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INTRODUCTION

This Deliverable is part of the work package 2 which aims at establishing a complete and cross-sectional diagnosis of the current situation of the solid waste management at a regional level in the targeted countries: Côte d'Ivoire, Ghana, Nigeria and Senegal. It will facilitate the proposal of appropriate technological and organizational solutions in work package 3, as well as policy guidelines and recommendations in work package 4.

Specific objectives include the following:

- To present a regional characterization and assessment of the targeted countries regarding SWM aspects.
- To identify key actors and stakeholders in the targeted countries
- To evaluate the current solid waste management practices in the targeted countries.
- To evaluate the national and regional policy and legislative frame, governance and socio-economic structure regarding SWM in the targeted countries.
- To detect and analyze main barriers and obstacles related to SWM in the targeted countries.

Project funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	**x**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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SECTION 1: REGIONAL CHARACTERIZATION OF THE TARGET COUNTRIES

1.1. Background information

The regional characterization of the target countries presented in this section builds on the work coordinated by KNUST in the section 1 of deliverable 1.1*. "Criteria for evaluation of the regional socio-economic situation and policy background"* under Work Package 1.

However, a few changes were made:

- Population growth: prospective figures were selected presenting the annual population growth from 2005 to 2015 in percentage, estimated by the UNDP in its Human Development Report 2007/2008
- Level of urbanization: proportion of urban population on the total population of the country expressed in percentage in 2005 and prospective figures for 2015, as estimated by the UNDP in its Human Development Report 2007/2008. This indicator replaces the one on internal migration for which reliable sources were hard to find. The level of urbanization, current and future, is very relevant for the waste collection systems, in particular for the feasibility of door-to-door collection.
- The criterion "gender" expressed in terms of % of women/men and the participation of women to the formal/informal sector was found not to be relevant in tems of SWM.
- The criterion GDP growth in the last 10 years or 5 years is very relevant in terms of waste production because there is generally a link between economic growth and waste production except in the countries that are very conscious of environmental issues (dematerialized growth) i.e. mainly European countries.

1.2. National indicators affecting needs related to SWM

1.2.1. Demographic characteristics

Table 1 Demographic characteristics

Criterion	Côte d'Ivoire	Ghana	Nigeria	Senegal
Expected yearly population growth from 2005-2015[1]	1,8%	1,9%	2,2%	2,5%
Population density	64,7[2]	79.3[2]	167	54
Age	0-14: 40,85% 15-34: - 15-64 :55,34% 64 and above (old age) : 3,73%[3]	0-14: 39.2 % 15-34: 33.2% 34-64: 11.3% 64 and above: 2.1%[4]	0-14: 44% 15-59: 51%[5] 60 and above: 5%[6]	0-14: 47% 15-34: 35 %[7] 34-64: 14% 64 and above: 6%
Life expectancy at birth[8]	47,4	59,1	46,5	62,3
Level of urbanization: percentage of urban population on the total population in 2005 (+ prospective for 2015)[9]	45,0% (49,8%)	47,8% (55,1%)	48,2% (55,9%)	41,6% (44,7%)
Mortality (deaths/ 1000 inhabitants)	112 / 1000	8.93 /1000[10]	16.31 /1000[11]	10.72 /1000
Household income	Low : 48,9% of households live with 241	High: 61.20%[12] Moderate: 29.9%	High : 20% Low: 40%	High Moderate

[1] Source : UNDP Human Development Report 2007/2008
[2] Source: Ghana in Figures, 2008, Ghana Statistical Service
[3] Source : World Bank Report 2009. http: //donnees.banquemondiale.org/pays/côted'ivoire
[4] Source : 2000 Population and Housing Census of Ghana
[5] Source : slight adjustment in age grades based on http://www.talktalk.co.uk/reference/encyclopaedia/countryfacts/nigeria
[6] Source : http://www.talktalk.co.uk/reference/encyclopaedia/countryfacts/nigeria
7 Source : CIA, 2006
[8] Source : UNDP Human Development Report 2007/2008
[9] Source : UNDP Human Development Report 2007/2008
[10] Source: CIA factbook
[11] Source : http://www.indexmundi.com/nigeria/death_rate
[12] Source: Ghana Living Standards Survey, 2005

Criterion	Côte d'Ivoire	Ghana	Nigeria	Senegal
	145 FCFA/year (or 1,5$/day).	Low: 8.9%		Low : 43,9% of households live with less than 600.000 FCFA/year, i.e. 50.000 FCFA/month Average household yearly income : 2.231.867 FCFA; Dakar : 3.169.093 FCFA Secondary cities : 3.873.423 FCFA Rural areas : 1.075.662 FCFA
Employment status	Unemployed : 15,7% Independent job : 48,8% Informal : 40%	Employed: 89.6%[13] Unemployed: 10.4%	Unemployed: 10.8%	Formal : 17,6% Informal : 33,4% Unemployed : 49%
Settlement	Urban population 51%	Rural population is just about 49% of the total population whiles urban population is about 51% of the population. This means as many people live in urban areas as rural areas in Ghana.	About 50% of Nigerians live in rural areas	There is a planned settlement policy, with institutions such as the SICAP[14], the SNHLM[15], HAMO[16] as well as private companies specialized in housing building. There is also a cooperative network which is promoted by the BAHSO[17]. There is a National Fund for Social Housing. The production of housing with access to services (on various areas such as ZAC Mbao (600 ha), SIPRES, NAMORA) are supported by external aid, notably the World Bank.

[13] Source: Ghana in Figures, 2008
[14] Société Immobilière du Cap Vert
[15] Société Nationale des Habitations à Loyer Modéré
[16] Habitat

[17] BAHSO means « bureau d'assistance des collectivités pour l'habitat social ». This organisation helps Senegalese cities to develop social housing programmes.

1.2.2. Economic characteristics

Table 2 Economic characteristics

Criterion	Côte d'Ivoire	Ghana	Nigeria	Senegal
Annual GDP growth per capita from 1990 to 2005[18]	-0,5%	2,0%	0,8%	1,2%
Principal production sectors/ main economic activities *in terms of GDP*[19]	Agriculture :14,2% Industry : 19,3% Commerce : 20,3% Mixed : 46,2%	Agriculture : 27,3% Industry : 12,6% Commerce : 12,3% Mixed : 47,8%	Agriculture : 31,7% Industry : 40% Commerce : 14,9% Mixed : 12%	Agriculture : 13,5% Industry : 14,9% Commerce : 15,4% Mixed : 1,4%
Household income[20] (USD per inhabitant)	900	485	752	707
Income distribution - Gini Coefficient (GC)[21] 1. Complete equality (GC = 0) 2. Variable levels of Equality (0<GC<100) 3. Complete Inequality (GC = 100)	44,6 Variable levels of Equality	40,8 Variable levels of Equality	43,7 Variable levels of Equality	41,3 Variable levels of Equality
Quality of life (The Economist Intelligence Unit's quality-of-life index, 2005 report. Ranked from 1 to 10 (10= best)	No data	5.174	4.505	No data
Financial capacity of households: percentage of the population living below the poverty line i.e. with less than 1.25 US$ per day (poverty rate)[22]	No data	29,99 % (in 2006)	No data	33,5 % (in 2005)
Cost of waste collection and disposal (national average for annual cost in dollars per household)	1500 FCFA per month i.e. 18 000 FCFA per year[23]	$ 60	Mainland : $3.50c -$16 Island : $17- $35[24]	No data
Expenditure on waste collection and disposal (at household level)	5% of household income is spent on waste disposal	7% of household income is estimated to be spent on waste disposal	No data	No data

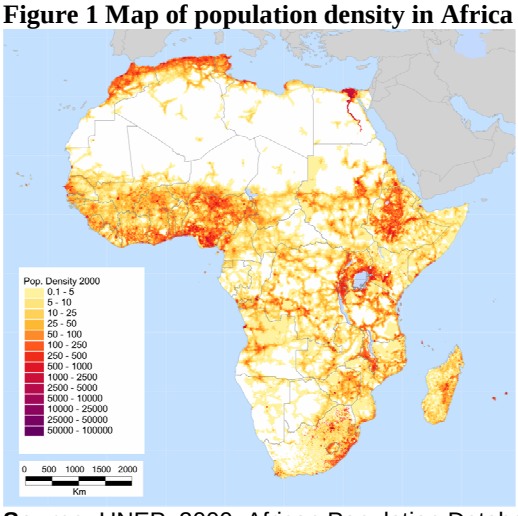
[18] Source : UNDP Human Development Report 2007/2008
[19] Source for all figures : OECD, African Economic Outlook 2008, country reports
[20] Source : UNDP Human Development Report 2007/2008
[21] Source : UNDP Human Development Report 2007/2008
[22] Source for all figures : Worldbank, 2010
[23] Source : Rapport du cifal, 2009. Cadre organisationnel de la filière de gestion des déchets en cote d'ivoire, 16p. www.cifal-ouaga.org
[24] Cost depends on the location and financial capacity of residents

1.3. Regional profiles for the 4 target countries with regard to their needs of SWM systems

1.3.1. General remarks on the comparison criteria

The map below shows a very clear tendency: the highest population densities in Africa are situated along the coasts. However, it should be noted that there are also high levels of population density in the North of Nigeria.

Figure 1 Map of population density in Africa

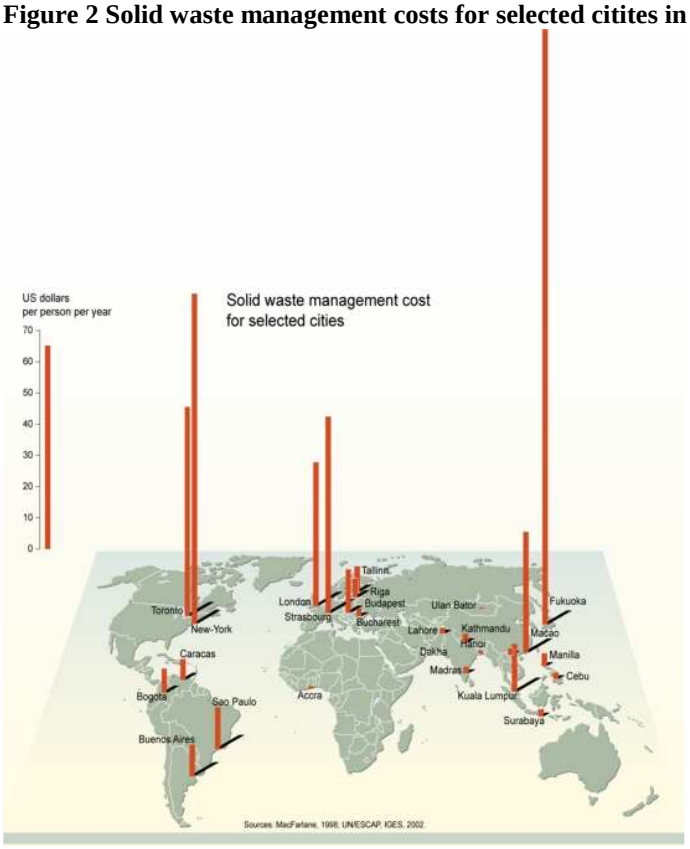


Source: UNEP, 2000, African Population Database

Concerning the criterion on the cost of solid waste management (collection and disposal) in the 4 countries, the map below reminds that the costs in West African countries are almost null (less than 2 US$/person/year) in comparison with the costs of solid waste management in Western countries that can go well beyond 100 US$/person/year.

Source: UNEP – GRID Arendal, 2008, Environmental Knowledge for change.

Figure 2 Solid waste management costs for selected citites in the world



1.3.2. Côte d'Ivoire

Côte d'Ivoire is composed of 19 regions (figure 3), each one supervised by a "préfet de région" that represents the central governement (the executive). Decentralisation has been decided by the governement in May 2001 by the Regional Councils are still not in place.

Figure 3 Administrative map of Côte d'Ivoire

Ivorian population is inequally distributed across the country. The Région des Lagunes (with the main city Abidjan) alone accounts for 34 % of national population; the 5 most populated regions (Lagunes, Haut-Sassandra, Savanes, Vallée du Bandama, Montagnes) represent more than 73 % of the population.

The North (région des Savanes) ; North-East (région du Zanzan) and North-West (région du Denguélé), are vast but less populated than the South (région des Lacs, de l'Agnéby, du sud Comoé). 78% of the population lives in forest areas while 22% in bush areas (in the North).

As far as urbanization is concerned, Côte d'Ivoire has approximately 70 cities, out of which 31% are situated in the bush areas in the North, 37% in forest areas in the Eastern part of the country and 32% in the Western forests. Population census dating from 2002 indicates that the Région des Lagunes has 4.210.200 inhabitants on an area of 13172 km2 which means a population density of 320 inhabitants per km2.

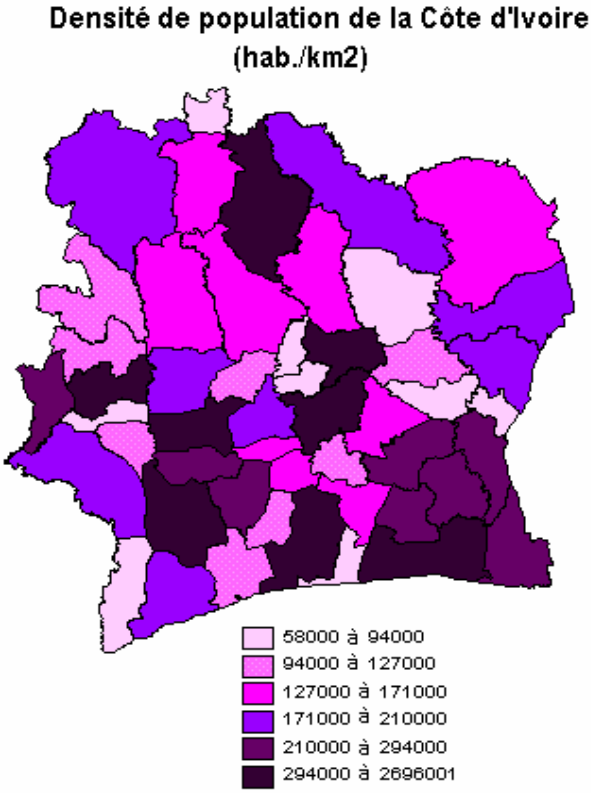
At the Nort-West, the Région du Bafing is the less populated with 178400 inhabitants on an area of 8720 km2. This population represents 1,4 % of Ivorian population.

In Côte d'Ivoire, each region is divided into départments. There are 59 departments in total. Population density by department is presented in Figure 4.

Departments are divided in 243 "sous-préfectures". The 197 main cities, so called "communes" are led by mayors and city councils.

The decentralization process started in 2001 has set up 2 Districts (Yamoussoukro and Abidjan). Abidjan is the political capital of Côte d'Ivoire (3 millions inhabitants). Yamoussoukro is the administrative capital (300.000 inhabitants). Both districts are led by governors and district councils.

Figure 4 Population density by departments, Côte d'Ivoire



Source : FAO, 1998

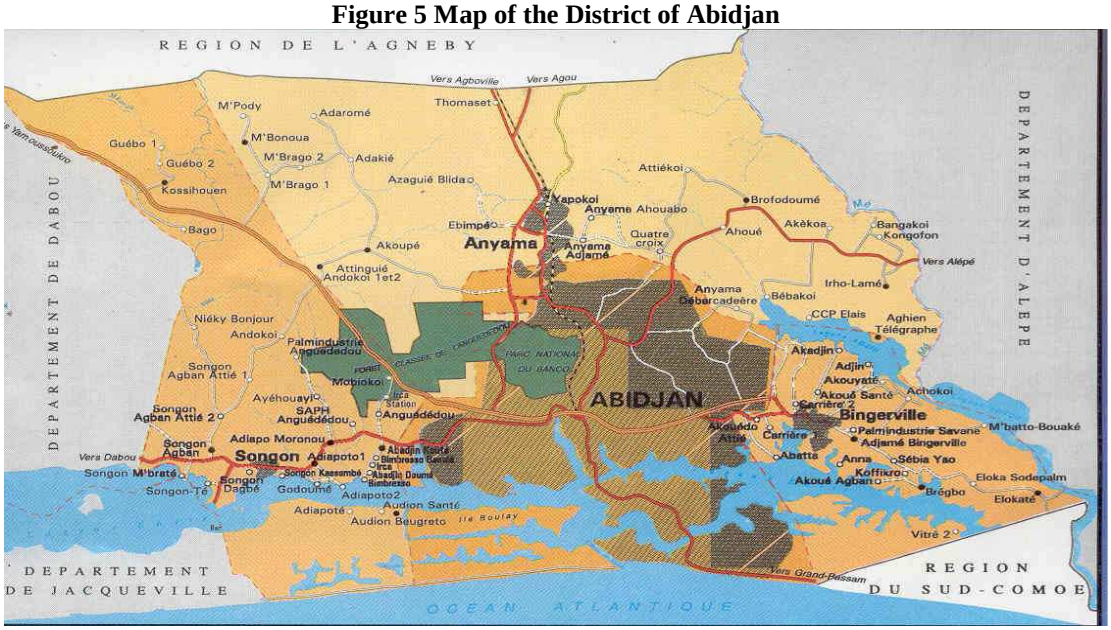
In practice, decision-makers consider 3 main areas for waste management:

- The District of Abidjan ;
- Secondary cities ;
- Rural areas.

1.3.2.1. The District of Abidjan

The District of Abidjan was created in 2001. It gathers 10 metropolis (Abobo, Adjamé, Attécoubé, Cocody, Koumassi, Marcory, Plateau, Port-Bouët, Treichville and Yopougon) and 3 "sous préfectures" (Anyama, Bingerville and Songon) on a area of 2119 km^2, i.e. 0,6% of the national territory.

Figure 5 Map of the District of Abidjan



The District of Abidjan is geographically composed of a coastal area, a peninsula (*la péninsule du Petit-Bassam*), a lagoon (la lagune Ebrié) and a series of plateau from the South to the North.

Its 4 million inhabitants are very young. Approx. 70% of Ivorian population is aged below 40. The political crisis has paralyzed the whole administrative system in the North of the country and disturbed all municipal public services. One million internal refugees moved towards the South and more specifically towards Abidjan. This has created a profusion of precarious suburbs where public service is almost nonexistent. Population is now 5.000.000 inhabitants. Annual demographic growth is now 4.8% in Abidjan and population density is very high (2359 habitants per km²).

In the District of Abidjan, annual waste generation at household level has increased from 1155185 tons in 2000 to 1512532 tons in 2005, meaning an increase in waste generation of 357347 tons in 5 years. Waste collection ratio in the same period is 60% (Dongo, 2006).

About twenty companies collect and transport household waste in the Akouédo dumping site which is now saturated.

According to available data, the District of Abidjan concentrates more than 90% of Ivorian industries (92,8% of the 2822 industrial estates identified in 2006), 700 medical institutions (3 public hospitals "Centres Hospitaliers Universitaires"), 147 hospitals and public clinics, 556 private formal companies and 610 000 informal production units, despite of the political tumult resulting from the crisis of 2002 and the violent period of November 2004.

Ivorian industrial profile is mainly agro-industry, energy, chemicals, petrol-chemicals, textile industry which account 80% of companies in the District of Abidjan, concentrated in areas such as Zone 4, Koumassi, Vridi, Treichville and Yopougon. Industrial production for the national market and exportation has been authorized provided environmental impact studies were made, which has led in most cases to the construction of sanitation plants, at least for the biggest factories.

But the political and economical crisis, and the lack of public control, have had many negative consequences in terms of maintenance of industrial waste treatment units, in particular sanitation plants. Most sanitation plants have been degraded so much that they are no longer operational.
The Environmental Profile of Côte d'Ivoire carried out in 2006 stated that industrial waste generation was 150 000 tons/year (also according to MINEEF[25]/DCV (2001)) , biomedical waste 1900 tons/year (in 2002).

Poor neighborhoods and suburbs in the District of Abidjan are almost not, or not at all covered by waste collection systems.

Before the crisis, waste collection ratio was 60%, representing 683.000 tons of waste collected in Abidjan (BNETD, 2002[26]). Nowadays, waste collection ratio is much lower because the surplus generated by the 1 million refugees could not be absorbed.

The dumping site of Akouédo is not a controlled landfill. All types of waste are transported there without any previous treatment or recycling. A noticeable exception if the SOCIPLAST company that pays women for each kilogram of plastic bags collected.

The accumulation of waste for more than 34 years in this area has created gas emissions that must now be controlled to ensure the population's safety. Sanitary risks are high, as thousands, if not millions of tons of waste are not collected and are just dumped in the streets which results in water pollution, air pollution (during incineration) and spreading of mosquitoes and rodents.

There is a technical landfill in project to replace the old Atiekoi landfill yet it would be situated just above Abidjan's underground water reserves. It is therefore urgent to reconsider waste management policy in Abidjan.

1.3.2.2. Secondary cities

In the cities situated in the "inner areas" of Côte d'Ivoire, population density is below 1000 inhabitants per km^2 (see table). In these cities, pre-collection and collection of household waste is a public responsibility. Collected waste is transported to a landfill and to another site for incineration.

But these cities are not able to pay for waste collection and final disposal with their own budget. Municipal waste collection and transportation equipment is obsolete. The situation

[25] Ministère de l'Environnement, de l'Eau et des Forêts (MINEEF)
[26] Bureau National d'Etudes Techniques et de Développement

has become worse after the political crisis of 2002. In several cities from the North and the West, municipal technical services no longer operate.

The international NGO CARE has contributed to manage domestic waste for the city of Bouaké (approx. 600.000 inhabitants) and Korhogo (approx. 250.000 inhabitants).

None of the secondary cities of Côte d'Ivoire has a controlled landfill. Due to the political crisis, it is very difficult to get information concerning solid waste generation and collection in secondary cities in Côte d'Ivoire.

Table 3 Classification of Ivorian regions according to population density

Administrative regions (region capital) : population density	*Classification*
Région des Lagunes (Abidjan) : 2359	Population density > 2000 inhabitants per km^2
Région du Sud-Comoé (Aboisso) Région de l'Agnéby (Agboville) Région du Haut-Sassandra (Daloa) Région du Moyen-Comoé (Abengourou) Région des Montagnes (Man) Région des Lacs (Yamoussoukro) Région du Sud-Bandama (Divo) Région de la Marahoué (Sinfra) Région du Fromager (Gagnoa) Région du Moyen-Cavally (Guiglo) Région des Savanes (Korhogo) Région de la Vallée du Bandama (Bouaké) Région du Bas-Sassandra (San-Pédro Région N'Zi Comoé (Bougouanou Région du Zanzan (Bouna) Région de Worodougou (Mankono) Région du Denguélé (Odienné) Région du Bafing (Touba)	Population density < 1000 inhabitants per km^2

1.3.2.3. Rural areas

As for secondary cities, there is little information available on waste management in rural areas. In villages, there is no waste collection system and waste is just dumped in nature or in open air dumping sites outside of the village.

1.3.2.4. Conclusions concerning Côte d'Ivoire

The main differences between the District of Abidjan, secondary cities and rural areas are the following:

Type of waste generated
In most secondary cities, waste is generated mainly by households; whereas in the District of Abidkan, industrial waste in quite large quantities has to be taken into account.

Waste management system
The District of Abidjan is in charge of waste collection and transportation for all types of waste. Final destination is the landfill. There is a contract between the District and private companies (procurement).
Secondary cities are in charge of pre-collection and collection of domestic waste.

1.3.3. Ghana

Administratively, Ghana is divided into ten regions with each region governed by a Regional Coordinating Council headed by the Regional Minister which runs the day to day activities of the region. In terms of size, the Northern region is the biggest of all the ten regions whiles Greater Accra Region is the smallest. Ashanti Region is the most populated with a population of 3.6 million in 2000 and a projected population of 4.77 million in 2010. The least populated region is the Upper west region which had a population of 576,000 people in 2000 and a projected population of 639,000 people in 2010 (NPC, 2005). The population density of the various regions also differs significantly (see Fig 1). Regions in the Northern part of the country as in Northern Region, Upper East and Upper West Regions and Brong Ahafo Region have a comparatively lower population densities as compared to regions in the southern part of the country comprising Greater Accra, Ashanti, Central, Western, Eastern and Volta Regions. Greater Accra is the region with the highest population density of 859.5 whiles the Northern region has the least population density of 25.9. The national average is 79.3.

The regions are further divided into Metropolitan, Municipal, and District Assemblies (MMDAs). The districts are managed by an assembly of elected people headed by the District Chief Executive. The Municipal and Metropolitan Assemblies are also managed by Municipal and Metropolitan Chief Executives with elected representatives.

