

Solid Waste Management in some Countries of the Eastern Mediterranean Region



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Solid Waste Management

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Solid Waste Management

Introduction:

During the last decade the increasing urban population pressure, accelerated industrial development, and increased conveniences of life have resulted in the generation of tremendous volumes of solid waste in the Eastern Mediterranean Region (EMR). Improperly stored, collection and managed solid wastes; which act as breeding sites for rats, flies, mosquitoes, cockroaches and other vermin which act as passive vectors; have resulted in transmitting diseases to the sanitation workers as well as the resident, thus causing serious environmental health hazards and problems. The local authorities in cities and towns are not able to tackle the solid waste problems due to the shortages of financial resources; lack of trained and skilled manpower; lack of education and awareness of communities about the environmental health problems associated with solid waste; shortage of adequate and proper equipment; lack of adequacy of the EH curricula in national academic and professional institutions, non-availability of adequate and reliable information and records about the volume, nature and available methods including salvaging of solid waste; and the weaker national policies, legislation and strategies dealing with the environmentally sound management of solid wastes (1).

In order to prepare regional training needs and guidelines, it is important that an assessment of the current national situation of the solid waste problem in each Member State be carried out. The EMR States were invited by CEHA in 1992 to prepare a study on "Solid Waste Management". By September 1993, seven studies were received by CEHA. The studies are from the states of Egypt, Iran, Jordan, Morocco, Syria, Tunisia, and Yemen.

The following topics were suggested for the scope of study and the terms of reference of the researcher:

- An overview of the national solid waste management (SWM) situation. Current and expected volumes, characteristics and disposal options in the country.
- Review of recent developments and innovative approaches in all aspects of solid waste management and their potential applications in the country.
- Current SWM practices and their environmental health implications.
- Necessity, role and needs of solid waste recovery, recycle and reuse.
- Status of disposal of special (Medical, Clinical, etc.) and hazardous wastes.
- Existing and planned national policies, strategies, regulations, standards and action plans.
- Needs and priorities for community awareness, participation and involvement in solid waste practices and technologies.
- Suggestions, recommendations and plans of action for SWM strategies, policies, approaches, and practices.

1. Overview of SWM Situation in Some Countries of the EMR:

In **Egypt**, the problems related to SWM have been growing at an alarming rate. Their manifestation in large cities like Cairo and Alexandria reached such serious proportions that they called for considerable government intervention and a series of judicious actions. An important action was the establishment of two specialized cleansing and beautifying agencies for Cairo and Giza to undertake the various responsibilities associated with SWM.

Until recently, proper solid waste management techniques were not practiced in Egypt on any notable scale, particularly from the standpoint of waste treatment and disposal. Attempts at resource recovery and reuse are neither organized nor hygienic. Final waste disposal was mainly achieved through non-sanitary, non-aesthetic open dumping. The situation, however, is being rectified through the adoption of appropriate treatment and disposal schemes. A specialized technical group has conducted many full-fledged SWM studies covering large cities like Cairo and Giza, as well as smaller towns. The group also undertook specialized technical studies and feasibility assessments.

In **Jordan**, up to ten years ago, one could witness large heaps to small mountains of refuse on the outskirts of Amman and other major cities. However, since then, the government of Jordan has given this problem the needed priority and the Ministry of Municipalities, Rural Affairs and the Environment along with Amman Municipality, opted the use of landfills which resulted in a much better disposal system and corrected most of the environmental nuisance and hazards caused by the previous disposal system (open dump). Even then, there still exist major problems in waste management in Jordan which are basically related to allocation of land for disposal, transport, collection, possible landfill leachate and human violations of the unprotected landfills and the collection places in municipalities.

In **Syria**, the open dump method of solid wastes was known for a long time. In rural areas, the wastes were used from the open dumps to fertilize agricultural lands. While in cities the wastes were used by incineration to heat water of public bath houses.

In **Tunisia**, solid waste management has become one of the major priorities of the environmental policy. Ministry of Environment was created in 1991 and has elaborated a national strategy of protection of the environment including a certain number of programs such as the "Solid Waste Management" program within the "National Program of Solid waste Management".

1. Assessment of Solid Waste Management:

1.1 Municipal Solid Waste

This normally consists of:

1. Residential solid waste which represents all types of wastes which originate in a single family and multifamily dwelling, such as food wastes, rubbish, ashes, and special wastes.
2. Commercial solid waste which includes wastes generated in stores, restaurants, markets, offices, hotels, motels, print shops, auto-repair shops, medical facilities and institutions.

3. Special waste such as street sweepings, road side litter, dead animals and industrial wastes.
4. Bulky refuse such as bicycles, refrigerators, machines, furniture, and old cars.

1.2 Current Volumes and Generation Rates:

Quantities of solid wastes vary considerably in composition and quantity depending on the economic status, ethnic composition, and social habits of neighborhoods. Quantities also vary with seasons, the horticultural choices of neighborhoods, the geographical characteristics of the land, rainfall, climate, and the habits of people: what they eat, drink, and the packaged materials they buy (2). Variation also depend on the availability of fresh fruits and vegetables. Residents of large cities and towns tend to throw away more than residents of small towns and villages.

There is a considerable confusion on generation rates of solid waste. This is because of the different methods of measurement and the different waste classification adopted for reporting data. The reason for measuring generation rates is to obtain data that can be used to determine the total amount of wastes to be managed. Therefore, in any solid waste management study, extreme care must be exercised in allocating funds and deciding what actually needs to be known (2).

Amounts of solid waste in some cities of the EMR states and generation rates follow:

Table - 1: Solid wastes and generation rates - EMR States

City/State	Population (million)	Quantity (Tons)	Generation rate kg/c/d	Year	Reference and Page
Cairo, Egypt	6.253	5074/day	0.81	1988	(3) - 14
Tehran, Iran	6.7	2074162/yr	0.85	1991	(4) - 17
Amman, Jordan	1.4	25000/month	0.60	-	(5) - 3
Morocco	25	3000000/yr	0.33	1990	(6) - 4
Syria	14	4000/day	0.29	1993	(7) - 2
Damascus	4	800-1300/day	0.2 - 0.325	-	(7) - 1
Tunisia	8	1200000/yr	0.41	-	(8) - 1
Yemen	15	-	0.3 - 0.6	1993	(9) - 6

Generation rates for several Egyptian cities vary from 0.46 to 0.81 kg/c/d. In **Jordan**, the average waste generation per capita per day in Greater Amman was 0.719 kg in 1984 and 0.844 kg in 1986. At present, it is 0.75-0.80 kg. In view of existing hard economic conditions, lower generation rates of solid wastes in Jordan are expected. It is also reported that, based on another study, the generation rate is 0.4 kg/c/d. Rural areas of Jordan are expected to have lower rates, about 0.2-0.4 kg/c/d. The overall average generation rate in Jordan is estimated to be 0.55 kg or less (page 4). In **Syria**, the average generation rate is 0.50 kg/c/d (page 1). In **Tunisia**, generation rates vary from 0.9 kg/c/d in Great Tunis, 0.75 kg/c/d for Sousse to 1.0 kg/c/d for Sfax. The average generation rate in urban areas is estimated to be 0.5 kg/c/d (page 1).

The amounts of municipal solid waste will increase in the future, simply because of the increase in population. In **Jordan**, it is estimated that generation of municipal solid waste will increase by 40% in the year 2000 and will about double by the year 2005 (page 4).

In Damascus, **Syria**, it is reported on pages 2 and 3 that the quantities estimation is 2000 tons daily for now and it will be 4000 tons daily for Damascus and 10,000 tons daily for the whole country in the year 2000.

The following tables 2, 3 and 4 are taken from the reports of some EMR States which show: quantities of solid wastes, generation rates, sources, characteristics, ..etc.

Table 2 : Population and generation of SW for typical Egyptian cities. [Table - 1. (3)]

	Cairo	Alex	Giza	Tanta	Port Said	Azhar	El Zagazig	El Suez	Ismailia	El Bah	Shibha El Khayma	Damanhur
	1989	1985	1985	1985	1986	1985	1989	1989	1984	1990	1990	1993
Population (1000)	6253	2000	1553	947	800	327	200	363.60		151.00	143.30	108.00
Generation rate kg/capita/day	0.71	0.50	0.70	0.72	0.73	0.46	0.45	0.67		0.72	0.80	0.75
Quantities generated (ton/day)	6074	1337	1088	256	370	149.40	166	210.40	108	109	114.00	82.00
Sources (%)												
Household	64.30	72.00	64.30	70.30	55.60	76.70	24.30	90.20	63.50	72.50	50.00	65.90
Streets&green areas	12.30		15.90	8.60	13.30	21.00	6.00	6.00	15.30	7.30	27.50	12.20
Commercial	14.90	19.00	8.80	9.00	17.00		9.50		13.20	11.00	9.00	20.20
Industrial	2.30		5.80	0.00	4.40		2.40	7.40	0.00	2.80	7.00	
Educational	0.90		0.90	1.00			2.00		1.50	1.20	2.00	1.70
Hotels	0.20		1.50	0.40			0.30			0.20		
Hospitals	0.09		0.80	0.40			0.60			0.00		
Others	4.51	0.20	5.60	4.60	0.70	1.40	4.72		0.50	4.20	4.00	

Table - 3: Weight of solid wastes transfer to the land fill site of Tehran (Iran) (from 1981 - 1991), (4)

Year	Population*	Transferred solid waste to the site (ton)
1981	5,539,000	1062411
1982	5,636,356	1283319
1983	5,735,218	1394748
1984	5,835,813	1515590
1985	5,938,175	1737249
1986	6,042,584	1814944
1987	6,168,693	1873930
1988	6,296,323	1843839
1989	6,428,861	1992387
1990	6,563,031	1964912
1991	6,700,000	2074162

* Population of Tehran calculated from the base of 1980 and 1986.

Table - 4: Detailed data for the amount solid waste transferred to the Tehran site, During the First month of Autumn (1992) (Iran), (4)

city zone No.	Numbers and kind of vehicle					Totals	
	Open	coverd	Roller	semi-trailer	Total	Total distance	total Weight (ton)
1	10	20	1	2	33	712	7038
2	14	17	3	-	34	872	12235
3	11	26	2	-	39	289	3286
4	20	8	2	7	37	768	12177
5	8	5	2	4	19	328	4451
6	14	11	5	-	30	1043	3518
7	9	14	1	-	24	11318	10880
8	11	-	1	6	18	321	8131
9	10	10	-	-	20	831	6199
10	14	17	2	-	33	1416	3207
11	17	14	2	-	33	1442	10807
12	15	19	-	-	34	1826	13428
13	10	14	2	-	26	772	7157
14	15	15	2	-	32	1315	11670
15	17	11	-	2	30	776	10666
16	19	3	1	3	26	574	9101
17	14	7	-	-	21	3023	3747
18	14	10	2	-	26	1744	3827
19	10	-	1	4	15	161	4318
20	11	10	1	-	22	830	7817
Total	262	248	11	19	540	21354	174472

In addition to the above sums 12662 ton industrial solid wastes and 4156 ton of urban refuse from other parts of the city is transferred to the city site by the municipality in the same month.

1.3 Characteristics and Composition:

Since solid wastes are generated from many different sources, they are composed of many materials which range in size from specks of dust to discarded vehicles. The major constituents of domestic and commercial wastes are fermentable organic matter, glass, wood, metals and plastic. The relative proportions of these components depend upon various local factors.

Information on the chemical composition of solid wastes is important in evaluating alternative processing and recovery options. For example, consider the incineration process. Typically wastes can be thought of as a combination of semi-moist combustible and noncombustible materials.

In terms of solid waste management planning, knowledge of future trends in the composition of solid wastes is of great importance. For example, if a paper recycling program were instituted on the basis of current distribution data and if paper production were to be eliminated in the future, such a program would become a very costly. Although this case is extreme, it nevertheless illustrates the point that future trends must be assessed carefully in long-term planning. Another important question is whether the quantities are actually changing or only the reporting system has improved.

The overall compositions of municipal solid wastes were reported in some of the EMR reports, Table-5 through Table-18.

