2
5	With health inspector (morning)	2
6	Follow up with Roll On trucks	1
7	Evening Shift	4
8	City and Commercial center (Western)	3
9	Off duty (for 1 year)	1
10	Other	1
	Total	27

(Halawah, 2006)

The laborers are distributed in the different parts of the city as table 3-4 shows.

The laborers had decreased from 360 in year 2002 to 196 nowadays (Halawah, 2006). Still there is a need to increase the equipments to face the current and future challenges in the field of solid waste collection. Table 3-5 shows the required equipments.

Equipments used in the Refugee Camps:

In the refugee camps, the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) uses hand carts driven by labors in collecting waste from houses. These are collected outside the

camp in the 10 m³ size containers that belong to Nablus municipality. After that the municipality takes these containers for disposal. The distribution of laborers working in refugee camps is shown in table 3-6.

Table 3-4*: Distribution of SW laborers of Nablus Municipality

No	Work Location	No of laborers
1	Mountain areas and suburbs	94
2	Morning Shift (6-11am) – City center and western commercial market	16
3	Morning Shift –Old city and eastern market (6-11am)	23
4	Evening Shift (5-10 pm) – city center and commercial center	18
5	Compacting Trucks	12
6	Roll-On Trucks	7
7	Central Vegetable market	7
8	Italian Sanitary Unit	1
9	Municipal playground	1
10	Western garage sanitary unit	1
11	Cleaning The eastern garage	1
12	Cleaning sanitary unit at Habs Al Dam	1
13	Prisoner at Israeli prisons	2
14	Maintenance cart wheel	1
15	Spraying rats poisons	1
16	Spraying insecticides	1
17	Working as Foreman	5
18	Waiter in the health office in municipality	1
19	For “Nissan” cars at old city	2
20	Eastern Compressor	1
	Total	196

* (Halawah, 2006)

Equipments used in the villages:

The communities in the villages usually adopt manual door-to-door collection combined with truck transport. The localities can be classified according to the equipment they are using for collecting the solid waste as appears in table 3-7.

Table 3-5*: Urgent need for Nablus municipality for solid waste collection section

No	Specifications	Required	Unit Price \$	Total
1	Truck Compressor- gross weight 30 tons	3	90,000	270,000
2	Roll on off – gross weight 18 tons	3	100,000	300,000
3	Roll on off – gross weight 27 tons	1	150,000	150,000
4	Tipper – gross weight 18 tons	2	120,000	240,000
5	Loader	1	180,000	180,000
6	Truck – gross weight 30 tons	1	100,000	100,000
7	Small Tractor	2	25,000	50,000
8	Sweeper – gross weight 15 tons	2	120,000	240,000
9	Containers 8 m3 size	20	900	18,000
	Total			1,548,000

*(Mansour, 2006)

Table 3-6*: Solid Waste laborers and carts distribution for Nablus refugee camps

Item	Balata camp	Askar camp	Al Ein camp
Labor	19	15	6
Carts	19	15	6
Foreman	1	1	1

*(Miary, 2006)

Table 3-7 shows that 25 localities are using compacting truck for solid waste collection. These localities are enrolled with 87,362 inhabitants

which represents 27% of the served population. It also shows that 22 localities are using Tractor. These localities are enrolled with 64,702 inhabitants which represents 20% of the served population. Only one village is served by an ordinary truck which is Beit Wazen. The rest five localities are served by Nablus municipality. This covers 169,890 inhabitants which represent 53% of the population served.

Table 3-7: Classification of Nablus District localities according to the equipment used for solid waste collection (only served localities)

Equipment Used	The localities	Number of Localities	Total Populatio	Pop. %
Compacting Truck	Burqa, (Yasid, Beit Imrin, Sabastiya, Ijnisinya), (Deir Sharaf, Beit Iba), Asira ash Shamaliya, (Azmut, Beit Dajan), (Sarrah, Iraq Burin, Tell), Rujeib, (Madama ^a , Burin ^a , Einabus ^a , Urif ^a), (Huwwara, Beita, Odala ^c), Beit Furik, (Osarin ^b , Aqraba ^b , Majdal Bani Fadil ^b)	25	87,362	27%
Tractor	Bizzariya, Nisf Jubeil, Talluza, An Naqura, Al Badhan, Zawata, Qusin, Deir Al Hatab, Salim, Asira al Qibliya, Awarta, Zeita Jamma'in, Jamma'in, Yatma, Qabalan, Jurish, Qusra, Talfit, As Sawiya, Al Lubban Ash Sharqiya, Qaryut, Duma	22	64,702	20%
Truck	Beit Wazan	1	1,120	0%
Different Vehicles	Al Ein camp, Balata camp, Askar camp, Nablus city, Al Juneid	5	169,890	53%
Total		53	323,074	100%

Notes: Population according to enrolment projections for 2006

^a The compacting truck is a private property of the contractor

^b The compacting Truck is owned by Aqraba Municipality

^c The compacting Truck is owned by Beita Municipality

There is a case where the compacting truck is a private property of a contractor. This case appears in the villages of Madama, Burin, Einabus, Urif. These villages are served by the same contractor.

In the case of Aqraba the compacting truck is owned by Aqraba municipality. This municipality is acting as a contractor for the other villages (Osarin, Majdal Bani Fadil). The same case applies for Beita municipality which is acting as contractor for Odala.

It is noted that the currently available owned assets for solid waste sector are 10 compacting trucks and two tractors.

Most villages depend on collection the waste from a small container (about 50 liters) which is put by the household in front of the house at the collection time. Few exceptions to this case arise in Bizzariya, Burqa, Yasid, Sabastiya, Al Badhan, Asira ash Shamaliya, Azmut, Beit Dajan, Rujeib, Beit Furik which have few containers ranging in sizes between 90 and 1000 liters.

In the case of Rujeib, the compacting truck is serving only this village. This reflects on the cost of services as will be seen later.

3.1.1.2 Service provider

Nablus city

Solid waste Department of Nablus Municipality is responsible for collection of the solid waste in the city. The total population served by Nablus Municipality is 134,503 which represent 42% of the total served population.

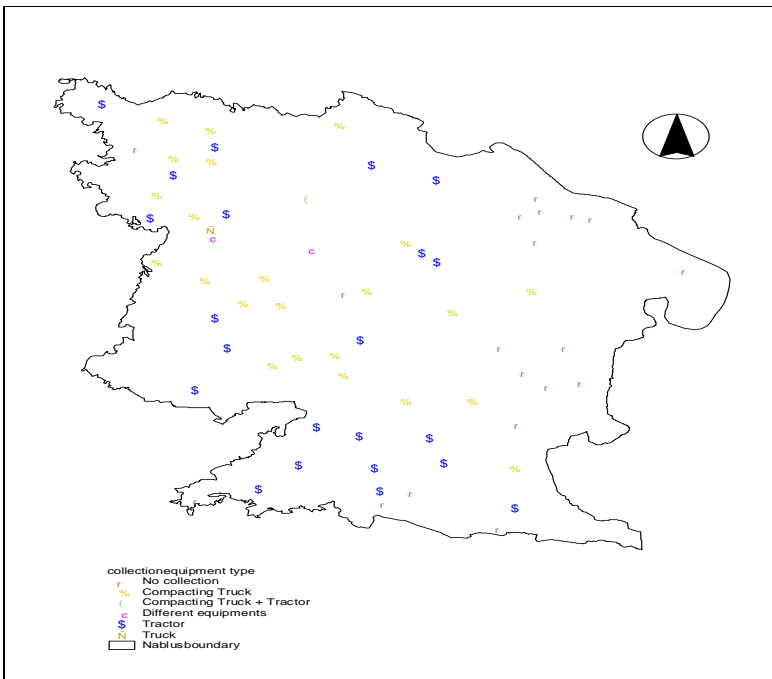


Figure 3-2: Equipment used for solid waste collection in Nablus localities

Refugee camps

The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) is responsible for collection within the borders of the refugee camps which are Askar Camp, Balata Camp, Al Ein Camp. The total population served by UNRWA is 35,387 which represents 11% of the total served population.

This service is not complete. UNRWA only took the solid waste from the camps to the near outside container. After that the municipality is taking it to the dumping site.

Surrounding villages

The service provider differs from locality to locality. Some localities are included within the collection system of the city like Al Juneid.

For the other villages that have a collection system, the service provider is one of the following:

- The village council or the municipality: In this case the council has its own equipment and employees and is managing the collection directly . In addition to the city there are 8 localities served by the councils. The population served is 44,797 which represents 14% of the total served population
- The Joint service Council Committee: In this case the committee has its own equipment. Each locality is paying his share according to the enrolment ratio with other localities that share the service. Thirteen localities are served by this type. The total served population is 39,137 which represent 12% of the total served population.
- A Private contractor: In this a private contractor collects the waste two or three times a week. In most cases the contractor has his own tractor. Usually this contractor is assisted by one of his relatives (In many cases his son). This reduces the cost of the service. In some cases one of the municipalities acts as a contractor for other village as in the case of Aqraba Municipality which is acting as a contractor for Majdal Bani Fadel and Osarin villages. In some cases the contractor has a compacting truck like the contractor of Madama, Burin and Einabous. Twenty seven localities are served by a contractor. The total served

population by this type is 69,250 which represent 21% of the total served population.

3.1.2 Solid Waste fees System

As the collection system represented by the equipments and service provider changes from location to location, also the fees changes. In this regard we are going to present the amount of the solid waste fee, frequency of collecting the fee (monthly or yearly), method of collecting the fee, and number of participants in the solid waste service.

Table 3-8: Classification of Nablus District localities according to the solid waste service provider (only served localities)

Service Provider	Localities	Number of localities	Pop. of localities	Pop. percentage
Council	Burqa, Nisf Jubeil, Asira ash Shamaliya, Rujeib, Beit Furik, Awarta, Aqraba, Qusra	8	44,797	14%
Contractor	Bizzariya, Talluza, An Naqura, Al Badhan, Zawata, Qusin, Beit Wazan, Deir Al Hatab, Salim, Madama, Burin, Asira al Qibliya, Urif, Odala, Einabus, Zeita Jamma'in, Jamma'in, Osarin, Yatma, Qabalan, Jurish, Talfit, As Sawiya, Majdal Bani Fadil, Al Lubban Ash Sharqiya, Qaryut, Duma	27	69,250	21%
Joint Service Council	(Yasid, Beit Imrin, Sabastiya, Ijnisinya), (Deir Sharaf, Beit Iba), (Azmut, Beit Dajan), (Sarraf, Iraq Burin, Tell), (Huwwara, Beita)	13	39,137	12%
Nablus	Nablus city, Al Juneid	2	134,503	42%
UNRWA	Al Ein camp, Balata camp, Askar camp	3	35,387	11%
Total		53	323,074	100%

Amount of fee in Nablus City

In Nablus city the existing fee for solid waste is 12JD /year on most residential house. Details about different categories for garbage tax tariff system are presented in table A-6 in the appendix.

Amount of fee in The Refugee camps

For the Refugee camps the UNRWA is responsible for collecting the solid waste. Thus residents of the camps do not pay any fee for this service

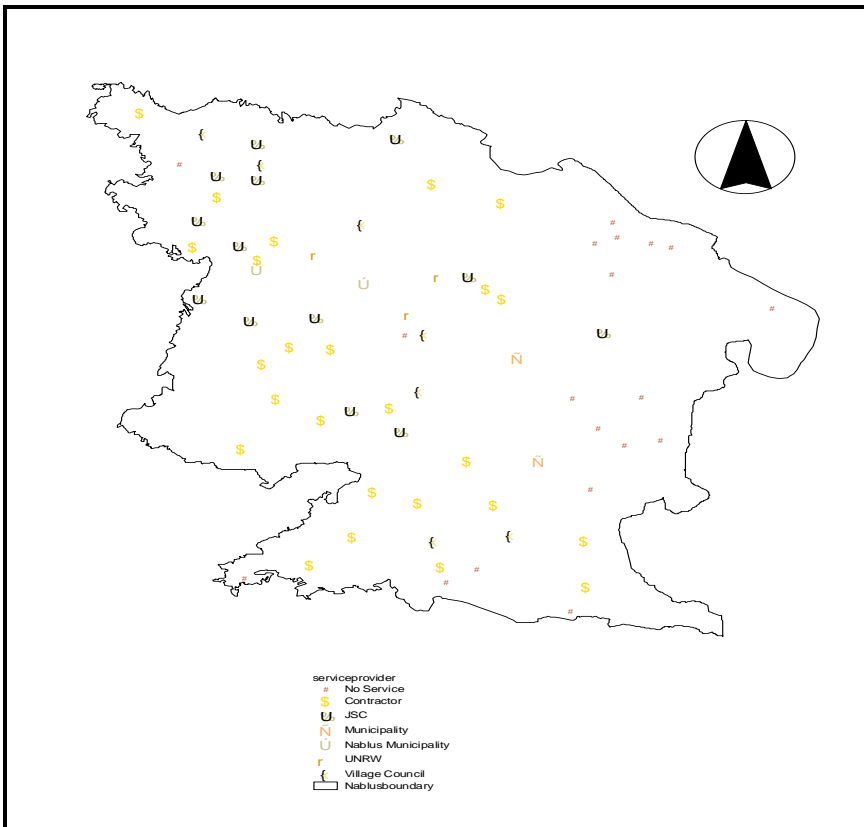


Fig 3-3: Classification of localities in Nablus district according to type of service provider

Amount of Fee in the Surrounding Villages

In the villages where the service is provided, the solid waste fees differ from locality to locality. Not only has the value of the fee differed, but also the method of collecting these fees. And of course the collection percentage differs from one village to another. Table 3-9 summarizes the monthly fee in the different villages.

The monthly fee ranges between 5 NIS and 15 NIS. It is noted that the dominant value of the fees is 8-10 NIS per month.

From table 3-8 we can conclude that 3 localities do not pay any fee (The camps). These represent 11% of the served population.

Twenty nine localities have a fee value between 5NIS and 9 NIS. These represent 28% of the served population.

Citizens of seventeen localities are paying the ten NIS fee. This represents 13% of the served population.

Four localities are paying fee value more than 10 NIS. This represents 6% of the served population.

For the case of the city, the citizens are paying 12JD per year. This is equivalent to 6.2 NIS per month. This applies on 42% of the served population.

Some villages had developed an improved fee system. An example of this is An Naqura village. It has a 6 NIS solid waste fee on the electricity bill as well as 6 NIS solid waste fee on the water bill.

Table 3-9: Classification of Nablus District localities according to the solid waste Fee amount (only served localities)

Monthly fee (NIS)	Localities	Number of localities	Pop. of localities	Pop. percentage
0	Al Ein camp, Balata camp, Askar camp	3	35,387	10%
5	Salim, Madama, Asira al Qibliya, Beita, Qusra, Al Lubban Ash Sharqiya	6	24,750	8%
6	Beit Dajan, Beit Furik, Awarta, Urif, Osarin	5	24,271	8%
7	Ijnisinya, Qusin, Azmut, Burqa,	4	9,047	3%
8	Bizzariya, Beit Imrin, Sabastiya, Al Badhan, Talluza, Deir Al Hatab, Sarra, Tell, As Sawiya, Qaryut	12	22,814	7%
9	Beit Iba, Jamma'in	2	9,048	3%
10	Yasid, Nisf Jubeil, Deir Sharaf, Asira ash Shamaliya, Zawata, Beit Wazan, Iraq Burin, Burin, Huwwara, Einabus, Zeita Jamma'in, Yatma, Jurish, Talfit, Majdal Bani Fadil, Duma, Odala	17	42,502	13%
11	Aqraba	1	7,931	2%
12	An Naqura	1	1,658	1%
13	Rujeib	1	3,915	1%
15	Qabalan	1	7,248	2%
76 annual Fee	Nablus city, Al Juneid	2	134,503	42%
Total		53	323,074	100%

Another one is Rujeib which has a 1JD solid waste fee on the electricity bill as well as 1JD solid waste fee on the water bill

Another one is Madama which has a 5 NIS solid waste fee on the electricity bill up to 10 person's family and additional 0.5 NIS for any additional person in the family.

Asira al Qibliya has a 5 NIS solid waste fee collected separately up to 5 persons family and additional 1.0 NIS for any additional person of family.

Huwwara applies 120 NIS annual solid waste fee collected separately, 150 NIS for grocery stores, 300 NIS for butchers and chicken slaughterhouses.

Jamma'in applies 9 NIS solid waste fee collected separately, 15 NIS for commercial stores.

Beit foureek applies 6 NIS solid waste fee. But for commercial stores it rises to 8 NIS.

Aqraba applies 11 NIS solid waste fee for residential, 18 NIS for commercial stores, and 22 NIS for multi houses invoiced on the electricity bills.

For Qabalan the solid waste fee for residential is 15 NIS and for commercial stores it is 30 NIS.