Table 4 Classification of Ghanaian regions according to their SWM profile

Regions (capital)	Characteristics
Regions situated in the Northern area of Ghana: Upper West (Wa) Upper East (Bolgatanga) Northern (Tamale)	Least urbanised regions (urbanisation rate below 27%) Industrial activity Only 9.5% of industrial activities take place in these three regions Mean annual Household income Northern: GHC 1,452[27] (second highest in the country) Upper East: GHC 616 Upper West: GHC 606 (lowest in the country Waste management Upper West: 2.3 % of generated waste is collected Upper East: 3.3 % of generated waste is collected Northern: 2.1 % of generated waste is collected
Regions situated in the Central area of Ghana:	Intermediate level of urbanisation (around 35%)

[27] Source: Ghana Statistical Sevice, Ghana living Standards Survey, 2005

Regions (capital)	Characteristics
Brong-Ahafo (Sunyani) Eastern (Koforidua) Ashanti region (Kumasi)	Industrial activity Ashanti Region: 24.7[28] % of manufacturing industries in Ghana Mean annual household income Brong Ahafo: GHC 1202 Ashanti: GHC 1,149 (fifth highest in the country) Eastern:GHC 1,145 (sixth highest in the country) Waste management Low waste collection: around 0,8 % of waste collection rate in Brong-Ahafo 2.2 % in Eastern and 1.3 % in Ashanti Region.
Regions situated in the Central-Southern area of Ghana: Greater Accra (Accra) Volta (Ho) Western (Takoradi) Central (Cape Coast)	Most urbanised regions (urbanisation rate between 53-87%). Industrial activity Greater Accra : 25.7 % of manufacturing activity in Ghana[29] The other three regions account for 22 % of manufacturing activity with central region accounting for the highest (9.6 %) Household income Greater Accra has the highest mean national income and also the highest mean per capita national income of GHC 1,529 and 544 respectively Central: GHC 1,310 (third highest in the country) Western: GHC 1,222 Volta: GHC 913 Waste management Highest waste collection rates: 19,5% of waste generated in the Greater Accra region is collected. Volta 2.4 % Central 0.8 % Western 2.2 %

Ghana's localities can be divided into 3 categories[30]:

- Urban localities:

Kumasi: 1,1 million inhabitants
Accra: 1,6 million inhabitants (Greater Accra region)
Tacoradi: 260 000 inhabitants
Tamale: 300 000 inhabitants
Ashiaman: 150 312 inhabitants (Greater Accra region)
Tema: 161 000 inhabitants (Greater Accra region)

- Semi –urban localities

More than 105 localities have more than 15 000 inhabitants, of which the 10 biggest are:
Teshie: 92 000 inhab.
Cape Coast: 118 000 inhab.
Obuasi: 115 000 inhab.
Madina: 76 000 inhab.
Koforidua: 87 000 inhab.
Wa: 66 000 inhab.
Techiman: 56 000 inhab.
Nungua: 62 000 inhab.

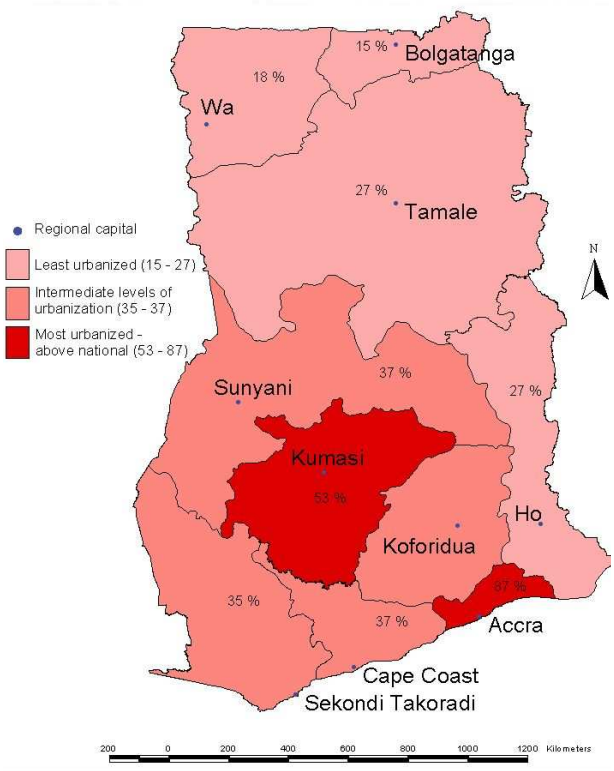
[28] Source: Ghana Statistical Service, National Industrial Census, 2003 http://www.statsghana.gov.gh/docfiles/2%20Phase%20I%20&%20II%20Report.pdf
[29] Source : http://www.ghanadistricts.com/reg-info.asp/RegionID=1, quoted by Catherine Farvacque-Vitkovic, Madhu Raghunath, Christian Eghoff, Charles Boakye, 2008, Development of the Cities of Ghana - Challenges, Priorities and Tools, Africa Region Working Paper Series Number 110, p. 9.
[30] Sources for the population estimations : Census of March, 26th 2000.

Tema New Town: 58 000 inhab.
Sunuyani: 61 000 inhab.

- Rural localities (with less than 15 000 inhabitants).

As far as solid waste management in Ghana is concerned, there is informal waste disposal all across the country. According to the National Population Council (2005), only 4.8 % of household waste is collected. A staggering 57.6 % of all waste generated ends up at public dumping grounds untreated and in unhygienic conditions. Burning contributes 7.9 % whiles 25 % of the waste is dumped elsewhere and 3.9 % are buried. Moreover, close to 76 % of households still rely on improper waste collection and disposal methods, and only 5 % rely on house-to-house collection, according to baseline environmental sanitation data gathered in 2007/8 (MLGRD, 2010).
Regionally, Greater Accra performs better than all the other regions with 19.5 % of waste generated collected. Central and Brong Ahafo Regions have the lowest quantities of waste generated collected, 0.8 % and 0.9 % respectively. The three northern regions – Northern, Upper East and Upper West have the highest rate of indiscriminate waste disposal, 55.3 %, 55.2 % and 65.6 % respectively. This accounts for more than half of the waste generated in their respective areas.

Figure 6 Map of Ghana with indications of degrees of urbanization in the regions



1.3.3.1. Urban Areas

The trend is quite different in the municipal and metropolitan assemblies where government effort coupled with private involvement is yielding some positive fruits. The five metropolises namely Kumasi, Accra, Secondi-Takoradi, Tamale and Tema together form 70 % of the urban population and 20 % of the entire population of the country (Boakye, 2005), and their residents generate an estimated 3,200 tones of solid waste per day (MLGRD, 2010). This perhaps explains the reason why government attention is greater in these areas. At the moment, Kumasi Metropolis happens to be the only Metropolis with a scientifically engineered landfill site at Dompoase, one of the suburbs of the metropolis. The remaining metropolis namely Accra, Tema, Tamale and Sekondi-Takoradi are without engineered landfill sites. Accra and Tema are located in the Greater Accra Region, Kumasi in the Ashanti Region, Tamale in the Northern Region and Sekondi-Takoradi in the Western Region. Waste collection in these metropolises is usually carried out by private contractors who dump them in old quarry sites and degraded lands as a way of reclaiming the lands.

According to the National Population Council report (2005), Tema Metropolitan area had 29.5 % of its waste generated collected. This was the highest in the country. Accra and Kumasi metropolis followed suit with 20.9 % and 2.2 % of the total waste generated collected. Available data for Ghana's five largest cities show that collection and transport ratios (waste collected and transported to disposal/waste generated) for refuse is gradually improving over the last few years - Accra 70 %, Kumasi 75%, Sekondi-Takoradi 60 %, Tamale 55 % and Tema 68 % (MLGRD/NESSAP, 2008).

The various Metropolitan Assemblies have been further divided into sub-metros to make the administration easy. Kumasi Metropolis for instance has ten sub metros under it whiles Accra has 11 metropolises. Two collection systems are practiced in all five metropolises: communal and house-to-house collection. Residential areas in the metropolis are classified into 1st class residential areas where social amenities are relatively better (rich neighborhoods), second class residential areas and third class residential areas for purposes of billing. Interestingly, rates charged for waste collection differ significantly among the Metropolis.

Whiles Accra is practicing full cost recovery and thus charging close to commercial rates, residents in the other metropolises are being subsidized by the Government of Ghana. For instance, residents in Accra are charged between $ 6 -$ 10 per month of waste collected whiles residents in the four other metropolises are charged between $ 2.5 - $ 3.5 per month, depending on the classification given above (Boakye, 2004). In the case of communal dumping grounds, residents pay as they dump.

1.3.3.2. Semi-Urban Areas

The stories in municipal areas are not quite different from what occurs in the entire country: low percentage of waste generated is collected leading to heaps of waste scattered everywhere. Coupled with this, the focus and attention of the government on waste management and collection are at a rather low ebb.. Even though some private waste collection companies have been tasked to collect the waste, monitoring of the waste collectors by the Assemblies is not adequately done. According to MLGRD (2010), there are about 105 other localities each with population above 15,000 with challenges in solid waste management similar to those of large cities. These communities are known to generate in excess 5,000 tones of solid waste each day. Assemblies are often over burdened financially since close to 40– 50 % of the internally generated funds are used to fund waste management (Boakye, 2004) by paying contractors. This leaves them with very little money to carry out developmental projects and also ensure effective monitoring of the waste collectors.

1.3.3.3. Rural Areas

Rural areas in the entire country lack any well coordinated waste collection system in place. People do indiscriminate dumping of waste. A good majority burn their waste whiles others burry the waste in the compound. As a result of this practice rural areas are much cleaner than urban areas since each individual is responsible for its waste.

People in these areas often fall in lower quintile of household income and thus are often below the poverty line. Any waste management practices that will require the people paying will likely meet some form of resistance, but with increased education on the associated benefits of such a scheme, the peoples will embrace and fully support such interventions.

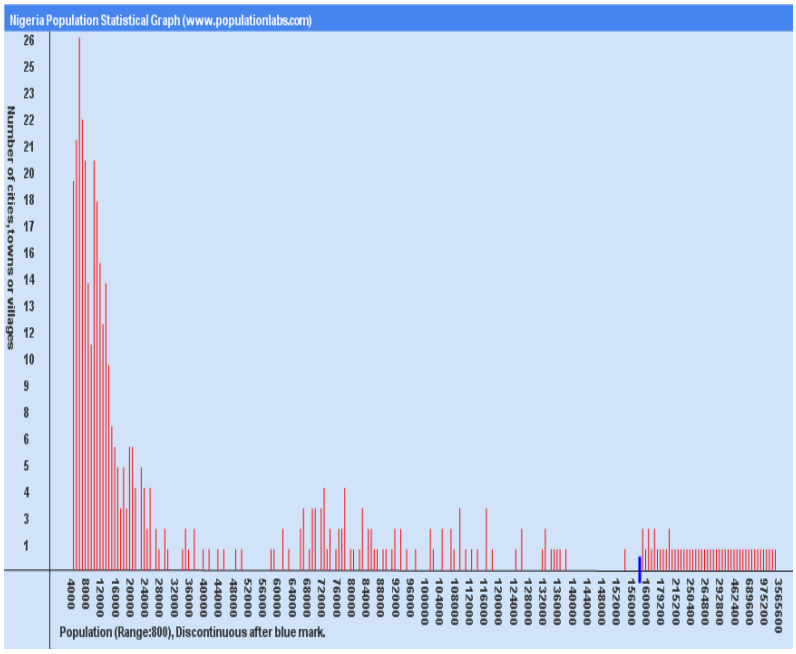
1.3.4. Nigeria

Nigeria, officially referred to as the Federal Republic of Nigeria, is a nation comprising 36 states and its Federal Capital Territory, Abuja. The country shares land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. It has a total area of 923,768 km^2. The three largest ethnic groups in Nigeria are the Hausa, Igbo and Yoruba. In terms of religion, Nigeria is dominated by Muslims and Christians with a very small minority practicing traditional religion. Nigeria is the most populated country in Africa.

Nigeria is endowed with both natural and human resources, but with a long history of political instability, corruption, inadequate infrastructure, and poor macroeconomic management. The return to democracy after almost three decades of military rule however, should afford Nigeria the opportunity to arrest the decline in her socio-economic development and embark on an economic revival but success is yet to be experienced in this area.

Solid waste management presents problems in both mega cities and rural areas. Similarly, the growth and distribution of the population in these areas has influenced the total amount of solid waste generated in recent years. Below is a graphical representation of the population distribution.

Graph 1 Graphical representation of population distribution



This, together with lack of infrastructures, economic development, poverty, increased urbanization and lack of competence of the municipal government, has resulted to an

unprecedented rise in solid waste generation. In addition, problems with solid waste management in all the regions in Nigeria apart from the ones mentioned above are a lack of continuity in implementation of government policies, inadequately formulated policies, financial and operational constraints, and poor attitude of citizens towards waste management (Waste Management, 2009). Generally, indiscriminate dumping of wastes by the road side gutters and other unauthorized dumping grounds characterize the regions in the country.

Behavioural changes in the attitude of the populace towards waste management through public awareness can affect the whole solid waste management system. All steps in solid waste management starting from household waste storage, to waste segregation, recycling, collection frequency, the amount of littering, the willingness to pay for waste management services, disposal facilities, all depend on public awareness and participation. The main drivers of solid waste problems in Nigeria have been attributed to poverty, high population and urbanization growth rates compounded by a weak and under-funded infrastructure (Walling et al. 2004). It is also suggested that management of solid waste in Nigeria cities continues to pose serious challenges due to the absence of appropriate and organized waste management culture and technologies arising from financial, political instability, poor implementation of policy and technological constraints.

A survey conducted in two cities in Nigeria showed that about 90% of people interviewed are ignorant of the impact of illegal dumping of refuse in the environment and 80% don't worry or care about dumping waste anywhere. Also, large percentage of litters generated in Nigeria was due to lack of public education and wrong behaviour. More than 80% of Nigerians don't understand what sustainable waste management is all about nor do they know the penalty of their poor refuse disposal attitude if any.

The general practices of solid waste management in the country are uncontrolled dumping of waste on the outskirts of towns and cities. Some national, state and local government authorities in charge of solid waste management systems have official open dumpsites where wastes could be legally disposed off while others do not. These legal and illegal practices have been disastrous to the environment, resulting in pollution of waterways, groundwater creation of public health problem.

As such, waste management has emerged as one of the greatest challenges facing National, State and Local government environmental protection agencies in Nigeria. Hitherto, there is no clear government policies in Nigeria aimed at controlling the menace of illegal dumping nor is the existing environmental protection and legislation enforced. The volume of solid waste being generated continues to increase at a faster rate than the ability of the agencies to improve on the financial and technical resources needed to parallel this growth. The common constraints they face include but is often not limited to lack of institutional arrangement, insufficient financial resources, absence of bylaws and standards, inflexible work schedules, insufficient information on quantity and composition of waste, and inappropriate technology.

Under task 1.2, we indicated that the three tiers of government in Nigeria are often involved in one way or another in the provision of services in the country. Constitutionally though, some of these services fall within the statutory function of one tier or all tiers of government. The Constitution also provides under section 1 (a) of the Fourth Schedule that the duties of local government councils in Nigeria includes sewage and refuse disposal[31]. In other words, the local governments are responsible for the management and maintenance of waste. In practice however, the State governments more often than not step in to complement the

[31] Constitution of the Federal Republic of Nigeria 1999

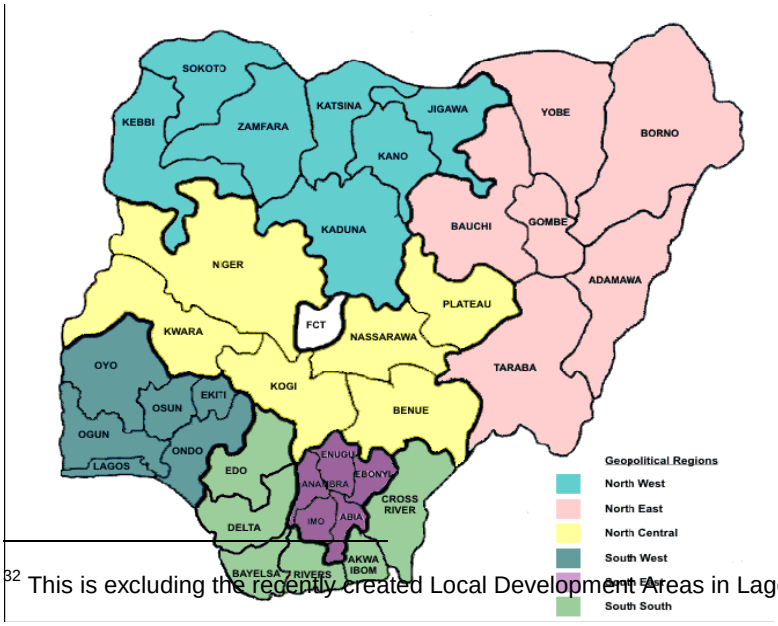
efforts of the local governments, particularly in the State capitals. As a result, the responsibility for waste management varies between the geopolitical zones that make up Nigeria.

Administratively, the Federation of Nigeria is made up of 36 states and a Federal Capital Territory (FCT), which are grouped into six geopolitical regions: North Central, North East, North West, South East, South South, and South West. There are also 774 constitutionally recognized Local Government Areas (LGAs)[32] which forms the smallest administrative structure in the country. The six geopolitical zones are as shown in the table below.

Table 5 Nigeria's Geopolitical Zones

Zone	*Constituent States*
North West	Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara
North East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe
North Central	Benue, Kogi, Kwara, Nassarawa, Niger, Plateau
South West	Ekiti, Lagos, Ogun, Ondo, Osun, Oyo
South East	Abia, Anambra, Ebonyi, Enugu, Imo
South South	Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo, Rivers
Federal Capital Territory	Abuja

Figure 7Administrative map of Nigeria



[32] This is excluding the recently created Local Development Areas in Lagos State, South West, Nigeria.

Due to the country's diverse ethnic and cultural beliefs, solid waste management practices differ which may also be attributed to religious beliefs, level of education and information etc. The composition, density, political, economic framework, awareness and attitude in both rural and urban areas of the country also differ and these have major effects on solid waste management. Generation rates of municipal solid waste vary from city to city and from season to season and have a strong correlation with levels of economic development and activities. Generally solid waste management in Nigeria is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal. The economic growth and urbanization experienced in some part of the country has significantly escalated the quantities of waste being generated in such areas. The quantity of solid waste generated in urban areas of the country is higher than that from the rural areas. The waste generation rates in Nigeria ranged from 0.66kg/capita/day in urban areas to 0.44kg/capita/day in rural areas. The rate of waste generation is highly influenced by the population income. The volume of solid waste being generated continues to increase at a faster rate than the ability of the agencies saddled with the responsibility to cope with.

1.3.4.1. South East Zone

Solid municipal waste management in several cities in the Eastern states of Nigeria are relatively slow and as such are not commensurate with production processes and economic activities in those cities. As at 1989-1992[33] for instance, 44% of Enugu did not have access to waste collection. In the remaining areas household wastes are dumped along roads, in illegal dumps and in storm water drains - or is buried. A random sampling of waste piles show that the percentage composition by weight of garbage range between 32-56%, rubbish 8-30%, ash/dust 15-35% and Miscellaneous wastes 4-12%. These waste streams though of peculiar nature vary in quantity within each city. The waste situation in this region has received considerable support from the United Kingdom Department for International Development programme (UK DFID) through its State and Local Government Programme (SLGP). The DFID through its programme has supported the government of Nigeria in embarking on governance reforms in which the solid waste management sector has received considerable attention. Enugu was among the cities that benefited from the reform of their solid waste management systems (Nzeadibe, 2009). Prior to the reform, open dumping and incomplete collection of municipal solid waste are common practice in Enugu and many cities in the south eastern states. With the DFID support, Enugu state Waste Management Authority (ESWAMA) landfill was created in 2004. Since the creation informal recyclers have taken over the site for waste recovery, aggregation, processing, buying or selling recovered materials to make a living.

Reports show that the State Environmental Protection Agencies in the South eastern zone of Nigeria are still in an infant stage of operation and require improved funding by government and also private sector participation. Also, advocacy visits and awareness campaigns are recommended for proper education of the inhabitants of this region on modern ways of waste disposal and waste management. The State governments in these zones have made commendable efforts, within available limited resources, towards meeting the solid waste management demands of its indigenes but with little impact as a result of the people's attitude towards waste generally. In some cities in the south east such as Enugu[34] and

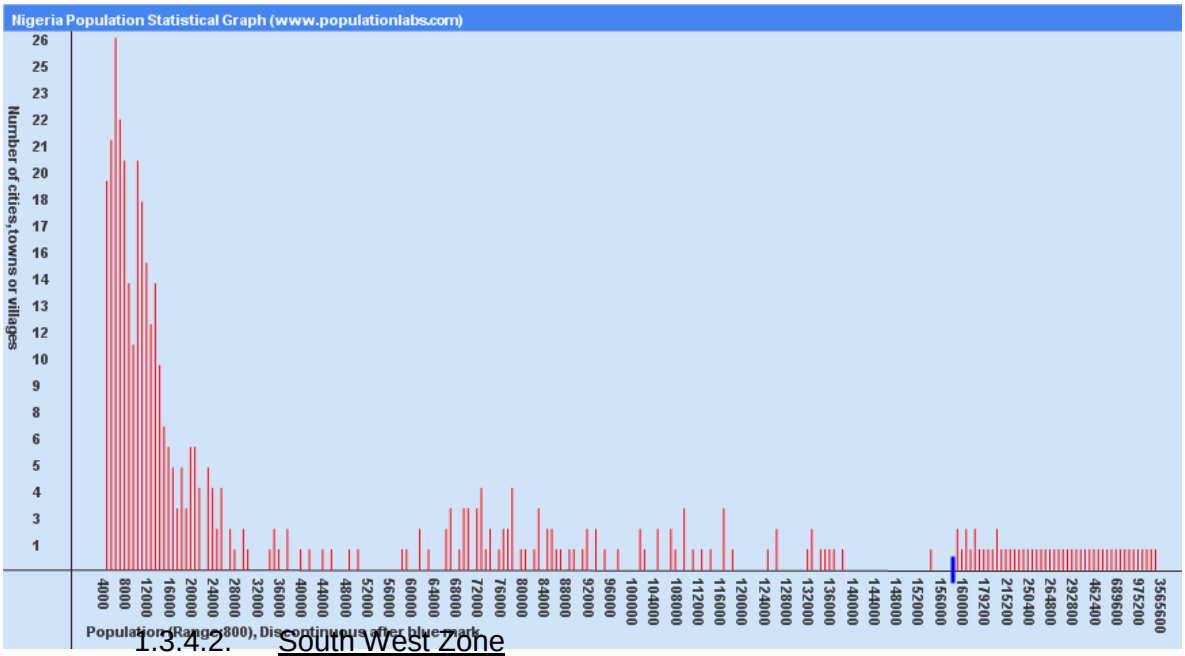
[33] Onibokun, A.G. 1989. Urban Growth and Management in Nigeria. *In* Stren, R.E.; White, R.R.; ed., African Cities in Crisis: Managing Rapid Urban Growth. Westview Press, Boulder, CO, USA. pp. 69-111.
[34] Enugu State

Awka[35], initiatives are currently in progress in the area of waste disposal. Attempts are being made by the authorities to put wastes in refuse bags numbering over 300 across the city. In Onitsha, a privately owned waste company LARGA (Waste Disposal Company) is undertaking the clearing of garbage in the gutters and on the streets with the aid of trucks and compactors. This initiative is commendable as it exhibits an attempt by the authorities at ensuring effective solid waste management in the city.

