EVALUATION OF COMPOSTING FACILITIES

IN EGYPT

Prepared for:

Egyptian Environmental Affairs Agency (EEAA)
United States Agency for International Development (USAID)

Prepared by:

Abt Associates Inc.
SCS Engineers
Community & Institutional Development
The Institute for Public-Private Partnerships

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ACRONYMS

EEAA	Egyptian Environmental Affairs Agency
EEPP	Egyptian Environmental Policy Program
EMUs	Environmental Management Units
RBOs	Regional Branch Offices-EEAA
USAID	United States Agency for International Development

SECTION 1

INTRODUCTION

The Egyptian Environmental Affairs Agency (EEAA) requested an evaluation of composting facilities currently operating in Egypt. The Solid Waste Technical Assistance Project, a component of the USAID-funded Egyptian Environmental Policy Program, conducted this study in support of EEAA solid waste management activities.

Egypt has historically had some of the most productive and fertile land in the world. The Nile River not only provides water critical for agriculture, but in times past, the annual flooding of the Nile deposited nutrient-rich soil onto the land. In recent years, the Aswan High Dam has virtually eliminated the annual flood which has resulted in a loss of the beneficial soil deposits leading to a need for organic material on lands used for agricultural production in Egypt.

Composting involves the biological decomposition of organic waste materials to produce a stable humus-like product. When mixed into soil, compost promotes plant growth, reduces plant disease (and the resultant use of pesticides), increases soil nutrients retention, and increases soil water retention capacity thus increasing soil resistance to wind erosion and plant resistance to dehydration.

Composting can be used as an alternative to disposal for many organic components of the waste stream. While composting is not an effective alternative to disposal for the non-organic waste materials, non-organic materials can be recovered from the waste stream during the pre-processing phase and can be recycled.

In most areas of Egypt, the current solid waste stream has an adequate percentage of organic materials. The combination of high organic material content, low labor costs, and the need for desert transformation into agricultural lands makes composting a desirable alternative to consider for Egyptian solid waste management systems.

PURPOSE

The purpose of this report is to evaluate the current status of Composting Facilities and make overall recommendations for improving the operating and environmental conditions of those facilities where it is needed. The Solid Waste Technical Assistance Project performed this study to satisfy the requirements of the Solid Waste Harmonization Study in the Tranche II Scope of Work.
The report provides information and recommendations related to the following:

- Methods of waste collection in areas where the composting facility is located (e.g., collection methods and vehicles, types and quantities of waste, and site related information).

- Process used to produce the compost (i.e., composting systems, available equipment at the facility, operations, management, compost quality, and difficulties associated with processing).

- The compost as a product (i.e., end product uses, types of tests on the product, and marketing methods for the product).

- Economic and technical indicators (i.e., quantities of different kinds of compost, re-usables and rejects, as well as operating costs and budgets for the facility).

SCOPE

This report assesses current composting facilities in Egypt. The information presented in this report reflects the data collected in a survey and site visits of the existing facilities within the 26 governorates conducted from September through October 2003. Numbers and locations of the facilities were provided to the project team by EEAA's Secretary General's Office and Solid Waste Management Department. The survey and site visits primarily covered municipal solid waste composting facilities, although two facilities using either agricultural waste or wastewater treatment plant sludge were included for comparison purposes.

METHODOLGY

This report has been developed and based on the review of existing composting facilities in the Egyptian governorates. Site visits, personal meetings, phone, and fax communication were used to provide the necessary information for this report. EEAA approved the survey form that was used in the evaluations and agreed to have the Environmental Management Units (EMUs) in each governorate and EEAA Regional Branch Offices (RBOs) schedule, prepare and participate in each visit in coordination with the project team.

Facilities were informed by these local authorities of the time and date of the visits. There was some lead time in which the facilities received the survey forms prior to the visits. Table 1 lists the facilities included in this report.

It should be noted that the quantitative data presented throughout this report are taken from the completed survey forms that are included in Appendix C. The responsibility for the accuracy of the data falls upon those who delivered the information. It was out of the scope of this study to validate data. Additional data were sent by some local authorities after the visit. Photos were taken by the project team to document the visits.

In most visits, the cooperation from local authorities and facility managers was satisfactory. In other cases, records were not available or there was an un-willingness to cooperate which is reflected in several sections of this report.

The survey form (Appendix B) developed by the project team for this study focused on the following:

- An assessment of the current status of each facility and the collection systems in its service areas.

- Methods of processing the compost produced at each facility. Operational considerations and concerns were also included.

- Marketing strategies and the markets targeted for each type of product.

- Economic and technical indicators at each facility outlining the constraints and benefits of composting.

- Environmental health and safety measures.

Table 1: List of Existing Governorates and Facilities

Governorate	City/Town	Management	Source of Information
1- Cairo	Qatamiya (1, 2, 3)	Private (Lease)	Survey Form and Site Visit
	El-Salam City	Private (Management Contract)	Data were not readily available
	15th of May	New-non operating	
2- Giza	Shabrament (1, 2)	Private (Management Contract)	Survey Form and Site Visit
3- Qaluibiya	There is no facility in Qaluibiya		
4- Alexandria	Mountaza	Private (Management Contract)	Survey Form and Site Visit
	Abis 1	Private (Management Contract)	Survey Form and Site Visit
	Abis 2	Private (Management Contract)	Survey Form and Site Visit
5- Behira	Damanhour	Private (Lease)	Survey Form and Site Visit
	Kafr Edawar	Public	Survey Form and Site Visit
6- Matrouh	Matrouh	Public	Phone and Fax Communication
7- Kafr El-Sheikh	Kafr El-Sheikh	Private (Lease)	Phone and Fax Communication
	Biyla	Private (Lease)	Phone and Fax Communication
8- Gharbia	El-Mahla El-Kobra	Private (Lease)	Survey Form and Site Visit
9- Menufiya	Menouf	Public (shortly into Private lease)	Survey Form and Site Visit
10- Sharqia	Zagazig	Public	Survey Form and Site Visit
	Belbeis	Private (Lease)	Survey Form and Site Visit
	Abu-Kebeer	Under Construction	
11- Dakhaliya	Mansoura (1, 2)	Public	Survey Form and Site Visit
	Belqas	Public	Site Visit-No Information
	Mit Qamer	Public	Survey Form and Site Visit
12- Damietta	Damietta	Public	Survey Form and Site Visit
	Ras El-Bar	Public	Survey Form and Site Visit
13- Port Said	Port Said	Private (Lease)	Survey Form and Site Visit
14- Ismailia	Ismailia (1)	Rehabilitation	Status Quo Information
	Ismailia (2)	Under construction	Information Not Available

Governorate	City/Town	Management	Source of Information
15- Suez	Suez	Private (Lease)	Survey Form and Site Visit
16- North Sinai	Arish	Private (Lease)	Survey Form and Site Visit
17- South Sinai	Sharm El-Sheik	Out of Service	No Available Information
18- Red Sea	Hurghada	Private (Lease)	Survey Form and Site Visit
19- Fayoum	El-Edwa	Private (Lease)	Survey Form and Site Visit
20- Beni Seuf	Senour	Public	Survey Form and Site Visit
	Somosta	Public	Survey Form and Site Visit
21- Minya	New Minya	Private (Lease) going into a divestiture	Survey Form and Site Visit
	Malwy	Private (Lease) New-non operating	No Information Available
	ECARU (agricultural waste compost)	Privately owned	Survey Form and Site Visit
22- Asuit	Asuit	Out of service for 4 years	No Available Information
23- Sohag	Sohag	Public	Survey Form and Site Visit
24- Qena	Qena	Public	Survey Form and Site Visit
25- Aswan	Aswan	Private (Lease)	Survey Form and Site Visit
	Edfu	Private (Lease)	No Information Available
26- Luxor	Luxor – Sahra El-Gabal	Private (Lease)	Survey Form and Site Visit
27- Wadi El Gedid	Dakhla Oasis	Under construction	No Information Available

STRUCTURE

This report is divided into four sections:

- Section 1: Introduction
- Section 2: Findings
- Section 3: Recommendations
- Section 4: Case Example

SECTION 2

FINDINGS

The findings presented in this report are based on the interviews with personnel at the facilities located in the various governorates, the information gathered from the returned survey forms, observations made during site visits, and discussions with local authorities, EEAA RBOs staff, and others. In some cases, production and operation records were reviewed by the project team, but in other cases they were not available for review.

FINDING 1: CAPACITY OF SOLID WASTE COMPOSTING PLANTS IN EGYPT

Egypt experienced a recent rapid expansion of solid waste composting facilities. An overview of the stages of building composting facilities is provided below:

- The first composting facility was built at Shoubra, Cairo in the 1950s.
- Additional facilities were built from 1983 through 1986. In Alexandria (Abis 1), in Cairo (Shoubra and El-Salam City), in Damietta (Damietta), and in Giza (Abou Rawash).
- In the 1990s, the Egyptian Government commissioned a plan for the establishment of 50 plants to be provided to various governorates during the period 1995-2000. The result was a phased design, construction, and operation of 10 plants in 1997/98, 11 plants in 1999/2001 and 11 plants in 2001/03 as indicated in Table 2.
- In Damietta and Mansoura, one composting line was designed and built by foreign support, and another locally manufactured line was built at a later stage. It is designated by 2 (1+1) in the (# of sorting lines) column in Table 2.
- One Co-Composting Facility was built in Port Said in 1998.

Facilities in the beginning were designed and constructed using available foreign technology: Abis 1 (British), Mansoura in Dakhaliya (British and local), Shoubra and Damietta (Swiss), El-Salam City and Abou Rawash (Danish), and Abis 2 (Japanese). The Port Said Co-Composting Facility was fully established with USAID funds and American technology. The remaining plants were constructed as a result of a Protocol between Ministry of Local Development utilizing funds from USAID, Ministry of Military Production, and Ministry of Scientific Research. Recipient governorates would provide the land for the facilities.

Solid waste composting facilities in Egypt are operating below their design capacities. There are 39 existing facilities in Egypt. The status of the facilities is summarized below:

- Three facilities have been out of service for several years (Ismailia, Assuit, and South Sinai)
- Nine facilities have operated intermittently with periods of operations ranging from few months to a few years (Zagazig in Sahrqiya, Damanhour in Behira, Mansoura and Mit Gamer in Dakhaliya, Arish in North Sinai, El Edwa in Fayoum, Senour in Beni Seuf, New Sohag in Sohag, and Hurghada in Red Sea).

- Four facilities are beginning operations due to the change of management from the public to the private sector (Shabrament 1 and 2 in Giza, Belbeis in Sahrqiya, Port Said, and Aswan).

- Three facilities have been constructed but have not started operations (15th of May in Cairo, Malwy in Minya, and Edfu in Aswan).

- The remaining eighteen facilities have been in regular operations.

