

Operation Economics of Separation, Recycling and Composting Plants

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Introduction

In 1998 the Egyptian government has given a great attention to the implementation of municipal solid waste recycling projects with a strong belief that these projects are essential demand in the solid waste management system in Egypt.

This belief lead to the national project for constructing solid waste treatment plants. According to this project the government has financed the construction of 34 separation and composting plants distributed all over the country in the last 5 years starting with capitals of governorates ending with capitals of marakez (small cities).

Using the open aerobic composting system has proven to be the most suitable system economically and technically. Accordingly another 9 projects are funded for the year 2003.

All these projects were constructed and supplied by NOMP (National Organization of Military Production) emphasizing that this project should be implemented by local capabilities in design, manufacture and development, according to our local needs.

And another 9 plants were established in different governorates, using different international funds, and by this stage the number of plants established till year 2003 are 54 plants.

These projects are listed in detail at the beginning of this study, as a part of the government strategy in establishing MSW composting plants showing their geographical distribution and their capacities related to waste produced.

According to the current situation of these plants, they failed to play the role required due to some factors related to finance, operation and management in general.

These factors are economic in the first place and related mainly to governmental management of these plants, and thus it might be more serious and efficient to have the private sector run these plants.

Through one of the leading experience in operation and maintenance of 2 of these plants in Quattamia and 15th May (Cairo), we will demonstrate a financial study showing actual running costs for managing these plants with the designed capacities.

From this study we will recognize the reasons why private sector is not willing to enter this field. Then we will go through the different alternatives for managing solid waste recycling

plants and the feasibility of each alternative to reach the most suitable solution for managing this sector as a part of integrated solid waste management.

1. The government strategy in constructing solid waste treatment plants:

In 1995, a cooperation protocol was signed between ministries of scientific research, local development and NOMP for establishing 50 plants in a 5-year program; and to build 10 plants annually with a capacity of 10 ton/hr each with estimated cost of 5.5 million Egyptian pounds/each. The contracts of the first phase for this national program was signed at that time. After of establishing the first phase of the project which included 10 plants located at the capitals of some governorates, technological developments in composting & recycling systems sponsored by some private consultants & experts arised, and accordingly the ministry of local development decided to make a comparative study amongst all the financial & technical alternatives available prior to continuation of this cooperation protocol program.

Finally a decision was made to choose an alternative depending basically on using compost turning machine in a composting phase, with a simplification of the project equipment, infra structure and buildings of the plant and consequently reduce the investment cost. A contract with ENTAG was signed to provide a project design and consultancy, and with NOMP (military factories) for equipment fabricate and erection.

The investment cost of the plant was defined to be 3.6 million Egyptian pounds/each, thus 15 plants were constructed in this phase (II) instead of ten.

In 2000, the third phase of the project was constructed and the consultant reduced the investment cost so as to include equal capacity to 19 plants.

The 4th phase is in the contracting phase .

The following tables demonstrate all plants implemented all over the Egyptian governorates chronologically:

Table No. 1: Plants implemented from 1985 – 1988:

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|-------|-------------|---------------|---------------------|--------------------|
| 1 | Cairo | El-Salam City | DMT-Danish | 96 |
| 2 | Alexandria | Abis | Motherwell- British | 160 |
| 3 | Giza | Abou Rawash | DMT-Danish | 96 |
| 4 | Damietta | Damietta | Buhler- Swiss | 160 |
| Total | | | | 512 |

Table No. 2: Plants implemented from 1992 – 1995:

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|------|-------------|-------|------------------|--------------------|
| 1 | Alexandria | Abis | Japanese grant | 160 |
| 2 | Asiut | Asuit | Aircraft Factory | 160 |

| | | | | |
|-------|------------|---------------|---|------|
| 3 | Mansoura | Sandob | ENTEC & EEAA financed by SEAM project | 160 |
| 4 | Port-Said | Port-Said | American Co. financed by USAID | 200 |
| 5 | Cairo | El-Salam City | Aircraft Factory | 160 |
| 6 | Zagazig | Zagazig | Academy of Scientific Research And NOMP | 160 |
| 7 | Alexandria | Montazah | Scientific Research Academy And NOMP | 160 |
| Total | | | | 1160 |