These efforts notwithstanding, garbage spilling and littering of all kinds of waste is still in no way commensurate with waste management activities in this region which is evident in the heaps of waste that may still be seen on roadsides, drainages and streams in the cities. (Oluwemimo,2007)

This Graph tries to provide statistical analysis of the population distribution in Nigeria. It shows the total number of cities, towns, villages in Nigeria having population in the range as mentioned on the horizontal axis.[36]

Graph 2 Statistical analysis of Nigeria's population



1.3.4.2. South West Zone

In the south west, the conventional municipal solid waste management approach has been put in place by the local government councils which is based on collection and disposal. This in a way has assisted to evacuate the waste out of the communities to the outskirts in government owned open dumpsites. However, the approach has failed to provide efficient and effective services to the ever growing urban centers. The urban environment steadily degrades due to wastes which are not managed efficiently. For example, a 1989 report characterized Lagos, as the "dirtiest" capital in the world; this is because in most parts of the city, streets are partially or wholly blocked by solid waste. Similarly open spaces and marketplaces are littered with solid waste. Drains are clogged or totally blocked and many residential buildings are hemmed in by the wastes. These solid wastes, depending on the

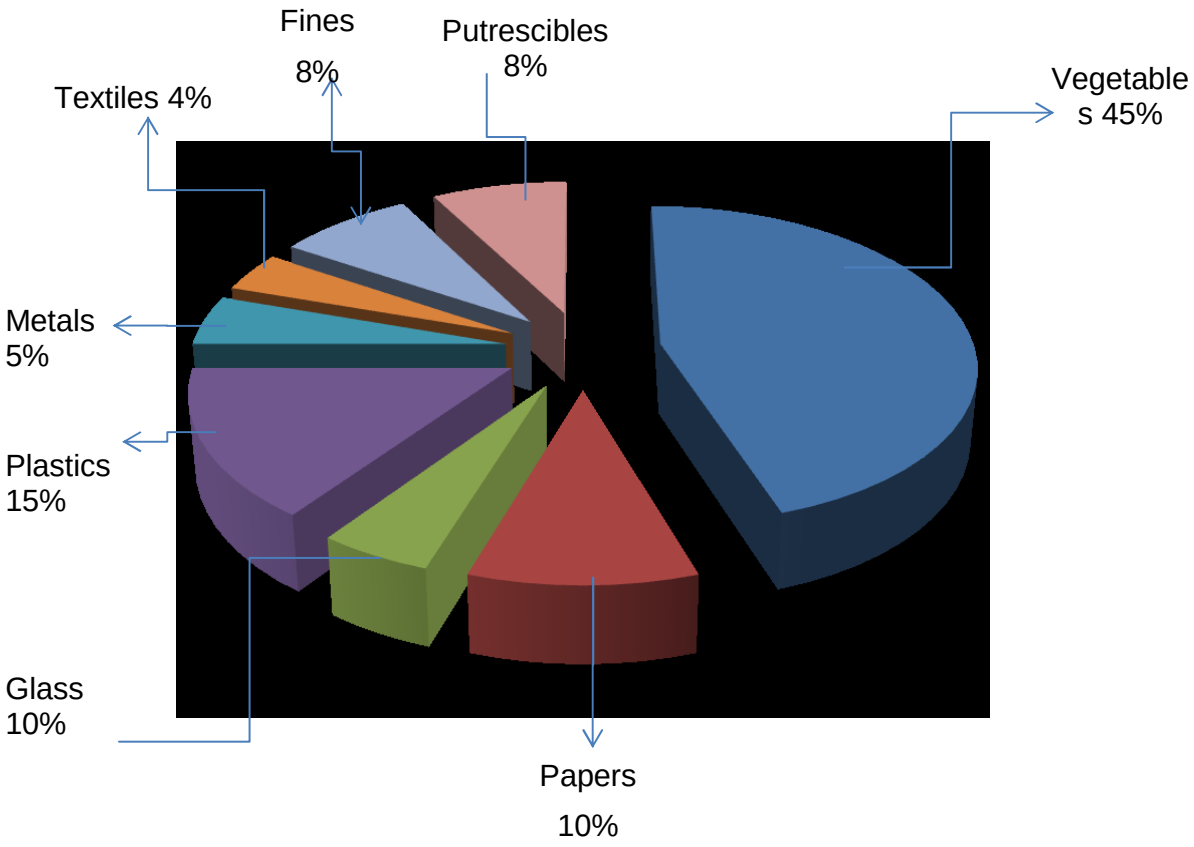
[35] Anambra State

[36] www.populationlabs.com/Nigeria_populations.asp Please note that the Nigeria Statistical Graph is just an indicative graph since population data of only partial places is available. Also that population data of Nigeria and cities in Nigeria is not up to date and complete. It is also pertinent to note that there is a low level public awareness on waste management in Nigeria.

size, income and consumption patterns of the population in different areas have varying components. Below is an analysis of the variation in solid wastes generated in Lagos State presently.

An analysis of the waste generated in Lagos state south west Nigeria[37]

Graph 3 Waste generated in Lagos, Nigeria



This deplorable situation was not unique to Lagos alone, but is characteristic of most cities in the south west particularly those linked with high economic activities. However, amongst the six geopolitical zones in Nigeria, the South West has made giant strides at improving its waste management system. This is evident in the establishment of waste management agencies by the different States within the region as a result of the failures recorded by local governments in solid waste management. These agencies are structured to have a regional outlook (that is, covering more than one local government):

- For example, in Oyo state, the Ibadan Solid Waste Management Authority (ISWMA) was established in 1997 to control the management of solid wastes in all eleven local government areas (Ayininuol and Muibi, 2008)).

[37] www.lawma.gov.org

- Lagos State established the Lagos State Waste Disposal Board (Adefemi, 1980)[38] which has evolved into the Lagos State Waste Management Authority (LAWMA). Presently in Lagos state, LAWMA, Lagos State Environmental protection Agency (LASEPA), the Local Government Councils (LGCs) and the Ministry of Environment and Physical Planning (MEPP) have been entrusted with the responsibilities of keeping the environment clean while LAWMA takes larger role in municipal solid waste management (Kofoworola,2007).

The concerted efforts of these agencies to make the streets of Lagos state clean have achieved commendable success in contrast to what some of these cities used to be, of worthy of note are places such as Abeokuta, Ibadan, Akure particularly Lagos. Of course in Lagos, the hastate government has allocated substantial resources in terms of human, material and financial resources to combat its attendant waste problem. Some of the efforts of the state includes the establishment of a composting plant in the Ikorodu area of the state; its waste management authority LAWMA is currently working on generating electricity from one of its dumpsites Olusosun; the state's environmental protection agency LASEPA, is also working on a pilot project of waste segregation, currently located in some urban areas of the state are different coloured waste bins for disposal of different types of waste.

In the same vein, Ondo State Waste Management Authority (OSWMA) was established in 1999 (Ondo State of Nigeria, 1999). The desire of the Ondo State Government to derive value from waste while at the same time effectively protecting the environment led to the creation of the Ondo State Integrated Wastes Recycling and Treatment Project (OSIWRTP) out of OSWMA. OSIWRTP came into existence in June 2006 with the commissioning of the project office complex along Igbatoro Road Akure by the then Nigeria President, Chief Olusegun Obasanjo. The Project started initial operation in December 2006 with an initial staff complement of 84. Essentially, OSIWRTP was established by the Ondo State Government to promote the possible profitable, safe handling and recycling of every type of waste generated within the State. These efforts notwithstanding, the accelerated growth of urban population with unplanned urbanization, increasing economic activities and lack of training in modern solid waste management practices complicates the efforts to improve solid waste services. The changes in consumption patterns with alterations in the waste characteristics have also resulted in a quantum jump in solid waste generation in most parts of the south west particularly Lagos, Oyo and Ogun States. Practically in all the south western states, recycling and recovery of waste materials are carried out by informal sector popularly referred to as scavengers in all the sanitary landfill and dumpsites. Presently, only cans, paper, glass, plastic containers and metals have high market values in the region.

1.3.4.3. South South Zone

The waste management system in this part of the country popularly addressed as the "Niger Delta" is similar to that of other parts of Nigeria. Municipal solid waste is generated and collect in large quantities by the relevant authorities in this region. But a huge quantity still remains as litter in many parts of the municipalities. A common practice in most parts of the south south is that refuse is mostly buried, openly –burnt, a practice which poses serious environmental hazards to the environment and humans (Igoni et al., 2007). Most of the illegally dumped solid wastes clog drainage systems, increasing flooding and water-related diseases. When dumped into nearby water bodies, they reduce water quality and aggravate health risks. Municipal solid waste generation in Uyo - Akwa Ibom State, Calabar, Cross

[38] Waste to Wealth: A Case Study of the Ondo State Integrated Wastes Recycling and Treatment Project, Nigeria: O. O. Olanrewaju and A. A. Ilemobade, *School of Civil and Environmental Engineering University of the Witwatersrand Private Bag 03, WITS 2050, Johannesburg, South Africa Department of Agricultural Engineering The Federal University of Technology Nigeria*

Rivers State, Warri-Delta State and particularly Port Harcourt in Rivers State, (approximates 96,000 tons per year) is in an order of magnitude higher than industrial solid waste generation. Neither of the two largest cities, Port Harcourt and Warri, have sanitary landfills. They rely on open dump sites and river dumping. Given the high social costs of improper disposal of municipal solid wastes, the future benefits of intervening are relatively high. The costs of appropriate management programs involving sanitary landfills, waste collection, and separation of selected wastes for recycling, are generally moderate in comparison to the benefits.

In this region, the agencies entrust with responsibilities of waste management includes[16]: Akwa-Ibom, Akwa Ibom State Ministry of Environment & Mineral Resources; Bayelsa, Bayelsa State Ministry of Environment and Bayelsa State Environmental Sanitation Authority; Cross-River, Cross River Ministry of Environment; Delta, Delta State Waste Management Board; Edo, Edo State Environmental & Waste Management Board; Rivers, River State Ministry of Environment and River State Environmental Sanitation Authority

Until recently, a city such as Port Harcourt was known as the "garden city of Nigeria" because of its neatness and the overwhelming presence of vegetation and flowers all over the metropolis. But today, the presence of piles of refuse dotting the entire city has turned Port Harcourt rather to a "garbage city". Indiscriminate dumping of wastes - industrial, commercial and household - such as food waste, paper, polyethylene, textiles, scrap metals, glasses, wood, plastic, etc. at street corners and gutters, has become a common feature in the city. The situation is so bad that traffic flow is obstructed, while there is likelihood that leachates from such dumps, after mixing with rain water, have the potential to contaminate drinking water.

1.3.4.4. North West Zone

Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara constitute North West zone of Nigeria.

Kano is chosen as a representative of North West zone. Some studies have been reported on waste management in Kano metropolis (Nabegu, 2010) reported that a substantial part of the urban residents in Kano city and suburban informal settlements of Kano metropolis have little or no access to solid waste collection services. This he attributed to lack of proper land use planning which resulted in the creation of informal settlements with narrow streets that make it difficult for collection trucks to reach many areas. Solid waste in Kano metropolis according to the researcher is to be dumped by the public at designated collection areas which are made up of metal boxes that are easily loaded on to trucks mechanically. Even where these are available, the waste are thrown in a more or less uncontrolled manner and the file of waste does not allow free access to waste points and often produce unpleasant and hazardous smoke from slow burning fires. The result is that a large portion of the population is left without access to solid waste management. Waste disposal practices in Kano metropolis include Refuse Management & Sanitation Board bin, Authorized dump site, unauthorized empty plot, open burning, Personal bin. The components of waste produce in Kano metropolis include Food scrap, Paper cardboard, Textile rubber, Plastic material, Metal, Glass, Ash, dirt and Vegetable. Nabegu (2008) investigated the operations of the state agency responsible for waste management in the metropolis and reported that a significant portion of the population, 80%, does not have access to waste collection services, only 20% of the waste generated is actually collected and vast majority of users of the service 92% consider the service very poor.

The economic potentials and organization of the informal plastic waste recovery sector showed that besides being a source of livelihood for nearly 30,000 individuals, it provides

cheap raw materials for plastic industries (Mukhtar 2008). Saleh (2008) studied the contributions made by scavengers and showed that over 25,000 people are directly involved in the activity and that 15% of municipal solid waste that would have gone in to the municipal solid waste stream is removed by them.

Previous studies carried out on solid waste management system in parts of the north west particularly in the Kano metropolis and Kaduna showed that over 25,000 people (mainly scavengers) are directly involved in the activity of waste management and that 15% of municipal solid waste that would have gone into the municipal solid waste stream is removed by them. An analysis of the operations of the state agency responsible for waste management in the metropolis reported that of the total population of the region, a significant portion of the population, say about 80% do not have access to waste collection services, only 20% of the waste generated is actually collected and of the vast majority of users of the service, 92% consider the service very poor. It is therefore no surprise that out of the population of about 9 million people living in the city, more than two-thirds of the residents do not use authorized dumpsites for their waste. (Lewcock, 2004)

In this region, the agencies entrust with responsibilities of waste management includes: Jigawa,Jigawa State Ministry of Environment, Jigawa State Rural Water Supply & Sanitation Agency and Jigawa State Small Town Water Supply & Sanitation Agency, Kaduna, Kaduna State Ministry of Environment & Natural Resources and Kaduna State Waste & Sanitation Project; Kano, Kano State Refuse Management & Sanitation Board (REMASAB) and Kano State Rural Water Supply & Sanitation Agency (RUWASA); Katsina, Katsina State Rural Water Supply & Sanitation Agency; Kebbi, Kebbi State Ministry of Environment; Sokoto (has none) Zamfara, Zamfara State Ministry of Environment & Solid Minerals Development

1.3.4.5. North East Zone

Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe the topography of this part of Nigeria is such that it gives ample scope for generation of biomass. The North east region generate a large amount of crop residues and farm wastes in addition to the municipal solid wastes generated from expanding neighbouring urban centers in the Northern zone. In other words the way the region is strauctured is such that the waste situation in one zone has the capacity to adversely impact neighbouring towns. Thus the economic activities in these areas though not as high as those in South-Western and South-Eastern regions is still not matched by the waste management activities that are put in place thereby creating a need for the total overhauling of the existing solid waste management system already in operation there (Dauda & Osita, 2003).

The agencies/authorities responsible for waste management in the Northern eastern zone are: Adamawa, Adamawa State Ministry of Environment ;Bauchi, Bauchi State Ministry of Housing & Environmental and Bauchi State Environmental Protection Agency; Borno, Borno State Ministry of Environment and Borno State Rural Water & Sanitation Agency; Gombe, Gombe State Ministry of Water Resources & Environment and Gombe State Environmental Sanitation & Protection Agency; Taraba,Taraba State Environmental Protection Agency and Taraba State Rural Water Supply & Environmental Sanitation Agency; Yobe, Yobe State Ministry of Environment and Yobe State Environmental Protection Agency.

1.3.4.6. North Central Zone

Benue, Kogi, Kwara, Nassarawa, Niger, Plateau in the north central zone, the waste situation is not only characterized by its population growth but also by the construction boom in Nigeria in the zones in past few years. The state of affairs has added waste from construction

sites as another category of waste stream to the already know menace of municipal waste and has resulted in the daily production of over 3,000 tonnes of solid waste. Some of this has been accumulating, causing serious health and environmental damage especially in places like this region as evidenced in places like Abuja. The municipality now reckons that there is now a daily build-up of at least 300 tonnes of solid waste in and around Abuja, the Federal Capital Territory. Despites its 2,000 workers and about 50 trucks, the municipality cannot keep pace with the daily solid waste production in Abuja.

In fast-growing residential areas in particular, there has been a build-up of waste material, posing a direct health and environmental hazard to the people, especially children who play nearby and/or those who try to eke out a living by scavenging anything of value from the rubbish heaps. Increasingly, wind and rain, in recent times, is spreading pollution. It is estimated that about 12 % of children in most Nigerian cities living in this region have access to sanitation; only 32 % have access to improved drinking water, and water-borne diseases such as diarrhea kill thousands of children annually. These activities mount more pressure on the already inflated need for SWM system in this region (Yusuf, R.O; Oyewumi, M.O., 2008).

The agencies/authorities responsible for waste management are: Benue, Benue State Environmental Sanitation Authority (BENSESA) and Benue State Local Empowerment & Environmental Management Project, Kogi: Kogi State Ministry of Environment & Physical Planning Development and Kogi State Environmental Protection Boardand Kogi State Sanitation & Water Management Board; Kwara, Kwara State Ministry of Environment & Tourism and Kwara State Environmental Protection Agency; Nassarawa, None; Niger, Niger State Environmental Protection Agency; Plateau, Plateau Rural Water Supply & Sanitation Agency and Plateau State Environmental Protection & Sanitation Agency.

1.3.4.7. Conclusions concerning Nigeria

The challenge of solid waste in Nigeria is serious. The situation in each of the zones represented in this assessment is the same, it is replete with issues such as lack of data, ignorance, poor funding, high cost of waste transport owing to poor urban planning, illegal dumping and open burning amongst others have become a norm posing great threat to human health and the environment.

Considerable efforts are being made by many waste management authorities in the zones in tackling these problems, there are still major gaps to be filled in this area. There is a need to overhaul the waste management system in the country from the choice of equipments (most of them are obsolete) to the collection, transportation, storage to final disposal. The variations in the waste management system and the apparent similarities in the challenges faced by the zones is a reflection of the variation in the living standards of the people in the zones particularly in the rural areas. Again it points largely to the absence of public awareness and inadequate local and private sector participation in the management of waste. Thus, to have a proper waste management structure in place, there has to be a review of the existing legal framework on waste management both at the national, state and local, massive awareness, private sector participation and increased funding.

1.3.5. Senegal

Senegal is divided in 14 administrative regions (Dakar, Diourbel, Fatick, Kaolack, Kolda, Louga, Saint-Louis, Tambacounda, Thiès, Ziguinchor, Matam, Kaffrine, Kédougou and Sédhiou) and 44 departments.

Senegal has one of the highest urbanization rates in Africa, approximately 47 % en 2008[39]. The Senegalese population was estimated 12 171 265 in 2009.
The urban growth rate is 4% while the population growth rate is 3,8%. However, the situation is very different in each of the 14 regions of Senegal.

Figure 8 Administrative map of Senegal

The national department for land planning (Direction de l'Aménagement du Territoire) has defined a classification of Senegalese cities.

Table 6 Official classification of Senegalese cities

Cities	Classification
Dakar	National metropolis
Diourbel, Kaolack, Louga, Saint-Louis, Tambacounda, Thiès, Ziguinchor	Intermediate metropolis (Métropôles d'équilibre)
Bignona, Fatick, Kolda, Matam, Mbour, Podor, Richard Toll	Regional development poles
Bakel, Bambey, Dagana, Foundiougne, Gossas, Joal Fadiouth, Kaffrine, Kébémer, Kédougou, Linguere, Mbacké, Nioro du Rip, Oussouye, Sédhiou, Tivaouane, Velingara	Secondary centres
Dahra, Diawara, Dioffior, Gandiaye, Goloe, Gousomp, Guinguineo, Kahone, Kanel, Kayar, Khombole, Koungheul, Ndoffane, nguekhokh, Marsassoum, Mekhé, Mboro, Ndioum, ourossogui, Passy, Pout, Ranerou, Rosso, Semme, Sokone, Thiadaye, Thilogne, Thionck-Essyl, Waoundé	Intermediary centres

Source : Republic of Senegal, Direction de l'Aménagement du Territoire, 2000

However, this classification is not operational for waste management purposes. More relevant characteristics are the following:

1. The Region of Dakar
2. Secondary cities
3. Rural areas

1.3.5.1. The Region of Dakar

[39] Source: Senegalese statistics agency, ANSD, 2008

The Region of Dakar is situated in the peninsula of Cabo Verde, on a 550 sq km area which represents 0,28 % of the national territory. However, more than half of the urban population of Senegal lives in the Region of Dakar.

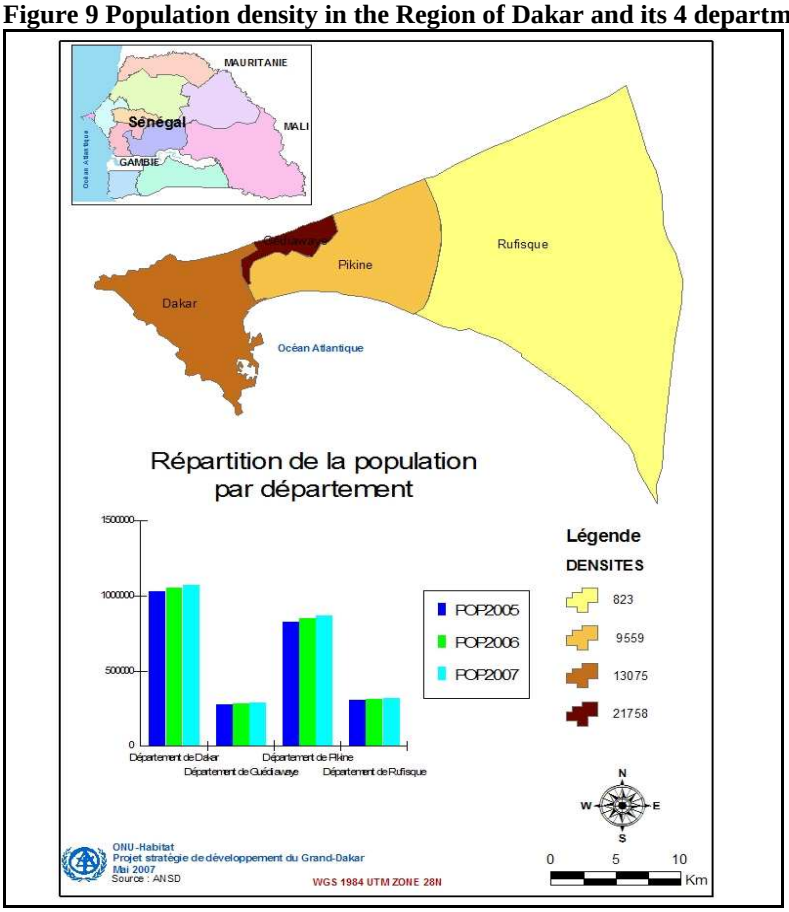
The population of the City of Dakar is growing rapidly (4% per year) along with urbanisation. The population density is high: approximately 13 000 inhabitants per sq km. This population is very young : 60% is less than 25 years old.

Demographic growth in Dakar has led to urban sprawling. Areas occupied for housing purposes have more than tripled between 1960 and today. All the departments within the Region of Dakar, and in particular Pikine and Guédiawaye, have sprawled in rural areas and in trough of low pressure without land planning. Illegal buildings represent more than 25% of the surface of urban areas. These areas are poorly equiped in infrastructures.

The other urban centres can be classified in 2 categories :

- Thiès, Kaolack, Saint Louis, Ziguinchor and Mbour, with more than 150 000 inhabitants each ;
- Diourbel, Louga, Tambacounda and Kolda, with less than 50 000 inhabitants each.

Figure 9 Population density in the Region of Dakar and its 4 departments



The Region of Dakar is the destination of rural migrants as well as migrants originating from border countries and other continents. The departments of Guédiawaye and Pikine are important destinations, accounting for 35,7 % of migratory flows. Yet the department of Dakar is destination n°1 accounting alone for 34,1% of mi gratory flows. The department of Rufisque and the 2 rural centres (communautés rurales) account for the rest of migratory flows i.e. 30,2 %.

This situation leads to a strong pressure on urban equipment, infrastructure, networks and streets. Land reserves are disappearing at a quick pace and illegal occupation of land is growing in importance.

The density rates are very different between the 4 departments of the Region of Dakar. The department of Guédiawaye only represents 2,3 % of the surface but has the highest population density (22 108 inhabitants per sq km), compared to the department of Dakar (13 366 inhabitants per sq km), Pikine (9 777 inhabitants per sq km) and Rufisque (842 inhabitants per sq km) which represents 67,6 % of the regional surface.

It is worth noting that waste production within the Region of Dakar varies according to the population density of its 4 departments. The 2 departments of Dakar and Pikine are by far the most populated and have the highest waste production.

Table 7 Waste production in the 4 departments of the Region of Dakar

Department (population)	Waste production in tons	Waste production/pers/day in kg
Dakar (1 036 506)	560	0,54
Guédiawaye (281 412)	152	0,541
Pikine (837 393)	452	0,539
Rufisque (308 925)	167	0,54

Source: IAGU (2007), quoted in IAGU, 2007, *Résumé du rapport GEO Ville, Région de Dakar*, 27 pages.

This concentration of human settlements, combined with the geographical situation (peninsula) and the structure of the network, causes a few weaknesses in the domestic waste collection and evacuation system.

Concerning Dakar's "hinterland", the strong urbanisation in the area has considerably reduced the distance between the capital and secondary cities such as Thiès or Mbour that are touristic areas (especially in Mbour), attracting thousands of international tourists every year. Thus, Thiès and Mbour could be considered as Dakar's hinterland but their specific situation will be described more in detail in the following sub-section.

In Senegal, the production of domestic waste is estimated at 6 000 tons per day, with great disparities between the various regions. The Region of Dakar has a daily production of nearly 1 500 tons, and is followed by the Region of Thiès with 850 tons per day.

The City of Pikine, in the suburb of Dakar, hosts the only landfill of the Region of Dakar. This landfill, called "Mbeubeuss", receives 475.000 tons of waste every year. The only organised "treatment" on this landfill consists in compacting waste transported by trucks after it has been weighted.

The City of Pikine has a high demographic growth which poses many problems of cohabitation with the landfill in terms of land planning, housing, sanitation, environment, health and education.

The current waste management in Dakar is characterised by many weaknesses at institutional, financial and technical level. Institutional responsibility is still provisory (transition period). A new collection, cleaning and waste transportation system, within a Public-Private-Partnership is being discussed.

The Cities of the Dakar metropolis (l'Entente) and the government have already decided : (i) to close and rehabilitate Mbeubeuss landfill, (ii) to open a Sanitary Landfill in Sindia,(iii) to modernise the Separation and Transfer Site.

It is worth mentioning that the City of Dakar has planned to privatise pre-collection, collection and transportation of waste but will remain directly in charge of street sweeping.

Waste transportation in Dakar cannot be carried out everywhere with collection trucks. In some neighbourhoods and cities such as Ouakam, Rufisque, Pikine and Guédiawaye, due to the narrow streets and spontaneous land occupation, animal-driven carts are used to transport waste.

