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Good Governance and Integration for Sustainable Municipal Solid Waste Management: A Case Study of Egypt

A Thesis submitted to the Graduate Program in Sustainable Development
The American University in Cairo, School of Sciences & Engineering

In partial fulfillment of the requirements for the Degree of
Master of Science in Sustainable Development

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Abstract

The management of solid waste has become a major cause of concern over the past few years in both developed and developing countries. For the sustainable development of any nation, proper management of solid waste is very essential. The effect of waste accumulation can be extremely serious for many communities in developing countries. In Egypt, the issue gets more complicated as the municipal solid waste management system lacks good governance and integration among stakeholders due to unclear law and undefined roles among stakeholders. These aspects impose severe health and environmental threats on Egyptian communities and waste its resources. To solve the MSWM issue in Egypt there are several factors to be considered. At first, good governance must take place in terms of equity and inclusiveness among stakeholders especially the informal sector. Besides, rule of law execution is important as to have clear laws and institutional frameworks that are soundly implemented. Also, laws promoting Extended Producer Responsibility (EPR) have to take place. The EPR shifts responsibility from the government and user to producer to organize and finance the collection system for used products. This will lessen the environmental stress and also benefits the producer and user. Moreover, promoting source reduction by implementing the (4Rs) has to be done in order to minimize the amounts of generated waste; therefore reusing products or making them with the least materials will alleviate waste tremendously; hence, less materials to be recycled or sent to landfills. Also, creating sources of revenue in the system is very crucial and this can happen by having a satisfying collection fee via cross subsidy, private sector investment, polluter pays, SWM tax, waste valorization, etc. In addition, having a solid recycling plan and benefitting from the local recycling systems such as Zabbaleen and private sector will be of added value to the waste management chain and will increase system's efficiency. Having capacity building that can develop the waste management system and aid in engineered landfills design will lead to less ecological and minimum public health problems resulting from mismanagement of waste. Additionally, raising awareness on integrated sustainable waste management will change the attitude and behavior towards dealing with waste. Finally, integration among all stakeholders, waste system elements, and all aspects must take place with regular follow-up and monitoring. By doing such efforts in municipal solid waste management, a road will be paved for a better future for the upcoming generations leading to sustainability in waste management.

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List of Acronyms

CBA	Cleaning and Beautification Authorities
CCBA	Cairo Cleansing and Beautification Authority
CDW	Construction and Demolition Waste
CWG	Collaborative Working Group
EEAA	Egyptian Environmental Affairs Agency
EGED	The Egyptian- German EU Development Partnership
EIA	Environmental Impact Assessment
EPA	Environment Protection Agency
EU	European Union
EPR	Extended Producer Responsibility
GCR	Greater Cairo Region
GDP	Gross Domestic Product
GNP	Gross National Product
GIZ	Gesellschaft für Internationale Zusammenarbeit
IDA	Industrial Development Authority
IMA	Inter-Ministerial Committee
ISWM	Integrated Sustainable Waste Management
ISWMS	Integrated Solid Waste Management Sector
KfW	Kreditanstalt für Wiederaufbau
MSEA	Ministry of State for Environmental Affairs
MSW	Municipal Solid Waste
MoLD	Ministry of State for Local Development
MSWM	Municipal Solid Waste Management
MURS	Minister of State of Urban Renewal and Informal Settlements
MWRI	Ministry of Water and Irrigation
NGOs	Non-Governmental Organizations
3Rs	Reduce, Reuse and Recycle
SDGs	Sustainable Development Goals
SP-ISWM	Strategic Plan for Integrated Solid Waste Management
SWM	Solid Waste Management
WM	Waste Management
WMRA	Waste Management Regulatory Agency

1. Chapter 1

Introduction

1.1 Background

'Waste' is defined as the material that has fallen out of the economic cycle of manufacture and consumption. It is an unwanted by-product, a material output from economic inefficiency. If waste is poorly managed and left to pile up over time, it can harm public health, safety and the quality of the environment. (MSEA, 2017)

Proper waste management is vital to achieve global sustainable development. Sustainable development has been defined in various ways but the most frequently quoted definition is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."(Ward, 2012)This means that the current generation should put in consideration the future ones as their current behavior will affect future resources. According to Waste and Sustainable Development Goals (2016), there are more than 7 billion people on the planet producing waste every day. A staggering half of that waste is not collected, treated or safely disposed, and it is causing a global waste crisis. The Sustainable Development Goals (SDGs) cannot be achieved except if waste management is dealt with as a top priority. As per SDG number 12 in Figure 1, dealing with resources as if they were infinite will hinder the global goals for sustainable development; hence, a shift from waste management to resource management has to be implemented; in other words, make the best out of the current resources without wasting them. Innovative methods are needed to attain higher productivity in the use of materials and to decrease total environmental impacts from material consumption; hence, an introduction of a phased approach for recycling markets in developing countries is needed i.e. promoting sustainable and eco-friendly materials. (Hotta , 2012)



FIGURE 1: SOLID WASTE MANAGEMENT IS A KEY TO DELIVERING THE GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT (WASTE AND THE SUSTAINABLE DEVELOPMENT GOALS, 2016)

According to WasteaidUK, “forty percent of the world’s waste generated from homes, businesses, agriculture, hospitals and industry – is not collected or treated.” (WasteaidUK, 2018)

As stated in Figure 1 solid waste management (SWM) is a key to delivering the global goals for SDGs. Solid waste is defined as the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. Proper SWM has a powerful and positive impact on people’s well-being as mentioned in goal 3 “Good Health and Well-being: less disease caused by open dumping and burning”. Additionally, open dumping and burning of waste leads to numerous severe health problems and pollutes the environment. Open dumps encourage vermin, poison air, water and land, and regularly result in waste entering the sea and affecting marine life as shown in SDG 14 “Less plastic pollution in the oceans and sea

life” and SDG 15 “Less pollution on the land, healthier environment” affecting the below water and life on land. Around 0.3% of international development aid is invested in solid waste management, yet it is vital to delivering many of the SDGs. In a nutshell, we can attain the global goals effectively once we identify waste management as a dominant driver of sustainable development. (Waste and the Sustainable Development Goals, 2016)

In fact, human health and environment can be affected by poor SWM. Waste is diverse in its origin and variety resulting in various impacts. Previously SWM actions have been limited to regulation, policies, and financial practices; however, the rapid change in technologies has resulted in several impacts that are affecting human wellbeing and environment. The waste dumping in forests, deserts, streams, oceans, lakes, and other place has resulted in wide impacts resulting in international and national legislations.(Chandrappa & Bhusan Das, 2011)

As seen in Figure 2, the activities involved in the management of solid waste from the point of generation to final disposal can be grouped into six main phases:



FIGURE 2: SOLID WASTE PHASES (IBRAHIM AND MOHAMED, 2016)

Additionally, low collection rate and improper disposal of solid waste signify a source of water, land and air pollution. Nevertheless, wet organic waste represents the bulk of the problems and could comprise around 60% of the total generated waste. (Ibrahim & Mohamed, 2016) Fortunately, some of the organic waste could either be reduced or transformed into organically beneficial products via the application of novel and innovative approaches and technologies. These resources could be reused for the manufacture of energy, organic fertilizers, and animal feed. Such approach is in line with the ideology of sustainable development, where competent utilization of resources is closely related with poverty mitigation goals. (Ibrahim & Mohamed, 2016)

The challenges of SWM in Egypt have always been one of the most pressing challenges facing Egyptian authorities. During the 1990s, Egypt followed the Structural Adjustment Program (SAP) that was proposed by the International Monetary Fund (IMF) and the World Bank. One of the reform objectives was to liberalize the economy by increasing the involvement of the private sector in operating public projects. Within this context, the private sector (predominantly international companies) became involved in the management of solid waste in Egypt. After years of international private sector participation, the situation has worsened as admitted by the Minister of State for Environmental Affairs (MSEA) in a report issued in 2009. The report projected that the annually generated solid waste in Egypt reached nearly 75 million tons, while municipal waste was about 20 million tons. (Ibrahim & Mohamed, 2016)

The term municipal solid waste (MSW) is normally assumed to comprise all of the waste generated in a community, excluding waste generated by municipal services, treatment plants, industrial and agricultural processes. (Ibrahim & Mohamed, 2016)

Unfortunately, no accurate data is available on municipal waste flow in Egypt. Estimates have been made of per capita MSW generation rates by Governorate, differentiating between urban and rural areas. These approximations were included in the June 2000 draft National Municipal Solid Waste Strategy, lacking explanation of how they were derived. Those coefficients have been mutual with population data from the 1996 census to develop MSW generation estimates. (MSEA, 2013)

As stated in MSEA, 2013, Figure 3 and Table 1 show that construction and demolition waste (CDW) constitutes 44% of the total waste in Egypt. Followed by agricultural waste 32% and the followed by MSW 14% and then followed by others (medical, industrial, and waterway cleansing waste).

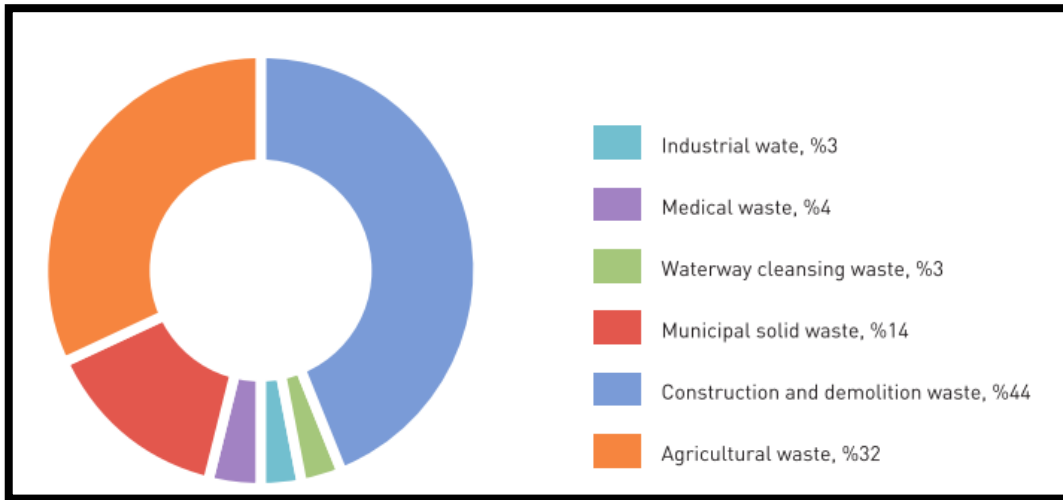


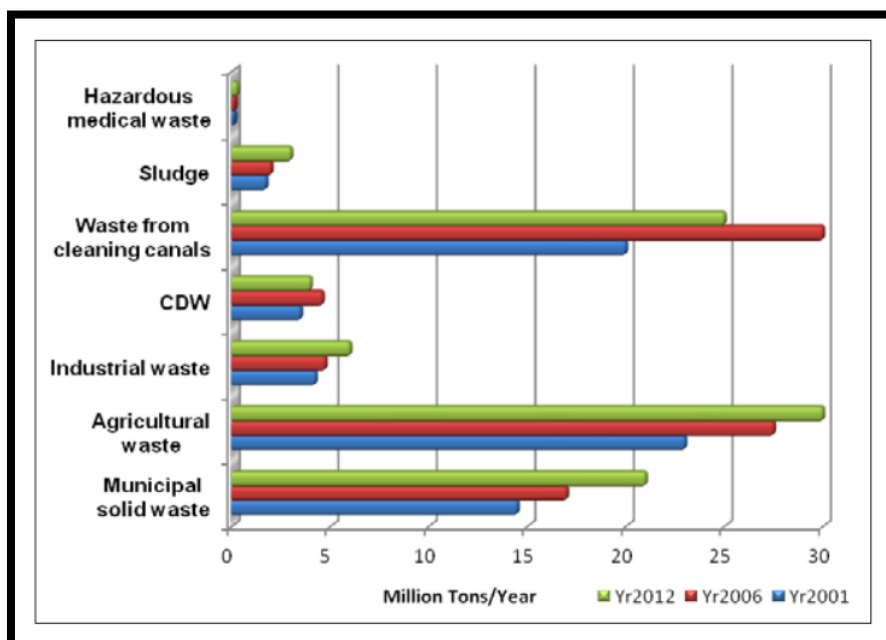
FIGURE 3: GENERATED SOLID WASTE IN EGYPT, 2010 (MSEA, 2013)

TABLE 1: GENERATED WASTE IN EGYPT, 2010 (MSEA, 2013)

Waste Type	Generated Quantity (Tonnes)
Municipal solid waste	13,806,269
Construction and demolition waste	41,748,603
Agricultural waste	30,000,000
Industrial waste	2,906,895
Medical waste	3,416,254
Waterway cleansing waste	3,058,509
Total	94,936,530

Table 2 and Figure 4 show that MSW has increased from 2006 to 2012 by 24%. While construction and demolition decreased by 13%. Agriculture waste has increased by 9% and industrial waste has increased by 26%. Medical waste has increased by 87% and waterway cleansing waste decreased by 17% and sludge increased by 50%. The total waste in Egypt has increased by 3.8%. The above figures are based on Egyptian Environmental Affairs Agency (EEAA). (MSEA, 2013)

TABLE 2: GENERATED MSW IN EGYPT, 2001, 2006 AND 2012



Waste Type	Generated Quantity (Million Tonnes)		
	2001 ¹⁷	2006 ¹⁸	2012 ¹⁹
Municipal solid waste	14.5	17	21
Construction and demolition waste	3.5	4.6	4.0
Agricultural waste	23.5	27.5	30
Industrial waste	4.25	4.75	6.0
Medical waste	0.12	0.15	0.28
Waterway cleansing waste	20	30	25
Sludge	1.75	2	3
Total	67.12	86	89.28

FIGURE 4: GENERATED SW IN EGYPT 2001, 2006, AND 2012

Figure 4 and Table 2 show the evolution of generated solid waste and are based on the Ministry of State for Local Development (MoLD). They have a deviation from EEAA data in Figure 4 and Table 2. One main challenge in the national development and planning of the SWM sector is the deficiency in trustworthy data on the quantities of generated waste and its composition. To design an efficient waste management program, it is vital to know how much MSW generated must be managed. Moreover, if we aim to decrease MSW generation, tracking the total MSW will be an imperative indicator of success. Hence, the total amount of generated MSW is

essential information and there is a crucial need to exploit trustworthy and precise methods for its continual measurement. Within the context of The Egyptian-German-EU-Development Partnership (EGED) - National Solid Waste Management Program (NSWMP) reinforcing the sustainable development of Egypt's SWM sector, all confirming the lack of data collection and systematized reporting. This limits the competence to reach truthful plans and to appeal investment in infrastructure and services. (MSEA, 2013)

In addition, the above figures lack electrical and electronic wastes (e-waste) which are rapidly growing forms of waste that are generating much concern. By 2020, e-waste from used computers in emerging economies will have increased by 200-500 percent over 2007 levels. E-wastes contain metals such as mercury, cadmium and lead that may leach into the environment and cause a health hazard to human beings, unless handled with care. (United Nations, 2011) There are data gaps regarding the numbers of computers and mobile phones in Egypt. The absence of studies and trustworthy quantitative data makes it a challenge to measure the size of the problem and to plan appropriate e-waste management systems. (MSEA, 2017)

The total amount of municipal waste generated yearly in Egypt is around 22 million tons according to 2015 estimates. This is translated to a total amount of municipal waste of 60,000 tons generated per day. (MSEA, 2017)

Table 3 below shows an estimate of the quantities of MSW generated daily and annually in each Governorate. It shows that Cairo is on the top list by far followed by Giza governorate. This comes as no surprise, seeing that Cairo is the highest populated governorate in Egypt. (MSEA, 2017)

TABLE 3: THE DAILY GENERATED MSW IN EGYPT, 2015- - (MSEA, 2017)

Governorate	Municipal solid waste generation per day (tonnes)	Municipal solid waste generation per year (million tonnes)
Cairo	15400	5.62
Alexandria	4300	1.57
Giza	4800	1.75
Qalyubeya	3800	1.39
Daqahliya	4800	1.75
Gharbiya	3800	1.39
Menoufiya	2650	0.97
Beheira	3700	1.35
Kafr El Sheikh	2750	1
Al Sharqia	2350	0.86
Damietta	1200	0.44
Ismailia	620	0.23
Port Said	670	0.24
Suez	410	0.15
Fayoum	740	0.27
Beni Suef	820	0.29
Minya	1440	0.53
Asyut	720	0.26
Souhag	1130	0.41
Quena	1335	0.49
Aswan	920	0.34
Luxor	330	0.12
Red Sea	465	0.17
Matrouh	310	0.11
North Sinai	250	0.09
South Sinai	570	0.21
New Valley	135	0.049
Total	60,434	22.049

According to Environment Protection Agency (EPA), MSW is known as trash or garbage. In other words, it consists of everyday items we get rid of, such as food scraps, newspapers, grass clippings, bottles, paints, etc. All previous items are generated from households, schools, businesses and hospitals. Cairo, the most populated city in Egypt, has the most serious waste disposal issue due to its high density population; Egypt is the most populated country in the Middle East. Egypt's population, industrialization, and urbanization are increasing dramatically. Also, change in consumption trends has caused the generation of diversified solid waste representing mainly perceptible environmental problem among many especially in urban areas. (MSEA, 2013) A total of 90-95 million tons of waste is generated annually of which 14-20 million tons is MSW. The trends in MSW generation show that the total volume of MSW is projected to reach 35 million tons yearly by 2025. (The World Bank, 2014) The issue of municipal solid waste management (MSWM) in Egypt has become a challenging matter. It has diverse ecological, economic, and social effects.

In 2004, the official privatization of solid waste services via contracts with high-tech multinational companies threatened the sustainability of the informal garbage collectors, Zabbaleen, by removing access to their chief economic asset: waste garbage. Even though, the Zabbaleen have created what is one of the world's most efficient resource-recovery and waste-recycling systems. The objectives of the privatization program tend to favor tourist-orientated projects, while ignoring the local population's interests via the removal of informal Zabaleen settlements in Muqattam Mountain. Privatization threatened the socio-economic sustainability of the Zabaleen community. Consequently, the Zabaleen could lose their access to the environmental assets, i.e. the garbage, which they have converted into economic and social assets. Additionally, Zabaleen began losing their licenses when international waste management companies started taking over Cairo's waste collection routes. The city sold annual contracts for US\$50 million to 3 private companies, hoping to dispose 10,000 pounds of garbage produced by 16 million Cairo residents each day. Such a privatization approach fails to allow people to build incrementally on technologically appropriate indigenous patterns of living. (Fahmi, 2005)

In September, 2013, a decision was made to establish a new "Integrated Solid Waste Management Sector (ISWMS)", as a separate sector, under the MSEA. The new national authority planned to take charge of the SWM sector in Egypt and to execute the National Solid Waste Management Program (NSWMP). The program is jointly supported by the European Union (EU) and the German Cooperation, Kreditanstalt für Wiederaufbau (KfW) and Gesellschaft für Internationale Zusammenarbeit (GIZ). They are the executors of the program together with the Egyptian side. The ISWMS initiated a program to improve SWM, by adapting a "Decentralized system" and community participation functioning with roles and responsibilities clearly identified to every stakeholder. The key driver of the plan is to comprise citizen and community organizations in WM. Community groups should be involved in various activities comprising collection, segregation, processing, dissemination of information and awareness building. Units should be set up to process the organic waste locally generated into compost. All issues relating to this have to be tied up to guarantee the continuity of capacity utilization in operation and maintenance. The NSWMP will adopt the Integrated and Sustainable Waste Management (ISWM) concept to reform the municipal solid waste sector. The waste management hierarchy, prioritizing certain waste management practices over others, will be

taken into consideration within the preparation of the new national policy and the solid waste management law that will be drafted. (SWEEPNET, 2014)

The integrated solid waste management (ISWM) approaches entails a waste prevention program has to be developed and implemented, followed by promoting the reuse of products and materials, and then recycling comes next. But the focus in Egypt has been on recycling. Policy makers seem unconcerned with prevention or reuse. ISWM has proven its success in various countries in dealing with waste management as it covers three critical dimensions as it will be elaborated later. ISWM is a framework that was initially developed in the mid-1980s by WASTE, a Dutch non-governmental organization (NGO), and WASTE's South partner organizations, and further expanded by the Collaborative Working Group (CWG) on Solid Waste Management in Low and Middle Income Countries in the mid-1990s. Since then it has become the "norm". (MSEA, 2013)

A paradigm shift from conventional waste management practices to ISWM is vital for cities in order to efficiently manage the waste stream. (United Nations, 2011) ISWM is comprehensive waste management system that comprises a prevention, recycling, treatment, and disposal program. It considers how to deal with solid waste most efficiently to the environment and human health. Waste management planning should consider institutional, financial, economic, social, legal, technical, and environmental factors. The sustainable management of solid waste is necessary from planning to design, to commission, to operation, to shut down, and decommissioning.(Chandrappa and Bhusan Das, 2011)

Additionally, ISWM is a concept targeting the creation of an environmentally sound and financially sustainable SWM. It concentrates on all the elements in the waste management from generation to final disposal. This integrated approach should encompass technical, environmental, legal, socioeconomic and financial aspects, involving the stakeholders at various levels to ensure an effective implementation. (MSEA, 2013)

ISWM planning is a dynamic tool encompassing aspects that range from policy-making and institutional development to technical design of integrated solutions for the management and disposal of waste. The model of ISWM varies from the conventional approach towards waste

management by seeking stakeholder participation, considering how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment; by comprising interactions with other systems and promoting integration among all stakeholders. ISWM does not deal with waste management (WM) as just a technical issue, but also identifies the political and social factor as the most vital. (MSEA, 2013)

As seen in Figure 5, ISWM entails three dimensions if handled properly will lead to sustainability; each is of crucial significance and must be cautiously taken care of all through the planning process: those are: 1. Stakeholders, 2. Waste System Elements; and 3. Aspects of the SWM System. Stakeholders: local authorities, NGOs, service users, private informal sector, private formal sector, and donor agencies have different roles and interests in relation to waste management. The main challenge of the ISWM process is to get all stakeholders to agree to cooperate for a common purpose; that of enhancing the waste management. The waste management elements are the technical components of a WM system and refer to how solid waste is managed and where it is disposed at the end as seen in Figure 5. The aspects could be defined as attributes through which the current waste management must be evaluated and with which a new or expanded management could be planned. In order for the new or expanded SWM to be sustainable, it has to take into proper consideration all the technical, environmental, health, financial-economic, Socio-cultural institutional, legal and political aspects. (MSEA, 2013)

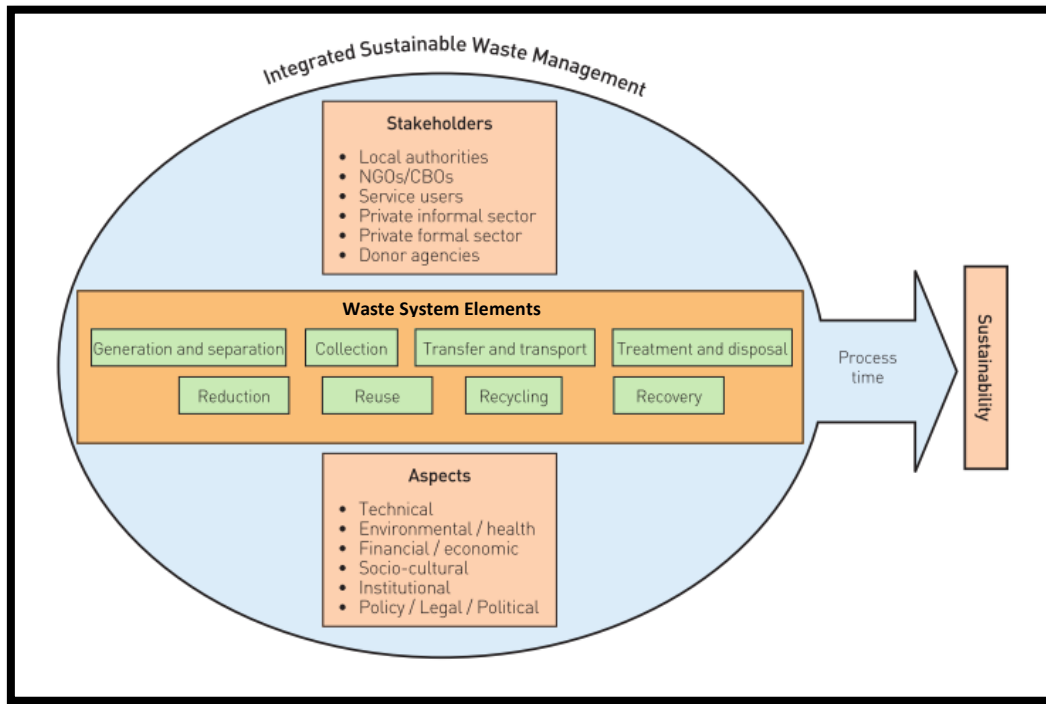


FIGURE 5: INTEGRATED SUSTAINABLE WASTE MANAGEMENT (ISWM) FRAMEWORK (MSEA, 2013)

1.2 Performance Measurement

There are several researches that have been published in the last decades on SWM in Egypt targeting diverse approaches and audience. But till now SWM is still lacking an organized set of objectively verifiable indicators measuring the actual performance of SWM sector on the ground, and the quality of data that assists such analysis (MSEA, 2013). This research will discuss the initiatives implemented in regards to municipal solid waste management (MSWM) in Egypt; however, the outcome does not reflect any improvements in the MSWM system. In fact, to manage effectively the tons of generated waste every day an integrated approach have to be implemented by properly managing involved stakeholders, waste system elements, and other aspects as to reach ISWM sustainability.