- Capacities of the facilities are in the range of 10 tons per hour (tph) per sorting line. The only exception is the co-composting facility at Port Said with a capacity of 18 tph. The design capacity does not reflect the actual operating capacity which varies from being lower than 10 tph in most facilities to full capacity in just a few facilities as indicated in Table 2.

Several facilities operate with one shift per day leading to most facilities running below their full capacity. The number of shifts is dependent on factors such as: quantities of waste received, labor availability, electric power availability, machines in/out of full operation, as well as the overall management of the facility. The number of hours per shift is dependent on the same factors between a few hours to ten hours in any one shift.

Compost Facility - Senour, Beni Seuf

Table 2: Existing Facilities Capacities[1]

Facility/ Governorate	Year of Operation	Capacity (tph)/line		# of Sorting Lines	# of Shifts/hours	Comments
		Design	Actual			
Abis 1, Alexandria	1985	10	10	1	2 (16 hrs)	Operating
Abou Rawash, Giza	1986	6	------	1	-------	No data
El-Salam City	1986	6	-----	1	-----	No data
Damietta, Damietta[2]	1987	10	6-7	2 (1+1)	2 (16 hrs)	Operating
Zagazig, Sharkia[3]	1992-5	10	6	1	2 (# hrs)	On & Off
Montaza, Alexandria	1994-5	10	8	1	3 (24 hrs)	Operating
Abis 2, Alexandria	1997	10	10	1	3 (24 hrs)	Operating
Shabrament 1,Giza	1997/98	10	1-2	1	1 (8 hrs)	Starting
El-Edwa, Fayoum	1997/98	10	--------	1	2 (# hrs)	On & Off
Ismailia, Ismailia	1997/98	10	N/A	1	N/A	Re-habilitation
Mansoura, Dakhaliya	1997/98	10	8	2 (1+1)	2 (16 hrs)	On & Off
Damanhour, Behira	1997/98	10	2-3	1	2 (# hrs)	On & Off
New Sohag, Sohag	1998	10	3	1	1 (6 hrs)	On & Off
Senour, Beni Seuf	1998	10	4	1	1 (7 hrs)	On & Off
Port Said, Port Said[2]	1998	18	12-14	2	N/A	Starting
Luxor, Luxor	1998	10	6-8	1	2 (16 hrs)	Operating
New Minya, Minya	1998	10	8	1	1 (8 hrs)	Operating
Hurghada, Red Sea	1998	10	7-14	1	2 (12 hrs)	On & Off
Asuit, Asuit	1999	10	N/A	1	N/A	Out of Service
Matrouh, Matrouh	1999	10	8	1	1 (3 hrs)	Operating
Menouf, Menoufia	1999	10	6	1	1 (# hrs)	Operating
Aswan, Aswan	1999	10	N/A	1	N/A	Starting
Shabrament 2, Giza	1999	10	1-2	1	1 (8 hrs)	Starting
Qatamiya (1, 2 ,3) Cairo	2000	10	12	3	1 (12 hrs)	Operating
Arish, North Sinai	2000	10	3-5	1	1 (3 hrs)	On & Off
Sharm El Sheik, South Sinai	2000	10	N/A	1	N/A	Out of Service
El-Mahla ElKobra, Gharbiya	2000	10	6	1	2 (16 hrs)	Operating
Belqas, Dakahliya	2001/02	10	No Data	1	1 (8 hrs)	Operating
Suez, Suez	2001/02	10	10-10+	1	1 (10 hrs)	Operating
Qena, Qena	2002	10	6-7	1	1 (8 hrs)	Operating
Kafr El Sheik, Kafr El Sheik	2002	10	4-6	1	1 (8 hrs)	Operating
Somosta, Beni Seuf	2002	10	8	1	1 (10 hrs)	Operating
Ras ElBar, Damietta	2002	10	6-7	1	1 (8 hrs)	Operating
Kafr El-Dawar, Behira	2002	10	5-6	1	2 (# hrs)	Operating
Beila, Kafr El-Sheik	2002	10	4-5	1	1 (# hrs)	Operating
15th of May, Cairo	2003	10	N/A	2	N/A	Not Yet
Mit Gamer, Dakhaliya	2003	10	8	1	1 (6 hrs)	On & Off
Belbeis, Sharqiya	2003	10	2	1	1 (3 hrs)	Starting
Malwy, Minya	2003	10	N/A	1	N/A	Not Yet
Edfu, Aswan	2003	10	N/A	1	N/A	Not Yet
Total / (~ Average)	**39**	**(~ 10)**	**(~ 6-7) tph**	**46**	**(~ 9) hpd**	

[1] Based on data provided by the Completed Questionnaires
[2] Facility designed to process pre-sorted waste only
[3] First pilot plant designed and manufactured by the Ministry of Military Production and the National Research Centre on behalf of the Ministry of Scientific Research.

There are 39 existing facilities utilizing 46 sorting lines with processing design capacity of 10 tph. Waste processing hours per day (hpd) consist of either one or two 8 hours shifts per day. The total design capacity in these facilities is 7,200 (45 X10 X 16) tpd. Both lines at Abou Rawash and El-Salam are 6 tph each and together were considered as one 10 tph sorting line for simplicity.

Actual processing is well below the design capacity. The data collected and presented in Table 2 presents the current average waste processed as 6 to 7 tph for an average of 9 hpd. Three facilities are out of service (1 line each), so only 42 lines are operable. So the total actual processing represented by the facilities is between 2,268 to 2,646 tpd, or less than 37 percent of the design capacity.

FINDING 2: SOLID WASTE COMPOSITION AND COLLECTION IN SERVICE AREAS

Waste stream composition and quantities generated in the service area have great impact on the effectiveness of the facility when assessing composting programs. Waste stream composition is the most important factor affecting the composting quality depending on the level of organic content. Composition and quantity of waste generated depends on many factors including, the extent of urbanization, the citizen income level, degree of industrialization, commercialism, and established cultural values.

Collection practices are another important factor. Waste generators fall into the following categories: residential, commercial/institutional, medical, industrial, and agricultural. The collection practices for these categories influence the composting processes. Therefore, waste composition, quantities and collection methods contribute to the overall effectiveness of any composting facility.

Waste Quantities

When evaluating the data collected in the survey relative to "waste quantities", 27 facilities data are noted in Table 3. The data are described in the following:

- Households, commercial establishments, institutions, industries, and agricultural sectors generate different quantities of waste. There is a wide range of values for quantities delivered to the facilities.

- Ten facilities receive between 5 and 60 tpd of solid waste.

- Mansoura in Dakhaliya (2 sorting lines) and El-Mahla El-Kobra in Gharbiya (1 sorting line) receive waste quantities in excess of their capacities.

- Eight facilities receive between 10 and 25 percent agricultural waste (seasonal). These facilities are not equipped with shredders/hammer-mills to process the agricultural waste with solid waste.

- Four facilities receive types of waste other than municipal solid waste (street sweeping, construction and demolition, etc.). The facilities are not designed or operated in a manner which allows processing of this type of waste.

- Residential, commercial/institutionl, and industrial waste sectors are the primary source of organic material. Waste generated in residential sectors fluctuates in a range between 55 and 95 percent of total waste received.

Table 3: Waste Quantities And Categories Data[4]

Facility/ Governorate	Waste Received (tpd)	Waste Categories (% by weight)				
		Residential	Commercial/ Institutional	Industrial	Agricultural	Other
Qatamiya (1,2,3) Cairo	300	70 %	10 %	5 %	3 %	12 %
Shabrament (1,2) Giza	30 (test)	90 %	5%	--	5%	--
Abis 1, 2 Alexandria	210	90 %	10 %	--	--	--
Montaza, Alexandria	200	55 %	25 %	10 %	10 %	--
WWTP[5], Alexandria	400-600	0	0	0	0	100 % sludge
Damietta, Damietta	300	80 %	10 %	10 %	--	--
Ras ElBar, Damietta	20-24 (W)	90 %	5 %	5 %	--	60-80 (S)
Kafr El-Dawar, Behira	90	50 %	15 %	15 %	20 %	--
El-Edwa, Fayoum	80-90	20 %	20 %	5 %	5 %	50 % Streets
Mansoura, Dakhaliya	250-300	75 %	20 %	5 %	--	--
Mit Gamer, Dakhaliya	120	80 %	10 %	--	10 %	--
Zagazig, Sahrqiya	60	100 %				From dump
Belbeis, Sharqiya	20	20 %	--	--	10 %	70 % C&D
Menouf, Menoufia	60	80 %	10 %	--	5 %	--
El-Mahla, Gharbiya	460	80 %	15 %	--	5 %	--
K.ElSheik, Kafr ElSheik	80	40 %	5 %	10 %	10 %	35 %
Beila, Kafr El-Sheik	45	65 %	5 %	--	25 %	5 %
Matrouh, Matrouh	45	95 %	5 %	--	--	--
Arish, North Sinai	40	95 %	5 %	--	--	--
Suez, Suez	160-200	70 %	10 %	5 %	5 %	10 %
Hurghada, Red Sea	140	50 %	45 %	--	5 %	--
Senour, Beni Seuf	60	70 %	8 %	--	22 %	--
Somosta, Beni Seuf	50-60	40-50 %	30 %	--	10-20 %	10%
New Minya, Minya	160-180	70 %	20 %	3 %	7 %	--
ECARU, Minya	100	100 % agricultural				
New Sohag, Sohag	20	40 %	30 %	30 %	--	--
Qena, Qena	5-10	80 %	20 %	--	--	--
Luxor, Luxor	80	60 %	30 %	--	--	10 %C&D

[4] Percentages as per the completed questionnaires.
[5] WWTP: Wastewater Treatment Plant

Waste Composition

The composition of the waste stream delivered for composting plays a significant role in the quality of the final product. Only organic materials can be composted and some organic materials can slow the composting process. Additionally, inorganic material may cause contamination of the final product. They must be sorted and some of the re-cyclables can be sold and provide additional revenue.

When evaluating the data collected in the survey relative to "waste composition", data from 16 facilities provide various relationships between the service area (urban or rural) and the composition of waste (organic versus inorganic) and are described in the following:

- It cannot be generalized that urban areas generate waste richer in organic content than rural areas (see Table 4). Areas such as Kafr El-Sheikh, Suez, and Luxor Governorates demonstrate that organic content in the waste stream does not reflect the degree of urbanization. In those cases, waste stream includes as low as 20 percent compostable material although being categorized as predominately urbanized.

- Cairo, Alexandria, New Minya, and Damietta Governorates are cases where their waste stream organic content reflects the degree of urbanization and includes enough compostable material for the composting process.

- Rural areas may exceed –in rare cases- the percentage of organics generated in urban areas as was the case of Mit Gamer, Dakhalia. This can be attributed to socio-economic factors, since Mit Gamer is industrialized and the income levels are somewhat higher than other rural Governorates. El-Mahla El-Kobra in Gharbia represents rural areas with low organic content waste.

Table 4: Waste Composition Data.