Table 5: Characteristics of solid wastes in some Egyptian cities. [Table – 2, (3)]

	Cairo	Alex	Giza	Tanta	Fouk Tahl	Assut	El Zagazig	El Suez	Ismailia	Beal Senoff	Shibha El Koni	Dandetta
Putrescibles (POB)	46.00	67.2	44.3	52.6	46.20	49.5	54.6	40.0	30.5	54.70	59.00	62.70
Paper	21.20	17.5	20.4	12.7	28.00	15.0	12.4	15.0	23.1	13.70	8.60	14.20
Glass	1.70	2.1	1.4	2.0	2.00	4.5	1.0	2.5	1.3	1.00	1.40	1.00
Metal	2.40	1.8	2.8	2.6	2.30	8.0	1.5	8.0	3.0	2.30	1.20	2.50
Plastic	3.80	1.0	3.5	3.4	4.50	5.0	3.7	10.0	2.8	3.00	2.70	2.00
Textiles	2.40	2.7	2.2	3.7	2.10	3.5	2.5	8.0	2.2	2.70	2.40	
Others	22.50	7.7	25.3	23.0	17.00	11.5	23.3	23.5	30.1	22.00	23.60	17.60
Characteristics												
Moisture (%)	40	25	25	25		25	35	20	33			45
		upto	upto	upto		upto	upto	upto				
		35	35	35		35	35	50				
Specific gravity	0.32	0.3	0.4	0.34	0.25	0.34	0.34	0.21	0.21			0.25
		upto						upto	upto			
		0.4						0.34	0.34			

Table - 6: Quality and Quantity of Urban Solid Waste of Tehran and Rasht City (1991) (Iran), [Table-2, (4)]

Type of material.	Percent	
	Tehran	Rasht
Compostable	70.73	66.70
Paper	10.33	12.14
Plastics	3.72	3.50
Metals	1.43	4.33
Textils	2.73	2.94
Wood	0.71	2.66
Glass	2.83	1.28
Construction refuse	1.22	1.13
Other mat.	4.21	3.06
Total	100.50	100.00

Table - 7: Components of municipal solid waste for 1986: (Jordan) (5)

Component	% by wet weight
Food Wastes	49.48
Metals	2.46
Glass	3.29
Paper and carton	25.91
Plastic	6.55
Miscellaneous	6.55

Table - 8: Overall mean values of household refuse characteristics, generation rate physical condition. (Jordan) (5)

Density, Kg/M ³	153
Generation rate, Kg/c/d	0.40
Generation rate, L/c/d	3.03
Food waste	61.3%
Paper	15.6%
Cardboard	8.3%
Plastic	3.6%
Leather	2.3%
Wood	1.1%
Glass	3.7%
Tins and cans	3.5%
Garden trimmings	0.45%

Table - 9: Overall average moisture content (Jordan) (5)

Food waste	31.2
Paper	20.7
Cardboard	15.3
Plastic	7.4
Leather	16.1
Glass	7.3
Tins and cans	6.9

Table - 10: Composition of household waste of the commune of Yacoub El Mansour in Rabat (Morocco).

Following the measures of U.T.O.M. (1979) (6).

ELEMENTS	WEIGHT CONTENT %
Organic materials	67 %
Glass	0.4%
Plastic and rubber	2.6%
Metal	1.4%
Paper, cardboard	19 %

- Humidity rate 60 to 66 %
- Specific weight 0.35 %
- Calorific power 900 to 10000 cal/kg.

Table - 11: Composition of the household waste collected from the factory of household waste treatment of Oulja in Sale. (Morocco) (6) (U.T.O.M, 1992)

ELEMENTS	WEIGHT CONTENT %
Foodstuffs waste	69.8 %
Paper	13.9
Plastic	6.2
Textile	3.1
Garden's garbage	2.3
Leather, rubber	1
Wood	0.8
Glass	0.3
Stones, pottery	0.4

Table - 12: Evolution of the physical composition of household waste in Morocco. The situation in 1960, (6)

ELEMENTS	WEIGHT CONTENT %
Paper, cardboard, rags	15
Construction materials	0.8
Glass	0.6
Metal	0.4
Plastic and rubber	0.3
Vegetal fragments and material liable to putrefy	75
Varied (bones, pieces of wood...)	8

Table - 13: The situation in 1990, in Morocco (6)

ELEMENTS	WEIGHT CONTENT %
Paper, cardboard, rags	18 to 20
Glass	1
Metal	1 to 3
Plastic and rubber	2 to 3
Vegetal remnants and materials liable to putrefy	65 to 70
Varied (bones, pieces of wood...)	5 to 7

Mean specific weight is 0.4% and the moisture rate average is 5 to 70%

Table - 14: Example from the rural area, (6)

Physical composition of the household waste in a zone situation in the south of Morocco (El Gara, Bouarfa, Zaio).

ELEMENTS	WEIGHT CONTENT %
Organical materials, paper	83.3 %
Metal	1.9 %
Glass	1.3 %
Plastic	5.8 %
Others	7.7 %

Specific weight average is 0,4 % and the humidity rate is of 70 %.

A:

List of organizations who provided evidence or information: (Syria) (7), (related to table 15)

Ministry of Environment, Eng. Y. Owata, Eng. R. Abdrabo, and we numbered the counties who replied as follows = 1- Damascus county, 2- Damascus rural district, 3- Aleppo and Edleb counties, 4- Homs county, 5- Hama county and rural district, 6- South Syria (Dara'a, Sweda, Qinetra) district, 7- Deralzor county and rural district, 8- North Syria (Hasaka and Raka district, 9- Latakia county, 10- Tartos district.

We will indicate to counties or district by Numbers from 1 to 10 and population per millions by (P), houses refuses (tons per day) = H, hospitals refuse = h, trade refuse = t, industries refuse = i, vegetable and putrescible = O, Gardens = G, paper=P, Metals = M, glasses = g, pottery = po, plastics = pl, rubber = r, Skins = S, textile = te, wood = w, Small stone = S.S, Sand = Sa, Dust = d, unclassified = Un, Min = I, Max = III, AV = II

Chemical character = c.c, humidity ratio = hr, Carbon ratio = Cr, Nitrogen ratio =Nr, dust ratio = dr, and metals (mg/kg) such as pb, Cd, Hg, CN, Ni, laborer number = L,n, and if the land fill is safe = L,f,s and if it is not safe = l.f.n.s. incineration = inc, composting = com, expected refuse = e,r, transferred refuse =tr, big vehicle = B.v, med vehicle = M.v, Small vehicle = S.v, tractor = tr,

vehicle capacity per tons or per m3 = v.c,

collection time = c.t, vehicle number per day = V.n, total quantities per tons =t.q.

According to previous studies carried out in Tunisia, the composition of domestic wastes appears as follows (percentage of volume): (8)

Table - 16: Domestic wastes %, (8)

Component	Percentage
Organic matters	70 %
Paper, Cardboard	11 %
Plastic	7 %
Metal	5 %
Glass	2 %
Various matters (wood, textile,.....)	5 %

Table - 17: Waste Composition in Yemen % (9)

City	Year	Organic matter	Paper	Plastic	Metals	Glass	Other
Sana'a	1994	45	10	10	15	5	15
Sana'a (Ramdan)	1994	60	7	10	12	2	9
Sana'a (16)	1983	46.6	8.5	6.5	10.1	4.7	23.5
Taiz (16)	1978	44	7	5	12	4	28
Aden (19)	1990	4.5	13.4	7.7	6.6	1.4	66.4
Aden (6)	1976	57.0	15.5	2.9	13.2	2.6	8.8

Table - 18: Waste Compositions in Different Countries % (9)

Country	Organic matter	Paper	Plastic	Metals	Glass	Other
Yemen (10)	47	9	9	5	3	27
Kuwait (15)	37.5	35	5	5.5	3.5	13.5
Egypt (7)	60	13	1.5	3	2.5	20
Nigeria (6) Ibadan	76	6.6	4	2.5	0.6	10.3
India (4)	36	3	1	1	8	51
Lima (6) Peru	34.3	24.3	2.9	3.4	1.7	33.4
Canada (3)	33.7	36.5	4.7	6.7	6.6	11.8
Germany (13)	46	16	5	3	9	21

1. Rear loading compactor trucks,
2. Transfer trailers,
3. Compactor skip trucks,
4. Tipper trucks,
5. Pick-up.

In general, solid waste collection system in Yemen is characterized by a lack of operating collection vehicles and communal containers. This results in infrequent or no waste collection in low income neighborhoods. In these low income areas, wastes are dumped in open areas and drainage ways, and workers spend much time cleaning around these areas.

1.5 Disposal Options:

Disposal is the "no alternative" option because it is the last functional element in the solid waste management system and the ultimate fate of all wastes that are of no further value (2).

In the management of new disposal sites, the single most important issue for management is to find a location that is acceptable to the public and to local regulatory agencies. In the management of existing disposal sites, the major concern is to ensure that proper operational procedures are carefully and routinely followed.

The great majority of wastes collected by municipalities in the EMR states were disposed of in open dumps. For example, about 95% of the wastes collected by municipalities in **Egypt** were disposal of in open dumps (page 7). However, over the last few years, there has been a trend towards applying treatment or disposal methods.

In **Jordan**, except for villages which dump their solid wastes in heaps in the open and often burn them, municipalities opted to dispose their solid wastes in landfills.

In general, there are better techniques of disposal than open dumps. These are:

- * landfills
- * composting
- * incineration

1.5.1 Landfills:

Many municipalities in the EMR states opted to dispose their solid wastes in landfills. Landfills are used by Cairo and many Egyptian municipalities. Amman and most Jordanian cities use landfills. The current landfill area for Greater Amman, Zarka and Rusaifa is 300,000 m² and the municipality is planning to acquire another area of 500,000 m² which will satisfy disposal needs for several years.

In **Tunisia**, a landfill site of Henchir Yahoudia is in use since 1963 with a total area of 100 ha. The Ministry of Environment has elaborated a National Program for the Management of Solid Wastes (PRONAGDES). This program aims at improving the management of different types of wastes. The PRONAGDES is proceeding to improve and control landfills. There will be 27 controlled landfills according to the 8th plan (92/96) in chief towns of Tunisia.

1.5.2 Composting:

This is a process involving both the separation and bacterial conversion of the organic solid wastes. The process consist of (2):

- * preparation of solid wastes,
- * decomposition of the solid wastes, and
- * product preparation and marketing.

Composting is not used widely as landfills. In **Marocco** composting started in the sixties. As of now, there is only one factory in Rabat that is operating.

In **Tunisia**, four units of organic waste composting will be built by the PRONAGDES.

In **Yemen**, the farmers in some villages started to compost their waste and utilize it as soil conditioner.

In **Iran**, the first plant was introduced in Asfahan close to a slaughter house and sewage refinery in 1969 with a capacity of 100 tons/day. Two years later, Tehran compost plant was into operation with a capacity of 500 tons/day. These plants are now out of service because of inappropriate operation and management. In 1989, another plant with a capacity of 500-750 tons/day was operated in Asfahan.

1.5.3 Incineration:

This process can reduce the original volume of combustible solid wastes by 80 to 90 percent. But the questions of air pollution control and of economy remain major problems in implementation.

This process has been introduced in several Egyptian cities since the mid-eighties. But the performance of the incinerators units is very poor, page 8 (3). Studies on the incineration option showed that its prospects will be largely confined to hazardous or special wastes.

2. Current SWM Practices and Their Environmental Health Implications:

2.1 Collection:

The high percentage of domestic waste as part of the total solid wastes creates problems because of its high moisture content. This situation attracts flies and causes odor problems. This is hazardous to the public health, especially if the wastes are not collected regularly, particularly in summer when temperature rises.

2.2 Transference:

When solid wastes are transferred in open carts and trucks, light items, such as paper and plastics, may be blown away by the wind and will be scattered along the route to the disposal site. On the other hand, transport of highly moist wastes may result in spillage of wastewater on the roads, especially if compactor trucks are used in which the compaction squeezes the water content out of the waste.

2.3 Disposal:

2.3.1 Open dumps:

Open dumping is the main method of disposal in **Egypt**, page 28 (3). In Alexandria, all dumping sites are located adjacent to residential areas. This practice of open dumping has many side effects, such as the scattering of paper, plastics, and dust. According to the prevailing winds and humidity, the residential areas around the dump site were affected by soiling of laundry from fly ash, and irritation from noxious gases, all of which have a psychological as well as a physical health effect. The major dump site is close to Alexandria Airport and is also regarded as potential danger to aviation because of diminished visibility associated with dust and smoke rising from smouldering wastes.

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Exposed wastes in the open dump sites attract flies, rodents and sea-gulls. The incidence rates of infectious hepatitis among those living in Karmouz and Abbis sites, which are close to the dump sites, have shown to be higher than among those who are living further from dump sites, as in Khorshed.

The dump sites are also favorable breeding places for rodents. Animals caught in the Moharram Bay area close to the dump site were found to have a higher percentage of *Trichinella Spiralis* than those in other areas. These animals act as sources from which *Trichinella* can pass to other mammals and then to humans.

2.3.2 Landfills:

In Jordan, some landfills are not protected and the wastes are rarely covered with soil. In such cases, the refuse is often burned. Burning of refuse in containers is also practiced in refugee camps. Garden waste in Greater Amman is also burned by the municipality workers in empty lots in the various districts of Amman, page 12 (5).

A good example on the badly managed landfill is that which serves Irbid Governorate, Jordan, known as the "Akaidir Waste Dump". Aside of the solid waste which amounts to about 560 m³ per day, another 350 m³ or more of wastewater and sewage are daily dumped by sewage tanks in the area. Moreover, the dissolution of the dumped solid waste, combined with rainfall produce a large quantity of polluted water in the form of leachate. Such a situation where solid wastes and liquid wastes are dumped in the same area, cause an increase in amount of pollutants that result from washing of solid and liquid wastes.

A field investigation on the site in 1989 revealed the formation of large pools of wastewater, interconnected with one another at various elevations, intersecting the Jordanian-Syrian border and part of this water flows into the Syrian territory. This site cause air pollution, mostly has smell in the area which is often intolerable. The site also harbors an enormous populations of mosquitoes and flies and other insects as well and it is an excellent niche for rodents, which are of great nuisance to the region. It was also reported that at least one well, south of the waste dump, is unsuitable for drinking, but the water of the aquifer to the east, is still potable. Fortunately however, this area is far away from population centers and the topography, the structure and the climate make it suitable for drainage, page 13 (5)

In general, liquid from dumps and poorly engineered landfills can contaminate surface waters and groundwaters.