Method of collecting the fees differs from locality to locality. Some villages include the fee in the electricity or water bill. Others collect it separately. Some include it in both the electricity and water bill. Table 3-9 shows method of collection for each locality.

It appears that most of the localities include the solid waste fee within the electricity Bill. This may have advantage in achieving better collection percentage in addition to decreasing accountant effort and cost.

The table shows that eleven localities use separate collection. This represents 50% of the served population. The reason for the high percentage is presence of the city under this category.

Also the table shows that thirty five localities use the electricity bill for collecting the solid waste fee. This represents 35% of the served population.

Table 3-9 shows that two localities use the water bill for collecting the solid waste fee. This represents 1.5% of the served population.

Also the table shows that two localities use both the water and electricity bills for collecting the solid waste fee. This represents 1.7% of the served population.

Another variant is the frequency of collecting the fees; while Nablus, Talluza, Huwwara collect the fee annually, all other localities collect it on monthly basis.

Table A-4 in the Appendix shows the number of participants in solid waste service system in each locality. It appears that the number of participants ranges between 80 (in Nisf Jubeil) to 30,480 (in Nablus city).

The total number of participants is 55,618. In the city there are 55% of the participants.

Table 3-10: Classification of Nablus District localities according to the type of SW collection system

Collection System	Localities	Number of localities	Pop. of localities	Pop percentage
Separate Collection	Nablus, Talluza, Al Badhan, Zawata, Beit Iba, Sarra, Tell, Asira al Qibliya, Huwwara, Jamma'in, Al Juneid, Beit Wazan	11	162,570	50%
On Electricity Bill	Bizzariya, Burqa, Yasid, Beit Imrin, Nisf Jubeil, Sabastiya, Ijnisinya, Asira ash Shamaliya, Qusin, Azmut, Deir Al Hatab, Salim, Iraq Burin, Beit Dajan, Madama, Burin, Beit Furik, Awarta, Urif, Odala, Beita, Zeita Jamma'in, Osarin, Aqraba, Yatma, Qabalan, Jurish, Qusra, Talfit, As Sawiya, Majdal Bani Fadil, Al Lubban Ash Sharqiya, Qaryut, Duma	35	114,565	35%
On Water Bill	Deir Sharaf, Einabus,	2	4,979	2%
On Water & Elec. Bill	An Naqura, Rujeib,	2	5,573	2%
No Collection	Al Ein camp, Balata camp, Askar camp	3	35,387	11%
Total		53	323,074	100%

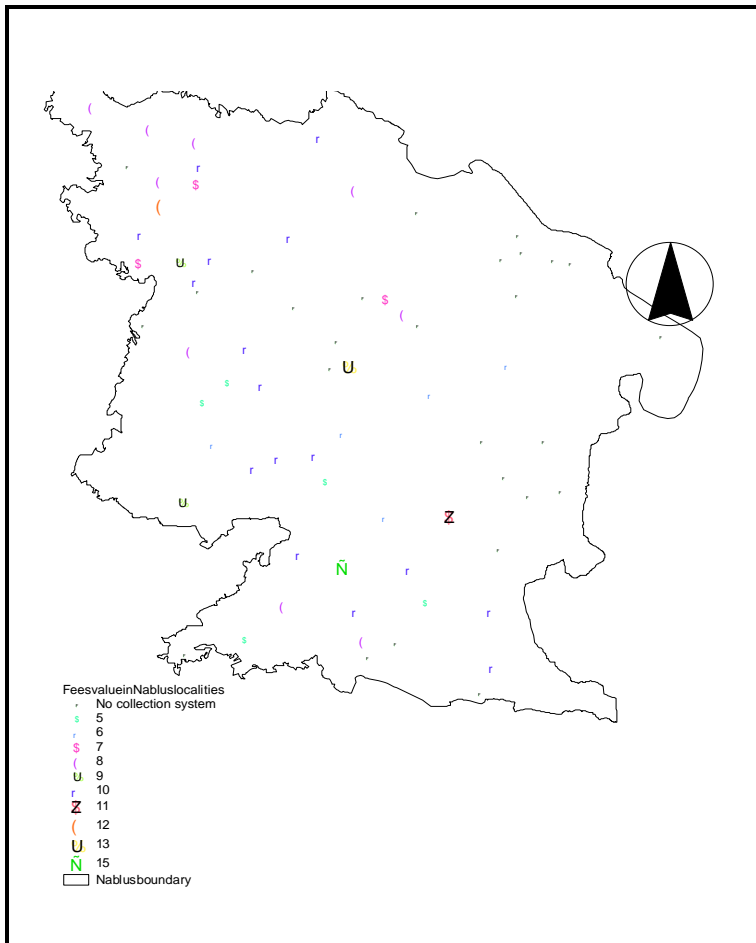


Fig 3-4: Solid Waste Collection Fees in Nablus Localities

3.1.3 Disposal System

Nablus City

In the case of Nablus city, all the refuse produced in Nablus are discharged in a dump (as a transfer station) located near the industrial area at a distance of approximately 6 kilometers from the city center of Nablus.

All the various refuse produced in Nablus city are actually unloaded in the existing dump (transfer station) without being separated. This refuse is generated from the following sources:

1. Residential (single family homes, multi-family homes, parks, etc)
2. Commercial (Shops, offices, retail stores, parks, landscaping, restaurant, hotels, slaughterhouse, services stations, green market)
3. Industrial (Small –scale manufacturing, trades and crafts)
4. Institutional (universities, schools, hospitals, governmental offices)
5. Agricultural (animal farm wastes, plant nurseries, olive mills)

Furthermore in the existing dump are also discharged at present dead animals, infectious materials coming from hospital. There are also blood containers, hazardous and uncontrolled waste. No any restrictions are present in the site and you can expect to find any type of waste.

At the moment it is not operating any system to prevent air and groundwater pollution. In fact the unloaded refuse are sometimes burnt in the open air with enormous danger for the health of the citizens of Nablus area. After that, the waste is disposed into Al Aghwar area in a legal site. This costs the municipality a great part of its restricted income. The municipality pays around sixty two NIS for disposal of each ton.

In some times of closure, the Israelis prevent the transfer of solid waste, so it is thrown in a near area called Al Sairafy on Al- Badan main road.

Refugee Camps

The solid waste collected by the UNRWA is merged with the city waste. Nablus municipality is disposing it after that as explained earlier. The municipality is now negotiating with the UNRWA about the responsibility of disposal of these wastes after being collected from the refugee camps.

The villages

For many municipalities, the closure of initial network before Intifada, has resulted in the establishment of emergency sites closer to collection areas

The villages differ in disposing their waste from locality to locality. Some dispose it randomly where the driver of the truck find a place to empty his truck. Some have a definite place where they dispose their waste. And some dispose it with Nablus Municipality like Rujeib village. Some villages are renting their dumping site. Table 3-10 shows the classification of localities according to dumping site ownership type.

The table shows that seven localities are using random sites. This represents 6% of the served population.

Nine localities are renting land and paying for this rent. This represents 7% of the served population.

Six localities are disposing their waste on governmental land. This represents 5% of the served population. For this type of dumping site, there is a specific location where the truck driver empties the waste.

Twenty three localities are disposing their waste on a land owned by the local council. This represents 27% of the served population. One of the

distinguished ones is that of Aqraba. This dumping site has an area around 40 donums. It is owned by Aqraba municipality and two additional villages are using it.

In one case the dumping site is rented by the contractor who collects the waste and is paying 600 NIS for each village he is using the site for. This is the case with the contractor of Burin, Madama, Einabus, and Urif.

For the random sites there is no specific place for emptying the truck. Usually there is open area or beside the Wadi. This is usually left to the judgment of the tractor driver.

The total number of dumping sites is thirty four. This figure includes the transfer station of the city. Sometimes several localities are benefiting from the same dumping site as can be seen from localities between brackets in the table in the Appendix. For example for the dumping site of Deir Sharaf, Beit Iba other villages of Jenin district are using it like Ajja, Anza, Jaba..etc.

For the case of private ownership, this means the land is owned by a citizen but it is used as dumping site without any rental value. The only case is in Burqa.

Table 3-11: Classification of dumping sites of Nablus District localities according to ownership type

Ownership type	Localities	No of DS	Number of localities	Pop. of localities	Pop. %
Random sites	An Naqura, Al Badhan, Beit Wazan, Sarra, Salim, Talfit, Duma	7	7	18,304	6%
Rented	Nisf Jubeil, Zeita Jamma'in, Yatma, Qusra, Al Lubban Ash Sharqiya, (Burin, Madama, Einabus, Urif) ¹	6	9	21,680	7%
Governmental land	Bizzariya, (Deir Sharaf, Beit Iba), Qusin, Beit Dajan, Asira al Qibliya	5	6	15,787	5%
Council owned	(Yasid, Beit Imrin, Sabastiya, Ijnisinya), (Talluza, Asira ash Shamaliya) ³ , Azmut, Deir Al Hatab, Iraq Burin, Tell, Beit Furik, Qabalan, Jamma'in, (Awarta, Odala, Huwwara, Beita) ² , (Osarin, Aqraba, Majdal Bani Fadil) ⁴ , Jurish, As Sawiya, Qaryut	14	23	87,568	27%
Private	Burqa	1	1	4,030	1%
With Nablus city	Zawata, Rujeib, Askar camp, Balata camp, Al Ein camp, Al Juneid, Nablus city	1	7	175,705	54%
Total		34	53	323,074	100%

Notes:

¹ The dumping site is rented by the contractor who collects the waste and is paying 600 NIS for each village he is using the site for.

² The dumping site is owned by Beita municipality

³ The dumping site is owned by Asira ash Shamaliya municipality

⁴ The dumping site is owned by Aqraba municipality

3.1.4 Solid waste expenses and income

In this section we will present the expenses and income of the solid waste sector in the city and villages. In addition the role of the private sector in providing the service will be presented.

In the city

Not so many studies had been made on this issue. But there is a recent study done by municipality about that. This study reveals a huge cost is being expended on solid waste collection and disposal. The study summarizes the expenditures for the year 2005 as shown in table 3-12:

Table 3-12*: Cost of solid waste collection and disposal, for Nablus municipality

Item	Sub Item	Cost NIS
Direct Operating Costs	Transfer and dispose solid waste Fees	3,104,104
	Weighting solid waste fees	17,740
	Salaries of the health employees	6,496,705
	Required cleaning materials and supplies	9,121
Direct Administration Costs	Administrative costs (health Section)	270,853
Indirect Costs	Indirect Operating Costs	109,638
	Indirect Administrative Costs	929,490
Total		10,937,651

*Accounting department, Nablus municipality for the period 1/12/2004 and 30/11/2005

The indirect operating cost that appears in the table represents 5% of the expenditure on insurance, licensing, maintenance and fuel for municipality vehicles.

The indirect administrative cost represents 5% of the administrative and salaries expenditure of the accounting, head, mechanical and transport sections.

From table 3-12 it is clear that the wages and salaries consume the major part of the budget and reaches around 60% from the expenditures.

On this basis we can calculate the cost of collection and disposal of each ton if we know that the total quantity of solid waste was 50,022 tons.

Table 3-13*: Breakdown Cost of solid waste collection and disposal per ton, for Nablus Municipality

Item	Cost of each item per ton	Cost (NIS)
1	Transfer and dispose	62
2	Weighing	0.4
3	Wages and salaries	130
4	Cleaning costs	0.2
5	Direct Administrative costs	5
6	Indirect operating costs	2
7	Indirect Administrative costs	19
	Total	219

*accounting department, Nablus municipality

This table reveals that each ton costs the municipality around 219 NIS for collection and disposal.

The tariff system of the solid waste fee in the city of Nablus is 12 JD annually for residential houses.

The full details about different categories are presented in table A-6 in the appendix. Currently there are 30,480 participants; most of them are household units.

According to municipality the fee collection in 2005 was supposed to be 1,865,091 NIS which represents a small portion of the total expenditure costs (only 17%). So the fee should be six times the current fee in order to cover the expenses. Suggestions for increasing the collection percentage are by increasing awareness, and charging the fee on electricity bill instead of separately.

Expenses and income in the surrounding villages

The researcher wants to present the adequacy of the current fee for covering the expenses of solid waste collection and disposal. Assuming the percentage of fees collection is 100%, and then the income will be simply the multiplication of the number of participants times the fee value. The expenditure will be the cost paid by the council to cover the solid waste collection and disposal. This cost includes the equipments, the laborer, the street cleaning (if any), and the cost of renting the dumping site (if any).

Table A-5 in the appendix shows the income and expenditure of the villages for the solid waste. It is clear that most of the localities is recovering their expenditures assuming 100% collection.

One of the localities not recovering their expenditure is Beita. There is a shortage of 2,600 NIS monthly. But currently Beita had raised the fee from 5 to 7 NIS.

Another locality is Qabalan. It had the highest fee in the district. But there is a monthly shortage of 3,500 NIS.

Another locality is Qusra. There is a monthly deficiency of 1,500 NIS.

Another locality is Al Lubban Ash Sharqiya. There is a monthly deficiency of 950 NIS.

All other localities are recovering their expenses or making some savings.

3.1.5 Role of the private sector in solid waste management

The private sector is already playing a major role in the delivery of solid waste management services in Nablus governorate. About 10,000 household in the villages are served by private contractors. This represents 21% of the served population. The contractors usually own a tractor and a trailer that they use to collect the garbage and deliver it to the local dumping site.

Around 15,000 household in the villages are served directly by local councils or joint service councils. This represents 26% of the served population. Even the service provided by the local councils, sometimes the labor for the available equipment is contracted and not salary based appointed. This proves to be a good policy that reduced management effort and costs and improves the service.

3.1.6 Solid waste quantities

The quantities of solid waste in Nablus city are accurate. This is because a contractor is taking the waste to a landfill and is charged per ton. The price differs from contractor to contractor and from time to time. The average price in each year could be used for analysis although the variation in the price in each year is very large from one contractor to another. Table 3-14 shows the prices as taken from Nablus Municipality that covers the years 2002-2005:

Table 3-14 * : Solid waste quantities and their disposal cost for the years 2002-2005 Nablus municipality

Year	Quantity (tons/year)	Population	Mean generation rate (kg/cap/day)	Total Cost (NIS)	Cost Range NIS/ ton	Average cost NIS / ton
2002	42,153	154,649	0.75	1,321,168	20-45	31.3
2003	59,284	159,753	1.02	1,901,148	20-49	32.1
2004	40,716	164,864	0.68	2,492,023	60-62.5	61.2
2005	51,160	169,975	0.82	3,137,029	30-62.5	61.3

* (Fahed, 2006)

These quantities cover the localities of Zawata, Ein Beit El Ma refugee Camp, Al Juneid, Nablus, Askar refugee Camp, Balata refugee Camp, and Rujeib. According to population projection in 2006, the total enrolment of the previous localities is 175,705 inhabitants.

The method of disposing solid waste is by transferring the waste to a legal site. The municipality tenders this service for contractors and usually the lowest price win the tender. During the year several tenders are done. Column four in the above table shows the total cost burdened by the municipality for disposing the solid waste. Column five shows the contractors prices ranges. It is clear that there is wide range. The lower range of 20 NIS per ton is exceptional. This is the case when there is a closure on the city. In this case the contractor is taking the solid waste to a nearby location (Al Sairafy), with no need to transfer a long distance.

This means that the average daily generation of solid waste ranges between 0.75 to 1.02 kg/ cap-day. The average is 0.82 Kg/ cap-day.

There are no accurate records about the solid waste quantities in villages. Some studies suggest 0.4-0.6 Kg /cap/day in rural areas and 0.6-0.8 in towns/ villages (United Nations Environment Programme, 2003).

3.2 Interaction of citizens with solid waste issues

Awareness of citizens is very important. A special questionnaire was designed as explained in Chapter II. The questionnaire is designed to measure the awareness and concerns of citizens about solid waste issues. This is assessed by asking the citizen about some concepts like definition of solid waste and also his readiness to participate in solid waste campaigns. The response of the citizen for suggesting proposals to improve solid waste management system will be detected.

In this part we are going to present the results collected through the questionnaire.

The sample was comprehensive and included the separated households as well as the flats in buildings as shown in table 3-15:

Table 3- 15: Sample distribution according to residence type

Type of house	Frequency	Percent
Separate	767	71.8
Apartment	301	28.2
Total	1068	100.0

The mean number of residents in each house was 6.45. The number of r
Also the average monthly income for each household differs in accordance with table 3-17.

Residents in each household differs in accordance with table 3-16.