Facility/Governorate	Waste Received (tpd)	Service Area		Waste Composition (%)	
		Urban	Rural	Organic	Non- Organic
Qatamiya (1,2 ,3) Cairo	300	√	√	50 %	50 %
Abis 1, 2 Alexandria	210	√	--	40-65 %	35-60 %
Damietta, Damietta	300	√	--	70 %	30 %
Kafr El-Dawar, Behira	90		√	25 %	75 %
Mansoura, Dakhaliya	250-300	√	--	55 %	45 %
Mit Gamer, Dakhaliya	120	--	√	60 %	40 %
El-Mahla, Gharbiya	460	--	√	15 %	85 %
K.ElSheik, Kafr ElSheik	80	70 %	30 %	20 %	80 %
Arish, North Sinai	40-80	80%	20 %	40 %	60 %
Suez, Suez	160-200	√	--	20 %	80 %
Senour, Beni Seuf	60	√	√	40 %	60 %
New Minya, Minya	160-180	80 %	20%	40-50 %	50-60 %
New Sohag, Sohag	20	√	√	15 %	85 %
Qena, Qena	5-10	√	√	30-40 %	60-70 %
Luxor, Luxor	80	√	√	20 %	80 %

√ Indicate the service area category - percentages not known (Urban vs Rural or both)

Waste Collection Methods

All residential, commercial/institutional, and industrial sectors typically produce at least some organic material that could be separated and composted. Collection systems for this waste can include formal collection of waste either mixed or separated or informal scavenging of many re-cyclables as is common in much of Egypt.

When evaluating the data collected in the survey relative to "waste collection" in service areas within which facilities exist, it is clear that:

- Mixed (not-sorted) collection of the waste stream by formal (public or private) contractors is prevailing.
- Informal scavenging of recyclables has been reported by almost half of the facilities.
- The combined provision of collection services and composting by the same contractor improves the efficiencies of sorting and further processing in the composting facilities as is the case in Alexandria, Giza, Kafr El-Dawar in Behira, Suez, and Luxor.
- The separate provision of collection services and composting by different contractors (public or private) may yield a positive outcome as is the case in Cairo, Kafr El-Sheikh, and New Minya in Minya.
- The separate provision of collection services and composting by different contractors (public or private) may result in complications for the composting facility as is the case in Belbeis in Sharqiya, Damietta in Damietta, Arish in North Sinai, and Hurghada in Red Sea.

- Collection vehicles used are primarily non-compactor pick-up trucks/cars and a lower percentage of compactor trucks/cars.
- There was no possibility to identify the quantity of waste collected as a percentage of waste generated in each area. Not all facility operators have such data.
- Both facilities in Damietta and Port Said were designed to receive separated waste only, which was not the actual practice later during the operations of both facilities.
- Seasonal variations between summer and winter are common in Alexandria, Damietta, Matrouh, Port Said, Red Sea, North Sinai, Luxor, and Aswan which necessitates providing additional collection capacity during these seasons. Shifts would need to be added for processing facilities to absorb these variations.

Finding 3: How are Composting Facilities Sited?

Proper sitting is an important factor in establishing an effective composting facility. The two most important factors to siting a composting facility are the i) technical and ii) aesthetic considerations. Suitable locations must possess the topography and the sufficient land area needed for efficient operation.

The site must be capable of providing an adequate buffer between the facility and any nearby residents. A composting facility will require a site that is relatively flat and has sufficient space for the pre-processing, processing, and post-processing compost stages, as well as the buffer zone. The pre-processing area must be large enough to accommodate the receiving (tipping), storage, and sorting areas for incoming materials. This area must also accommodate the scales, office and employee areas, utilities, and maintenance functions.

The size of the processing area is dependent upon the amount of material to be composted, as well as the type of process that is selected. This area consists of the composting pad and the

Technical Considerations

When evaluating the data collected in the survey relative to "technical considerations" relevant to siting of the facility and during the site visits, the following observations can be noted:

- Amable facility space was provided free of charge by each governorate. Facility area ranged from 5.0 to 6.5 feddans providing enough space for the composting processes as well as a buffer zone.

- The El-Mahla El-Kobra, Gharbia facility has a significant waste accumulation problem. The problem will continue to persist since waste is delivered to the facility beyond its operated capacity to process waste.

- Few facilities face space availability problems when waste is being transported to the facility during out-of-service periods. Ras El-Bar in Damietta, Belqas in Dakhliya, El-Edwa in Fayoum, and Qena are some examples of such facilities.

- Open dump areas are common either adjacent to the facility or on both sides of the roads leading to the facility. These open dumps exist due to dumping of waste (after hours), lack of effective space utilization inside the facility, informal sector inhibiting the transfer of waste to the facility, and out-of service periods.

- Facilities built in Governorates with access to a desert area are located well outside of residential areas in agricultural or industrial areas.

- Facilities located in the Delta Governorates are in proximity of agricultural, commercial, or residential land use zones.

- An important technical consideration when siting a facility should be its proximity to or at a controlled dump and/or transfer station in absence of landfills.

Space Availability Problem

Table 5: Siting Composting Facilities in Proximity to Landfills, Dumps and Transfer Stations

Composting Facility	Landfills/Controlled Dump		Open Dumps		Transfer Station	
	Yes	No	Yes	No	Yes	No
Cairo	Qatamiya 1,2		Qatamiya 1,2		4 Zones	
	15th of May *			√		
Giza	Shabarament*		Shabarament		Shabarament	
Alexandria	Borg El-Arab landfill (40-50 kms away)				Montaza	
Kafr El-Sheik		√	No Data available			√
Behira	Damanhour * (70 Feddans)		Damanhour (5 Km)			√
	K. ElDawar * (70 Feddans)					
Matrouh	Matrouh §			√		√
Menoufia	Sadat District (70 Feddans)		√			√
Sharqia	Zagazig §		adjacent to facility		√ §	
Dakhaliya	Mit Gamer §		5 Km from facility			√
Damietta		√	Damietta (2 Km)			√
			Ras El-Bar			
Gharbia, El-Mahala El-Kobra	Tanta * 30 Km from the facility		adjacent to facility		temporary dump	
Port Said	√		adjacent to facility		√	
Ismailia	111 Feddans *		√		No data available	
Suez	1 Km from facility *			√		√
North Sinai		√	2 Km from facility			√
Red Sea	Hurghada*		3 Km from facility			√
Beni Seuf	Beni Seuf *		√			√
Fayoum	Fayoum *		40 Km from facility		Adjacent to the facility	
Minya		√	100 m from facility		Pooling Sites	
Sohag	New Sohag §			√		√
Qena		√	15 Km from facility		temporary dump	
Luxor	7 km from facility *			√		√
Aswan	Aswan 6 Km from facility			√		√
	Edfu *			√		√

√ Yes/ NO * Under construction § Site Approval stage

Table 5 indicates that most facilities were not constructed within or near a landfill. In Alexandria, the landfill built in Borg El-Arab is far from the composting facilities (Abis and Montaza) nearly located at opposite sides of the city.

Since landfills are only being constructed recently in Egypt, it can be noted from the table that most governorates are either in the phase of approving sites for landfills/controlled dumps or constructing them (such as Luxor), except in the governorates of Kafr El-Sheikh, Damietta, Minya, Qena and North Sinai. Data is not available for the South Sinai, Assuit, and New Valley Governorates.

It is common to find open dumps adjacent to the composting facility. However, open dumps were not located near the composting facility in Aswan, Luxor, Sohag, Suez, and Matrouh. The situation in Cairo, Alexandria, and Giza Governorates with respect to open dumps is changing due to the implementation of integrated solid waste management in these Governorates.

Aesthetic Considerations

The majority of all the facilities visited vary in meeting the aesthetic factor. Fencing is an important factor in maintaining aesthetics, litter control, and outlining the buffer zones. All facilities are surrounded by fences to provide for these considerations.

When evaluating the data collected in the survey relative to "aesthetic considerations" relevant to siting of the facility and during the site visits, the following observations were noted:

- Brick fences provide good control of the activities within the facility; litter control is maximized and the surrounding buffer zone is maintained. Eighteen facilities are brick fenced.

- Wire fences function well to provide control of on site-activities within the facilities. However, litter control is less efficient and buffering is least efficient. Reasons are that in many facilities, the adjacent sand dunes are encroaching towards the facility and since these sand dunes are mobile, it is not uncommon to find them within the inside boundaries of the facilities and in many cases they are mixed with the compost windrows thus hindering the fermentation process and affecting the quality of the finished product. Fifteen facilities are wire fenced.

- Fires were seen during the site visits to Ras El-Bar in Damietta, El-Mahla El-Kobra, in Gharbia, Mansoura, Belqas and Mit Gamer in Dakhaliya, New Minya in Minya, Qena, Hurghada in Red Sea, and Arish in North Sinai.

Wire Fence

Summary

Considering the assessment of waste quantities, waste composition, and waste collection methods provided indicates the following:

- Separated residential solid waste in urban service areas possesses the highest percentage of non-contaminated organic material suitable for producing a good quality compost.
- The prevailing practice is the mixed collection of waste with its associated contamination and need for subsequent sorting.
- The provision of integrated service (collection and composting in this case) by the same contractor enhances the effectiveness of composting facilities in producing good compost in some areas which generate low quantities of organic material (low population density).
- In areas generating large waste quantities such as Cairo, both separate (Southern zone) and integrated provision of the service (Eastern, Western, and Northern zones) will be practiced and are yet to be evaluated.

The size of the processing area is dependent upon the amount of material to be composted, as well as the type of process that is selected. This area consists of the composting pad and the curing area. For example, the turned windrow technology requires space between the windrows for the turning equipment. In the aerated windrow process the piles may be much closer together.

The post-processing area is utilized to perform curing, final screening, and testing. It may also be used for the storage of the final compost product. The buffer zone helps minimize the transport of odors off site. Careful attention to the cleanliness of the buffer zone and the surrounding fences is essential.

In Egypt, it is to be noted in the outset that the composting facilities program has been launched to address a pressing solid waste disposal problem and the program went ahead without being paralleled by the establishment of landfills, another crucial component of any integrated solid waste management program.

FINDING 4: WHAT ARE THE SOLID WASTE COMPOSTING PROCESSES?

Composting facilities produce an organic product (compost) in addition to recyclable materials from the solid waste collected in any service area. The organic compost is produced with the aim of being widely used for agriculture, landscaping, and land reclamation. The question is: How compost is produced from solid waste? The following evaluation will outline the elements related to composting methods, composting technologies and composting systems while presenting the actual situation in the facilities visited with respect to those elements.

Composting Methods

Depending on the “quality of the organic materials” to be composted, there are two different methods being primarily used:

Mixed Solid Waste Composting --

This method uses a commingled stream of municipal solid waste. Mixed solid waste must be sorted to remove, as much as possible, recyclable materials (metal, glass, plastics, paper, textile, etc), hazardous, and non-compostable materials from the organic portion to be used as raw material for composting. This separation can be made before and/ or after composting. This option is considered when difficulties exist in implementing a source separated solid waste management program. This system has some disadvantages, e.g., the contamination of the organic component in the waste stream.