2.3.3 Composting:

Composting is one of the treatment and disposal methods for domestic solid waste and its technology is now spreading in Egypt, page 31 (3). An assessment of the pilot plants in Alexandria and Cairo has shown that the windrow methods with material recovery is the appropriate technology for Egypt. Composting of domestic solid wastes into organic fertilizer is regarded as a public service which prevents breeding of the rodents, flies and insects which spread disease and consequently contributes to a reduction in environmental pollution.

However, the demand for compost is very high in **Egypt**. The estimation of potential land reclamation areas is about 800,000 feddans west and east of the Nile Delta and in Sinai. Based on the application of about 10 tons of compost for each feddan, the required amount would be about 8,000,000 tons. If all the domestic solid wastes collected from all cities were converted to compost, the yearly amount produced would cover about 10% of the total demand for organic fertilizers. Selling materials recovered in the pilot composting plant may be considered as a source of revenue and would cover some of the costs of maintenance and operation.

2.3.4 Incineration:

One of the most attractive features of the incineration process is that it can be used to reduce the original volume of combustible solid wastes by 80 to 90 percent. But air pollution control remains a major problem in implementation. With most incinerators, the primary concern in air pollution control is with particulate emissions rather than with gases and odors.

2.4 Resource Recovery:

In **Egypt**, domestic solid wastes and industrial solid wastes which are collected by the private sector are sorted by these same collectors. Sorting is performed manually in streets, on vacant land and/or at dumping sites, page 30 (3). Salvable items such as glass, metals, high density plastics, wood, paper, rag, leather and bones are baled to be sold. This recycling process is beneficial as it provides pertinent industries with some raw materials at low prices. However, the current procedure has many side effects both on the public and on the workers. The baled salvable items are generally stored within residential areas and are a menace to safety and to the public health of the neighborhood.

2.5 Hazards Affecting Solid Waste Workers:

In **Egypt**, a sample of workers engaged in street, domestic, and industrial solid waste management, and a control sample, were selected to investigate the hazards to which waste workers are exposed. The result showed that the workers were exposed more to the following hazards, page 32 (3):

- respiratory diseases particularly chronic bronchitis,
- eye diseases particularly conjunctivitis and pterygium,
- skin disease,
- parasitic infestations particularly *Ascaris*, *Ancylostoma*, *Trichuris*, and *Schistosoma haematobium*,
- accidents particularly wounds, back aches, dog biting, and sun stroke,
- enterica and diminished vision, and
- bacterial counts were more among waste workers than among control workers.

The main cause for the high incidence rates of the previous hazards, apart from the solid waste management per se, were found to include the lack of personal protective measures, lack of water supply and washing facilities at working sites, and the presence of sensory defects among the workers.

To abate the previously impacts, some measures have to be adopted. The most important single measure is to achieve sanitary SWM starting at the source of generation of this waste and ending in the disposal site. Solid waste workers deserve certain guidelines to alleviate the health hazards affecting them. The later guidelines are:

- pre-employment examination to exclude persons with sensory defects,
- health education and training of all personnel engaged in SWM,
- supply of protective measures as uniforms, gloves, boots, and hats,
- use of mechanical means to lift heavy loads to avoid the occurrence of low back aches and hernia,
- provision of water facility at work site for drinking and washing,
- provision of first aid kits in the trucks and at the disposal sites, and
- adequate salaries and compensating allowances should be paid, with incentives for optimum performance.

2.6 Social Aspect:

Disposal of solid wastes in scattered manner in open lands and close to residential areas give ugly sites, and discourage visitors. In Casablanca, Morocco, the polluted environment around the city with unpleasant sites disturbs travellers to the city with bad smells and smokes. In coastal cities, dumped wastes on the coast hurts tourists and pollutes beaches and waters.

3. Necessity, Role and Needs of SW Recovery, Recycling, and Reuse:

At present solid wastes recovery, recycling and utilization is receiving more attention than before. Various feasibility studies on composting were offered to Greater Amman Municipality, Jordan, required large financial assistance from the Municipality. The Municipality and the Ministry of Municipalities, Rural Affairs, and Environment welcome the utilization of part or all municipal solid wastes; provided that there is no requirement for assistance other than collection and transport of the wastes. In view of this, the local authorities are in favor of any sort of recycling.

3.1 Methane Production:

A study for methane production project was recently made by a team of specialists from Denmark, on the expense of the United Nation Development Program (UNDP) for the Municipality of Greater Amman. The study calls for the establishment of the pilot project which requires up to 200 tons of municipal solid waste daily, and it is to offer training on methane production from municipal solid wastes for the region and offer great opportunities for jobs and research to the local people. The project is to be financed by the UNDP and the Municipality is to assist in providing the required solid wastes, land, and technical as well as non-technical personnel. Though the government on this project is still not finalized, the Municipality of Greater Amman is willing to cooperate and to provide the project with certain unmixed wastes, such as that generated from the slaughter houses which amount to about 300 tons per day; vegetable refuse from the Central Vegetable Market (about 3-8 tons per day); spoiled food (600-800 tons per day) and wastes from dairy industry which amount to about 400 tons/month.

3.2 Recycling and Reuse:

In Egypt, recycling is done by the garbage collectors (Zaballeen). This system has been in operation for more than 50 years in large Egyptian cities, page 23 (3). The collected wastes are transported to Zaballeen settlements, mainly by donkey-drawn carts, where recycling takes place by:

1. Hand sorting of recoverable materials such as: paper, plastic, glass, metals, cloth and bones.
2. Processing of recovered materials - each type is baled and transported as raw materials to factories.

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In **Jordan**, presently, certain components of municipal solid wastes are being recycling. The components, such as, glass, plastic, paper, iron and steel, and aluminum, are mostly separated by children and women scavengers from solid waste collection centers or collection containers from the neighborhoods.

3.2.1 Aluminum:

In **Jordan**, aluminum containers of soft drinks are being separated from the wastes by needy children and families, sold for 0.2-0.3 JD/kg. These containers are sent to Syria and Saudi Arabia for recycling. Aluminum scraps are recycled by a local, privately owned aluminum factory. The Arab Aluminum Factories incorporated recycles its rejects of aluminum.

In **Morocco**, recycling of metals saves 75-97% of consumed power.

3.2.2 Glass:

In **Jordan**, glass bottles generated from soft drink industries are being automatically reused by the concerned companies, through consumer merchant dealings which permit for either change or sale of empty bottles. About 98% of such bottles are continuously reused.

Part of the other glass of all sorts, is being recycling by two family workshops for glass blowing. The products of these two shops are mainly marketed to tourists.

In **Morocco**, recycling of glass results in saving raw materials and power. Each time, a glass bottle is used for a second time, 300 g of fuel are saved.

3.2.3 Paper and Cardboard:

The carton factory in Greater Amman, **Jordan**, region receives and recycles 5-30 tons of waste paper and cardboard per day. These wastes are manufactured into chipboard, fluting and test liner sheets for making carton boxes.

Two smaller Jordanian family business projects, manufacture egg trays from newspaper and magazines. Jordan paper company recycles about 600 tons of paper waste, which amounts to 65% of its needs. Costs of local transport of paper waste, as of 1986 was 12 JD/ton.

In **Tunisia**, the total need in paper is 180,000 tons per year. About 30,000 tons are recycled yearly.

In **Syria**, there is a paper industry without raw materials which are imported. They are not using the wasted paper which amounts to 375 tons.

3.2.4 Plastic:

There exists one light industry in **Jordan** that recycles plastic refuse. The industry recycles about five tons of plastic wastes per day.

In **Syria**, municipal refuse contains 1125 tons of plastics. It seems that they are not making use of it.

In Tunisia, the plastic recycling industry, still at an embryonic stage disposes of an installed capacity of 5,000 tons distributed on two units (total volume of plastic matters transformed annually in the country is about 120,000 tons). More companies, originally non specialized in recycling, join the sector in order to get the needed supplies of recycling raw materials for the manufacturing of plastic items.

3.2.5 Meat Scraps:

A feed factory in Jordan recycles daily three tons of meat scraps, skin, bones, and chicken insides for the production of animal feed. This factory also utilizes an unknown quantities of blood from slaughter houses

3.2.6 Orientation of Solid Waste Recycle and Reuse in Tunisia

Solid wastes recovery, recycling and utilization have become matters of the moment that only a transparent, coherent and planned approach could promote.

Financial incentives and fiscal advantages would allow to boost the sector and incite economic operators to invest in the new openings offered by the opportunity to develop the activities, often margined, of recovery, recycling and reuse of wastes.

3.2.6.1 Current situation, Tunisia

Scattered activities of recovery are undertaken all landfill sites, mainly those the sites of Henchir Yahoudia and Raoued, by ragmen for the recovery of metals, paper, board, and other sub-products. It is anarchic, non organized and uncontrolled sector.

Besides these activities, recycling concerns wrapping wastes and interests two industrial sectors that is the plastic and paper and board. The plastic recycling industry, still at an embryonic stage, disposes of an installed capacity of 5000 tons distributed on two units (total volume of plastic matters transformed annually in the country: about 120,000 tons). More companies, originally non specialized in recycling, join the sector in order to get the needed supplies of recycled raw materials for the manufacturing of plastic items.

Several problems of various natures restrict the activity of plastic recycling units. First, we should note the fluctuation of virgin plastics prices. In fact, since 1990, these prices have witnessed a considerable rise which has had negative repercussions on the ratio of price of virgin matters on the price of recycled matters reduced from 2 to 1.2.

Regarding the sector of paper and board recycling, we note that for a total need in paper of 180,000 tons a year (all varieties included) about 30,000 tons are recycled.

Some companies have their own channels of recovery of used paper mainly clients traditionally known in the sector. Others have set up a structured network spread out in the whole country particularly at the level of large cities.

Besides these companies, other paper manufacturers use for part of their needs used paper and board either recovered on the local market or imported, in order to mix them with virgin pulp, especially for certain varieties.

The problems that hinder today the functioning of the sector of recycling are of variable importance. The most important are as follows:

- the energetic cost of the transformation of recovered matters makes up a big part of the cost price. In fact, the operations of purification and separation of wastes require an additional energetic input that can reach 12% of the cost price.
- the collection is hindered on the sites because of the landfill of matters to be recycled with the rest of industrial and domestic wastes.
- the transport also burdens the cost of recycled matters. It represents more than 15% of the cost price.
- the investing cost is expensive (high). Banks are often reluctant to finance such projects.

3.2.6.2 Recommendations for the development of the recycling sector, Tunisia

Among the actions up to promote and develop recycling projects:

- The promotion of a legislative frame and an inciting regimentation to sustain the effort of sorting and selective collection of wastes and encourage the industrialists to take part in recycling projects.
- To carry out several actions of sensitization of all operators: industrialists, distributors, tradesmen and consumers. Intervening could be called on to proceed to a primary sorting at the source and ease the operations of selective collection.
- The carrying out of in depth studies of all the recycling opportunities. These exhaustive studies covering all economic sectors should identify market openings for possible projects in the field.
- Projects selection should be done on the same bases of viability and profitability than any other industrial project which supposes a supplying in products to be treated at the less costs and specific incentives (subsidy, fiscal and customs incentives,..)
- The carrying out of actions of training of staff and promoters who should be in charge of the execution of antipollution actions and programs and the development of recycling units.

4. Status of Disposal of Special and Hazardous Wastes

4.1 Industrial Wastes, Egypt

4.1.1 Introduction

As from the results of the survey conducted on industrial solid wastes in the industrial sector, industry has proposed a set of consultant projects representing first priority for the solid chemicals resulting as wastes due to the absence of a sufficient data base for an actual survey of industrial wastes-but the data rather being estimative.

Moreover there is no national plan for the safe disposal of solid wastes resulting from industrial processes in Egypt till now.

And in order to cast light on the volume of wastes that might exist, we refer to the fact that the industrial sector affiliated to the Ministry of Industry represents about 50% of the total state industrial sector. Table (19) indicates the types and distribution of the industries.

Table - 19: Type and Distribution of Industries, (Table-12, in Egypt (3))

Serial	Industrial Sector	No. of Units	Greater Cairo	Alex.	Delta Region	Upper Egypt	Canal Zone	% ge
1	Food	119	32	31	29	20	7	36.1
2	Chemical	53	23	18	7	3	2	16.1
3	Textiles	75	24	20	23	7	1	22.7
4	Engineering	39	30	7	-	-	2	11.8
5	Metallurgical	11	7	2	1	1	-	3.3
6	Mining	33	10	7	-	1	12	10
	Total	330	126	85	60	35	24	100.0
	Percentage	100	38.18	25.76	18.18	10.61	7.27	

4.1.2 Chemicals Industries - Upper Egypt

This Sector Comprises of, as regards upper Egypt, 3 industrial units affiliated to 3 companies. The wastes of the Egyptian Chemicals Industries Company (Kima) being the most important, amounting to 3650 tons/year of fine coal, 3480 tons/year of quartz and 7860 tons/year scrap.

4.1.3 Food Industries Sector

The most important company of this sector is the Sugar and Distilleries Company with its varied units amounting to 11 industrial units in the different Upper Egypt governorate and may be considered the only company which has conformed to specific types of solid wastes and their quantities in detail being represented by 412100 tons/year of filter mud, 8750 tons/year of boiler incinration dust and 7000 cu.m/season of bagasse burning products.