Table 3-16: Sample distribution according to number of residents

No of residents	Frequency	Percent
1-3	138	13.1
4-6	405	37.9
7-9	396	37.1
10 or more	129	11.9
Total	1,068	100.0

Table 3-17: Sample distribution according to average monthly income

Average monthly income (NIS)	Frequency	Percent
less than 1501	355	33.2
1501-3000	403	37.7
3001-5000	192	18.0
more than 5000	118	11.0
Total	1068	100.0

The maximum affordable fee for improving solid waste collection

In this section we are going to present the affordability of citizens to pay for solid waste services in relation with: locality type, house type, and average monthly income.

The question was: what is the maximum monthly fee in Jordanian Dinars that you are willing to pay in case the solid waste collection system was improved. The results were as shown in table 3-18:

Table 3-18: Locality type versus maximum affordable fee (number and valid percentage)

Locality Type	maximum affordable fee				Total
	1-2	3-4	5-6	7-8	
City	123 (31.5)	154 (39.4)	62 (15.9)	52 (13.2)	391 (100.0)
Village	180 (36.4)	187 (37.8)	72 (14.5)	56 (11.3)	495 (100.0)
Camp	22 (34.4)	30 (46.9)	7 (10.9)	5 (7.8)	64 (100.0)
Total	325 (34.2)	371 (39.1)	141 (14.8)	113 (11.9)	950 (100.0)

Table 3-18 reveals that the class of citizens ready to pay more than 5JD per month is very low. In the city the percentage is 26% while in the villages it is 18% and in the camps it is only 12%.

Although in reality when adopting a solid waste tax system the citizens may retreat, still these figures show the trend in variation between the city and the village and the camps, and distribution of classes of citizens according to affordability to pay.

Another variable is the house type, whether it is a flat in a building or a separate house. Table 3-19 reveals some facts about the reply of citizens:

Table 3-19: House Type versus maximum affordable fee (number and valid percentage)

House Type	maximum affordable fee				Total Valid	Total
	1-2	3-4	5-6	7-8		
Separate	239 (34.7)	266 (38.6)	101 (14.7)	83 (12.0)	689 (100.0)	767
Apartment	86 (33.0)	105 (40.2)	40 (15.3)	30 (11.5)	261 (100.0)	301
Total Count	325 (34.2)	371 (39.1)	141 (14.8)	113 (11.9)	950 (100.0)	1068

71% of citizens who live in a separate house are ready to pay up to 4 JD/month. This percentage is 73% for the citizens who live in a flat in a building. The percentage is nearly the same for both the citizens of the flats and those who live in a separate house.

From the cross tabulation, it was found that there is a statistically significant relationship between the average monthly income and the maximum affordable fee for improving solid waste collection (P-value=0.001) as shown in table 3-20.

The Pearson Chi- square equals 0.001 which indicates that there is a significant relationship between the average monthly income and the maximum affordable fee for improving solid waste collection.

Table 3-20: Average monthly income versus maximum affordable fee (number and valid percentage)

Average monthly income	maximum affordable fee				Total Valid	Total
	1-2	3-4	5-6	7-8		
Less than 1501 NIS	126 (40.4)	116 (37.20)	42 (13.50)	28 (9.0)	312 (100.0)	355
1501-3000 NIS	122 (33.8)	147 (40.7)	50 (13.9)	42 (11.6)	361 (100.0)	403
3001-5000 NIS	54 (32.1)	63 (37.5)	33 (19.6)	18 (10.7)	168 (100.0)	192
more than 5000 NIS	23 (21.1)	45 (41.3)	16 (14.7)	25 (22.9)	109 (100.0)	118
Total	325 (34.2)	371 (39.1)	141 (14.8)	113 (11.9)	950 (100.0)	1068

This relationship can be explained as follows. 77% of citizens whose income is less than 1501 NIS are ready to pay up to 4 JD/ month. This percentage is 74% for the citizens whose income is between 1501-3000 NIS. But for those who have income between 3001-5000 NIS the percentage reaches 69%. And for those whose income greater than 5000 NIS, it reaches 63%.

These percentages make sense. As it is expected, the lower economic level has higher percentage in the lower affordable ranges.

The maximum walking distance to the container

A question was: what is the maximum distance you are ready to walk to the container. According to WHO the recommended distance between the containers is 150m (WHO,1988). This implement a maximum walking

distance of 75m. The citizen had to choose one answer out of four. The answers were: 10-20m, 21-50m, 51-100m, and 101-150m. The results were analyzed with respect to locality type, house type, No of residents, and average monthly income.

Table 3-21 shows that 80% of the city citizens are ready to walk up to 50 meters to the container. In the villages this percentage reaches 78% and in the camps it reaches 73%. No notable differences between the three zones. Although, the camps have the lowest percentage as they are ready to walk larger distances.

From the cross tabulation, it was found that there is a statistically significant relationship between the house type and the maximum walking distance to the container (P- value =0.015) as shown in table 3-22.

This relationship can be explained as follows. 77% of the citizens who live in a separate house are ready to walk up to 50 m to the container.

Table 3-21: Locality Type versus maximum walking distance to the container (number and percentage)

Locality Type	Maximum distance, citizens are willing to walk to the container (m)				Total
	10-20	21-50	51-100	101-150	
City	222 (51.2)	127 (29.3)	54 (12.4)	31 (7.10)	434 (100.0)
Village	278 (52.0)	140 (26.2)	56 (10.50)	61 (10.4)	535 (100.0)
Camp	46 (46.50)	27 (27.3)	14 (14.1)	12 (12.1)	99 (100.0)
Total	546 (51.1)	294 (27.5)	124 (11.6)	104 (9.7)	1068 (100.0)

For the citizens who live in a flat in a building the percentage reaches 82%. This means that citizens living in a separate house are ready to move a larger distance to the container.

Table 3-22: House Type versus maximum walking distance to the container (number and valid , percentage)

House Type	maximum distance, citizens are willing to walk to the container (m)				Total
	10-20	21-50	51-100	101-150	
Separate	401 (52.3)	192 (25.0)	89 (11.6)	85 (11.1)	767 (100.0)
Apartment	145 (48.2)	102 (33.9)	35 (11.6)	19 (6.3)	301 (100.0)
Total	546 (51.1)	294 (27.5)	124 (11.6)	104 (9.7)	1068 (100.0)

The relation between the number of residents in the household and the maximum walking distance are shown in the table 3-23.

Table 3-23: Number of residents versus maximum walking distance to the container

Number of residents in the household	maximum distance, citizens are willing to walk to the container (m)			Total
	10-20	21-50	101-150	
1	4 (57.1)	1 (14.3)	1 (14.3)	7 (100.0)
2	19 (48.7)	9 (23.1)	7 (17.9)	39 (100.0)
3	42 (45.7)	30 (32.6)	9 (9.8)	92 (100.0)
4	62 (49.2)	38 (30.2)	8 (6.3)	126 (100.0)
5	60 (54.5)	31 (28.2)	11 (10.0)	110 (100.0)
6	85 (50.3)	48 (28.4)	17 (10.1)	169 (100.0)
7	95 (54.6)	41 (23.6)	16 (9.2)	174 (100.0)
8 or more	179 (57.7)	96 (31.0)	35 (11.3)	310 (100.0)
Total	546 (51.1)	294 (27.5)	104 (9.7)	1068 (100.0)

There is no significant relationship between the number of residents and the maximum walking distance to the container. This indicates that large families had the same willing to walk to the container as small families.

The maximum walking distance that the citizens are ready to walk with respect to average monthly income is shown in table 3-24:

Table 3-24: Average monthly income versus maximum walking distance to the container

Average monthly income	maximum distance, citizens are willing to walk to the container (m)				Total
	10-20	21-50	51-100	101-150	
less than 1501 NIS	189 (53.2)	88 (24.8)	34 (9.6)	44 (12.4)	355 (100.0)
1501-3000 NIS	208 (51.6)	116 (28.8)	50 (12.4)	29 (7.2)	403 (100.0)
3001-5000 NIS	101 (52.6)	52 (27.10)	23 (12)	16 (8.3)	192 (100.0)
more than 5000 NIS	48 (40.7)	38 (32.2)	17 (14.4)	15 (12.7)	118 (100.0)
Total	546 (51.1)	294 (27.5)	124 (11.6)	104 (9.7)	1068 (100.0)

There is no significant relationship between the average monthly income and the maximum walking distance to the container. This indicates rich and poor families have the same willing to walk to the container

Readiness to participate in awareness campaigns

To measure the interest of citizens in improving the solid waste management, they were asked about their readiness to participate in awareness campaigns. The results were as shown in table 3-25.

Table 3-25: Locality Type versus readiness to participate in awareness campaigns

Locality Type	readiness to participate in awareness campaigns		Total
	yes	No	
city	264 (60.8)	170 (39.2)	434 (100.0)
village	354 (66.2)	181 (33.8)	535 (100.0)
camp	67 (67.7)	32 (32.3)	99 (100.0)
Total	685 (64.1)	383 (35.9)	1068 (100.0)

Table 3-25 shows that 4.1% are ready to participate in such campaigns. The percentage in the city is 60.8% while in the villages it is 66.2%. This reflects the interest of the village citizens to improve their management system. This may be due to more problems with solid waste issue, or to their interest and having enough time to do. In the camps this percentage is 68% which is more than city and very close to the village.

From the cross tabulation it was found that there is a statistically relationship between the average monthly income and readiness to participate in awareness campaigns (P-value=0.038) as shown in table 3-26.

The results are explained as follows. It is noted that there is a trend for lower participation in these campaigns as the income increases. This may be due to less available time as the income increases. 43% of high income citizens are not willing to participate in these campaigns, while this percentage is 31% for low income citizens.

Table 3-26: Average monthly income versus readiness to participate in awareness campaigns

Average monthly income	readiness to participate in awareness campaigns		Total
	Yes	No	
less than 1501 NIS	244 (68.7)	111 (31.3)	355 (100.0)
1501-3000 NIS	261 (64.8)	142 (35.2)	403 (100.0)
3001-5000 NIS	113 (58.9)	79 (41.1)	192 (100.0)
more than 5000 NIS	67 (56.8)	51 (43.2)	118 (100.0)
Total	685 (64.1)	383 (35.9)	1068 (100.0)

The person in charge of picking the waste to the container

This question is important to find the community tradition in this respect. The citizen was given the following alternatives to pick from them the answer on who is picking the waste to the container: The father, the children, the mother, others, all the previous. Note that the answer to the question will be about the person who is taking the waste most of the time.

From the cross tabulation, it was found that there is a statistically significant relationship between the locality type and the person in charge of throwing solid waste away (P-value= 0.000) as shown in table 3-27.

Table 3-27: Locality Type versus who is in charge of throwing away the solid waste

Locality Type	who is taking the solid waste away					Total
	Father	children	Mother	Other	All	
City	88 (20.3)	182 (41.9)	17 (3.9)	69 (15.9)	78 (18.0)	434 (100.0)
Village	47 (8.8)	206 (38.5)	81 (15.1)	60 (11.2)	141 (26.4)	535 (100.0)
camp	17 (17.2)	46 (46.5)	7 (7.1)	12 (12.1)	17 (17.2)	99 (100.0)
Total	152 (14.2)	434 (40.6)	105 (9.8)	141 (13.2)	236 (22.1)	1068 (100.0)

This relationship can be explained as follows. The father is throwing the waste in 14.2% of the time. This percentage is 20.3% in the city, and only 8.8% in the village, and 17.2% in the camps. It is very clear that city the father is doing this duty more than in the village.

The children are throwing the waste in 40.6% of the time. This percentage is 41.9% in city, and 39% in the village and 46.5% in the camps.

The mother is throwing the waste in 9.8% of the time. This percentage is 3.9% in the city, and 15.1% in the village and 7.1% in the camps. It is very clear that in the city the mother is rarely throwing the garbage compared to the mother in the village.

Main Problems related to solid waste containers

A question was designed to find the main problems related to solid waste containers. The citizen was asked to answer if there is a problem or there is no problem with the following items:

- 1) Absence of solid waste container
- 2) Far distance of container from house
- 3) Sound annoyance when emptying the container
- 4) Smells coming from container
- 5) Insects and rodents close to container
- 6) Not emptying the container regularly
- 7) Continuous Dirtiness of container

Table 3-28 shows the main problems as seen from the household.

The most dominant problem is the smells coming from the container as 49% of citizens are complaining from it. The most suitable distance would be 50-100 m. In the second rank come the insects and rodent and the dirtiness of the container.

Table 3-28: Distribution of households according to the presence of problems related to solid waste containers

Type of problem	Number	Percentage
Absence of solid waste container	257	24
Far distance of container from house	284	27
Sound annoyance when emptying the container	228	21
Smells coming from container	521	49
Insects and rodents close to container	501	47
Not emptying the container regularly	299	28
Continuous Dirtiness of container	488	46

The far distance and not emptying the container regularly came in the third rank. The sound annoyance when emptying the container is the least problem with a percentage of 21%. The percentage of citizens who are not served by a container in the sample is 24%.

Readiness to separate the solid waste into five categories

For any system to succeed it must be accepted by the citizens. This question was designed to measure the readiness of citizens to help in separating the waste into five categories which are: glass, plastics, metal, paper and organics.

The citizen has three alternatives to answer which are: Yes (free of money), Yes (for little symbolic money), and No. The distribution of the answers was as follows:

Table 3-29: readiness of citizens to separate solid waste into five components

Are you ready to separate solid waste into five components?	Frequency	Percent
Yes	486	45.5
Yes for little symbolic money	164	15.4
No	418	39.1
Total	1068	100.0

About 61% of citizens are ready to separate the waste into five components. Only 15.4% of the citizens are going to do that for a little symbolic amount of money. On the other hand 39% of citizens are not willing to do that. When asking the citizens why not, the common answers were: we have no time, we are disgusted to do so, we believe it is not feasible, and we are afraid of diseases.

Getting rid of food residuals

One of the questions for citizens was about the method they are getting rid of food residuals. The result are shown in table 3-30:

Table 3-30: Answers of citizens about methodology of getting rid of residual food

Disposal of food residuals	Locality Type			Total
	city	village	camp	
With garbage	312 47%	293 44%	62 9%	667 62%
Reuse as compost	10 34%	31 74%	1 2%	42 4%
Feeding animals	80 30%	162 61%	25 9%	267 25%
Other	32 35%	49 53%	11 12%	92 9%
Total	434	535	99	1068

Around 62% are disposing it with other waste. There is a considerable percentage which is 25% who are feeding animals with food residuals. It is clear that a very small percentage is using it as compost (around 4%).

3.2.1 Multivariate analysis

The analysis was also carried out using the multivariate method. This is to find the interaction of variables among each other. In order to do so the variables were grouped into four categories as follows:

Group 1 : variables related to current situation. These are represented by questions 3, 4, 16, 17, 18, 19.

Group 2: variables related to household income. This is represented by question 5.

Group 3: variables related to household awareness. These are represented by questions 8, 9, 11, 13, 21, 22, 23, 24, 25.

Group 4: Secondary variables. These are represented by questions 1, 6, 7, 10, 12, 14.

The hypothesis was there is a relation between the answers of citizens about solid waste issues in relation to locality type, house type, number of residents, and monthly income.

The following equation shows the effect of the independent variables and its interaction among each other on the dependent variables:

Design : $\text{Intercept} + q_2 + q_3 + q_4 + q_5 + (q_2 * q_3) + (q_2 * q_4) + (q_3 * q_4) + (q_2 * q_3 * q_4) + (q_2 * q_5) + (q_3 * q_5) + (q_2 * q_3 * q_5) + (q_4 * q_5) + (q_2 * q_4 * q_5) + (q_3 * q_4 * q_5) + (q_2 * q_3 * q_4 * q_5)$

Table 3-31 shows results of multivariate analysis test. Table 3-31 shows that locality type has significant statistical relationship with existing situation and awareness.

House type has no significant statistical relationship with existing situation and awareness.

Number of residents in house has no significant statistical relationship with existing situation and awareness.

Average monthly income has significant statistical relationship with awareness.

Table 3-31 : Results of multivariate analysis

Source	Value	F value	Degree of freedom for hypothesis	Degree of freedom for error	Statistical significance
Intercept	0.743	742.697	3	769	0.000
q2	0.287	43.047	6	1540	0.000
q3	0.006	1.595	3	769	0.189
q4	0.052	1.13	36	2313	0.274
q5	0.018	1.517	9	2313	0.136
q2 * q3	0.005	0.639	6	1540	0.699
q2 * q4	0.073	0.963	60	2313	0.558
q3 * q4	0.039	0.933	33	2313	0.578
q2 * q3 * q4	0.056	1.216	36	2313	0.178
q2 * q5	0.019	0.835	18	2313	0.660
q3 * q5	0.008	0.657	9	2313	0.748
q2 * q3 * q5	0.015	0.796	15	2313	0.683
q4 * q5	0.122	0.963	102	2313	0.586
q2 * q4 * q5	0.134	1.061	102	2313	0.322
q3 * q4 * q5	0.081	1.128	57	2313	0.239
q2 * q3 * q4 * q5	0.04	1.144	27	2313	0.277

Table 3-31 shows that locality type has significant statistical relationship with existing situation and awareness.