**Table No. 3: Plants implemented in phase one (96-97)
with a credit of L.E 55 million**

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|-------|-------------|------------|--|--------------------|
| 1 | Giza | Shabrament | Academy of Scientific research National organization of military production of | 160 |
| 2 | Fayoum | Fayoum | | 160 |
| 3 | Bani Suief | Bani Suief | | 160 |
| 4 | Minia | Minia | | 160 |
| 5 | Sohag | Sohag | | 160 |
| 6 | Qena | Qena | | 160 |
| 7 | The Red Sea | Hurghada | | 160 |
| 8 | Dakahlia | Mansoura | | 160 |
| 9 | Loxor | Luxor | | 160 |
| 10 | Ismailia | Ismailia | | 160 |
| Total | | | | 1600 |

**Table No. 4: Plants implemented in phase two (98-99)
with a credit of L.E 55 million**

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|-------|-----------------|-----------------|--|--------------------|
| 1 | Cairo | Qatameya 1 | ENTAG and National Organization of Military Production | 160 |
| 2 | Cairo | Qatameya 2,3 | | 320 |
| 3 | Giza | Abu Rawash | | 160 |
| 4 | Giza | Shabrament | | 320 |
| 5 | South Sinai | Sharm El-Sheikh | | 160 |
| 6 | Menoufiya | Menouf | | 160 |
| 7 | Aswan | Aswan | | 160 |
| 8 | North Sinai | El-Areesh | | 160 |
| 9 | Suez | Suez | | 160 |
| 10 | Marsa Matrouh | Marsa Matrouh | | 160 |
| 11 | Gharbiya | Mahala El-Kobra | | 160 |
| 12 | Kafer El-Sheikh | Kafer El-Sheikh | | 160 |
| 13 | Dakahlia | Belkas | | 160 |
| Total | | | | 2400 |

Table No. 5: Plants implemented in phase three (2000-2001) with A credit of L.E. 55 million:

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|-------|-----------------|---------------|--|--------------------|
| 1 | Cairo | 15 May city | ENTAG / National Organization of Military Production | 960 |
| 2 | Cairo | 15 May city | | 640 |
| 3 | Bani Suief | Samasta | | 160 |
| 4 | El-Minia | Mallawi | | 160 |
| 5 | Qena | Qena | | 160 |
| 6 | Aswan | Edfu | | 160 |
| 7 | Dakahliya | Meet Ghamr | | 160 |
| 8 | Damietta | Ras El-Bar | | 160 |
| 9 | Kafer El-Sheikh | Beala | | 160 |
| 10 | Beheira | Kafr El-Dawar | | 160 |
| 11 | El-Sharkia | Belbes | | 160 |
| Total | | | | 3040 |

Table No. 6: Plants proposed in phase four (2002-2003) with a credit of L.E. 55 million:

| Ser. | Governorate | Site | Design / Import | Capacity (Ton/day) |
|-------|-----------------|--------------|--|--------------------|
| 1 | Qaluobiya | | Academy of Scientific Research National Organization of Military Production | 320 |
| 2 | Minia | El-Adwa | | 160 |
| 3 | Kafer El-Sheikh | Sedi-Salem | | 160 |
| 4 | Damietta | Faraskour | | 160 |
| 5 | Dakahliya | Aga | | 160 |
| 6 | Giza | El-Saf | | 160 |
| 7 | Elwady Elgedeed | El-Kharga | | 160 |
| 8 | Gharbiya | Tanta | | 320 |
| 9 | Qena | Nagaa Hamadi | | 160 |
| Total | | | | 1600 |

From the pervious tables it is shown that total amount of MSW which could be treated by the implemented plants are 8652 ton / day in case of operation with the designed capacity. As the estimated amount of produced MSW in the urban areas in Egypt is 30000 ton/day, we can conclude that 30% of the daily produced waste could be treated.

2. Current Situation of implemented plants:

There are (41) MSW treatment plants all over Egypt with a value of L.E.193 million distributed on 24 governorates. The current situation of these plants is as follows:

| Ser. | Situation | Governorates | No. | percent |
|------|--------------------------|--|-----|---------|
| 1 | Rented to private sector | El Mahala, Kafer El-Sheikh, Beila , El Arish, El Minia, Mallawi, kattamia1,2,3, Louxer | 9 | 23% |
| 2 | Irregular operation | Matrouh – Damnhor - Damietta - Kafer El-Sheikh | 15 | 30% |