And due to the fact that the brown mud resulting from the filter presses and containing silt from the adhering soil and particles from the sugar cane bagasse and some time, sulphur and phosphate residues, included in the process phases as well as mineral salts found in the syrup as it used to be mixed with the water and discharged to the Nile. This waste causes pollution to the River Nile, therefore the company undertook preparations to separate it and transfer it outside the factories where its viability was proven for use as an agricultural fertilizer to be added to the soil at a ratio of 2 tons/feddan. However the problem of its storage leads to certain troubles because it undergoes fermentation due to temperature rises and ignites which has lead certain factories to stop this process sometimes to avoid the occurrence of fires especially at the storage sites at the neighborhood of factories and farms.

4.1.4 Textiles Sector

The industrial wastes of this sector represent the wastes of 6 industrial units affiliated to 2 companies, namely central Egypt company and the Upper Egypt Spinning and Weaving Company.

4.1.5 An Overview of Solid Wastes at the Alexandria Region

In the framework of the responses received from the companies emitting solid wastes resulting from an industrial activity in the Alexandria governorate, they may be categorized into three classes:

1. Solids which may be benefited from through selling or reuse, such as plastics, paper and wire cuttings and scrap. They are represented in the production wastes of 8 industrial companies totalling to about 18500 tons/year, taking into consideration that this quantity may be increasable upon adding the companies whose responses have not yet been received.
2. Wastes which may be disposed by dumping in the public garbage and are represented in dusts-woods-silt-sands-hulls and fibres of a quantity amounting to 56000 tons/year.

Table - 20: List of the Solid Wastes in the Cairo Region.
Industrial Solid Waste Indices/Chemical Sector,
(Egypt), [Table-13, (3)]

Serial	Name of Company	Site	Type of Solid Wastes
1	Abou Zaabal Fertilizers & Chemical Industries	Abou A Zaabal	Accumulation of Wastes on the bottom of Liquid waste separation funnels.
2	Middle East Paper (Sime)	Mestorod	Paper Foreign Matter (Wires-Pieces of Wood-Plastics-Steel-Pins) Paper 10 cu.m/day
3	Egyptian Woodworking	Helwan	Data not available.
4	Nasr Coke & Basic Chemicals	El-Tebbin	Carbaceous matter
5	Nasr Rubber products	Shubra El-Kheima	Tarry matter- tar oils used as boiler fuel
6	National Plastic	Shubra El-Kheima	Thermal plastic- Reprocessed more than once beared scrap reused
7	General Batteries	Dar El-Salam	Scrap 60 tons/year- spent batteries 5 tons/year copper scrap 60 tons/year
8	Egyptian Leather Manufacture	Basateen	Hides - Fibres (Disposed in the desert).
9	Industrial Gases	Mestorod- Hawandia- Shubra El-Kheima	
10	Paints & Chemicals	El-Antyna	Wastes Paste & Toner Dustings 120 tons/year Sold or discharged in the public garbage yards
11	Nile Match	Imbaba	Solid Wastes (sulphur-sand-phosphorous-Gelatin)
12	Nasr Pencils & Graphite Products	Nasr City	Laboratory & different process stages waste which are disposed by incineration or storage outside the factory limits

3. Industrial drainage wastes usually being hazardous wastes which must be gotten rid of through safe and secure procedures due to their inclusion of heavy metals and toxic matters, such as the wastes from the Paints and Chemical Industries Company (post cleansing wastes-paints, 120 tons/year). The Nile Match Company (chemical laboratory wastes), Nasr Tanneries (tanning and hide, treating wastes, 480 tons/year), Nickel salt wastes used as a catalyst in the ghee industry, 15 tons/year, (Table 20).

4.1.6 Agricultural Waste

The total area of cultivated land in Egypt is 3.1 million ha (1989). Agricultural solid waste includes residues from different kinds of crops, manure, and pesticide and fertilizer residues.

- Crop residues are estimated at 20.6 M tons/year (1985), of which 60% or 13.6 M tons/year, is used as fuel, with an energy efficiency rate of 6-11%, while 7 M tons/Year are used as fodder.
- Annual production of animal manure is estimated at 187.6 million m³. Approximately 113 million m³ is used as fuel. The remainder (75 million m³) is to some extent used as fertilizer.
- Up until 1991, pesticide use was relatively stable at around 15,000 to 18,000 tons/year. This year a reduction in subsidies brought about a decrease in use. Over the last 30 years, a large number of pesticides were used at very high doses. Pesticide residues accumulate in the food chain and can have serious health impacts. There is no data available on the number of used containers or quantities of outdated pesticides requiring disposal.
- The use of chemical fertilizer has grown in recent years, from 75 kg/ha in 1970 to 140 kg/ha in 1990. Total use is estimated at 5.6 M tons/year. Problems with cadmium can result from certain types of fertilizer.

4.2 Hazardous Wastes

Hazardous wastes can be best defined as wastes containing highly persistent elements, chemicals, compounds and microbes, with potential chronic and acute impact on human health and the environment.

Also, a hazardous waste is defined as any waste, excluding domestic and radioactive waste, which because of its quantity, physical, chemical or infectious characteristics can cause significant hazards to human health of the environment when improperly treated, stored, transported or disposed.

4.2.1 Types of Hazardous Wastes, Jordan

The types of hazardous wastes that are generated in Jordan are:

1. Liquid wastes from electroplating or similar industries and/or residues from treatment of such wastes.
2. Slag from industries melting metal scrap.

3. Oil waste (used lubricants, engine oils, grease, etc.) mostly from car-wash, garages and workshops.
4. Waste from laboratories particularly organic solvents.
5. Pesticides from agricultural practices.
6. Refinery sludge.
7. Sharp ends, drugs and microbes from hospitals.
8. Radioactive materials from hospitals, clinics universities and industry.

4.2.2 Types of Dangerous Waste, Morocco

Even if principal types of dangerous waste change according to communities, we can include the following:

- Waste which contain cyanide
- Waste of metal finishing (including acidic waste)
- Polychlorine diphenyls and similar
- Hydrocarbon
- Solvent
- Mercury waste
- Pharmaceutical waste
- Biomedical waste and contaminated materials
- Antibiotics
- Tar wastes
- Asbestos
- Plastic waste
- Phenol (carbolic acid)

Actually, many communities provide little information on the types and quantities of wastes they produce. Information of this kind is essential to the drawing of an appropriate system of elimination.

4.2.3 Types of Hazardous Wastes, Syria

Hazardous wastes in Syria include:

1. Phosphate mining
2. Asbestos
3. Mineral oil
4. Toxic industrial wastes, include:
 - metal finishing
 - textiles
 - pharmaceutical
 - chemicals
 - activated carbon production
 - edible oil
 - fertilizer
 - petrochemical
 - pesticides

4.2.4 Waste Streams, Jordan

1. Clinical waste from medical care in hospitals, medical centers and clinics.
2. Waste from the production and preparation of pharmaceutical products.
3. Drug waste and expired medicines from several resources.
4. Wastes from bio and chemical research at research institutes and the universities.
5. Wastes from manufacturing, formulation and use of wood preserving chemicals.
6. Wastes from the production, formulation and use of organic solvents.
7. Wastes originating from oils/waters, hydrocarbons / water mixtures and emulsions.
8. Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs).
9. Tarry residues arising from refining, distillation and any pyrolytic treatment.
10. Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish.
11. Wastes from production, formulation and use of resins, latex, plasticizers, glasses and/or adhesives.

In a recently performed study on hazardous waste management in Jordan, it is estimated that 22,000 tones of solid hazardous waste and 36,000 tons of hazardous liquid waste were generated in 1993. More than 50% of the liquid hazardous waste consist of waste oil.

4.2.5 Current Disposal and Treatment Practices

Ever since the government of Jordan become increasingly aware of protecting the environment for the last decade or more, the industries have been forced to do something about the hazardous waste they generate. Accordingly, most of the industries treat liquid waste on-site, but few do it properly and the conditions of the treatment plants are very poor. Moreover, most of the hazardous wastes are dumped at the landfills for domestic waste; despite the fact there are no leachate collection systems or monitoring programmes for these sites. Some companies (e.g. ARAL Aluminum) have special and approved disposal sites in abandoned quarries or similar places.

In the municipality of Amman, a license system has been established where companies must have an agreement before they are allowed to dump the waste on the landfill. The license must be renewed every year, and amount and type of waste have to be declared before approval. However, in absence of alternative disposal facilities, rejection of applications has not been practiced and control of the waste received on the landfill is minimal.

4.2.6 Hospital waste

4.2.6.1 Generation Rate

A study conducted in 1988 in Jordan revealed that general hospitals in Greater Amman to generate waste 3.73 - 5.5 kg/patient/day, with an average of 4.7 kg/patient/day, or 3.5 kg/bed/day. On the other hand, the generation rate in specialized hospital, e.g. Royal Farah Rehabilitation Centre, was found to generate 6.41 kg/patient/day.

However, generation rate of solid wastes at hospitals is directly related to number of bed-patient available at the hospital, type of specialization, range of care and number. Kind and size of its departments have also a direct effect on generation rate of solid waste and its quality.

4.2.6.2 Physical characteristics

The average density of solid waste generated from departments was found to be 140 kg/M³ and about 909 kg/M³ for that generated from kitchen. The overall density of the mixed solid waste was 202 kg/M³, with an over all average moisture content of 43%, page 25 (5).

4.2.6.3 Composition

Kitchen waste constituted 38 to 46% of the total waste generated; paper waste constitute 23.6%. Needles and syringes constituted 1.12%. Other components (metals, plastic, plaster, cotton and cheese cloth) constituted 2.65 - 14.43%, page 25 (5).

4.2.7 Medical laboratories

The generated rate of solid waste from medical laboratories was found to be 0.084 Kg/test/day; with an average density of 139.1 kg/M³ and an over all moisture content of 19.5%. Paper constituted 37.8% of the waste and metals constituted 1%. Other components ranged from 2.5% for needles to 27.1% for glass, page 25 (5).

4.2.8 Medical and Clinical Wastes, Tunisia

The development of the health cover in Tunisia in the late years led to the certain of a dense network of hospitals (158 all over the country) and basic health centres (662). The reception capacity of these institutions was estimated to about 16000 beds in 1989.

The District of Tunis alone counts 9 institutes and specialized centres, 9 university hospitals, 2 military hospitals, 3 circumscription hospitals, 2 publics polyclinics and about 15 private clinics.

All these medical institutions produce about 2000 tons/year of clinical wastes of all sorts: ordinary wastes comparable to domestic wastes, contaminated septic wastes, anatomic wastes, chemical wastes.

An investigation was conducted by the Administration for the Hygiene and Protection of the Environment (Ministry of Public Health) about the amounts of wastes produced by hospitals and clinics in the Great Tunis in 1992. It appears from this study that the most part of wastes produced are of the ordinary sorts (about 80%), the rest being mainly septic wastes (19%) and about 1% laboratory wastes.

As for anatomic wastes, organs are often inhumed for religious reasons while placentas are either inhumed, or conserved for the needs of the MERIEUX Laboratories (France), or simply eliminated with ordinary wastes for most clinics. About 88% of hospital wastes produced daily in the Great Tunis are forwarded to the site of Henchir Yahoudia, main site of the governorate of Tunis.

According to this same study, hospitals in the Great Tunis produce as an average 54 m³ of wastes per day: 83% ordinary wastes, 16% septic wastes and 1% laboratory wastes. The quantity of wastes produced by hospitals varies according to their field of specialization. The specific production by bed and by day has been estimated to 11.4 liters or about 3 kg for the hospitals of the Great Tunis.

Private clinics in the Great Tunis produce as an average 11 m³ of wastes per day, 77% ordinary wastes and 23% septic wastes. The specific production per bed and per day has estimated to 14 liters.

Wastes, often not sorted at source, are taken in charge by municipal services and forwarded to public landfill sites sometimes without much care.

It is to be noted that some hospitals, mainly those of the District of Tunis, are equipped with incinerators for the destruction of contaminated septic wastes. However, these apparatus are often non functional either because of the wearing away of parts of their unavailability in Tunisia, or because of the lack of maintenance and absence of skilled technicians that would ensure a good operation and a durable functioning of the equipment.

Thirteen (13) hospitals (81%) of the Great Tunis have incinerators only 5 of which are functional and 2 in the course of installing. Two (2) private clinics have functional incinerators among 4 equipped.

4.2.9 Industrial Wastes, Tunisia

These are mainly wastes of raw materials, finished and semi-finished articles by manufactures and industry units during or after the production cycle.

The quantity produced annually is estimated to about 317000 tons a year (phosphogyps wastes not included).

Table - 21: Distribution of Wastes Quantities by Industrial Branches

(Source: National Report on the Status of the Environment,
Ministry of the Environment - 1993, (Tunisia) (8))

Industrial Branch	Wastes Quantity (ton/year)
Mines, quarries	4 500 T
Agro alimentary	50 400 T
Textile	30 100 T
Leather	17 800 T
Wood and paper	13 700 T
Chemistry	27 600 T
Materials	38 400 T
Metals*	40 400 T
Energy	7 100 T
Iron and steel industry	84 400 T
Various	2 800 T

* (besides the steel and iron industry)

We could consider that there is presently no channel meant specifically for the collection, transportation, treatment or dumping of industrial wastes.