1.3.5.2. Secondary cities

Apart from Dakar, the main touristic infrastructures are located in Mbour, Thiès, Saint Louis and cap Skirring. This has an important impact in waste production and the nature of waste produced.

Contrary to Dakar, in most secondary cities, the waste management service is not privatised yet. Some secondary cities are being accompanied and reinforced by NGOs or international cooperation (Saint Louis with NGO Enda Tiers Monde and Belgian Cooperation; Richard Toll with Luxemburg Cooperation, Thiès with Italian cooperation…).

In 2005, a group of NGOs and research institutes (French NGO GRET, Italian NGO LVIA, Senegalese NGO Pacte and Canadia reseach institute IRDC) that had been promoting integrated waste management systems in Senegal for several years published a study base on their experiences with "secondary cities".

The table hereafter presents some of the characteristics of these secondary cities:

Table 8 Main characteristics of existing waste management in 10 secondary cities in Senegal

	Cities with more than 100 000 inhabitants						Cities with less than 100 000 inhabitants				
City	**Thiès**	**Rufisque**	**Kaolack**	**Ziguinchor**	**St-Louis**	**Mbour**	**Louga**	**Tambacounda**	**Kolda**	**Dagana**	**Mboro**
Region	Thiès	Dakar	Kaolack	Ziguinchor	St-Louis	Thiès	Louga	Tambacounda	Kolda	St-Louis	Thiès
Inhabitants	320 000	300 000	250 000	225 000	200 000	150 000	77 000	62 000	61 000	30 000	19 000
Operational landfill	Former quarry, not improved	Former lake	Simple landfill	Former quarry, not improved	Simple landfill	Former quarry, not improved	Simple landfill	Former quarry, not improved	No landfill	Improved landfill	No landfill
Available human resources	1 waste management officer 9 unskilled workers 40 employees of a private company	120 employees of a private company	1 waste management officer 80 technicians and unskilled workers (among which 20 part-time)	10 unskilled workers	120 unskilled workers Staff of the Agence de Développement Communal	1 waste management officer (elected) 10 unskilled workers	1 waste management officer 17 skilled and unskilled workers	1 waste management officer (elected) 6 unskilled workers Occasionnally: voluntary staff	7 skilled and unskilled workers	1 waste management officer 6 unskilled workers	1 waste management officer (elected) 4 unskilled workers
Type of service provided	Collection by the city on the market and the main roads. Elsewhere, subcontracted to a company or community based organisations (CBOs).	Subcontracted to a company on the main roads. Elsewhere, pre-collection by CBOs.	Collection by the city in central areas. Elsewhere, pre-collection by CBOs.	Collection by a sub-contracted company in central areas. Elsewhere, pre-collection by CBOs.	Collection by the city in central areas. Pre-collection by sub-contracted CBOs in 10 areas. In other suburbs, no collection.	Door to door collection sub-contracted to a company. Pre-collection by CBOs.	Collection by the city in central areas. Poorly organised pre-collection by CBOs.	Collection by the city of transit sites. Pre-collection by CBOs and small companies.	Collection by the city (1 truck). Door to door pre-collection by CBOs.	Door to door collection by subcontracted CBOs.	Collection by the city (1 truck). Poorly organised pre-collection by CBOs.

Source: adapted from GRET, 2006, *La gestion des ordures ménagères dans les villes secondaires du Sénégal, Vers des politiques municipales incluant les quartiers périphériques*, pages 24 and 35.

The table below shows that there is a certain degree of homogeneity in terms of waste production according to the size of the city.

Table 9 Domestic waste production in relation to number of inhabitants in Senegal

Cities	Cities with more than 100 000 inhabitants				Cities with less than 100 000 inhabitants			
	Rufisque	Kaolack	Ziguinchor	St-Louis	Louga	Tambacounda	Kolda	Mboro
Inhabitants	300 000	250 000	250 000	200 000	77 000	62 000	61 000	19 000
Domestic waste production (kg/inhab/ day)	0,70	0,49	0,63	0,61	0,34	0,4	0,28	0,21
	Average for these cities: 0,60 kg				**Average for these cities: 0,33 kg**			

Source: GRET, 2006, La gestion des ordures ménagères dans les villes secondaires du Sénégal, Vers des politiques municipales incluant les quartiers périphériques, p. 27.

The table below shows that the bigger the city, the most likely is waste collection to be mechanised.

Table 10 Waste collection coverage rates and types of collection equipment in relation to number of inhabitants in Senegal (estimation)

	Cities > 100 000 inhabitants	Cities < 100 000 inhabitants	Average
Coverage rate by mechanical equipment	27%	10%	20%
Coverage rate by animal- or man-driven carts	13%	18%	15%
Total average coverage rate	**40%**	**28%**	**35%**

Source: GRET, 2006, La gestion des ordures ménagères dans les villes secondaires du Sénégal, Vers des politiques municipales incluant les quartiers périphériques, p. 32.

The table below shows that secondary cities in Senegal spend in average 10% of their budget for cleaning (waste collection and disposal being the main expense).

Table 11 Municipal budgets dedicated to cleaning in Senegal

Cities	Cities with more than 100 000 inhabitants				Cities with less than 100 000 inhabitants			
	Rufisque	**Kaolack**	**Ziguinchor**	**St-Louis**	**Louga**	**Tambacounda**	**Kolda**	**Mboro**
Municipal budget (in million FCFA)	1 898	1 152	1 500	1 998	1 500	914	485	125
Municipal budget for cleaning (in million FCFA)	389	100	180	100	163	110	11	12
In %	20%	9%	12%	5%	11%	12%	2%	10%
	Average for these cities: 11,5%				**Average for these cities: 8%**			
Estimated coverage rate	45%	12%	30%	43%	35%	10%	5%	40%
Cleaning budget per inhabitant (in FCFA)	1 255	400	800	526	1 086	1429	178	1 750
Average : 928 FCFA								

Source: GRET, 2006, La gestion des ordures ménagères dans les villes secondaires du Sénégal, Vers des politiques municipales incluant les quartiers périphériques, p. 45.

1.3.5.3. Rural areas

There is little information available on waste management in rural areas. Waste is usually "self-managed" by the inhabitants of villages. Most of the time, it is either burnt in the open air (which poses sanitary problems) or spread in the field as a fertilizer.

1.3.5.4. Conclusions concerning Senegal:

No regional differences in terms of waste management, but the size of the city is an important criterion.

The biggest the city, the better the coverage rate of waste collection by the public service: the waste collection coverage rate is in average 40% for cities with more than 100 000 inhabitants but only 28 % for cities with less than 100 000 inhabitants.[40] The most populated cities seem to better manage to ensure a collection service, probably because of better infrastructure, better roads and more important financial means.

The differences between central neighborhoods and suburbs can be observed in all the regions of Senegal.

In terms of access to waste collection services, suburbs are very disadvantaged compared to central areas of cities. For instance, in the city of Ziguinchor, central and fully serviced neighbourhoods gather more than 2/3 of the city population and the main administrations, banks and shops. 56% of the waste in these neighbourhoods is collected. However, suburbs are not concerned, which means that the coverage rate for the whole city is only 40%.
In fact, a typical Senegalese city can be divided in 3 areas:

- Central area, residential, with administrations and modern roads, where there is generally a correct waste collection service. Waste is collected by trucks that take it to the disposal site.
- Suburbs where there is an operational pre-collection service (organised by NGOs, CBOs, officially subcontracted by the city or not). Waste is regrouped in big containers and then transported by the city trucks to the disposal site.
- Suburbs where there is no organized pre-collection system. Inhabitants manage their waste by themselves by scattering them, burning them or using them as backfill for buildings.

But there is even a difference in the type of waste produced. Senegal being a Sahelian country, sand represents up to 1/3 of the collected waste, yet the proportion is even more important in popular suburbs because of the sweeping of houses' backyards and the lack of modern roads that causes the sand to accumulate in the backyards with other organic waste especially during the rainy season.

In fact, all across Senegal, the same weaknesses are observed: unreliable collection, low coverage, inadequate collection equipment with regard to the type of habitat and lack of an efficient waste elimination system.

The constraints are also common: excessive urbanization in urban centers, growth of waste production as a result of demographic growth. This growth of both domestic and industrial waste, combined by insufficient cleaning and collection equipment, poses one of the main challenges to Senegalese cities.

[40] GRET, 2006, *La gestion des ordures ménagères dans les villes secondaires du Sénégal, Vers des politiques municipales incluant les quartiers périphériques*, 92 pages.

2. SECTION 2: REGIONAL EVALUATION OF LEGAL BACKGROUND, GOVERNANCE AND SOCIO-ECONOMIC STRUCTURE

2.1. Background information

The aim of this sub task was to carry out a review of the current national and regional legal and institutional frame regarding solid waste management in the four target regions. The review sought to identify, the policy gaps and the legislative needs for enhanced implementation of solid waste management systems in the target regions. It also took into consideration the needs for the institutional development of regional and national administrations identified in the regions. As part of the appraisal, an evaluation of the capability of regional and national authorities for the executive implementation of successful solid waste management action plans was performed. The socio-economic structure and its relation with the management of waste is also included in this analysis, with especial importance to the role of the informal sector.

In order to gather information for this review, a questionnaire was prepared and applied across the target countries by the national partners. The objectives of the questionnaire was to collect information regarding: Legal framework and its applicability, investment in SWM, economic activity linked to solid waste, involvement of micro and small enterprises (MSEs) and community-based organizations (CBOs), waste services responsibility, fees, seasonal or cultural variations in waste generation, etc.

2.2. Comparative synthesis of the legislation on SWM in the 4 countries

Ratification of international conventions: a wide consensus, but a weak implementation

Table 12: Ratification of international conventions as of July 2011.

	Ghana	Nigeria	Senegal	Ivory Coast
Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	✓	✓	✓	✓
Basel Ban (of the Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)	✓	✓		
Bamako convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa	✓	✓	✓	✓
Stockholm convention on persistent organic pollutants	✓	✓	✓	✓
Rotterdam convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	✓	✓	✓	✓
United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982	✓	✓	✓	✓
Part XI of the UNCLOS		✓	✓	✓
The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the "London		✓		✓

	Ghana	Nigeria	Senegal	Ivory Coast
Convention") of 1972				
The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the "Abidjan Convention") of 1981	✓	✓	✓	✓

All the 4 countries have ratified the main international conventions on hazardous waste and international trade, which means that in principle, their populations and environment are protected from toxic waste coming from abroad.

It is worth noting that apart from these international conventions, Western African countries have also set up specific conventions: the Bamako Convention (e-waste) and the Abidjan Convention (waste dumping into the sea).

However, enforcement of all these Conventions is still weak, for instance e-waste ends up in those 4 countries in the form of shipments officially containing second hand equipment but is most often not used as such and simply dismantled by the popular sector.

Senegal and Ivory Coast have not ratified the Basel Ban amendment which was written in 1994 and 1995 by the conference of parties of the Basel Convention to establish a new Article 4A. The article would obligates Parties that are listed on Annex VII of the Convention (country members of the OECD, EU and Liechtenstein) to purely ban exports of hazardous wastes to all countries not listed on Annex VII. The ban would take place immediately for final disposal, and for those wastes bound for recycling destinations. The Amendment will go into force when 62 countries (3/4ths of Parties present) have ratified it which is still not the case.

Marine pollution is considered a transboundary issue which is not limited to national territorial waters alone but often extends to the high seas used by other states and as such is regulated at the international level by the United Nations Convention of Law of the Sea (UNCLOS), 1982. As signatories to the UNCLOS, Nigeria, Ghana, Senegal and Côte d'Ivoire are enjoined to adopt laws and regulations to prevent and reduce the pollution to environment (this is stated in particular in article 145 of Part XI of UNCLOS). UNCLOS and other treaties imposes some duties on the country (as a coastal and flag state) and on its ports in respect to pollution on the marine environment. In preventing pollution however, there are established standards that are calculated to be very vital for the prevention of pollution. These standards prohibit or restrict certain types of activities such as dumping[41] of radioactive wastes, conducting of nuclear weapon tests in the sea, designing and maintenance of ships.

In addition, only Nigeria and Côte d'Ivoire have ratified the Convention on the prevention of marine pollution (1971) but it is not quite sure that the provision are adequately been enforced.

National legislation and regulations on SWM

[41] The UNCLOS includes a definition of « dumping » in its PART I, Introduction, *Article 1 : « (5) (a) "dumping" means:*
(i) any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea;
(ii) any deliberate disposal of vessels, aircraft, platforms or other man-made structures at sea;
(b) "dumping" does not include:
(i) the disposal of wastes or other matter incidental to, or derived from the normal operations of vessels, aircraft, platforms or other man-made structures at sea and their equipment, other than wastes or other matter transported by or to vessels, aircraft, platforms or other man-made structures at sea, operating for the purpose of disposal of such matter or derived from the treatment of such wastes or other matter on such vessels, aircraft, platforms or structures;
(ii) placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Convention. »
For the full text, see website :
http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

Table 13 : Existing legislation or regulations concerning SWM in the 4 countries

	Ghana	Nigeria	Senegal	Ivory Coast
Municipalities are in charge of SWM	✓ 1990	No (at State level not at municipal level)	✓ 1996	No longer since 2007
Tax for SWM	No	✓	✓	✓
Waste dumping punished	✓	✓	✓	✓
Treatment plants	Landfill guidelines			
Healthcare waste	Guidelines	✓	✓	✓
e-waste	No	In view	No	No
Industrial waste	No	✓	✓	✓
Mining Code	✓ Minerals and Mining Act, 2006	✓ Mining Act, 2007	✓ Code Minier, 2003	✓ Code Minier, 1995
Environmental Impact Assessment	✓	✓	✓	✓
Waste separation at the source	No	No	No	No

All the 4 countries have transferred the responsibility of SWM to municipalities except for:

- Ivory Coast where it was the case until an ordinance dating from 2010 re-transferred SWM to national authorities.
- Nigeria which is the only Federal State, while the 3 other countries are centralised States.

Nigeria has a very large number of local agencies for waste management (more than 50) in the various States, whereas Senegal and Ivory Coast have only national agencies.

Despite of these specificities, the common point is that in none of the 4 countries, the municipalities are financially independent from the Central government as far as financing the SWM service is concerned. For instance, Dakar and most Ghanaian metropolises (except Accra) receive grants from the central government for SWM.

All the 4 countries have defined fines and penalties to punish waste dumping.

A specificity of francophone Western African countries (Senegal and Ivory Coast) is the emphasis on the concept of hygiene and salubrity: both countries have Codes of Hygiene and public bodies carry out public awareness raising campaigns on these issues. Anglophone countries (Ghana and Nigeria) refer more to the concept of “environmental health” or “health and sanitation”.

None of the 4 countries have a legal framework concerning e-waste, which means that e-waste is collected and treated along with municipal waste, which poses acute environmental problems.

Ghana is the only country having official guidelines for the management of landfills.

Concerning waste separation at the source, it is not foreseen by the law in any of the 4 countries yet it is implicit in some legal texts for instance in Senegal : the Decree 74- 338 of April 4th 1974 on waste collection and final disposal and the Law 83-71 providing for the Code of Hygiene in its article L 33 both forbid *"to mingle household waste with anatomical or infectious waste, as well as pharmaceutical waste and any other toxic waste or waste from slaughterhouses"*.

Note on Mining Codes and their specifications concerning SWM:

The assumption that important mining activities could be an obstacle to the development of legislation on SWM was examined. All the 4 countries have extractive industries, be it phosphate mines in Senegal, goldmines in Ghana, or oil in Côte d'Ivoire and Nigeria.

Concerning the mining issue, the legislation is very unprecise in the 4 countries.

It is true that Senegalese and Ivorian mining codes[42] both make reference to the issue of waste generated by mining activities with almost the same words. However, it is only to specify that slag heaps (i.e. mining waste heaps principally composed of contaminated rocks and sand, in French: terrils) and residues of metallic minerals (in French: haldes) cannot be valorised withour prior authorisation by the ministry.

It is interesting to note that Article 73 of the Senegalese mining code states that the possession of a mining permit gives the company *"the right[43] to see to the storage/disposal of by-products and waste…"*

The mining sector in Ghana is regulated by legislative instruments such as Act 703, Minerals and Mining Act of 2006, Minerals Commission Act 1993, Environmental Protection Act, Act 490 of 1994, Environmental Assessment Regulation of 1999, LI 1652 etc.

The Mining and Minerals Act, Act 703 of 2006 recognize that the disposal of the above wastes from mining operations may impact negatively on the environment, though there is no specific provision in the Act that deals with waste from mining. Section 18 of the Act state that *"(1) Before undertaking an activity or operation under a mineral right, the holder of the mineral right shall obtain the necessary approvals and permits required from the Forestry Commission and the Environmental Protection Agency for the protection of natural resources, public health and the environment".* Sub – section 2 of section 18 of Act 703 of 2006 is more definite on the protection of the environment which include sustainable and efficient manner of waste disposal. It states as follows *"(2) Without limiting subsection (1), a holder of a mineral right shall comply with the applicable Regulations made under this Act and any other enactment for the protection of the environment in so far as relates to exploitation of minerals".*

Conclusions drawn from the questionnaire distributed to SWM stakeholders

[42] Senegalese mining code (Loi n°2003-36 du 12 novemb re 2003 portant Code minier, title VII) and Ivorian mining code (Loi n°95-553 du 17 juillet 1995 portant code mini er, title V)

[43] Not the duty !

Within this sub-task of IWWA, a questionnaire was developed and distributed in the 4 countries. No answers were gathered in Senegal and Côte d'Ivoire. The answers of 201 respondents (170 households, 29 businesses and 2 institutions) in Ghana and 130 respondents (70 households and 60 institutions) in Nigeria were analysed.

The main common conclusions were:

- there is generally a low level of awareness of the legal framework, especially among households as compared to businesses
- there is also a low level of awareness of the involvement of Small and Medium Entreprises (SMEs) in SWM, and it is even lower concerning the involvement of NGOs and Community Based Organisations (CBOs) although those actors play in major role in SWM in the concerned countries
- the weakness of the institutions in charge of SWM is widely acknowledged.

2.3. ANALYSIS BY COUNTRY

2.3.1.Ghana

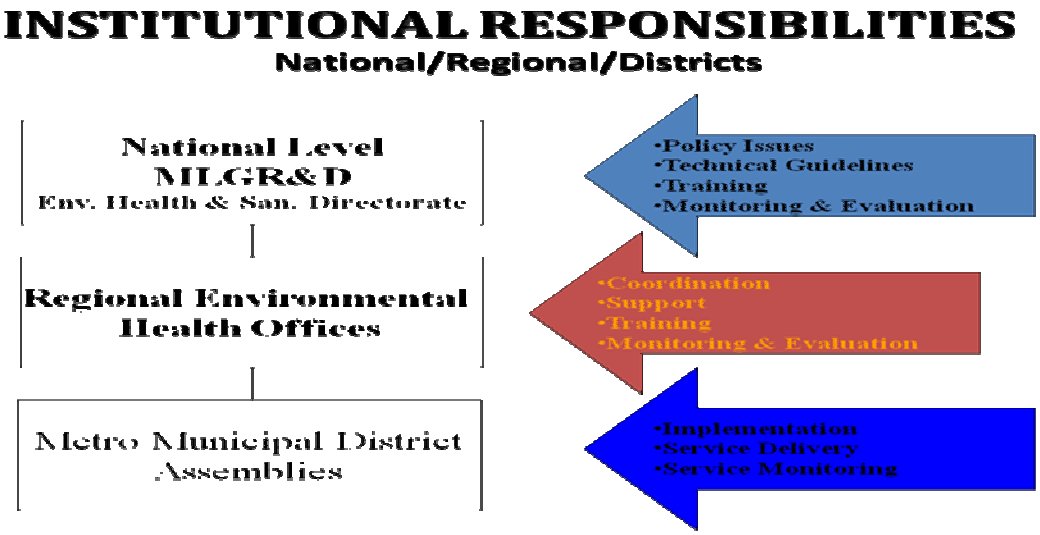
2.3.1.1. The legal framework of solid waste management in Ghana

2.3.1.1.1. Institutions

Given the harmful effects of solid waste on human and ecological health, Ghana has over the years been working on promoting laws which could adequately deal with this issue. As far as the formulation and enforcement of waste management laws in Ghana are concerned, this is the responsibility of politicians (District Assembly members), administrators, and environmental protection officials from Ghana's Ministries of Environment, Science and Technology (MEST), Ghana's Environmental Protection Agency (EPA) and Ministry of Local Government and Rural Development some other ministries who prepare, enforce, and implement policies on waste handling. These officials participate in the planning and management of issues relating to waste. In addition to this group of officials, there are two other stakeholder categories in solid waste collection in Ghana: the private service providers (private waste companies), the served public (residents) and local authorities (government officials). Though these parties have made commendable efforts, some loopholes could still be identified Ghana's legal approach to managing waste, and some recommendations made for a better functioning of waste management laws in this country.

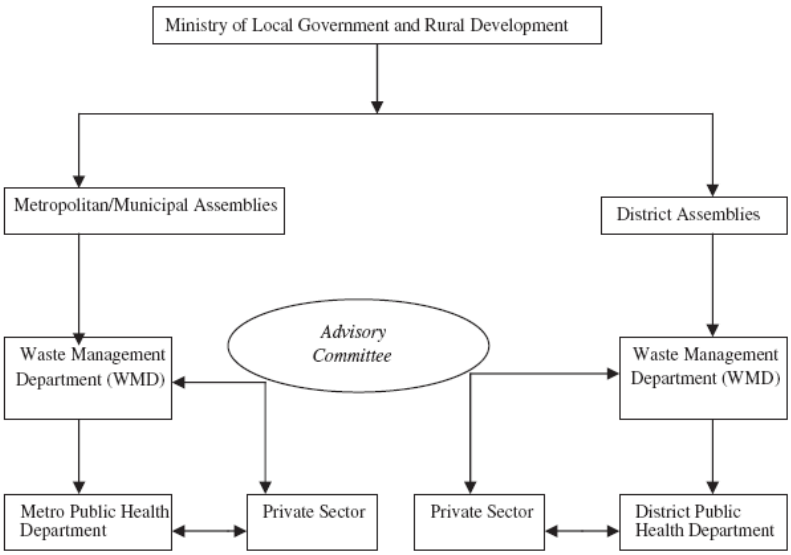
The Figure below presents the institutional roles and responsibilities for waste management from national to local levels. The Ministry of Local Government and Rural Development (MLGR&D) is responsible for policy. District Assemblies are the key institutions responsible for waste management service provision at the local and community level. The Ministry also take care of the national level, providing policy and technical guidelines in order to ensure sustainable financing which serves as a catalyst to improving service delivery. Solid waste collection user fee schemes have been introduced by a number of municipalities to mobilize revenue from service beneficiaries to support the financing of waste collection by the private sector.

Figure 10 Institutional responsibilities for waste management service delivery



From Fig. 10 above, waste management in Ghana has been decentralized. At the national level, the Environmental Health and Sanitation Directorate of the Ministry of Local Government and Rural Development initiate polices, and technical guidelines as well as capacity building of environmental health and sanitation officers in the regions and the districts to effectively implement all the policies regarding waste management in Ghana. Whilst the Regional Environmental Health Officers coordinate the activities of the metropolitan/municipal/district assemblies Environmental Health and Sanitation Officers who are directly involved in waste management at the local level. The policy is that waste generated at the local level is the property of the municipal/metropolitan/district assembly. However, as noted by Fobil et al., (2008), most the municipal/metropolitan/district assemblies at the local level are not able to management the solid waste generated effectively and as such has invited some private entities (see fig. 2 below).

Figure 11 Typical institutional Arrangement in Ghana (adopted from Fobil et al (2008))



2.1.1.2. Main laws and regulations

Local Government Act, 1990 (Act *462*);

It sets the various metropolitan/municipal/district assemblies in Ghana. It also prescribes their functions. In terms of waste management, the Act empowers the various metropolitans/municipal/districts to enact bye laws to regulate waste management.

Environmental Assessment Regulations, 1999 (LI 1652);

LI 1652 requires that any entity whose activities is likely to impact negatively to conduct an environmental impact assessment to identify the potential impacts as well as prescribed measures on how to overcome the negative impacts.

Criminal Code, 1960 (Act 29);
The criminal code of Ghana prescribes penal actions against indiscriminate dumping of waste at unauthorized places.

Water Resources Commission Act, 1996 (Act 522)
It seeks to protect water bodies from dumping of solid wastes and other pollutants into it.

Pesticides Control and Management Act, 1996 (Act 528);
It deals with the use of pesticides and other agricultural wastes in Ghana.

National Building Regulations, 1996 (LI 1630, 1996)

The National Building Regulations, LI 1630 of 1996 spell that all buildings in Ghana must have well designed facilities sewage facilities and also makes provision for disposing of solid wastes.

Environmental Protection Agency Act 490 (1994)
The EPA Act vests the protection of the environment including solid waste management

Ghana Landfill Guidelines (2002)
It describes guidelines for the constructions of landfill as well as management of solid wastes in their respective districts/municipal/metropolitan assemblies.