1.3 Research Problem

On one hand, total annual MSW generation in Egypt has increased more than 36 % since 2000, to reach the level of 20.5 million tons per year 2010, (SWEEPNET, 2010). It is projected to reach 35 million tons per year in 2025 (United Nations, 2011). Although the Egyptian government launched several initiatives to improve the waste management sector with the start of the new millennium, their programs resulted in minimal improvement. Less than 65% of generated waste was regulated by some form of public or private sectors. Unfortunately, the rest

accumulates on city streets and at illegal dumping sites. Furthermore, managing this waste remains inefficient and inadequate. This leads to serious environmental and public health problems. In fact, the inappropriate disposal of solid waste in waterways and drains has caused water contamination which hinders Egypt's natural resources, heritage, and welfare of its community. (SWEEPNET, 2010) Such findings are alarming as they threaten Egypt's future; hence, making solid waste a vital topic worth exploration.

On the other hand, a sustainable MSWM system is known as an opportunity for cities for creating job opportunities, raising awareness on responsible consumption, and protecting the environment (Fuss, et al., 2018); however, many decision makers have not given MSW an integrated thought. As a result, MSW management has been facing challenges that are affecting its sustainability; this research intends to scrutinize the current MSW system and identify factors that will lead to integrating sustainability in the SWM system in Egypt.

1.4 Research Gap

The key purpose of the research is to try to comprehend the reasons behind the failure of the current MSWM in Egypt, and to pin point the factors that would lead to better system which will pave the way towards system's sustainability. A research gap was found in the literature regarding the available updated accurate data on the total amount of SW especially the MSW in Egypt and what is the current status regarding MSWM.

1.5 Research Objectives/Goals

Literature review conducted shows that there is deficiency in the current MSWM system performance and it indicates that there is lack of good governance and integration among all stakeholders. The research objectives are to:

- 1- Analyze and assess the current status of MSWM in Egypt
- 2- Identify the challenges that hinder its performance and
- 3- Compare it with developing countries' case studies in order to improve it and pave the way towards sustainability

2. Chapter 2 Literature Review

2.1 Waste Management Overview

Cities are at the nexus of a further risk to the environment, namely the production of an increasing quantity and complexity of wastes. The projected quantity of MSW generated globally is 1.7 – 1.9 billion metric tons. In several cases, municipal wastes are not well managed in developing countries, as cities and municipalities cannot cope with the pace of waste production. Waste collection rates are often less than 70 % in developing countries. More than 50 % of the collected waste is often disposed of via uncontrolled landfilling and about 15% is processed via unsafe and informal recycling. Establishing and enhancing facilities for collection, recycling, treatment and disposal for MSW management can be very expensive. For example, building and operating sanitary landfills and incineration plants require huge investments and incur substantial operation and maintenance costs. Additionally, if waste is growing at 3-5% yearly and rural-urban migration increases a city's population at a similar rate, and then a city's waste generation will twofold every 10 years. As a result, urban managers are supported to pursue the paths of Integrated Solid Waste Management (ISWM) and Reduce, Reuse and Recycle (3Rs) that place highest priority on waste prevention, waste reduction, and waste recycling instead of just trying to cope with ever-increasing amounts of waste via treatment and disposal. Such efforts will help cities to reduce the financial burden on city authorities for waste management, as well as lessen the pressure on landfill requirements.(United Nations, 2011)

2.2 Solid Waste Management in Egypt

As mentioned previously, the Egyptian SWM sector suffers from severe and critical ailments which hamper its efficiency and challenge public health, environment and natural resources. These ailments must be tackled holistically to ensure sustainable restructure and investments in the sector. The restructure in the SWM sector will open the door to new job opportunities that guarantee environmental, health, and safety conditions; in addition to the establishment of essential professional standards within an environment of effective institutions.

The main challenges facing the sector are the insufficient planning and legislation, resource constraints, institutional deficiencies and the nonexistence of stakeholders' participation. Additionally, the MSW system lacks adequate collection equipment. According to the Ministry

of Environment, this is a result of both the poor maintenance and the lack of resources to improve and modernize collection and treatment equipment. Building capacities to better understand the functioning of equipment as well as to develop technical guidelines will need to go hand in hand with securing sufficient funds to manage MSW in an adequate manner. Integration of the informal sector in the formal public and private waste management sector, putting in place economic instruments, such as public-private partnerships, and strengthening human resources will be essential in the more effective implementation and enforcement of the existing policies. Enhancing the coordination among governmental entities responsible for regulating and operating MSW management is also required. Raising awareness in the population about the benefits of at-source waste separation will have a vital role in complementing the efforts undertaken at governmental and company level. Unfortunately, most of the generated MSW ends up in open, public and random dumpsites, causing a severe threat to public health and the environment. Table 4 shows the distribution of those dumpsites in the respective Governorates, along with the daily generated MSW in 2012. (SWEEPNET, 2014) Table 4 findings reflect that the government does not have planning for sanitary landfills.

TABLE 4: THE DAILY GENERATED MSW IN EGYPT, 2012

Governorate	Generated MSW (tons)	Number of Dumpsites		Governorate	Generated MSW (tons)	Number of Dumpsites	
		Public	Random			Public	Random
Cairo	15,000	5	12	Fayoum	720	5	7
Giza	4,500	1	7	Bani Souwaif	800	2	8
Alexandria	4,000	1	2	Menia	1,300	9	12
Kalyobiya	3,500	5	8	Assiut	700	2	8
Dakahlia	4,500	6	13	Sohag	1,100	11	13
Al Gharbiya	3,500	5	10	Qena	1,080	11	12
Monofiya	2,500	4	14	Aswan	800	5	10
Al-Beheira	3,500	14	16	Luxor	470	2	3
Kafr El-Sheikh	2,500	6	15	Red Sea	450	6	10
Sharqia	2,200	5	10	Matruh	300	8	8
Damietta	1,100	5	12	North Sinai	250	6	8
Ismailia	600	1	7	South Sinai	500	8	10
Port Said	650	1	1	New Valley	100		
Suez	400	1	3				
Total		60	130	Total		75	109

2.2.1 Cairo's MSW Overview

Egypt in total contains 909 slum areas, occupied by more than 5.5 million people. (Euromonitor, 2017) Most Cairo slums emerged in the mid-1960s, due to the population explosion that took place after World War II. Cairo has many challenges as other large cities in developing countries: problems of transportation, solid waste, lack of sufficient drainage and sewage, and lack of usable spaces. Cairo has 23 million inhabitants, is the largest metropolis in the Middle East. Cairo represented 33% of Egypt's total Gross Domestic Product (GDP) in 2016. (Euromonitor, 2017) Population growth rate reached 1,91% in 2005. The GDP, according to the World Development Indicators database 2006, is \$78,8 billion. The annual GDP growth is 4,2%. (Iskandar et al, 2010). Only 65% of urban population has accessibility to collection service and the open dumpsite is widespread with the related health damages. The current situation of the MSW sector is deteriorating mainly in Greater Cairo. The effectiveness of the existing MSW system is very modest with only 65% of the urban population has accessibility to basic collection services, less than 5% of the waste collected all over the country is being disposed in a sanitary way and only 11% of the waste is being composted or recycled. In general, the current service levels are poor with significant impact on public health and some vital economic activities like tourism, agriculture and trade. The related health harm costs have been estimated by the World Bank about 1.5% of GDP. (World Bank, 2014)

The Greater Cairo Region (GCR) is distributed over three governorates: Cairo, Giza, and Qalyubeya. Its jurisdiction contains the cities of Cairo, Giza, Shubra el Kheima, as well as several other small towns, villages, suburban and agricultural areas as shown in Figure 7, with population estimates close to 20 million people (Iskandar et al, 2010). The informal waste sector is residing in informal settlements as shown in Figure 6, which shows the informal garbage collector settlements in GCR. (Didero, 2012)

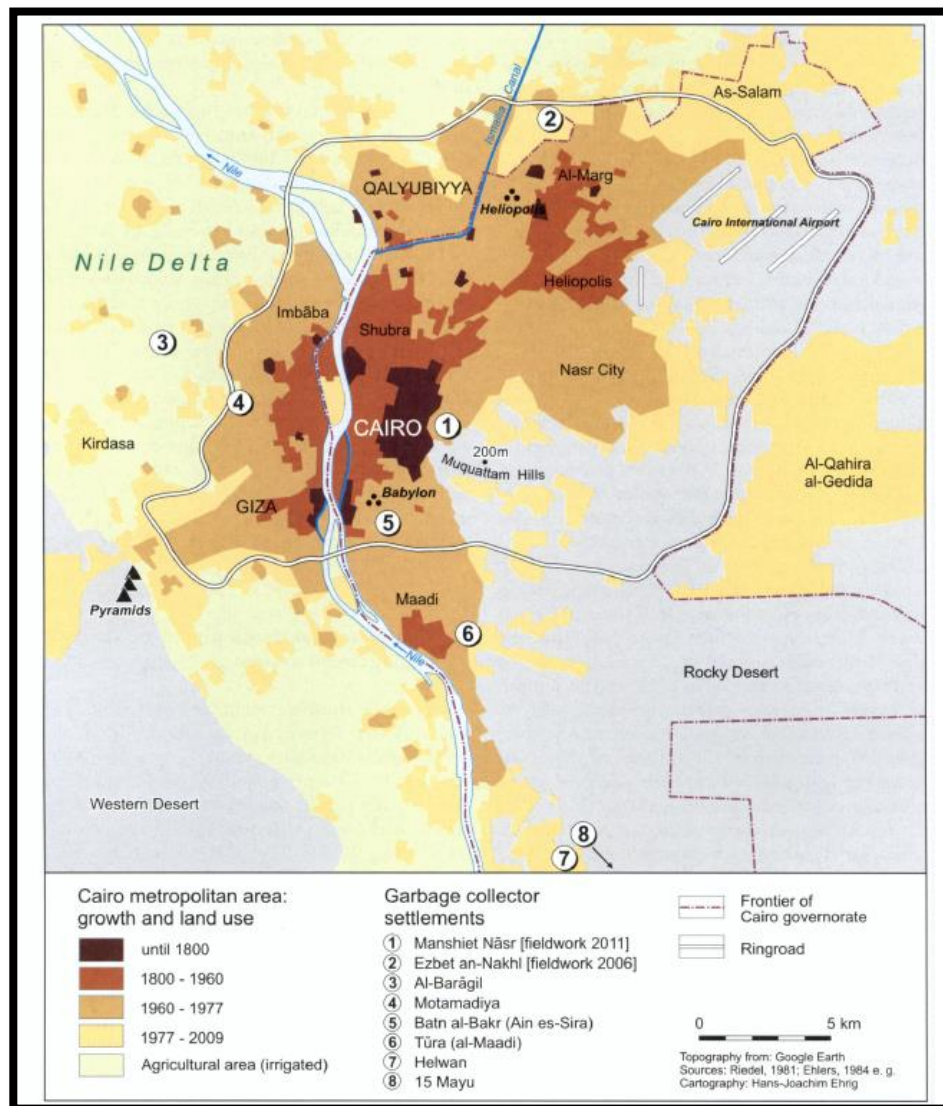


FIGURE 6: MAP OF GREATER CAIRO REGION, SHOWING INFORMAL GARBAGE COLLECTOR SETTLEMENTS (DIDERO, 2012)

Unfortunately, the rapid growth of Cairo has led to an extraordinary augmentation of municipal wastes. Treating this waste has become a gigantic burden on local governments and causing an increasing risk to public health of urban populations. It also forms a vital aspect of diminishing the carbon footprint: CO₂ produced from human activities as well as impact on climate change: weather phenomena as a result of increase in global average temperatures. Currently, municipal governments failed to efficiently handle this rising volume of waste. Government dumpsites are not well managed and cannot absorb the growing volume of generated waste. This forces cities to allocate new dumpsites further out of the city; hence, leading to higher transport cost and additional carbon emissions. As fuel prices are projected to increase even further, the burden on municipal budgets is expected to rise. (CID Consulting, 2010)

Studies from several developing countries in the southern hemisphere state that approximately 15 to 20 % of the waste generated in cities, is recycled by the informal sector. This is generally inorganic dry wastes such as metals, plastics, paper, glass etc. In Cairo, the Zabbaleen-the informal sector recycle almost 80 % of what they collect. It is estimated that they collect approximately 50 percent of the waste generated by Cairo, which means that they collect 50 percent of 14,000 tons daily. It is claimed that 7 to 8 jobs are created in the informal recycling economy. This fact is disregarded by municipalities and policy makers as the connection between waste management and economic policies, pro poor policies and national employment schemes are not complete. This is frequently manifested by policies and regulations which hinder their access to the materials, replace them by contracting to foreign companies which use advanced compaction trucks which obliterate the intrinsic value of recyclables. (CID Consulting, 2010) This shows that there is a gap between the informal sector Zabbaleen and the government which hinders the performance of the SWM system.

In Cairo, the general public has a wide understanding that informal sector does a good job and should not be banned from collecting wastes. As a result, it is critical to advocate for (CID Consulting, 2010):

- Rethinking that waste is a problem, but rather a resource
- A departure from costly, capital intensive methods to technologies which are reasonable and functional in the framework of cities

- An endorsement of recycling and a departure from landfilling
- An integration of the marginalized people/informal sector into the solution of waste management of the city as they have already proven that they have the know how to manage a considerable amount of that waste but need to be upgraded and guided to handle more of it
- Reduce transportation costs so that solving the waste problem of the city does not cause a higher carbon footprint.

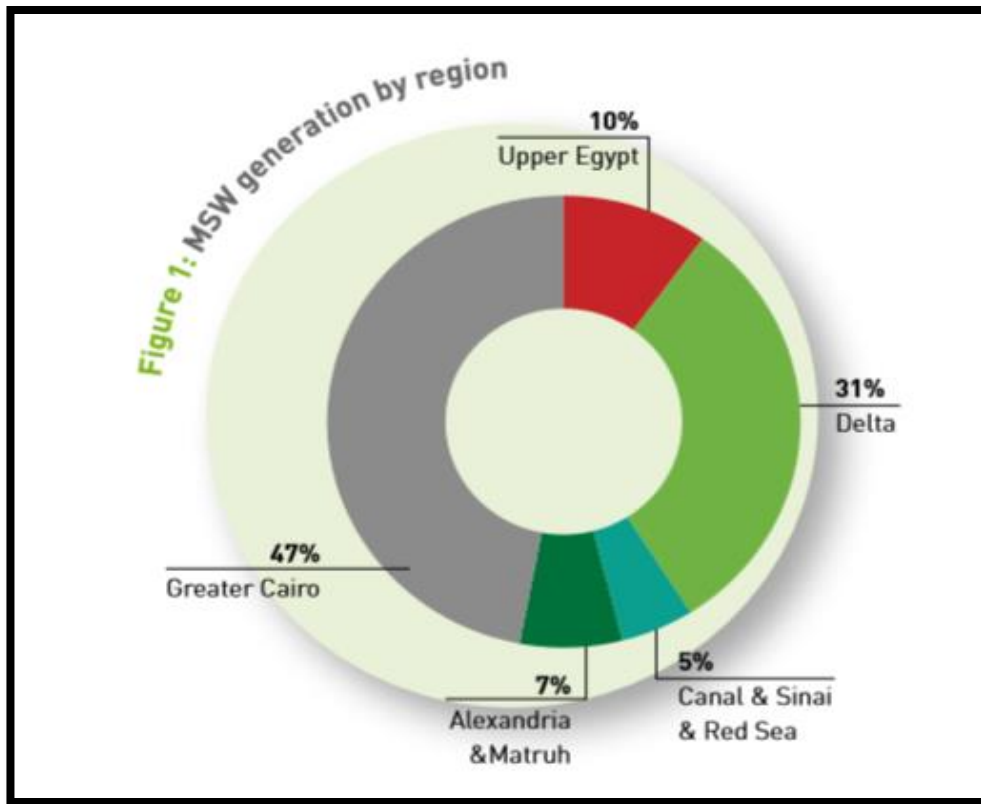


FIGURE 7: MUNICIPAL SOLID WASTE GENERATED BY REGION (THE SWEEPNET, 2010)

Figure 7 depicts that Greater Cairo generates 47% of MSW, followed by Delta region 31%. These two regions are followed by Upper Egypt 10% and Alexandria and Matruh; then, the Canal, Sinai and Red Sea. (SWEEPNET, 2010) This means that solving Greater Cairo SWM system deficiency will solve almost 50% of the problem.

2.2.2 Legal Challenges

Unfortunately, Egypt does not have adequate regulations for solid waste management. The legal framework is scattered in several areas of legislation. There are two major legislations regarding SWM: law No. 38/1967 on General Public Cleaning and Law No. 4/1967 for the Protection of the Environment and their adjustments. The key amendments of the legislations in 2005-2010 are:

- Law No.10/2005 creating a solid waste collection fee scheme
- Prime Minister Decree No. 1741/2005 modifying the executive regulations of Law No. 4/1994 and encompassing regulations for the selection of the sites for recycling and land filling and equipment necessities for waste collection and transfer
- Law No. 9/2009 modifying Law 4/1994 and managing collection, treatment and disposal of hazardous waste
- Presidential Decree No. 86/2010 regulating the closure of existing dumping sites and the landfill at Greater Cairo and allocation of five new sites away from the inhabited and commercial belt of Greater Cairo (SWEEPNET, 2010)

Additionally, the outdated private companies' contracts and scattered laws and regulations hinder the performance of SWM (SWEEPNET, 2010). Moreover, investors, regardless of whether they are private or public, small or large, face problems and obstacles in developing and executing projects. Among these are limitations on allocating spaces for public benefit, lack of legally established planning processes for infrastructure and services, absence of planning, permits and project approval procedures, as well as lack of legal framework. These aspects, altogether, act as a significant and ongoing barrier to sector development. Hence, a Waste Management Law is being drafted to stipulate requirements for the waste management sector. The Law will establish, amongst other measures: institutional roles and responsibilities, general obligations, planning obligations, regulatory mechanisms, licensing/permitting requirements and penalties. (MSEA, 2017)

In order to uphold the SWM stability, a national SWM policy, which describes the basic framework of the sector, is needed. A policy was all set; it represents the foundation for a series of integrated actions seeking a holistic and sustainable restructure and regulation of the SWM sector in Egypt. These actions are taken based on international best-practice applied at the Egyptian political, legal, institutional, social, and financial perspectives. The projected framework within the national policy will improve the development of new laws, guidelines, standards, institutions, professional capacities, data reporting requirements, and awareness and education programs dedicated to ISWM and directed by good governance ideologies. Moreover, the policy will also espouse an inclusive approach towards the informal sectors based on recognition and integration of such informal capacities and protection of their livelihoods. (NSWMP, 2014)

2.2.3 Financial Challenges

The information available on financial aspects of waste management services in Egypt is limited. There is lack of budget for waste management within governorates, apart from Cairo and Giza that have their own cost centres for these services via Cairo Cleaning and Beautification Authority (CCBA) and Giza Cleaning and Beautification Authority (GCBA).