Moreover, there is a total lack of regimentation defining the necessary dispositions for the setting of a real legal structure controlling the handling of dangerous wastes, industrial and other.

As a consequence, there is a multitude of wastes evacuation systems, often ill-adapted and almost always not controllable.

The lack of sensitization or sometimes the carelessness of some industrialists has contributed to the current anarchy of the situation.

The absence of regimentation has led to practises, making this sector be a field of predilection for opportunistic intermediaries which have instituted themselves for the matter as industrial wastes carriers.

Generally, the evacuation of these wastes follows one of the following patterns:

- The industrialists evacuate their wastes by their own means: This situation occurs mainly when the frequency of evacuation is important or in geographically isolated industrial units;
- The industrialists call on a non-specialized intermediary. This is often financially advantageous for the industrialist even more because it frees the industrialist of all responsibility concerning the destination of the wastes.

In these two cases, the means used for the evacuation and the transportation of wastes are not adapted and no specific arrangements are made for the handling of these wastes.

- The industrialists call on specialized companies, particularly when the wastes need a specific handling.

Due to the absence of appropriate sites, industrial wastes are eliminated with domestic refuses with no preliminary treatment.

Part of these wastes end up in uncontrolled sites which has led to the proliferation of wild and anarchic landfill sites, especially near industrial zones.

This situation remains worrying mainly regarding:

- Inadequate stocking of wastes by industrialist within their manufactures, with no arrangement for leak proof.
- Future of sites because these become privileged sites for the dumping of all sorts of wastes, even more since these sites are sometimes located in residential areas.
- Pollution of natural receiving areas by the rejection of wastes and effluents presumably pre-treated.

- The responsibility of the industrialists in the "laissez-aller" accentuated by the existence of non specialized carriers which make up the real uncontrolled link causing the profusion of wild sites and the pollution of natural environment, sometimes quite sensitive (forests, rivers,...).

4.2.10 Miscellaneous

It is estimated that 22,000 tons of hazardous solid waste and 36,000 tons of hazardous liquid waste are generated in Jordan in 1993. More than 50% of the liquid hazardous waste consists of waste oil (page 30 (5)).

As often the case, hazardous wastes of either industries or hospitals are mixed with municipal solid wastes and end up in landfills (page 26 (5)).

In Iran, industrial wastes are collected with municipal solid wastes. While those wastes of hospitals and clinics are disposed of by incinerators, some hospitals in Iran do not have incinerators. Except for few hospitals, incinerators are already out of order.

A plan which was launched in Tehran in 1991, solid wastes from hospitals are collected by special vehicles and buried in independent trenches, 30 km far from cities. A more comprehensive plan is being prepared by the municipality, providing for collection of hospital solid wastes without direct handling of workers from loading to unloading and subsequent precaution and disinfection (page 29 (4)). In Tehran, Iran, there are already 132 hospital holding 26682 bed. The total hospital wastes are 70945 kg/day with an average of 2.659 kg/bed/day.

At one large and new hospital (Al-Asad hospital), in Syria, the solid waste is disposed of by incineration. Incinerator ashes are collected by the local authority. There are no incinerators in very small hospitals (page 13 (7)).

5. Existing and Planned National Policies, Strategies, Regulations, Standards and Action Plans

5.1 Egypt

5.1.1 Agencies Responsible for Refuse Collection in Egypt

Three systems are currently involved in Solid Waste Management (SWM) in Egypt:

- a. The governmental system operated by the municipalities in most of Egyptian cities or by special agencies dedicated to cleansing and beautification in larger cities (Cairo and Giza). This system is disciplined in nature and utilizes various types of collection and transport facilities. The scope of service includes collection of solid wastes arriving at streets or yards from different sources. Thus it may be stated that collected wastes include basically conventional street wastes, commercial refuse and considerable fraction of household wastes that are normally uncovered by other systems. The municipalities are also responsible for treatment or disposal of collected refuse.
- b. The conventional Zaballeen system which dates back to the early decades of this century. This system offers door-to-door service principally to households and selected commercial enterprises. Wastes are collected and transported by primitive facilities (uncovered donkey-drawn carts). From the view point of the client such type of service is satisfactory. However, the system works with the least coordination with municipalities or other responsible agencies. The collected wastes are sorted and the left-over organic wastes are used as animal feed.
- c. A formal private sector system which has been recently introduced in larger cities and some provincial towns. This system is in fact a refined model of the Zaballeen system retaining its scope but utilizing rather upgraded facilities. Wastes collection by the private sector are either delivered to the Zaballeen communities or to municipal treatment or disposal sites.

5.1.2 Existing Legislation (Law No. 38 (1967)), Regarding Public Cleansing

(Published in the Official Journal No. 77, Aug. 31, 1967):

Item # 1:

It is forbidden to dispose garbage or wastes or wastewater in places other than those specified by the local council.

Item # 2:

The residents of buildings of the directors of public commercial industrial and other activities have to keep garbage, wastes and dirt in special vessels and empty them according to conditions and standards specified by the executive legislation of this law.

In case of violations, the local council supplies these vessels against violation fees.

In case of presence of waste chutes and collection room(s), the chutes, connections and collection rooms should comply with the requirements specified by the local council.

Owners of unutilized areas (whether fenced or not) have to remove any piles of soil or dirt and keep them clean.

Item # 3:

It is forbidden to commit any of the following actions:

- Bathing or washing of household tools, clothes, vegetables, etc.. in public springs or public water bodies, except in places specified.
- Defecation or urination except in the specified water classes.
- Washing of animals bathing except in animal houses or specified places.
- Passage of cattle or animals in roads or streets specified by the local council.

Item # 4:

The owners of building in areas with no sewerage have to construct sanitary drainage means for wastewater according to the requirements specified by the executive legislation in the sites approved by the concerned authority.

In case of violation, the corrections or construction of these means may be implemented at the expense of the owner according to situations specified by the executive legislation. The owners of places with reservoir for water classes have to empty them, directly upon being filled, in the times specified by the local council. The local council may conduct that work, at the expense of the owner, with or without the owner's request.

In all cases, the process of emptying, transfer and discharge of wastes and the workers responsible should fulfill the conditions declared from the local council.

Item # 5:

It is not permitted to practice the profession of waste collection or emptying reservoirs except after issuing the necessary license from the local council according to conditions and rules declared by the council.

Item # 6:

Every owner of unused land has to fence it when requested by the local council in the determined date according to the conditions and the situation specified by the executive legislation. In case set of violation, the local council may fence the land at the owner's expense.

Item # 7:

The local council may impose an obligatory fee on residents of buildings not exceeding 2% of the rental value. The sum of this fee is directed to public cleansing affairs.

A cleansing fund is established in each council imposing this fee, where sum of this fee, violations fees and budget allocated by the council are deposited. The total sum deposited is directed to cleansing works expenses.

Item # 8:

Without violating any stringent penalty stated by another law, the penalty of violation of this law or its executive decisions is not less than LE 1.00 and not exceeding LE 5.00.

The local council may assign the violator to remove violation causes in the specified time , otherwise the council removes them at the expense of the violator. The sum of expenses are fulfilled through administrative route.

In case of violations of item # 1 and # 4, an agreement may be settled. Accordingly the violator has to pay a sum of PE 25 (in case of passers! and PT 50 for other variants within 48 hours of submitting the violation sheet).

Item # 9:

This law is valid for towns. It is also valid for villages specified by the concerned governor. The decision will be valid only after 30 days of its submission.

Item # 10:

The law 151 (1947), concerning fencing of space lands and keeping them clean, and law 159 (1953) concerning public cleansing in squares, roads, streets and like and organization of collecting and transferring garbage and their complementary laws as well as any statement not complying with this law are not longer valid.

Item # 11:

The law is published in the Official Gazette and is in action on date of publishing. The Minister of Housing and Utilities may submit the rules for its execution.

5.1.3 Management and Organization in Cairo and Giza

Due to the special nature of Cairo and Giza in an effort to combine solid waste activities under effective central control, the Cairo and Giza Cleansing and Beautification Authorities have been founded in 1983.

These central agencies are responsible for planning, management of municipal activities including regulation of private service delivery (Figure 1).

Inspite of creating such powerful entities, numerous problems have evolved including:

- * Coordination with district activities.
- * Insufficiency of available facilities to extend service coverage program.

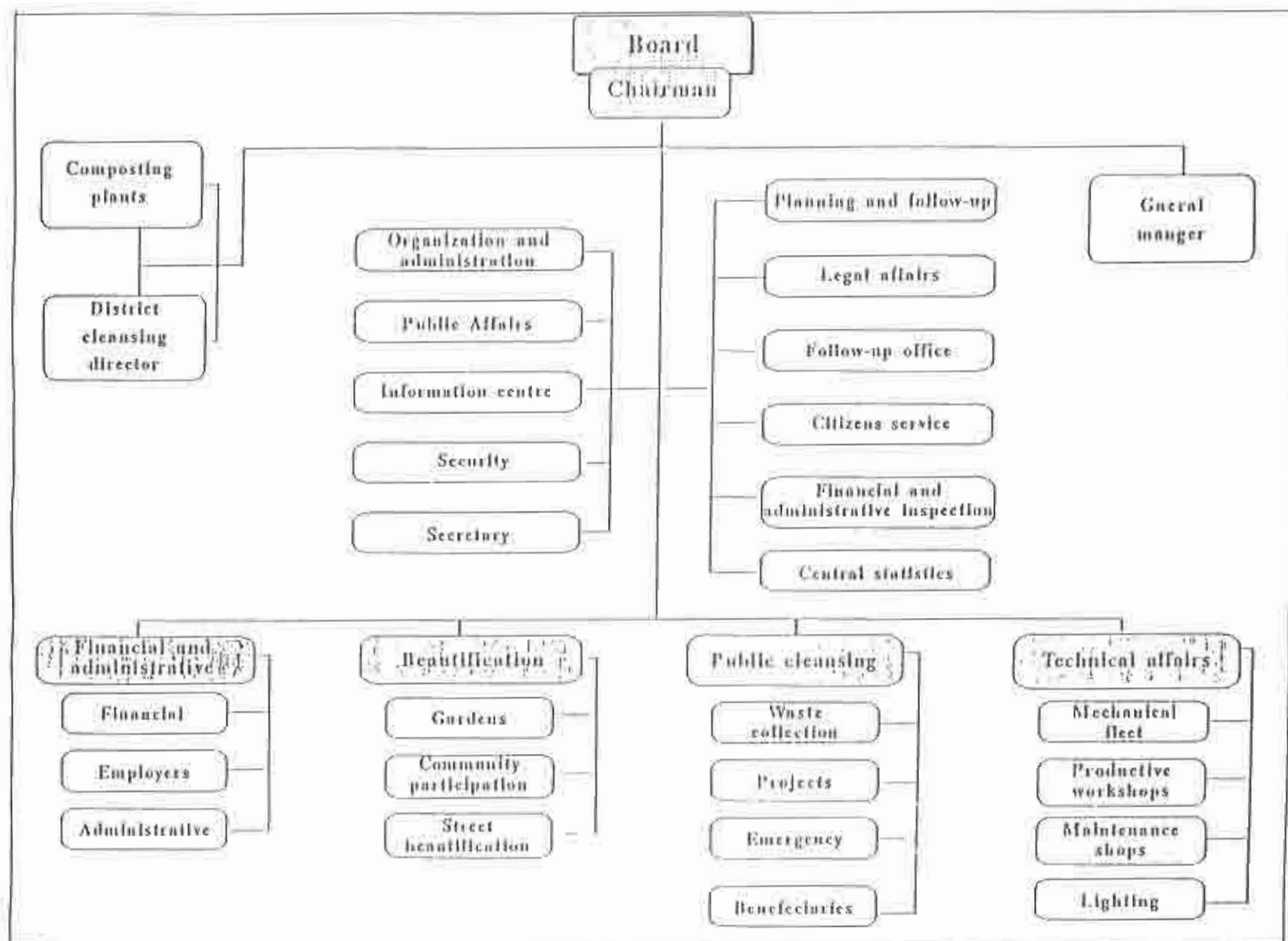


Figure (1): The Organization Chart of Cairo Cleansing and Beautification Authority.

- * Irregular follow up of the numerous daily activities.
- * Poor coordination with private collectors. However dedicated efforts have been undertaken to improve supervision and coordination of their activities.
- * Unbalanced labor force among the diverse activities affects efficiency of field activities. Considerable fraction of the work force is entitled to administrative activities. Both sides of over staffing and understaffing lead to inappropriate management and execution of solid waste services.

5.1.4 Organization and Funding of Local Governments

Responsibilities of solid waste management in provincial governorate is entrusted to the chairman of the City Council. Executive cleansing activities are divided between the engineering and environmental protection departments.

Example of the organization structure for municipal solid waste management is shown in Figure 2 for Tanta.

Funding for SWM is allocated from the governmental budget for services in addition to the cleansing fund. Budgets for some larger and provincial cities have been given in Table (22).