| | | | | |
|---|---|---|----|------|
| | by municipalities (10-20% of the capacity) | - El Minia - Sohag – Kafer El-Dwar – Raas El-bar- Bani Suief – Semesta – Mallawi – El-Fayoum - Asuit – Qena – Edfo - Belkas | | |
| 3 | Not operating | Menouf - Sharm El-Sheikh - Esmalia – - Hurgada. | 10 | 7% |
| 4 | Not operating to be delivered to contracted companies | Shabrament1,2,3 – Abo Rouash – Elmansoura - El Salam – Bor said - Aswan | 8 | 19 % |
| 5 | Not operating for lack of utilities | 15 th may 1000 ton - 15 th may 640 ton – Meet Ghamr | 3 | 21% |

3. Dominant problems facing plants operation with their designed capacities:

The common factors and problems which affect the plants performance e and make them uncapable of reaching their targets are:

- i- Unavailability of a suitable budget and finance for operation & maintenance:
- ii- Low salaries and consequently absence of qualified and experienced workers able to maintain the equipment.
- iii- Irregularity of waste supply to the plants due to bad arrangements with different departments of municipalities.
- iv- Unavailability of marketing department for the produced compost & recyclables.
- v- Low efficiency of operation, which is reflected on the product quality because of negligence or inexperience.
- vi- Low economic feasibility of plants operation and maintenance which discourage the private sector to invest in operating these plants.

4. Operation & maintenance actual costs of solid waste management treatment plant:

Through actual expenses of operation and maintenance in Quattamia 1,2 &3 plants , the following table shows the analysis of these expenses (units are in L.E.)

Table No. 7: Solid waste management treatment, operation & maintenance elements:

| Item | Capacities (Ton/ hr) | | | |
|----------------------|----------------------|-----------|-----------|-----------|
| | 10 | 20 | 40 | 60 |
| Total wages | 537432 | 1072704 | 2169024 | 2798352 |
| Fuel & oil | 72242 | 144484 | 288974 | 577949 |
| Operation utilities | 103980 | 208595 | 294002 | 478985 |
| Maintenance | 121865 | 245555 | 587653 | 1175305 |
| Total operation cost | 835519 | 1671338 | 3339653 | 5030591 |
| marketing cost | 110700 | 221400 | 442800 | 664200 |
| Total cost | 946,219 | 1,892,738 | 3,782,453 | 5,694,791 |

Outline frame for MSW management in Egypt

Following is a brief description of the current integrated solid waste management system in Egypt. The activities related to this system include collection, transportation, recycling, composting (treatment units) and final disposal of rejects.