In Cairo, costs of waste management services have two parallel user-charging systems that are functioning:

1. The main one is the cleaning fee, a formal locally collected fee implemented on the electricity bill
2. Another one is an informal cash payment at the door for informal garbage collectors, Zabbaleen

In 2005, the Egyptian People's Assembly issued Law 10/2005, allowing solid waste management collection fee on the electricity bill. Revenues for the cleansing fund are mostly the monthly fee by households in return for SWM services. Moreover, other sources of revenues to the cleaning fund comprise fines and penalties for violations as per law 38/1967. Governorates utilize collected fee to either pay contract to private companies and to finance their SWM systems. Monthly payment thresholds per household set in law 10/2005 vary from L.E. 1 to 10 in cities and from L.E. 1 to 4 in smaller cities. On the other hand, shops and other commercial premises pay from L.E. 10 to 30 per month. (EEAA, 2011)

In a nutshell, Egypt would be required to triple investment in MSW sector to meet the needs in regards to quality and access to service. MSW is among the most significant municipal services in terms of local expenditures and fiscal transfers. It is projected that Egypt spends L.E. 1 billion per year, which is equivalent to L.E. 74 per ton of MSW collected. Recent studies highlight that the financial services for the sector are inadequate to meet satisfying service standards including coverage and quality of service. International benchmark for alike middle income countries shows an average cost of US\$ 28 per ton which implies that Egypt would be required to triple allocated waste management budget to L.E. 3.4 billion to improve the performance of its MSW sector. (The World Banks, 2014)

2.2.4 Waste Collection and Treatment

The coverage of waste collection services varies among governorates. A very significant percentage of the population, especially in rural areas, does not receive waste collection service at all. Lack of collection services causes significant public health, safety and environmental threats. The health implications of waste management deficiency, amongst others, comprise viruses and bacterial infections transmitted either via polluted water, animals and insects, and respiratory illnesses resulting from open burning. Egypt has 63 waste recycling and composting plants distributed throughout the governorates. Almost all of these plants are no longer functioning or running at low capacity except for a limited number of plants run by the private sector. The weak performance of the recycling and composting plants can be linked to technical and financial factors and poor management. Unfortunately, the waste supplied to the plants is mixed, hence, leading to the production of low-quality compost, and causing increase in plant operation costs. Another challenge is the inadequate budget for operation and management and shortage in qualified labor force and product marketing departments. (MSEA, 2017)

There are four operating composting plants in Cairo Governorate: Cairo Governorate (municipality) owns 3, and one is owned by an NGO -Association for Protection of the Environment (APE). Private contractors, via concession contracts, manage all the composting plants. The capacity of each of the Governorate- owned plants is 10 tons/ hour, and that owned

by the NGO, (APE), is about 5 tons/ hour. Also, two new composting plants are presently under construction, and will join the composting activities.(Bushra, 2000)

Around 90 tons per year of health care waste are incinerated in several university and public hospitals. The rest of the waste (amounts to 3,700 tons per day), that is not sorted by the informal garbage collectors, zabbaleen, or by the composting plants or that is not incinerated, is transferred to the open dumps that are owned and operated by Cairo Governorate (municipality). Table 5 illustrates some important information about the existing open dump sites in Cairo Governorate:

TABLE 5: DISPOSAL SITES IN CAIRO GOVERNORATES (Bushra, 2000)

Open dump sites	Waste Inflow (tons/day)	Life Expectancy (in years)	Starting Date
Quatamia	1000	10	1989
Nasr City	800	15	1991
Es-Salam	700	3	1993
Al- Nahda	700	3	1993
Al Wafa wa Al Amal	500	10	1993
Total	3700		

Recycling by the formal sector represents around 2% of total waste produced, with composting at 8%. The rest 90% is divided between the informal recycling sector and in open landfills. It is expected that recycling by the informal sector could account for some 40% of total produced waste. As a result of inadequate waste collection, it is burnt in the open air by local residents. Disposal in landfills is considered the only method of waste disposal; though, it is poorly regulated. Almost all collected waste will end up in a landfill. It is assessed that the proportion of waste collected for recycling or composting lingers around a 5% of the amount collected. This shows the very small amounts of treated waste. Figure 8 depicts that the MSW composition in Egypt and proves that 56 percent comes from organic followed by 13 percent from plastics. (MSEA, 2017)

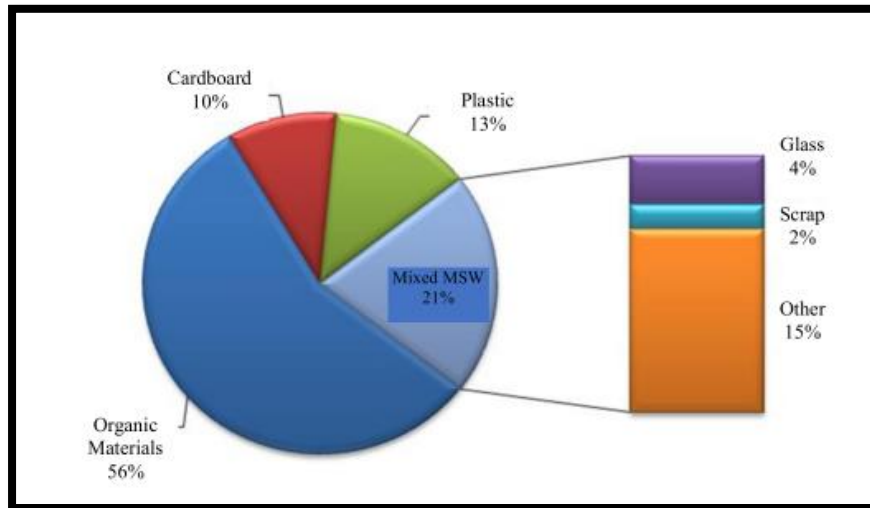


FIGURE 8: INDICATIVE COMPOSITION OF MUNICIPAL SOLID WASTE IN EGYPT (MSEA, 2017)

Moreover, civil and informal sector play a role in SWM in some of the Egyptian Governorates. Several NGOs offer MSW treatment, recycling, community development and public awareness related to SWM. Furthermore, informal sector workers, namely Zabbaleen and Wahyas (informal garbage collectors) are actively involved in door-to-door household collection service, transport, sorting and recycling activities in Greater Cairo and Alexandria Governorate. (EEAA, 2011) The international companies manage sanitary landfill sites which receive the residual waste arising from their collection activities and from their residual of their composting plants. Besides, the waste collected by municipalities is brought to government managed dumpsites. (Iskandar, et al, 2010)

Cairo's waste collection and disposal have been partly privatized through tendered contracts to international and national waste management companies. Three of the four districts of Cairo have such international companies managing the waste collection and disposal. Mostly, they hire or subcontract to the traditional informal sector waste collectors, the Zabbaleen, to do the door to door collection. In the fourth district, no international companies could be found, and so the original system is still largely in place. Yet, the city has placed intermediaries between the Zabbaleen and the households, which resulted in less earning for the informal sector. (Iskandar et al., 2007)

Waste management in Egypt has traditionally only been thought of as waste collection. Additionally, investment has been focused mainly on providing equipment to collect waste in order to get it out of the neighborhood and into the desert. Therefore, a shift in the current system is needed and implementing this shift requires a restructuring of financial and economic incentives through the ISWM chain as shown in figure 9. These are extensively addressed later in this document. (MSEA, 2017)

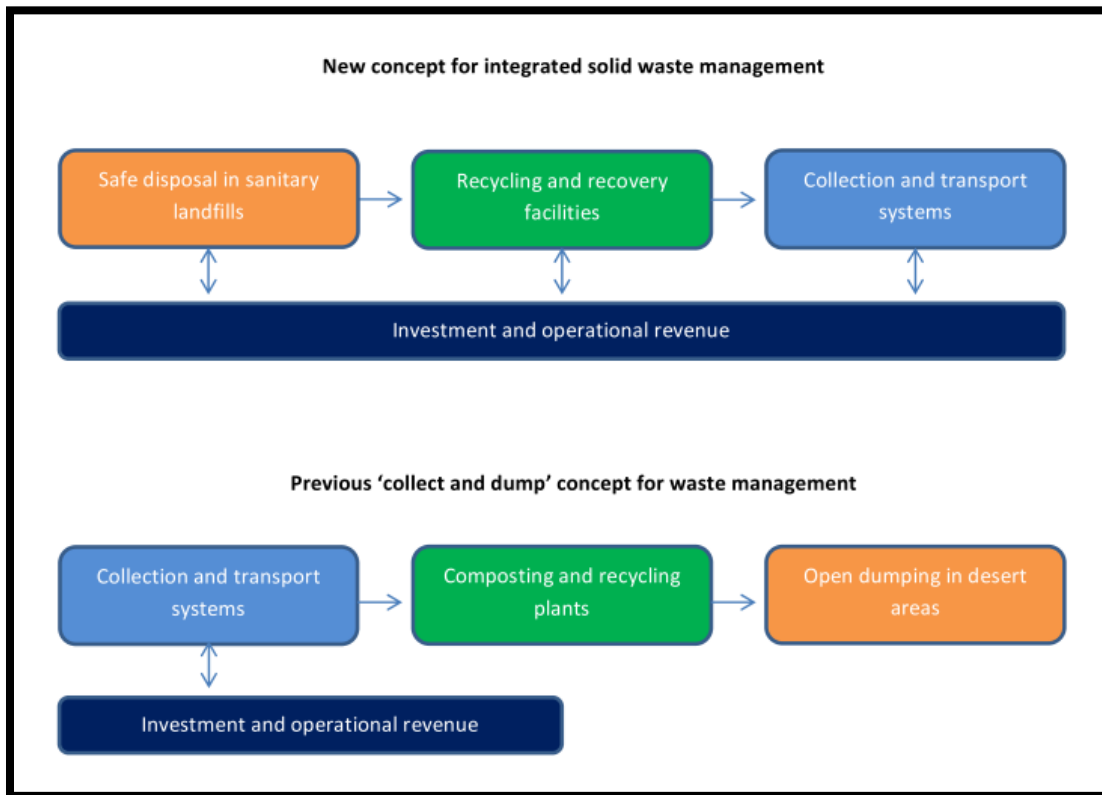


FIGURE 9: NEW CONCEPT FOR INTEGRATED SOLID WASTE MANAGEMENT

2.3 Stakeholders Role in Egypt

2.3.1 Stakeholders Overview

Figure 10 below illustrates the various groups, institutions and people involved in the entire integrated waste management system. It traces waste from point of collection in households, commercial waste generators and industrial small and medium workshops through formal and informal diversion and on to waste processing, recovery, recycling and through to final disposal.

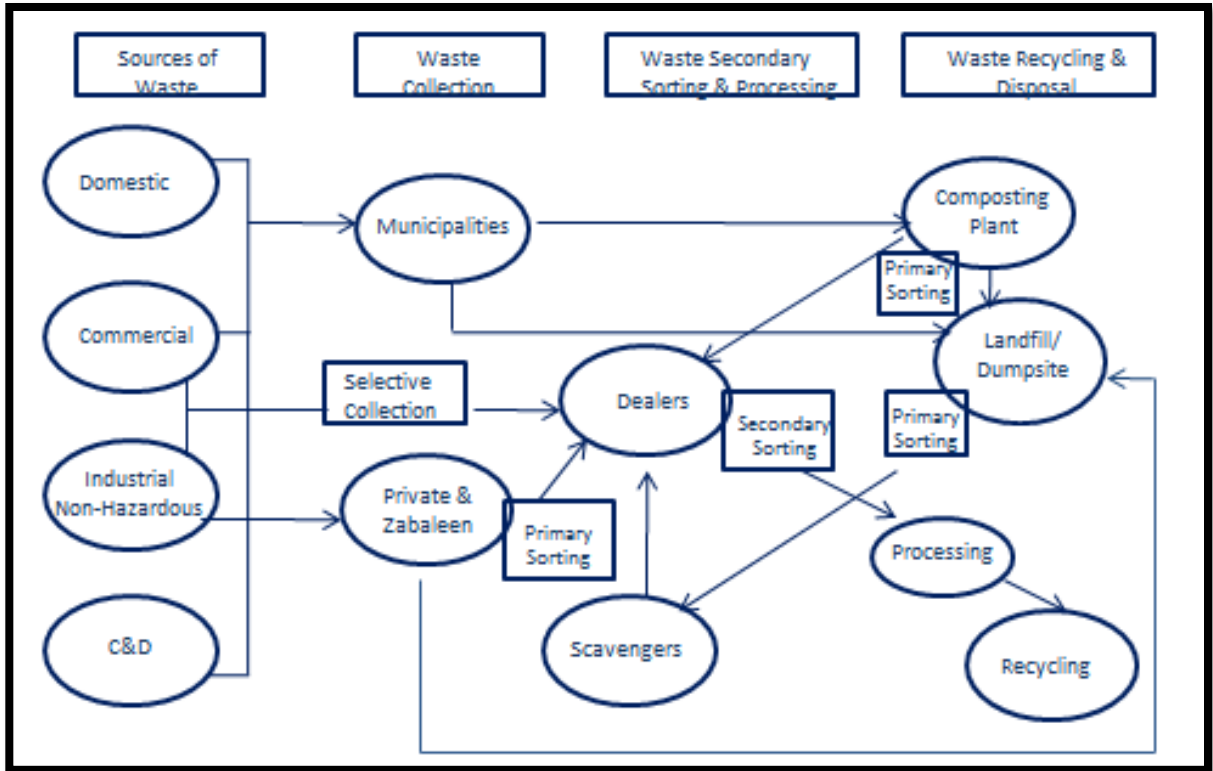


FIGURE 10: STAKEHOLDERS IN THE INTEGRATED WASTE MANAGEMENT SYSTEM (ISKANDAR et. al., 2010)

SWM is not a decretory activity with particular stakeholders. It includes nearly every person in the society and organizations in almost all sectors. Figure 11, shows categorization of stakeholders in SWM “The stakeholders at national level include (1) waste producers; (2) local entities; (3) private waste handlers; (4) employees of local entities and private waste handlers; (4) local, regional, national government; (5) Non-Government Organizations (NGOs); (6) community based organizations; (7) industries that produce waste; (8) recycling industries; (9) commercial establishments; (10) Scavengers/waste pickers; (11) scrap dealers; (12) consultants; (13) financial institutions; (14) media; (15) citizens; (16)

Self Help Groups (SHG); and (17) waste processing and disposal organizations.”

The stakeholders at international level include: (1) international organizations,(2) international donor agencies and lending agencies, (3) international waste handling companies, (4) international NGOs, (5) scrap importers and exporters, (6) media,; and (7) international consultants.” (Chandrappa & Bhusan Das, 2011)

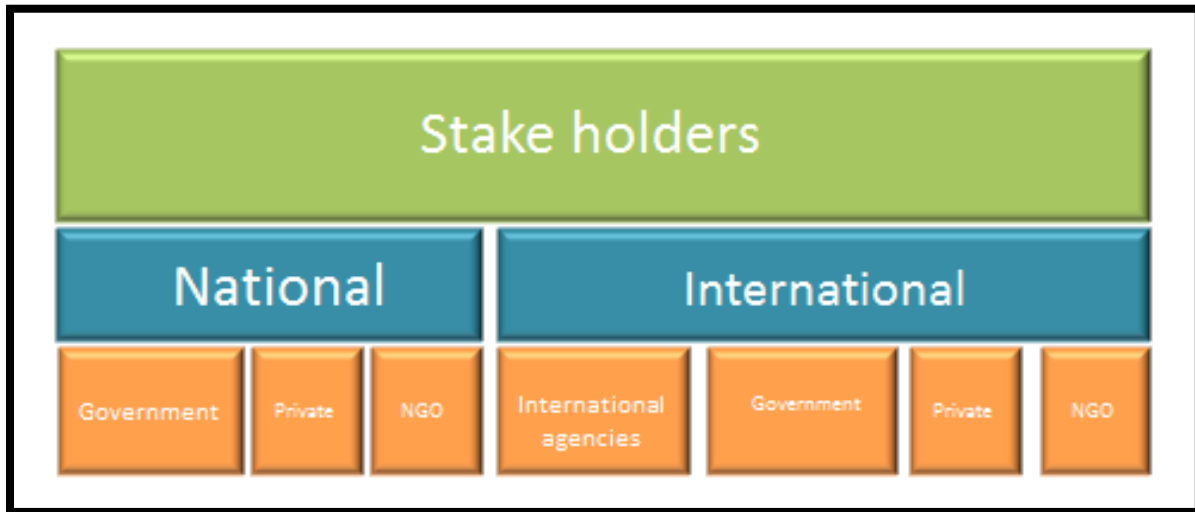


FIGURE 11: SOLID WASTE MANAGEMENT STAKEHOLDERS (CHANDRAPPA & BHUSAN DAS, 2011)

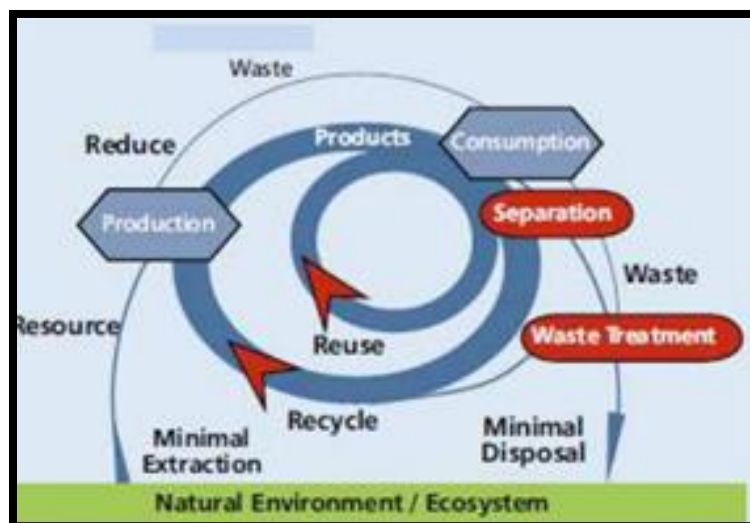


FIGURE 12: THE CLOSED-LOOP Economy (UNITED NATIONS, 2011)

In figure 12 stakeholders should promote closed loop economy in which resource input, waste, emission, energy leakage are minimized by narrowing energy and material loops. One aspect that

seems to be overlooked is the economic competitiveness that can be improved with resource efficiency. Resource efficiency has become a major factor that determines the competitiveness of firms, cities and countries. Many lucrative new business opportunities are available both in input-efficient production and in environmentally responsible recycling and waste disposal. Meanwhile, cities should also be mindful of the fact that over-dependence on conventional waste collection, treatment and disposal is not sustainable and it is too expensive. Waste management should be designed and planned in a holistic, integrated way on the principles of ISWM and practices of 3Rs,(reduce, reuse, recycle) with disposal. (United Nations, 2011)

Table 6 summarizes the roles and responsibilities of stakeholders in Cairo. They are divided into 7 main stakeholders the Central Government institutions including all ministries, Governorates, Municipalities, Private sector, Informal Sector, NGOs, Civil Society, and Recycling Industry. (Iskandar et al., 2010)

TABLE 6: STAKEHOLDERS IN SOLID WASTE MANAGEMENT SECTOR IN CAIRO (Iskandar et al., 2010)

Stakeholders	Areas of Activity, Responsibility, interest
Central Government institutions: Ministries: <i>Agricultural & Land, Housing, Industry, Health and Population, Local development and the Egyptian Environmental Affairs Agency).</i>	Setting policies at the national and regional level that pertains directly to waste management as well as to related issues of environmental protection and human health, economic development
Governorates:	Setting the strategies based on national policy, including training, monitoring and inspection
Municipalities:	implementing solid waste strategies and services and overseeing contracting and providing inspection and monitoring
Privatise sector waste companies:	both domestic and international firms provide contracted collection and disposal for Cairo
Informal sector:	Waste pickers in streets, dumpsites, transfer station plants, landfills, itinerant waste buyers, piggeries and junkshops).
NGOs and Civil Society organisations, including: <i>Hemaya Association, Association for the Protection of the Environment, Association of Garbage Collectors for Community Development, Arab Office for Youth and the Environment, Friends of the Environment & Development Association, Hurghada Environmental Protection & Conservation Association</i>	Perform services, advocate for the informal sector, operate social development activities for the informal sector including schools, training institutes, and the like, finance higher education
Recycling industry:	Includes all kind of enterprises which processes recyclables.

2.3.2 Informal Sector Role

Around 100 years ago, a group of people from the Dakhla oasis, Western Egyptian desert, settled in downtown Cairo. These migrants, known as the Wahiya, were responsible for the collection and disposal of Cairo's household waste. Working with a contract, the Wahiya paid owners an initial sum, then collected monthly fees from the ones whose waste were collected. Back in 1930s and 1940s, the Wahiya began to work together with another group of migrants, the Zabaleen, who had come to Cairo searching for work. Due to economic hardship, these landless farm workers who came from El Badary, area in Assiut, a rural region in southern Egypt, purchased waste to feed their pigs. Since that time, the Zabaleen have emerged as garbage collectors and recyclers. Therefore, there is a distinction between the Wahiya and the Zabaleen. The Wahiya have maintained control over access to the waste and collection rights, acting as middleman between Cairo's households and the Zabaleen. The Zabaleen, in general, have had no share in the fees given by residents; however, pay the Wahiya to get access to the waste garbage. But, in 1989 an agreement between the Wahiya and the Zabaleen was made and resulted in the establishment of a waste collection company named Environmental Protection Company (EPC). Under this agreement, the Wahiya contract the Zabaleen to gather and dispose solid waste. Although accountability for SWM has long been shared between the municipal sanitation service and the Zabaleen, the establishment of the EPC made the Wahiya and the Zabaleen as key participants in the local government's program to improve SWM in Cairo. The Wahiya have managed the system, promoted the company's services, collected household fees and administered service deliveries. Afterwards, as the Zabaleen have become more involved in the work, some have received a negligible charge from the Wahiya. The Zabaleen are nowadays scattered over seven garbage collector settlements in the Greater Cairo Region (GCR). (Fahmi, 2005)

The Zabaleen are stratified into door to door collectors, sorters, intermediaries, processors, manufacturers, maintenance technicians, and recycling machine manufacturers. This is mainly organized as small-scale enterprises and regularly as family owned businesses. In this way, the sector provides wages and employment to a large group of urban poor, and recycles waste generated by the community. The population which is responsible of the waste is most likely among the poorest of the poor. They live and work in unsanitary neighborhoods and are exposed

to risks as they are forced to sort mixed waste by hand, regularly process hospital waste and use machines lacking safety standards. Additionally, their income varies considerably in regards to the fluctuations in prices of recyclables in the international markets. (CID Consulting, 2010)

The social aspect of SWM in Egypt is high, in particularly the informal sector. From a public health perception, the poor are seriously impacted as solid waste collection tends to be minimal in low income neighborhoods. Moreover, about 65,000 informal waste collectors are involved with waste collection and recycling. The informal waste system plays a significant social support part, since a considerable number of waste pickers who are mostly marginalized urban citizens rely on waste picking activities as their main source of income. The transition to a formal system with privatization has adversely affected the income of the informal sector pickers. (The World Bank, 2014)

As previously stated, the Zabbaleen, traditional waste collectors of Cairo, have been accountable for creating one of the world's most efficient and sustainable waste-recycling and resource-recovery systems. Since 1950's, the Zabbaleen have been scouring the city of Cairo to collect waste from households and streets using donkey carts and pickup trucks. After transferring the waste to their settlement in Muqattam Village, also called Cairo's garbage city, the waste is sorted and transformed into valuable products like rugs, quilts, paper, compost, livestock food, recycled plastic products etc. After take out recyclable and organic materials, the segregated waste is passed onto several enterprises owned by Zabbaleen families. They collect about 60 percent of the total solid waste generated in Cairo and recycle up to 80 % of the collected waste which is higher than recycling efficiencies observed in the Western world. Over the last few decades, the Zabbaleen have advanced their collection and sorting methods, built their own labor-operated machines and formed a system in which every man, woman and child works. (Zafar, 2018)

On one hand, figure 13 depicts the process flow for the collection of one third of the waste of the greater Cairo area by the semi-formal Zabbaleen system which operates door to door. (Iskandar et al, 2010)

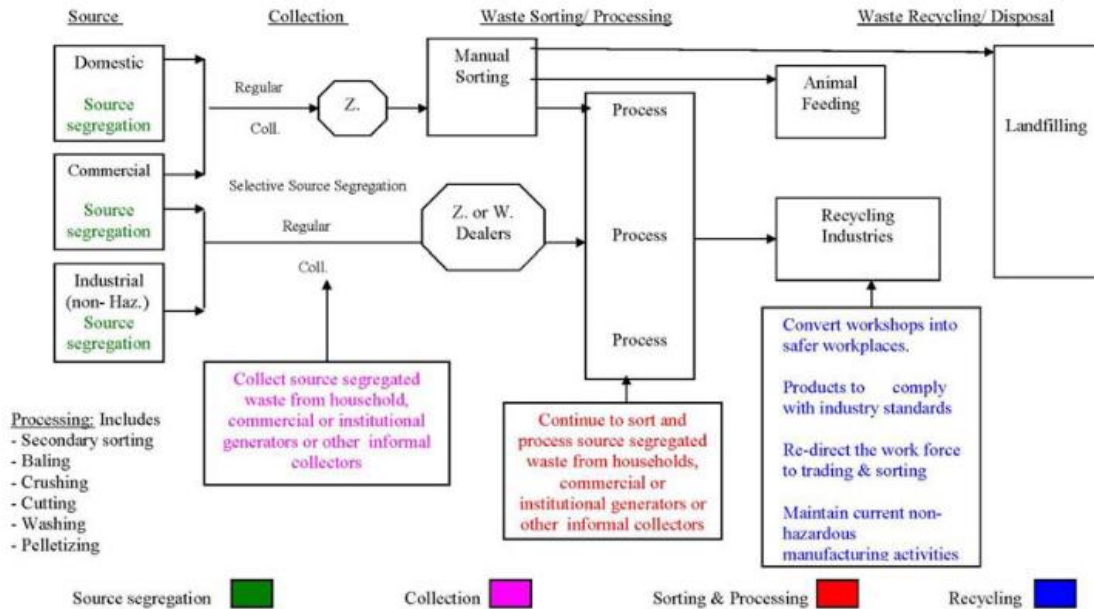


FIGURE 13: FLOW CHART OF WASTE MANAGEMENT-SEMI-FORMAL (ISKANDAR et. al., 2010)

On the other hand, the following figure 14 illustrates the flow of materials in the informal waste sector (roamers and scavengers) which is not semi formalized Zabbaleen but other informal sector actors and activities. These may go via the Zabbaleen system or not depending on their knowledge or traders, appropriate prices, etc.