5.1.5 Legislation and Institutional Arrangements

As has been pointed before, there is a lack of legislation concerning environmental issues, which has led to that different authorities have a responsibility depending on the type of waste. Currently the following arrangements are set up:

5.1.5.1 Municipal waste.

The basic law for solid waste collection, treatment and disposal is law no. 38 of 1967 with amendment by law 31 of 1967. This law regulates collection and disposal of waste from houses, public places, commercial and industrial areas, and is valid for towns at the discretion of the concerned Governor. Among other points, the law forbids disposal of garbage in any place not specified by the local council. Solid waste collection is regulated by license delivered by the local council. The Ministry of Housing and Utilities is responsible for the implementation of the law and may submit rules for its execution. Solid waste management is the responsibility of the municipalities; however, in Cairo and Giza a Presidential Decree has led to formation of Cleaning and Beautification Authorities for both of these cities.

5.1.5.2 Industrial and Hazardous Waste.

There is no specific legislation for management of industrial solid and hazardous solid waste. Various laws and decrees address transport, handling and storage of chemicals. In addition, law no. 48/1982 addresses prevention of water resource pollution from hazardous wastes, both solid and liquid.

The Ministries responsible for the actual industry is also responsible for the waste generated by the industry, which creates a confusing situation and counteracts common solutions, which can support several industrial sectors.

A future organization dealing with questions related to the industrial solid (nonhazardous and hazardous) must cooperate with the following Ministries, unless the environmental legislation will define otherwise: Industry; housing and Utilities; Supply; Health; Petroleum; Economy; Interior; Public Works and Irrigation; Manpower; Local Administration; and Scientific Research.

5.1.5.3 Hospital and laboratory waste.

The management of hospital and laboratory waste is not regulated.

5.1.5.4 Agricultural waste.

Although there are several laws on pesticide use, there is no legislation on waste disposal in the agricultural sector.

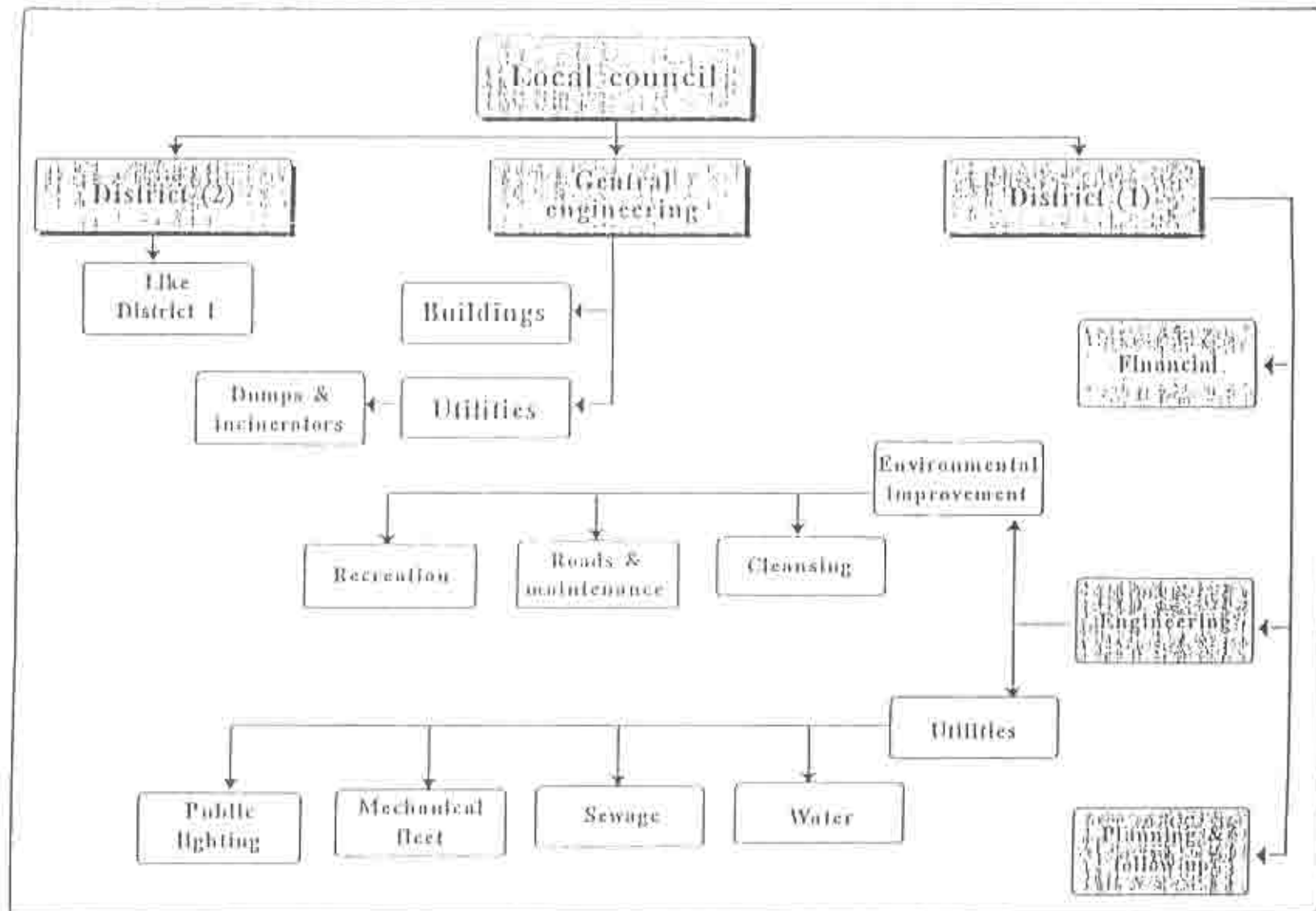


Figure (2): Organization of governmental cleansing system in Tanta city.

Table 22: Funds allocated to solid waste management services for some Egyptian cities ,
 [Table - 11, (3)]

Source LE 1000	Cairo 1986/1987	Giza 1983/1984	Alexandria 1984/1985	Tanta 1986/1987	Bent Saeuf 1986/1987	Shubra El-Khayma 1988/1989	Zagazig 1988/1989
Governmental Budget (Thousand L.E.)	27100	4000	2100	547	900	585	802
Cleaning Fund	4300	550	1370	(Other than re- current costs), 247	121	102	191
Foreign aid over several years and on an irregular basis.	1000	N/A	2320	N/A			50

5.1.6 Actions

Actions stated in this section as they appear in the Egyptian Environmental Actions plan for 1992.

5.1.6.1 Policy Actions

Action 1: Introductions of full coverage for management of municipal waste

Introduction of a fee covering the full management of municipal waste, including collection, transportation, and final environmental sound treatment. Currently, the charged is based on 2% of the rental value, which, due to very low rents, is LE 0.04 - 0.4/month. In wealthier areas, household participation amounts to LE 1-3/month. Estimates for the city of Cairo show that the cost for services would be LE 2/month. The fee should be based on real cost, which will differ between the cities and municipalities, depending on chosen treatment technology. It will be collected together with the electricity bill and be proportional to the energy consumption.

This action will provide the means necessary to establish an organization capable of willing to collect waste from poorer areas and thereby improve the local environment to a very large extent as well as putting a stop to dumping along the River Nile and random burning in the streets. It is expected also to have a positive impact on health status, especially in poorer areas.

Action 2: Introduction of earmarked surcharges on environmentally hazardous products

Overview of possibilities to introduce earmarked surcharges or taxes on specific products, which have a documented negative impact on the environment, such as alkaline and Ni-Cd batteries, products containing cadmium paints, containing mercury, motor oils, etc. The surcharge or tax will be gathered on a specific account and used exclusively for collection and treatment/destruction.

This action will provide an incentive for the general population to switch to environmentally less harmful products and influence industry and suppliers to provide substitutes. The reduced use of products such as those mentioned will improve the quality of municipal waste and/or sewage sludge, contribute to reduction in waste volume.

Action 3: Introduction of full coverage for treatment of industrial hazardous waste and infectious hospital waste

After preparation of guidelines and regulations by EEAA, full cost coverage for treatment of industrial hazardous and infectious hospital waste will be introduced, enforcing use of available facilities for destruction and treatment.

This action will constitute a large step forward in natural resource protection and stimulate increased awareness of the risks connected with these types of wastes.

5.1.6.2 Institutional Actions

Action 4: Establishment of licenced companies for waste management

Based on full coverage for their services in collection and management of municipal waste, companies will be licenced by the municipality, which will take full responsibility to ensure that necessary services are provided to achieve an environmentally sound management of municipal wastes.

The action will guarantee that all areas are covered, resulting in an improved environment and controlled management of the waste disposed of.

Action 5: Creation of guidelines and strategies for waste management

There is currently a lack of a strategy and clear guidelines for management of all types of waste, although municipal waste management to a certain extent has been addressed and considerable information is available. Thus it remains a serious need for more planning to optimize management and create more facilities to treat and handle the waste generated.

This action will provide the necessary guidelines and strategies, based on local conditions, to handle the different types of waste in an acceptable way. The strategies will depend on the capabilities of the environmental authorities to enforce regulations and guidelines, but also on the existence of treatment facilities. The strategies will consider already existing facilities and the guidelines should provide information about possibilities to reduce waste generation, as well as create incentives to change waste generation production processes.

Fully implemented, this action will create a base for a less waste generation society and have a large impact on the negative effects resulting from the current non-regulated disposal.

5.1.6.3 Investment Program

The investments foreseen to improve management of solid waste to reduce impact on health, air and water quality, and utilize household and agricultural waste as a natural resource. The investment have divided into two phases of five years each (Table-23).

Table - 23: Solid Waste Investment Program, (Egypt) [Table-14, (3)]

Projects	Phase I	Phase II
Municipal waste		
• Strategies and Pilot studies	19	
• Generation of biogas	16	
• Improved collection system-Urban Areas	160	300
• Improved collection system-Rural Areas	33	80
• Sanitary Landfill	16	150
• Manufacturing of equipment for composting plants	10	30
Hospital Waste		
• Pilot Study	5	30
• Upgrading existing small incinerators	2	120
Agricultural Waste		
• Decomposition and generation of biogas and production of compost	7	120
Industrial Hazardous Waste		
• Strategy	3	
• Pilot projects	9	130
• Incineration (cement kiln or other kiln)		65
• Safe landfill		

5.1.6.4 Solid Waste Management

There is currently no clear strategy for waste management. Management of solid waste must be upgraded and information provided on alternative technologies. Efforts are required to develop management systems, collect more adequate information, and carry out a number of pilot projects. The actions over the next five years will therefore focus mostly on pre-investigations, pilot studies and development of management systems.

Action 1: Development of systems for sound management of municipal waste and pilot studies before 1994

This action will concentrate on ways of establishing systems to collect and manage municipal solid waste, specific to each type of area-urban, peri-urban and rural. These systems should be harmonized with management of other types of waste, such as agricultural residues and sewage sludge, with a view to reuse, or recycle wastes in the form of compost or energy. As part of the action, pilot projects will be carried out in rural areas, both to demonstrate the positive economic result and gain experience in the operation and maintenance of the system.

The action will result in reduction of the amount waste material, as well as the negative impact on the environment. It will provide resources to improve soil conditions and reduce the use of fossil fuels, which will have a beneficial effect on the environment through reduced air pollution and emission of greenhouse gases

Action 2: Development of system for management of industrial hazardous waste and pilot studies before 1995

This action will provide adequate information about the generation of different types of industrial waste, in both the private and public sectors. The current estimated amount, 20,000 - 50,000 tons/year, is only a rough estimate which does not give a clear picture of waste generation or its composition. Future treatment of hazardous waste will have to be based on several solutions and treatment cost, ranging between LE200 - 3,000/ton, will depend on the alternatives chosen. However, before a decision on technology choice can be reached, more precise information is needed about waste generation and composition, as well as a prognosis for industrial development and production technologies. This action will also include pilot tests on the use of a cement kiln to incinerate organic wastes, by using them as an additional fuel to the kiln, thereby reducing energy consumption and improving performance for hazardous waste disposal.

Development of a system based on existing industrial activities and new facilities for hazardous waste treatment supported by enforced guidelines and regulations, will lead to sound waste management in the future. The current practice of uncontrolled disposal of hazardous waste in water courses and on land, and subsequent contamination of surface water, groundwater and soil, will be eliminated. Disposal cost will be based on the actual cost depending on the choice of treatment technology, which will have an impact on waste generation as well as providing incentives to modify production technologies.

Action 3: Elaboration of Municipal Solid Waste Management plant based on evaluation on existing MSWM plans before 1995

This action is currently in progress as municipal waste collection is a major problem. The present system does not provide sufficient revenues to meet the demand for collection and disposal in an environmentally sound manner.

The action will recommend system improvements necessary to assure that waste from various areas can be collected and transported to acceptable disposal sites or treatment plants for further processing. The recommendations are expected to differ depending on climatological and geographical conditions. The action will also identify: (a) necessary transfer stations for waste compacting; (b) collection organization and necessity for further treatment facilities; and (c) fees and system to collect the fees based on full coverage for services provided.

5.2 Jordan

5.2.1 Existing National Laws and Policies

According to the national law No. 29 of 1955 concerning municipal duties, all responsibilities and authorities for solid waste management or public cleansing are delegated to municipalities.

Another law No. 21 of 1971 authorizes municipalities to collect fees for public cleansing services and to demand the residents to store and place their refuse in a responsible and appropriate manner.