Source Separated Organic Composting --

This method depends on residents, businesses, and institutions to separate the organic materials from other recyclables and trash for collection. This option results in better quality compost but it might be more costly to implement the collection part as well as it will need community training and public awareness and might be less convenient for residents.

In Egypt, when evaluating the data relative to the "quality of organic materials", it is to be clearly mentioned that only mixed solid waste composting is in practice. As was mentioned in Finding 2, two composting facilities were designed to process only separated waste (Port Said and Damietta). One experimental project was conducted to convince Cairo residents of the benefits of separating their wastes into organic and non-organic components before collection. These progressive efforts have remained without wide implementation and mixed solid waste composting prevailed.

Composting Technologies

When evaluating the data collected in the survey relative to the composting technologies of local facilities, two generations (stages) of composting facilities are operating. Stage one is characterized by high electric consumption machines, heavy duty mills and several trommel screens with varying sieve sizes (30, 50 mm). Stage one includes the composting facilities located at:

- Shabarament, Giza
- Senour, Beni Seuf
- Sohag
- Mansoura, Dakhaliya
- El-Edwa, Fayoum
- New Minya, Minya
- Hurghada, Red Sea
- Ismailiya
- Luxor

Stage two includes all other locally manufactured facilities. Stage two is characterized by using bag opening devices, no heavy duty mills, one trommel screen (100 mm), one mobile trommel for producing fine compost, and a scarab for turning windrows. Please refer to Appendix C of this report for a full list of the equipment available at each facility.

When evaluating the data collected in the survey relative to the "pre-processing technologies" and during the site visits the following observations were noted:

- All of the technologies use sorting processes to remove non-organic materials before composting.

- Removing non-organic constituents is significantly more complex and costly when composting mixed solid waste compared to separated waste materials.

- Picking belts, magnets, air classifiers (only at Abis 2 in Alexandria) are used to remove unwanted materials.

- Pre-processing steps usually include particle size control. Trommel screens (30 mm) are used before the sorting process.

- Large rotary cylinders are used to reduce the size of all particles to a desired homogenized specification in stage one facilities.

- A Shredder is used only in Mansoura, Dakhaliya and is fixed after the pre-processing and picking belts. In Sohag and Luxor a locally manufactured shredder for agricultural waste is used.

- The compost process is optimized when the particle size is reduced. Size reduction is often accomplished by screening the material to remove larger-than-desired particles. Trommel screens (50 mm) are used in stage one facilities for that purpose.

- Luxor composting facility operated by AMOUN has the highest percent of locally manufactured equipment (see Section 4: Case Example)

When evaluating the data collected in the survey relative to the "post-processing systems" and during the site visits the following observations were noted:

- Most composting processes include an active composting cycle where the biological decomposition activity is very high. Once that is completed, the material is moved to a curing area or pile. During the curing stage, the biological activity slows down and the temperature cools down. This step is necessary to assure that the product material leaving the facility is of high quality. Even though these curing piles require less turning, they are turned at least weekly over the 1 to 2 month curing process.

- Post-processing steps generally include one or more screening steps. All facilities included a rotary trommel for producing the fine compost.

- Bailing presses for cardboard and metals were available.

- Port Said, Abis 2 in Alexandria, and Damietta composting facilities have different equipment than the other facilities.

Damietta Composting Facility

Composting Systems

The types of systems that can be utilized for composting waste include the following basic systems or technologies.

- Passive/Static Piles
- In-Vessel Composting
- Turned Windrows
- Co-composting
- Aerated static piles

In Egypt, based on the survey and site visits data, only Turned Windrows and Co-Composting systems are in operation. All facilities utilize the Turned Windrows system as being the most suitable technology for Egypt. Only the Port Said facility has been constructed for co-composting of sludge resulting from sewage water treatment plant and solid waste as co-streams for the composting process. The Waste Water Treatment Plant in Alexandria which was visited is capable of co-composting solid waste and sludge but currently operates with sludge only. The first pilot plant at Zagazig, Sharqiya was designed and constructed for co-composting operation, but has been operating on a solid waste stream only. A brief description of both systems is presented below.

Turned Windrows --

A windrow is a long row, triangular in cross section, whose length exceeds its width and height. A windrow height ranges from 1 to 3 meters with a width between 3 and 8 meters. Machines equipped with augers, paddles are used for turning and oxygenating the piles, some of them have an incorporated watering system. The control of the composting conditions promotes the natural decomposition process. This is done by the frequency of turning, adding water, and lowering the temperature when needed. The windrows can be placed in large open-air areas (as is the case in Egypt) or under a roof, but that increases the capital cost of the facility.

Co-composting --

This system consists of the simultaneous composting of two waste streams, solid waste and sewage sludge. This system is best handled in an enclosed system because of the odor and the leachate collection problems. Co-composting requires very specific conditions and subsequently very careful management. The Port Said composting facility is a co-composting operation.

Port Said Co-composting Facility

FINDING 5: OPERATIONAL AND TECHNICAL CONSIDERATIONS IN COMPOSTING FACILITIES

Operation of composting facilities varied throughout the different Governorates. Facilities should be operated in a manner compatible with the objectives of running the facility. In this section, the evaluation addresses the following considerations: efficiency of sorting, monitoring of the fermentation process, labor skills, maintenance, spare parts, machine types and record keeping.

Efficiency of Sorting

Sorting of inorganic material from waste stream affects the rest of the composting steps as well as the product. The site visits provided a close look on the sorting process. High sorting efficiency at Cairo, Giza, Alexandria, Red Sea, Suez, Damietta, Minya, Sohag, Belbeis in Sharqia, and Menoufia was observed. Medium sorting efficiency was observed at Zagazig in Sharqiya, Behira, Kafr El-Shiek, Fayoum, Dakhaliya, Luxor, Matrouh, Gharbia, and Qena. Low sorting efficiency was observed at Somosta, Beni Seuf where there was only hand sorting and the sorting belt is not being used.

Those facilities achieving a high sorting efficiency apply sorting personnel at the receiving area as well as on the picking belt. However, it is common to find plastic bags and broken glass in the windrows.

Monitoring of the Fermentation Process

The fermentation process is monitored throughout the stages of maturation stage in some facilities. Experienced personnel play a very important role in the monitoring of fermentation process. It is common to see that windrows where the fermentation process goes without any type of monitoring. Micro-organism activity, temperature, and humidity are the parameters of concern when undergoing the monitoring activity.

Labor Skills

Most facility employees mentioned their attendance at a one week training course on composting facility operation. The training was during the commissioning phase of each facility. Many of those receiving the training have moved on to other jobs and the new ones are learning on the job. The old facilities enjoy experienced personnel that maintain the composting process ongoing against a lot of obstacles. Meanwhile, several cases noted the lack of technical staff (chemists, electricians, and mechanics) among the employees.

Maintenance

Maintenance is divided into two categories: during the start-up phase (before final delivery of the facility to the local authority) and after the delivery to the local authority. In the first category, some of the facilities are under the scrutiny of the Ministry of Military Production (Belbeis in Sharqiya, Mit Gamer in Dakhaliya, Menouf in Menoufiya, and Ras El-Bar in Damietta). In other cases, they conduct visits when contacted by facility operators when needed, like in El-Edwa, Fayoum on the day of the visit of the project team.

As for the second category, maintenance after the start-up phase is more complicated. Lack of funds and lack of technical staff (maintenance) in many facilities hinder the regular

maintenance from being conducted on schedule. Down time is one of the major factors for the less efficient operation of those facilities. It was a surprise to find that Mit Gamer composting facility in Dakhaliya commissioned for less than 3 months was not operating because of maintenance problems.

Depreciated Equipment

Zagazig composting facility is totally depreciated and its condition cannot be upgraded or improved. In many cases, private operators have complained that at the time they were starting operations, depreciated equipment compromised a high percentage of the equipment (Damanhor in Behira, El-Mahla El-Kobra in Gharbiya, Suez, El-Edwa in Fayoum, and New Minya in Minya). In Port Said equipment was removed from the facility by the local authority and the private operator had to replace the equipment.

Spare Parts

One of the most common observations is that spare parts for equipment is not readily available. Tires for skid loaders, belts parts, and others were reasons mentioned for down time of equipment in many facilities. Remote facilities face the dilemma that operators have to travel long distance even to only one place in Egypt which would sell the spare parts. It is hard to judge the accuracy of this complaint especially as there was no opportunity to get feedback from the equipment producers.

Machine types

High electric power consumption is the most common observation mentioned in the survey forms. In the first generation of the facilities (Damietta, Fayoum, Zagazig, Ismailia, Beni Seuf, Giza (1), Hurghada, Minya, Luxor, and Sohag) the Shredder Mill was the clear example. Most other equipment is manufactured locally except for the Windrow Turner which is imported from USA. In Luxor, the windrow turner is imported from Germany and most other equipment is manufactured by the company operating the facility.

Record Keeping

Record keeping in most facilities was poor. It was not an easy task to receive direct data from the publicly operated facilities because most records were kept at the local authority. It has been possible to partially overcome this shortcoming by sending the survey forms earlier to the local council to provide lead time to prepare the completed survey form. On the site records were accessed in Behira (Kafr El-Dawar), Damietta, Beni Seuf, and Suez. Difficulty accessing records or receiving completed survey forms were experienced in Cairo, Alexandria, and Giza Governorates.

FINDING 6: MANAGEMENT OF SOLID WASTE COMPOSTING FACILITIES

All solid waste composting facilities operating in Egypt are property of the Governorate having the facilities within their boundaries. Management of the facilities is either under public authorities or a private contractor. Table 1 outlined the type of management of each facility at the time of the site visits. In this section an analysis of types of management is provided. Of those facilities currently operating the following observations were noted:

- Most governorates are moving towards involving the private sector in the management of those facilities, either based on managing the facility separately, or as part of an integrated solid waste management contract within the Governorate/Municipality.

- Of the various private sector participation options, lease is the most common (Sixteen contracts), followed by management contracts (Four contracts). All four management contracts are within the framework of an integrated solid waste management contract, while five out of the sixteen lease contracts are within a framework of an integrated solid waste management contract.

- The facility at New Minya, Minya is negotiated between the current lessee and the Governorate for purchasing the asset and transferring ownership. The previous lessee of this facility is building his own composting facility few kilometers away from this facility. It is also worth mentioning the existence of a privately owned agricultural waste composting plant (100 tpd) in close proximity that is producing organic compost with high demand from consumers and is sold at the rate of 250 L.E. per ton.

- Publicly managed facilities amount to sixteen versus twenty three privately managed. This shift from public to private management happened in the past two years. Aiming to improve operations is the reason behind this shift.

- The case of Alexandria demonstrates that private management of several facilities within any one Governorate results in improved overall performance. This is due to the integration of the facilities under one management umbrella which optimizes the performance and eliminates previous competition among the facilities.