House type has no significant statistical relationship with existing situation and awareness.

Number of residents in house has no significant statistical relationship with existing situation and awareness.

Average monthly income has significant statistical relationship with awareness.

3.3 Solid Waste Composition in the study area

The composition of solid waste is very important. It affects the density of the waste. It affects the proposed methodology of disposal. Knowing the composition is necessary for economic recycling of the waste. In the following articles we are going to present the results of the study.

3.3.1 Sample distribution:

Thirty samples were taken from the city and the villages. Fourteen of these samples were taken from the transfer station of Nablus city near the slaughterhouse. Another eight samples were taken from the dumping site of Beita. This site is used by the villages Awarta, Odala, Huwwara, and Beita. All the previous villages use compaction truck except Awarta which uses a tractor. Another eight samples were taken from the dumping site of Beit Imrin. This site is used by the villages Yasid, Beit Imrin, Sabastiya, and Ijnisinya. All of these villages use the same compaction truck.

3.3.2 Sample Analysis

Each sample was analyzed to find the weight of each constituent. The main constituents for analysis were:

Organic material: This includes food wastes, vegetables, dead animals etc

Plastics: includes plastic bottles or vessels, Nylon, etc

Paper and cardboard

Metals

Textiles

Others: like wood, leather,

Inert materials: Which passes the mesh and is mainly dirt ashes

Each ingredient of the above items was weighted and recorded. In addition to the weight the volume was also measured and recorded. The volume was measured by measuring the height of the waste in the dustbin. The height is then converted to volume according to a previous calibration done for the dustbins that links each height with its matching volume.

3.3.3 Composition of the waste

The results of analysis of thirty samples are shown in table 3-32. As expected the maximum constituent is the organic material. Table 3-33 shows the weight percentages for each component.

From table 3-33 we can detect that the percentages of the solid waste components are very close in the three sites. Main constituents are presents in all these sites.

It is clear that the dumping site of Beita is very close in the composition to the transfer station of Nablus. Small difference is in the percentage of organics which is a little bit higher in Beita and this may be due to the presence of Al Hisba in Beita which increases the percentages of vegetables and fruits under the organic waste item.

Table 3-32: Weight components of the solid waste samples (kg)

	Samples from city transfer station														
Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Plastics	12.6	9.0	14.2	10.2	6.3	13.6	4.0	5.5	16.3	21.5	12.5	6.0	14.5	8.1	11.8
Metals	4.8	3.0	3.5	8.0	6.0	5.0	2.0	2.0	0.9	3.1	2.9	6.0	6.5	3.6	3.5
Glass	1.9	2.1	8.5	6.3	5.2	1.8	2.9	4.8	0.8	1.4	1.8	3.8	1.5	5.1	3.4
Paper & cardboard	9.2	4.8	31.2	9.7	13.5	6.8	8.9	18.9	16.5	15.4	20.5	11.8	13.8	19.8	8.7
Organics	90.9	97.3	42.3	64.5	78.4	66.8	82.2	69.3	51.4	50.9	58.6	96.2	42.3	65.1	89.5
Textiles	6.2	5.0	1.8	2.0	1.0	10.0	3.1	2.0	5.6	1.2	2.8	8.0	6.0	4.3	2.1
Others	1.2	7.0	2.6	8.0	15.0	12.0	8.0	4.0	6.4	8.2	3.9	7.0	6.2	11.2	6.3
Inert	1.0	5.0	2.5	3.0	6.0	7.1	10.0	5.0	9.7	4.3	5.6	2.0	1.3	2.3	3.7
Total weight	127.8	133.2	106.6	111.7	131.4	123.1	121.1	111.5	107.6	106.0	108.6	140.8	92.1	119.5	129
Density (Kg/m ³)	256	266	213	223	263	246	242	223	215	212	217	282	184	239	258
	Samples from Beita dumping site							Samples from Beit Imrin dumping site							
Component	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Plastics	4.8	6.1	12.5	10.3	15.2	9.8	8.7	6.5	5.5	5.3	4.6	8.7	3.7	9.8	9.6
Metals	4.6	3.9	4.9	8.6	1.2	0.6	1.9	2.6	1.5	6.3	1.2	2.1	3.1	1.2	2.3
Glass	0.8	5.2	3.9	4.6	2.1	3.1	4.3	5.2	3.2	4.6	5.2	1.3	7.8	2.1	1.2
Paper & cardboard	14.9	14.3	12.8	8.5	11.6	14.5	13.8	7.5	4.2	5.3	9.8	7.8	5.4	6.2	4.8
Organics	77.0	85.9	74.2	63.8	62.3	56.4	67.5	97.5	98.6	88.7	101.2	97.6	107.6	85.3	85.9
Textiles	2.8	6.3	1.9	2.1	4.2	5.1	0.2	0.3	5.3	7.8	2.3	1.2	6.5	4.3	3.4
Others	4.8	3.9	4.8	6.8	12.5	3.5	10.1	9.3	6.2	4.5	2.3	3.8	5.6	12.3	2.4
Inert	2.9	3.7	5.6	0.8	2.8	1.8	11.2	1.8	3.8	0.6	9.8	4.5	7.6	9.7	5.3
Total weight	112.6	129.3	120.6	105.5	111.9	94.8	117.7	130.7	128.3	123.1	136.4	127	147.3	130.9	114.9
Density (Kg/m ³)	225	259	241	211	224	190	235	261	257	246	273	254	295	262	230

Table 3-33: Composition of solid waste in the study area (weight percentages of the components)

Item	Beit Imrin			Beita			City			Gross		
	max	min	avg	max	min	avg	max	min	avg	max	min	avg
Plastic	2.5	8.4	5	4.3	13.6	9	3.3	20.3	10	20.3	2.5	8
Metal	0.9	5.1	2	0.6	8.2	3	0.8	7.2	3	8.2	0.6	3
Glass	1.0	5.3	3	0.7	4.4	3	0.7	8.0	3	8.0	0.7	3
Paper & Cardboard	3.3	7.2	5	6.7	15.3	11	3.6	29.3	13	29.3	3.3	10
Organics	65.2	76.9	73	55.7	69.4	62	39.7	73.0	57	76.9	39.7	63
Textile	0.2	6.3	3	0.2	5.4	3	0.8	8.1	4	8.1	0.2	3
Other	1.7	9.4	5	3.0	11.2	6	0.9	11.4	6	11.4	0.9	6
Inert	0.5	7.4	4	0.8	9.5	3	0.8	9.0	4	9.5	0.5	4
Density Kg/m ³	295	230	260	259	190	230	282	184	234	295	184	240
Number of samples	8			8			14			30		

Beit Imrin dumping site, which represents the small villages, shows a higher percentage of organics. The percentage reaches 73% compared to 57% in Nablus and 62% in Beita.

Beit Imrin dumping site shows a lower percentage of plastics. The percentage is 5% compared to 9% in Beita and 10% in Nablus.

Beit Imrin dumping site shows a lower percentage of paper and Cardboard. The percentage is 5% compared to 13% in Nablus and 11% in Beita. The high percentage of paper and cardboard in the city may be due to the presence of institutes that through a lot of paper and cardboard. Also due to the high commercial activity compared to Beit Imrin village and its surroundings.

The three sites show a close percentage for the glass which is 3%.

The low percentage of metals in all sites (2-3%) may be attributed to presence of scavengers who collect this valuable item from the source and from the collection containers.

Figure 3-5 shows the weight percentages of the components of the solid waste in the different sites.

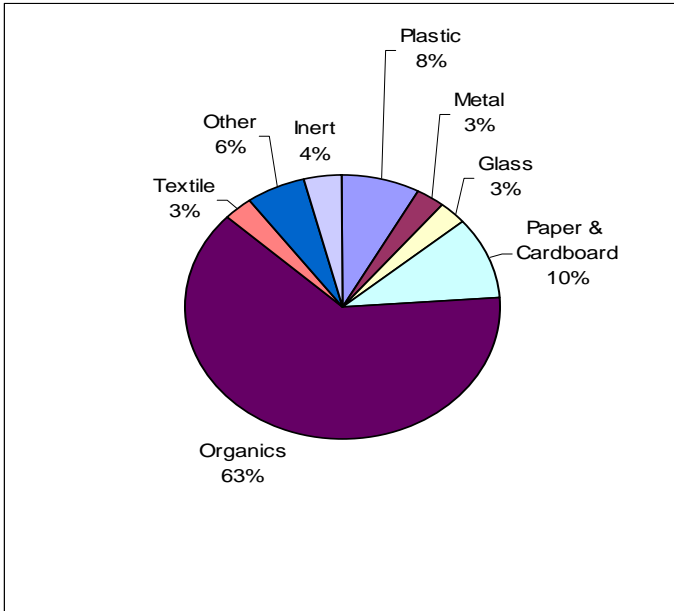


Figure 3-5 /A: Gross average of solid waste components by weight

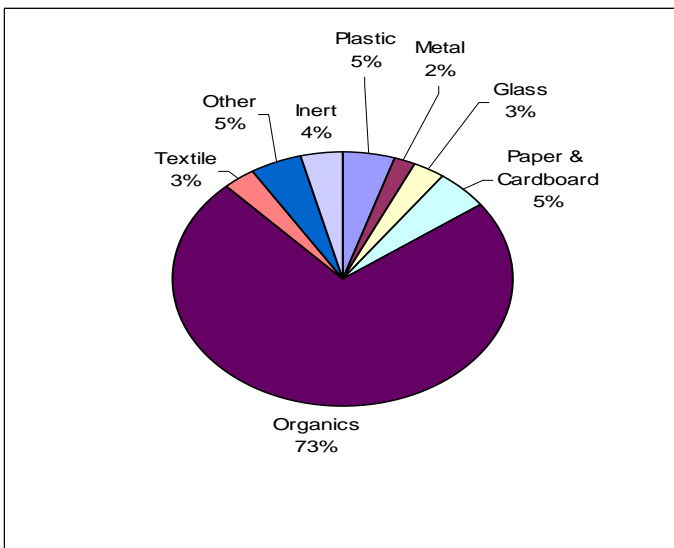


Figure 3-5/B: Solid waste components by weight for Beit Imrin DS

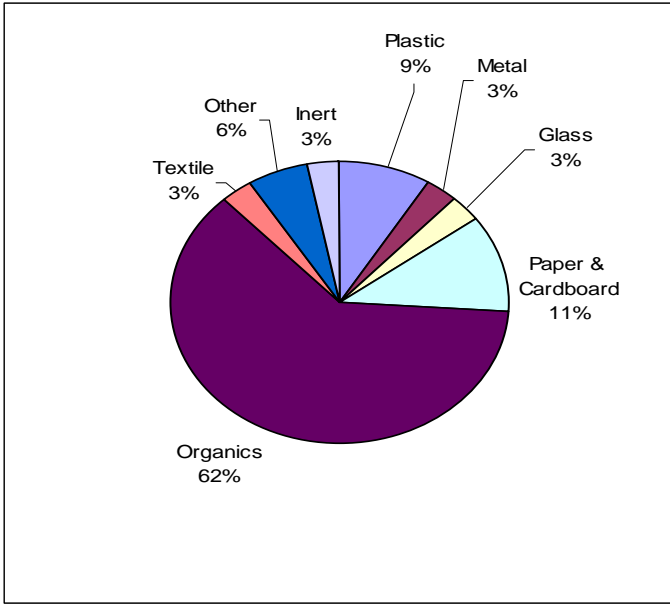


Figure 3-5/C: Solid waste components by weight for Beita DS

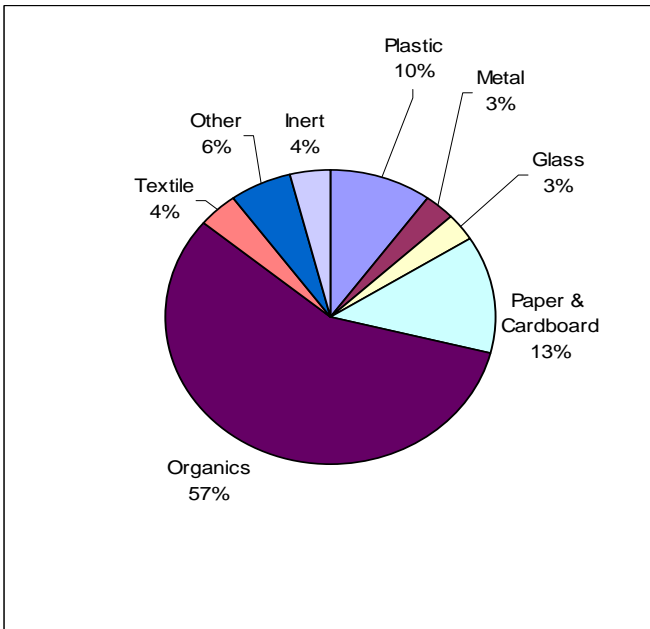


Figure 3-5/D: Solid waste components by weight for the city

Also the volumes of each component was recorded. Table 3-34 shows these volumes. Table 3-35 shows the volume percentages for the components of solid waste in the three sites (maximum, minimum, and average).

3.3.4 Solid waste Density

As an average the density of the solid waste is 240 Kg/m^3 . This density shows a small variation between the three sites. The maximum is in Beit Imrin dumping site which reaches 260 Kg/m^3 . The higher density is due to the high organic ratio and to the presence of the compacting truck for all the waste thrown in this site.

The density of the waste in Beita is 230 Kg/m^3 and is the least. This may be due to presence of some of the uncompacted waste that come from Awarta and this lowers the density a little bit compared to Beit Imrin and the city.

According to the samples the maximum density was reached in Beit Imrin and it was 295 Kg/m^3 . Then in Nablus and it was 282 Kg/m^3 .

According to the samples the minimum density was reached in Nablus and it was 184 Kg/m^3 . Then in Beita and it was 190 Kg/m^3 .

Beit Imrin site shows the least variation in density results and all the densities were between 295 Kg/m^3 and 230 Kg/m^3 . Nablus site shows the highest variation in density results and all the densities were between 184 Kg/m^3 and 282 Kg/m^3 . In Beita the density ranges between 190 - 259 Kg/m^3 .

The gross average solid waste density was 240 Kg/m^3 . In the city it was 234 Kg/m^3 , in Beita 230 Kg/m^3 and 260 Kg/m^3 in Beit Imrin.