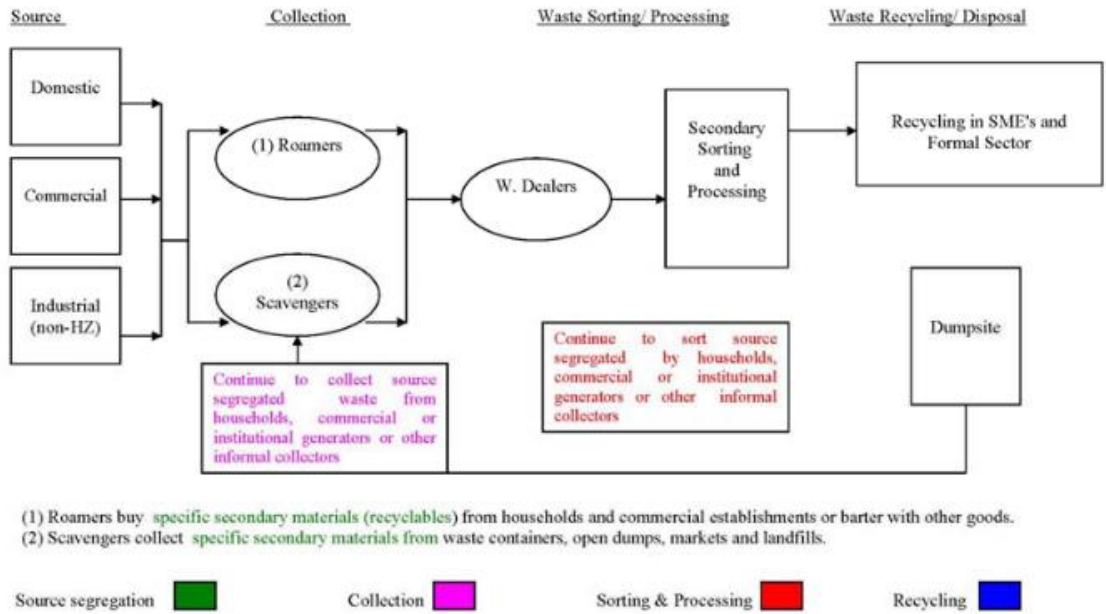


FIGURE 14: FLOW CHART OF INFORMAL SECTOR (ISKANDAR et. al., 2010)

Zabbaleen handle around 40 percent of the city waste. They are able to recycle around 85 percent of collected waste; surprisingly this percentage is much higher than most cities in North America and Europe. The Zabbal gathers waste from every apartment on his route and then takes it to his neighborhood, where it is sorted into different categories -plastic, glass, metal, etc.; and then sell it to other families or companies that recycle it. The sorting phase was normally done in the neighborhood by women and girls, causing high rates of diseases i.e. hepatitis and tetanus, as well as increased rates of infant mortality. The Zabbaleen moved around the city as to avoid the municipal authorities. Then, a large group of Zabbaleen settled under the cliffs of the Moqattam, which has now grown from a population of 8,000 in the early 1980s, into the largest garbage collector community in Cairo, with about 50,000 Zabbaleen residents. At present there are also four other Zabbaleen settlements scattered around the Greater Cairo governorate, including the smaller one of Torah (A.P.E, 2010). The informal solid waste sector has a vital and normally positive effect on the economy and the environment. Hence, overlooking the informal sector in modernization efforts of solid waste management, or limiting access to recyclables, means taking away a massive amount of money from the local economy. Also, this will negatively impact thousands of poor people. The policies should support the integration of the solid waste informal sector into the formal solid waste systems wherever possible. (Iskandar et al., 2010)

2.3.3 Government Role

National central government is accountable for establishing the institutional and legal frameworks for SWM and making sure that local governments have the necessary authority, powers and capabilities for effective SWM. To assist local government to implement their SWM duties, national government provides them with guidelines and/or capacity building measures in the field of administration, financial management, technical systems and environmental protection. In addition, national government involvement is often required to solve cross-jurisdictional issues between local government bodies, and to create appropriate forms of association when – as in most metropolitan areas – effective waste management calls for the collaboration of several local bodies. (Bushra, 2000)

Although the Egyptian government started various initiatives to develop the waste management sector with the start of the new millennium, their efforts resulted in minimal improvement. Less than 65% of that waste is regulated by some form of public or private sector collection, disposal or recycling operation. The rest of the waste accumulates on city streets and at illicit dumping sites. Moreover, the management of this waste is inefficient; hence, causing severe environmental and public health issues. Unfortunately, the inappropriate dumping of solid waste in waterways and drains has caused contamination of water supplies which hampers Egypt's natural resources, and the health and welfare of the public. (SWEEPNET, 2010)

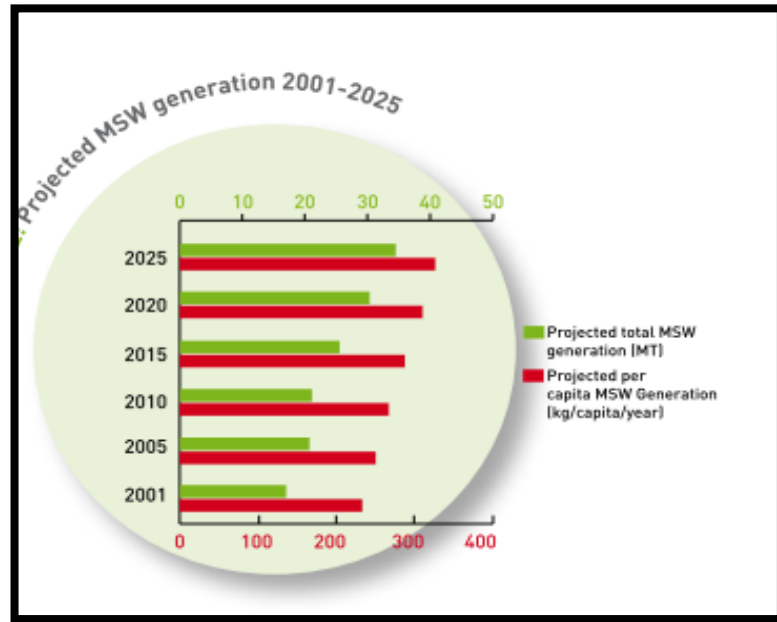


FIGURE 15: PROJECTED MSW GENERATION 2001-2025 (SWEEPNET, 2010)

Figure 15 shows the projected waste generation 2001 – 2025, as given in Egypt’s Country Report of 2004. The waste generation is projected to exceed 30 MT yearly by 2025. (SWEEPNET, 2010)

The World Bank, 2014 depicts the resulting situation as follows:

“In developing countries, it is common for municipalities to spend 20 to 50 percent of their available recurrent budget on SWM. Yet, it is also common that 30-60 percent of the urban solid waste in developing countries is uncollected and less than 50 percent of the population is served. In some cases, as much as 80 % of the collection and transport equipment is out of service, in need of repair or maintenance.”

The complexities in providing SWM in developing countries noted by the World Bank are mainly due to limitations on the available funds. In developed and developing countries, funding for waste management amounts to approximately one-half of one percent of Gross National Product (GNP) per capita. In developing countries most waste management efforts focus mainly on collection. It is estimated that 80 to 90 % of the total SWM budgets are spent on collection only. Developed countries normally spend 10 percent or less of their budgets on collection, with other funds on recycling, composting, and disposal. (The World Bank, 2016)

Until now, there has been no particular Ministry in charge with responsibility for SWM at the national level. In fact, responsibilities are divided among: (EEAA, 2011)

- Ministry of State for Environmental Affairs (MSEA)/Egyptian Environmental Affairs Agency (EEAA)
- Ministry of State for Local Development (MoLD)
- Ministry of Housing, Utilities and New Communities
- Ministry of Water and Irrigation (MWRI)
- Industrial Development Authority (IDA)
- Ministry of Agriculture and Land Reclamation
- Ministry of Health and Population
- Ministry of Finance
- Ministry of Investment

The present division of responsibilities among Ministries makes major coordination problems. Institutional roles and responsibilities are vague and there is a shortage of technical, organizational and institutional capacity at the national level. The ambiguous division of responsibilities has led to replication of efforts, ineffective use of human resources, and lack of accountability. EEAA, Egyptian Environmental Affairs Agency, is the coordinating agency with no executive authorities to direct investments or plans neither at the national, regional nor the local level. The main responsibility of the EEAA is to ensure execution of the provisions of environmental legislation, in particular Law No 4 of 1994 and its amendments Law No 9 of 2009 (The Environmental Law), and associated regulations and decrees. The EEAA formally interacts with local waste management planning through the Environmental Impact Assessment (EIA) process. Waste management facilities are granted licenses to operate subsequent to the approval of the EIA. Under the umbrella of EEAA, there is a Central Department of Waste and Material and Hazardous Substances. The Central Department was accountable for preparing the National Strategy for Integrated Solid Waste Management (the precursor to this NSWMP) in 2000. It is usually regarded as the technical SWM experts within national government, assisting many Governorates with aspects of waste management.(EEAA, 2011)

The AMANA, General Secretariat for Localities, is established under the Ministry of Local Development. According to the Law of Local Administration 43/1979, AMANA's main roles and accountabilities could be summarized as follows:(EEAA, 2011)

- Provides advice and technical support to local administration;
- Synchronizes legal views addressing local administration matters among local administration units;
- Duplicates successful experiences in Governorates;
- Handle training to local administration employees;
- Works as the technical secretariat for the Minister of Local Development in presenting issues to the Cabinet, as well as communicating the Cabinet's decisions to the local units;
- Suggest legislations significant to local administration systems;
- Examine means of decentralizing central authority's functions to the local level;
- Assists local units preparing local budgets and participate in their discussions with central authorities; and
- Manage grants and loans granted to Governorates and follow-up on the execution of investment projects in the Governorates

AMANA is a technical secretariat of the Ministry of State for Local Government, and has extensive responsibilities interconnected to all issues at the Governorate level, and waste management is just a very minor part of their role. Hence, the sector does not receive the attention that it desires within the existing institutional structures, and this lack of policy consideration translates into personnel numbers and levels of professional specialization devoted to the sector. It is also accountable for supplementing the Governorates in developing SWM facilities, mostly composting plants of which there are 60 in the different Governorates. The assessment of the performance of the composting plants showed that few numbers of these plants are operating efficiently. The rationale is that these types of projects are regarded as service projects with extreme labor demand.(EEAA, 2011)

The composting plant operated in 15th-May-City is considered as a successful representation that should be replicated. The plant functions via contract with Cairo Cleansing and Beautification Authority (CCBA) with one of the national private companies sub-contracted. Service fees are applied for the treatment and safe disposal of waste.(EEAA, 2011)

A National Solid Waste Management Program (NSWMP) was first identified in 1999-2000 as a result of the severe air pollution identified as “black cloud” phenomenon. NSWMP was arranged but was not effectively implemented, probably because of the absence of a sustainable institutional system at the National level that could offer support, guidance and follow up on the execution. In 2009, the need for a NSWMP has been revitalized given the growing solid waste management crisis being faced by the country. The policy aims to tackle the situation was highlighted by the establishment of an Inter-Ministerial Committee (IMC) by the Government of Egypt. The IMC encompasses representatives from all core Ministries currently playing a role in the waste management sector, and was in charge of tasks including arranging a proposal for the future institutional preparations to manage the waste management sector in Egypt.

The key outcome of the IMC consultative process is a broad based agreement between stakeholders of the need to create a national SWM body as a centre for excellence in policy, legislation, strategy, technology, contracting and financing of SWM; working to maintain decentralized execution of enhanced waste management practices in governorates. (EEAA, 2011)

In 2015, Waste Management Regulatory Agency (WMRA) was established by the Prime Minister’s Decree No. 3005. As per figure 16, the mandate of WMRA is to regulate, monitor, and control all aspects associated to waste management at central and regional levels in a way that leads to the improvement of environment-friendly management of all types of waste. Additionally, WMRA utilizes and coordinates development of the waste management sector. It regulates the waste sector, implements the policies, plans and programs, and technically assists the authorities for all waste streams. (MSEA, 2017)

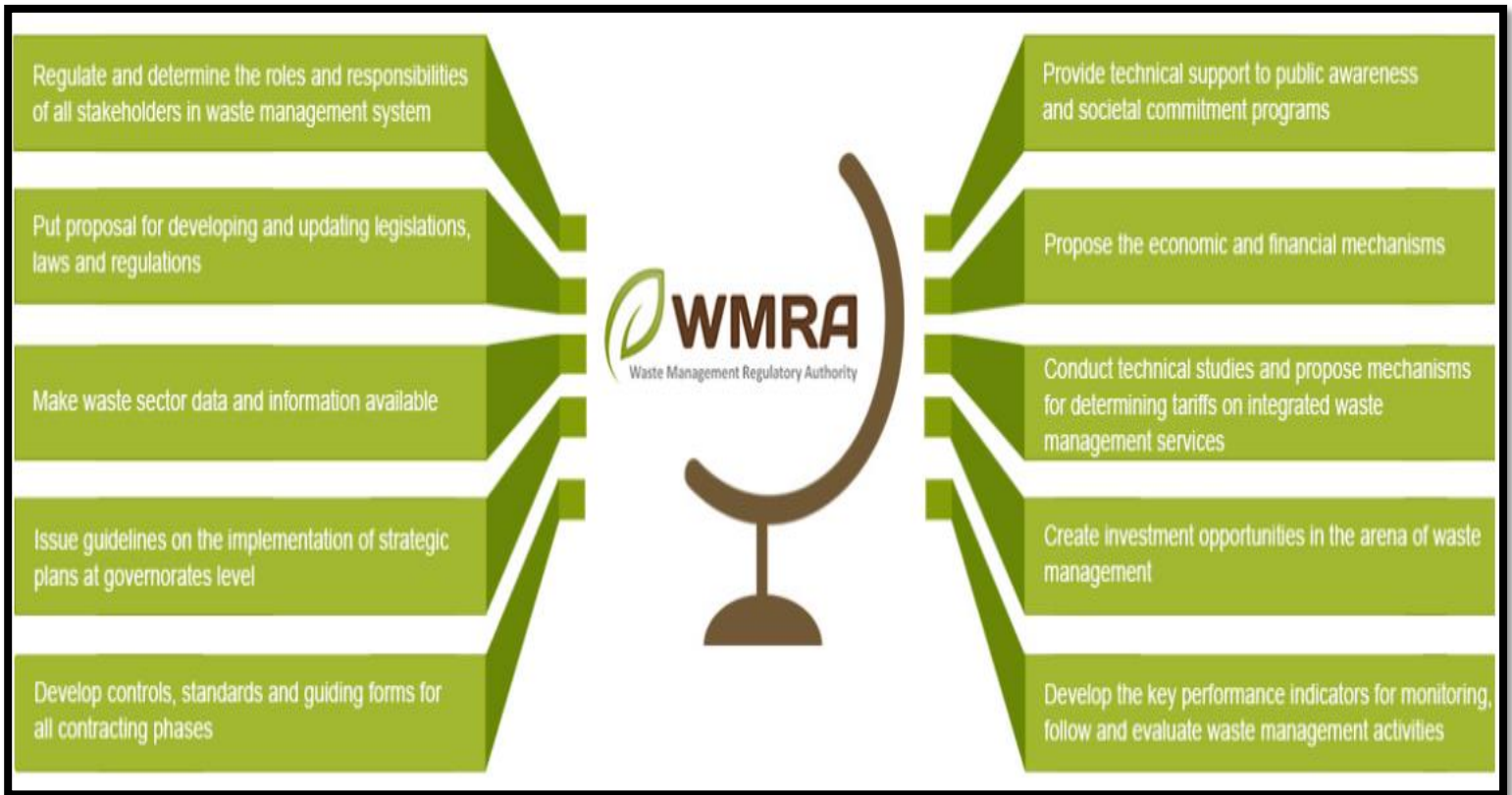


FIGURE 16: WASTE MANAGEMENT REGULATOR AUTHORITY (WMRA) ROLE
 (HTTP://WWW.WMRA.GOV.EG/EN-US/ABOUTUS/PAGES/WHOWEARE.ASPX)

Table 7 summarizes the role and responsibilities of governmental stakeholders including Ministry of Environment, Waste Management Regulatory Agency (WMRA), Egyptian Environmental Affairs (EEAA), Ministry of Finance (MoF), The Ministry of Housing, Utilities and Urban Development (MoHUUD), Ministry of Health and Population (MoHP), Ministry of Trade and Industry (MTI), Ministry of Agriculture and Land Reclamation (MoALR). (MSEA, 2017)

TABLE 7: THE RESPONSIBILITIES OF DIFFERENT LINE MINISTRIES IN THE WASTE SECTOR (MSEA, 2017)

Ministry/Agency	Role
Ministry of Environment (MoE)	Establishes the enabling framework of policies, legislation, strategic plans and financial/economic instruments for sector reform.
<ul style="list-style-type: none"> • Waste Management Regulatory Agency (WMRA) 	Catalyses and coordinates development of the waste management sector. Regulates the waste sector, implements the policies, plans and programmes, and technically supports the competent authorities for all waste streams.
<ul style="list-style-type: none"> • Egyptian Environmental Affairs Agency (EEAA) 	Supervises the EIA process for waste management facilities and carries out environmental inspections.
Ministry of Finance (MoF)	Supervises the fiscal management processes, and authorises investment and budgetary financing allocations to governmental agencies and Governorates.
The Ministry of Local Development (MoLD)	Coordinates the budgeting and performance monitoring processes of Governorates.
Ministry of Housing, Utilities and Urban Development (MoHUUD)	Plans and implements waste management systems in new Cities.
Ministry of Health and Population (MoHP)	Plans and coordinates the implementation of health care waste management systems.
Ministry of Trade and Industry (MTI)	Plans and coordinates the implementation of industrial waste management systems.
Ministry of Agriculture and Land Reclamation (MoALR)	Plans and coordinates the implementation of agricultural waste management systems.

Recently, as per the Strategic Plan for Integrated Solid Waste Management (SP-ISWM) proposed by the government; a reform in the sector is about to change the status quo, breaking the cycle of deteriorating public health, safety and quality of the environment; developing a new prosperous and socially inclusive sector of the circular economy. The SP-ISWM aims action over a 5-year period from 2017-2022, and includes the major solid waste types generated across Egypt. The main focus is on those materials that threat the greatest harm to public health, safety and the environment. (MSEA, 2017)

This Plan represents the need for an action because the Government alone cannot resolve the issue. In the Implementation Plan, accountabilities for each measure are identified, along with the procedures and resources needed to make them take place. The Implementation Plan is followed by a Financing Plan, which defines the costs for each measure, and the projected source of funds. (MSEA, 2017)

The SP-ISWM signals to launch an ambitious program of infrastructure-development and improvement across the country. This has already inaugurated, with the opening of materials recycling facilities Qalyubeya and Port Said, and will carry on across the country until an inclusive network of waste recycling, treatment and disposal facilities takes place. Focusing on investing in recycling, treatment and disposal infrastructure transforms the approach to waste management in Egypt. Waste management in Egypt has conventionally only been thought of as

waste collection. Investment has been focusing on providing machinery to collect waste as to get it out of the living area and place it in the desert. (MSEA, 2017)

SWM is a complex task, which depends upon organization and cooperation between several public and private sector players as it does upon appropriate technical solutions. Accordingly, a wide range of individuals, groups and organizations are concerned with SWM as service providers, service users, regulators and/or intermediaries.(Bushra, 2000)

Local (municipal) government authorities are generally responsible for the provision of solid waste collection and disposal services. They become the legal owners of waste once it is collected or put out for collection. Accountability for waste management is usually specified in regulations and bylaws and may be taken from policy goals in respect to environmental health and protection. Besides their legal obligations, local governments are normally motivated by political interests. Besides SWM, municipal governments are also responsible for the provision of the entire range of the infrastructure and social services. To fulfil their SWM responsibilities, municipal governments generally establish special purpose technical agencies, and are also authorized to contract private enterprises to provide SWM services. In this circumstance, local authorities remain responsible for regulating and monitoring the activities and the performance of these enterprises.(Bushra, 2000)

Unfortunately, this depicts at national level there is not a single entity that is entrusted with SWM, nor a national body in charge of organization. Only local authorities are accountable by law for SWM contained by their area. Their responsibility is basically limited to road maintenance as well as collection and transport to the areas assigned for storage and treatment. Moreover, sub-contractors are often used to support with these activities. However, the Governorates of Cairo and Giza have a particular regime, in which “Cleaning and Beautification Authorities” (GBA) are responsible for SWM. These authorities have their individual funds within the budget of the State, offering for public and private sector operation. For instance, in 2000, the Egyptian authorities instigated a reform exercise in the waste management sector.

By introducing an international tendering procedure; their intension was to develop the performance of what was still vastly incompetent waste management. Several contracts were signed in Egypt's two mega governorates: Alexandria and Greater Cairo, though for the projected results were not achieved due to the following reasons; the majority of the overseas companies hurried to invest in Egypt lacking appropriate studies prior to such investment. Once these companies started, their European technology was not adjustable to the Egyptian urban plan, in regards to 1- the type of waste generated and 2- people's behavior. The authorities themselves also mismanaged the situation. The execution of a waste management model marked by integrated system management failed to take in account all local features such as: social, environmental, technical and political, which led to the majority of the companies to go bankrupt. Hence, shortly after signing their contract, three companies vacated from the market (planblue.org)

Additionally, in 2017, the government took a new action without involving stakeholders. A new initiative that pays cash for sorted recycling. Project founders claim that everyone can advantage from the new way of doing business. Two kiosks have opened in the middle and upper class district of Heliopolis, while the project founders have marketed the campaign on social media and mainstream. The prices of the recyclables change daily depending on the prices in the informal recycling and scrap market” Hany Ebeid, the supervisor of one of the kiosks. Despite, positive reactions from government, media and citizens, Sell Your Garbage have been met with total rejection by some of Egypt's private garbage collectors. Moreover, “Some garbage collectors are jobless now,” Shehata Meqadas,, head of the garbage collectors syndicate, stated when asked about the project only six days post its limited launch in Heliopolis district. The criticism has not stopped project founders from moving forward with their idea, which does not end at kiosks. They describe the project as a first step towards greener economic policies and an overhaul of the method garbage is managed in Egypt. In the meantime, Meqadas said that he cannot contain the angry garbage collectors from escalating the matter, or bringing it before the country's parliament and president. (El Gundy, 2017) These kiosks were part of a pilot project started in March 2017 that pays people for their metals, glass, plastic, card and paper. Officials behind the project claim it will help streets to be clean and diminish landfill from the waste

generated by Cairo's more than 20 million residents by rewarding people with an incentive to recycle. But news of the initiative kept on raising worries among the Zabbaleen, with many blaming the new project. Since the first recycling kiosks opened in the collection area of Zabbaleen in Heliopolis, their income has dropped considerably. They claim that they used to end with five bags of cans and five bags of plastics every day; however, "Now, they only get about two of each. They claim that it is not the first time the state has sought to modernize the city's trash collection system. Back in 2003, an international trend was followed toward privatization, Cairo awarded multimillion-dollar contracts to three European companies to haul the city's waste. The effort was not as expected, as the companies failed to compete with the Zabbaleen's system. Also, in 2009, in the midst of the worldwide swine flu disease, Egyptian authorities slaughtered around 350,000 waste-fed pigs that were both reducing waste and providing the Zabbaleen with an additional income as pork they sold to hotels and restaurants. The Zabbaleen have survived regardless of these moves. (Bower, 2017) All these actions reflect that the government does not align all stakeholders together and there is always a gap between local authorities and other stakeholders. Consequently, a new approach tackling the waste management in Egypt has been in action; however, there is still a gap between the government and other stakeholders while taking the action prior to implementation. Hence, it is highly recommended that the government should partner with other stakeholders to get the best results.