- Lease periods are normally for three years intervals.

- Integrated solid waste management contract periods vary considerably. For example, the Luxor contract is for three years, where Suez, Alexandria, Cairo (El-Salam City), and Giza are for fifteen years.

- Damanhour, Behira facility was performing well under public operation and was transferred to a private operator in 2001 for three years. The plant is poorly operated at the moment due to the lack of experience in managing a composting facility on the part of the operator including a period of 15 months of non-operation.

- Behira Governorate is negotiating with the private operator in Alexandria to extend the contract to cover the service in Damanhor and Kafr Elawar cities, including the two composting plants.

Table 6: List of Facilities and Management Type

Governorate/ (# facilities)	Facility	Management Type			Comments
		Public	Private		
			Lease	Management Contract	
Cairo (3)	Qatamiya (1, 2, 3)		X		Separate contract
	El-Salam			X	Integrated contract
	15th of May			X	Separate contract
Giza (2)	Shabrament (1, 2)			X	Integrated contract
	Abou Rawash			X	Integrated contract
Alexandria (3)	Abis 1			X	Integrated contract (one contract for three facilities)
	Abis 2				
	Mountaza				
Matrouh (1)	Matrouh	X			
Behira (2)	Kafr El-Dawar	X			
	Damanhour		X		Separate contract
Kafr El-Sheik (2)	Kafr El-Sheik		X		Separate contract
	Beila		X		Separate contract
Sharqiya (2)	Belbeis		X		Separate contract
	Zagazig	X			
Dakhaliya (3)	Mansoura (1, 2)	X			
	Mit Gamer	X			
	Belqas	X			
Menoufia (1)	Menouf	X			
Gharbiya (1)	El-Mahla El-Kobra		X		Separate contract
Damietta (2)	Damietta (1, 2)	X			
	Ras ElBar	X			
Port Said (1)	Port Said		X		Integrated contract
Suez (1)	Suez		X		Integrated contract
Ismailiya (1)	Ismailiya 1	X			
North Sinai (1)	Arish		X		Separate contract
South Sinai (1)	Sharm El-Sheikh	X			
Red Sea (1)	Hurghada		X		Separate contract
Fayoum (1)	El-Edwa		X		Separate contract
Beni Seuf (2)	Senour	X			
	Somosta	X			
Minya (2)	New Minya		X		Separate contract
	Malwy		X		Separate contract
Assuit (1)	Assuit	X			
Sohag (1)	New Sohag	X			
Qena (1)	Qena	X			
Luxor (1)	Luxor		X		Integrated contract
Awan (2)	Aswan		X		Integrated contract
	Edfu		X		Integrated contract
Total	**39 facilities**	**16**	**16**	**5**	

FINDING 7: SPECIFICATIONS OF COMPOST PRODUCED

Specifications

Ministry of Agriculture Decree No. 100 1967, Article 9 states that compost seller/producers should have a sales registration book stamped with the Minister's seal, and should provide purchasers with a receipt that specifies the compost name, amount, and its composition.

The Law states that compost from municipal waste should have the following specifications:

- Nitrogen not less than 0.5 %
- Organic content not less than 18 %
- Moisture content not more than 30 %
- Sodium chloride not more than 5%
- Density not less than 0.75 (or 750 kg/m3)
- C/N ratio between 17:1-25:1

It is important to note the Egyptian Standard Specification for Organic Compost includes limits for heavy metals, pH value, phosphorus, potassium, electric conductivity (salts) as well as physical and biological specifications that need to be considered. Appendix (A) includes a list of Egyptian Laws and Standards applicable to compost.

When evaluating the data collected in the survey relative to "Specifications", it was among the least responded to item in the survey forms. It can only be attributed to the lack of data and/or knowledge of the majority of plants operators regarding the required specifications of the compost produced. Table 7 compares those facilities of possession of compost analysis.

Table 7: A Comparison of Compost Specifications

Facility	Compost Specifications					
	Particle Size	C:N ratio	Moisture content	Heavy Metals	Pathogens, Nematode, Seed weeds	Organic contents
Qatamiya (1, 2 & 3)	--	17:1	25 %	Normal	None	27-30 %
Abis (1, 2) and Mountaza	30-50 mm	18:1	25-28%	Normal	None	--
Matrouh	80 mm	--	20 %	--	None	--
Kafr El-Dawar	--	19:1	14%	Normal	None	--
Kafr El-Sheikh	--	16:1	15%	--	None	--
El-Mahla El-Kobra	--	17:1	29 %	Normal	None	40.86 %
Mansoura	--	19:1	10%	Normal	--	30.79 %
Mit Gamer	--	--	16 %	Normal	--	12 %
Damietta	15 mm	20:1	25 %	Normal	None	44 %
Ras El-Bar	15 mm	12:1	16%	Normal	None	14 %
Suez	--	19:1	22 %	Normal	None	50%
Arish	--	15:1	19%	Normal	None	33 %
Somosta, Beni Seuf	--	15:1	17 %	Normal	None	18 %
Senour, Beni Seuf	--	17:1	25 %	--	None	18 %
Sohag	--	--	15 %	--	--	18 %
Qena	--	--	--	--	--	85 % [6]
Luxor	< 5 mm	--	--	Normal	None	--

[6] The value of 85 percent of organic contents for Qena facility could not be validated.

Comparing the results of the Laboratory analysis may identify the lack of consistency with regards to parameters measured. Many of the analyses focused on the chemical parameters, leaving the physical and biological parameters untested. Testing equipment was not available on site.

End Product Uses

Normally, the end product uses depend on the results of the compost analysis. Most of the facility managers who keep no records of laboratory analysis have mentioned that it is left to the vendor/ buyer to make the analysis before purchasing the product.

When evaluating the data collected in the survey relative to "end product uses" it can be clearly noticed that agriculture uses are the primary use for the compost (field crops, fruit trees, and vegetables). Fewer responses mentioned landscaping or land reclamation as potential uses.

Quality compost can be beneficial biologically, chemically, and physically to the soil. The benefits in each category are explained below and can be used as a guide:

- Biological: Promotes the growth and development of flora (micro) and fauna, allows faster root development of plants, reduces the risk of plant diseases, thus resulting in a reduction in pesticide use.

- Chemical: Increases nutrient retention, converts minerals in the soil to usable forms, replenishes the microbial activity thus enhancing a plant's ability to resist disease, and enhances pH stability.

- Physical: Increases water retention capacity allowing for better control of moisture content of the soil, increases resistance to wind and water erosion, enhances aeration capacity and decreases soil crusting, promotes temperature stability.

Fine Compost in Minya

FINDING 8: PERFORMANCE INDICATORS IN COMPOSTING FACILITIES

Performance standards are a mean to tell operators what performance levels can be achieved. From the data collected, two indicators were selected in this report to reflect how the facilities are performing, namely Products (outputs) and Marketing of the products.

Products (outputs)

Producing quality compost is one quantitative factor to assess the performance of a facility. Quantitatively, most facilities were designed with a daily processing capacity of 160 tons of waste over a 16 hour period. Products would include the recovered organic content of the waste transformed into compost with a reduction in material weight, recoverable recyclables, and rejects to the landfill. The compost produced is either fine or coarse with different subsequent uses for each type.

When evaluating the data collected in the survey relative to "products", the following can be concluded:

1. Rejects compromise the highest percentage of waste intake. In Fayoum and Belbeis in Sharqiya (see Table 4) the waste delivered to the facility is primarily street sweeping or construction and demolition waste. In other cases, processing yields high quantities of rejects due to either technical, operational, or management reasons.

2. Quantities of compost produced can vary from 6 to 35 percent organic content. Optimum conversion rates are achieved at Abis 2 and Montaza in Alexandria.

3. The remaining percentages are those accounting for re-cyclables.

4. Combining values for quantities of compost produced and amounts of recyclables sold provides an indication to the performance evaluation related to the revenues of the facility. In Hurghada, recyclables present a high percentage of the facility revenues.

The data provided by facility managers is in need for adjustment in many cases. A value in tpd for the different categories was included in the survey and responses do not add-up to the mass balance in many cases, and this should be taken into consideration when studying the values in Table 8.

Sorted Recyclables in Qena

Table 8: Composting Facilities Performance Indicators

Facility/ Governorate	Waste received (tpd)	Actual Capacity (tph)	Organic Matter (%)(tpd)	Compost Produced (tpd)		Recyclables (tpd)	Rejects (tpd)
				Fine	Coarse		
Qatamiya, Cairo	300	12	50 %= 150	60	10	2.5	147
Abis 1, Alexandria	210	10	40-45% = 95	Per request	34	10	110
Abis 2, Alexandria	210	10	65 %=135	Per request	80	10	65
Montaza, Alexandria	200	8	50 %=100	Per request	70	10	90
Matrouh	45	8	N/A	3-9	6-15	0.2	30
Kafr El-Dawar, Behira	90	5-6	25 % = 22.5	13	40	4	26
Mansoura, Dakhaliya	250	8	55 % = 137	14	50	7.5	112
Damietta	300	6-7	70 % = 210	30	20	negligible	20
Suez	160-200	10	20 % = 40	15-35	--	55	105
Arish	40	3-5	40 % =16	5-8	5	0.6	16
Somosta, Beni Seuf	50-60	8	40 % = 24	12	--	negligible	25
New Minya, Minya	160	8	40 % = 65	10	10	10	35
New Sohag, Sohag	20	3	15 % = 3	Per request	8	0.5	11
Luxor	80	6-8	20 % = 16	5	5	3	60

Marketing

Being able to market the produced compost is an integral element of performance. Studies in Egypt indicated that the market for compost produced from solid waste organic matter is widely available. Marketing of the compost can be evaluated considering the sales, quality, compost standards, and competition with other types of compost in the market.

When evaluating the data collected in the survey relative to "marketing", the following was noted:

1. Marketing efforts are not continuous. Marketing materials (leaflets, brochures, handouts, etc.) are not available in most facilities. In few cases (Alexandria, Damietta, Arish, Cairo, and Somosta in Beni Seuf), marketing material existed and they vary in the information they include.

2. Competition with the compost produced from solid waste comes from the animal manure, sludge compost (between 3 to 20 L.E per ton), and agricultural residues compost.

3. Consistent quality of produced compost is hard to maintain due to the fact that the incoming waste stream may fluctuate.

4. Selling of compost is either through direct sales to dealers/customers or via auctions. Testing in most cases is carried out by the customer.

5. Pricing of the product is mainly on a case by case basis. Direct sales prices are a tool to diversify revenues. Auctions wholesale prices were the only selling option in a number of facilities dictated by local authorities (Ras El-Bar in Damietta, Mansoura and Mit Gamer in Gharbiya). This has its implications in lowering revenues.

6. In the New Minya facility in Minya, compost produced is either sold packaged (at a higher price) or unpackaged.

7. Developing new markets for new end uses is very limited. Large potential users find many producers and the quality/price combination becomes the determining factor.