Table 3-34: Composition of solid waste in the study area (volume of components in m³)

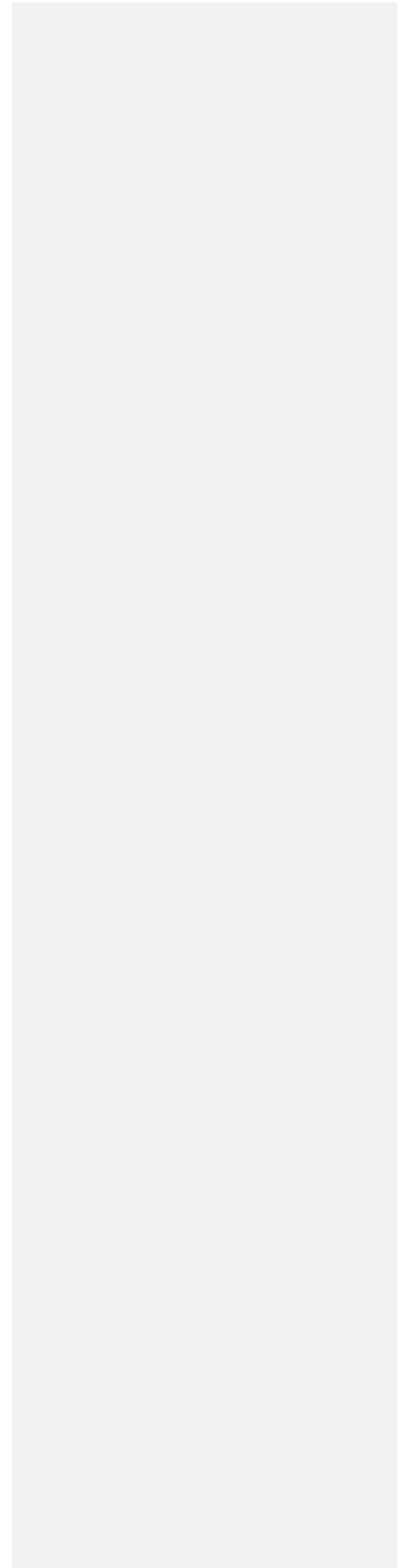
	Samples from city transfer station														
Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Plastics	0.185	0.138	0.189	0.162	0.084	0.181	0.062	0.073	0.240	0.299	0.184	0.095	0.193	0.108	0.197
Metals	0.028	0.017	0.019	0.048	0.033	0.024	0.012	0.011	0.005	0.017	0.017	0.033	0.036	0.021	0.026
Glass	0.010	0.011	0.041	0.034	0.025	0.009	0.017	0.026	0.004	0.007	0.009	0.020	0.008	0.026	0.018
Paper & cardboard	0.106	0.052	0.284	0.088	0.123	0.080	0.137	0.217	0.176	0.167	0.214	0.120	0.144	0.222	0.010
Organics	0.216	0.246	0.097	0.177	0.220	0.171	0.265	0.198	0.133	0.128	0.148	0.243	0.107	0.169	0.245
Textiles	0.095	0.079	0.027	0.031	0.015	0.139	0.048	0.030	0.086	0.017	0.043	0.123	0.092	0.066	0.033
Others	0.006	0.035	0.012	0.043	0.080	0.063	0.044	0.020	0.030	0.039	0.019	0.033	0.030	0.060	0.033
Inert	0.001	0.004	0.002	0.003	0.005	0.006	0.008	0.004	0.008	0.004	0.004	0.002	0.001	0.002	0.033
Total	0.647	0.582	0.671	0.586	0.585	0.673	0.593	0.579	0.682	0.678	0.638	0.669	0.611	0.674	0.565
	Samples from Beita dumping site							Samples from Beit Imrin dumping site							
Component	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Plastics	0.089	0.103	0.167	0.158	0.220	0.166	0.158	0.094	0.083	0.084	0.073	0.138	0.051	0.158	0.141
Metals	0.041	0.022	0.027	0.054	0.006	0.003	0.013	0.014	0.008	0.035	0.007	0.012	0.017	0.007	0.014
Glass	0.005	0.029	0.020	0.025	0.011	0.017	0.030	0.029	0.018	0.025	0.028	0.007	0.042	0.011	0.006
Paper & cardboard	0.171	0.163	0.147	0.102	0.136	0.167	0.131	0.087	0.048	0.060	0.111	0.092	0.068	0.065	0.057
Organics	0.225	0.217	0.192	0.199	0.157	0.164	0.221	0.300	0.308	0.246	0.307	0.293	0.330	0.221	0.274
Textiles	0.041	0.089	0.029	0.032	0.065	0.078	0.004	0.005	0.082	0.120	0.035	0.018	0.107	0.066	0.065
Others	0.026	0.019	0.027	0.037	0.060	0.020	0.054	0.049	0.035	0.023	0.012	0.022	0.030	0.066	0.018
Inert	0.003	0.003	0.005	0.001	0.003	0.002	0.010	0.002	0.003	0.001	0.009	0.009	0.006	0.010	0.005
Total	0.601	0.645	0.614	0.608	0.658	0.617	0.621	0.580	0.585	0.594	0.582	0.586	0.651	0.604	0.580

Table 3-35: Composition of solid waste in the study area (volume percentages of the components)

Item	Beit Imrin			Beita			City			Gross		
	max	min	avg	max	min	avg	max	min	avg	max	min	avg
Plastic	26.2	7.8	18.1	34.9	14.8	23.2	44.1	10.5	24.3	44.1	7.8	22.6
Metal	5.9	1.2	2.6	8.9	0.5	3.0	8.2	0.7	4.0	8.9	0.5	3.4
Glass	6.5	1.0	3.3	4.8	0.8	3.7	6.1	0.6	2.9	6.5	0.6	3.2
Paper & Cardboard	19.1	8.2	12.7	28.5	15.0	19.8	42.3	1.8	24.2	42.3	1.8	20.5
Organics	52.7	36.6	46.4	43.4	23.9	36.0	44.7	14.5	29.1	52.7	14.5	34.8
Textile	20.2	3.1	11.3	13.8	0.6	7.7	20.7	2.5	8.8	20.7	0.6	9.0
Other	10.9	2.1	4.7	9.1	2.9	6.1	13.7	1.8	6.1	13.7	1.8	5.8
Inert	1.7	0.2	1.0	1.6	0.2	0.6	1.3	0.2	0.6	1.7	0.2	0.7

Chapter 4

Discussion of results



4.1 Current system of solid waste management in the district

The results of the study reveal important facts. The important fact is most of the localities have solid waste collection system. The localities that have no solid waste collection represent only 2.6% of the district population. This percentage is low.

Most of the localities that have no solid waste service have very low enrolment. But some are densely populated. One example of that is Kafr Qallil. It is a densely populated area and also very close to the city, but it has no solid waste collection service.

In the cases of absence of solid waste system, the citizens dispose their own waste by collecting it and burning it in a special container every few days. This usually creates bad odors and smoke. Of course this will have serious effects on health. The effects are more in the case of dense areas like Kafr Qallil for example.

4.2 Absence of unified solid waste management system

Another fact is the absence of unified solid waste management system in the district. Villages differ from city and differ from camps. The villages differ in their system from one village to another.

There exist systems for solid waste management in most localities of Nablus district. Unfortunately, and in the absence of a unified system, each locality had developed its own system.

The differences are in all aspects. There are differences in the equipments, in the frequency of collection, and in the ownership of the disposal site. The localities differ also in the disposal system.

The localities differ in the collection system. Some collect garbage each day, some each two days, and some each three days.

They differ in the equipment used for collections. Some use compacting trucks, others use tractors. The trend to use a compacting truck or a tractor depends on the availability of the equipment.

Differences also exist in the fee system. These differences appear in the fee value, collection method, and the fee period (annual/ monthly).

In some cases the difference in the fee value has nothing to do with the type of service provided. It seems that the tariff system is defined on an extemporaneous basis. The difference in the fee value from locality to locality has no reasonable reason. It is apparent that no correlation appears with the service provider or the collection frequency.

One important case is the case of Rujeib where it has the second highest value. This may be related to the high operational cost of the compacting truck that is serving the village. Another reason for that is the high cost of disposal of solid waste. The village paid around 60 NIS for each disposed ton.

Another case is Qabalan. The citizens there pay the highest fee in the district. This is due to the high rate of service. Each home has its dustbins and nylon slag for waste disposal. The waste is collected every day. There is also a system for cleaning the streets of the village.

In the case of Aqraba the fee is close to the dominant one but no explanation why it is high. The localities served by Aqraba municipality have lower fee values.

Another difference is in service provider. Sometimes it is the council, other private contractor and sometimes the joint council. The sources for these differences are the existence or absence of equipment for the councils. If equipments are not available, they are going for contracting. If they get fund for purchasing equipment they are making the job. This is an issue that should be analyzed on an economical and social basis.

These differences reflect the fact of absence of an organizing body for this sector. Every council is acting on his behalf. Every council is introducing the fees he wants and disposing the solid waste in the way he likes.

4.3 Dumping sites

The city

For the city, after the solid waste is collected, it is transferred to a temporary site till final disposal. The existing temporary dump station suffers from the following:

- It is not fenced so that various animals are continuously present in the above dump. Without any fencing, every kind of animal has the possibility of entering the dump; there is a serious risk of transporting infectious and dangerous materials in other areas.
- The present situation of the existing dump is dramatic from aesthetic point of view.
- The current management of the existing dump is completely out of date and is creating relevant environmental damages.

- The location of the existing dump in the industrial area is too near to the city of Nablus, and with this kind of management this is not acceptable.
- The existing dump, having not a lining system, is undoubtedly polluting the groundwater in that area.
- The discharge of the various kind of refuse, which are not separated, creates, if possible further difficulties to manage in a safe way the existing dump.

The other problem is the high cost of disposal after that. The cost per ton reaches 62 NIS which consumes a large part of the exhausted budget of the municipality.

Seven localities are disposing their waste with Nablus municipality. This represents 54% of the served population in the district. The municipality is now paying the cost of disposal of these localities. This creates a clear problem in the case of the camps whose population is 35,387 inhabitants. This should be the responsibility of UNRWA. The municipality is now negotiating with UNRWA about this issue. Currently there is a trend for some villages to make negotiation with the municipality to be included within its service as if they were part of the city.

In the villages

To begin with, the choice of the dumping sites is done arbitrary according to what is available. Differences in ownership of these sites are part of the absence of a unified solid waste management system. No site had been evaluated environmentally before it had been chosen. Some sites are close to the water source of the village like the case of Tell.

The common about these dumping sites is the catastrophic conditions. The method in which these dumping sites are operated is out of environmental standards. This makes a serious health threat on the long as well as on the short run.

There is little to no control on what gets dumped at these facilities (for example there are no fence or guard). Open burning is a common practice. No cover is applied on what is dumped. Dumping encroaches onto farmlands in some cases. No equipment to manage the incoming waste, except a loader from time to time. Sitting of the dumps is arbitrary. Unsafe practices (unsafe slopes, no personal protection equipment).

Some of these dumping sites have enough area and are well sited. Examples of that are Beita and Aqraba. In case of global solid waste management plan these sites could be used as landfills or transfer stations.

4.4 Refugee camps

Another issue is the refugee camps. In the Palestinian Territories, the percentage of households that are served by UNRWA in the solid waste collection service had risen from 10.0% in 1999 to 11.9% in 2005 (PCBS,2005).

For Nablus district, all of the camps are located inside the city. The UNRWA is collecting the solid waste from the camps to the containers of municipality.

Compared to other localities for example Tulkarm, the UNRWA is responsible for taking the waste to the dumping site. So Nablus municipal council is raising the issue of disposing the solid waste with UNRWA.

4.5 Main Problems in the collection system

In the city

The collection system in the city has many difficulties. Some of these difficulties are due to management, others due to citizens themselves and others due to Israeli.

One of the problems due to the management is insufficiency of existing staff to handle the increasing population. The population is increasing, the built up area is also increasing, and the quantity of waste is increasing. The same problem appears with the labor. Only 240 employees belong to the solid waste sector in Nablus municipality. This figure includes the foremen and thus only 196 labor remains. This is a small figure that should be increased to at least 360, which is the same number as before Intifada. Finding enough funds to purchase equipment for solid waste will be a major obstacle for better management.

Insufficiency of existing equipments to sustain a good level of service is another main problem. The municipality depends on foreign donation for providing equipments. As the donation decreases, the municipality has to make its best with the existing old vehicles. For example the only tipper truck is out of duty since many years. Although of that, no new one had been purchased to replace it. Another item is the special containers that are used for medical garbage. Although 4 out of 10 are working, nothing had been done to purchase another 6 to replace the damaged ones. Another problem is that many of the vehicles have been provided through various donor programmes over a period of many years. As a consequence the

model of equipment varies quite widely, causing challenges for maintenance of these vehicles.

Also there are some problems that are related to behavior and education of citizens. One of the most important problems is the low collection level of solid waste fees (according to municipality only 40%). Some of the low collection is due to the economic situation. But there are cases of wealthy people who do not pay. Another problem is the damage done to the solid waste containers by some citizens. Before the containers were used as obstacles during Israeli invasion. Stealing some parts of the containers by the citizens (the wheels) is not strange.

Other problems concerned with behavior of citizens include throwing the garbage near the container instead of inside it. Another one is dissatisfaction of citizens with the location of the container. The citizens complain if the container was put in front of their houses, but they also complain if it was far away. The citizens in some cases want the container close in winter, but far in summer.

And some problems are because of the special topography and geography of the city. There are streets with dead end which make it impossible for the solid waste vehicle to turn back. Also there are unpaved streets which increase the tear and wear of the vehicles wheels and parts. The narrow road in some parts of the city and especially in the old city is another problem. The high slopes of some streets due to the mountain nature of the city are another problem.

Main Problems in collection in the Refugee camps

There is a good collection system in the refugee camps. Monitoring and control of the process is good. The main problem is burning the waste in the container by some children from time to time.

Main Problems in collection in the surrounding villages

In some villages the collection is done through a tractor and a trailer. Normally collection is carried out two or three times a week. On the day of collection, people leave the waste in plastic bags and buckets near the doors where it is collected by the tractor. This system has problem of accumulation of waste piles in roads. Till it is collected, it is opposed to animals, rodents, and insects in addition to the ugly view. The contracts between contractors and the council are annual. The advantage of the current system is the low cost compared to that of the city.

Like the city, the low collection of fees is a problem. This reflects on making restrictions on improving the level of service provided.

4.6 Expenditure and cost recovery in the surrounding villages

Almost in all cases the council is recovering the expenses by the fees (assuming 100% collection). But the fees differ as well as the level of service provided. So effort should be directed toward the best way to make use of the collected fees.

One of the localities not recovering their expenditure is Beita. There is a shortage of 2,600 NIS monthly. But currently Beita had raised the fee from 5 to 7 NIS.

Qabalan is another example. Qabalan had the highest fee in the district. But there is a monthly shortage of 3,500 NIS. This is due to the high service level in this village. This reflects in the high expenditure which reaches 20,000 NIS monthly.

Qusra is another example. It had the lowest fee in the district which is 5 NIS / month. There is a monthly deficiency of 1,500 NIS.

Another locality is Al Lubban Ash Sharqiya . It had also the lowest fee in the district which is 5 NIS / month. There is a monthly deficiency of 950 NIS.

All other localities are recovering their expenses or making some savings.

It seems based on the discussions with municipalities and village councils that they have not a clear idea of the full costs of waste management. Once they do, they will be able to start thinking about private sector participations as an alternative opportunity. Privatization may lead to cost savings provided there is enough competition. Using of private sector may raise the level of service at the current solid waste income.

5.3 Role of the private sector

As seen from the results 21% of the served population is covered by private sector. This represents around 40% of the served population outside the city. What are the reasons for privatizing solid waste services? The answer is highly dependent upon the community itself. In some places, it may be a lack of resources (funding, equipment, etc.) to provide the services directly. In other areas, it may be the expectation to achieve substantial reductions in costs or decreasing risk.

Both public and private sectors are active in handling SWM in Nablus district. Actors from each sector are presented in their particular advantages and constraints. Public sector in SWM generally means municipalities or village councils or Joint councils. They operate under certain inherent limitations. For instance, rigid laws, under which they must work, make it difficult to bring change to operational matters. Moreover, the public sector must employ a number of labors. These labors may suffer from low productivity of staff, inadequate supervision and unsatisfactory equipment.

The private sector in some villages is playing a significant role in SWM. Many of the private operators are relying on relatives labour (like father and son).

There are differences in the contractor's prices depending on the number of household, distance to the dump site, economical condition of the village, available contractors in the village ...etc.

For the city, the change of the service into the private sector should be studied seriously. This may be economically feasible. The municipality had already given the cleaning services of some public sanitary units in the city to the private sector and it was successful.

Reducing the waste quantity is another important factor the private sector is acting. Scavengers are collecting metals from houses, streets, and thus reducing the amount of waste to be collected. Even in some dumping sites they are looking for these metals.

Small businesses involved in SWM are mainly recyclers of waste material. They purchase items like metals (and glass, plastics in sometimes). The

informal private sector comprises of business initiatives using very small capital relying mainly on relatives household or individual labour, and is outside government regulations (e.g., itinerant waste buyers). Their suppliers may be waste pickers; itinerant and stationary waste buyers, even micro enterprises.

These are self-sustaining operations that remain in existence as long as the demand for their product remains. For example glass factory in Nablus is ready to buy the glass for 200-250 NIS per ton. This is after separation of glass into three colors: white, green and honey. Unfortunately the factory had stopped because Israelian did not allow the export of some raw materials (according to speech with director of the factory).

4.8 Awareness of citizens

In the evident that the level of awareness of environmental issues is quite low. Governmental officials, industrial owners and workers , students teachers and the public at large lack environmental awareness. The problem of littering, water and land pollution, and many health problems could be solved by raising the environmental awareness among people.

One of the important issues is to raise awareness to motivate affected groups to participate in environmental management. People should be educated about local environmental quality, the effect of existing environmental management practices. The mechanism for raising awareness will be through school curriculum, training programs for target groups such as employees of solid waste sector, school teachers, health workers, children, media and public campaigns.

The interaction of citizens with this issue is very important. Awareness of citizens, concern, help are very important for any system to succeed. To bear in mind any system is targeted toward the citizen. So every system should take into account the human being to succeed. In addition to that, results will help researchers in making any mathematical model in the future. Another important thing is finding the main problems of the current solid waste management system as seen from citizen's point of view.

Results showed that willing of citizens to pay more for improving solid waste collection system is not affected by house type, locality type.

On the other hand there is a significant relationship with the average monthly income. This means that as the income increases, the readiness of citizens to pay more increases.

The maximum distance the citizen is ready to walk to the container was analyzed with respect to different variables. Results showed that this distance is not affected by locality type, number of residents, and average monthly income. On the other hand there is a significant relationship with the house type. This means that residents living in separate houses are ready to walk a distance more than residents living in a flat in a building.