Manual for the preparation of District Waste Management Plans in Ghana (2002)

Guidelines for the Management of Healthcare and Veterinary Waste in Ghana (2002)
It deals with management of solid waste from health institutions as well as wastes from Veterinary Services.

Handbook for the Preparation of District level Environmental Sanitation Strategies and Action Plans (DESSAPs, 2009).
It sets out modalities for constructions of landfill sites in Ghana as well as how to manage solid wastes at the local level.

International Environmental Treaties ratified by Ghana

- The Basel Convention :International treaty addressing cleaner production, hazardous waste minimization and controls as well as transportation of this waste across borders of nations.
- The Basel Ban (of the Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)
- Bamako convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa
- The Stockholm Convention on Persistent Organic Pollutants: It seeks to reduce or eliminate the use of Persistent Organic Pollutants (POPs). POPs possess toxic properties, resist degradation, bio-accumulate and are transported, through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems.
- The Rotterdam Convention on Prior Informed Consent of Certain Hazardous Chemicals International Trade: To promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans.
- The United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982
- The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the “Abidjan Convention”) of 1981

2.1.1.3 Policy gaps and needs in terms of institutional development

In Ghana, there is no fixed/uniform legislation which regulates the management of waste.
Furthermore, there is an absence of legal enforcement capacity and collaboration between relevant governmental ministries working on this matter. For example, the 1959 Petroleum Regulations govern the importation of petroleum, the Prevention and Control of Pests and Diseases of Plants Act 17 (1965) regulates the importation of pesticides and the Explosives Regulations L.I. 666 (1970) covers the importation of explosives. For more uniformity though, it may be commendable to enact a single law. In this uniform law, all aspects of hazardous waste will be covered, be it hydrocarbons in petroleum, mercury, lead scrape for batteries and so on. Through this, it also becomes easier for prospective importers, exporters and ordinary persons to consult these laws for easy reference, before engaging in these shipments.

There is also a serious lack of collaboration between the various offices such as the GAEC, MEST, Ghana Standards Board, Ministry of Trade and Industry and the few environmental NGOs which work on toxic waste trade regulation. For instance, the EPA in the MEST, is the principal ministry for implementing legislation which regulate the management of chemicals and generally control pollution, as well as other environmental problems, which *inter-alia*, result from mismanagement of chemicals and toxic waste in the country.

The Ministry of Employment and Social Affairs ensures that workers are guaranteed maximum protection from the potential hazards of chemicals. Within this Ministry, there are inspectors who ensure that the provisions of the laws pertaining to occupational safety and health are abided by.

The Ministry of Food and Agriculture is relevant in toxic waste management, as it has established a Department of Plant Protection and Regulatory Services (PPRSD) which provides training to farmers on the safe use of pesticides.

Another important ministry in the regulation of toxic waste in Ghana is the Ministry of Mines and Energy. Through its Mines Department, this Ministry is responsible for the implementation of the laws enshrined in the Mining and Minerals Law, as they relate to health and safety in the mining environment, and also, monitors the use and storage of explosives which are utilised in this sector.

The Ministry of Trade and Industry ensures that under the Imports and Export Regulations, it grants licenses prior to the importation of goods specified in the second schedule which includes a number of chemicals.

Compounded with the abovementioned laws and policies, ministries, departments and agencies are tasked with the provision of environmental sanitation infrastructure and services. While the Local Government Act, 1993 (Act 462) and Local Government Service Act, 2003 (Act 656) seek to effectively transfer the functions and offices of central ministries, departments and agencies to the Assemblies, this has not happened and many still exist and function as central government dependencies.

The Ministry of Health, as part of the Pesticides Technical Committee, is important in ensuring that the occupational health of workers who could be exposed to chemical hazards and their safety are guaranteed. It must also be borne in mind that narcotic drugs can only be imported and exported only by the Minister of Health who then grants the appropriate license in this regard. It may be suggested at this point that such substances be extended to cover a wide range of chemicals, which are toxic and must not be limited to narcotic drugs alone.

On the other hand, such co-operation exists to some extent between the relevant FAO and UNDP country offices. In Ghana, a Hazardous Chemicals Committee has been established by the EPA. This Committee comprises the Ghana Standards Board, GAEC, Ghana Cocoa Board, Crops Services Department of the FAO, Veterinary Services Department of the Ministry of FAO, three officers from the Agency and three other persons who should have special knowledge and experience in toxic chemical management (Article 10, EPA Act 490 of 1994). Though agencies such as the Ghana Standards Board and the GAEC are abreast of developments relating to the importation and exportation of pesticides, the main thrust of the work lies with the EPA and the MEST which possess much more information on the regulation of pesticides in this country. It is reasonable that every pertinent detail about the regulation of pesticides under this Committee be made available to each member. A Department of Waste Management could be established within this Ministry.

(On these challenges, see Idun, YNA. *Regulating Hazardous Waste in Ghana, Côte d'Ivoire and South Africa: A Comparative Review of Municipal Legislation*, United Nations University-Institute for Natural Resources in Africa. Woeli Publication, Accra (2010)).

Partnerships for Various Stakeholders in Waste Management

There exists a gap requiring that there is an ensuring legal instrument to support institutional functions including public-private partnerships, financing and funding arrangements, licensing, monitoring, control and ownership, of wastes, point and non-point discharges.

Metropolitan, Municipal and District assemblies in Ghana have byelaws on environment and sanitation that are regulated by the EPA. These bye-laws aid to simply the main policy frameworks and legislations for domestic waste management in Ghana. The policies are embedded in the National Environmental Policies (1990); the Local Government Act, 1993 (Act4 62); the Environmental Protection Agency (EPA) Act, 1994 (Act 490); the Environmental Assessment

Regulations, 1999 (Legislative Instrument 1652); and the Environmental Sanitation Policy, (1999). There is no legislation that requires residents to sort out the waste generated and also to ensure that residents pay for waste disposal services. However, most Assembly and Unit-Committee representatives have in recent times played an active role in household waste management in their communities. The metropolitan, municipal and district assemblies bye – laws do not cover electronic and industrial waste which are emerging problems in the waste stream in Ghana.

Absence of Adequate Penalties

As there are no harsh penalties under the existing hazardous waste regime in Ghana, it is practically very easy for people to knowingly or unintentionally abuse laws which deal with waste management. In the absence of stringent punitive measures, the likelihood of disobedience on the part of the populace to any legislative instrument becomes high. The inevitable result of such a scenario is clear: the legislation or policy becomes a white elephant.

Hence, it may be suggested that Ghana's waste management law incorporates highly strict punitive measures, unimaginably prohibitive fines for those who infringe the laws on this matter and dump waste in a reckless manner.

Lack of Sufficiently Trained Personnel

In Ghana, the number of suitably trained experts, level of capacity-building and training resources in general environmental problems and the specific issue of the collection and management of waste is meagre.

Financial setbacks prevent officials from being adequately paid. This makes undertaking such assignments unattractive, meaning that many people do not aspire to work in this area. A relevant solution might be for the MEST, EPA, the private sector and other agencies to collaboratively consider prioritising these issues, presenting financial statements, with clear indications of the points where budgetary constraints are faced, to government.

It is necessary that Ghana works on having enough quality trained personnel in this field, in order to avoid events such as the 1992 environmental tragedy of Cheliabinsk and Orehovo-Zuevo in Russia. This case demonstrates the potentially tragic danger of permitting inexperienced people to deal with hazardous waste. In this year, both towns in question, upon receipt of seventy tonnes of toxic cellulose waste, which had been disguisedly labelled as humanitarian aid, tried unsuccessfully to burn the waste. These substances produced defoliant toxins, causing a great deal of dioxin poisoning and the resultant uncontrollable vomiting among the populace (See Marbury, HJ. "Hazardous Waste Exportation: The Global Manifestation of Environmental Racism" (March 1995), *Vanderbilt Journal of Transnational Law*, Vol. 28 No. 2, 251-294, at 258-259).

In the light of these, Ghana's government and other stakeholders in waste management need to find financial support for the training of inspectors and other officers in this very important. It seems reasonable that people dealing in any area/field be endowed with the relevant expertise. In this vein, one could advocate the establishment of Certificate and Postgraduate Diploma Courses in Hazardous Waste Management within the context of International Trade and Environmental Issues-given the economic benefits which could be derived from recycling waste in an environmentally sustainable manner when principles such as those of precaution, the preventive principle, polluter pays and others are incorporated into such recycling activity. These courses could organised at the initiative of the EU, WTO, UNEP, national universities, agencies such as Zoomlion and other stakeholders

3.3.1.2. The role of the private sector

3.3.1.2.1. The popular private sector

Description

In Ghana the popular private sector had been the informal sector until recent times where well organized formal private sector was empowered. These informal private sector operators range from single person to a group of about five collecting waste from house to house, valuable waste from the street and scavenging from the various landfills. They are not organized in any way and also not resourced. The use wheel barrow, cart pushing, motorized tricycles in few cases.

Though there is no appropriate data on the activities of this sector, it is estimated that there are about three thousand (3,000) of such numbers operating mostly in the urban centres. They do not have specific name for identification since the specific name for identification since they are not organized and mostly one man activity. They usually do house to house collection of waste and are paid before service. The collected wastes are sent to a Central communal container managed by either the local Assembly or a formal private sector for a fee, since they cannot move straight to the landfill. Waste type collected is municipal solid waste, e-waste and any other profitable waste stream. The waste type include organics, thus, these informal waste collectors also hunt for valuables in the waste as well.

There are also Community Base organizations (CBOs), Non Governmental Organizations (NGOs) who are also engaged in waste management activities such as collection through central communal container system, Clean up exercise, Public education on waste.

Integration into solid waste management systems

These actors do not have any agreement with the local authorities. In recent time their activities conflict with that of the formal private sector when zoning of waste collection started, especially in the metropolitans (Accra, Kumasi, Tema, Tarkoradi and Tamale). There is ongoing dispute as to allow this sector to operate as it is, integrate or organize them or stop their activities all together.

2.3.1.2.2. The formal private sector

Description

The Private waste management services are believed to have started from the use of donkeys and carts to push carts then to the use of overage trucks imported from Europe. The next era was the Zoomlion era with the introduction of manual and motorized tricycles and brand new affordable trucks of different ranges. Currently, there are 17 formally registered waste management companies in Ghana.

Some of the waste management companies are: Zoomlion Ghana, Amanee Waste, Liberty Waste , Daben Waste, J. Stanley Owusu, Yafuru Waste, ABC Waste, Asandu Waste, Mess World, Antoko Waste Company, Waste Group

Almost all of them, except Zoomlion have few numbers of staff who operate few operational trucks. They have smaller structures as offices and their activities are not greatly known by the public. Zoomlion Ghana Limited, the largest waste management company in Ghana, has 3000 core staff and 65,000 field workers, mainly working under partnership programmes with the government. The company is well resource with equipment holding of over 50,000 collection trucks and tricycles, 1500 communal containers of various sizes and aimed at distributing 1000000 waste bins nationwide. Currently the waste companies promote waste collection to disposal. Realizing the problems associated with landfilling, Zoomlion is establishing compost plant in the Greater Accra region to treat 300 tonnes 8hours shift operational work and expected to be in operation this year.

Waste collected is municipal solid waste and collected from public places such as markets, beaches, street, homes and corporate bodies.

Integration into solid waste management systems

In the urban areas, activities of the formal private companies are estimated to be 80%. The companies are having an agreement with the Metropolitan Assemblies to collect waste from certain public places in the cities. Zoomlion has this agreement with all the MMDAs in Ghana to provide various waste management services to the local authorities. There are franchise form of agreement and other forms of contract. Notable among the waste companies is the house to house collection of which residence are to bear the full recovery of cost. Hence, it the client's responsibility to pay for the services of these private companies involved. Apart from this, government or MMDAs have agreement with some private companies to provide public cleansing, lifting of waste from communal containers, desalting of storm drainage, beach cleaning

2.3.1.3. Results of the survey carried out

2.3.1.3.1 Presentation of the methodology

In all 201 respondents view were collated. Out of 210 questionnaires distributed to households classified into socioeconomic classes, high, middle and low classes, 170 respondents answered in a written form either from the respondents or with the help of the interviewer. 30 set of questionnaires were administered to different business set up in Accra, Ghana. Out of this 29 respondents filled and returned the written answers, representing 96.7%. These were mostly corporate organizations that produce waste; they are ranged from small and medium scale enterprise as well as large scale industries.

The list of corporate respondents (Class B) is as found below:

1. KRIF Ghana Limited (stationery)
2. Accra Markets Limited
3. Las Palmas Restaurant (restaurant-food and pastries)
4. Golden Pearls international School(education)
5. Aqua Fill drinking water(bottled mineral water production)
6. Diligent Hands Ghana limited(Estate developer)
7. Central Furniture Works (furniture and wood products)
8. Danblesco Pub (restaurant)
9. Josgrandy Company (Liquid Soap production)
10. Kpogas Furniture (Furniture)
11. Ad-Media Ghana Limited (Advertising)
12. Ghana Red Cross Society (N.G.O)
13. Anglogold Ashanti, Gold House (mining -gold)
14. Melcom Group of companies(Rubber producing industry)
15. Beko Appliance masters (purchasing)
16. Yankee Nuts (Food processing company)
17. City Laundries (Laundry services and general cleaning)
18. Lolababy Hotel (Hotel and restaurant facilities)
19. VIP Jeoun transport Company Limited (Transport)
20. Concord Business College (Education)
21. Richies Systems Solutions (phones and phone accessories)
22. Gamey and Gamey Group (Consultancy in Mediation and Labour management)
23. Avenue Chemist (Pharmacy)
24. Achimota Bus Terminal (Transportation)

25. Liberty Waste (Waste Management Company)
26. Ghacem (Cement producing Company)
27. Fountain water (Sachet Water Producers)
28. Tema Port Police Station
29. Custom Excise Preventive Service (CEPS)

Class C (institutions)

1. Environmental Protection Agency (Mr. John Pwamang)
2. Waste Management Department, AMA (Mr. Samuel Kpodo)

Two interviews were granted by officers of the Metropolitan Assembly (AMA).

2.3.1.3.2. Quantitative results and analysis

Table 14 Quantitative results and analysis

Actors/ regulators	Laws/guidelines/standards/ policies regulating waste management	% Waste policies lack clear strategies for action	% Laws regulating waste management are inadequate	% Level of awareness of waste management laws	% Aware of investment in SWM	% Aware of economic activities linked to SWM	% Aware of involvement of MSEs in SWM	% Aware of participation of NGOs/CBOs in SWM	% Waste management institutions are weak
Household/ Residence	N/A	In general most households believe the policies lack clear strategies; 63.8% believe, 5.2% did not provide answer. It was 31% who believe the policy spell out clear strategies	64.4% are not aware of the existing laws and some suggest because they might not be adequate. However, 35.6% believe there are adequate numbers of laws in the sector.	61.5 % are not aware of the existing laws while 2.9% did not answer. 35.6% are aware and understand the existing laws	54.4% are aware of investmnt from multinational in SWM and others from the public and local private companies	Great number of the respondents are aware of the economic fortunes in linked to SWM and this represents 98.5%. Only 1.5% did not answer	58.0% are aware of involvement of MSEs in SWM	12.6 % know about the participation of NGOs and CBOs in SWM	9.2% believe institutions of Waste management are strong. Quite a bigger size 70.4 think they are weak. 16.7% did not know about their strength whereas 9.2% did not answer
Corporate organizations	N/A	3.4% agreed that the policies are well strategized, 13.2% believe the strategies are weak,14.4% think there is no strategy, 24.1% did not know any strategy available, 6.9% made personal comments on the fact that no plan had been outlined for the public to take notice and 37.9% did not	86.2% could not provide answer to this; they could not mention any of the laws. However, 13.8 are aware of only Bye laws from the MMDAs	Only 37.9% are aware of waste management laws, 51.7 are not aware whiles 10.3 did not respond to the questionnaire	Many of the respondents are not aware of specific investment in the SWM representing 51.7% . Only 31.o% are aware of investment such as transportation of waste, landfill management and logistics for collection. 6.9% did not	93.7% are aware of existing economic activities such as collection by informal sector, itinerant buyers, scavenging and buy back centres. The rest did not respond	Few of the respondents are aware of the involvent of MSEs in SWM and this represents 20.7%	41.4% are aware NGos/CBOs participate in SWM	3.6% of the respondents think the institutions are strong, 82.4% agreed that the institutions are very weak. The rest did no answer

		comment on the this			know of any investment and 10.3% did not comment				
Reguatory Bodies (EPA and AMA, Waste Management Dep't)	42% of the respondents from the regulatory agencies agreed that there are laws on waste management.	The two organizations agreed there are more to do to make the policies and laws clear and understandable. They however could not assign any percentage to the level of clarity of the policies and laws on SWM	The two did not accept the laws are not adequate but rather the implementation strategies are lacking	They agreed wider scope of awareness creation should be targeted by both public and private sector stakeholders	Aware of investment from equipment, human resource, public education, transportation, haulage and landfill management	The two are aware of the numerous economic activities linked to the SWM	The two are aware	Acknowledge participation of NGOs and CBOs in SWM	Think waste management institutions lack the logistics, funds, and free will to perform

2.3.2. Nigeria

2.3.2.1. The legal framework of solid waste management in Nigeria

The legal and institutional framework of ISWM refers to policies, laws, regulations and institutions used for solid waste management in a country. Nigeria has an existing legislative framework for the management of the environment pursuant to which solid waste is managed including the regulation of industrial and hazardous waste. The snag however, is that the laws are lax in enforcement and compliance level is almost at a zero level.

2.3.2.1.1. Institutions

The Institutions responsible for waste management in Nigeria, and their role in theory and in practice are outlined in the table below.

Institution	Role in theory	Role in practice
National level 1.The Federal Ministry of Environment	To coordinate environmental protection and natural resource conservation for sustainable development, and specifically to: • Secure a quality of environment adequate for good health and well being, • Promote the sustainable use of natural resources, • Restore and maintain the ecosystem and ecological processes and preserve biodiversity, • Raise public awareness and promote understanding of linkages between environment and development • Cooperate with government bodies and other countries and international organizations on environmental matters. • Its strategy for the discharge of its mandate consists of policy formulation, setting up of standards, establishment of guidelines and regulations.	Regulator of municipal solid waste management
2. The National Environmental Standards and Regulations Enforcement Agency (NESREA)	It is the main enforcement parastatal of the Federal Ministry of Environment. NESREA is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations to enforce compliance with provisions of international agreements, protocols, conventions and treaties on the environment.	Enforcement
State level	Each state of the federation has a	Regulator of municipal solid

Institution	Role in theory	Role in practice
	board or an Agency or a task force and supervising ministry that oversee the management of solid waste and policy implementation	waste management
1. Statutory bodies- Ministry /agency/ Waste Disposal boards State Ministry of Environment, State Environmental Protection Agencies (SEPAs) State Ministry of Health State Waste Management Authorities/Boards,	Enforcement on laws, regulations and standards regarding municipal solid waste management, waste storage, collection, transportation, treatment, resource recovery and disposal	Enforcement on laws, regulations and standards regarding municipal solid waste management Waste management operations- ensuring that collection of municipal solid waste takes place and that the collected materials are delivered to processors, markets, or disposal facilities. Also responsible for management of all government owned disposal facilities.
2. Task force on sanitation Local Government Environmental Health Officers	Education, monitoring, and enforcement on laws regarding municipal solid waste management	Inspection and Enforcement
3. Community Based Organisations (CBO)& Non Governmental Organisations	Traditionally the role of CBOs and NGO has been that of raising public awareness on environmental issues and promoting environmental protection. In Nigeria, these initiatives have been focused more on the issue of oil pollution facing the Niger Delta regions.	In practice this role has been enhanced towards participation in legislative advocacy to encourage establishment of environmentally sustainable laws in the areas of waste management.

2.3.2.1.2 Main laws and regulations

The Constitution of the Federal Republic of Nigeria 1999, s. 20

Ensuring general environmental sustainability

National environmental (sanitation and wastes control) regulations, s.1. 28 (2009)

The Regulations apply to issues in environmental sanitation and all categories of solid wastes covering every stage of existing solid waste management chain.
It is the most comprehensive regulation on solid waste so far in the country.

The National Environmental Standards and Regulatory Enforcement Agency (Establishment) (NESREA Act) No 25 (2007)

Protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology including

coordination and liaison with , relevant stakeholders within and outside Nigeria's on matters of enforcement of environmental standards and regulations.

The National Urban and Regional Planning Decree No 58 (1992)

The legislation provides for the creation of physical development plans at Federal, State and Local Government levels.

The Environmental Impact Assessment Act (1992)

Provides for the need for an environmental impact assessment of all projects that may affect the environment.

National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, S.19 (1991)

This regulation restricts the discharge of hazardous or toxic substances into the air, water or land of Nigeria ecosystem beyond limits.

National Environmental Protection Management of Solid and Hazardous Waste Regulations S.1 15 (1991)

The regulations specifically provides for the management of solid and Hazardous Waste and adopts a multi –pronged approach which involves the Agency, private operators, industrial and other public agencies.

The Hazardous waste (Criminal Provisions) Decree No 42 (1988)

Prohibits the carrying, depositing and dumping of harmful waste on any land, territorial waters and related matters. It prohibits activities relating to harmful wastes, and lists such activities.

International Conventions and Treaties ratified by Nigeria

- The Basel Convention on the Transboundary Movement of Hazardous Wastes and their Disposal (1991)
- The Basel Ban of the Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- The Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1991)
- The Stockholm convention on persistent organic pollutants
- The Rotterdam convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- The United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982, ratified in 1986 by Nigeria
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the "London Convention") of 1972

- The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the "Abidjan Convention") of 1981

2.3.2.1.3. Policy gaps and needs in terms of institutional development

Within the current environmental management and protection framework, Local Governments are excluded from participating in the legislative review, revision and redrafting process. This not only limits local-level inputs into the legislative process, but it also decreases local-level institutions awareness of and ownership over environmental management and protection.

Limitations on the interpretation of waste issues by personnel at state and local government levels responsible for waste management.

Institutional framework is uncoordinated. There is no clarification of relationship between NESREA, SEPAs, Ministries and LGA with respect to policy development, enforcement and implementation.

Non implementation of the national guidelines on solid waste management and lack of awareness/training on the guidelines in some states of the country.

2.3.2.2. The role of the private sector

The sector, which is made up of both formal and informal sector encompasses all aspects of, integrated solid waste management practice including collection, transportation, recovery, recycling and merchandise of both recovered and recycled materials.

2.3.2.2.1. The popular private sector

Description

The popular private sector in Nigeria is the informal sector. It includes individual workers and unregistered, small enterprises who recover materials from the waste stream, either by segregated collection, buying of recyclable materials, or by picking through waste. These workers and enterprises clean and/or upgrade and sell the recovered materials, either to an intermediate processor, a broker, or a manufacturer. Informal sector workers sometimes manufacture new items using the recovered materials, making, for example, kerosene stoves, lamps, gaskets and shoe soles out of discarded materials.

They have established a very high network of operation and distribution of their valuables both within and outside the country. They involved mainly **cart pushers** (house-house waste collection at a small fee), **cart builders** (construction of the carts being used by the cart pushers), the scavengers (This group is involved in both on-site and off-site waste/ resource recovery, they recover re-usable and recyclables materials like plastics, aluminum, glass, paper, scraps metal, animal wastes like horn, bones etc.), the **resource merchants** (This group is made up of traders (merchants) involved in the purchase of all recovered recyclable and re-usable materials from the scavengers), the recyclers (This group includes both the micro and the small scale recycling companies, they converts recovered waste materials like paper, aluminum, animal by-products, plastics scrap metals etc, to valuable materials and raw

materials for the consumption of the industrial sector).The operators of the informal sector cut across every state in Nigeria.

Integration into solid waste management systems

Non-formalization of the entire activities of the informal private sector in ISWM, and these results in non-regulation and coordination by government and her agencies.

2.3.2.2.2. The formal private sector

Description

Formal private sector is involved in the collection of waste, in employment of street sweeper and, recovery of materials in construction of compost plants. The popular formal private companies in the country are mainly refuse collection contractors.

The number and size in each state of the country depend on the socio-economic conditions of the state. They collect and facilitate, transportation of municipal solid waste to official government dumpsites using compacting trucks. The involvement of formal private sector in integration solid waste management systems (ISWMS) in Nigeria is basically profit oriented.