8. Offering more than one grade (fine and coarse) is a wide spread practice in many facilities, while offering more than one product with different enhancements is very rare.

9. Transport costs in many cases were not taken into account. This adds another burden on the ability to sell the compost.

10. The Governorate/local authority as a potential buyer of the compost produced within their jurisdictions is not in existence.

11. Compost quality standards/specifications as a marketing tool was only utilized in a few number of facilities (Alexandria, Damietta, Arish, Cairo, and Somosta in Beni Seuf).

Packaged compost in Minya

FINDING 9: ECONOMIC INDICATORS IN COMPOSTING FACILITIES

Composting rarely generates profits on its own. However, when viewed as a component of an integrated solid waste program, composting can provide economic benefits on a much larger scale. In this section, economic indicators such as operating cost, revenues, lease values, and budgets will be evaluated.

Operation Cost, Lease, and Revenues

When evaluating the data collected in the survey relative to "costs and revenues", the following was noted:

1. Facilities managed by public sector rarely keep the cost and revenues records since they are kept at the local government. Data relevant to the quantities of compost produced is rare.

2. Few facilities operators were willing to reveal data due to its implications on their financial accounts. Few others were providing good data as described in Table 9.

3. There is a significant variety of monthly lease values paid by private contractors to the local government. The range in lease values seems not to be based on any criteria.

4. Revenues often are lower than expenses. Revenues generated from sales of compost and re-cyclables follow no particular criteria.
5. Three facilities can sell with wholesale prices and through auctions only (Ras El Bar, in Damietta, Mansoura and Mit Gamer in Dakhaliya) which generates less revenues in these facilities.

6. No tipping fees are enforced in all facilities.

7. Some facilities use the scale house as an extra source of income by allowing commercial truck drivers to weigh their loads for a fee. Other facilities stop short from practicing the same approach to avoid any questioning from the local government.

Budgets

When evaluating the data collected in the survey relative to "budgets", the following was noted:

1. Sixteen facilities completed this section of the survey form, but most were not fully completed due to lack of recorded data.

2. Twelve facilities reported losses in 2002 while three facilities reported profits and Damietta in Damietta reported a break even budget for 2002 (Table 9).

3. Privately operated facilities in Cairo, Alexandria, and Giza, were not willing to provide any accounts. Facilities in Aswan, Belbeis in Sahrqiya, Port Said, El-Mahla El-Kobra in Gharbiya and Shabarament in Giza are in the start-up phase under a private operator and therefore accounts were not available yet.

4. Facilities in Zagazig in Sharqiya, Menouf in Menoufia, and Mit Gamer in Dakhaliya data were not available.

Table 9: Composting Facilities Economic Indicators

Facility/ Governorate	Expenses (L.E/month)			Revenues (L.E/month)				Balance (L.E)
	Running cost	Rent	Total	Fine	Coarse	Re-cyclables	Total	
K. El-Sheikh, Kafr El-Sheikh	19,300	7000	26,300	24,000	36,000	3000	63,000	+ 36,700
Somosta, Beni-Seuf	59,316 in 2002			40 L.E/t	--	1000L.E/t	--	+ 34,520
Kafr ElDawar, Behira	21,800	--	21,800	70 L.E/t	30 L.E/t	12,000	67,500	+ 45,700
Damietta, Damietta	200,000 in 2002			200,000 in 2002				Even
Ras Elbar, Damietta	175, 000 in 2002-2003			28 L.E/t	24,000 in 2002-2003			- 151,000
Mansoura, Dakhaliya	30,500	--	30,500	37 L.E/t	--	2000	17,000	-15,500
Damanhur, Behira	11,800	9000	20,800	35 L.E	20 L.E/t	1000	16,000	- 4800
Arish, N. Sinai	35,500	3000	38,500	40-60 L.E/t	40 L.E	7500	23,500	-15,000
Suez, Suez	15,545	16,000	31,545	40-50 L.E/t	--	2000	17000	- 14,545
Senour, Beni Seuf	31,100	--	31,100	36 L.E/t	36 L.E/t	500LE	23000	- 11,100
New Minya, Minya	43, 620	11,200	54,820	80 L.E/t	--	--	--	--
New Sohag, Sohag	14,200	--	14,200	22 L.E/t	12 L.E/t	830 L.E	2500	-11,700

WHY COMPOSTING FACILITIES ARE HAVING PROBLEMS?

Based on the above findings, it is possible to reach the conclusion that composting in Egypt has its benefits, experiences some constraints, and faces certain challenges. A summary of the benefits, constraints and challenges are presented below.

Benefits

Composting functions best when it is a component of an integrated solid waste management system. Suez, Luxor, and Alexandria are clear examples where an integrated contract has been awarded to private sector. Waste reduction tops the hierarchy of management options but is very rarely utilized in management policies. Resource recovery either in the form of recycling or composting provides economic, environmental and social benefits.

Economic Benefits--

Economic Benefits can be demonstrated through reduction in disposal needs in landfills/controlled dumps as is the case in Egypt which lacks landfill capacity. Selling of organic compost and in-organic re-cyclables are the main sources of revenues for the facilities.

Environmental Benefits--

Because of its organic content, compost makes a valuable soil amendment and provides nutrients to plants as well as providing other physical, chemical and biological benefits.

Social Benefits--

Compost social benefits involves informal sectors making their living through the collection, separation, and recycling of waste or through the decentralized community composting as in Ismailiya and Beni-Seuf. The local manufacturing of most facilities is another element that benefits the composting program.

Constraints

Composting facilities in Egypt experience some constraints. A summary of these constraints is discussed below.

Waste Management Planning--

Local authorities focus their planning on waste collection and transport and considered composting as a disposal option given the situation in Egypt, rather than a recovery option. Waste which should be normally kept from reaching the composting facility is transported there first. Facility operators receive orders from some local authorities to allow all waste hauling trucks to dump at the facility un-acceptable waste. Inspection and acceptance of waste intake is not in practice. Therefore, sorting and subsequent processing is affected negatively. The high percentages of rejects resulting at many facilities tend to support poor upfront load screening and sorting.

Enabling Environment--

What could be termed "the enabling environment" for an effective composting program in different governorates is under question. The local authorities within a certain program should support the operation of the composting facility rather than considering the facility as the opportunity to export their collection, transport, and disposal of waste problems. The facility should function as a recovery option and not a replacement to integrated waste management.

Marketing--

Poor marketing experiences and lack of integration with the farmers who fear a certain risk regarding the compost quality and specifications prevails. At Arish in North Sinai, one of the reasons mentioned by users for not using the compost is that it causes seed death when used and farmers lost their investments in a previous year.

Operational Constraints--

Operational constraints such as inadequate attention to the composting process, failures of the equipment used, lack of maintenance, and unavailable spare parts are very common.

Production Line in Fayoum Composting Facility

Technical Constraints--

Technical constraints pose a risk in the way the finished product might be used. For example, requirements such as the absence of heavy metals, pathogens, and weeds cannot be completely guaranteed. This happens is due to the lack of testing and analysis either at the facility or at laboratories. Common practice is that the purchaser of the compost takes the burden of undertaking the testing. In addition, poor waste quantities and composition might require purchasing organic materials (e.g., chicken manure) to improve the product quality as in Sohag and North Sinai. This increases the cost of producing the product. Additionally, inadequate pre-process sorting and post-process cleaning yields finished compost with limited possible uses and that is difficult to market to users.

Challenges

Composting faces certain challenges in achieving a successful operation. The high percentage of rejects can be attributed to the design of production lines in addition to the reasons mentioned above. It can be a result of combination of factors among them, design of machines, inappropriate waste intake, and lack of fermentation process monitoring. Design of good production lines which provide high quality finished product and minimize environmental pollution is on top of the challenges.

In Egypt, it is fair to conclude that one of the top challenges faced by composting programs is the provision of trained management and technical staff for running the composting facilities. This is particularly in the new facilities being built. Furthermore, the role of the private sector as a partner to the public sector in operating the facilities to the benefit of the communities served is weak. In sum, many technical problems and poor management lead to higher production costs and ultimately financial losses.

Qualified Management at the Dammitta Composting Facility

SECTION 3

RECOMMENDATIONS

Governorates faced with the task of managing solid waste generated in their areas should consider all alternatives available. According to the principles of integrated waste management, no single solid waste management option can solve all of any service area waste problems.

Selecting a solid waste management option should be based on the objectives and criteria best addressing the needs of the governorate. In the same manner, developing a composting program should be within the framework of an integrated system that addresses collection, transport and transfer, recovery and recycling, and disposal of waste. Composting facilities within this framework function as a recovery and recycling point and cannot be required to address other steps in the management hierarchy such as disposal.

From the previous section, a group of objectives could be outlined to set the road for improving the current and future performance of solid waste composting facilities. These objectives are derived from the findings of the survey, the site visits, as well as discussions with concerned persons at the Governorates, composting facilities, and EEAA.

OBJECTIVES OF A COMPOSTING PROGRAM

To guide the planning process for a composting project the following objectives could be considered to overcome the existing status of the facilities in Egypt.

- Mixed source oriented collection
- Siting and minimized transportation
- Recycling-oriented segregation
- Target-oriented compost product
- Cost-efficient process
- Reliable operation
- Effective product marketing
- Minimized waste disposal (rejects)
- Financial Autonomy
- Enabled environment for operators (public or private)

These are some of the objectives that would need to be identified for any composting project to serve the population of any governorate. When objectives are clearly defined, it helps concentrate activities and resources.

Mixed Source Oriented Collection

Current experience in Egypt shows that the scope of the project should be based on:

- Mixed collection of solid waste (residential, commercial, industrial, etc.).
- Ensuring high percentage of organic content (inventory).
- Adequate quantity of recyclables in the waste composition (inventory).
- Avoidance (minimizing) of non-compostable, non-recyclable waste.

- Considering seasonal variations (inventory).
- Integration of small quantities of garden, park, and agricultural waste.

Siting And Minimized Transportation

- Siting facilities near to or within controlled dumps and/or landfills.
- Siting facilities away from residential, institutional, or commercial areas.
- Ensuring fencing of the facility, brick fences preferred.

Recycling-Oriented Segregation

The design of the facility should take into consideration:

- Increasing the purity of sorting (inorganic material) to minimize the need for post-processing screening (by using bag openers, manual sorting in the receiving area as well as on the picking belt, magnetic separator, etc.).

- Developing recycling potential of certain material (e.g., plastics) on-site as the case of Hurghada, Red Sea and Qatamiya, Cairo.

- Decreasing volume of residues for disposal (as the case in Damietta where unacceptable waste is refused at the gate of the facility).

- Local authorities should ensure that scavenging of valuable re-cyclables is minimized and possibly involving the informal sector in the program.

Target-Oriented Compost Product

Operators should take into their consideration for producing compost the following:

- Producing multiple products to cater for different markets (fine and coarse).