The readiness of citizens to participate in awareness campaigns was analyzed with respect to different variables. Results showed that readiness to participate in these campaigns is not affected by locality type. On the other hand readiness had a significant relationship with average monthly income. As income increases readiness to participate decreases. This may be due to not finding time for such activities.

The data were analyzed for the person in the family responsible for picking away the garbage. There is a significant relationship with the locality type. In the villages it is not strange that the mother do that. In the city and camps this is not usual. In the camps the children are throwing the garbage more than in the city and the villages.

The readiness of citizens to separate solid waste into five components was good. The percentage was 61%. This is a good percentage if a source separation system was adopted.

The citizens get rid of residual food with garbage. In 63% of time. It is noted that the percentage of citizens making compost is only 4%.

4.8 Solid waste composition

As expected main constituent of solid waste is organic materials which represents 63% of the waste. This percentage is large. In the city disposal of this large amount costs the municipality a large portion of its budget. There should be trends toward making compost. This will be practical for some wastes like those of vegetables market. The main problem for this is availability of land to begin a sample project.

The metals represent around 3% of the waste. This is a small percentage. The reason is the current high price of metals (steel, copper, aluminum). Metal collectors did not leave much metal in the solid waste. The remaining metals are cans, and some remaining items from households.

Paper and cardboard had a high percentage which reaches 10%. There should be a trend to use these large quantities. Recycling of paper and cardboard should be considered.

The results of the study compares well with results obtained by Marinianscky in 2000 for Nablus city. The methodology used by Marinianscky covered 15% of the daily generated waste. All the vehicles were weighted and the waste from the vehicles assigned for After that 50% of the pile was removed. And then it was thoroughly mixed again. Again 50% was removed and the reminder was mixed. This was done six times until about 0.35-0.40 ton and the sample was placed in a container 0.50 m³. This sample was weighted and sorting was done manually for the following components: organics, paper & cardboard, metals, textiles, plastics, wood, glass.

Table 4-1 shows the difference in results between the two studies.

Table 4-1: Comparison between results of the study and Marinianscky study for the weight components of solid waste in the city:

Component	Existing study	Marinianscky study
Organics	57%	63.7%
Paper & cardboard	13%	8.7%
Glass	3%	2.2%
Metals	3%	4.4%
Plastics	10%	11.3%
Inert	4%	-
Textile	4%	4.3%
Wood	-	2.7
others	6%	2.7
Total	100%	100.0%

4.10 Influence of Intifada on solid waste management

In this part we are going to discuss the direct influence of Intifada and the Israeli restrictions on the management of the solid waste system in Nablus area. This will be discussed from the collection point of view as well as on the effect of the disposal of the solid waste.

Influence on the city

Since the start of the second Palestinian uprising (Al-Aqsa Intifada), and due to the Israeli activities, curfews, closures, and military checkpoints imposed since 2000, the quality of social services rendered by Nablus city has been gradually deteriorating. Solid waste management in Nablus city was badly affected by these conditions, and this situation is negatively affecting health and damaging the environment. Most of these cases were due to reasons beyond the capability of the municipality with its limited resources. Some of the important municipal solid waste (MSW) equipment had been damaged during the uprising. The workforce in the MSW system was reduced and certain MSW-related development projects and activities have been frozen due to these conditions. The city's medical waste incinerator had been phased out and the number of special medical containers had been reduced from 16 to 10. Some MSW compressing trucks had been out of use with no substitute. Another important figure is the number of waste collection workers which decreased enormously as mentioned before, although the city is growing in premises as well as population. The created unsanitary solid waste transfer station is now a pollution source on its own, causing an ugly scene at the eastern entrance of Nablus city (Arafat et al., 2006).

Influence on the villages

The ministry of Local governments had gathered several close villages in a JSC as explained earlier. Some of these JSC had been provided with compacting trucks for serving these localities. Unfortunately, due to closure between the villages these trucks could not service as planned. And instead of serving the localities assumed to serve they only serve one

or two localities. In addition to preventing some localities from using them, it adds additional operating and maintenance expenses to the locality that is using them.

This situation can be seen in a clear picture in the case of Rujeib where the compacting truck was shared with Deir al hatab and due to Intifada and closure now is used only by Rujeeb. This had raised the expenses of solid waste collection on citizens of Rujeib sharply and forces Deir Al hatab to use rented Tractor instead of the compacting Truck.

Another case is Burqa. There the compacting Truck was for Bizzariya as well as Burqa and due to closure now it is used only by Burqa. Again this had raised the expenses on Burqa and prevented Bizzariya from using it.

Influence on disposal system of the villages

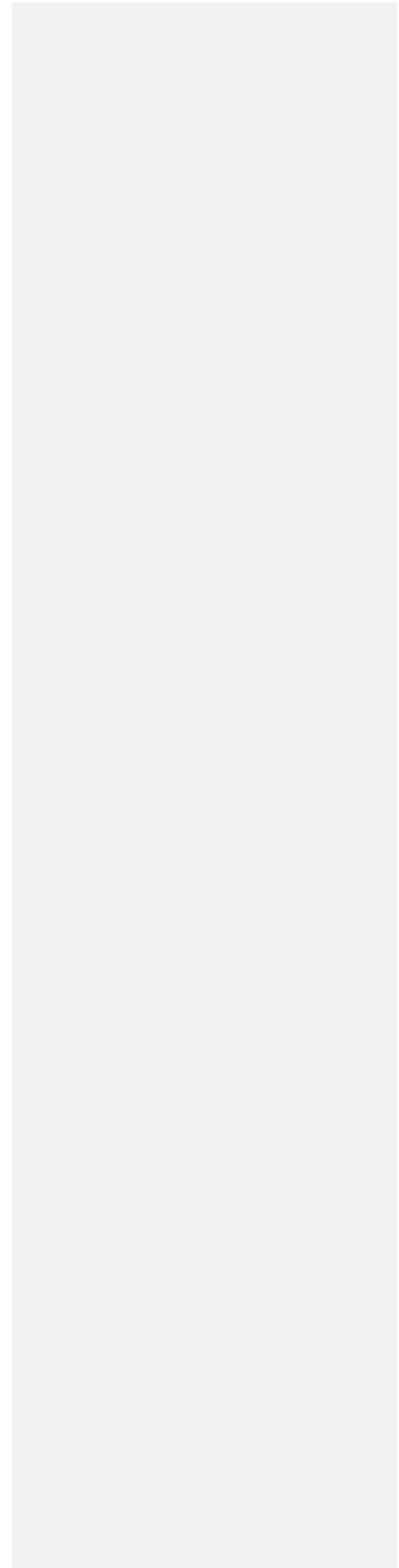
The present situation , which strictly enforced mobility restrictions, makes it impossible or very difficult to reach the network of disposal sites in operation before September 2000. For many municipalities , this has resulted in the establishment of emergency sites closer to collection areas. For others , re-routing of waste transport has been necessary , often using poor , unpaved roads, causing increased wear and tear to vehicles.

During periods of full closure and/or curfew, disposal of solid waste in the usual designated sites is not possible, and random temporary disposal takes place, often within city and town limits.

This has resulted in the following Environmental Impacts:

- Lack of mobility during curfews and other special restrictions cause municipal solid waste to pile up during the periods in question. This is both an environmental problem and –even more- a health problem.
- Lack of site access causes the use of emergency disposal sites close to or inside villages, resulting in emissions to water and air, as well as potential health hazards. In some cases these dumping sites were closed to the drinking well of the village (as Tell for example).
- The widespread practice of open burning causes additional environmental and health risks.
- Different types of military waste were generated by the use of bullets, tear gas, bombs, rockets, and other types of ammunitions.

Chapter Five
Conclusion and Recommendation



5.1 Conclusion

Solid waste management systems in Nablus district are plagued by a number of problems, solution for which are mainly constrained by financial and technical deficiencies, in addition to management. Inability to make enforcement of regulations may be the most important deficiency. There is dependence on donor funding for purchasing new equipments. Consequently there is no sustainability of solid waste service level upon termination of donor funding. Added to all, there are the Israeli obstacles.

Management system

Most of the localities have solid waste collection system. The objectives should be toward developing and improving the current systems.

There is a great variance in solid waste management system from locality to another. These variations are reflected in the equipment used in collection, frequency of collection, solid waste fee value, and method of collecting the solid waste fee.

The percentage of collection solid waste fees varies from village to village. The amount of the fee also varies. The range is very high. In some villages it is as low as 5 NIS per month per household; in other it reaches 15 NIS per month per household.

Laws governing MSW disposal, revenue collection and project implementation and management often are not enforced.

Both public and private sectors are active in management of solid waste in the district. Greater participation of private sector may improve the

efficiency of the entire sector and create new opportunities for employment.

The economic theory of property rights assigns rights of ownership as the reason for the private sector to excel (Chang and Davila, 2006).

The high cost of power in some cases lead to stoppage of solid waste activities like hazardous waste incineration. The dependence on the Israel's power supply is another factor that hinders proper solid waste management in Palestinian localities.

Environmental impact

The use of open dumps for MSW makes environmental pollution highly probable. Both surface water and groundwater remain vulnerable to MSW pollution because disposal dumps were chosen for convenience rather than based on environmental safety considerations. The dumping sites are located arbitrary with no study. The extent of groundwater pollution in and around the dumpsites still is unknown because adequate pollution assessment studies have not been done on the groundwater. An investigation into the extent of pollution of groundwater urgently needs to be carried out within the vicinities of the MSW dumpsites.

Bad habits of disposal like burning are dominant in almost all dumping sites. Odors, rodents, flies and vectors are common in the dumping sites. Scavanging is practiced unsafely in some dumping sites and sometimes by children.

As a result of this study it was clear that all types of solid waste are going to the dumping sites. This includes: food wastes, paper, cardboard,

plastics, textiles, leather, yard wastes, wood, glass, tin cans, other metals, ashes, street leaves, special wastes (including bulky items, consumer electronics, oil, tires) and household hazardous wastes.

The presence of toxic chemicals in MSW is highly probable because of a lack of strict monitoring of the MSW entering the dumpsites. This practice can become a major source of pollution.

Public awareness and interaction

From the household questionnaire outcome, it was found around 60% of the residents agree and are willing to separate the residential solid waste into five different components that are glass, plastic metals, paper, food organic waste. This means there is a good chance for the separation system to be successful in the target area, if a proper system is adopted. This is essential to reuse the amount of waste to be disposed.

Community involvement can be helpful. Other measures include cultivation of a sense of clean environment through clean community awareness programmes. These can go a long way in sensitizing people to keep the environment clean. Regular activities such as clean up of the neighborhoods, schools, parks and roadsides can be effective in changing the “NIMBY” attitudes. In general, the proper management of municipal solid waste is determined by the attitudes of people towards waste, such as the ability to refrain from indiscriminate dumping. Socio-economic characteristics may determine attitudes such as the ability/willingness to recycle MSW. These attitudes, however, may be positively influenced by awareness-building campaigns and educational measures. In a word, it is the desire of the people that can keep the country clean.

Solid waste composition

The percentage of the different components of the solid waste was calculated. It was found that the density of solid wastes ranges from 184 Kg/m³ to 295 Kg/m³ with a mean value of 240 Kg/m³. During the field work there were some people who were collecting metals for selling them for recycling purpose. The metals represent around 3% of the total wastes. The percentage of the organic waste (including paper) is 73%. Comparing the results of the solid waste composition in the city with that obtained during 2000, the change is little.

Solid wastes contain significant amounts of valuable materials like steel, aluminum, copper and other metals. Now most of these are recovered and reused, before reaching the dumping site and thus reducing the volume of the wastes to be collected and at the same time would yield significant salvage and resale income. In addition, better reclamation techniques will help to save valuable natural resources and turn wastes, which could be dangerous, into useful products. Some important solid wastes that have been successfully reclaimed are paper, plastics, glass and metals (Safian and Bala, 2006).

5.2 Recommendations

Based on the above conclusions and the whole study, many recommendations can be drawn. For ease of understanding we will classify these recommendations into the following categories:

- Recommendations for Legislation, laws, and monitoring
- Recommendation for improving the management
- Recommendation for sanitary landfill and closing dumping sites
- Recommendation for improving public awareness

Recommendations for Legislation and laws

There is a need for establishing a unified solid waste laws and rules. The role of the Ministry of local governments and EQA should be toward equating service level in different localities.

There is a need for building regulatory System. This system should concern with developing solid waste laws and regulations. Also developing enforcement and monitoring system. Developing licensing and permitting program for the dumping sites is also needed.

The role of the environmental quality authority in municipal solid waste and hazardous waste coordination, planning, licensing and monitoring must be revitalized.

There is a need to establish a monitoring and data base system for the solid waste sector.

Recommendations for management

Any system should depend on the citizen in the long run. Although at the beginning there should be an external aid or fund. If the citizen feel that he owns the system, he will feel responsible towards it and try to make it succeed. Waste is a complex issue; and requires high caliber managers to make complex decisions.

The role of the informal sector through the private sector in offering solutions towards improvement of MSWM should be explored.

There are urgent needs for solid waste collection section. In the city many of the vehicles are old, and are being out of use one by another. If urgent aid is not being available a shortage of vehicles in the field of solid waste collection will occur in the city. In the villages, they are managing well by

the compacting trucks and tractors. The problems occur when the compacting truck requires maintenance. The tractor system is very practical especially for localities of low resources.

In the city, there is a need for increasing the staff working in the solid waste. This is to cover the service around the city. In the villages current staff is enough as increasing it more will cost the local councils additional expenses which are not available.

There is a need for strengthening the donor funds for solid waste. Projects should focus also on the treatment, and should take into account the cost of operation and maintenance. As most fund go toward purchasing collection vehicles or containers.

Separate collection and disposal schemes for key hazardous waste types should be established, based on initial, simple disposal or storage.

Recommendations for legal landfill site

The need to dispose of some wastes to land is inevitable, even when wastes are pre-treated.

Other disposal methods such as separation and composting of organic waste, incineration, separation and recycling of certain waste streams are only practical when combined with a sanitary landfill. Only after the collection and sanitary landfilling system has proven to be effective, these alternatives treatment measures will be considered.

A good system should include the surrounding villages in a common disposal system. This will help in solving the problem of these villages as well as making the quantity of the waste generated more economical for processing. This will also aid in alleviating the reject of the villages to

allocate the disposal site close to their premises if the study prevails that is the best choice.

The transition from dump-sites to sanitary landfills is essential to protect public health and environmental quality. This can be achieved in a step-wise manner, with incremental improvements.

Another waste stream of importance to deal with is namely the hospital waste. Incineration unit that belong to Nablus municipality exists. But it is not working. The clinical waste at the city as well as villages is dumped and burnt under uncontrolled conditions. This waste stream has to be treated properly.

An immediate assessment should be conducted to map the sites that pose a great threat to human health and to the environment.

Recommendations for Public awareness

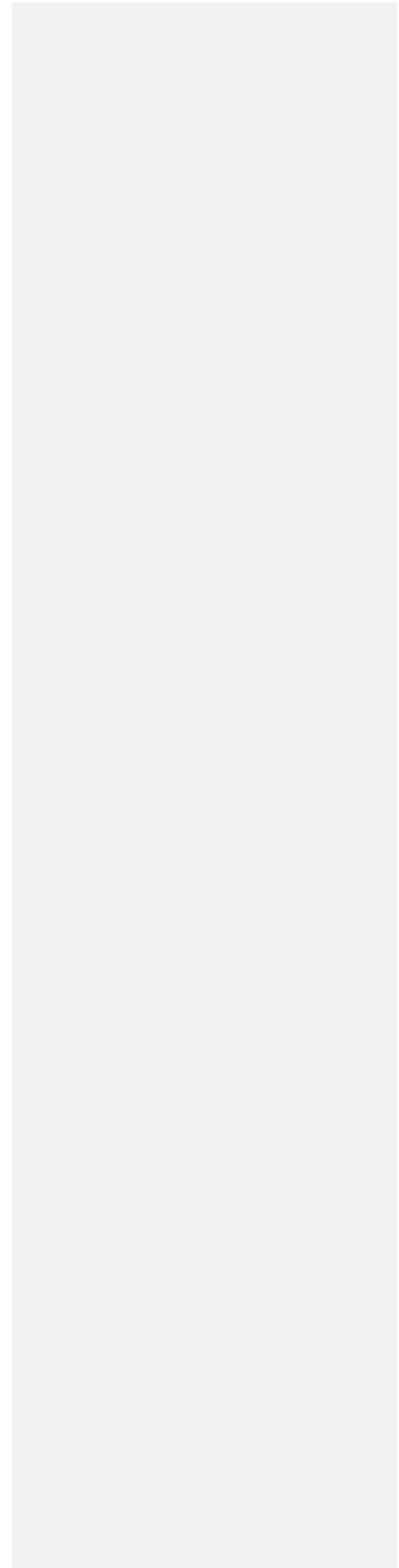
Most of the people are educated. With awareness campaigns and propaganda it is very likely to change citizens behavior toward the best. This is easy as it is part of religion to keep a clean environment all around.