Table 15 Waste management Companies in Lagos (Nigeria)

SN	Name	Contact	Type of Waste Managed
1.	Atlantic Waste Management Limited.	+234 1 2616048	Municipal
2.	Environ Waste Nigeria Limited	Website: http://www.environwaste.com +234 84 759866	
3.	Multi Waste Systems Limited	0803-3168836	«
4.	Multi-Waste Management Co. Ltd	234 1 2613788	«
5.	Sutrad Limited	http://www.sutrad.com	«
6.	Waste Disposal Systems	+234 1 525530	«
7.	Waste Matters Nigeria Limited	+234 1 5833911	«
8.	Association of Waste Managers of Nigeria (AWAM)	7364011	
9.	Waste Management Consultants & Disposers	Mrs. Margaret Oshodi 08033235033	Electronic Waste
10.	Haroon Adekilekun Maintenance Systems Consult (Appointed e-waste Manager for the Lagos State Government)	08022236336	Electronic waste

2.3.2.3. Results of the survey carried out

The first part of the questionnaire (Class A) sought to obtain information from Household waste producers while Class B was used to cover Business waste producers. On the average, some of the questionnaires were not returned, some were returned without respondents' age/sex, while others were returned with "I don't know" recorded for all the questionnaires. We also realized that some of the category B questionnaires were not returned particularly in the South south, the North east, North west and North east zones. On the whole, there was 25% return of the questionnaires administered. The results of these questionnaires are shown in the tables below.

2.3.2.3.1 Presentation of the methodology

Structured questionnaires and field work were used in this study. These questionnaires were designed to collect information regarding: legal framework and its applicability, investment in SWM, economic activity linked to solid waste, involvement of medium and small enterprises (MSEs) and community-based organizations (NGOs/CBOs), waste services responsibility, fees, seasonal or cultural variations in waste generation, etc. Also, about 60 selected officers of the relevant waste management agencies were interviewed, 300 structured questionnaires were distributed randomly among the selected household and commercial areas (markets and business premises) within each of the geopolitical zones. Six States were used as samples to represent the respective geopolitical zones – South West (Lagos); South East (Imo); South south (Uyo, Akwa Ibom capital); North west (Kano); North East (Maiduguri, Borno State Capital); North Central (Minna, Niger State capital).

2.3.2.3.2. Quantitative results and analysis

Table 16 Age/Sex composition of Respondents

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Age/Sex of Respondents	Male/Female	Male/Female	Male/Female	Male/Female	Male/Female	Male/Female
Less than 20 years	-	-	-	-	-	-
20-50 years	68.9%	62.5%	39%	54.31%	60.3%	55.4%
Above 50 years	-	-	-	-	-	-
Total						

Table 17 Laws/guidelines/policies regulating waste management

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)		-	-	-	-	-
Households	31%	0	47.3%	21.26%	86.4%	86%
Businesses	100%	0	52.6%	90%	88.9%	86.6%

Table 18 above shows disparity in the levels of awareness of the existence of legal framework for SWM in all the zones. It also indicates that though these legislations exist, their enforcement have been carried out rather poorly.

Table 18 Percentage Waste Policies lack clear strategies for action

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)						
Households	27.6%	100	52.6%	86.9%	83.9%	92%
Businesses	50%	100	77.3%	70%	77.8%	82.3%

Table 19 shows a high level of lack of clear strategies for action in the Northern zones as indicated in average percentage feedback as compared to the southern zones.

Table 19 Percentage aware of laws regulating waste management are inadequate

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)						
Households	24%	100%	52.6%	86%	69.3%	92%
Businesses	50%	100%	77.3%	70%	77.8%	84.5%

Table 20 indicates that laws regulating waste management are inadequate as evidenced in the average percentage feedback received in the northern zones whereas these laws are relatively adequate in the southern zones

Table 20 Percentage level of awareness of waste management laws

Geopolitical zones	**South West**	**South East**	**South South**	**North West**	**North East**	**North Central**
Actors/Regulators (class of waste producers)						
Households	31%	0%	26.3%	21.3%	13.5%	24%
Businesses	100%	0%	77.3%	30%	0%	13%

In Table 21, there is a discrepancy in the awareness of respondents of waste management laws; the south west records 31%, south east 0%, south 26.3%. This is in relative contrast to the feedback from the northern zones

Table 21 Percentage awareness of investment in SWM

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)						
Households	69%	75%	36.8%	55.6%	73.8%	62%
Businesses	66.6%	91.6	57.9%	80%	33.3%	76.9%

In Table 22, worthy of note is an upsurge in the percentage ratings in all the zones especially in the south eastern zone known for its high level of economic activities.

Table 22 Percentage aware of economic activities linked to SWM

Geopolitical zones	**South West**	**South East**	**South South**	**North West**	**North East**	**North Central**
Actors/Regulators (class of waste producers)						
Households	69%	75%	36.8%	71.6%	73.8%	62%
Businesses	66.6%	91.6	57.9%	80%	33.3%	71%

Table 23 shows an increased level of awareness of economic activities linked to waste management across the different zones especially in the South east and North west zones. These activities include industrial processes, commercial activities (buying and selling) and Agriculture. However, a marked variation exists among the zones in this regard. Thus, in the North West, specifically Kano, it was discovered that ineffective waste collection and disposal system had led to economic utilization of the waste generated. Although the people show a 21.3% of lack of awareness of waste management laws, they are inadvertently carrying on informal activities in SWM and even deriving substantial employment from it.

Table 23 Percentage aware of involvement of MSEs in SWM

Geopolitical zones	**South West**	**South East**	**South South**	**North West**	**North East**	**North Central**
Actors/Regulators (class of waste producers)						
Households	38%	25%	15.8%	36.1%	22%	40%
Businesses	33.3%	83%	13.6%	30%	11.1%	18.6%

In Table 24, it can be observed that awareness levels of the involvement of medium and small enterprises in waste management dropped considerably. This is attributed to low entrepreneurial activities particularly in the northern zones. However, there is an established network of operation amongst the informal sector in the distribution and transportation of materials recovered from waste in the zones.

Table 24 Percentage aware of participation of NGOs/CBOs in SWM

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)						
Households	20.6%	50%	15.8%	19.45%	31.1%	30%
Businesses	0%	75%	45.5%	40%	22.2%	42%

Table 25 clearly shows a dearth of NGO/CBO presence in the Northern zones due to the remoteness of these areas and other socio-cultural variations compared to the influx of activities of CBOs/local and international NGOs in the Southern zones willing to participate in waste management activities. Their activities are mainly focused on inter-governmental relations and public sensitization on inadequate waste management and its attendant impact on public health. Nonetheless, the CBO/NGO participation within the southern zones is basically driven by the high level of economic activities in the zone.

Table 25 Percentage aware waste management institutions are weak

Geopolitical zones	South West	South East	South South	North West	North East	North Central
Actors/Regulators (class of waste producers)						
Households	72.4%	12.5%	89.5%	51.1%	86.2%	60%
Businesses	16.6%	83.3	91%	90%	66.7%	nil

In most of the study areas, households considered the problem of managing solid wastes as very serious (89.5%) as indicated in Table 24 and attributed it to a weakness in the legal framework for waste management. In terms of the applicability of the laws regulating the management of waste, while about 90% businesses indicated that the laws were not properly applied.

Conclusions and Recommendations

To this end, the current operational difficulties in SWM in Nigeria is reflective of the weak legal framework, general infrastructural and economic decay in the country. Following the analysis presented in this report, the following conclusions can be made:

- Regardless of the type of waste management system selected, no amount of urban planning nor municipal solid waste management strategy be effective unless the legal framework is clear and understandable by the respective stakeholders. Government must also be willing to support with necessary infrastructure; ;

- There is an urgent need for a reform of existing laws to specifically address waste management both at the federal, state and local government level, and also streamline the role of all stakeholders;

- Most people believe that it is the responsibility of the government to manage SW and hence exhibit carefree attitudes towards the SWM activities. There is a need for proper re-orientation to change this perspective;

- Government's management of SW is inadequate. This usually manifests in delays in the collection of waste for disposal and near absence of service in some areas. This is particularly true of the northern zones. There is a need for government to give greater encouragement and support to public private partnership (PPP), government alone cannot do it. Government must begin to adopt integrated SWM management solutions that would be private sector driven as this will have greater potential for long term environmental and economic improvements

- There is need for government to intensify its efforts in the provision of modern equipments and personnel for removal of SW, ensure compliance with existing laws and regulations on waste management;

- There is need to overhaul waste management service operation to guarantee citizens cooperation and confidence in the waste management system;

2.3.3. SENEGAL

2.3.3.1. The legal framework of solid waste management in Senegal

2.3.3.1.1. Institutions

According to the legal and regulatory framework, several stakeholders are involved in the Senegalese waste management system:

Institution	*Responsibility in SWM*
The Department of Environment and Protected Areas (*Direction de l'Environnement et des Etablissements Classés - DEEC*),	Within the Ministry of the Environment. Its role is to draw up, to ensure proper implementation of the environmental policy, to ensure that that all public policies and public activities comply with Senegalese environmental policy, laws and norms. Its role is more strategic than operational. The DEEC comprises an office in charge of waste management and an office in charge of environmental impact assessments. Its role is also to monitor the state of the environment and to provide technical support.
The National Department of Hygiene (*Direction Nationale de l'Hygiène - DNH*	Within the Ministry of Public Hygiene, is in charge of monitoring the policy on hygiene and salubrity. It has offices in various areas of the country and local agents to monitor the implementation of the Code of Hygiene and public awareness-raising campaigns.
The Department of Local	Is part of the Ministry of Decentralization and Local

Institution	*Responsibility in SWM*
Governments (*Direction des Collectivités Locales -DCL*)	Government. Provides technical support for municipalities and controls proper implementation of the Local Government Code. It is in charge of drafting laws and regulations to provide guidance for the action of local governments. It has no tutelage upon local governments.
The Department of Industry (*Direction de l'Industrie - DI*),	Within the Ministry of Industry, is in charge of monitoring waste management on industrial sites. Together with DEEC, it has to set up an industrial waste management system.
The Department of Urbanism and Architecture (*Direction de l'Urbanisme et de l'Architecture - DUA*), Department of Land-Use Planning (*Direction de l'Aménagement du Territoire - DAT*), Department of Observation and Control of Land Use (*Direction de la Surveillance et du Contrôle de l'Occupation du Sol - DSCOS*)	Are in charge of planning and setting up public infrastructure as well as controlling unplanned land use. Their action is supposed to facilitate waste management systems by improving the physical context.
The National Agency for the Cleanliness of Senegal (*Agence Nationale de la Propreté du Sénégal - APROSEN*)	Under the tutelage of the Ministry of Hygiene, draws up the national waste management strategy and provides support to local governments to implement policies within their scope.
The *"Entente CADAK-CAR"*	Acting on behalf of local governments in the Region of Dakar, is the awarding authority for waste management in the Region of Dakar and is responsible for the related infrastructure.
The implementing agencies	They implement program on behalf of local governments. The main implementing agencies are the Agency for the Promotion of Investments and Public Works (*APIX*), the Agency for Municipal Development (*ADM*), the Agency for the Implementation of Public Interest Works (*AGETIP*).

2.3.3.1.2. Main laws and regulations

Law n°72-52 providing for a Tax for Domestic Waste Collection (TEOM)

Issued on June, 12th 1972, it settles the rate and basis of the Tax for Domestic Waste Collection (*Taxe d'Enlèvement des Ordures Ménagères - TEOM*). The TEOM provided by article 156 of Municipal Administration Code concerns all landed properties and real estate for

which the owner has to pay land taxes, including temporary properties, except for plants and properties located in areas where domestic waste collection does not work. Maximum rate is :
- 6 % in the city of Dakar ;
- 5 % in other Senegalese cities.

Decree n°74-338 providing for domestic waste transp ortation and disposal

Issued in April, 10th 1974, it states that domestic waste transportation is essential for public salubrity. The decree defines domestic waste and is mainly focused on collection and disposal.

Law n° 83.71 providing for Code of Hygiene

Issued on July, 15th 1983, its articles L 16, L 20 and L 21 provide for individual and public hygiene.

Law n° 2001 providing for the Environmental Code

Issued on January, 15th 2001, the law and its application decree of April, 12th 2001 put the emphasis on "ecologically sound management", making physical and moral persons more responsible and reinforce control of toxic waste. They provide that :
– waste must be disposed of, or recycled in an "ecologically sound manner" so as to suppress or reduce negative impacts on human health, on natural ressources, fauna and flora or the quality of the environment (article L30) ;
– any person producing or holding waste must provide for its disposal or recycling, by doing it itself or by sub-contracting companies approved by the Minister of the Environment.
If it is not possible, the person must hand over its waste to the local government or to any company agreed by the State for proper management. This company, or the local government itself, may sign agreements with waste producers or waste for the disposal or recycling of waste.
Recycling must be carried out in compliance with Senegalese norms (article L31) ;
– local governments and their inter-city associations are in charge of domestic waste disposal, and may be in touch with regional or national authorities, in compliance with the legislation in force (article L32) ;
– waste disposal includes collection, transportation, storage, and appropriate treatment to recuperate useful materials or energy, any kind of dumping in appropriate sites so as to avoid harmful effects mentioned in this law (article L33) ;
– underground burying must be authorized by the Minister of the Environment, who decides upon technical instructions and specific rules to comply with (article L42).

Law 96.06 providing for Local Government Code

Issued on March, 22nd 1996, according to its article 29 (modified by the Law n° 2002.15 of March, 22nd 2002), waste management is one of the responsibilities transferred from the central government to local governments, in the context of institutional reform (creation of regional councils, rural municipalities and rural communities).

The Region of Dakar is the only exception because the Ministry of the Environment is responsible for the technical management of waste, the Entente Cadak/Car being responsible for financial management.

Decree n° 96-1134 related to the Law 96.06 transferring responsibilities of environmental protection to region, cities and rural communities

Issued on December, 27th 1996, according to its article 34, *« the city is responsible for the management of all waste generated on its territory. It shall organize waste collection, transportation and treatment. Appropriate waste treatment units may be built in the city.*
The city may build these waste treatment units in partnership with one or several other cities. Agreements on the management of these units may be signed between the parties ».

Article 35 concerns specific waste : *« Hazardous industrial waste and medical waste must be treated where they have been generated or in special treatment plants. »*

Law n°88-05 providing for the Urban-planning Code

Issued in June, 20th 1988, the objective is to provide for gradual and planned urban planning, with social and economic development policies and environmental protection policies. Through rational land-use, it aims at creating an enabling environment for inhabitants. Several plans have been drawn up to specify time schedules and urban planning rules (Article 7): known in French as *schémas d'urbanisme*, *plans directeurs d'urbanisme* and *plans d'urbanisme de détails*.

Articles 8, 9, 10 and 11 provide general guidance on urban planning.

International agreements

Senegal has ratified:

- The Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- The Bamako convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa
- The Stockholm convention on persistent organic pollutants
- The Rotterdam convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- The United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982
- The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the “Abidjan Convention”) of 1981

2.3.3.1.3. Policy gaps and needs in terms of institutional development

Lack of knowledge on the quantity and composition of waste to be collected and treated

Available waste characterization studies in Senegal are insufficient and do not enable decision makers to set up adequate waste collection, recycling and treatment systems. However, waste characterization studies have been carried out in 2008 in the Region of Dakar by APROSEN and IAGU.

Decentralization still on-going

One of the main weaknesses of the Local Government Code of Senegal is the absence of budget heading for waste management in the chart of accounts of local governments. In the Region of Dakar, a solution was found by creating the entente CADAK/CAR which is in charge of financial management. However, this also created a risk of opportunistic behaviors on how to share the available funds equitably among the member cities of the entente CADAK/CAR. For instance, the president of the Entente CADAK/CAR is also the Mayor of Dakar and sub-contracted a concessionary company (Veolia) for the Plateau and the Médina central neighborhoods[44].

Low collection rate of local taxes

The Senegalese tax collection system is not efficient and not adapted to socio-economic and cultural context. The number of households contributing to the TEOM remains quite low, which means limited financial means for the local governments[45].

By paying the TEOM, the inhabitants indirectly pay the City of Dakar for the collection and disposal of their domestic waste. Almost the whole region of Dakar is concerned by the TEOM. Waste collection trucks even go in the traditional villages located in the East (Yène, Sangalkam) that are not concerned by the TEOM. However, only a small percentage of the TEOM is collected (33 % in 1996). This means, in practice, that only inhabitants actually benefiting from a waste collection service pay this tax.

The real cost of waste management has always been compensated by public funds, both before and after the second privatization of waste management in 1971.

In 1983, the cities located in the Region of Dakar got together to create the “Communauté Urbaine de Dakar (CUD)” to put financial means in common. The central government also started to provide financial support to the CUD through a grant. It has to be recalled that the CUD used to gather the 4 departments of the current Region of Dakar: Dakar, Pikine, Rufisque, Guédiawaye, i.e. approximately 2.500.000 inhabitants and 550 km²[46].

For half of the Senegalese cities, the available budget for waste management represents less than 1% of recurrent incomes[47]. The limited available taxes for waste management has led

[44] IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* page 26

[45] IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* page 25

[46] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, 792 pages.

[47] Bureau d’études 2iEC/ République du Sénégal, Ministère de l’Environnement et de la Protection de la Nature, Direction de l’Environnement et des Etablissements Classés (DEEC), 2006, *Plan d’Action National décennal sur les Modes de Production et de Consommation Durables au Sénégal*, 102 pages.

local decision makers to look for new tax payers. Neighborhood markets, un-planned road stations, small shops which used to escape from official taxes started to be obliged to pay taxes. This has also caused disputes among cities and sub cities to decide on whom was entitled to collect these taxes.

Inappropriate containers for door-to-door collection

A container can help defining the average quantity of waste generated in kg/day, which can later help to define waste collection equipment at the municipal level. Municipalities with well organized waste collection systems provide households with standardized containers or require them to use specific containers.

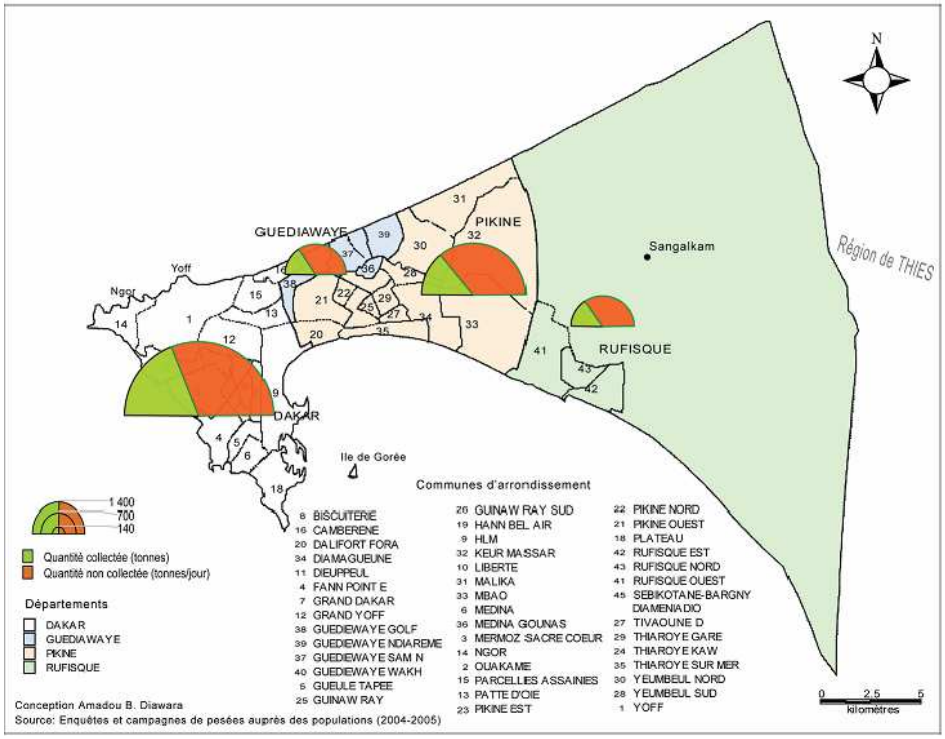
In the 90s, the terms of references of the City of Dakar and the institution responsible for waste collection mentioned that domestic waste had to be presented in individual containers with a maximum capacity of 50 liters but they did not specify who was supposed to buy these containers (households or local governments).

Until today in Dakar there is not a standardized container for door-to-door waste collection. Neither the City, nor the Entente CADAK/CAR, nor the sub contracted company have requested households to use specific containers, which is why domestic waste is presented in containers that are sometimes not even closed or waterproof.

18 % of the households in the Region of Dakar are equipped with “standard” containers, although shapes and capacity may vary a lot. The prototype called « APROSEN », in rubber, containing 100 liters is the most common. Rubber containers are more resistant to corroding due to wet waste. Their average price is 5000 FCFA, i.e. 8 Euros.

Strong discrepancies in the efficiency of waste collection service at national level and even in the Region of Dakar

The cartography carried out by Amadou Bélal DIAWARA illustrates the issue :



Source : Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 112.

Average waste collection rate in the Region of Dakar amounts to 61 %, but the department of Dakar has the best road system and is therefore in advance compared to the other departments. This explains why central neighborhoods benefit from a proper waste collection service by the concessionary company, whereas unplanned neighborhoods and traditional villages such as Yoff, Ouakam or Hann are well below the rate of 61%.

However, these different waste collection rate also reveal:

- important urban inequalities, in particular regarding accessibility
- logistical weakness of cleaning companies
- absence of treatment infrastructure.

It should also be noted that even in areas where waste collection rate is high, waste is not always transported until a final disposal site but is simply dumped in a neighboring area[48].

All in all, several collection systems co-exist in Senegal:

- Door to door collection organized by the municipality (with trucks, in accessible neighborhoods)
- Grouped collection organized by the municipality (with containers, generally located in town centers)
- Private collection, sometimes organized by formal companies but also by individuals

[48] Bureau d'études 2iEC/ République du Sénégal, Ministère de l'Environnement et de la Protection de la Nature, Direction de l'Environnement et des Etablissements Classés (DEEC), 2006, *Plan d'Action National décennal sur les Modes de Production et de Consommation Durables au Sénégal*, 102 pages.

- No collection at all, which means dumping waste in every kind of places, especially in rural areas or in the suburbs[49].

Waste collection is not rationally organized

Asphalted roads are still rare in Senegal, included in Dakar. It is therefore complicated to organise waste transportation with trucks. Waste collection companies therefore rely on public investment to increase the number of asphalted roads and prevent sand from covering even asphalted roads[50].

In addition, there is no collection circuit with routes and regular collection frequency. The available collection equipment is not adapted to the topography and type of habitat. It is often old (vehicles, containers) or not operational (broken, lack of fuel…), which is why collection with carts in sandy or swampy areas is particularly relevant. Staff is not enough qualified and not motivated[51].

Punctual "big cleaning" operations

In parallel to official waste collection, public authorities organize punctual collection of waste in unplanned dumping sites.
These kinds of operations are not new. Already in 1928, due to sanitary problems (waste provide adequate habitat for the mosquitoes responsible for the malaria disease) and in the context of an existing waste collection system, the national Service of Hygiene helped by 300 soldiers cleaned the City of Dakar and Gorée Island.

Inappropriate waste management in islands

The Gorée Island located in the Atlantic Ocean in front of Dakar, represents 0,182 km² and 500 000 visitors every year. There used to be an incinerator on the island but it stopped working in 2002. Waste is dumped into the ocean[52]. The situation is improving slowly.

It should be noted that Gorée is not the only Senegalese island; there are several inhabited islands on the Atlantic Coast of the country.

Many unofficial dumping sites

More than 425 unofficial dumping sites have been identified by Amadou Bélal DIAWARA from 2004 to 2005. The map below illustrates the issue. Small dumping sites (less than 5 m²) are in

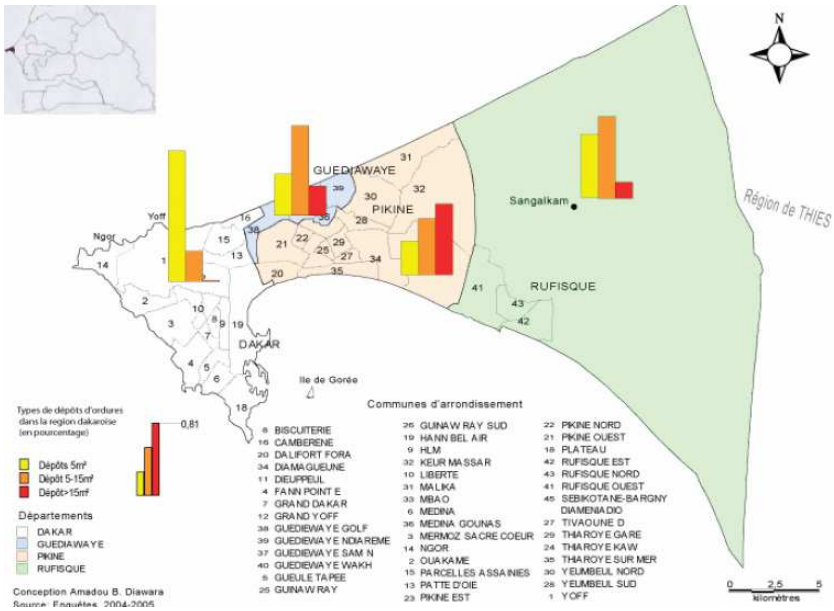
[49] Ibid

[50] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 321.