- Producing compost with certain additives (sulphur, potassium, phosphorous, metals, etc.) to achieve different quality outputs.

- Adapt product to customer needs e.g., packaged product for better storage and transportation as is the case in Minya.

Cost-Efficient Process

A cost-efficient process can be achieved by considering three elements; producing valuable products and minimizing rejects; limiting production cost, and ensuring human safety.

To produce valuable products and minimizing rejects, the following must be considered:

- Optimizing manual sorting although it is time consuming.

- In Stage One facilities: a process re-design where by less trommels would be needed and are replaced by strong enforcement of effective manual sorting.

- In stage two facilities, the trommel pores (size 100mm) are wide, an internal drum screen with smaller pores would be more appropriate as was implemented in Suez and Arish.

- Monitoring physical, chemical, and biological aspects of the composting process via easy to conduct tests (bacteria activity, temperature, particle size, pH, humidity etc.).

- Recording data for each windrow separately (dates, analysis, watering and turning times, etc).

- Attention to meeting products specifications.

The following should be considered to limit production costs:

- Training for employees and staff (using the expertise among old facilities operators as in Damietta, Mansoura, and Qatamiya to train their counterparts in the new facilities in Belbeis, Edfu, Mit Gamer, Matrouh, Sohag, Qena, etc.).

- Maintaining consistency in the product to the highest level.

- Increasing facility capacities in both Mansoura, Dakhaliya, and El-Mahla El-Korba, Gharbiya to meet the increasing quantities of waste generated in the service areas.

- Maintenance plans with associated budgets to maintain the assets.

The following should be considered to improve human safety:

- Employee vaccination is integral to maintaining their health.
- Safety gloves, boots, and masks should be worn during processing.

Reliable Operation

In order to improve facility operation, the following should be considered:

- An upgrade in the facility technology to improve system efficiency.

- Avoid problems during the delivery stage by which several facilities were not commissioned due to refusal of local authorities to legally commission the facility from the Military Production due to defects in machine operation.

- Hiring technical staff at facilities to maintain a reliable operation (chemist, electrician, and mechanical technicians).

- Ensure maintenance plans are implemented to avoid down time losses.

- Increasing the operations to reach the maximum attainable capacity of the facilities (as is the case in Alexandria and Suez).

- Protect the segregation line from breakdowns due to bulky materials.

- Quality control needs to be highlighted to facility operators during training or follow-up visits by the environmental authorities.

- Ensuring the continuous supply of water and electricity to the facility to avoid down time losses, this complaint was common in many facilities.

- Including locally manufactured shredders for agricultural waste (as in Sohag) will enhance the operation.

Locally Manufactured Shredder for Agricultural Waste

Effective Product Marketing

To achieve the aim to better market the product, composting facilities should strive to:

- Certify compost quality; such a certificate from a certified laboratory indicating that the product confirms with Ministry of Agricultural decrees and ordinances should not be overlooked as most facilities currently do.

- Regular testing is an efficient tool and a positive advantage against competition.

- Networking with farmers and agricultural land developers to secure contracts.

- Producer networks formed among producers of compost should be another tool to form a union of information exchange and support among them.

- Local authorities should support composting programs by purchasing and using the compost within its jurisdiction in planting, maintaining public parks, and green areas.

- New uses of produced compost should be sought.

- Consumer-customer information should be enhanced through brochures, leaflets, or handouts. Few facilities are currently producing such material.

Minimized Waste Disposal (Rejects)

The following recommendations are made to minimize waste disposal:

- Gate control of incoming waste was noted in few facilities (Alexandria, and Suez). This is an effective procedure for the overall performance of the facility if gate inspection is applied.

- Process optimization (sorting and screening and maturing) in order to minimize the amounts of rejects produced.

- Integrated solid waste management services by same contractor in some Governorates guaranteed some control by the operator over the types of waste delivered to the facility.

Financial Autonomy

Under public management, local authorities keep the financial records in their control. This hinders the functioning of the facility due to bureaucracy and routine in addressing urgent needs. This financial autonomy of the facility should be granted with review and audits from the local authorities as it sees fit.

Selling via auctions only should be reviewed, and direct sales along with auctions should be allowed at Ras El-Bar in Behira, and Mansoura and Mit Gamer in Dakhaliya.

Revenues from tipping fees must be enforced (occasionally applied in Suez) to sustain the financial viability of the facility

Enabling Environment for Operators (Public Or Private)

EEAA and Governorates as well as Ministry of Local Development should jointly launch research programs on aspects of composting in order to build a technical group to guide the decision making process in this field. EMUs and EEAA RBOs have a joint role in supporting the operations of composting programs within their areas of jurisdiction rather than just requiring their complying with the laws and ordinances.

A partnership between local authorities and operators should be the contractual environment between both parties. The current practice has shown that municipalities and local authorities shift the burden of waste management to the facilities and leave the operators (public and private) facing the flood. Exceptions do exist in few Governorates.

Governmental support to composting programs within their boundaries can take many forms as noted by facility operators and detailed in Appendix D. Re-considering the criteria by which the lease value per month is estimated as well as the duration of the lease period, currently three years, to allow for private operators to implement some investments if they are assured a long term contract.

CONCLUSION

Composting facilities in Egypt are considered one of the largest programs to address solid waste in the country. Current practices within this sector have not achieved the desired results. This report was an attempt to document the current status of the facilities and look into ways of improving the program. The findings in Section Two addressed the capacities of the facilities which are operating at almost 37 percent of their design capacity.

Composition and collection of waste in service areas were provided and analyzed. The location of the facilities and the considerations that should direct the siting criteria were presented and discussed.

The compost processes were the focus of another section in the report where the most suitable technology for Egypt was found to be turned windrows. Local manufacturing of the components of the facilities has been one of the advantages of this program but turned to be one of its constraints as well. When studying the technical and operational considerations, it is obvious that producing compost in most facilities needs attention to all aspects of the process. Compost quality is inconsistent. Marketing strategies could be improved by learning from best practices in Alexandria, Damietta, Suez, Minya, and Luxor.

The utilization of composting as an option for waste management should continue in Egypt. It offers a potential for sustainability through ecological benefits, resource efficiency (recovery and recycling), and waste disposal minimization. Socially, composting creates employment opportunities. Economically, composting is not able to generate profits, although the private sector is continuously stepping in and operating more facilities today in Egypt than the public sector.

The actions in the future should concentrate on creating a vision on why the composting program existed and where should it go. Research on composting aspects should be encouraged by EEAA and Ministry of Local Development and areas that need further study should be identified. For example, a comparative study on Stage One and Two facilities regarding reliability, percentage of reduction of waste stream, and operations cost could provide a basis for further development in the technology. Reaching a consensus on private sector procurement for operating composting facilities and circulated as a guideline would be a needed step. Efforts to apply techniques of co-composting should be encouraged. Documenting best practices and disseminating to other operators is crucial and needs to be addressed and executed in the very short term.

On the long term, the operators of composting facilities might start discussing the possibility of forming a union or association to include the interested members in order to institutionalize their efforts and maintain this service in existence for a long period of time.

SECTION 4

CASE EXAMPLE

Luxor Compost Facility - Integrated Waste Management System

A 160 ton per day municipal solid waste composting plant was constructed at Luxor in November/1999 to convert mixed solid waste from the city in to organic compost.

The facility is sited in a desert area outside the city and a landfill is under construction 5 to 7 km from the facility. The facility was established as part of the National Program for Composting Facilities during the first stage of the program. The facility is operated by a private contractor, under a lease contract within the framework of the integrated contract (16/5/2002) for 3 years that involves collection, transport, conversion, recycling, and final disposal of waste. The lease amounts to 12,000 L.E/month. The total contract paid by the Governorate to the private contractor amounts to 6 Million L.E/year.

Waste is generated by around 175,000 inhabitants at a rate of 113 to120 tpd of which 80 tpd is received at the facility. The rest is directed to the municipal dump. The operator has upgraded the municipal dump into a landfill with German technical assistance. A landfill gas detection and control system is installed. A separate cell for disposal of medical waste was constructed.

The organic content of the waste produced is very low and most of the waste received is from residential sources. The contract with the Governorate does not include the waste from the tourism industry which has its own arrangements with private companies and the operator works on including this sector in his contract.

The operator has upgraded the equipment at the facility and added the following equipment to ensure a reliable operation:

- Compost turning machine imported from Germany.
- Agricultural waste shredder.
- Fine compost rotary screen.
- Watering tank truck.
- Loaders.

Target-oriented compost produced in the facility is used in land reclamation and by vegetables and fruits farms. The product is sold at a price of L.E 36 for bulk quantities and L.E 60 to 70 for small quantities. The revenues of the facility are enhanced by the amount of recyclables sold.

The EMU in the Luxor Supreme Council has joined the project team during the visit. It was clearly noted that the contractual environment between the two sides is very good. It is expected to extend the current contract by Luxor City after the end of the 3 years period.

It is advisable for this case example to test the possibility of implementing a pilot project for waste separation at the source to improve the composting process considering the potential for support in the implementation by the tourism sector (Hotels and Cruise boats).

APPENDIX A

EGYPTIAN COMPOSTING LAWS & STANDARDS

Law No. 38/1967 contains the basic solid waste regulations and gives the Ministry of Housing (MOH) the authority to promulgate regulations to implement these laws.

MOH Decree 134/1968, Article 17 requires that a suitable place be provided for sorting waste and removing glass, tin, rubber, rocks, and other non-organic waste from the waste stream. MOH Decree 134/168 also prohibits the use of organic waste as animal food unless it meets conditions set by the competent local council.

Law No. 53/1966 contains the measures that must be taken to control compost production on a commercial basis.

Law No. 53, Article 69 states that no one should produce, treat, sell, or import organic fertilizer without permission from the competent authority.

Law No. 53, Article 70 states that advertisements for organic fertilizers, or other documents used for disseminating technical information, should be based on Ministry of Agriculture technical specifications, the Ministry's approved handling conditions or registration, and the Ministry's recommendations concerning its usage.

Ministerial Decree No. 100/1967, Appendix No. 1 lists the types of organic fertilizers and includes compost products on this list.

Ministerial Decree No. 100, Article No 9 states that compost seller/producers should have a sales registration book stamped with the Ministry's seal, and should provide purchasers with a receipt that specifies the compost name, amount, and its composition.

The law states that compost from municipal waste should have the following specifications:

- Nitrogen not be less than - 0.5 %.
- Organic content not less than 18%.
- Moisture content not more than 30%.
- Sodium chloride not more than 5%.
- Density not less than 0.75 (or 750 kgm3)
- Carbon/Nitrogen (C/N) ratio between 17:1 – 25:1.