Still there is a need for an educating and awareness program on the importance to cooperate in paying the solid waste collection fees. Of course a powerful implementing agency to collect by law is the most essential.

Increase in the budget allocation for both collection and treating waste is essential for improving the environmental quality.

Involvement of stakeholders is important to achieve any meaningful and sustainable MSWM.

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Tables

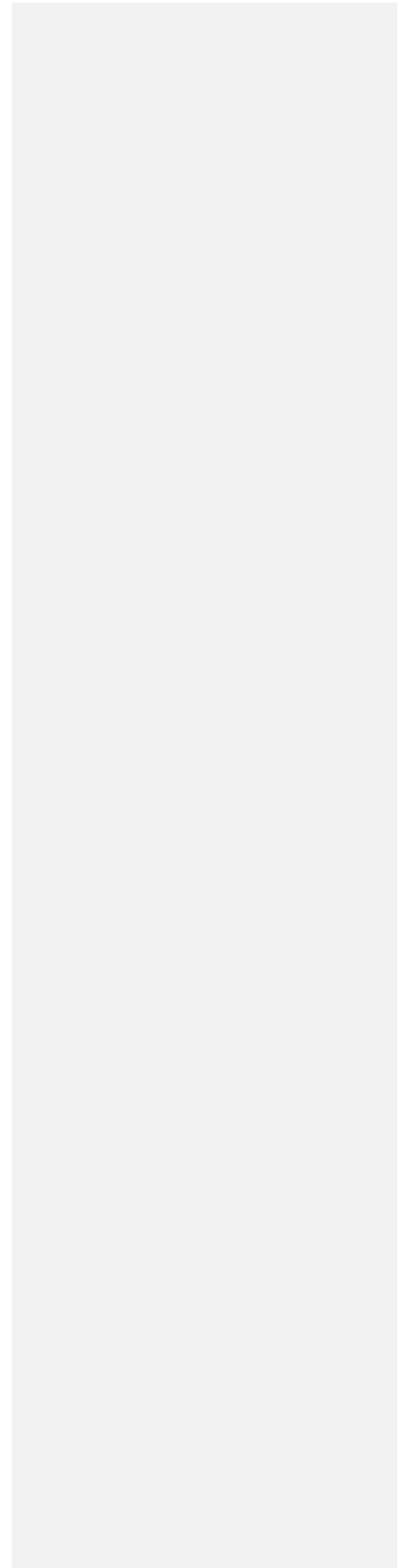


Table A-1: Enrolment in Nablus District localities for the year 1997 and 2006

No	Locality Name	Enrolment 1997	Estimated Enrolment 2006	Type of Council
1	Bizzariya	1,608	2,152	
2	Burqa	3,012	4,030	
3	Yasid	1,712	2,291	
4	Beit Imrin	2,149	2,876	
5	Nisf Jubeil	378	506	
6	Al Mas'udiyia	14		
7	Sabastiya	2,171	2,905	Municipality
8	Ijnisinya	418	559	
9	Talluza	2,003	2,680	
10	An Naqura	1,239	1,658	
11	Al Badhan	1,810	2,422	
12	Deir Sharaf	2,062	2,759	
13	Asira ash Shamaliya	5,800	7,761	Municipality
14	An Nassariya	1,012	1,354	
15	Zawata	1,420	1,900	
16	Al ' Aqrabaniya	669	895	
17	Khirbet Tall al Ghar	9		
18	Qusin	1,296	1,734	
19	Beit Iba	2,442	3,268	Municipality
20	Beit Hasan	891	1,192	
21	Beit Wazan	837	1,120	
22	Ein Beit El Ma Camp	3,764	5,036	Camp
23	Ein Shibli	148	198	
24	Al Juneid	289	387	
25	Azmut	2,036	2,724	
26	Nablus	100,231	134,116	Municipality
27	Askar Camp	9,496	12,706	Camp
28	Deir Al Hatab	1,687	2,194	
29	Shihda wa Hamlan	34		
30	Sarra	2,161	2,810	
31	Salim	3,799	5,083	
32	Balata Camp	13,187	17,645	Camp
33	Iraq Burin	576	771	
34	Tell	3,542	4,739	
35	Beit Dajan	2,682	3,589	
36	Rujeib	2,926	3,915	
37	Kafr Qallil	1,862	2,491	
38	Frush Beit Dajan	866	1,159	
39	Madama	1,239	1,658	

Table A-1 cont...d: Enrolment in Nablus District localities for the year 1997 and 2006

No	Locality Name	Enrolment 1997	Estimated Enrolment 2006	Type of Council
40	Burin	1,923	2,573	
41	Beit Furik	7,774	10,402	Municipality
42	Asira al Qibliya	1,708	2,285	
43	Awarta	4,343	5,811	
44	Urif	2,122	2,839	
45	Khhirbet Tana	15		
46	Odala	809	1,082	
47	Huwwara	4,332	5,797	Municipality
48	Einabus	1,659	2,220	
49	Yanun	115	154	
50	Beita	6,564	8,783	Municipality
51	Ar Rajman	1		
52	Zeita Jamma'in	1,466	1,962	
53	Jafa an Nun	13		
54	Jamma'in	4,320	5,780	Municipality
55	Osarin	1,218	1,630	
56	Aqraba	5,927	7,931	Municipality
57	Za'atra	43		
58	Tall al Khashaba	3		
59	Yatma	2,228	2,981	
60	Qabalan	5,417	7,248	Municipality
61	Jurish	1,034	1,384	
62	Qusra	3,319	4,441	
63	Talfit	2,235	2,991	
64	As Sawiya	1,720	2,301	
65	Majdal Bani Fadil	1,632	2,184	
66	Al Lubban Ash Sharqiya	1,868	2,500	
67	Qaryut	1,845	2,469	
68	Jalud	338	452	
69	Ammuriya	234	313	
70	Duma	1,659	2,220	
71	Khirbet Sarra	25	218	
72	Khirbet al Marajim	6		
	Other Localities		218	
	Total	251,392	336,380	

(Source: Palestinian Central Bureau of Statistics, , World Web Page: <http://www.pcbs.gov.ps/populati/pop06.aspx>, access date 5/2006)

Table A-2: The number of samples to be taken from each locality (Only served localities)

No	Locality Name	No of household 1997	No of household 2006	No of Questionnaires
1	Bizzariya	272	364	7
2	Burqa	607	813	16
3	Yasid	290	388	7
4	Beit Imrin	343	459	9
5	Nisf Jubeil	75	100	2
7	Sabastiya	410	549	11
8	Ijnisinya	80	107	3
9	Talluza	347	464	9
10	An Naqura	197	263	5
11	Al Badhan	278	372	7
12	Deir Sharaf	357	478	9
13	Asira ash Shamaliya	1122	1503	27
15	Zawata	269	360	7
18	Qusin	188	251	5
19	Beit Iba	440	589	11
21	Beit Wazan	121	162	4
22	Ein Beit El Ma Camp	632	846	15
24	Al Juneid	52	69	0
25	Azmut	279	373	7
26	Nablus	17,977	24,089	455
27	Askar Camp	1,528	2,047	38
28	Deir Al Hatab	240	321	6
30	Sarra	334	447	8
31	Salim	531	711	13
32	Balata Camp	2,199	2,946	54
33	Iraq Burin	99	132	3
34	Tell	581	778	16
35	Beit Dajan	373	499	10
36	Rujeib	491	657	13
39	Madama	219	293	6
40	Burin	360	482	10
41	Beit Furik	1,298	1,739	30
42	Asira al Qibliya	284	380	8
43	Awarta	720	964	18
44	Urif	369	494	10
46	Odala	123	164	4
47	Huwwara	742	994	20
48	Einabus	290	388	8

Table A-2 Cont...d: The number of samples to be taken from each locality

No	Locality Name	No of household 1997	No of household 2006	No of Questionnaires
50	Beita	1,133	1,518	28
52	Zeita Jamma'in	214	286	6
54	Jamma'in	646	865	16
55	Osarin	223	298	6
56	Aqraba	987	1,322	25
59	Yatma	344	460	9
60	Qabalan	915	1,226	23
61	Jurish	144	192	4
62	Qusra	473	633	13
63	Talfit	330	442	9
64	As Sawiya	269	360	9
65	Majdal Bani Fadil	276	369	7
66	Al Lubban Ash Sharqiya	287	384	8
67	Qaryut	287	384	8
70	Duma	238	318	6
		41,883	56,092	1,068

Table A-3: Nablus District Localities that have no solid waste service and its enrolment

Serial Number	Locality Name	Estimated Enrolment 2006
1	Al Mas'udiya	22
2	An Nassariya	1,354
3	Al ' Aqrabaniya	895
4	Khirbet Tall al Ghar	14
5	Beit Hasan	1,192
6	Ein Shibli	198
7	Shihda wa Hamlan	54
8	Kafir Qallil	2,491
9	Frush Beit Dajan	1,159
10	Khhirbet Tana	24
11	Yanun	154
12	Ar Rajman	2
13	Jafa an Nun	21
14	Za'atra	68
15	Tall al Khashaba	5
16	Jalud	452
17	Ammuriya	313
18	Khirbet Sarra	218
19	Khirbet al Marajim	9
	Total	8,645

Table A-4: Number of participants in solid waste collection system for Nablus District localities

No	Locality Name	Participants	No	Locality Name	Participants
1	Bizzariya	360	37	Kafr Qallil	No Collection
2	Burqa	900	38	Frush Beit Dajan	No Collection
3	Yasid	320	39	Madama	318
4	Beit Imrin	480	40	Burin	330
5	Nisf Jubeil	80	41	Beit Furik	1,700
6	Al Mas'udiya	No Collection	42	Asira al Qibliya	320
7	Sabastiya	500	43	Awarta	750
8	Ijnisinya	110	44	Urif	420
9	Talluza	380	45	Khhirbet Tana	No Collection
10	An Naqura	450	46	Odala	140
11	Al Badhan	400	47	Huwwara	1,000
12	Deir Sharaf	450	48	Einabus	280
13	Asira ash Shamaliya	1,500	49	Yanun	No Collection
14	An Nassariya	No Collection	50	Beita	1300
15	Zawata	250	51	Ar Rajman	No Collection
16	Al 'Aqrabaniya	No Collection	52	Zeita Jamma'in	300
17	Khirbet Tall al Ghar	No Collection	53	Jafa an Nun	No Collection
18	Qusin	250	54	Jamma'in	1,000
19	Beit Iba	900	55	Osarin	270
20	Beit Hasan	No Collection	56	Aqraba	1,400
21	Beit Wazan	120	57	Za'atra	No Collection
22	Ein Beit El Ma Camp	Free	58	Tall al Khashaba	No Collection
23	Ein Shibli	No Collection	59	Yatma	400
24	Al Juneid	With Nablus	60	Qabalan	1,000
25	Azmut	350	61	Jurish	220
26	Nablus	30,480	62	Qusra	640
27	Askar Camp	Free	63	Talfit	350
28	Deir Al Hatab	360	64	As Sawiya	370
29	Shihda wa Hamlan	No Collection	65	Majdal Bani Fadil	300
30	Sarra	500	66	Al Lubban Ash Sharqiya	350
31	Salim	600	67	Qaryut	350
32	Balata Camp	Free	68	Jalud	No Collection
33	Iraq Burin	120	69	Ammuriya	No Collection
34	Tell	750	70	Duma	350
35	Beit Dajan	480	71	Khirbet Sarra	No Collection
36	Rujeib	670	72	Khirbet al Marajim	No Collection

Table A-5: Solid waste fees Income and expenses for Nablus District localities

Locality Name	Fee (NIS)	Participants	Income	Expenses	Savings
Bizzariya	8	360	2,880	2,500	380
Burqa	7	900	6,300	4,000	2,300
Yasid	10	320	3,200	3,000	200
Beit Imrin	8	480	3,840	3,300	540
Nisf Jubeil	10	80	800	850	(50)
Sabastiya	8	500	4,000	3,300	700
Ijnisinya	7	110	770	1,500	(730)
Talluza	8	380	3,040	2,000	1,040
An Naqura	12	450	5,400	1,350	4,050
Al Badhan	8	400	3,200	1,600	1,600
Deir Sharaf	10	450	4,500	5,000	(500)
Asira ash Shamaliya	10	1,500	15,000	11,000	4,000
Zawata	10	250	2,500	2,300	200
Qusin	7	250	1,750	1,400	350
Beit Iba	9	900	8,100	5,000	3,100
Beit Wazan	10	120	1,200	1,100	100
Azmut	7	350	2,450	2,000	450
Deir Al Hatab	8	360	2,880	2,350	530
Sarra	8	500	4,000	2,200	1,800
Salim	5	600	3,000	2,500	500
Iraq Burin	10	120	1,200	1,100	100
Tell ⁽¹⁾	8	750	6,000	3,300	2,700
Beit Dajan	6	480	2,880	2,000	880
Rujeib	13	670	8,710	7,000	1,710
Madama	5	318	1,590	1,800	(210)
Burin	10	330	3,300	1,700	1,600
Beit Furik	6	1,700	10,200	10,000	200
Asira al Qibliya	5	320	1,600	2,200	(600)
Awarta	6	750	4,500	4,200	300
Urif	6	420	2,520	2,100	420

Table A-5 (cont...d): Solid waste fees Income and expenses for Nablus District localities

Locality Name	Fee (NIS)	Participants	Income	Expenses	Savings
Odala	10	140	1,400	1,000	400
Huwwara	10	1,000	10,000	8,500	1,500
Einabus	10	280	2,800	2,000	800
Beita ⁽²⁾	5	1,480	7,400	10,000	(2,600)
Zeita Jamma'in	10	300	3,000	1,500	1,500
Jamma'in	9	1000	9,000	4,500	4,500
Osarin	6	270	1,620	1,400	220
Aqraba	11	1,400	15,400	15,000	400
Yatma	10	400	4,000	3,300	700
Qabalan	15	1,100	16,500	20,000	(3,500)
Jurish	10	220	2,200	2,000	200
Qusra	5	640	3,200	4,700	(1,500)
Talfit	10	350	3,500	3,300	200
As Sawiya	8	370	2,960	3,000	(40)
Majdal Bani Fadil	10	300	3,000	2,000	1,000
Al Lubban Ash Sharqiya	5	350	1,750	2,700	(950)
Qaryut	8	350	2,800	2,400	400
Duma	10	350	3,500	1,600	1,900

Notes:

⁽¹⁾ Currently Tell council had increased the solid waste fee to 10 NIS⁽²⁾ Currently Beita municipality had increased the solid waste fee to 7 NIS

Table A-6: Tariff system for garbage tax in Nablus city

Type of Utility	Value in JD
Habitant less than four rooms	12
Habitant 4-5 rooms	16
Habitant 6 rooms above	24
Clinics and pharmacies	24
Fruit shops and grocery	28
Restaurants and coffee shops and clubs	34
Theaters and hotels	96
Stores and garages	10
Money Exchangers	24
Smithery and plumbers	34
Construction materials stores	48
Gas stations	48
Third class bakery shops	28
Shoe factories	36
Fashion shops	28
Appliances shops	28
Photo shops	28
Beauty saloons and barbers	28
General trade shops	48
Sweet shops	28
Manual bakery shops	28
Auto backers shops	36
Sweet factories	36
First class labs	36
Construction tools stores	28
Furniture stores	32
Universities	152

(Source: Nablus Municipality, world web page:
http://www.nablus.org/en/hm/tariff/garbage_tax.htm/ Access date 8/2006)

Table A-7: Percentage of solid waste fee collection for some localities

Locality		Year 2003	Year 2004	Year 2005	Average
Bizzariya	To be collected	2,400	2,600	2,800	
	Actually collected	1,540	1,680	1,060	
	% collection	64%	65%	38%	56%
Burqa	To be collected	55,000	65,000	65,000	
	Actually collected	36,000	24,000	65,000	
	% collection	65%	37%	100%	67%
Sabastiya	To be collected	71,104	83,480	60,600	
	Actually collected	31,079	41,242	50,417	
	% collection	44%	49%	83%	59%
Asira ash Shamaliya	To be collected	130,000	140,000	150,000	
	Actually collected	78,000	84,000	90,000	
	% collection	60%	60%	60%	60%
Nablus	To be collected	3,439,822	3,446,109	3,581,678	
	Actually collected	2,025,685	1,611,641	1,865,091	
	% collection	59%	47%	52%	53%
Deir Al Hatab	To be collected	30,000	30,000	30,000	
	Actually collected	8,000	10,000	12,000	
	% collection	27%	33%	40%	33%
Beit Furik	To be collected	115,000	120,000	120,000	
	Actually collected	87,000	94,000	107,000	
	% collection	76%	78%	89%	81%
Urif	To be collected	2,470	2,600	2,730	
	Actually collected	1,482	1,820	1,911	
	% collection	60%	70%	70%	67%

Table A-7 (Cont...d): Percentage of solid waste fee collection for some localities

Locality		Year 2003	Year 2004	Year 2005	Average
Jamma'in	To be collected	82,500	86,000	96,000	
	Actually collected	82,500	86,000	96,000	
	% collection	100%	100%	100%	100%
Huwwara	To be collected	N.A	77,580	80,460	
	Actually collected	N.A	42,063	41,251	
	% collection	N.A	54%	51%	53%
Osarin	To be collected	20,000	20,000	21,000	
	Actually collected	20,000	20,000	21,000	
	% collection	100%	100%	100%	100%
Yatma	To be collected	44,400	46,200	48,000	
	Actually collected	20,000	25,000	24,000	
	% collection	45%	54%	50%	50%
Qabalan	To be collected	152,000	178,000	176,000	
	Actually collected	120,000	125,000	130,000	
	% collection	79%	70%	74%	74%

Appendix
Questionnaire

1) Household Questionnaire

بسم الله الرحمن الرحيم

أخي المواطن

الباحث عبد السلام أبو زهرة يقوم بعمل دراسة حول واقع النفايات الصلبة في محافظة نابلس. تتناول الدراسة الواقع الحالي ومدى رضى المواطنين عن مستوى الخدمة المقدمة واستعدادهم للمساهمة في ابقاء البلد نظيفة ومرتبّة.