2.3.4 Private Companies Role

The beginning of the private sector in Egyptian cities has been a rational response to poor and ineffective public delivery of MSWM. Nevertheless, while the beginning was promising, the execution has been weak. The introduction and execution of private companies' arrangements have followed an unsmooth entry into the Egyptian market. The need to enhance MSWM competence, and the shortage in a viable public sector alternative, is high. (The World Bank, 2014)

In 2000, the government started substituting informal sector role by having annual contracts with international waste management companies reaching US\$ 50 million annually. In addition to the Egyptian Company for Garbage Collection (ECGC), these companies are FCC and Urbaser, Enser (Spanish), AMA(Italian), who started functioning in Egypt to benefit from potentially profitable niche in the market. This approach intimidates the sustainability of the garbage

collectors' communities by eliminating their access to their main economic asset, waste garbage. Also, officials from the CCBA considered the Zabaleen's methods of garbage collection as insanitary, and were positive about the new methods of investors and business people establishing 10 to 12 new recycling facilities in Cairo's eastern outskirts. Whilst the Zabaleen had formerly recycled around 80 % of collected waste, foreign companies are asked to recycle merely 20 percent, with the rest going into a new landfill. The Zabaleen would carry on collecting garbage but they are required to be working for foreign companies that would also be in charge of street sweeping and placing garbage bins. Officials at CCBA, on the other hand, seemed to be ignoring the fact that the multinational companies cannot collect from narrow streets since their high-tech machinery is too big. The companies oblige residents to take their garbage to central collection points, while the Zabaleen were capable to collect waste from each house, even if these were situated in narrow areas. Local Cairo residents, particularly those in slum areas, care more about their municipalities' malfunction to collect garbage from their homes than about where the government desires to dispose the waste. Cairo's households are expected to pay for privatized garbage collection via monthly rate depending on their electricity bill. Disagreement to this was expressed by Cairo residents who favored to sustain the traditional system of depending on the Zabaleen for garbage collection. Lately, the High Administrative Court created a verdict to abolish the additional monthly payment compulsory on households as illegitimate and unconstitutional. (Fahmy, 2005)

The legal framework for SWM in Egypt is comprehensive, yet, a consistent model and guidance for private sector arrangements is absent. While MSWM accountability is appropriately delegated to a lower administrative level- particularly governorates- there are overlapping institutional accountabilities for SWM at national level, and lack of a clear center of the overall responsibility for MSWM within national government. A main source of incompetence has been shortage of sufficient understanding of the government capacity as well as insufficient national guidance and support. (World Bank, 2014)

Table 8 shows private sector participation in SWM activities in Cairo governorate. According to official information, the cost for collection, transport and disposal could reach 215 LE per ton and consequently the private contracts might be subject to changes if the provided services are

destined for enhancement and sustainability. The estimated required financial allocations are L.E. 4, 76.6 million. (MSEA, 2013)

TABLE 8: ANNUAL CONTRACT VALUES OF SWM COMPANIES SERVING CAIRO GOVERNORATE
(MSEA, 2013)

No.	Company	Service Area	Annual Value (Million LE)
1	AMA Arab Environment Co	Northern Zone	132.3
2	AMA Arab Environment Co	Western Zone	124
3	FCC	Eastern Zone	118.1
4	Misr Service	El-Marg	14.8
5	Europa 2000	Maadi and Helwan	53.3
6	Ertecaa	Manshiyat Nasser	5.8
7	ECARO	Recycling and disposal	20
8	EcoConServ	Medical waste management	7.4
9	Contractors		0.9
Total		476.6	

2.3.5 NGOs /Society's Role

Some non-governmental organizations (NGOs) also perform some partial solid waste services. These also advocate for the Zabbaleen. In South Sinai, Hemaya NGO has executed a town wide source segregation scheme.(Iskandar et al., 2010)

The Association for the Protection of the Environment, A.P.E. works with the informal garbage collectors of Cairo. The aim is to assist the traditionally marginalized group find creative ways to aid the environment and support themselves. A.P.E. focuses on developing environmentally sound waste management and recycling methods, which facilitate to build the human capacity of the Zabbaleen communities, to "recycle and re-use". The collaboration with the Zabbaleen started 25 years ago; and the experience was very successful and it proven that environmental, social and economic development can go hand in hand. Additionally, through the several programs of A.P.E., women particularly, have become empowered to build better lives for themselves. Income generating programs have assisted generations of women enhance their circumstances. A.P.E. is proud to be collaborating with the Zabbaleen towards the objective of Zero Waste. This depicts that A.P.E. is doing a great job with Zabbaleen towards sustainability

and the notion of zero waste (A.P.E, 2010). Additionally, another renowned NGO is Hemaya Association for Community Development. It is a non-governmental organization founded in 1997 in Basata eco-lodge in Nuweiba, Southern Sinai. It is an official association at the Directorate of the Social Solidarity with a Proclamation No. 46/ 1997. It seeks at protecting the environment and developing the local community in South Sinai. Hemaya tries not to bring ready-made development to the local community; however, it rather aspires at maintaining the environment's specificity, recognizing the interaction between the natural and the cultural. Hemaya assists the locals find out who they are, what they need and help them reach their own objectives, while preserving their environment. (www.hemaya.org)

2.4 Importance of Good Governance

As stated in (GIZ, 2014), good governance targets to generate effectual and fair decision-making and management frameworks. This involves having a clear regulatory organization and transparent and responsible institutions.

Good governance will need the following in Egypt:

1. Legal and institutional restructuring and enforcement
2. Financial and economic reform
3. Technical/operational funds and capacity building of practitioners
4. Social capital generation and recruitment

Good governance can be achieved via:

- Constructive basic framework and building capacities at the national level by creating a framework strategy and legislation, as well as a guide regulatory institution accountable for SWM
- Assuring that planning and execution in governorates conform with national frameworks
- Optimally assigning responsibilities, authorities and capacities to related actors, in addition to monitoring and developing their performance
- Formulating policies and measures inclusive of key stakeholders; integrating the informal sector. (GIZ, 2014)

The concept of "governance" is not novel. It is as old as human civilization. Governance can be used in numerous contexts such as corporate governance, international governance, national governance and local governance. Government is one of the actors in governance. Other actors involved in governance vary depending on the level of government that is under discussion. Good governance targets to generate effective and equitable decision-making and management frameworks. This involves having a clear regulatory structure and transparent and accountable institutions. (NSWMP, 2014) In other words, good governance “encompasses the role of public authorities in establishing the environment in which economic operators function and in determining the distribution of benefits as well as the relationship between the ruler and the ruled.” (Ward, 2012)

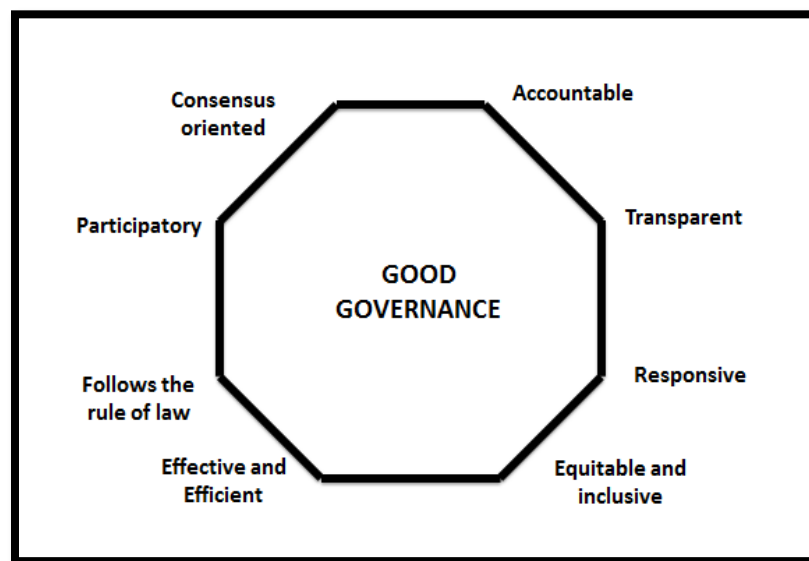


FIGURE 17: GOOD GOVERNANCE (UNESCAP, 2009)

In Figure 17, good governance has eight main characteristics. It is **participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law**. It assures that corruption is diminished, the views of minorities are taken into consideration and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of community.(UNESCAP, 2009)

Cornerstones of Good Governance are:

1. Participation

A key cornerstone of good governance is participation by both men and women.

2. Rule of law

Good governance requires fair legal frameworks that are imposed impartially.

3. Transparency

Transparency means that decisions taken and their implementation are done in a manner that follows regulations and rules.

4. Responsiveness

Good governance requires that institutions and processes try to assist all stakeholders within a reasonable timeframe.

5. Consensus oriented

Good governance requires mediation of the different interests in society to achieve a broad consensus in society on what is in the best interest of the entire community and how this can be attained.

6. Equity and inclusiveness

A society's well-being depends on guaranteeing that all its members feel that they have a stake in it, equal share and do not sense excluded from the mainstream of society.

7. Effectiveness and efficiency

Good governance means that processes and institutions produce outcomes that meet the needs of society while making the best use of resources at their disposal. The notion of efficiency in the context of good governance also encompasses the sustainable use of natural resources and the protection of the environment.

8. Accountability

Accountability is a key requirement of good governance. Not only governmental institutions but also civil society organizations and the private sector must be accountable to the public and to their institutional stakeholders. Accountability cannot be achieved without transparency and the rule of law.

Poor governance is a main reason why cities' solid waste and other urban systems fail. In examining governance aspects, it was focused on inclusivity of users and service providers, financial sustainability, and the strength of the institutional framework. This shows that Egypt lacks good governance due to lack of inclusivity of all stakeholders, lack of financial sustainability, and solid institutional framework (MSEA, 2013). Compiling comparative – and comparable – data on costs and on cost recovery has proved to be particularly strenuous: accounting systems vary widely; cost and budgeting mechanisms are often fragmented and scattered over several departments; many cities are either unable or perhaps unwilling to share information. From the above discussion it should be clear that good governance is an ideal which is hard to attain in its totality. Very limited countries and societies have come close to attaining good governance in its entirety. But, to guarantee sustainable human development, actions must be taken to work towards this ideal with the goal of making it a reality. (UNESCAP, 2009) As per the (“GIZ, 2014”) report, good governance comes as the first objective to gain control over generated waste through affordable, professional, sustainable, and inclusive integrated solid waste management. This shows that good governance is a prerequisite for ISWM as to reach a better approach in handling SWM.

2.5 Developing Countries Case studies

In the following case studies from some developing countries are demonstrated through the perspective of their adopted strategies for sustainable SWM. The selection comprises cases of developing countries like India, Kenya, and Brazil. Analyzing these successful cases will aid in managing effectively the tons of generated waste every day via the involvement and participation of all the stakeholders, waste system elements, all aspects to reach the integrated sustainable waste management (ISWM) in Egypt.

2.5.1 India

Urban India produces around 42 million tons of MSW per year. It is projected that by 2050, 50 percent of the country's population is expected to be urban; hence, the total amount of waste generated will augment substantially. Also, the 12th Schedule of the Constitution of India makes it mandatory for municipal authorities to make cities and towns clean. Dealing with waste in practical and environmentally sound ways is challenging, and innovative alternatives are called for. The total urban population in India in 2011 stood at 373.1 million and it is expected to reach

600 million by 2030, at which point urban inhabitants will make up 50 percent of the country's population.(Gupta & Gupta, 2015)

MSWM in India has been somehow neglected and responsible for numerous health issues. More than 90% of the total municipal waste generated is disposed in unsatisfactory manner. These actions have resulted in governments at central, state and city levels, non-governmental organizations and even individuals paying more efforts and to the continuously irritating problem of waste by initiating various MSWM strategies and special cleaning drives.(Rana et al., 2014)

Policy is just in the foundation phase; however; the more difficult challenge lies in the execution stage. The city of Chandigarh is one of the most successful cases in urban planning in modern India and is ranked one of the top cities in India to live in. It has also constantly been evaluated best in the country on sanitation and known for its effective solid waste management. Yet even in Chandigarh, with its excellent rating, there remains considerable challenge as it is one of the fastest growing cities. In Chandigarh, the **waste collection and storage services can be generally divided into primary and secondary collection.** (Gupta & Gupta, 2015)

Chandigarh Municipal Corporation has constructed buildings named Sahaj Safai Kendras (SSKs) as **primary collection centres at 35 selected points for solid waste storage of each area.** Primary collection is **the process of collecting waste from households, markets, institutions, etc. and then moving it to transfer station or dumping site.** The residential waste is collected **door to door by private waste collectors** who collect a fee every month from the residents. Once collecting this waste, they separate waste of value and take the rest to the garbage bins in SSKs. **Secondary collection entails the transfer of waste from the community bins, transfer stations to waste processing sites or to the final dumping site.** In Chandigarh, the garbage of the SSKs is transported to the garbage processing plant and rejected waste is moved to the landfill site for final disposal. (Gupta & Gupta, 2015)

A combination between primary and secondary collection and transportation system is vital to prevent excess from containers and waste litter on streets. Municipal Corporation employees in Chandigarh assure that 100 percent of the city's waste is collected every day. However, with only 35 SSKs in the whole city, there is a greater dependence on collection from

residences in carts. Hence, there is a bad-smelling waste scattered from exposed carts, leading to ground-level pollution. (Gupta & Gupta, 2015)

Waste segregation is one of the major challenges in Chandigarh. **At the moment, there is no means for waste segregation in the city. Waste is not segregated from the household by the residents.** Residents claim that they would find it difficult and that in any case it is pointless to segregate waste except the private collectors maintain the separation. **The private collectors refuse the notion of household waste segregation, arguing that it is impractical for them to carry diverse carts for different segregated waste.** In addition, waste segregation at the source would also hinder their capacity to separate out valuable materials from the waste, a good source of income that they depend on. The segregation by the private waste collectors is not actually segregation in its true sense as they take out mainly the valuable waste like tins, glass bottles, cardboards, etc., leaving behind the remaining of the organic and inorganic waste in mixed form.(Gupta & Gupta, 2015)

Municipal officials stated that segregation of waste must take place at the source of waste generation itself, since it is harder, costly, time consuming and dangerous to do it later on, and due to the lack of this segregation, the following processing is so much less efficient. Efforts have been made to promote source segregation and several awareness initiatives have been encouraged; yet, the resistance from both residents and private waste collectors has caused the failure of these initiatives. **Unfortunately, no stakeholder is well prepared at this point to be accountable for waste segregation.**(Gupta & Gupta, 2015)

The challenges must be balanced with practical short-term and long-term strategies. As the population grows in the future, more efforts will be vital for an effective solid waste management system. The segregation of waste at the source becomes critically essential for effective processing and must be obligatory at the household level. The corporation plans to begin a pilot project on waste segregation at source with different color-coded bins to separate the organic and inorganic waste, which can be applied to the whole city later on. To encourage private waste collectors, they will take a share of the profits from the recovery of recyclable waste.(Gupta & Gupta, 2015)

It is recommended that all stakeholders must be all integrated in the consultation, planning and decision-making processes. Municipal Corporation should promote **community involvement**. Initiatives need to be moderated via group discussions and the involvement of community leaders, and local residents who represent the community at large. More campaigns have to be implemented in schools and colleges as to promote change in behavior and practices. Also, a “green culture” needs to be adopted, in which everyone has an impact on waste minimization by reducing, reusing and segregating waste. The Clean India Campaign has been launched. However the Municipal Corporation should make sure that community participation is not restricted to the period of the Clean India Campaign.(Gupta & Gupta, 2015)

Also, cost recovery needs to be enhanced as to offer people better-quality service. The Municipal Corporation is in the process of establishing two biomethanation plants. The plants will process the organic waste from vegetable markets and use it to generate electricity. Optimizing the methane produced from the dumpsites, a great number of landfill gas capture initiatives have been launched and proven successful around the world. Hence, the waste sector provides opportunities for avoidance of greenhouse gas emissions that could be used in the form of carbon credits or certified emission declines.

From table 9, around US\$ 13.61 million were spent on SWM in Chandigarh in the year 2013–14. Yet, a very small amount of this was generated from solid waste services such as sanitation charges or from fines on littering. Identification of additional sources of revenue is needed. Hence, the Municipal Corporation is enthusiastically considering **implementing sanitation fees** on all the commercial areas in the city. Also, more sources of revenue could be included such as **SWM tax** along with property taxes, apart from solid waste user charges, **and user charges linked to utility** (water/electricity) bills. In addition, certain regulations such as the “polluter pays” principle could be executed.

TABLE 9: SOLID WASTE MANAGEMENT AND SUSTAINABLE CITIES: CHANDIGARH- (GUPTA & GUPTA, 2015)

Expenditure (2013–15) in US\$ million (approx.)		
Category	Expenditure (2013–14)	Budget Estimate (2014–15)
Sanitation-cum-mechanical transportation of garbage	3.68	4.32
Maintenance of landfill site	0.064	
Salaries	8.49	9.56
Office expenses	1.38	1.87
Total expenditure	13.61	15.75

SOURCE: Municipal Corporation, Chandigarh.

The experience and know-how of informal sector could be optimized by formalizing and systemizing them. In Chandigarh, rag pickers must be brought together in some formal association or union. Hence, healthcare, social security, and safety can be implemented easily. For example, in Pune city, another city in India, waste pickers’ association called KagadKach Patra Kashtakari Panchayat (KKPKP) is a **successful model of how community mobilization can effectively ace in improving the livelihoods of waste pickers**. The same could be implemented in Chandigarh by integrating rag pickers’ associations in the efficient implementation of the city’s SWM plan.

TABLE 10: ISWM STAKEHOLDER INVENTORY- (ISKANDAR, et al. , 2010)

Formal	Informal
Generators – households - commercial	KKPKP (Union of wastepickers and IWBs)
Formal sector employees – SWM staff	Informal Service Providers
PMC administration	Wastepickers
Municipal Councilors	Itinerate Waste Buyers
Airforce Station	Scrap dealers – retail to wholesale
Maharashtra Pollution Control Board	Farmers
Recycling enterprises	Informal sector composting agents
Biogas, compost, RDF technology providers	Villagers in the vicinity of the landfill
Financial Institutions(ILFS, HUDCO, NBCC)	NGOs
PMC municipal workers union	
PMC-appointed Committees for SWM (Apex and Steering Committee)	

As shown in table 10, the KKPKP is part of the informal sector. Nevertheless, it is a stakeholder in the formal sector to the degree that the members hold identity cards authorized by the Pune Municipal Corporation (PMC) and the fact that the KKPKP is the official agency for door to door collection. The informal waste sector in Pune is a source of livelihood for 9025 persons. Twice as many workers are involved in the informal waste sector as compared to the formal sector. Nearly half the workers in the informal waste sector are women. There are ten times as many women in the sector in comparison to the formal sector. The total annual income earned by all workers in the sector is € 11492325. All workers in the informal sector earn more than the minimum wage. Collectors earn about twofold the minimum wage. (Iskandar et al.-India, 2010)

In developing countries, where local governments have shortage of resources, the public–private partnership (PPP) model appears to be the most suitable solution for managing solid waste. Nevertheless, the Municipal Corporation in Chandigarh needs to execute the PPP agreement efficiently by guarantying that the plant treats the full tons of garbage produced in the city daily, including the tons of waste generated from hotels and vegetable markets. Hence, scientific disposal of waste on the landfill sites is the main objective is minimizing impact on the

environment. This will help The Municipal Corporation to enhance the life of the present landfill site and ensure effective disposal of waste with minimum impact on the environment as they go hand in hand with the National Environment and Energy Research Institute.

Proper execution of all the above actions will lead to the revolution in **SWM from being focused on service delivery to saving resources for the future**. Also, waste management is one of the priority issues of sustainable development, stating that moving towards zero waste is achievable. According to the UN-Habitat framework identifies that three governance characteristics are vital for sustainable SWM, that is: **inclusivity to all stakeholders; financial sustainability; and sound institutions and proactive policies**. This needs rethinking and rearranging waste management on a life-cycle basis and integrating waste management into the developing “green economy”. When these measures are executed, the path to the future will include a succession of individual, pragmatic and incremental decisions on the ground. (Gupta & Gupta, 2015)

2.5.2 Kenya

Kenya is located in the eastern part of Africa. It is a developing country, with a land area of about 569,137 km² and a population around 33.4 million. MSWM includes the processes of collection, transfer, resource recovery, recycling, and treatment. The key target of MSWM is to protect the population's health, endorse environmental quality, develop sustainability, and support economic productivity. To meet these targets, sustainable SWM systems have to be embraced totally by local authorities in partnership with both the public and private sectors. Even though in developing countries the quantity of solid waste generated in urban areas is low compared to industrialized countries, the MSWM still remains ineffective. (Henry, et al. , 2006)

The increase in MSW generation has been rapid. Meanwhile, the capacity to collect and safely dispose material has been deteriorating. Therefore, developing countries should work on area-specific solutions for MSWM. The notion of MSW composition can aid developing countries make the correct decisions in importing MSW handling machinery. For instance, there is no need to import compactor trucks which are appropriate to less dense MSW; dense MSW which requires no compaction but just requires hauling trucks which might be more economic. Also,

other management challenges that need be taken into consideration embrace **decentralization via subdivision of urban districts into boroughs as to improve management and service provision; community participation through neighborhood.**(Henry et al., 2006)

Clusters of people from middle and higher income clusters and business individuals can offer the desirable solution in mobilization of community-based efforts. Sanitary neighborhood clusters can utilize financial resources and engage private groups or employ private trucks to infrequently collect and dispose MSW from neighborhoods. Other initiatives include clean **community awareness programs.** Activities such as cleanup of the neighborhoods, schools, roadsides and parks can be effective in changing the behavior even among the poor communities. Sponsors can be initiated from UNEP (United Nation Environmental Program which has its headquarters in Nairobi), Ministry of Environment Conservation, Ministry of Health and private corporations. Generally, the effective management of MSW is determined by people's behavior towards waste, such as the ability to abstain from unsanitary disposal. Also, Socio-economic traits may determine attitudes such as the eagerness to recycle MSW. These attitudes, however, may be positively impacted by awareness-building campaigns and educational initiatives. In a nutshell, it is the willingness of the people that can make the city clean. (Henry et al., 2006)

In Nakuru town, the fourth largest urban centre in Kenya, daily solid waste generation is estimated at 250 tonnes. Before changes were implemented in 2006, the average daily collection rate was less than 30%. To solve this challenge on domestic solid waste handling, the Municipal Council of Nakuru (MCN) enacted 2006 Nakuru Environmental Management by-laws that paved the way for decentralized service delivery of domestic SWM.