APPENDIX B

SURVEY FORM

(SURVEY/COMPOSTING FACILITY)

1. Contacts	Governorate		Facility
Address	Phone/Fax/Email	Facility Manager	Contact person

2. Basic Data	Location	Areas served	Area (m2)

Plant	Supplier/Vendor	Capacity (tph)		Capacity (tph)		Sorting Lines	Year of Operation
		MSW	Agricultural	Design	Actual		

COLLECTION

3. Collection of Waste	Quantity of Waste Receipt (tpd)	Collection Methods		Collection Vehicles	
		a- mixed	b- pre-sorted	Compactor	Non-Compactor
		c- formal	d- informal	Pick-up	Carts w wheels

Types of Waste	%Residential	%Commercial	% Industrial	% Agricultural	% Organic	% Non-Organic

Location	i- Urban/ Suburban	ii- Rural	iii- adjacent to: a- landfill b- transfer station

Process

4. Composting Systems	**5. Available Equipment**		**6. Operations**
a- Systems	**a-** *Feeding Equipment*	***c-*** *Size Reduction*	i- monitoring the fermentation process
i- Passive/Static Piles	i- Skid Steer loader	i- Screening	ii- # of shifts
ii- Turned Windrow	ii- other	ii- Shredding	iii- labor skills
iii- Co-composting	**b-** *Preprocessing*	**d-** *Post Screening*	
iv- Aerated Static Pile	i- Picking belt	i- Air separation	
v- In-Vessel	ii- Magnets	ii- Mechanical Application	iv- efficiency of sorting
b- *Manufacturer*	iii- Trommel Screens	iii- Ballistic separation	
i- Local %	iv- Air Classifier	**e-** *Windrows turning*	v- maintenance
ii- Imported %	v- other	**f-** *Organic material separation*	
		g- *Baling press (#) (Glass-Cardboard-Plastic)*	vi- Spare parts availability

7. Technical	**8. Management**	**9. Compost Quality**		
i- lack of waste shredders	i- Government	i- Specifications	Moisture content	Heavy Metals
ii- high fuel/electric power extensive machines	ii- Private	Particle size	Pathogens	ii-Litter control
iii-lack of mixing machines	iii- Renting	C:N ratio	Seed Weeds	iii- Vaccinations
iv- other	iv- other	Non-organic contaminants	Nematode	iv- other

Product

10. End Product uses		**11. Testing Lab**	
Private Gardens	Fruit trees	Bulk Density	Volatile solid content
Public gardens & Parks	Vegetables	Moisture Content	Cress test
Ornamental Plants	Landscaping	Sieve Analysis	pH
Field crops	Medical Plants	C:N ratio	Conductivity

12. Marketing

Direct Sales to users	Auctions	Competition from sludge compost

13. Technical Indicators			
Quantities of compost (ton)		a- fine (ton)	b. coarse (ton)
Quantities of re-useable (ton)		Quantities of reject (ton)	
14. Economic Indicators			
a- Operating Accounts			
Running Cost	L.E.	Revenues	L.E./ton
1- Administrative		Compost (Fine)	
2- Fuel/Water/Electricity		Compost (Coarse)	
3- Maintenance		Re-usables	
4- Wages			
5- Incentives			
Total		Total	
b- Budget for the Plant			
PLANT/YEAR	Expenses	Revenues	Profit
( ) 2002			
( ) 2001			

APPENDIX C

FACILITY SURVEY FORM PER GOVERNORATE

BEHIRA GOVERNORATE

1. Damanhour

2. Kafr ElDawar

١. بيانات الإتصال	المحافظة : البحيرة		إسم المرفق :مصنع السماد العضوى وتدوير المخلفات الصلبة
العنوان: كفر الدوار سيدى غازى	رقم التليفون/الفاكس/البريد الإليكتروني ت/٠٤٥٥٩٤١٥٠ فاكس/٠٤٥٢٢١٨٦٧٦	مدير المرفق جلال محمد العايدى	القائم بملىء الإستبيان: محمد عبد الرءوف أبو زيد

٢. معلومات أساسية	الموقع :سيدى غازى	المنطقة/المناطق المستفيدة مركز ومدينة كفر الدوار	المساحة (م٢) ٢١٠٠٠م٢ (٥ أفدنة)

إسم المرفق	المُورد/المُصنع	السعة (طن/ساعة)		السعة (طن/ساعة)		خطوط الفرز	سنة التشغيل
		المخلفات البلدية الصلبة	الزراعية	عند التصميم	الفعلية		
مصنع السماد العضوى	المصانع الحربية	١٠ طن/ساعة			٥ طن/ساعة	محطة فرز بمنخل ثابت	٢٠٠٢

الجمع

٣. جمع المخلفات	كميات المخلفات التي يتم استلامها (طن/يوم)	طريقة الجمع:		وسيلة/شاحنات الجمع	
		(أ- مختلطة	ب- سبق فرزها	بالكبس	بدون كبس
	٩٠ طن/يوم ٨٠%(المدينة)	(ج- رسمي (البلدية)	د- غير رسمي (جامعى القمامة)	عربات نقل	كارو

نوع المخلفات ونسبتها	% السكنية	% التجارية	% الصناعية	% الزراعية	% المكونات الغيرعضوية	% المكونات العضوية
	٥٠%	١٠%	٣%	٥%	١٠%	٢٢%

المنطقة	١. حضري /. شبه حضري	٢- ريف	٣. المرفق بجوار: أ. مدفن صحي	مقلب	ب. محطات النقل الوسيط

المعالجة

٤. نظم الكمر	٥. المعدات المتاحة				٦. أعمال التشغيل
أ. الاسلوب المستخدم	أ. معدات المناولة	عدد	ج. معدات تقليص الحجم	عدد	١. مراقبة عملية التخمير كمر هوائى لمدة شهرين مع التقليب و الترطيب
١. كومات خاملة/ثابتة	ا. لودر حمل منزلق	٢ محلى	١. الغربلة	٢ محلى	
(٢) تقليب المصفوفات	٢. أخرى	غير موجود	٢. الطحن (التكسير)	غير موجود	٢. كفاءة الفرز: يتم تنقية المادة العضوية بالعمالة اليدوية مع سير الفرز
٣. الكمر المشترك	ب. معدات قبل المعالجة	عدد غير موجود	د. معدات بعد الغربلة	عدد غير موجود	٣. عدد الورديات عدد(٢) وردية
٤. كومة خاملة هوائية	١. سير الفرز √	١ محلى	١. الفصل الهوائي	غير موجود	١. مهارات العاملين: يتم عمل دورات تدريبية للعاملين قبل الاستلام والتشغيل ويتم

٥. في أوعية	٢. المغناطيس √	١ محلى	٢. التطبيق الميكانيكي	غير موجود	المتابعة المستمرة من قبل الادارة والتوجيه.
٦. أخرى	٣. غربال التنقية √	١ محلى	٣. الفصل القذائفي	غير موجود	٥. الصيانة: يتم صيانة المحطة والمعدات ميكانيكياً وكهربائياً بصفة دورية أسبوعية من قبل طاقم الصيانة الموجود بالمصنع ويتم توفير قطع الغيار أول بأول
ب. المعدات	٤. معدات التصنيف الهواء		**هـ.** تقليب المصفوفة		
٢. محلي (%)	٥. أخري		**و.** فصل المواد العضوية		٦- توافر قطع الغيار
٣. مستورد (%)			**س.** ماكينات الحزم (حدد) (زجاج - بلاستيك- كرتون)		

٧. النواحي الفنية (صعوبات)	**٨. الإدارة**	**٩. مواصفات السماد**		
١. نقص طواحين (كسارات)	① حكومى	١. المواصفات	محتوي الرطوبة: ١٤,٣٦%	الجراثيم
٢. ماكينات ذات استهلاك وقود عالي/طاقة كهربائية كبيرة: لا توجد صعوبات	٢. قطاع خاص	نسبة الكربون: النيتروجين ١٩ : ١	العناصر الثقيلة توجد	**٢.** التحكم في بعثرة المهملات
٣. النقص في ماكينات الخلط	٣. مستأجر	حجم الجزيئات	بذور الأعشاب الضارة لا توجد	**٣.** تطعيم الأفراد يتم التطعيم عن طريق الصحة
٤. أخري: لا توجد	٤. أخري	الشوائب غير العضوية: لا توجد	دود النيماتودا: لا توجد	**٤.** أخرى

المنتج			
١٠. الاستخدام النهائي للمنتج		**١١. معمل الاختبارات**	
الحدائق الخاصة √	شجر الفواكه √	الكثافة √	محتوي المواد الصلبة المتطايرة
الحدائق العامة والمتنزهات√	الخضر √	نسبة الرطوبة √	اختبار كرس (Cress)
نباتات الزينة √	المناظر الطبيعية √	تحليل المنخل	الاس الهيدروجيني pH
مزارع المحاصيل√	النباتات الطبية √	نسبة الكربون: النيتروجين√	الموصلية/الكهربية √

١٢. التسويق		
البيع المباشر للمستخدم √	المزادات	هل توجد منافسة للمنتج من السماد المستخرج من الحمأة فى المنطقة؟ لا توجد

١٣. المؤشرات الفنية	
كمية السماد (طن) : ٦٠ طن/يوم	أ. ناعم (طن) :١٣,٣ طن /يوم ب. خشن (طن) : ٤٠ طن/يوم
كمية المواد التي يمكن إعادة استخدامها (طن) : ٤ طن/يوم	كمية المرفوضات (طن) : ٢٦ طن/يوم
١٤. المؤشرات الاقتصادية	

أ. حسابات التشغيل			
التكلفة الجارية	**بالجنيه**	**الإيرادات**	**جنيه/طن**
١. الإدارية	**١٠٠ شهرياً**	الكمر (ناعم) ٢٤٢٠٦ شهرياً	٧٠جنيه /طن
٢. الوقود/المياه/الكهرباء	٢٢٠٠ شهرياً	الكمر (خشن) ٣١٢٠٠ شهرياً	٣٠ جنيه /طن
٣. الصيانة	٥٠٠شهرياً	المواد الممكن إعادة استخدامها	١٢٠٠٠ جنيه /طن
٤. المرتبات	٩٠٠٠ شهريا		
٥. الحوافز	١٠٠٠٠شهرياً		
الإجمالي	٢١٨٠٠شهرياً	الإجمالي	٦٧٤٠٦ شهرياً
ب. ميزانية المرفق			
المرفق/السنة	**التكلفة**	**الإيرادات**	**الربح**
٢٠٠٢	٢١٨٠٠	٦٧,٤٠٦	٤٥,٦٠٦
٢٠٠١			

ملاحظات

- **يتم تشغيل ميزان بسكول الخاص بالمصنع للمواطنين مقابل رسوم كمثيله فى المصانع الأخرى مما يدر دخلاً للمصنع بمتوسط ١٤٠٠,٠٠ يتم توريدها بإيصالات لحساب المصنع بالبنك.**
- **المنخل ١٠ جم**
- **ممكن إضافة خط أخر وتوسيع لمنطقة لخدمة**
- **خط إعادة تدوير البلاستيك**
- **إضافة وحدة زراعية**
- **مفرمة**