أن تعيّنكم الاستمارة بصدق وموضوعية وجديّة سيكون له الأثر الكبير على دقة هذه الدراسة المقدمة للحصول على درجة الماجستير من جامعة النجاح الوطنية.

شاكرين لكم جهودكم ووقتكم.

ادارة النفايات الصلبة في محافظة نابلس

الاستمارة المنزلية لغرض البحث العلمي

التاريخ: رقم الاستمارة:.....

1) اسم القرية (او اسم المنطقة في المدينة) :

2) نوع التجمع:

1) مدينة (1) قرية (2) مخيم (3)

3) المنزل:

1) مستقل (1) شقة في مبنى أو عمارة (2)

4) عدد الساكنين في المنزل :

5) معدل الدخل الشهري لجميع الساكنين في المنزل:

1) أقل من 1501 شيكل

2) 1501-3000 شيكل

3) 3001-5000 شيكل

4) أكثر من 5000 شيكل

6) ما هو مقدار رسوم جمع النفايات السنوي التي تدفعونها حالياً (بالدينار الاردني)؟

7) كيف يتم تحصيل الرسوم؟ (1) شهرياً (2) سنوياً غير ذلك حدد

8) ما أعلى حد للرسوم تستطيع دفعها شهرياً (بالدينار) في حال تحسين خدمة جمع النفايات ونقلها:

1- من 1 الى 2

2- من 3 الى 4

3- من 5 الى 6

4- من 7 الى 8

9) ما هي المسافة بالمتر التي أنتم مستعدون لقطعها لايصال النفايات الى الحاوية:

1- من 10 الى 20

2- من 21 الى 50

3- من 51 الى 100

4- من 101 الى 150

10) اكثر مبلغ شهري (بالدينار) مستعد لدفعه مقابل خدمة أخذ النفايات من المنزل.....

11) الاستعداد للمشاركة في حملات تطوعية للتنظيف: (1) نعم (2) لا

12) كم يقدر معدل وزن النفايات الصلبة من المنزل يوميا

13) ما المقصود بالنفايات الصلبة؟

14) من الذي يقوم عادة بالقاء النفايات في الحاوية او غيرها :

1- الأب 2- الأطفال 3- الأم 4- غير ذلك (5) جميع من ذكر

15) ضع علامة بجوار المشاكل المحددة ذات العلاقة بالنفايات الصلبة (الحاوية) في التجمع السكاني عندكم.

1) عدم وجود حاوية

2) بعد الحاوية عن المنزل

3) الازعاج الصوتي عند تفريغ الحاوية

4) الروائح المنبعثة من الحاوية

5) وجود حشرات أو قوارض بالقرب من الحاوية

6) عدم تفريغ الحاوية بشكل دوري

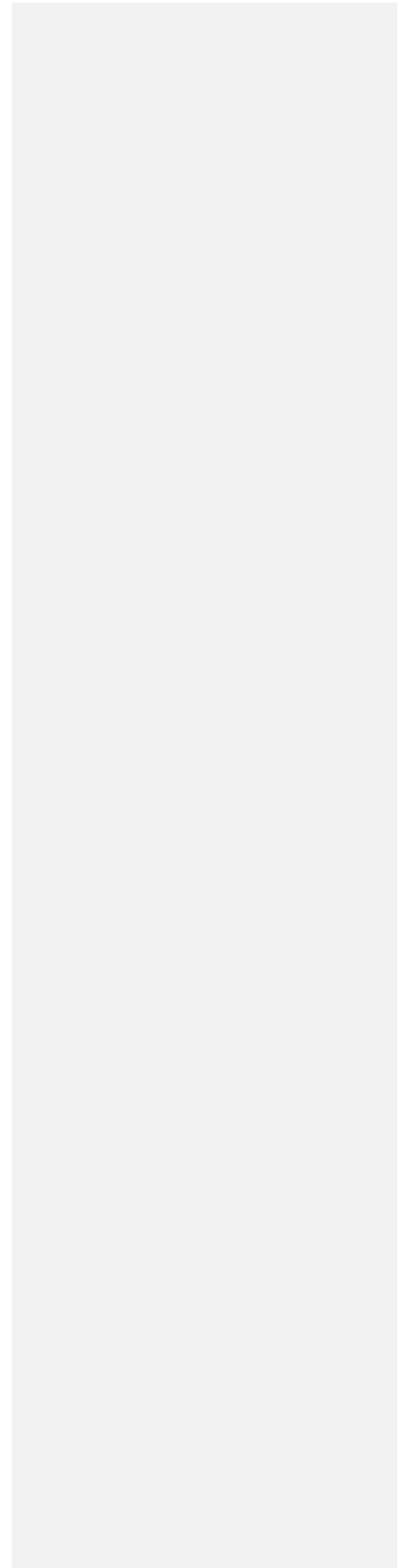
7) اتساخ الحاوية بشكل دائم

- 16) الشوارع حول المنزل نظيفة
- (1) دائما (2) غالبا (3) احيانا (4) نادرا
- 17) مسافة أقرب حاوية الى المنزل (بالمتر):
- (1) اقل من 75 م
(2) 76 الى 150 م
(3) أكثر من 150 م
(4) لا يوجد حاوية
- 18) وضع الحاويات من ناحية ميكانيكية :
- (1) جيدة (2) ليست جيدة (3) لا يوجد حاوية
- 19) وضع الحاوية القريبة من ناحية صحية:
- (1) مقبولة (2) غير مقبولة (3) لا يوجد حاوية
- 20) يتم جمع النفايات:
- (1) كل يوم (2) كل يومين (3) كل ثلاثة ايام (4) كل اسبوع
- 21) هل انت راض عن وتيرة جمع النفايات :
- (1) دائما (2) غالبا (3) احيانا (4) نادرا
- 22) هل تعاني من وجود حاويات قريبة من منزلك:
- (1) دائما (2) غالبا (3) احيانا (4) نادرا (5) لا يوجد حاوية
- 23) هل لديك استعداد لفرز النفايات المنزلية الناتجة الى خمسة أنواع رئيسية هي:
- الزجاج، البلاستيك ، المعادن ، الورق، المواد العضوية. وذلك اذا طلب منك خلال توزيع أكياس ذات ألوان خاصة ليبدل على نوع ما بداخلها من نفايات لاغراض الاستفاده من المخلفات:
- (1) نعم مجانا
(2) نعم مقابل مبلغ رمزي
(3) لا
- 24) كيف تتخلص من بقايا الطعام:
- (1) التخلص منها مع النفايات
(2) اعادة استخدامها كسماد عضوي
(3) طعام للحيوانات
(4) غير ذلك
- 25) هل لديك الاستعداد لاجراء عملية التذليل في حديقة المنزل (تحويل بقايا الطعام ومخلفات الحديقة الى سماد عضوي) في حال تدريبكم على عمل ذلك:
- (1) نعم
(2) لا
- 26) اذا كان الجواب لا ما السبب:

27) ما هي اقتراحاتك لتحسين إدارة النفايات الصلبة بالشكل الأمثل

.....
.....
.....

2) key person questionnaire



إدارة النفايات الصلبة في محافظة نابلس

الاستمارة بغرض البحث العلمي

رقم الاستمارة:

التاريخ: 2006/ /

(1) اسم التجمع:

(2) عدد السكان:

(3) آليات ومعدات جمع النفايات

النوع	العدد	السعة (م3)	الحالة (جيدة -متوسطة- سيئة)	مستأجرة / ملك
تراكتور				
سيارة ضاغطة				
سيارة شاحنة				
حاوية سعة 1 م3				
حاوية سعة 3 م3				
حاوية سعة 5 م3				
حاوية سعة 8 م3				
حاوية سعة 30 م3				
عربات يدوية				
غير ذلك				

(4) ما هي الآليات والمعدات الخاصة بجمع النفايات الصلبة التي تعتقدون انكم بحاجة اليها زيادة عن المتوفر لديكم؟

النوع	العدد	السعة (م3)	الحالة (جيدة - متوسطة-سيئة)	مستأجرة / ملك
تراكتور				
سيارة ضاغطة				
سيارة شاحنة				
حاوية سعة 1 م3				
حاوية سعة 3 م3				
حاوية سعة 5 م3				
حاوية سعة 8 م3				
حاوية سعة 30 م3				
عربات يدوية				
غير ذلك				

(5) وتيرة جمع النفايات من المنازل

- (1) كل يوم
 (2) كل يومين
 (3) كل ثلاثة أيام
 (4) كل أسبوع

(6) عدد العاملين في مجال النفايات:

الوظيفة	العدد	دوام كامل / جزئي
إداري		
مفتش		
عامل جمع قمامة		
عامل تكنيس		
شوارع		
سائق		
غير ذلك		

(7) عدد العاملين في مجال النفايات الصلبة الذين يحتاجون اليهم زيادة عن الموجودين لديكم:

الوظيفة	العدد	دوام كامل / جزئي
إداري		
مفتش		
عامل جمع قمامة		
عامل تكنيس		
شوارع		
سائق		
غير ذلك		

(8) هل تجدون عمال بسهولة للعمل في قسم النفايات عند الحاجة

- 1- نعم
 2- لا

(9) اذا كانت الاجابة لا ما هو السبب؟.....

(10) كم يبلغ متوسط أجور عمال النفايات في بلدكم.....شيقلا شهر

(11) هل يوجد نظام لصيانة الحاويات؟

- 1- نعم
 2- لا

(12) كيف تم اعتماد خط سير سيارة النفايات أثناء عملية الجمع؟

- 1- عشوائياً
2- بناءً على دراسة
3- غير ذلك.....
- (13) ما هي نسبة السكان التي تغطيهم خدمة النفايات بشكل عام (بغض النظر عن الآلية)؟-----
- (14) التكاليف الشهرية لجمع والتخلص من النفايات (موظفين ومعدات):
- (15) طريقة تحصيل رسوم جمع النفايات:
- (1) على كل فرد
(2) على كل منزل
(3) على كل عائلة
- (16) قيمة الرسوم:
- | | | | |
|------------------------|---------------|----------|----------|
| | سنة 2003..... | سنة 2004 | سنة 2005 |
| القيمة الواجب تحصيلها: | سنة 2003..... | سنة 2004 | سنة 2005 |
| القيمة المحصلة فعلاً: | سنة 2003..... | سنة 2004 | سنة 2005 |
- (17) كمية النفايات يوميا كغم
- (18) طريقة التخلص من النفايات
- (1) الحرق
(2) الردم
- (19) مساحة موقع التخلص من النفايات:
- (20) ملكية موقع التخلص من النفايات
- أ- المجلس المحلي
ب- الأوقاف
ت- حكومية
ث- خاص
- (21) قيمة إيجار موقع التخلص من النفايات:
- (22) ما هي التجمعات الأخرى التي تستخدم موقع التخلص من النفايات.....
- (23) هل هنالك اناس يجمعون بعض انواع النفايات من الموقع.....
- (24) حدد ماذا يجمعون
- (25) الموازنة السنوية لقطاع النفايات في المجلس:

المصادر الأخرى للنفايات في التجمع:

26) النفايات الصناعية

نوع النفايات	الكمية اليومية (كغم)

النفايات الصحية:

يوجد في التجمع:

(27) مستشفى

(28) مختبر تحاليل طبية

(29) عيادة

(30) من المسئول عن جمع النفايات الطبية.....

(31) ما هي اقتراحاتكم لتحسين وضع ادارة النفايات الصلبة في تجمعكم السكاني؟

.....

.....

.....

جامعة النجاح الوطنية
كلية الدراسات العليا

تقييم ممارسات ادارة النفايات الصلبة في محافظة نابلس

عبد السلام فهمي ابو زهرة

اشراف

د حافظ شاهين

د عصام الخطيب

قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في هندسة المياه والبيئة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين

الخلاصة

تتناول الدراسة واقع نظام ادارة النفايات الصلبة في محافظة نابلس من ثلاثة جوانب وهي الادارة وتفاعل المواطنين ومكونات النفايات.

تبين أن 97% من السكان في منطقة الدراسة يعيشون في تجمعات يوجد بها نظام لجمع النفايات الصلبة. هنالك فروق كبيرة في أنظمة إدارة النفايات الصلبة سواء بين القرية والمدينة او فيما بين القرى. هنالك 25 تجمع تستخدم السيارات الضاغطة في جمع النفايات بينما 22 تجمع تستخدم التراكتور . في 9 تجمعات تتم خدمة جمع النفايات عن طريق المجلس المحلي , 27 عن طريق مفاول و 13 تجمع عن طريق مجلس الخدمات المشتركة. قيمة رسوم جمع النفايات تتراوح بين 5 الى 15 شيكل شهريا. الرسوم يتم جمعها بشكل منفصل في 11 تجمع، مع فاتورة الكهرباء في 35 تجمع، بشكل منفصل في 11 تجمع، على فاتورة الكهرباء في 35 تجمع، على فاتورة الماء في تجمعين، وعلى فاتورتي الماء والكهرباء معا في تجمعين. هنالك أيضا اختلاف في ملكية موقع التخلص من النفايات.

المشكلات الرئيسية عدم كفاية العمالة والاليات والتخلص من النفايات بطريقة غير صحية وتدني تحصيل الضرائب ومنها ضريبة النفايات لا يوجد فصل للنفايات الخطرة والطبية في جميع التجمعات مما يؤدي لزيادة المخاطر على البيئة والمواطن.

هنالك سؤال عن الحاجة لتوحيد نظام ادارة النفايات في المحافظة. واذا حصل ذلك يتوجب ان يتم بمبادرة من وزارة الحكم المحلي بصفتها مسؤولة عن المجالس المحلية هنالك حاجة لانشاء مكب صحي ويتوجب ان يكون بالتزامن مع اغلاق المكبات غير الصحية وزيادة التدوير و عملية التزيبيل حيثما تكون مجدية.

يتوجب على وكالة الغوث أخذ دورها بالتخلص الكامل من النفايات الى الموقع الصحي وعدم الاكتفاء بأخذها من المخيم والقائها في حاويات البلدية.

في منحى اخر تتناول الدراسة الاتجاهات المختلفة لدى المواطنين فيما يتعلق بموضوع النفايات الصلبة. فمثلا لوحظ التوجه لدى المواطنين ذوي الدخل المرتفع لدفع المزيد مقابل تحسين جمع النفايات الصلبة. كما لوحظ استعداد اصحاب المنازل المنفصلة لمشي مسافة

ت

أكبر للحاوية من الساكنين في شقق. ولوحظ كذلك استعداد المواطنين لفرز النفايات الصلبة إلى خمسة مكونات رئيسية وذلك للتدوير فيما بعد. وعموماً هنالك حاجة لزيادة وعي المواطنين بموضوع النفايات الصلبة.

وقد تبين أن 63% من مكونات النفايات الصلبة في المحافظة هي مواد عضوية وبمعظمها بقايا طعام. وأن 8% مواد بلاستيكية وأن 3% مواد معدنية وأن 3% زجاج وأن 10% ورق وكرتون إضافة إلى 10% مواد أخرى ومواد خاملة. وإن الفروق في نسبة المكونات بين المدينة والقرية ضئيلة. حيث تزيد نسبة المكونات العضوية في القرية بينما تزيد نسبة المكونات الورقية في المدينة.