In 2006, new by-laws were brought into action which provided for decentralized service delivery for domestic waste collection, transportation and sanitary disposal at the Council refuse site. Refuse management zones have been categorized into three categories: (a) Community based organization zones (b) Private waste handlers' zones and (c) Municipal Council zones. Tenders were promoted and awarded to proficient local waste organizations, with contracts typically lasting for 2 years. Additionally, the MCN organizes regular clean-ups, seminars, and workshops

training for stakeholders to create awareness about SWM, and to guarantee compliance by residents and the licensed organizations. The role of the Council has altered from being largely a service provider, to being a regulator of other service providers. It only delivers waste collection services itself in two of the zones (one of which is the central business district). The municipality with other stakeholders is enhancing enforcement of the Environmental by-laws of 2006 to garbage producers to embrace and support decentralized SWM in Nakuru. This shows that decentralized service delivery in SWM collection services is feasible with active participation of organized and supported community based groups. Moreover, collection coverage has increased from 30% to 64% in 2010. (Mwanzia et al., 2013)

2.5.3 Brazil

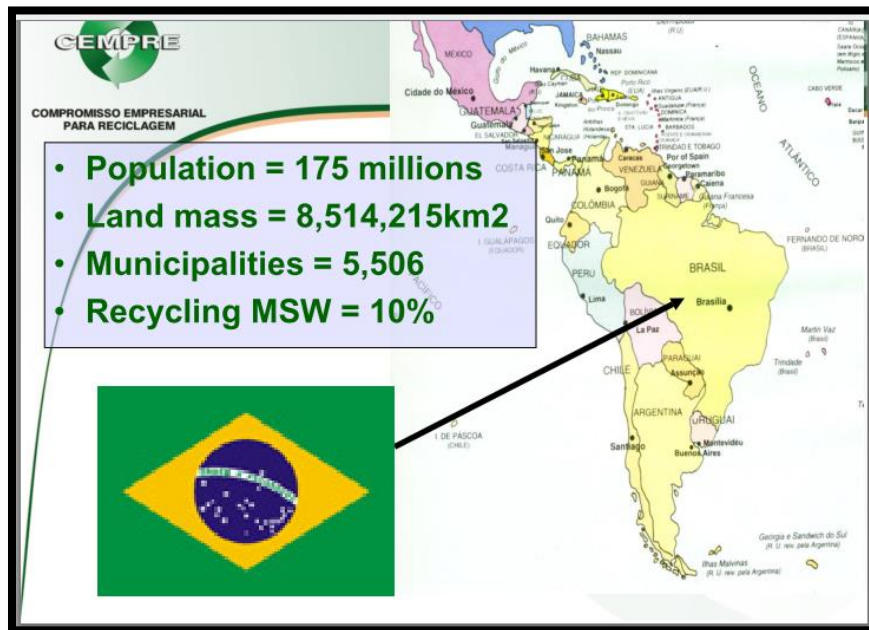


FIGURE 18: BRAZIL POPULATION- ("BRAZILIAN NATIONAL LAW")

One of the major challenges for Brazilian cities is properly handling the more than 180,000 tons of MSW collected daily. There are legal and regulatory tools in place, in particular the Basic Sanitation National Policy and the Solid Waste Law. Conversely, the objectives made by the National Solid Waste Policy to end dumps and waste disposal in landfills were not met. Also, there are still dumps in over 3000 cities, which have a major impact on the environment and the public health. The collection service is in only 20 % in the Brazilian cities. The emerging market for recycling is depending on the work of thousands of waste pickers, who are subject to

environmental risks and put their own health at danger. Worth to mention is the selective collection model managed mutually by municipalities and waste picker entities, formed into associations and cooperatives. (Besen & Fracalanza, 2016)

One of the most noteworthy modifications in the last decade in the solid waste sector in Brazil and other developing countries was the **integration between formal and informal sectors in the waste chain. The unorganized collection of recyclables, both on the streets and in open dumps, is now a main concern and has progressively become the main concern of government policies.** Local authorities in developing countries have worked on selective waste collection services in collaboration with organized groups of waste pickers. **Strategies encompass the validation of pickers' activities, incentivizing cooperatives, contracts for collection and recycling, as well as public-private partnerships between local governments and waste pickers' entities. This was acknowledged by the International Solid Waste Association (ISWA), along with which the informal micro-business sector in recycling, reuse and recovery achieved considerable rates of recycling: between 20 percent and 30 percent of the total generated waste in low-income countries .**The majority of municipalities in Brazil have not integrated selective waste services into MSWM systems. It is portrayed that **the model employed as "hybrid", where municipalities and waste pickers share tasks, benefits and earnings from selective waste services. In Brazil, this form of selective waste service differs from the conventional notion of service privatization, integrating new elements for instance social inclusion and income generation for citizens excluded from the official employment market.** (Besen & Fracalanza, 2016)

Selective waste services are managed by the municipalities, however are subcontracted or managed in affiliation with structured groups of waste pickers, who still play an extremely trivial part in the entire amount of waste recovered. **This service is offered via door-to-door or through voluntary delivery points or sites.** Generally, municipalities utilize a combination of these to endorse recycling. **Door-to- door collection includes trucks driving via streets and picking up recyclable material which householders have previously separated. Residents can leave small amounts of dry waste at sites, also known as "Ecopoints".** These are placed in public areas, and recyclable materials can differ depending on each municipality. Delivery

points are located in public areas, parks, schools and shopping centers. (Besen & Fracalanza, 2016)

Selective waste management with **the socio- productive inclusion** of structured waste pickers is nowadays a public policy in Brazil. Until 2007, municipalities had no legal tools to aid the hiring of waste pickers' associations to offer selective waste services without tender. Also, these associations did not fall under legal contracting criteria. As soon as the National Policy for Basic Sanitation was accepted, tender was no longer obligatory. Municipalities were able to employ waste picker cooperatives or organizations with the inclusion of low-income workers. It is argued that in spite of subsidizing formal selective waste services, the employment of waste pickers is considered a positive externality, adding value to local authorities, who do not have to pay for these services. (Besen & Fracalanza, 2016)

Belo Horizonte, Brazil's third largest city, recognized in the 1990s that it had a challenge in managing increasing amounts of waste, particularly given its rapid population increase. It addressed the issue by enhancing recycling, creating sustainable landfill, and partnering with an unlikely group of workers: the cooperatives of local catadores (waste-pickers). In 1993 Belo Horizonte introduced its Integrated Solid Waste Management (ISWM) model, a selective approach to waste collection and treatment. ISWM was planned to enhance waste collection and management and to increase recycling rates. One aspect of the initiative was to legitimize the collection of recyclables by cooperatives of waste pickers, recognizing that these workers were already contributing to the increasing amount of recycling. By entering a partnership with them, the city would enhance their productivity and help the city meet its environmental and socioeconomic objectives.

As per (Centre for Public Impact, 2016), the policy highlighted the "segregation of waste at source to minimize environmental impacts and maximize social and economic benefits in local communities." The city allocated more than 100 voluntary drop-off sites for household waste, which was then transported to the cooperative warehouses for sorting. There is also a regular, weekly, door-to-door recycling of metal, paper, plastic and glass, picked up by Belo Horizonte's waste collection trucks and delivered to waste pickers cooperatives to be sorted and processed.

“Door-to-door collection currently covers about 14% of the city’s 2.5 million inhabitants.” By 2012, 93 percent of total waste was disposed of in controlled disposal sites or environmentally sound landfills. The majority (95 percent) of the population benefited from the city’s domestic waste collection services. About 600 people were officially employed in the waste management sector via various cooperatives that had individual contracts with the city. Working conditions for waste pickers had improved considerably and they profited from the monthly minimum wage of US\$321. Belo Horizonte’s pioneering approach to waste collection has had positive impacts and is seen as a template for waste management throughout Brazil. (Centre for Public Impact, 2016)

2.6 Literature Review Summary

2.6.1. Egypt’s MSWM Recap

The total amount of municipal waste generated yearly in Egypt is around 22 million tons according to 2015 estimates. This is translated to a total amount of municipal waste of 60,000 tons generated per day. Egypt would be required to triple investment in MSW sector to meet the needs in regards to quality and access to service. It is projected that Egypt spends L.E. 1 billion per year, which is equivalent to L.E. 74 per ton of MSW collected. Recent studies highlight that the financial services for the sector are inadequate to meet satisfying service standards including coverage and quality of service. International benchmark for alike middle income countries shows an average cost of US\$ 28 per ton which implies that Egypt would be required to triple allocated waste management budget to L.E. 3.4 billion to improve the performance of its MSW sector. (The World Banks, 2014)

The main causes of the deficiency in the SWM system are as follow; (NSWMP, 2014)

1. Complex and incomplete legal framework
2. Inadequate capacities
3. Undefined roles
4. Contradicting institutional structures
5. Scarce financial resources
6. Insufficient monitoring and evaluation methods
7. Centralized planning lacking sufficient social inclusion

Although the Egyptian government started various initiatives to develop the SWM sector with the start of the new millennium, their efforts resulted in minimal improvement. Less than 65% of that waste is regulated by some form of public or private sector collection, disposal or recycling operation. The rest of the waste accumulates on city streets and at illicit dumping sites. Moreover, the management of this waste is inefficient; hence, causing severe environmental and public health issues. Unfortunately, the inappropriate dumping of solid waste in waterways and drains has caused contamination of water supplies which hampers Egypt's natural resources, and the health and welfare of the public. (SWEEPNET, 2010)

Currently, municipal governments failed to efficiently handle this rising volume of waste. Government dumpsites are not well managed and cannot absorb the growing volume of generated waste. This forces cities to allocate new dumpsites further out of the city; hence, leading to higher transport cost and additional carbon emissions.

In Cairo, the Zabbaleen-the informal sector recycle almost 80 % of what they collect. (CID Consulting, 2010) This fact is disregarded by municipalities and policy makers as the connection between waste management and economic policies, pro-poor policies and national employment schemes are not complete. This is frequently manifested by policies and regulations which hinder their access to the materials, replace them by contracting to foreign companies which use advanced compaction trucks which obliterate the intrinsic value of recyclables. (CID Consulting, 2010) This shows that there is a gap between the informal sector, Zabbaleen, and the government which hinders the performance of the SWM system.

In 2017, the government took a new action without involving key stakeholders. A new initiative that pays cash for sorted recycling. Project founders claim that everyone can advantage from the new way of doing business. Two kiosks have opened in the middle and upper class district of Heliopolis, while the project founders have marketed the campaign on social media and mainstream. This initiative has stopped few weeks later as the informal sector protested as their income was affected dramatically. Informal sector claim that it is not the first time the state has sought to modernize the city's trash collection system. Back in 2003, an international trend was

followed toward privatization, Cairo awarded multimillion-dollar contracts to three European companies to haul the city's waste. The effort was not as expected, as the companies failed to compete with the Zabbaleen's system. Also, in 2009, in the midst of the worldwide swine flu disease, Egyptian authorities slaughtered around 350,000 waste-fed pigs that were both reducing waste and providing the Zabbaleen with an additional income as pork they sold to hotels and restaurants. The Zabbaleen have survived regardless of these actions. (Bower, 2017) All these actions reflect that the government does not align all stakeholders together and there is always a gap between local authorities and other stakeholders. Consequently, a new approach tackling the waste management in Egypt has been in action; however, there is still a gap between the government and other stakeholders while taking the action prior to implementation. Hence, it is vital that the government should partner with other stakeholders to get better results.

Good governance comes as the first objective to gain control over generated waste through affordable, professional, sustainable, and inclusive integrated MSWM. This shows that good governance is a prerequisite for ISWM as to reach a better approach in handling MSWM. (GIZ, 2014) In addition, poor governance is a main reason why cities' solid waste and other urban systems fail. In examining governance aspects, it was focused on inclusivity of users and service providers, financial sustainability, and the strength of the institutional framework. This shows that Egypt lacks good governance due to lack of inclusivity of all stakeholders, lack of financial sustainability and solid institutional framework (MSEA, 2013).

Waste management should be designed and planned in a holistic, integrated way on the principles of ISWM and practices of 3Rs, (reduce, reuse, recycle) with disposal (United Nations, 2011). Waste management in Egypt has traditionally only been thought of as waste collection. Additionally, investment has been focused mainly on providing equipment to collect waste in order to get it out of the neighborhood and into the desert. Therefore, a shift in the current system is needed and implementing this shift requires a restructuring of financial and economic incentives through the ISWM chain as shown in figure 10. These aspects are extensively identified later in this document. (MSEA, 2017)

Recently, as per the Strategic Plan for Integrated Solid Waste Management (SP-ISWM) proposed by the government; a reform in the sector is about to change the status quo, breaking

the cycle of deteriorating public health, safety and quality of the environment; developing a new prosperous and socially inclusive sector of the circular economy. The SP-ISWM aims action over a 5-year period from 2017-2022, and includes the major solid waste types generated across Egypt. The main focus is on those materials that threat the greatest harm to public health, safety and the environment. This Plan represents the need for an action because the Government alone cannot resolve the issue. In the Implementation Plan, accountabilities for each measure are identified, along with the procedures and resources needed to make them take place. The Implementation Plan is followed by a Financing Plan, which defines the costs for each measure, and the projected source of funds. (MSEA, 2017)

2.6.2. Developing Countries Case Studies SWM Recap

Case studies from some developing countries are identified to benefit from their adopted strategies for sustainable MSWM. The selection comprises cases of developing countries like India, Kenya, and Brazil. Analyzing these successful cases will aid in managing effectively the tons of generated waste every day via the involvement and participation of all the stakeholders, waste system elements, and all aspects to reach the integrated sustainable waste management (ISWM) in Egypt.

In India case study, in Pune, (KKPKP) is a **successful model of how community mobilization can effectively ace in improving the livelihoods of waste pickers. It is essential that all stakeholders must be all integrated in the consultation**, planning and decision-making processes. Municipal Corporation should promote **community involvement**. Also, more sources of revenue could be included such as **SWM tax** along with property taxes, apart from solid waste user charges, **and user charges linked to utility** (water/electricity) bills. In addition, certain regulations such as the “polluter pays” principle could be executed. **In developing countries, where local governments have shortage of resources, the public–private partnership (PPP) model appears to be the most suitable solution for managing solid waste.**

In Kenya the increase in MSW generation has been rapid. Meanwhile, the capacity to collect and safely dispose material has been deteriorating. Therefore, developing countries should work on area-specific solutions for MSWM. Also, other management challenges that need be taken

into consideration is **decentralization via subdivision of urban districts into boroughs as to improve management and service provision; community participation through neighborhood.**(Henry et al., 2006) This shows that decentralized service delivery in SWM collection services is feasible with active participation of organized and supported community based groups. Moreover, collection coverage has increased from 30% to 64% in 2010. (Mwanzia et al., 2013)

In Brazil, one of the most noteworthy modifications in the last decade in the solid waste sector and other developing countries was the integration between formal and informal sectors in the waste chain. The unorganized collection of recyclables, both on the streets and in open dumps, is now a main concern and has progressively become the main concern of government policies. The collection service is in only 20 % in the Brazilian cities. It is portrayed that the model employed as “hybrid”, where municipalities and waste pickers share tasks, benefits and earnings from selective waste services. In Brazil, this form of selective waste service differs from the conventional notion of service privatization, integrating new elements for instance social inclusion and income generation for citizens excluded from the official employment market. (Basen & Fracalanza, 2016)

3 Chapter 3 Research Design and Methodology

There are several challenges in the current MSWM system. This study intends to scrutinize the current MSW system and identify factors that will lead to integrating sustainability in the SWM system in Egypt. By analyzing the different roles of stakeholders and how they are managing the SWM and analyzing case studies from some developing countries as to learn from their experiences and try to come up with an integrated system that improves the current system. In other words, to try to extenuate the current system's pitfalls and to reach a sustainable MSWM system as to maximize from the tons of daily generated waste. To reach this goal, Joseph Maxwell's Qualitative Research Design Approach was used as he defines five types of understanding and validity commonly used in qualitative research. (Maxwell, 2012, p.217)

This chapter discusses the research design exploited for this study using Joseph Maxwell's Qualitative Research Design Approach, which comprises five steps; 1) Goals 2) Conceptual Framework 3) Research Questions 4) Methods, and 5) Validity. This approach was found to be coherent in designing, conducting and analyzing this research.

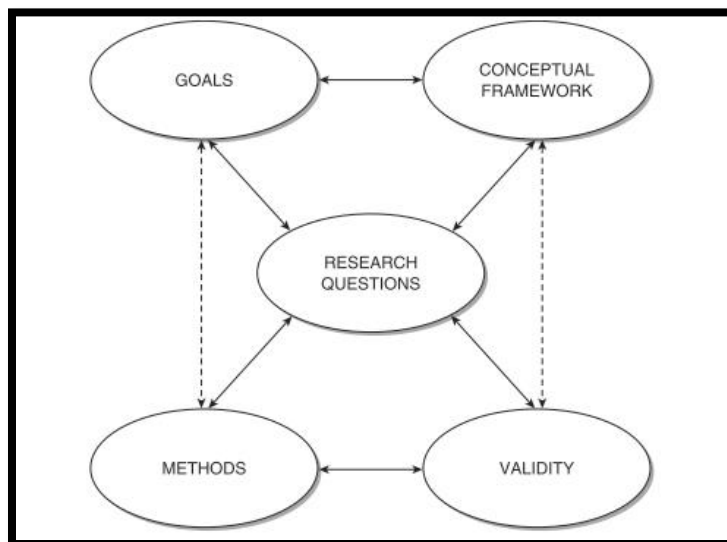


FIGURE 19: INTERACTIVE RESEARCH DESIGN MODEL (MAXWELL, 2012)

2.3 Conceptual Framework

The literature review was conducted to examine the sustainability of the MSWM in Egypt. It was clear in literature that the sector lacks sustainability. In other words, MSWM does not meet the needs of the current generation or even comprising the ability of future generations to meet their own needs. Moreover, there were several challenges that hinder the MSWM function; however, these challenges could be taken as opportunities to improve the system and maximize its performance.

Secondary research approach was utilized through thoroughly studying the literature review as to scrutinize the MSWM in Egypt and to know how sustainable it is. In addition, case studies on similar developing countries have been observed as to know the lessons learned and to find solutions that lead to good practices to reach sustainable MSWM system. There were efforts from the government taken towards system's improvement but without any positive impact. The research has shown that it is more challenging to reach a satisfying outcome in MSWM in developing countries due to limited resources. Such findings were disappointing, it had to be complemented by primary data collection from different stakeholders via semi-structured face to face interviews as to know how the current MSWM system is functioning and analyzing its performance. The interviews were conducted with a number of individuals prudently selected for their experience in the field and their position within the sector. Hence, the purpose of this study is to develop insights and ideas as well as to suggest a path for an efficient MSWM system in order to pave the way for sustainable ISWM.

Besides, several aspects and themes affecting the sustainability of MSWM were repetitive throughout the reviewed literature, the explored models and frameworks which have guided the research question to explore the following main topics; 1- an integrated sustainable waste management (ISWM). Figure 20, combining figure 6 and figure 19, shows the initial research diagram that includes the factors identified from the literature that were used to conduct the research. Figure 20 is crucial to reach SWM system improvement. Based on the literature survey Egypt's MSWM lacks integration among all stakeholders as well as among all other elements in the system. In addition, it does not have governance which is vital for any system to perform in

its best shape; whether, combining good governance and ISWM will lead system's improvement which will lead later to sustainability.

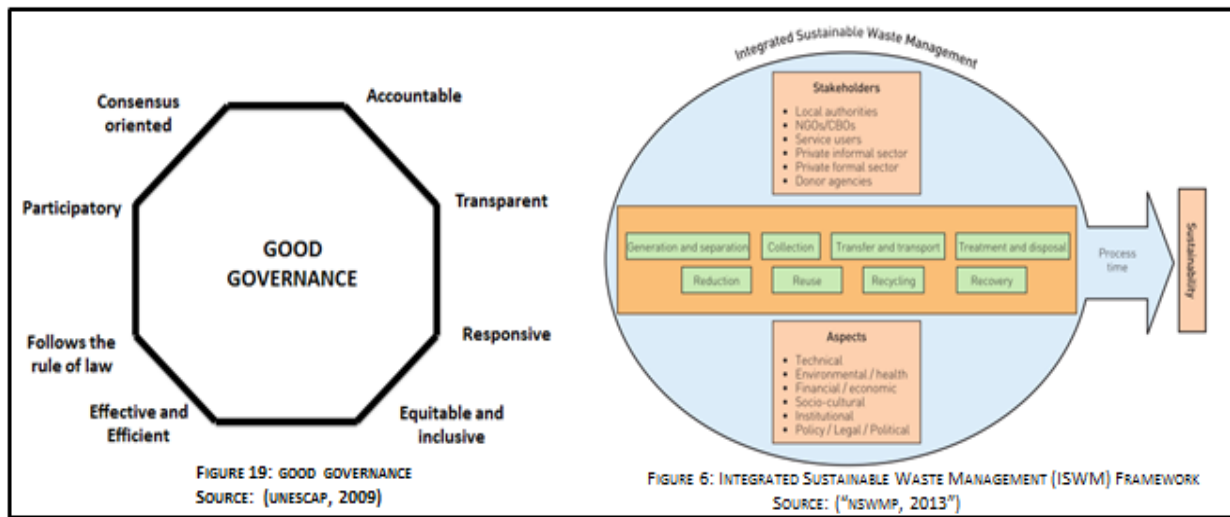


FIGURE 20: COMBINED FRAMEWORKS

2.4 Research Questions

The research study intends to answer the following questions:

1. What are the major factors that would lead to sustainable MSWM in Egypt?
2. What are the main reasons behind the failure of previous attempts to implement MSWM system in Egypt?
3. What are some successful case studies done in developing countries that could be applied in Egypt?

2.5 Methodology

2.5.1 Data Collection

A qualitative research based on semi-structure interviews with key stakeholders and secondary literature was utilized. On one hand, an intensive literature review was done as to gather as much data on the topic from secondary sources. Desk research was used by focusing on collecting existing literature available on the MSWM system in Egypt. This step encompassed analyzing the reviewed literature and then identifying a research gap. Additionally, successful case studies from some developing countries were analyzed to give an indication and to benefit from their previous experience. On the other hand, the semi-structured interviews were conducted with several direct stakeholders whom have been working in the field of MSWM for several years (i.e. local authorities, private sector, NGOs, informal sector, and consultants) to know the drawbacks and how to turn them into opportunities. The key purpose behind these interviews is to gain profound understanding on MSWM in Egypt from experts in the field as they are the people who have direct exposure to MSWM and hands on experience. The qualitative research was used to gather data in an attempt to analyze and understand what are the factors hindering the performance of MSWM system in Egypt and how to maximize the utilization of resources to reach an ISWMS that would lead to sustainability; which means less environmental, social, and economic stresses.

2.5.2 Sampling

The study was conducted based on descriptive research via extensive literature review and semi-structured face-to-face interviews with experienced stakeholders in MSW field. The interview questions were derived from gathered data from the secondary research as to answer the research questions. The sample of interviewees comprises governmental officials, members of NGOs, private sector representatives, and consultants involved in waste collection and recycling activity and key members of the Zabbaleen community in Manshiet Nasser. The ex-Minister of State of Urban Renewal and Informal Settlements (MURIS) is a key interviewee. This minister was also an ex-MSEA and has a profound experience in Cairo's waste management system and with the Zabbaleen in particular. The sample represents the public and the private sectors. Additionally, the interviewees were men and women. They are different in educational backgrounds, fairly educated, to uneducated; however, all of them have a profound background in SWM. Moreover,

their age group varied as to get the information/insights from different perspectives. Also, it was vital to know the role of different stakeholders and how they are contributing to the system and above all if they are aligned and working together to support the notion of sustainability or not. Interviews appointments were booked via phone calls to take their permission. Each interviewee was interviewed between 60-90 minutes and was conducted in English or Arabic languages. The interviews took place at the premises of the interviewees. They were asked semi-structured questions. All interviews were recorded and then translated to English language after making sure they entail the right meaning and with the permission of the interviewees. All interviews were conducted with direct stakeholders. The sample size was based on field experts with an average of 20 years of experience. Table 11 shows the interviewees' profiles and the details of the sample and how they are related to the MSW sector and the rationale behind choosing each stakeholder.