[51] Bureau d'études 2iEC/ République du Sénégal, Ministère de l'Environnement et de la Protection de la Nature, Direction de l'Environnement et des Etablissements Classés (DEEC), 2006, *Plan d'Action National décennal sur les Modes de Production et de Consommation Durables au Sénégal*, 102 pages.

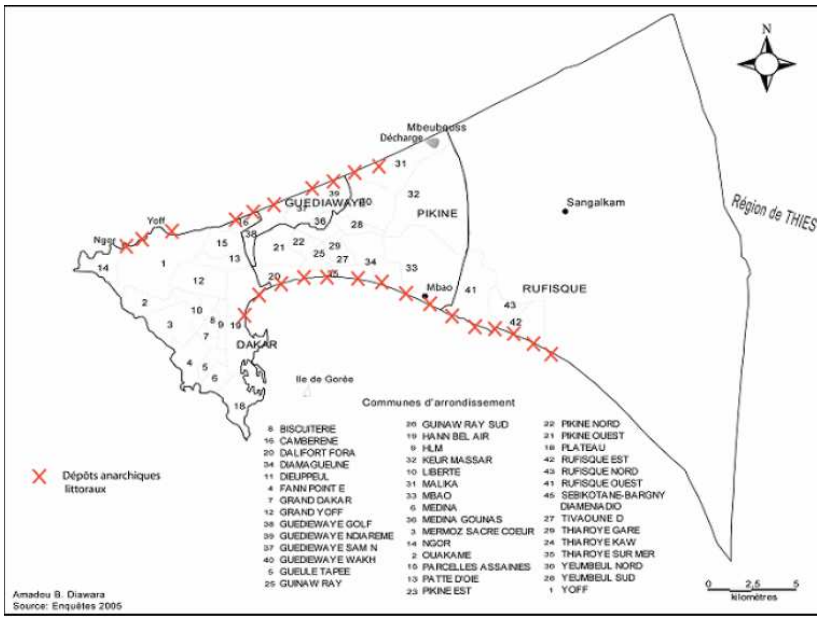
[52] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 127

average more numerous in the central neighborhoods of Dakar, whereas in the suburb their average size is often superior to 15 m².



Source : Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 146.

There are also many unofficial dumping sites at the seaside:



Source : Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page152.

Unofficial incineration or burying of waste is also frequent.

Lack of waste treatment infrastructure

In the Region of Dakar, works to build a transfer site, a sorting plant and a sanitary landfill have started. The infrastructure will be operational in July 2011.
There is a sanitary landfill in the Region of Saint Louis but it is not working properly.

There is not separate collection and treatment of hazardous domestic waste, which ends up in unofficial dumping sites or in municipal dumping sites or sanitary landfills, mingled with the other waste[53].

Unclear status of waste storage and treatment sites with regard to local land law

Despite of provisions contained in the Urban Planning Code, some waste storage sites and craftsmen's workshops are often established on residential areas or on roads. The Code is not implemented properly which creates or reinforces opportunistic behaviors and a divorce between the “legal country” and the “real country”[54].

Some laws and regulations are out of date

The decree n°74-338 on domestic waste transportatio n and disposal dating from 1974 is out of date because of the evolution of the environmental, socio-economic and political context and also because it does not mention the possibility to recover energy or recyclable materials from waste, whereas it now widely recognized that such options have a great potential. The decree focusses on waste elimination processes (sanitary landfills, incineration, see article 10).

The main evolutions of the context since 1974[55] are :

- quick urbanization and industrialization of the Region of Dakar in particular
- urban population growth ;
- waste generation growth, increased complexity of the composition of waste;
- insufficient and unadapted collection and treatment equipment ;
- insufficient coverage of collection service ;
- weaknesses in urban planning.

The Code of Hygiene

The application decree of the Code of Hygiene is still not operational. The national Service of Hygiene has very limited action means and staff to implement a credible national hygiene policy at individual and public levels.

[53] Bureau d’études 2iEC/ République du Sénégal, Ministère de l’Environnement et de la Protection de la Nature, Direction de l’Environnement et des Etablissements Classés (DEEC), 2006, *Plan d’Action National décennal sur les Modes de Production et de Consommation Durables au Sénégal*, 102 pages.

[54] IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* page 27

[55] In Stratégie nationale de gestion des déchets municipaux et industriels banals, par le Cabinet GESCONSEIL (2006) page 38.

The risks related to waste recuperation are not taken into account by the Service of Hygiene (waste picking on the dumping site or in containers, etc)[56], although the activity on dumping sites is continuously intensifying.

Some laws and regulations are not formulated clearly

For instance, the Environmental Code barely mentions “ecologically sound management” of waste without providing criteria.

A huge gap between official law and regulation, and the reality

None of the laws and regulations are actually being implemented properly. No sanctions are executed towards industrial waste producers, waste management companies and household waste producers that do not comply with the legislation. Public authorities are responsible for not having adapted the legislation to the evolution of the context and for not having organized investment in equipment and infrastructure[57].

The official legislation does not encourage waste recycling: according to the Environmental Code all activities related to waste management must be authorized by the Minister of the Environment (article 34 and 37), especially concerning industrial waste. But waste recyclers are very numerous and their activity is mainly informal which means that implementation of these articles is impossible[58].

On top of this, the population is not involved in waste management and not aware of hygiene-related issues[59].

2.3.3.2. The role of the private sector

2.3.3.2.1. The popular private sector

Description

Popular actors involved in waste management can be classified in different groups: profit-making micro-entreprises but with a strong social component (relatively equitable sharing of gains among their members), associations, and individuals.

Popular actors are mainly involved :

[56] IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* page 26

[57] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 561.

[58] IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* page 26

[59] Bureau d’études 2iEC/ République du Sénégal, Ministère de l’Environnement et de la Protection de la Nature, Direction de l’Environnement et des Etablissements Classés (DEEC), 2006, *Plan d’Action National décennal sur les Modes de Production et de Consommation Durables au Sénégal*, 102 pages.

- in domestic waste pre-collection in cities or neighborhoods not covered by official waste collection (mainly micro-enterprises or associations)
- in re-use and recycling (mainly individuals, exceptionally it can be cooperatives).

Integration into solid waste management systems

Integration of popular actors in municipal pre-collection systems

Several Senegalese secondary cities such as St Louis and Dagana, have formalized their relations with micro-enterprises (GIE) and associations for waste pre-collection.
Pre-collection operators are often supported by NGOs (technical support and methodology) and the service is paid by users, i.e. households. A cost/expense analysis of this activity shows that the pre-collection service is often showing a deficit and needs granting. Grants are often awarded to start the activity, most of the time, disbursed by NGOs within specific programs but more and more by municipalities, especially to cover recurrent costs[60]. Some pre-collection operators are paid in nature, for instance through the World Food Program within the "Food for Work" program.

Integration of popular actors in municipal recycling systems

This does not exist in Senegal. An IAGU report from 2009 has identified various limitations to the activity of popular waste recyclers:

Organizational limitations

Stakeholders act according to individual strategies, there is a lack of horizontal organization.
This means that waste pickers (those collecting recyclable materials) are small compared to the buyers of recyclable materials, who can then decide upon the price without negotiation.

Middlemen working in *packs* (informal warehouses) that buy metal scrap, copper and aluminum to re-sell it, create a fierce competition between local metal smelters counting on recyclable metals as secondary materials and Indian exporters that send recyclable metals to their country. Indian exporters buy recyclable metals at a much higher price than local metal smelters can afford. More and more local metal smelters face the risk of having to stop their activity.

Waste recyclers often occupy areas illegally, which is the case of most packs. Surrounding households complain about bulky waste and sharp objects in areas which generally lack proper street lighting (Rebeuss, Colobane). Waste recyclers work in precarious conditions because the areas where they work often belong to individuals, the State or municipalities.

In addition, most of these areas are too small and the possibilities to extend are rare, which is an obstacle to proper storage of recyclable materials.

Social limitations

[60] Rouyat J., Broutin C., Rachmuhl V., Gueye A., Torrasani V., Ka I., 2006, *La gestion des ordures ménagères dans les villes secondaires du Sénégal. Vers des politiques municipales incluant les quartiers périphériques*. Études et Travaux, série en ligne n°8, Éditions du Gret, www.gret.org, p. 51

Waste recyclers are socially discriminated. They are seen as dirty people and sometimes even as delinquents. Some civil society organizations, especially NGOs, try to change this social perception.

Big waste collection vehicles are a threat to waste recyclers, given that they do not have access to social protection and are mainly illiterate.

Financial limitations

Waste picking is an income-generating activity that can be started without having any start-up capital. However, waste trading and recycling requires financial means.
Local craftsmen face increasing difficulties in coping with the rise of non-iron metals (copper, aluminum) especially because of Indian and Chinese exporters. Savings and investment habits are poorly developed among waste recyclers, except maybe for the metal smelters of Rebeuss. Limited financial means leads to the impossibility of improving the working conditions and vehicles to sell recyclable materials.

2.3.3.2.2. The formal private sector

Description

Involvement of the formal private sector in metal collection and recycling

TREMEX, BENEX and RECUVER SARL are the main Senegalese companies involved in metal scrap and non-iron metals trading. They mainly buy recyclable metals from middlemen, packs managers and industrials, but also from hotels and administrations, and export it.

Some of the iron is recycled locally by industrial smelting plants (SOSETRA, FOMSEN) that are specialized in iron for building purposes (concrete)[61].

Involvement of the formal private sector in plastics collection and recycling

Some companies recycle their own plastic waste : SIMPA, SIPLAST, CCIS, PLASTIDUSTRIES, NATTES INDUSTRIE, UNIPLAST, SOSENAP and TRANSTECH transform plastic waste generated during their production processes into plastic pellets.

Some companies, such as TRANSTECH, process plastic waste which they receive from outside sources : containers, seats, basins are shredded, turned into polyethylene pellets that can be used to produce new containers[62].

Integration into solid waste management systems

[61] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 515.

[62] Amadou Bélal DIAWARA, 2010, *Les déchets solides à Dakar – Environnement, sociétés et gestion urbaine*, Thèse de doctorat, Université Bordeaux III Michel de Montaigne, page 515.

Agreements between formal private companies and local authorities concerning waste collection and disposal

The involvement of private sector in the public service of waste management is not a recent phenomenon in Dakar.

The first time dates back to the setting up of the very first cleaning municipal service at the beginning of the 20th century. In 1920, the cleaning service was placed under direct municipal supervision again because the subcontracted company was not able to deliver the service effectively.

In the 1970s, after a short attempt to set up a composting plant but it was a financial failure because there was no market for the compost resulting from waste decomposition, there was a second privatization of the public service of waste management with companies named SOADIP and SIAS. Several companies were sub contracted but the principle remained the same: the same concessionary was responsible for waste collection, transportation and disposal. However, concessionaries have focused their investments on collection and transportation and not on waste treatment. The last concessionary (AMA), just before the current concessionary (Veolia), had signed a BOT (Built-operate-transfer) agreement according to which it was supposed to finance and build waste treatment infrastructure. This part of the agreement has never been executed.

It should be noted that the concessionary is not directly paid by the user (households) but receives a lump sum from the local authority, whatever the amount of collected waste.

There are two major limitations in the agreements between the local authorities and the formal private sector in Dakar:

- the selection of companies has never been carried out in compliance with the rules on public procurement notably transparency and fair competition
- the agreements only concern domestic waste and not officially waste from shops or services. However, they are collected in the reality, which leads to important logistical problems. Concerning industrial waste, it seems that industries located in Dakar organize the management of their waste directly with the private sector.

Last but not least, there is a lack of private investment in waste treatment infrastructure. This is not likely to change in the future because the profitability of such infrastructure is very uncertain and there is a strong reject on behalf of the surrounding populations.
Private investors might be more interested in hazardous waste treatment[63].

Agreements between formal private companies and local authorities concerning separate waste collection for recycling purposes

"AXFIN is a private company established in Senegal since 2005. It currently operates in Pikine, on a site provided by the municipality. It recuperates car and boat wrecks to clean public areas and export the recyclable metals India, China, Pakistan or Europe (France, Italy). Metals are shredded, cleaned and uploaded in containers before being exported. The company employs 30 persons (20 permanent staff) and exports 200 tons of metals each

[63] Ibid, page 563.

month. It works in close partnership with the entente CADAK/CAR which was made responsible by the Government of getting rid of car and boat wrecks in Dakar.
However, one of the major difficulties in this partnership with the entente CADAK/CAR is the lack of a long term planning to clean bulky waste in the city. There is a lack of organisation, a lack of identification of sites to be cleaned and a lack of estimation of the quantity of bulky waste to be collected.
Last but not least, the company pays taxes whereas its competitors from the informal sector do not. Yet they collect an important proportion of recyclable metals and are not punished by local authorities. The financial loss for the company is huge[64]".

This interview provides interesting information on the challenges related to public-private-partnerships especially concerning the equitable access to valuable recyclable materials.

The importance of the competitors from the informal sector and the tax burden might be slightly exaggerated.

2.3.3.3. Results of the survey carried out

The questionnaire was distributed but not answers were received on time to enable the project team to analyze them.

2.3.4. Cote d'Ivoire

2.3.4.1. The legal framework of solid waste management in Ivory Coast

2.3.4.1.1. Institutions

At the central level

Institution	*Responsibility in SWM*
Ministry of Youth, Sport and Salubrity	The crisis on toxic waste has raised many debates on salubrity in Ivory Coast. A Ministry of Cities and Urban Salubrity was created by Decree N° 2007-458 of April, 20th 2007. It was the first official interlocutor of waste management operators. In March 2010, this Ministry was replaced by the Ministry of Youth, Sport and Salubrity created by Decree N ° 20 10-32 of March, 4th 2010. Concerning urban salubrity, the Ministry is in charge of taking initiatives and being responsible for : • providing assistance and advise to the cities (« *villes* »), districts (same word in French) and towns (« *communes* »), in collaboration with the Minister of

[64] Interview of Marco, October 3rd 2008 in Dakar, in IAGU, APROSEN, 2009, *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar*

Institution	*Responsibility in SWM*
	Home Affairs; • organizing public procurement and monitoring the construction of household and industrial waste final disposal infrastructure, in urban and peri-urban areas; • supervising and monitoring household waste management; • legislation and control of urban salubrity, in particular with regards to risk prevention linked to household and industrial waste; • drawing up legislation concerning public cleanliness; • preventing and warning on urban contamination, in collaboration with the Minister of the Environment, of Water and Forest; • fighting urban contamination and nuisances, in collaboration with the Minister of the Environment, of Water and Forest; • promoting cleanliness and citizenship in terms of salubrity and living conditions; • setting up and monitoring a fund to support development programs and urban salubrity in collaboration with the Minister of Economy and Finance ; • following up the private sector. Several sub-institutions have been created to assist the Ministry in carrying out its mission : • a Department for Urban Salubrity Operations (*Direction des Opérations de Salubrité Urbaine - DOSU*) in charge of drawing up planning and urban waste management tools (known in French as *plans, schémas directeurs*, and legislation) • a National Agency for the Salubrity of Urban Environment (*Agence Nationale pour la Salubrity de l'Environnement Urbain – ANASUR*) • an Urban Salubrity Brigade (*Brigade de Salubrité Urbaine*).
Ministry of Home Affairs	Decentralization gives a more important role to local governments regarding environmental management. Therefore, this Ministry, which has a tutelage on local governments, is involved in municipal waste management.
Ministry of Building, Land-use planning and Habitat (in French : MCUH)	This Ministry is in charge of managing habitat, and the local *plans directeurs d'urbanisme*. It is responsible of land management and takes part in the choice of the sites to build waste disposal infrastructure.

Institution	*Responsibility in SWM*
Ministry of Health and Public Hygiene (in French : MSHP)	This Ministry is in charge of implementing and monitoring the national policy on health and public hygiene, which implies : • drawing up and monitoring the legislation on public hygiene ; • drawing up, implementing and monitoring the national policy on medical waste; • monitoring and evaluating the compliance with the legislation of all food and medical products, in collaboration with the Minister of Agriculture and the Minister of Animal Production and Fishery ; • suggesting and implementing incentive measures and sanctions towards inhabitants and local governments to push them to carry out public hygiene measures.
Ministry of the Environment,of Water and Forests (in French : MEEF)	This Ministry is in charge of implementing and monitoring the national policy on water and forests. In collaboration of other ministries, it is responsible for : • drawing up environmental policy and planning, monitoring and control of its effectiveness ; • drawing up legislation on environmental protection and monitoring its implementation; • in collaboration with the Minister of Foreign Affairs, monitoring the implementation of international environmental conventions; • following up the activities of the Sustainable Development Commission ; • following up projects funded by the Global Environment Fund (GEF) and the United Nations Environment Program (UNEP), in collaboration with the Minister of Health and Public Hygiene, the Minister of Economy and Finance, the Minister of Foreign Affairs and the Minister of Cities and Urban Salubrity ; • promoting environmental services delivered by the network of national parks, in collaboration with the Minister of Tourism and Handicraft • protecting and promoting all types of ecosystems and wetlands ; • managing national parks, in collaboration with the Minister of Tourism and Handicraft; • controlling plants that are likely to have a negative impact on the environment (in the French and Ivorian law : Installations Classées pour la Protection de l'Environnement – ICPE); • coordinating management of major natural risks ;

Institution	*Responsibility in SWM*
	• organizing awareness raising campaigns in collaboration with the Ministers of Education and Research, of Communication and of Public Health ; • reinforcing follow up of industrial waste ; • participating to the control of sanitation and draining systems, in collaboration with the Minister of Building, Land-Use planning and Habitat, and the Minister of Cities and Urban Salubrity ; • supervising and following up industrial, agricultural, toxic or hazardous waste, in collaboration with relevant Ministries ; • preventing deforestation and bushfires, in collaboration with the Minister of Defense and Civil Protection, and the Minister of Agriculture ; • drawing up and monitoring national policy on risk prevention related to household, medical and industrial waste, in collaboration with local governments and the Minister of Cities and Urban Salubrity; • promoting renewable energies, in collaboration with the Minister of Mining and Energy.

Implementing agencies

Institution	*Responsibility in SWM*
The National Agency for the Salubrity of Urban Environment (ANASUR)	Was created by Decree n°2007-587 of October, 4th 2007. Its role is to : • follow up proper implementation of all types of waste management having an impact on urban salubrity; • act as a concessionary of the public service of urban cleaning in cities, districts and towns in Ivory Coast ; • act as a concessionary to treat and process waste ; • control the infrastructure owned by the State but managed by private or public actors, regarding transfer, sorting and waste treatment ; • organize and manage emergency actions ; • manage the Fund for Urban Salubrity Programs (*Fonds de Soutien aux Programmes de Salubrité Urbaine* -

	FSPSU) ; • fight insalubrities and nuisances in urban areas. To do that, ANASUR is in charge of: • planning and implementing urban salubrity infrastructure ; • organizing public procurement for all maintenance and rehabilitation of the above mentioned infrastructure ; • providing support to local governments and check compliance with the legislation of all sub contracted companies involved in the public service of salubrity, and also with the terms of reference and specifications or if not available, with any regulation taken by relevant authorities. The Urban Salubrity Brigade was created by a Departmental Order (signed by the Minister), as a component of the National Agency for Urban Salubrity. Its role is to provide logistical support in fighting unplanned settlements, all types of nuisances and illegal squatting of public areas.
The Fund for Urban Salubrity Programmes (FFPSU)	Is meant for mobilizing and managing funds for the financial sustainability of waste management. It mainly funds : · salubrity programs and measures; · investments in waste treatment infrastructure and equipment ; · special programs to support local governments.
The National Environmental Agency (in French : ANDE)	Is responsible for implementing Environmental Impact Assessments.
The National Environmental Fund (in French : FNDE)	Provides funding for projects with a positive environmental impact.
The Ivorian Anti-contamination Centre (in French : CIAPOL)	Fights all types of contamination and monitors lagoons and the sea.
The Controlling Agency for industries likely to have a negative impact on the environment (in French : le Service d'Inspection des installations classées)	Controls the activities of such industries.

The Department for Sanitation and Draining (Direction de l'Assainissement et du Drainage)	Implements, monitors and controls the legislation on sanitation and draining.

2.3.3.1.2. Main laws and regulations

Law n°96-766 providing for Environmental Code

Issued on October, 3rd 1996, it gives general principles on waste management in Ivory Coast. Aims at granting to each citizen an healthy and balanced environment (article 2).
This article is reinforced by article 33 stating that *« each person has a fundamental right to live in a healthy and balanced environment »*.

Article 26 : *« all waste, notably medical and hazardous waste, must be collected, treated and eliminated in an ecologically sound manner so as to prevent, to suppress or to reduce negative impacts on human health, natural resources, fauna, flora and the quality of the environment ».*

Article 27 : *« burying non-toxic waste must be authorized officially, in compliance with technical prescriptions and particular rules which are defined in a decree ».*

Article 28 : *« waste elimination must respect Ivorian norms and enable to recover energy or recyclable material. Relevant institutions must therefore develop and disseminate appropriate technologies ; include waste re-use in their agreements ; organize production patterns ».*

Article 66: municipalities in charge of waste collection, transportation and elimination, if needed, in collaboration with departments, regions, public agencies or the private sector. Municipalities must draw up household waste collection and treatment plans with the support of relevant institutions (note: since 2007, municipalities are no longer in charge of waste management).

Article 78 : it is forbidden to hold or dump waste which is likely to attract animal spreading diseases or cause damage to persons and goods.

Article 81 : non-authorized waste importation is forbidden ; non-authorized waste dumping on public areas is forbidden (including in the sea), waste drowning and incineration or any form of elimination in the national sea, rivers and lagoons. (Article 99 : jail sentence of 1 to 5 years and penalty of 5 million to 100 million FCFA).

Article 100 : waste dumping by a company punished by a penalty of 1000 000 to 30 million FCFA, 3 to 4 years of jail and suspension of the permit to carry out waste collection in the country for at least 2 years.

Article 102 : waste dumping punished by a penalty of 1000 to 10 000 FCFA except if dumping takes place on an area designed by the relevant authority.

Until today, there is no application decree of the Code of Environment.

Law N°88-651 on waste management

Issued on July, 7th 1988, it aims at preserving public health and the environment, article 1 states that *« it is forbidden to buy, sell, import, organize the transit, dumping and storage of industrial toxic and nuclear waste or any harmful substances ».*

Until today, there is no application decree on this law.

Decree n°83-152 on waste management

Issued on March, 2nd 1983, it aims at settling waste taxes and fees (when local governments were still in charge of waste management).
Article 17 states that *"The amount of the tax to be paid by tax payers can be defined by the city council or the council of Abidjan either according to the service delivered ; or according to the electricity bill (…)"*
Article 18 : when it is included in the electricity bill, the electricity company (concessionary of the public service of electricity) is in charge of recovering the tax. It then pays the tax to the municipality, deducting 5% for administration costs.

Decree n°2007-587

Issued on October, 4th 2007, it creates the National Agency for Urban Salubrity (ANASUR)..

International conventions ratified by Ivory Coast

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989, ratified by Ivory Coast in 1994). Article 4 *"Each Party shall take the appropriate measures to:*
    - *Ensure that the generation of hazardous wastes and other wastes within it is reduced to a minimum, (…)*
    - *Not allow the export of hazardous wastes or other wastes to a State or group of States belonging to an economic and/or political integration organization that are Parties, particularly developing countries, which have prohibited by their legislation all imports, or if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner, according to criteria to be decided on by the Parties at their first meeting"*.
- The Bamako Convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa (1991, ratified by Ivory Coast in 1994), aims at forbidding importation in Africa or all kinds of hazardous waste by third parties.
- The Rotterdam Convention (1998, ratified by Ivory Coast in 2003) covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the Prior Informed Consent (PIC) procedure. There are 40 chemicals listed in the Convention, including 25 pesticides, 4 severely hazardous pesticide formulations and 11 industrial chemicals. More chemicals are expected to be added in the future.

- The Stockholm Convention on Persistent Organic Pollutants (2001, ratified by Ivory Coast in 2003).
- The Stockholm convention on persistent organic pollutants
- The United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982, ratified in 1984 by Ivory Coast
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the "London Convention") of 1972
- The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the “Abidjan Convention”) of 1981

2.3.4.1.3. Policy gaps and needs in terms of institutional development

Institutional instability due to socio-political crisis since 1999 in Ivory Coast, which means frequent changes of ministries in charge of waste management, and impacts on waste management policies.

Lack of legislation, or inapplicability of existing legislation is also a major challenge. Until today, there is no application decree on waste management legislation.

The *ordinance* N°2007-585 of October, 4th 2007 repeals some articles of the Law N° 2003-208 by transferring the responsibility of waste management to the Ministry of Cities and Urban Salubrity. Cities no longer have the responsibility of solid waste pre-collection.