Furthermore, the national public health law No. 21 of 1971 grants municipalities broad authority and power to inspect and control public health nuisances and/or hazards. Until now, there is no consolidated laws which specifically call for regulation of hazardous wastes in Jordan. Few newly established or planned companies have been required by the authorities to prepare a waste handling programme, before approval of the actual company was issued. At present, all newly planned industries are required to include a waste handling programme in their scheme.

Other companies can obtain a license from Greater Amman Municipality which allows them to dump their waste on the landfill, upon a special agreement. However, rejection of applications for such licenses has not been practiced. Eventhen, several companies dump their wastes in close by land or in queries. At any rate, there seems to be no serious attempt, so far, for proper handling and treatment of hazardous wastes in Jordan

5.2.2 Organization

5.2.2.1 Greater Amman Municipality

Amman Municipality, the most important local government in Jordan, headed by the Lord Mayer, assisted by an under secretary, has complete freedom and responsibility to organize itself and reorganize as the needs arise.

With the establishment of Greater Amman in 1987, the Municipality restructured its organizational framework. Though the previously existing fourteen Departments within the Municipality's framework are kept as they were before, they were linked to six assistants to the Undersecretary.

The newly assigned six assistants to the Undersecretary are responsible for public health; technical services; general services; planning; finance, and administration ; one for each of these sectors.

Aside of the fourteen Departments, the Municipality organized Greater Amman into Nineteen Districts, in each of which there is a head of services who reports to the district director, who in turn reports directly to the Undersecretary.

5.2.2.2 Department of public cleansing

Within the organization of the Municipality, there exists a public cleansing Department which manages waste disposal and reports to the assistant for Public Health. The terms of reference for this department are:

1. To monitor and supervise the solid waste, street cleaning and collection services performed by the districts.
2. To develop, compile and analyze data for purposes of planning labor, equipment and facility requirements.
3. To provide technical guidance and develop equipment and civil work specifications.
4. To develop performance standards for operational effectiveness and efficiency.
5. To provide public education about public cleansing and related environmental and health issues.
6. To plan and operate appropriate disposal systems.

5.2.2.3 Workshop Department

All equipments for solid waste collection and disposal are assigned to the Workshop Department which reports to the assistant for Technical Services. This department is given the responsibilities for maintenance, repair and replacement of older equipments. The department also keeps records on daily assigned usage, distance traveled, consumption of fuel, oil and grease for each vehicle. Records for maintenance and repair are also kept. These records are reviewed on monthly basis, to determine the economic feasibility of each unit to determine replacement needs.

Moreover, the workshop Department makes sure that the districts as well as the public cleansing department are provided daily with the equipment they require to perform their operations.

5.2.2.4 The District

The district provides the labor and day-to-day supervision for street sweeping, collection and equipment operation. Furthermore, public health inspectors, working under the district community health doctors, are responsible for inspection of health nuisances and are expected to provide public education.

5.3 Syria

For more than 15 years ago, the Syrian Government had a Ministry of State for Environment. Two years ago, they called this ministry: "Supreme Staff to Environmental Affair" to be a supervisory staff. This staff established committees to plan for: nation policies, strategies, regulations, standards and action plans. But they do not have the authority to implement any action, rather they suggested the following regarding solid waste management, page 16 (7).

5.3.1 Water Pollution

(The law of general centre for protection of general water in 1972).

- There are statutory provisions for the protection against pollution of surface or underground water which may in some cases be relevant for refuse tipping.
- Prevention of pollution in 1972 seeks generally to prohibit the entry of poisonous, noxious or polluting matter in rivers, streams, etc., with penalties for offenders on conviction.
- Syrian law makes it a punishable offence if a person is guilty of any act or neglect whereby any spring, well or edit, the water from which is used or likely to be used for human consumption or domestic purposes, is polluted or likely to be polluted, also control discharges of any poisonous, noxious or polluting matter as well as any trade or sewage effluent, made to underground state by means of well, borehole or pipe.

5.3.2 Clean Air

Syrian law prohibits the emission of dark smoke from chimneys notified to local authorities, that all new furnaces in building burning solid liquid or gaseous matter on an appreciable scale in the public services shall be provided with plant, approved by the local authority, for arresting grit and dust, and that the plant shall be properly maintained and used, if they are satisfied that the emission of grit and dust will not be prejudicial to health or a nuisance.

The new suggestion of Syrian Environmental Ministry to make regulations prescribing limits on emissions of grit and dust from solid, liquid or gaseous matter is burnt, from industrial or trade premises.

5.3.3 Nuisances

Syrian law gives local authorities powers to deal with certain matters known as statutory nuisances that include any accumulation or deposit which is prejudicial to health or annoyance, some smoke emissions, e.g. from burning dump, if they are a nuisance to the inhabitants of the neighborhood, and noise or vibration nuisance.

Local authorities also have powers to make byelaws for the prevention of nuisances from dust, ashes, and rubbish and for regulating the removal through streets of offensive matter or liquid. The model byelaws for the former include a supplement for regulating the formation of deposits of filth, dust, ashes, or rubbish, etc., likely to cause a nuisance. Under these byelaws the maximum fine for an offence may be 500 lira = 10\$ in Damascus as against 1 \$ maximum in byelaws made under the local authorities Act at 1971. Not many authorities have, however, made byelaws under any of these provisions, but the new suggestion of Syrian Environmental Ministry to make the maximum fine for an offence from 10,000 to 1,000,000 lira = 200 - 20,000 \$ with prison from one month to one year.

5.3.4 Disposal at Sea

Syrian law of coast protection have aimed to control the deposit of material on the sea shore below high water mark, and within the 3 - mile limit.

5.3.5 Disposal In The Home Countries

Local Authorities applies only to refuse which has been collected inside the district, and environment ministry have suggested penalties for hazard waste disposal without consent or infringement of any condition in a consent, under sections of 48 (international standards of hazard waste which they will put it on Act..).

Section 49 (maximum levels of hazard materials of food production which is manufactured in Syria or import it), Section 50 (Consent conditions for hazard waste disposal), Section 51 (to avoid handling or disposing without special regulations), Section 52 (Environmental ministry will determine the sites and disposal of hazard materials), Section 53 (entirely prohibit any import to hazard waste or navigation near our coast...), Section 54 (protections for production or handling any hazard materials), Section 55 (emergency disposal and the provisions which is necessary done), Sections 56 to 63 (permissions and Environmental impact), Sections 64 to 69 (supervision and procedure), Sections 70, 71, about finance resources, Sections 72 to 78 about The responsibilities and compensations, Sections 79 to 83 (punishment), Sections 84 to 87 (another regulations).

Cleansing office have suggested to separate from the local authorities to be the unit with many Department of Divisions such as illegal behavior Division..etc.

Since 1971 the local authorities did a lot of by a laws which is important to conclude what is the Syrian action plans and to ask Syrian authorities to hold with what they planned as national policy.

5.3.6 Basis Philosophy and the Role of the Planning Authority

The main purpose of town and country planning legislation is to coordinate and synthesize all demands upon land by means of policies and plans using predictive data, impact of refuse disposal on land by local planning authority. There is strong public opposition to applications for use of land for tipping of crude refuse, due to fears of amenity disturbance from improperly controlled tipping and weeds growing with no attempt at restoration, local planning authority (or the Ministry of Environment as the future control of refuse disposal) may impose conditions concerning the following:

- Amenity and public health
- Physical relationship with and protection of adjoining land or water access
- Programming and achievement of satisfactory methods of working or operations
- Protection of refuse and/or underground water from pollution

There is no national legislation other than planning under which these objectives can be pursued.

From our investigations and the evidence received it seems clear that the planning are not particularly appropriate for regulation in detail, the way in which waste, of any sort is tipped on land, even more important, have not proved suitable for ensuring compliance with any conditions imposed.

We are sure that it would be right for the disposal of solid wastes of all types to be coordinated and controlled by a suitable authority (such as environment ministry) over a reasonably large area, the controlling authority have regard to the possibility of any pollution and would consult another authorities as necessary. These new bodies would be in a better position to employ staff, experts.

5.3.7 Scope of New Legislation of Environment Ministry

National coordination or sponsored arrangements for research will be carried out by individual officers into refuse storage, collection and disposal such as refuse analysis, further studies of recovery of waste materials for reuse investigation of design factors of different types of treatment in relation to operation to as certain optimum technical and economic design requirements, government funds should be made available to under write full-scale research or development projects most of which might be carried out in conjunction with local authorities. Such arrangement should also be available for the further development of promising laboratory - scale projects.

5.4 Tunisia

5.4.1 Legislative and Statutory Aspects of Solid Wastes Management

Up till now, there was no existing legislative frame for solid wastes management. However, at the level of communes, there are statutory texts regarding only the collection and transportation of wastes.

Thus, no one organism, or institution is judicially and explicitly responsible of the management of wastes in general.

The organic law of the communes (Law no. 75/33 of May 14, 1975 and the laws that have modified it) only stipulates the responsibility of the communes in very general terms, and only as it being the responsibility of the mayor, guarantor of the application of the municipal regimentation in order to insure public tranquillity and health.

The Decree of the Ministry of Interior of January 17, 1990 regarding the creation of the Municipal Agency for the Treatment and Utilization of Wastes (AMIVD) answerable to the Municipality of Tunis, entrusts this institution with the "mission of creating controlled landfills, to see over their management and to create units for the treatment of wastes".

On the other hand, one should underline the existence of certain texts of general scope:

- * The Wastes Code (Law No. 75/16 of March 31, 1975) institutes a system of protection and conservation of the hydraulic public domain. Article 126 states that "the elimination of pollution is at the cost of the users and businesses, and the public collectivities responsible for the evacuation of their wastes in the waters".
- * The Law No. 88/91 of August 2, 1988 modified by the Law No. 92/115 of November 30, 1992 creating the National Agency for the Protection of the Environment (ANPE), Article 8 (new) states that "the physical or moral persons... that damage the environment or whose activities cause pollution by the rejecting of solid, liquid or gas or other wastes, are responsible for the elimination of the rejected matters as well as paying for the damages resulting for them".

Thus, the communes have to legally assume the responsibility of the elimination of the wastes that they collect, even if the organic law of the communes does not explicitly mention this obligation. More generally, this legal obligation lies on every physical or moral person that produces wastes (hospitals, industries, businesses...).

On the operational level, this responsibility needs to be better defined and explained, and the conditions of exercising this responsibility should be specified.

Other than the producers, the management of solid wastes is a matter of interest to other institutions. Therefore, the juridical texts regarding the Ministry of Environment, ONAS and ANPE define the nature and the range of their responsibilities in the process of solid wastes management.

By its attributions, defined by the decree No. 93.303 of February 1st, 1993, the Ministry of Environment is responsible for the elaboration of the norms of rejection of wastes and to see to their application, in collaboration with the concerned ministries and organisms. The General Administration of Urban Environment at the Ministry of Environment is entrusted to assist the parties intervening in and affected by pollution to solve their problems regarding the elimination of wastes, to assist the communes for the carrying out controlled landfills creation projects and selection, treatment and recycling units for domestic wastes (Decree No. 93/304 of 1/2/93).

ONAS (Law No. 93/41 of 19/04/93) is responsible for the elaboration and carrying out of integrated projects for the treatment of domestic wastes within communal perimeters, and other wastes. It also has as a mission to carry out studies and to give assistance and paying or free advise to local collectivities regarding the fighting of any kind of pollution, coming from domestic and solid wastes that could affect the hydraulic environment.

ANPE, according to Law No. 88/91 of 2/8/99 and the laws modifying it, has to ensure the control and the follow up of polluting rejections and their treatment installations, and to give any assistance in order to eliminate or reduce remaining and effects of pollution.

Besides, "installations assigned for the stocking up or elimination of wastes no matter the nature and the process of elimination of the latter" have to undergo a study of the impact on the environment prior to any administrative authorization. The impact study has to be presented to ANPE according to decree No. 91/362 of 13/3/91.

A substantial job has to be done in the field of wastes management in order to fill the juridical gaps and voids. This should lead to the elaboration of a frame law that rules the obligations of the main intervening parties in this field.

5.4.2 Actions and Strategies of Development of the Recycling Sector

5.4.2.1 Consumers Sensitization: Selective Collection of Domestic Wastes - Pilot Project of the "Cite El Khadhra"

Conducted by the Ministry of Environment, this operation is centered on the selective sorting at source is part of the policy of involving households. It facilitates the collection to recycling agents who should thus dispose of recyclable matters.

The pilot project is financed by the Luxembourg. Its realization is anticipated during the years 93/95.

An action of sensitization, information and education has been set on a large scale (meetings with neighborhood committees, information and sensitization actions of the large public, radio and televised spots, posters, stickers, brochures,..).

It is an operation of selective collection of organic wastes, recyclable wastes (plastic, glass, board, metals, wood,..) and dangerous domestic wastes (medicine, pesticide, dry batteries,..).

Collected organic wastes will end up at the composting plant of Henchir Yahoudia to produce compost of good quality with a minimum of undesired matters.

Recyclable wastes are forwarded to the sorting unit set up at "Montplaisir" next to the "Cite" where a selective sorting is done. The recovered matters (plastic, glass, metals, paper) will be put at the disposition of recycling companies.

5.4.2.2 Financial and Fiscal Incentives

* Pollution fighting fund's intervention: Companies specialized in the collection and recycling of wastes, by their competence, have the advantage of benefiting of the aid of the "Pollution fighting fund" created by the Finances Law of 1993 (Law No. 92/122 of December 29, 1992).