TABLE 11: INTERVIEWEES' PROFILES

<p>Dr. Laila Iskandar- CID Consulting C.E.O., Former Minister of State of Urban Renewal and Informal Settlements (MURIS) / Former Minister of State for Environmental Affairs (MSEA)</p> <p>Rationale: to acquire data from the government perspective as she has worked directly with government, Zabbaleen community via informal recycling projects and also she has direct contract with the Zabbaleen and was in charge during the privatization of the SWM system</p>
<p>Dr. Ayman Ghanem- Erteqaa S.A.E. CEO</p> <p>Rationale: to know how private companies are functioning in the current SWM and how can its successful model be applied in other areas. Additionally, the company's main purpose is to reach Zero Waste. It has its own recycling plant and it is working in full capacity.</p>
<p>Mr. Ezzat Naeem- Rouh AL Shabab Association NGO Founder</p> <p>Rationale: He manages several companies and has a profound knowledge in the current SWM and his ancestors are the ones who started the Zabbaleen community in Egypt; hence, he's a well-known figure in the Zabbaleen Community</p>
<p>Eng. Duaa Ahmed- WMRA Representative</p> <p>Rationale: this entity represents the governmental body and works with several ministries and has managed MSW master plans & guidelines. WMRA is to regulate, monitor, and control all aspects associated to waste management at central and regional levels in a way that leads to the improvement of environment-friendly management of all types of waste.</p>

<p>Eng. Ahmed Abdel Rasoul- NSWMP Representative</p> <p>Rationale: this entity represents the governmental body and works with several ministries and have managed MSW master plans & initiatives</p>
<p>Dr. Ahmed Gaber- Chemonics Egypt CEO</p> <p>Rationale: Chemonics Egypt Consultants has been active in the SWM sector in Egypt and the MENA region for the past 20 years. Chemonics worked on numerous projects that cover all aspects of the SWM sector, from policy and strategy to construction supervision and management. Throughout these projects, Chemonics acquired solid knowledge and experience in all phases of the project lifecycle.</p> <p>Rationale: he has good knowledge on SWM and worked in the field of SWM for over than 30 years</p>
<p>Mr. Moneer Nawara-VP of Garbage Collector Association</p> <p>Rationale: he is responsible for Mansheiyt Naser area and has several recycling plants there and has over 20 years of experience in this field.</p>
<p>Mr. Ashraf Mohamed - Zenhom neighborhood-Project Supervisor & EX-FCC employee</p> <p>Rationale: He is responsible for Zenhom community and deals directly with Wahey subcontractors</p>
<p>Dr. Tarek Genena-Eco Conserve Chairman</p> <p>Rationale: He has delivered over 60 ISWM assignments</p>
<p>Eng. Mahmoud Mansour- CCBA representative</p> <p>Rationale: He has 27 years of experience in the SWM. He is currently the Director of Engineering Office for CCBA, local governmental authority responsible for waste management and area greening. The private companies working in waste management signed their contracts with this authority. The CCBA has a representative in each district.</p>

2.6 Validity

Validity of the research adds to its reliability and leads to generalizability which is one of the concepts required as for high quality qualitative research. In other words, the quality of a research is related to generalizability of the result. Triangulation (Golafshani, 2003) is typically a strategy for enhancing the validity and reliability of research or evaluation of findings. It strengthens a study by combining methods; hence, using several kinds of methods or data. Triangulation refers to the use of several methods or data sources in qualitative research to have a comprehensive understanding of phenomena. Triangulation also has been seen as a qualitative research strategy to examine validity via the convergence of information from different sources. There are four types of triangulation: (a) method triangulation, (b) investigator triangulation, (c) theory triangulation, and (d) data source triangulation. The first type of triangulation is method triangulation. Method triangulation involves the use of multiple methods of data collection about the same phenomenon. This type of triangulation, frequently used in qualitative studies, may include interviews, observation, and field notes (Carter et al, 2014). The method triangulation was used in this research by using findings from several reports and case studies from literature review and supporting it by semi-structured in-depth interviews. Additionally, comparison of the insights and findings were made to come up with a framework that would lead to sustainable integrated system that could aid in the enhancement of the current MSWM in Egypt.

3. Chapter 4 Research Analysis

3.1 Data Analysis

This section will elaborate on the results gathered from the semi-structured interviews and analyze how they correspond to the literature survey and the developed research framework as seen in figure 24. Table 12 and 13 highlights the key stakeholders' interviews analysis. They are color coded based on the themes and categories. The data analysis strategy that was used to be able to organize the collected data is one of Maxwell's basic strategies for qualitative analysis referred to as "categorizing strategy" or "coding" which means fracturing the information into themes or codes. The goal of categorizing and coding the data is to facilitate comparison between things in the same category and between categories (Maxwell, 2017). In the appendix, the transcription of the interviews was established to be able to identify the codes from the interviews and examine how they correspond to the identified themes.

TABLE 12: KEY STAKEHOLDERS INTERVIEWEES I

	Dr. Laila Iskandar	Dr. Ayman Ghanem	Mr. Ezzat Naeem	WMRA/NSWMP Representatives	Dr. Ahmed Gaber
Organization	Former Minister of State of Urban Renewal and Informal Settlements / former Minister of State for Environmental Affairs	Erteqaa S.A.E. CEO	Rouh AL Shabab Association Founder	WMRA/NSWMP Representatives	Chemonics CEO
Level of Interest	High: Has worked directly with Zabbaleen community via informal recycling projects	High: Main Company's Purpose Zero Waste	High: Represents Zabbaleen Community	High: Work on Master Plans & Guidelines	High: Worked in the field of SWM for over than 30 years
Level of Influence	High: Has connections with several stakeholders	High: Is working in Integrated Services in waste recycling/Strong Relationship with Zabbaleen	High: Established 85 other Associations owned by Zabbaleen	High: Works with Several Stakeholders	High: Local Consultant in Gharbeya & Kafr El Sheikh Governorates
Main Challenges in SWM	<input type="checkbox"/> System Mismanagement/Privatization (1) <input type="checkbox"/> Government/Private Companies perceive informal sector methods are backwards Zabbaleen exclusion (3) <input type="checkbox"/> Profitability Issue (2) <input type="checkbox"/> Collection fees duplication (2)	<input type="checkbox"/> National Awareness Campaign (4) <input type="checkbox"/> Fully Integrated Campaign not only Sorting at Source (3) <input type="checkbox"/> Profitability Issue (3)	<input type="checkbox"/> System Instability (1) <input type="checkbox"/> Unclear Governmental Roles (1) <input type="checkbox"/> Lack of Strategic Planning & Vision (1) <input type="checkbox"/> Centralized System (3)	<input type="checkbox"/> System Mismanagement (1) <input type="checkbox"/> Lack of Structure & Master Plans (1)	<input type="checkbox"/> Development and Institutional Support (1) <input type="checkbox"/> National strategy & master plan for governorates (1) <input type="checkbox"/> Geographic integration- not only solid was but waste in general (1) <input type="checkbox"/> Integration of Informal Sector (3) <input type="checkbox"/> Budget Shortage (2)
How to Reach Sustainability?	<input type="checkbox"/> Zabbaleen integration in the system (3) <input type="checkbox"/> Cross subsidy profitability from social perspective (2)	<input type="checkbox"/> Follow-up & Monitoring (5) <input type="checkbox"/> Profitability (2)	<input type="checkbox"/> Decentralization (3)	<input type="checkbox"/> Private Sector Involvement (2) <input type="checkbox"/> Integration of Extended Producer Responsibility(EPR) (3) <input type="checkbox"/> Facilitate Routine Work (1) <input type="checkbox"/> Institutional framework (1) <input type="checkbox"/> Capacity development (6) <input type="checkbox"/> Register the informal sector (3)	<input type="checkbox"/> Knowledge (6) <input type="checkbox"/> Management and Monitoring (5) <input type="checkbox"/> Solve Historic Problems & Linkage to Local Industries (1) <input type="checkbox"/> Awareness Campaigns (4)

Themes/Categories: *System Mismanagement (1) *Profitability (2) *Informal Sector Integration (3) *Awareness Campaign (4)
 *Follow-up & Monitoring (5) *Capacity Building (6)

TABLE 13: STAKEHOLDERS INTERVIEWEES II

	Mr. Moner Nawara	Zenhom neighborhood	Dr. Tarek Genena	Eng. Mahmoud Mansour
Organization	VP of Garbage Collector Association	Project Supervisor & ex FCC employee	Eco Conserve Chairman	CCBA Representative
Level of Interest	High: responsible for Mansheiyt Naser area	High: responsible for Zenhom community and deals directly with Wahey subcontractors	High: delivered 60+ ISWM assignments	High: The private companies working in WM signed their contracts with CCBA
Level of Influence	High: Collects 3K of MSW, Receives Sorted Waste from Red Sea, Mediterranean Sea, & Upper Egypt	High: deals with Zenhom community-Households, schools, etc.	High: collects industrial and hazardous waste	High: Very close contact with municipalities & private companies
Main Challenges in SWM	<input type="checkbox"/> Profitability (2)	<input type="checkbox"/> Profitability (2)	<input type="checkbox"/> Allocated collection fee (2) <input type="checkbox"/> Masterplan/System mismanagement (1) <input type="checkbox"/> Lack of monitoring and evaluation (5)	<input type="checkbox"/> Funds (2) <input type="checkbox"/> Capacity building (6) <input type="checkbox"/> Privatization(lack of solid contracts) (1) <input type="checkbox"/> Mismanagement(recycling plants and dumpsites) (1) <input type="checkbox"/> Low wages to contractors (2)
Way to Sustainability	<input type="checkbox"/> Awareness Campaign (4)	<input type="checkbox"/> Strong monitoring (5) <input type="checkbox"/> Awareness Campaign (4) <input type="checkbox"/> People's behavior (4) <input type="checkbox"/> Lack of penalty implementation (1)	<input type="checkbox"/> Collection fee (2) <input type="checkbox"/> Monitoring & Evaluation (5) <input type="checkbox"/> RDF is promising (2)	<input type="checkbox"/> Hire local companies to limited districts and CCBA should be an intermediary (Investment concept)-Sell waste (2) <input type="checkbox"/> Land availability to increase recycling plants (RDF) (1) <input type="checkbox"/> Sorting at source (2) <input type="checkbox"/> Cross Subsidy/Electricity consumption (2)

Themes/Categories: *System Mismanagement (1) *Profitability (2) *Informal Sector Integration (3) *Awareness Campaign (4)

*Follow-up & Monitoring (5) *CapacityBuilding (6)

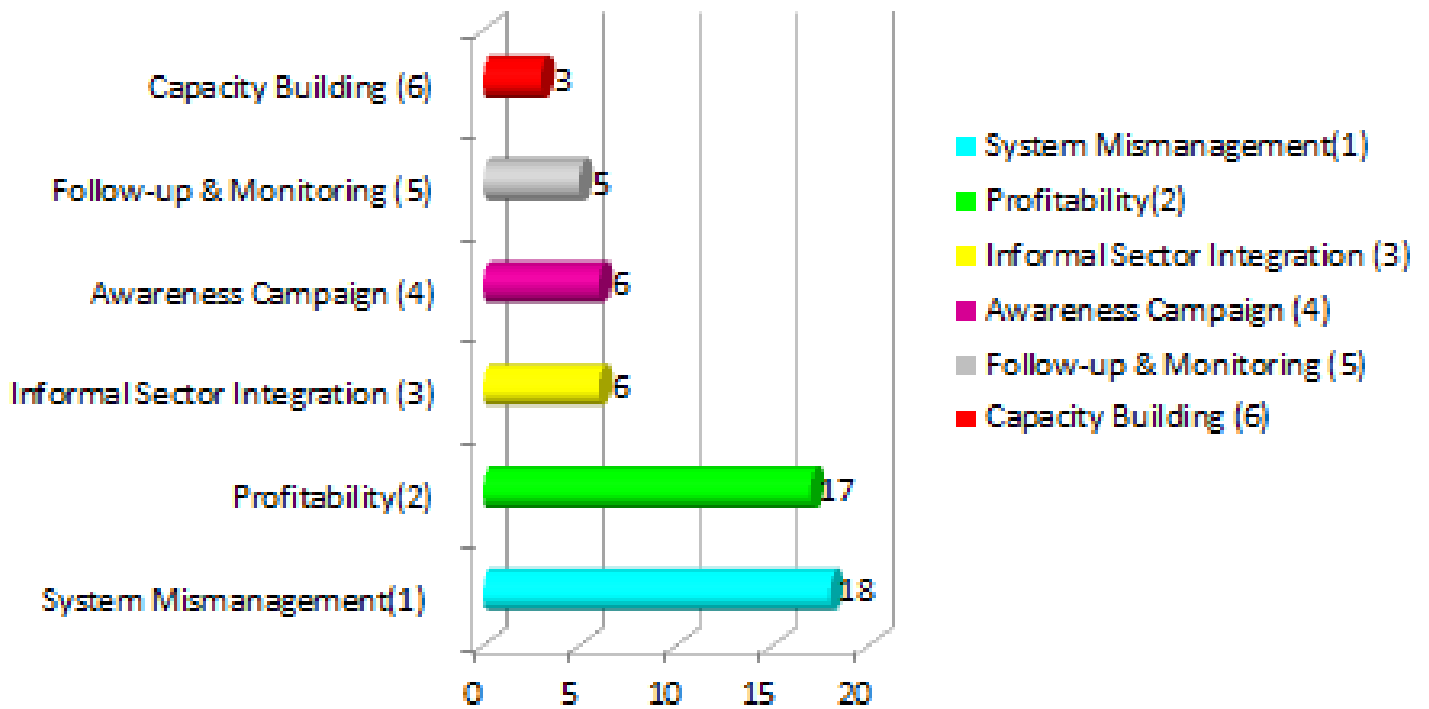



FIGURE 21: FREQUENCY OF OCCURRENCE OF THEMES

Based on the interviews findings, figure 21 shows that system mismanagement and profitability come as a top priority followed by informal sector integration, awareness campaigns, follow-up and monitoring and capacity building.

TABLE 14: CODING THEMES SUMMARY

Coding Themes	How to Reach Theme
System Efficiency	<ul style="list-style-type: none"> • National Strategy & Master Plan • Clear Government Roles • Development and Institutional Support • Clear Laws
Profitability	<ul style="list-style-type: none"> • Satisfying Collection Fees • Cross Subsidy Linked to Electricity Consumption • Private Sector Investment • Waste Valorization-Sorting at source • RDF is Promising
Informal Sector Integration	<ul style="list-style-type: none"> • Decentralization • Zabbaleen Formalization
Awareness Campaign	<ul style="list-style-type: none"> • National Awareness Campaign • Change People's Behavior
Follow-up & Monitoring	<ul style="list-style-type: none"> • Regular Monitoring & Evaluation
Capacity Building	<ul style="list-style-type: none"> • Capacity development • Knowledge



Sustainability

Table 14 summarizes the interviews findings themes and there is strong relation between the findings and lack of good governance as seen in figure 19. The system mismanagement/inefficiency shows that the SWM system lacks **Rule of law** which is a cornerstone for good governance. Additionally, informal sector exclusion shows that there is lack of **Equity and Inclusiveness** in which a society's well-being depends on guaranteeing that all its members feel that they have a stake in it and do not sense excluded from the mainstream of society. Also, the system lacks **Effectiveness & Efficiency** as it's not making a sustainable use

of the resources due to the lack of national strategy and mater plan. The next section will elaborate in details on the research findings and linking them to a framework that could be used to utilize all the resources and improve the current MSWM system which would lead later to sustainability.

In Figure 22, PESTLE analysis was used in classifying data findings. The main reason behind using the PESTLE analysis is to understand waste sector’s external environment, which is important to understand while applying Modified ISWM framework as to be aware of all external factors that might hinder its performance. PESTLE stands for Political, Economic, Social, Technological, Legal, and Environmental when analyzed gives a complete picture of the sector. (Zhang et al., 2011)

Political	Economic	Social
<ul style="list-style-type: none"> Lack of system transparency Imposing penalties on private companies due to their unsatisfying performance Pigs slaughtering traumatized Zabbaleen system as pigs eat 50-60% of organic waste Initiatives are easier made in small governorates as it is manageable in monitoring and frequently imposed penalties i.e. Qena Governorate unlike Cairo and Giza Governorates Corruption among different stakeholders and lack of follow up Lack of clear penalties for private companies 	<ul style="list-style-type: none"> Door to door collection is expensive as it is estimated that each household should pay around EGP40 Main Purpose of Erteqaa company is to reach zero waste meanwhile make profit to sustain the business Waste itself is not wealth ; sorted waste is a valuable resource; it varies from poor and rich neighborhoods There should be a minimum wage for Zabbaleen as to ensure pleasant outcomes A service should be accompanied by reasonable cost/fee (balanced cost revenue model) Suitable collection price that is satisfying for all stakeholders Inconsistent monthly payment from the government to private companies; hence, performance may be affected People pay fees twice on electricity bill and to the garbage collector which is not sustainable as the fee is not sufficient for garbage collector The fee could be linked to the electricity consumption An incentive for sorting at source could be complemented by free garbage bags in return 	<ul style="list-style-type: none"> Allocated communal bins were not compatible with community’s behavior; they were stolen Around 750 K Zabbal collecting waste People’s behavior in poor harder to manage Erteqaa company collaborates with Zabbaleen in Zenhom area and El Gouna A fully integrated model not only promoting sorting at source as to know where the rest of the waste will end Zabbaleen work per day not monthly based on the mentality/culture of the collectors
Technical	Legal	Environmental
<ul style="list-style-type: none"> Very costly for private companies to hire door to door garbage collectors New kiosks initiative is a complete failure it is recommended to have household collection till the system is enhanced Sorting at source needs a strong SWM system – could be done only on small scale Implementation is totally different from the top management vision Lack of private companies market study 	<ul style="list-style-type: none"> New Egyptian holding company is still unclear and none profoundly knows about it All stakeholders must be well informed and integrated together It is unclear the exact number of those companies enrolled in SWM A legislation is needed for a cross subsidy (i.e. Affluent areas can compensate poor areas) It is crucial to audit ISWM should be implemented with follow up and monitoring A 15 year contract with private companies is too long 	<ul style="list-style-type: none"> Inefficient waste management system Unsanitary dumpsites usage There is no guarantee that a company deals with waste in an environmental friendly way

FIGURE 22: PESTLE ANALYSIS

3.2 Discussion

The main concern that resulted from the MSWM system evaluation is **the lack of integration and coordination among stakeholders, waste system elements; and aspects** as seen in Figure 24. A key challenge in the ISWM process is to get all stakeholders agree to cooperate for a common purpose; that of enhancing the SWM. Additionally, **good governance** as stated previously comes as the first objective to gain control over generated waste through affordable, professional, sustainable, and inclusive ISWM. This shows that good governance is a prerequisite for ISWM as to reach better approach in handling SWM. Hence, **ISWM framework** has to be complemented with integration and coordination among its three dimensions and to be supported by good governance.

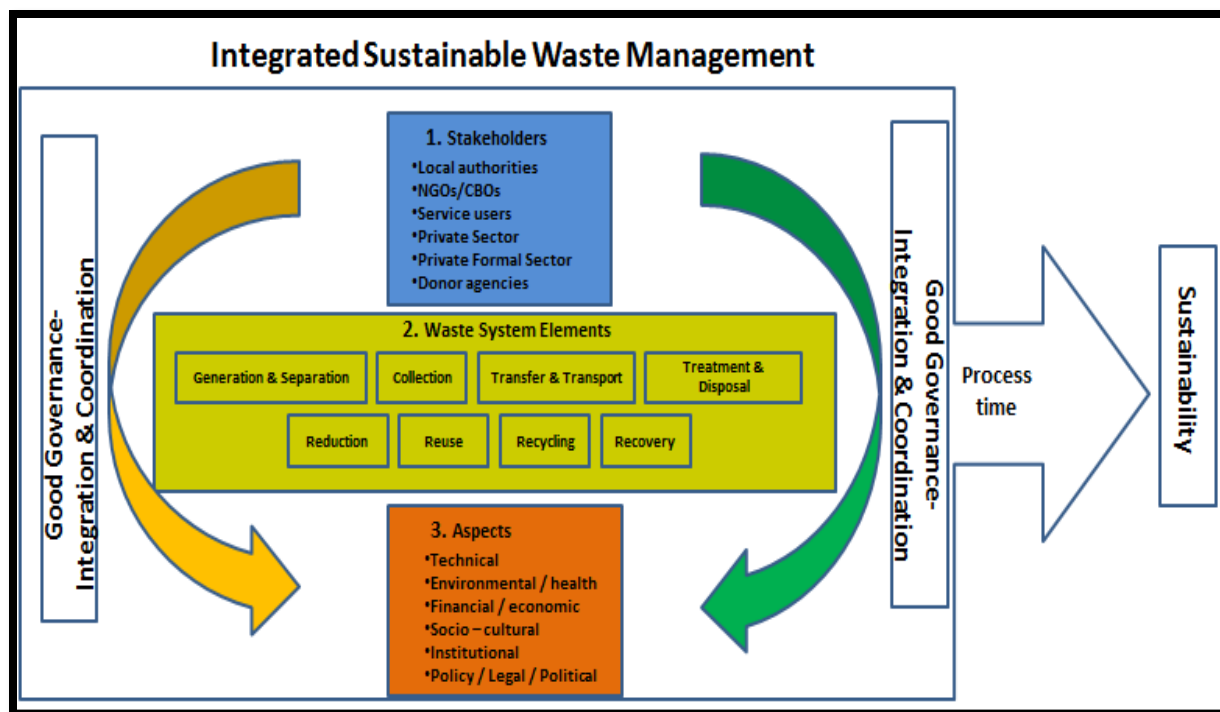


FIGURE 23: MODIFIED ISWM

In the first pillar in the modified ISWM framework, **Good Governance-Integration and coordination among all stakeholders** are needed for a better SWM. As stated in the literature review one of the latest government initiatives that was launched in March, 2017 was the garbage collection kiosks project. Surprisingly, the informal sector (Zabbaleen) was not aligned and they protested as it was affecting their income and they urged for terminating this project; consequently, it was ended. Also, same case happened back in 2004 during the official

privatization of solid waste services via contracts with technology-intensive multinational companies. It threatened the sustainability of the informal garbage collectors, Zabbaleen, by removing access to their chief economic asset, waste garbage. Even though, the Zabbaleen have created what is one of the world's most efficient resource-recovery and waste-recycling systems. Such privatization approach failed to allow people to build incrementally on technologically appropriate indigenous patterns of living. The households were also affected as they had to pay the informal garbage collector, Zabbal/Wahey, and also pay a collection fee on the electricity bill. Moreover, the scavengers were a result of the private companies as to benefit from the generated waste. Additionally, this decision costed a lot of money as the contracts were signed for 15 years. The above actions affected the **equity and inclusiveness** of all stakeholders and mainly the Zabbaleen. Optimistically, these contracts are ending gradually starting 2018. Moreover, government officials communicated in newspapers that a new waste holding company will replace these international companies; but, during the interviewing process none of the interviewees had any information on it. Hopefully, the government should integrate all stakeholders as a lesson learnt from previous experiences. As stated by Mr. Naeem, founder of Rouh Al Shabab Association, "decentralization is highly needed as to integrate the informal sector along with the formal sector" as to give a chance for the informal sector to have a say in the decision-making process and to benefit from their expertise. Decentralization improves management, aids in distribution of roles, community participation, and increases motivation among community groups. Also, it was encouraged in one of the developing countries case studies, in Nakuru town; the fourth largest urban centre in Kenya, the average daily collection rate was less than 30%. To solve this challenge on domestic solid waste handling, the Municipal Council of Nakuru (MCN) enacted 2006 Nakuru Environmental Management by-laws that paved the way for decentralized service delivery of domestic SWM. The collection coverage has increased from 30% to 64% in 2010. This shows that decentralized service delivery in SWM collection services is feasible with active participation of organized and supported community based groups. Another successful example of informal sector inclusion is in Pune, India, waste pickers' association called KKPKP is a successful model of how community mobilization can effectively ace in improving the livelihoods of waste pickers. Nevertheless, it is considered a stakeholder in the formal sector to the degree that the members hold identity cards authorized and the fact that the KKPKP is the official agency for door to door collection. Twice as many

workers are involved in the informal waste sector as compared to the formal sector. Also, according to the UN-Habitat framework identifies that three governance characteristics are vital for sustainable SWM, that is: inclusivity to all stakeholders; financial sustainability; and sound institutions and proactive policies. All the above aspects show that good governance along with integration and coordination among all stakeholders is vital to reach an ISWM.