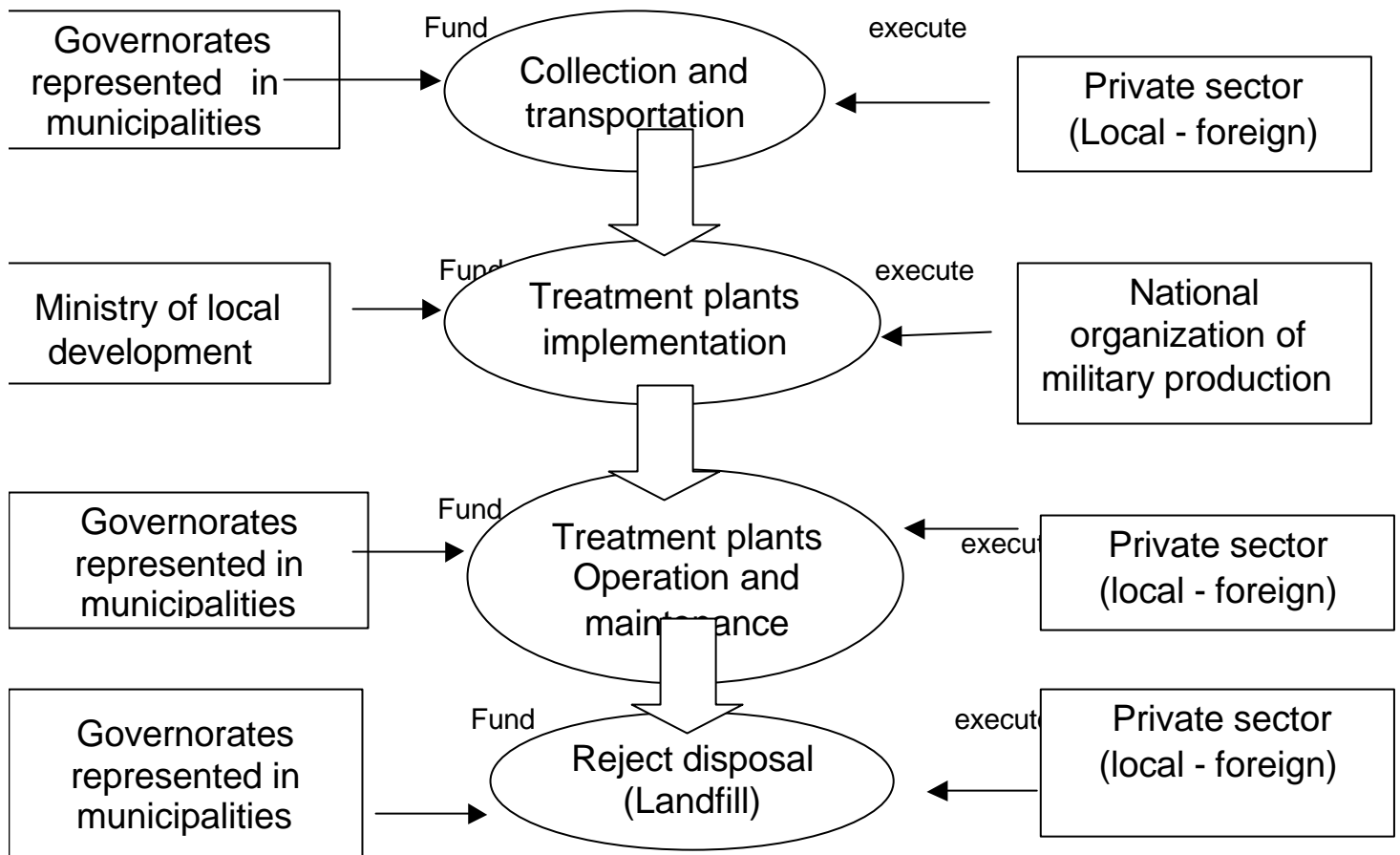


Figure (1): integrated solid waste management

5. Alternatives for solid waste management treatment plants:

Four alternatives for managing MSW treatment plants are demonstrated below describing advantages and disadvantages for each alternative.

- **Alternative no.(1): Management of the plants on a rental basis.**

In this type municipalities transfers the garbage to the plant site and also transfer the rejects out of the factory, and the investor pay monthly definite rent for the plant. The following table will show the gross profit and loss in case of different rental values:

Table (8) Gross profit and loss in case of payment of different rental values.

| Rental value | Item | Capacity (ton / hr) | | | |
|--------------------------|--------------------------------------|---------------------|-------|-------|-------|
| | | 10 | 20 | 40 | 60 |
| - | Total revenue | 975 | 1950 | 3900 | 5850 |
| L.E 2,000 / line monthly | Total cost | 970 | 1940 | 3854 | 5791 |
| | Gross loss and profit | 5 | 10 | 46 | 59 |
| | % of net profit and loss to expenses | 0.5% | 0.5% | 1.1% | 1.0% |
| L.E 4,000 / line monthly | Total cost | 994 | 1988 | 3926 | 5887 |
| | Gross loss and profit | -19 | -38 | -26 | -37 |
| | % of net profit and loss to expenses | -1.9% | -1.9% | -0.7% | -0.6% |
| L.E 6,000 / line monthly | Total cost | 1018 | 2036 | 3998 | 5983 |
| | Gross loss and profit | -43 | -86 | -96 | -129 |
| | % of net profit and loss to expenses | -4.4% | -4.4% | -2.5% | -2.2% |
| L.E 8,000 / line monthly | Total cost | 1042 | 2084 | 4070 | 6079 |
| | Gross loss and profit | -67 | -133 | -168 | -255 |
| | % of net profit and loss to expenses | -6.9% | -6.8% | -4.3% | -3.8% |

Table(8) shows the losses that the renters are exposed to and accordingly they would rather prefer to rent the plant equipment to cover their losses

- **Alternative no.(2): Management with zero rent value:**

Description :

The municipality transfers the solid waste to the plant site and transport the reject out of the plant , in return the operator produces compost and sell both compost and recyclables, no fees are paid to either sides. The following table (9) shows the total cost, revenues and net profit .