The fund's intervention's modalities, as stipulated by Decree No. 93/2120 of October 25, 1993 fixing the terms and conditions of intervention deal with the granting of subsidies up to 20% of the investment.

The Pollution fighting fund should also intervene at the stage of collection by granting a bonus of collecting by ton.

The object to reach is increase of collection of materials to be recycled which should triple for plastics from 5,000 ton/year today to 15,000 ton/year and double for paper evolving from 30,000 ton/year to 60,000 ton/year.

* Investment incentives code: This code provides for measures to boost the investment in general and industrial projects contributing to the preservation of the environment in particular. These advantages are concretely represented for companies specialized in the collection and the transformation of wastes by:

- exoneration of VAT, of consumers' fee, of customs duties on imported equipment goods and the exoneration of VAT for those locally made;
- the deduction of the benefits invested within a same company in the limit of 50% of net taxable benefits.

* Exoneration of VAT on recycled matters: Companies specialized in the industrial recycled currently buy the products from ordinary collectors without paying VAT. This tax is collected during the disposal of recycled products

In order to harmonize the VAT taxation system and to avoid a surplus of recycled matters, it is necessary to exempt these matters from VAT.

This measure could facilitate the disposal of recycled matters marketed with much difficulty because of their price.

* Obligation to mix recycled matters with virgin ones: Talks have been engaged with paper, board and plastic industrialists in order to promote the use of recycled matters, and it has been decided to incite all industrialists to incorporate recycled matters with virgin ones.

In the same object, circular have been addressed to all the transformers of paper and of plastic matters inviting them to introduce a fixed rate of recycled matters with virgin plastic on one part and the manufacturing of corrugated board from the test liner, product obtained from 100% old paper and board.

Recycled products being considered as 100% Tunisian products, they would benefit from consequent advantages (customs tariffs, preferences during market assigning).

* Prohibition of waste import: Several industrialists tend today to import recycled used paper and plastic granules for their needs of raw materials.

The Ministry of Environment in accordance with the Ministry of National Economy, would prohibit the import of these materials in order to boost the collection and gathering in Tunisia.

The import of these materials would be managed case by case with regard to their availability and the needs of the different users.

6. Needs and Priorities for Community Awareness, Participation and Involvement in SW Practices and technologies

SW practices and technologies in several EMR states are very poor. They have problems in collecting, transporting and disposal of solid wastes. The open dumps and uncontrolled landfills create many environmental problems. Local authorities and organizations should work on solving the problems and encourage public awareness and participation in SW practices through media: radio, TV, newspaper and other activities and programs.

6.1 Public Information Programs

The purpose of public participation in management is two folds: first, the opportunity is created for managers to inform and instruct the public; second, a channel of communication is opened that allows the public to communicate its needs and desires to managers. The opportunity for two-way communication is of great importance, for the activities, goals, and means of solid waste management presently are not well understood by the public.

There are numerous ways in which to convey the ideas and concepts concerning a technical system to a non-technical community. The most successful communication channels are developed by using simple terms and objective-oriented graphics in written materials (plans, information booklets, etc.) and an open-door policy for the input of new ideas to management. An example of such a communication technique is the pamphlet used to provide information to the people of Lane County, Oregon (USA), about their solid waste management system (2). It should be noted that an information program can be developed only when adequate money and time are applied to it. A specific portion of a plan development budget should be set aside for public information programs.

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6.2 Monitoring and Awareness in Egypt (3)

6.2.1 Recent Improvements in Awareness and Efficiency of Refuse Collection

With the increasing awareness of the detrimental consequences of inefficient refuse collection, active measures have been taken along the following two main lines to improve the refuse collection/transport process:

1. Raising the awareness of the population to estimate their compliance with applied systems and governing laws and legislation, as well as take the necessary actions to safeguard their own well being by living in a clean environment.
2. Developing proper collection/transport systems and providing the necessary facilities for sustained monitoring in order to ensure continual improvements.

Efforts along the first issue may be summarized as follows:

1. Dedicated TV broadcasting programs, and other information media on relevant activities, costs and impact.
2. Establishment of societies for environmental protection. These societies, in addition to their promising role in including awareness among the public as well as the decision makers, would also provide some sort of surveillance monitoring of cleansing activities on behalf of the concerned public.
3. The recent injection of appropriate relevant materials in the school curricula will definitely affect a chain-reaction awareness through family interaction.
4. Mosques and churches provide substantial help by conscious intervention during religious meetings since religion plays a very influential role in the life of Egyptians.
5. Moreover, various ministries, local government and several official organs started to assume increasing role in disseminating information and awakening up the awareness of the various sectors of the Egyptian social system. Among these, one may include: the Ministry of Scientific Research (particularly through the Academy of Scientific Research and Technology), the Ministry of Information through its diversified mass media organs, Ministry of Interior, Ministry of Health, Ministry of Local Administration and the Egyptian Environmental Affairs Agency.

On the other hand, and as regards improvements in efficiency of refuse collection, some improvements in efficiency of refuse collections have been achieved through the following major approaches:

- a. Development of integrated collection/transport schemes adequate to specific sites. This has been performed by foreign or national experts in collaboration with officials and specialists in municipalities.
- b. Provision of facilities for transfer or transport that comply with prevailing infrastructures. Thus while large compactors are in use to serve well-planned areas and main roads, small tractors or tricycles are in use in slum areas.

- c. Provision of communal containers to minimize wastes directly thrown to streets or alleys.
- d. Establishment of cleansing offices in the districts to supervise cleansing performance in addition to receiving and investigating complaints.

6.2.2 Involvement of the Private Sector

The private Zaballeen system has been in charge of refuse collection from households and commercial activities for over 50 years. Although the Zaballeen are operated by permission from the local government, yet the areas of service and routes were not defined.

It was only in the late eighties that the Zaballeen in larger cities were given licenses for specific areas and defined routes. Since then and with replacement of donkey-drawn carts motorized vehicles, the Zaballeen systems acquired a formal private sector status.

At present, involvement of the private sector in SWM is summarized as follows:

1. The Zaballeen in their reformed company type status offer their conventional door-to-door collection service. The collected wastes are transported to their settlements for recycling. Beneficiaries are charged L.E. 1-3/month for this direct service.
2. Private companies involved with the collection/transportation phases. Such companies also provide door-to-door collection using plastic bags. The collected wastes are transported in motorized vehicles to public disposal sites or Zaballeen settlements. The monthly charges are approved by the Popular Councils and municipalities. Such an activity appeared attractive and hence many private companies have been established. These companies vary in scale from small enterprises comprising tens workers and few motorized vehicles to large organizations (such as Car Service Company which is well equipped and organized and offers other services in addition to solid wastes handling).

As of 1991, the number of private companies licensed in Cairo is about 85. It is apparent that the trend of involvement of private sector is expanding at a fast rate.

6.3 Sensitization of the Population in Tunisia (8)

The sensitization of the population in the field of solid wastes management is part of the more global frame of the program of environmental sensitization and education.

This program aims to introduce the environmental dimension in the spirit of the Tunisian as well as in his daily behavior, and to implement a national environmental culture to support the efforts made by the government in the field of environment protection.

Aside from the Ministry of Environment, other organisms participate in the sensitization actions, especially the Ministry of Interior and that of Agriculture, the municipalities, non governmental organizations and neighborhood committees.

The objectives of this program are:

- to develop the environmental spirit in the citizens;
- push the citizens to actively participate in the success of the programs of environment protection and the improvement of living conditions;
- to come to a harmonization of the different intervening parties in the fields of information and sensitization.

The program and the actions set up around it articulate around 2 main axes: the environmental sensitization and education through the creation of scholastic channels in higher education and the reinforcement of environment clubs in high schools, as well as the elaboration of pedagogical documents.

One of the aims of solid wastes management has been achieved at the level of the Cite El Khadhra where a pilot project of selective collection of domestic wastes has been set up, and large scale sensitization actions have also been carried out (direct contact, meetings, pedagogical posters and documents, radio and TV announcements...).

Also, and as part of the national program of cleanliness and protection of the environment followed up by the Ministry of Interior, sensitization posters, radio and TV announcements have been launched in the field of solid wastes management.

7. Suggestions, Recommendations and Plans of Action for SWM Strategies, Policies, Approaches and Practices

7.1 Remarks and Recommendations from Jordan (5):

1. Public awareness in general is far from being adequate. In fact, it seems to be completely lacking in major population centres. A more adequate and efficient approach for creating public awareness of waste management is needed all over the country.
2. Often, available vehicles for transfer of solid wastes are insufficient and inadequate. Collection and storage of municipal solid waste in most of municipalities and in the rural areas suffer major set backs.
3. Several of the major cities in the Kingdom still without well preserved landfills.
4. Collection of Municipal wastes depends heavily on municipal workers, more mechanization of the process is needed.
5. Absence of special containers for glass and metal can disposal in the various neighborhoods, districts, cities and villages. Such containers would facilitate glass recycling and would result in the production of cleaner solid wastes.
6. Lack of hazardous waste management system, including legislation, regulations and licensing, and facilities for transportation, treatment and disposal of hazardous waste.

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6. Lack of hazardous waste management system, including legislation, regulations and licensing, and facilities for transportation, treatment and disposal of hazardous waste.

7. An independent agency for hazardous waste management is needed. This agency may best be under the Ministry of Municipal and Rural Affairs and the Environment.
8. Based on the amount of waste recorded and estimated, a hazardous waste site should be constructed with facilities for disposal of solid waste and residues from treatment plants; physical and chemical treatment of liquid wastes and thermal treatment for incineration of organic solid and liquid hazardous waste and some inorganic waste.
9. A national team of technical staff and experts for consulting in matters regarding hazardous waste and for its management is needed.
10. Hospitals should be encouraged to incinerate their solid waste and to avoid mixing it with municipal waste.
11. Municipalities need to increase their budgets for solid waste management by reconsidering the existing rules and regulations concerning fees collected for this purpose, in cooperation with the Ministry of Municipalities, Rural Affairs and the Environment.

7.2 Recommendations and Suggestions from Tunisia (8)

All the activities and programs set in the field of solid wastes management, certainly testify of the will for a new orientation. They are still very much centered on elimination aspects certainly more elaborate than in the past but still now accompanied by recycling, reduction or even prevention projects.

We have to go back to the source of the problems and lead a policy of prevention in priority in order to reduce the volume and the danger of the produced wastes.

It is also important to make sure of the coherence of the measures of solid wastes management all over the Tunisian territory.

Thus, a Directing Plan of the Management of Wastes should be elaborated and set, it could be oriented towards the idea of a planned management of wastes.

This Directory Plan for Solid Wastes Management (PDGDS) and the actions deriving from it, on the legislative and statutory level as well as on the level of practical achievements, should respect the following principals:

- Information that will insure the transparency of the management of solid wastes.
- Coordination that will avoid the anarchy of the projects while insuring coherence at the national level and thus by institutionalizing this coordination.
- Prevention by setting certain actions that will prevent the production of wastes prior to any reduction or elimination policy.
- The reduction of the quantities of wastes being produced at present in each field (domestic, industrial, septic, special,..).

- The recovery that should constitute a main axis and could become an obligation.
- Elimination should allow the treatment and stocking of residual wastes according to appropriate technologies.
- The sanction, the principle of "polluter/Payer" that will encourage the parties to respect the obligations resulting from a responsible wastes management directed towards prevention and utilization.

On the statutory and institutional level the following should be done:

Within this Directory Plan of Solid Wastes Management, the hygienic aspect of certain wastes and especially clinical ones or the sludge from the purification plants, have to be considered again in accordance with the respect of public health. Indeed, these are wastes which production is inevitable and their volume is hard to reduce.

Also, the reuse of recycled matters should be ensured. To such ends, the companies have to be encouraged to prefer them when buying. To do so, the public administrations should play a precursor role.

The use of products in series should also be encouraged.

If domestic wastes composting should be taken into consideration as a component of this directing plan, actions of selective wastes collection should be set in order to improve the quality of compost and to allow a better use of this product in agriculture. Quality norms should be promulgated.

On the regimentation and institutional level, the following could be enacted:

- promulgate a general law about solid wastes management (specifications, norms and quality criteria, definition of tasks and obligations for the different intervening parties).
- create a national organism specialized in the field of solid wastes management which would be provided with the necessary means and competencies and whose major tasks will be: objectives analysis of the situation, concerted elaboration of future perspectives, promulgation of necessary laws and norms, assistance for the different producers of wastes, implementation of incentive actions for a better management of the different sorts of wastes.
- set a taxation system for wastes elimination which should incite individuals to reduce their production. The basic principle should be the pricing in accordance with the real quantity of wastes produced by households. This system will have to be adapted to social constraints of the different households.

A new orientation in the field of solid wastes management would bring a considerable improvement to this management and the privatization in sub-contracting or concession.

7.3 Some Recommendations Applicable to EMR States:

- set up national solid waste policy,
- allocate enough funds for all aspects of SWM,
- form an advisory committee to monitor and conduct scientific and research studies on urban refuse management,
- train all personnel of difference levels of SWM,
- increase awareness of the public on all aspects of SWM,
- encourage recovery and recycling,
- select appropriate and controlled landfill sites,
- improve and encourage composting,
- and give special attention to hazardous wastes, health care wastes (hospitals, clinics, health centres), industries, etc.

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