In the second pillar in the modified ISWM framework, **Good governance- Integration and coordination in waste system elements**. As seen in figure 24, the waste system elements include: in the top row all attach to removal and safe disposal and the bottom row of boxes relate to valorization of commodities, SWM entails a variety of activities, including reduction, reuse, recycling and composting, functioned by a variety of stakeholders at various scales. Therefore, all the elements have to be integrated and well-coordinated as to reach the maximum level of outcome. Hence, promoting the notion of **effectiveness and efficiency**; this is a main pillar in good governance. The waste system elements could be interpreted as the technical dimension. However, the generation and separation box is related to users and service providers. Poor governance is a main reason why cities' solid waste and other urban systems fail. In examining governance aspects, it was focused on inclusivity of users and service providers, financial sustainability, and the strength of the institutional framework. (MSEA, 2013)

Also, it was stated by Dr. Iskandar that “the private collection companies are successful in their countries but they did not study the Egyptian market profoundly”. They did not benefit from informal sector in the beginning and they got stuck with labor problems. They used communal bins which did not match with the Egyptian behavior; the bins got stolen and the garbage was left in the streets. Additionally, they followed a specific timing for collection and it did not match the Egyptian mentality. They began to lose money as scavengers collected high value waste and international companies ended up collecting 1/3 of what was written in the contracts. This reflects that the system lacks **effectiveness and efficiency**. Also, it was very costly for these companies to hire workforce for door to door collection. The only reason the Zabbaleen did that is the value of recyclables. Waste management in Egypt has traditionally only been thought of as waste collection. Additionally, investment has been focused mainly on providing equipment to collect waste in order to get it out of the neighborhood and into the desert. Therefore, a shift in the current system is needed and implementing this shift requires a restructuring of financial and

economic incentives through the ISWM chain as shown previously in figure 10. Lack of collection services causes significant public health, safety and environmental threats. A successful collection case was applied in Brazil; one of the most noteworthy modifications in the last decade in the solid waste sector in Brazil and other developing countries was the integration between formal and informal sectors in the waste chain. It is portrayed that the model employed as “hybrid”, where municipalities and waste pickers share tasks, benefits and earnings from selective waste services. This form of selective waste service differs from the conventional notion of service privatization, integrating new elements for instance social inclusion and income generation for citizens excluded from the official employment market. Selective waste services are managed by the municipalities, however are subcontracted or managed in affiliation with structured groups of waste pickers, who still play an extremely trivial part in the entire amount of waste recovered. This service is offered via door-to-door or through voluntary delivery points or sites. Generally, municipalities utilize a combination of these to endorse recycling. Door-to-door collection includes trucks driving via streets and picking up recyclable material which householders have previously separated. Residents can leave small amounts of dry waste at sites, also known as “Ecopoints”. These are placed in public areas, and recyclable materials can differ depending on each municipality. Delivery points are located in public areas, parks, schools and shopping centers. (Besen & Fracalanza, 2016) This can be applied in Egypt by integrating the informal sector and giving an incentive to households to do so. By implementing door to door collection for recyclables, sorting at source is promoted which is the key solution for the waste issue as stated by the CCBA representative. According to Dr. Ghanem, Erteqaa CEO, it is suggested to collect sorted recyclables from households by offering incentive as to ensure that the collected waste is of value to the garbage collectors i.e. free garbage bags. The city of Chandigarh, India, has a successful collection case. The waste collection and storage services can be generally divided into primary and secondary collection. Chandigarh Municipal Corporation has constructed buildings named SSKs as primary collection centres at 35 selected points for SW storage of each area. Primary collection is the process of collecting waste from households, markets, institutions, etc. and then moving it to transfer station or dumping site. The residential waste is collected door to door by private waste collectors who collect a fee every month by the residents. Once collecting this waste, they separate waste of value and take the rest to the garbage bins in SSKs. Secondary collection entails the transfer of waste from the community

bins, transfer stations to waste processing sites or to the final dumping site. In Chandigarh, the garbage of the SSKs is transported to the garbage processing plant and rejected waste is moved to the landfill site for final disposal. A combination between primary and secondary collection and transportation system is vital to prevent excess from containers and waste litter on streets. Municipal Corporation employees in Chandigarh assure that 100 percent of the city's waste is collected every day.(Gupta & Gupta, 2015) Egypt could implement a combination between the primary and secondary collection as secondary collection should be placed in specific locations due to peoples' behavior and attitudes as stated above they do not have the education to throw in communal bin and also the scavengers take whatever they need and throw the rest in the streets. According to Dr. Gaber, Chemonics CEO, the solid waste issue is historic, complex, and permanent. The issue of solid waste is local as it differs from one governorate to another; therefore, a detailed planning should be applied including social, culture, behavior, etc. The government has to agree on a concept. For example, 300 service areas each area should be supported by 1 transfer station or Material Recovery Facility (MRF). In addition, each 2 service areas will be supported by a factory and each 6 service areas will be supported by landfill. Most importantly, the informal sector and communities have to be integrated in the system. This should be solved by collection, transport, recovery, disposal via phased implementation this means that some areas will recover faster than others. This shows that the waste management issues are somehow similar in developing countries. Many lucrative new business opportunities are available both in input-efficient production and in environmentally responsible recycling and waste disposal. Meanwhile, cities should also be mindful of the fact that over-dependence on conventional waste collection, treatment and disposal is not sustainable and it is too expensive. Waste management should be designed and planned in a holistic, integrated way on the principles of ISWM and practices of 3Rs,(reduce, reuse, recycle) with disposal (United Nations, 2011) The 4 Rs in figure 24 relate to 'valorization' of commodities as they make the waste of value via recycled products, RDF, compost, etc.

In the third pillar in the modified ISWM framework, **Good Governance-Integration and coordination among all aspects is crucial**. All technical, environmental, financial, socio-cultural, institutional, political, legal, policy aspects are to be considered as to have a sustainable WM system. Additionally, it should be complement with good governance. These form the third

dimension in figure 24. As stated in GIZ, 2014, good governance targets to generate effectual and fair decision-making and management frameworks. This involves having a clear regulatory organization and transparent and responsible institutions.

Good governance will need the following in Egypt:

1. Legal and institutional restructuring and enforcement
2. Financial and economic reform
3. Technical/operational funds and capacity building of practitioners
4. Social capital generation and recruitment

All the above shows that Egypt lacks good governance due to lack of inclusivity of all stakeholders, lack of financial sustainability, and solid institutional framework (MSEA, 2013). Good governance comes as the first objective to gain control over generated waste through affordable, professional, sustainable, and inclusive integrated solid waste management. According to Mr. Gaber's interview, **Technical aspect** is important to have capacity building as it is important to have technicians who are specialized in waste and know how to design a proper landfill. Additionally, Eng. Mansour, CCBA representative added that capacity building is a main challenge for municipalities as they do not have trained employees who are able to make a change in the system. Regarding the **Environmental aspect**: it is essential to secure a healthy environment for the garbage collectors. Zabbaleen involvement is crucial to maximize the resources and to be efficient as they have the knowhow of recycling and they have invented this industry several years back in Egypt. Additionally, to monitor people's behavior as to ban garbage burning and illegal dumping that causes environmental stress. **Financial aspect**: Central Government Allocations is the first source of funding. Allocations are made from the central government to various governorates at the local level. Allocations are not made directly to MSW management. Instead, certain expenditures are covered under different budgetary sections. There are no direct allocations for MSM programs. Allocations are generally insufficient.

Cost is partly recovered via fees collected on the electricity bill in the cities or through collection of fees from residents by NGOs implementing collection systems using different mechanisms that sometimes include separate service fees after getting the approval of the competent authorities (e.g. the Local People's Assembly). It is estimated that on average, there is a 35% gap between incurred costs for waste collection and disposal and the amount required. Cost recovered per ton of MSW relies on marketing of recyclables (15% of cost recovered), cleansing fees and penalties (50% of cost recovered). It is expected that cost per ton for collection, transport and disposal could reach up to 215 LE per ton. (EcoConServe,2010) The main deficiency is that the collection fees is doubled on households as they pay once on the electricity bill and they also pay to Zabbal. There is a duplication in payment. This shows that there is incoherence in the system. Based on the primary research it is recommended that their payment on the electricity bill should be related to the electricity consumption. This means that affluent areas should pay more than poor areas. Dr. Iskandar highlighted this could happen in a form of cross subsidy. This means that the rich can pay for the poor in an indirect way. Currenty collection fees on electricity bill is EGP8 per month. Dr. Iskandar recommended that a household in affluent areas should pay around EGP40 as to reach a satisfying outcome. It is very challenging to do so. Additionally, Dr. Gaber added that each household should pay around EGP30 per month as to have sufficient SWM budget as to give the informal sector a satisfying percentage as well as cleaning and beautifying the streets. Additionally, according to Chandigarh case study more sources of revenue could be included such as SWM tax along with property taxes, apart from solid waste user charges, and user charges linked to utility (water/electricity) bills. In addition, certain regulations such as the "polluter pays" principle could be executed. **Socio-cultural aspect:** this entails the different behavior among different cultures. For instance, the use of communal bins is successful in developed countries; however, it was not the case in Egypt as they got stolen during the private companies' era. Additionally, as stated by Mr. Naeem the waste is not wealth to some of the Zabbaleen; it's just a source of income as any job "a daily bread"; however, Mr. Nawara stated that waste is "hidden gold" but only for the people who know the knowhow. **Legal and Institutional aspects:** it was stated by Mr. Ashraf, Erteqaa project supervisor, lack of penalty implementation is a main challenge they face in Zenhom, a poor district in Cairo near Kasr Al Nile area. People may throw the garbage in the streets and no one can be penalized. Additionally, even if laws and regulations are present

they sometimes are not implemented effectively. For instance, According to Eng. Mansour, CCBA representative, by law it is forbidden that one can sell or buy garbage except via CCBA; however, this is not the real case people buy and sell garbage. He also added that law states that recycling plants should not be near residential areas; however, several recycling plants were closed due to urban sprawl; for instance, Kattameya plant. This shows the mismanagement in the system that hinders its performance. It is obvious that MSWM has to have an ISWM along with good governance as to pave a way towards sustainability.

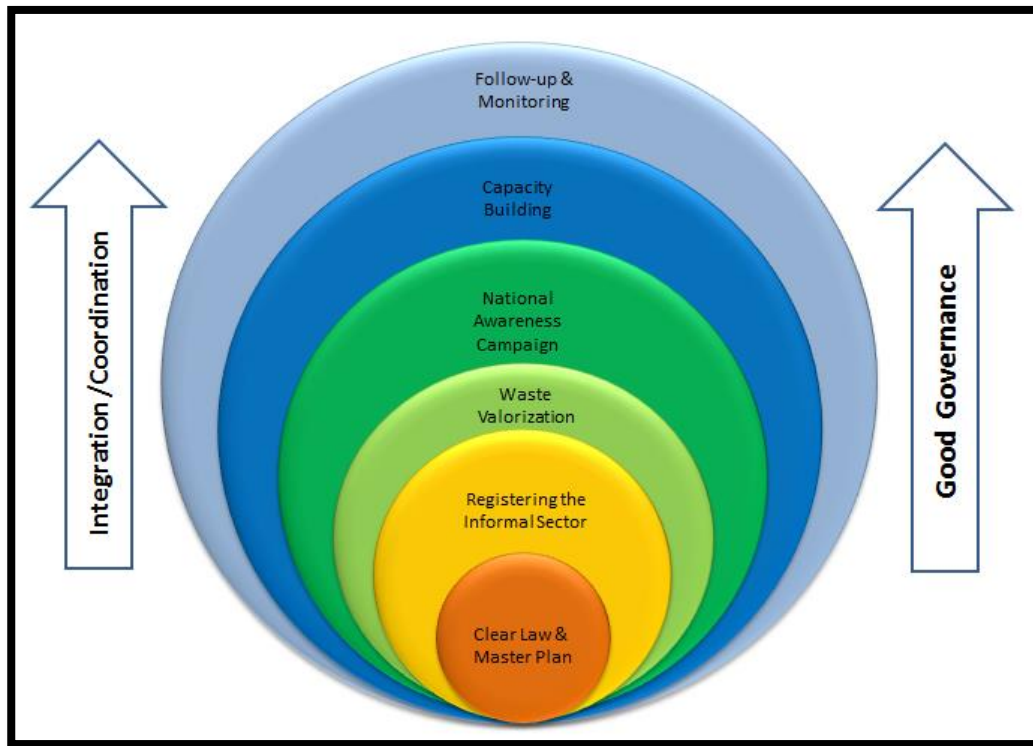


FIGURE 24: DISCUSSION CONCLUSION

In a nutshell, as seen in figure 24 in order to sustain MSWM system, all elements need to be integrated together and good governance must be a prerequisite to reach sustainability. MSWM elements can be stated as: (a) Clear Law and Master Planning, (b) Registering the Informal Sector, (c) Waste Valorization, (d) National Awareness campaign, (e) Capacity Building, and (f) Follow-up & Monitoring. The inter-relationship among the elements is shown in Figure 23. Integration and good governance along with clear law and master planning are a vital part of SWM as without them there would not be any clarity among the stakeholder about their roles and accountabilities. As could be seen from the historical development of MSWM the people tend to dispose the waste indiscriminately in the absence of law. The laws would not act themselves and

need proper execution of waste handling for both enforcing as well as managing. Apart from informal sector integration and waste valorization the waste generators needs wide awareness for changing their attitude/behavior which can be done through posters, leaflets, publicity in mass media like social media/Radio/Newspaper/Television etc. In addition, to capacity building and having qualified calibers in the field and above all frequent monitoring and follow-up to assess the performance regularly.

3.3 Research Limitations

There were some limitations faced while conducting the research. This is a qualitative research therefore the number of interviews is limited. Qualitative research gives good indication about the topic; however, it lacks statistical significance. Also, time constraint was challenging. As arranging and conducting interviews were hard and time consuming especially that experienced interviewees were targeted; therefore, it needed much effort to reach them via connections. Additionally, more time was needed to conduct more interviews with more stakeholders like Ministry of Finance, GIZ and GCBA.

The national development and planning of the SWM sector lacks trustworthy data on the quantities of generated waste and its composition. To design an effective waste management program, it is essential to know how much MSW must be managed. Moreover, if it is aimed to reduce MSW generation, tracking the total MSW will be an imperative indicator of success. Hence, the total amount of generated MSW is a desperate piece of information and there is an urgent need to exploit trustworthy and accurate methods for its continual measurement.

Another important limitation is that the new holding waste company that should take place post private companies is still under exploration. It seems to have a new concept but none of the interviewed stakeholders has any information regarding its framework. Access to any information on the progress of this stage was difficult to obtain.

4. Chapter 5

Conclusion and Recommendations

4.1 Conclusion

In conclusion, to solve the MSWM issue in Egypt there are several factors to be considered. At first, good governance must take place in terms of equity and inclusiveness among stakeholders especially the informal sector. Besides, rule of law execution is important as to have clear laws and institutional frameworks that are soundly implemented. Also, laws promoting Extended Producer Responsibility (EPR) have to take place. The EPR shifts responsibility from the government and user to producer to organize and finance the collection system for used products. This will lessen the environmental stress and also benefits the producer and user. Moreover, promoting source reduction by implementing the (4Rs) has to be done in order to minimize the amounts of generated waste; therefore reusing products or making them with the least materials will alleviate waste tremendously; hence, less materials to be recycled or sent to landfills. Also, creating sources of revenue in the system is very crucial and this can happen by having a satisfying collection fee via cross subsidy, private sector investment, polluter pays, SWM tax, waste valorization, etc. In addition, having a solid recycling plan and benefitting from the local recycling systems such as Zabbaleen and private sector will be of added value to the waste management chain and will increase system's efficiency. Having capacity building that can develop the waste management system and aid in engineered landfills design will lead to less ecological and minimum public health problems resulting from mismanagement of waste. Additionally, raising awareness on integrated sustainable waste management will change the attitude and behavior towards dealing with waste.

1. People will start thinking of waste as a resource instead of garbage. Recycling greatly reduces greenhouse gas emissions compared to landfilling the same material. Landfill leachate contains a wide range of toxic substances arising from the decomposition of waste, and causes contamination of domestic groundwater sources. (Zero Waste New Zealand Trust, 2018)
2. Landfills and incinerators are outdated technologies that do not have a place in a sustainable society of the 21st century. However, vested interests are still promoting them

as safe waste management solutions. Zero Waste is not a technology in itself, but rather a vision for a new way of designing material flows and a sustainable society. It includes a basket of technologies and solutions that will collectively refocus the energy and resources of communities throughout the nation towards waste elimination. (United Nations, 2011)

Communities cannot solve the waste crisis alone. However, every community can adopt a Zero Waste target to change the way its citizens think about waste, and to send a firm message to industry that communities will not always clean up after it. Industry must take greater responsibility for its own products throughout their entire life cycles. Unfortunately, landfills and incinerators destroy valuable resources. Even if they were proved 'safe' this destruction of resources would be enough reason to condemn them as outmoded disposal technologies. The final goal for a sustainable society is to create a 100% materials-efficient economy – a Zero Waste economy based on the same principles that nature has successfully proven for millions of years. (United Nations, 2011)

Finally, integration among all stakeholders, waste system elements, and all aspects must take place with regular follow-up and monitoring. By doing such efforts in MSWM, a road will be paved for a better future for the upcoming generations leading to sustainability in waste management.

4.2 Recommendations & Next Steps

- Organic waste constitutes around 60% MSW; solving its issue will solve more than half of the problem. It could be reused and transformed to energy, organic fertilizers, and animal feed
- Refuse-derived fuel (RDF) from municipal solid waste is very promising; and it helps in cement production
- The government should promote recycling by working hand in hand with the private sector as to benefit from its expertise and financial resources
- The new holding company handling solid waste should apply modified ISWM framework as to have better results. During the research phase nothing was clear about it
- The government should work on accurate data collection as the total amount of waste varied 89M tons in 2012 (MoID) and 94.9M tons in 2010 (EEAA)
- Solving Cairo's waste problem is solving around 50% of the waste issue
- E-waste should be put in consideration as it is not identified as a type of waste in all listed figures and it is increasing tremendously
- Resolving MSW issue will solve only 21% of waste threat. Therefore, a detailed plan needed to solve the rest of 95 million tons generated yearly

The above will happen with the below steps

- The WMRA must take the lead and communicate with all stakeholders via round tables, seminars, workshops to reach a common ground and delegate tasks
- WMRA to aid in collecting accurate data in regards to generated waste as this is the core of having a sound plan for managing the MSW
- All stakeholders have to benefit from the ISWM as to motivate them to participate and work actively in the system
- Future studies should be carried out in terms of quantitative research for instance the satisfying waste collection fee paid by stakeholders
- WMRA must have regular follow-ups to make sure all parties are working effectively and efficiently.

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6. Appendices

6.1 Appendix 1:

IRB Approval

Dear Randa

This is to inform you that I reviewed your revised research proposal entitled “Addressing the Sustainability of Municipal Solid Waste Management (MSWM)- Stakeholders Role in Egypt” and determined that it required consultation with the IRB under the "expedited" category. As you are aware, the members of the IRB suggested certain revisions to the original proposal, but your new version addresses these concerns successfully. The revised proposal used appropriate procedures to minimize risks to human subjects and that adequate provision was made for confidentiality and data anonymity of participants in any published record. I believe you will also make adequate provision for obtaining informed consent of the participants.

This approval letter was issued under the assumption that you have not started data collection for your research project. Any data collected before receiving this letter could not be used since this is a violation of the IRB policy.

Best Regards

Atta Gebril

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6.2 Appendix 2:

Consent Form



Documentation of Informed Consent for Participation in Research Study

Project Title: Addressing the Sustainability of Municipal Solid Waste Management (MSWM)- Stakeholders Roles in Egypt

Principal Investigator: Randa El Masry

*You are being asked to participate in a research study. The purpose of the research is to know how is the current municipal solid waste management system functioning, address the current stakeholders, and know the drawbacks that hinder its effectiveness and try to come up with proposal that makes it more sustainable , and the findings may be presented and published among AUC community and may be published if needed. The expected duration of your participation is around one hour during the meeting time.

The procedures of the research will be as follows it will be a combination between secondary and primary research-exploratory research via face to face interviews (they will be conducted in Arabic and English). The interviews will be mainly with involved stakeholders. Their contacts will be gathered via connections with the help of advisor and co-advisor. Then they will be contacted over the phone to set meetings with them. Around 5-7 stakeholders will be interviewed.

*There *will not be* certain risks or discomforts associated with this research.

*There will not be benefits to me from this research. But it is useful to the public.

*The information you provide for purposes of this research *is confidential*.

*Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or the loss of benefits to which you are otherwise entitled.

Signature _____

Printed Name _____

Date _____

استمارة موافقة مسبقة للمشاركة في دراسة بحثية

عنوان البحث : (التنمية المستدامة و كيفية ادارة المخلفات الصلبة)

الباحث الرئيسي: (رنده المصرى..مدير تسويق)
البريد الالكتروني: randa1_3@aucegypt.edu
الهاتف: 01224427792

انت مدعو للمشاركة في دراسة بحثية عن معالجة استدامة إدارة النفايات الصلبة - دور أصحاب المصلحة في مصر.

هدف الدراسة هو والغرض من البحث هو معرفة كيف يعمل نظام إدارة النفايات الصلبة الحالي، ومعرفة أصحاب المصلحة الحاليين، ومعرفة العيوب التي تعوق فعاليتها ومحاولة التوصل إلى اقتراح يجعلها أكثر استدامة.

نتائج البحث ستنتشر في دوريه متخصصه أو مؤتمر علمي أو ربما كليهم وتنتشر بين نطاق الجامعة

المدة المتوقعة للمشاركة في هذا البحث المدة المتوقعة للمشاركة هي حوالي ساعة واحدة خلال وقت الاجتماع

اجراءات الدراسة تشتمل علانحو التالي عبارة عن مزيج من البحوث الاستكشافية الثانوية والابتدائية عن طريق المقابلات وجها لوجه (ستجرى بين اللغتين العربية والإنجليزية). وستكون المقابلات أساسا مع أصحاب المصلحة المعنيين. وسيتم جمع جهات الاتصال الخاصة بهم عن طريق الاتصالات بمساعدة المستشار والمستشار المشارك. ثم سيتم الاتصال بهم عبر الهاتف لاجتماعات معهم. سيتم إجراء مقابلات مع حوالي 5-7 أصحاب المصلحة.

المخاطر المتوقعة من المشاركة في هذه الدراسة لن تكون هناك مخاطر أو مشكلات معينة مرتبطة بهذا البحث

الاستفادة المتوقعة من المشاركة في البحث: لن تكون هناك فوائد بالنسبة لي من هذا البحث ولكنها فائدتها للصالح العام

السرية واحترام الخصوصية: المعلومات التي ستدلى بها في هذا البحث سوف تكون سرية

ان المشاركة في هذه الدراسة ماهي الا عمل تطوعي, حيث أن الامتناع عن المشاركة لايتضمن أى عقوبات أو فقدان أى مزايا تحق لك. ويمكنك أيضا التوقف عن المشاركة في أى وقت من دون عقوبة أو فقدان لهذه المزايا.

الامضاء:

اسم المشارك :

التاريخ :/...../.....

6.3 Appendix 3:

Interview Questions:

1. kindly introduce yourself
2. Who are the stakeholders involved in the current Solid Waste Management (SWM) system?
3. What are the roles of the following:
 - a. Ministry of environment
 - b. Ministry of local authority
 - c. Cairo Cleaning and Beautification Agency (CCBA)
 - d. Waste Management Regulatory Authority (WMRA)
4. Do you know any successful cases on SWM systems?
5. Do you think the current solid waste management system is sustainable?
6. How to make SWM system sustainable?
7. What are the main reasons behind SWM system failure?
8. Have you previously worked on reduce/reuse/recycle initiatives? Were they successful?
9. Is the relationship between the government sector and the informal sector successful? Why/how?
10. Do you have any recommendations to make the current system sustainable?
11. What are the main challenges facing the solid waste management system in Egypt?
12. What are the noticeable benefits if we applied a sustainable system?
13. Who are renowned entities who support sustainable SWM initiatives?
14. Is the government supporting a sustainable SWM system? how?
15. Is an incentive scheme a crucial component for a sustainable system?
16. How many years will it take Egypt to have a sustainable SMW system?
17. What is the role of the media in SWM?
18. The media always say "garbage treasures", we still see the treasure accumulated and scattered on the street and open dumps. Why?
19. What is your assessment of the current garbage collection companies?
20. Are you satisfied with current collection fees
21. Some districts they pay the fees twice: to the garbage collectors (do the job) and to the government, please comment
22. Was March'17 sorting initiative kiosks in Heliopolis successful or not? why?