Table (9):Comparison between expenses & revenues for MSW treatment plants in case of its operation with zero rent value:

| Item (1,000 L.E/year) | Capacity (ton / hr) | | | |
|--------------------------|---------------------|------|------|------|
| | 10 | 20 | 40 | 60 |
| Total cost | 946 | 1892 | 3782 | 5695 |
| Total revenues | 975 | 1951 | 3902 | 5854 |
| Annual gross profit | 29 | 59 | 120 | 159 |
| Profit % | 3% | 3% | 3% | 3% |

In this case the operation expenses are covered by compost & recyclables selling revenue and the gross profit is 3% , which does not encourage the private sector to invest in this field.

▪ **Alternative no. (3): private sector getting treatment fee**

The municipalities transfer municipal solid waste to the plant site and transfer reject out of the plant with a payment of (2.5-10 L.E) / ton garbage imported to the plant for treatment to the investor, and the investor sell the compost and the recyclables for his own account. The following table (10) shows the revenue in case of payment of different sums per each treated ton,(which is known internationally with waste treatment fees).

Table(10):Total expenses & resources for the management of recycling plants in case of payment of treatment fee:

| Treatment fees | Item (1,000 L.E) | Capacity (ton / hr) | | | |
|----------------|-----------------------|---------------------|-------|-------|-------|
| | | 10 | 20 | 40 | 60 |
| - | Total annual cost | 946 | 1892 | 3782 | 5695 |
| 2.5L.E / ton | Total annual revenues | 1065 | 2131 | 4262 | 6394 |
| | Annual gross profit | 119 | 239 | 480 | 699 |
| | Profit % | 12.6% | 12.6% | 12.6% | 12.6% |
| 5L.E / ton | Total annual revenues | 1155 | 2311 | 4622 | 6934 |
| | Annual gross profit | 209 | 419 | 840 | 1239 |
| | Profit % | 22% | 22% | 22% | 22% |
| 7.5L.E / ton | Total annual revenues | 1245 | 2491 | 4936 | 7420 |
| | Annual gross profit | 299 | 599 | 1200 | 1779 |
| | Profit % | 31.6% | 31.6% | 31.6% | 31.6% |
| 10 L.E / ton | Total annual revenues | 1335 | 2671 | 5342 | 8034 |
| | Annual gross profit | 389 | 779 | 1560 | 2319 |
| | Profit % | 41% | 41% | 41% | 41% |

Table(10) shows that the paid fees become part of the plant resources and so the net profit is raised to high value, which encourages investment in this field.

▪ **Alternative no. (4): Management against operation contract**

In this type municipalities transfer the waste to the plant & transfer rejects out of the plant and the investor operate the plant covering wages, transportation, and the production requirements against predetermined contracted value. The produced compost and recyclables are marketed by the municipality.

Table (11): Financial analysis of MSW against operation contract:

| Item (1,000 L.E/year) | Capacity(ton/hr) | | | | | | | |
|------------------------------------|------------------|------|-------|------|-------|------|-------|------|
| | 10 | | 20 | | 40 | | 60 | |
| | month | year | month | year | month | year | month | year |
| Total cost | 68 | 817 | 136 | 1635 | 272 | 3268 | 410 | 4922 |
| Total revenues (contract value) | 85 | 1021 | 170 | 2044 | 340 | 4085 | 513 | 6152 |
| Gross Profit value | 17 | 204 | 36 | 409 | 68 | 817 | 103 | 1230 |
| Profit % | 25% | | 25% | | 25% | | 25% | |

As shown this is a feasible alternative, and it is applied in Lybia where a contract is signed with Egyptian co. to run a MSW composting plant, receiving 500 ton of garbage daily .

5. Conclusion

As management is one of the main reasons of the failure of most of the compost plants in achieving their objectives, and in order to achieve performance effectiveness & flexibility, some governorates have decided lately to rent these plants to the private companies to accomplish the following:

1. Recruit and select qualified labors, provide training and implement performance and appraisal system.
2. Improves plant performance by adding some equipment and machinery (shredders, moving machines “loaders” to the plants built before 98/99 plan – adding sorting unit).
3. Improves plants performance for both product and economy, by taking more care with sorting to increase the amount of recyclables.
4. Flexibility of the private sector will lead to better marketing technologies which will improve the plants economics by reducing expenses and increasing revenues.
5. Top management meetings to review the management of these plants, and to discuss alternatives and select the proper solutions.

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