Implementing this is very complicated. The existing system does not work properly because technical and administrative means are not adapted. The central State is very slow in paying waste management operators. This leads to huge unofficial dumping sites and garbage bins not being collected. Even the sewage system is not maintained properly. There is no efficient and sustainable salubrity system.

Given this situation, the World Bank has provided funding in 2009 and 2010 for an emergency program to build urban infrastructure (projet d’urgence d’infrastructures urbaines - PUIUR).

The challenge is to think beyond emergency situations and ensure the sustainbility of waste management systems. Cities should be authorized to be responsible for waste management, with a coherent legal land regulatory framework and adapted means. In Abidjan, one solution could be to set up an association of cities (in French : une intercommunalité) with a common fund. The project has been drafted and submitted to the Mayors of the cities for them to amend it if necessary.

In conclusion, the legal framework does exist but implementation has not been effective. Inhabitants are not aware of this legal framework.

Several laws and decrees have been issued but not implemented. For instance, the Environmental Code mentions the Polluter-Payer Principle but this cannot be implemented because the tax basis and collection systems have not been defined.

Concerning household waste, households are supposed to pay a collection tax but the tax basis has not been defined. It is therefore difficult to identify proper compliance with the

Environmental Code. As a consequence, sanctions provided for in the legislation are not implemented.

Awareness-raising campaigns are rare and not all towns have a policy on salubrity. Therefore, most of the legislation concerning environment in general and waste management in particular cannot be implemented.

Non-implementation of legislation leads to uncivil behavior on behalf of the users of public service (lack of respect of salubrity in public areas, solid waste dumping in the liquid sanitation system…), which causes insalubrities.

2.3.4.2. The role of the private sector

2.3.4.2.1. The popular private sector

Description

Popular private sector plays a very important role in waste management in Ivory Coast. But it is difficult to estimate the number of informal organizations such as cooperatives, youth associations, micro-enterprises (in French : *Groupements à Vocation Coopérative - GVC*) and individuals involved.

They work with very limited means : pushcarts with 2 or 3 wheels (no animal traction), wheelbarrows, spades, rakes, forks, nose masks and rarely uniforms.
Most of them only work on municipal waste.

Integration into solid waste management systems

Popular private sectors are independent workers. They get paid directly by households when they deliver the service. They only have moral/oral agreements with households. They get rid of the collected waste wherever they can (waste grounds, ravines, lagoon). They do not respect law and regulation. They are frequently in conflict with formal waste management companies approved by the authorities.

2.3.4.2.2. The formal private sector

Description

There are 4 formal private companies working in solid waste management in Ivory Coast :

- Lassire waste services (Lds);
- Clean Bor-Ivory Coast;
- Intercore ;
- Ciprom;

Recently, 3 new companies have appeared:

- SAS ;
- EIDA ;
- Villers Services Ivory Coast (VS-CI).

In total, there are 7 waste management companies in the district of Abidjan. In secondary cities, waste collection is under direct management of the municipalities.

There is no available data on the number of employees of these 7 companies. The material means they have it composed of compacting trucks, amply-roll ; KB ; trailers, tractors, etc.
They collect all types of waste (municipal, industrial, e-waste) except medical waste.

Integration into solid waste management systems

Private companies collect and transport waste from households to the municipal dumping site. Private companies are now selected by a call for tenders issued by the Ministry of Cities and Urban Salubrity.

They sign agreements with the Ministry through its implementing agency, the Agence Nationale de la Salubrity Urbaine (ANASUR).

To reinforce the private sector, the following measures should be taken:

- Involving the private sector in building or management of infrastructure traditionally under direct governmental supervision will facilities investment.
- Involving the private sector in environmental management. Currently, waste management companies collect 63% of produced waste.
- To attract new investors and increase the performance of waste management companies:
    - Setting up a “groupement d’intérêt économique” so as to better manage the available funds to support waste management ;
    - Using the “Build-Operate-Transfer” (BOT) system for future waste management infrastructure projects (sanitary landfills, transfer sites).
    - Setting up a “waste stock exchange” so that waste be not longer seen as a nuisance but rather a valuable resources, which will help mobilize investment in modern technologies.

2.3.4.3. Results of the survey carried out

20 questionnaires have been distributed to stakeholders involved in waste management in Ivory Coast. The 7 private companies have been contacted and meetings were agreed upon. However, the current socio-political situation has not enabled the project staff to go outside and collect the questionnaires to analyze them scientifically.

3. SECTION 3: EVALUATION OF SOLID WASTE MANAGEMENT PRACTICES AND TECHNOLOGIES IN TARGET REGIONS

3.1. Methodology

3.1.1. Scope

Task 2.4: Evaluation of SWM practices and technologies in target regions includes the collection of information through questionnaires regarding type and quantity of waste and characteristics of the collection, recycling and disposal practices. It comprises technical and tangible elements and the efficiency and effectiveness of the waste management system. The received information is also analysed with respect to best practices, giving especial importance to efficient and least-polluting ways to deal with the various components of the solid waste stream.

The evaluation bases on the criteria for the characterization of current solid waste management practices in the target countries, resulting from task 1.3.

3.1.2. General approach

The evaluation of SWM practices and technologies in target regions is split into three different questionnaires:

- Case documentation 'municipal solid waste management'
- Country documentation 'e-waste management'
- Country documentation 'industrial solid waste management'

The questionnaires are completed for each country by the respective partner organisations. These are KNUST, CEIA and Zoomlion for Ghana, UAA for Côte d'Ivoire, BCRC for Nigeria and ENDA for Senegal.

The different questionnaires are completed according to available information, existing studies, and expert knowledge. All available reports, studies, leaflets, articles, web links, photos, etc. are referenced and, if possible, enclosed.

3.1.3. Data collection

Case documentation 'municipal solid waste management'

The municipal solid waste management (including plastic waste management) is evaluated by cases.

For each target country, at least 2 cases are that are representative for the country's municipal solid waste management are selected and documented

- One for an urban area (>100.000 inhabitants, equals a large city)
- One for a semi urban area (10.000 – 100.000 inhabitants, equals a medium-size city)

Country documentation 'e-waste management'

The e-waste management is evaluated on country level.

In each target country, an e-waste country assessment has already been conducted within the framework of other projects, supported by Empa. Reports (for Ghana, Côte d'Ivoire and Nigeria: draft reports), comprising all necessary information, are available.

The country documentation 'e-waste management' is therefore completed by Empa directly, with the support of the respective partner organisation of each country.

Country documentation 'industrial solid waste management'

The industrial solid waste management is evaluated on country level.

The goal of the country documentation is to comprise only industrial solid waste which poses a mayor environmental problem and for which disposal is not existing or unsatisfactory. First, all problematic industry sectors and types of waste are listed and then prioritized according to their environmental impacts and the urgency to seek a disposal solution. Detailed information on the characteristics, the collection, recycling and final disposal are then given for the most relevant industrial waste streams.

3.2. Country OVERVIEW

3.2.1. Côte d'Ivoire

Due to the political situation in Côte d'Ivoire, it has not been possible for UAA to provide data on municipal waste management in the country.

The e-waste country documentation describes the e-waste sector in the whole country; however, most of the e-waste activities take place at different scrap yards around Abidjan. Most of the activities are informal. Apart from one study conducted in 2010, there is not much information available on the informal e-waste sector in the country.

The Ivorian industries are mainly comprised of food, energy, chemical, petrochemical and textile sectors. More than 80% of the major industries are concentrated in the capital Abidjan and about 10% are located in other big cities. Industrial waste, although often containing toxic substances is managed together with municipal waste. It is of relevance to mention, that the Ivorian government has ratified several international conventions related to solid waste, hazardous waste and pollution:

- The Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Elimination/1989
- The Bamako Convention on the Ban of the Import into Africa ratified June 9, 1994
- Rotterdam Convention on Prior Informed Consent Procedure knowingly on chemicals and pesticides that are traded international/1998, ratified July 23, 2003
- Stockholm Convention on Persistent Organic persistents/2001, ratified on July 23, 2003

3.2.2. Senegal

The municipal waste management cases documented for Senegal are the capital Dakar and the small city of Matam.

Dakar is the capital of Senegal situated at the West of the country, at the seaside. It is the most urbanised area of the country. The national agency for solid waste management, the Agence pour la Propreté du Sénégal (APROSEN) is in charge of elaborating national strategies. Waste management in Dakar has been particularly complicated for the last few

decades. Several solid waste management systems have been tested and a dozen of agencies specialised in solid waste management were set up but no sustainable solution could be found due to inefficient and inappropriate collection systems. Currently, a specific organisation based on the association of suburbs “l’entente intercommunautaire” (CADAK/CAR) is in charge of the waste management in Dakar. They receive a yearly grant 10 billion FCFA (more than 15 million Euros) from the central government and work in collaboration with private operators organized by areas. Other financial support is provided by various organisations to carry out an in-depth analysis of the current waste management system, a feasibility study to reorganise the Mbeubeuss dumpsite and a study to reorganise the inter-city organisations and to design an appropriate funding scheme for the region of Dakar.

Matam is a small city of approx. 15’000 inhabitants situated at the East of the country along the Senegal river at the border with Mauritania. The demographic growth is relatively low yet the economic profile of the city is changing from mainly agriculture activities to more small businesses and handicraft activities. Thus, the quantity of waste is continuously increasing, along with other challenges linked to urbanisation such as liquid sanitation, transportation, social service etc. The City of Matam has recently been set up as the “chef lieu” of the Region of Matam. In 2004, IAGU and other partners have helped the City of Matam to write its Agenda 21, an action plan towards sustainable development (IAGU, Coopération Belge, UN-Habitat, 2009). The city has some decentralised cooperation with some French cities that provide advice and help to mobilise technical, human and financial means. Since 2007, there is a formal municipal waste management system in place, initiated and supported by the NGO Lux-Development. This has led to the disappearance of many illegal dumpsites in the past years.

The e-waste country documentation focuses on the informal e-waste sector in Dakar. Products included in the study are personal computers (desktop and laptop), televisions and mobile phones. The volumes treated in Senegal are still rather low. However, due to efforts of the government to improve the access to new information and communication technologies, increasing amounts of second-hand electronic equipment was imported to Senegal which has led to a growing generation of e-waste.

The country documentation on industrial waste states that the area between Dakar and Rufisque concentrates more than 95% of the Senegalese industry and therefore produces the highest share of industrial waste. Due to improper industrial waste management, the area can be regarded as the most polluted area of the country. According to the country documentation on industrial waste metal waste and packaging waste, especially plastics and glass containers, are considered the industrial waste stream which poses the most urgent environmental problems. The Senegalese government has ratified several international conventions related to waste management, hazardous waste and pollution:

- Bamako Convention on the interdiction to import hazardous waste in 1991
- Basel Convention on Transborder Movements of Waste in 1992 (Senegal hosts the Regional Centre of the Basel Convention for Technology Transfer and Capacity Building)
- Stockholm Convention on Persistent Organic Pollutants (POPs) in 2003

In addition, Senegal adopted a National Action Plan for the management of hazardous waste in 1999. The driving forces of these changes have been the possibility to access international funding and sanitary scandals, especially around the Bay of Hann.

3.2.3. Ghana

The municipal waste management cases documented for Ghana are the Accra Metropolitan Assembly (AMA) and the Komenda Edina Eguafo Abrem (KEEA) District.

Accra as the Capital of Ghana is the commercial nerve centre of the country. The municipal waste management is organised as a Public-Private Partnership (PPP). The collection is mainly conducted by private waste service providers who are allocated specific operational areas by the waste management department. This system leads to the high collection rate of 85% of the total waste generated. In 2010, the polluter-pays-principle was introduced which makes the polluter bear a part of the cost of handling municipal waste. This should lead to more awareness and responsibility regarding the generation of waste and it also reduces the financial burden of the government. The main difficulties are inadequate logistics for operation and monitoring as well as land acquisition for final disposal or waste treatment sites.

Residents of the KEEA District are predominantly farmers, fishermen and women with few industrial activities. The waste management of the KEEA District is fairly representative of similar areas in Ghana. There is a functional waste collection system in place that is led by Zoomlion. Again, the residents as waste generators have to pay for the communal waste collection services in order to contribute to the costs of the waste management system. There is no sorting of waste at the source and also recycling is practically inexistent. The community also lack a sanitary landfill. Waste statistics are compiled through collaboration between the waste department, Zoomlion Ghana Limited and KEEA Environmental Sanitation and Health Unit.

The e-waste country documentation comprises the whole country, but has a clear focus on the Greater Accra Region, where most of the informal e-waste sector is found. Due to large amounts of imports of second hand equipment as well as growing e-waste generation of the Ghanaian population, the informal e-waste sector has become a growing business with significant negative impacts on the environment and the worker's health.

The country documentation on industrial waste prioritized wood waste as first priority, followed by metal scrap and then packaging waste from food and beverage industries. Mining wastes could have a more significant and devastating impact on the environment but there is neither data nor documentation on this waste type available. Both wood waste and metal scrap are at least partly collected and recycled.

3.2.4. Nigeria

The municipal waste management cases documented for Nigeria are the Lagos state as an emerging mega city and Ido as a local government area in Ibadan.

The Lagos state case is a good representative of good efforts towards municipal solid waste management in Nigeria. It features house to house collection and the commencement of recycling programmes. Responsible for the Lagos municipal waste management is the Lagos waste management authorities (LAWMA). Drawbacks of the system are the inefficiency of operations, partly due to bad road and weather conditions.

Ido represents a rural area which typifies the common norm of municipal solid waste management in Nigeria. They have created official dumpsites for the case area and provided

metal skips for the waste collection and storage in some areas and markets. This has contributed to the raise of public awareness and thus also to the reduction of illegal dumping.

The e-waste country documentation only focuses on Lagos, where large markets for second hand equipment can be found. These markets also include an extensive refurbishing and repair sector. Informal recycling activities are spread all over the city in backyards, along the streets or on dumpsites. Large amounts of imports of second hand equipment have led to a high availability of electronic devices and therefore also to a high generation of e-waste.

Industries in Nigeria are engaged in consumer goods (food processing such as palm oil or beer brewing) or non-food goods such as textiles, glass or metal processing. For the country documentation on industrial waste, five actors in metal processing, agriculture and food industry and energy production were consulted. Industrial waste is often managed together with municipal solid waste.

3.3. Municipal solid waste management

3.3.1. Main conclusions

Municipal solid waste generation varies between 0.5 and 1.1 kg per day and inhabitant. It is composed of recyclable materials such as organic matter, plastic, paper, cardboard, metal, glass, textiles etc. but also toxic materials such as car batteries, dry batteries from electronic devices, electronic components, pharmaceutical products and agrochemicals.

Municipal solid waste is rarely sorted at source but collected and disposed of as mixed waste. Sorting at source is only conducted by informal waste buyers, that collect valuable fractions directly from households, small businesses etc.

The formal collection theoretically is well organised and includes both door-to-door collection and communal collection from central collection points. It is normally carried out by private waste service providers contracted by local authorities. In practise however, the formal collection reveals some difficulties due to service providers that do not attend to their duties, inefficiency of operations, bad road and weather conditions, old vehicles etc.

Sorting and recycling of municipal solid waste fractions in significant quantities only exists in urban areas. Most of the sorting activities take place in the informal sector that is concentrated on the municipal solid waste dumpsites or on specialised scrap yards. Formal recycling comprises metal scrap recycling, plastic recycling, paper and cardboard recycling as well as recycling of organic waste. The formal recyclers often receive their material from the informal sector. Although sorting and recycling activities are only driven by economic interests, they still contribute to generating secondary resources and therefore conserve primary resources. However, not much attention is paid to negative environmental impacts during sorting and recycling processes and information on recycling technologies, environmental impacts etc. is rather scarce.

Municipal solid waste is finally disposed of mainly in official dumpsites but also in irregular or illegal dumps. None of the official dumpsites feature leakage water or gas control, leakage water often reaches the closest river or lake. In none of the target countries a sanitary landfill exists where municipal solid waste could be disposed of appropriately, although in some countries, such landfills are planned. Instead of dumping municipal solid waste, it is a very common practice for individual households to burn paper and plastic components of their waste. Also at irregular and official dumpsites, waste is often burnt in order to reduce the

volumes. Burning of municipal waste, especially plastics can leads to significant air pollution with dioxins and furans.

3.3.2. Main waste characteristics

The origin of municipal solid waste are mainly households, hotels and restaurants, market places and offices. In large cities such as Dakar, Accra or Lagos, waste also originates in significant quantities from slaughter houses, small businesses, smaller industrial estates, health care and schools.

The quantity of waste generated varies between 0.45 and 1.1 kg per day and inhabitant. Large cities such as Accra, Dakar and Lagos have to deal with 1'400 to 9'000 tons of municipal waste per day, what leads to enormous logistical efforts.

Table 26 Summary of quantity of waste stream

	Senegal		Ghana		Nigeria	
	Dakar	Matam	Accra	KEEA	Lagos	Ido
Area covered km2:	550	3.75	270	n.a.	3'577	n.a.
Population	3'000'000	17'500	4'000'000	200'000	8'000'000	n.a.
Quantity of waste stream (tons/day)	1'400	7.8	2'200	165	9'000	n.a.
Quantity of Waste stream (kg/day·inhabitant)	0.47	0.45	0.55	0.83	1.13	n.a.

The waste composition is similar in all target countries. 40 – 70% is organic, 15 – 20% is plastic, 4 to 13 % is paper and cardboard, 2 – 5 % is metals and 7 to 25% accounts for the rest (glass, textiles, other inert materials, ashes etc. (see Table 27). There are no differences in the waste composition between urban and semi-urban cases except for the region of Matam, where due to its location, a large amount of sand reaches the municipal waste stream. In all cases, municipal solid waste contains both toxic and valuable substances. Toxic materials mentioned are car batteries, dry batteries from electronic devices, electronic components, pharmaceutical products, oils, chemicals and agrochemicals. Valuable substances include metal scrap, glass bottles, plastics, organics, and tyres.

Table 27 Waste composition in %

Waste composition (%)	Senegal		Ghana		Nigeria	
	Dakar	Matam	Accra	KEEA	Lagos	Ibadan
Organic	44	n.a.	67	40	45	n.a.
Plastic	18	n.a.	20	20	15	n.a.
Paper, cardboard	13	n.a.	4	10	10	n.a.
Metals	4	n.a.	2	5	5	n.a.
Glass	n.a.	n.a.	2	n.a.	n.a.	n.a.
Textiles, inert materials, ashes etc.	n.a.	n.a.	5	n.a.	n.a.	n.a.
Rest	21	n.a.	n.a.	25	25	n.a.

Normally, there is no separation of waste at source and all sorts of waste types are mixed. Separate collection of different waste types is therefore usually only done by informal waste

collectors or itinerant waste buyers that collect e.g. glass, metal scrap or e-waste. Lagos is the only case where a collection of waste types in separate bins partly exists.

3.3.3. Collection and transportation practice and infrastructure

Many cases state a collection rate of above 70% related to the total amount of municipal solid waste generated. In Accra, they even reach 85%.

The collection containers vary widely even within cases. Waste is collected in plastic bags, in bins and barrels, in skip containers or openly at communal dumping grounds. Where no door-to-door collection exists – usually in rather low income areas - there are communal collection points where all types of waste are dumped. The density of collection points within the different cases could not be determined.

The collection frequency varies significantly between the different cases. In large cities, high income areas as well as centre communal containers are served daily, house to house collection in middle and low income areas is conducted once to 3 times a week. In smaller communities, waste collection also takes place around 2 - 3 times a week.

The entities responsible for collection and transportation of municipal waste are normally private waste service providers who are contracted by the local waste management authority. If more than one waste service company is contracted, each of them is allocated a certain operational area. Waste transportation is conducted with compactor trucks, skip trucks, tipper trucks and roll-on roll-off trucks, or in more rural areas with tractors and carts. In Ghana, also tricycles are used to transport waste in otherwise inaccessible areas by road.

The number of formal workers responsible for the collection and transportation of municipal solid waste varies from 0.4 to 0.8 per 1000 inhabitants according to the different cases documented. In addition to the formal worker, a large amount of informal waste collectors should be added. These numbers could though not be determined. For a better overview, some of the above information is compiled in Table 28.

Table 28 Summary of collection practices

	Senegal		Ghana		Nigeria	
	Dakar	**Matam**	**Accra**	**KEEA**	**Lagos**	**Ibadan**
Collection frequency	3 times a week. In public areas: 6 times a week	Twice a week	Centre Communal Container: at least daily House to House: once a week	3 times a week	High income/ organized do-mestic waste: once daily Low income domestic waste: twice a week,	variable
Waste collected related to total waste generated	70%	n.a.	85%	77%	> 75%	n.a.

Number of workers engaged in collection and transportation	1701	9	3200	141	3000	120
Number of workers per 1'000 inhabitants	0.57	0.51	0.80	0.71	0.38	n.a.

In Ghana, the population has to pay a token for the waste collection and transportation. Costs are indicated with 7 Euros per ton haulage from the centre communal collection to the landfill in Accra and 1.5 Euros in KEEA. In Nigeria, for residential areas the cost are calculated and paid per room, flat or house. Businesses have to pay per lift of waste bin (14 Euros) or per lift of compactor truck (322 Euros). The concessionaires in charge of waste disposal in Dakar are paid around 12 Euros per ton of disposed waste, the financing mechanism itself could not be determined.

3.3.4. .Recycling practices and secondary markets

Recycling practices vary significantly between urban and semi-urban cases.

Urban

In the metropolis Accra, Dakar and Lagos, paper and cardboard, organic waste and metal scrap are recycled (plastics and e-waste are covered in chapter 3.4 and 3.5 of section 3). The Dakar case documentation also identifies recycling of glass, textiles and wood. Formal recycling only accounts for a small share, most of the recycling activities take place in the informal sector on dumpsites or scrap yards.

The share of waste recycled in relation to the total waste generated is difficult to estimate. Some fractions such as metal scrap might have a very high recycling rate while other, less valuable fractions end up in the dumpsites to a large extent.

In Dakar, waste pickers on the dumping site of Mbeubeuss have organised themselves within the association 'Bokk Diom' This association has 800 members. Next to the dumping site, 2 'recyclers' villages' can be observed: Gouye Gui and Baol. In Gouye Gui, there are 11 'packs' (informal warehouses for recyclable materials) specialised in industrial waste management brought there with the trucks of the factories located in the Region of Dakar. In Baol, 50 'packs' mostly recuperate household waste from the dumping site (APROSEN and IAGU 2009)

In Accra, there exists the scrap dealers association with around 3'000 members which mainly work at the Abgogbloshie scrap yard. How waste pickers on dumpsites around Accra are organised, could not be determined. The case documentation Accra highlights that recycling on a larger and formal scale has not really caught up yet not because the benefits are not known but rather since it has not been possible so far to grapple with the fundamental problem of managing one waste stream conveniently. They state that the issue of recycling would become more relevant if there were adequate resources to deal with the problem. Moreover, there is not enough support from both local authorities and government for companies and business people who would want to establish businesses that make use of waste materials.

Paper and cardboard

In Accra, there is a formal company that produces toilet rolls out of paper waste. The technology used is compaction and paper bailing. Since the recycling process does not include bleaching, it is assumed that there are no significant environmental impacts. In Lagos,

paper is formally shredded using also paper bailing machines. The shredded paper is then sold as a recycling product. In Dakar, cardboard is collected at the dumpsite and then sold to plants, drugstores (to protect glass bottles), poor households (as wind-breakers or housing), fruit and vegetable processers/sellers (secondary packaging), sheep breeders or sellers (especially during the religious ceremony of Tabaski, as meat is packaged in cardboards) (APROSEN and IAGU 2009).

Metal scrap

Metal scrap (mainly steel, aluminium and copper from vehicles, machinery, electric and electronic equipment etc.) is generally collected through informal door-to-door collection and is then brought to scrap yards for sorting and pre-processing. In Accra, even though a state owned agency is actively involved in the recycling of scrap metal by buying the scrap metal from informal collectors and recyclers, a significant amount of recycling of scrap metals takes place in the informal/unregulated sectors. Dealers located on the informal scrap yards tend to export most of the metal scrap to China, where they are likely to fetch a good price. This practice led the government to place an embargo on exporting of scrap metal since the local industry was being starved off raw material to stay in production. In Ghana, there are at least 6 formal Ghanaian steel melting companies that also process scrap steel. The industry could use more scrap than they actually process. Ghana also exports more scrap than it processes in the country. There are many aluminium smelters operating again with a demand higher than the supply. There are also many informal aluminium smelting activities in Accra and Tema. Some of the products of this informal sector include coal pots and cooking utensils moulded out of the parts of refrigerator and aluminium scrap. There are no copper refineries and smelters in Ghana, but there are some companies that produce wires from imported copper rods. However, many informal copper smelting operations exists, mainly for jewellery making. Most of the copper scrap is exported.

Metal prices according to information from the labourers and the scrap metal dealers at the Agbogbloshie Market, one of the country's largest scrap market, are compiled in Table 29.

Table 29 Scrap metal prices in Dakar and Accra

Metal	Price Dakar (Euro)	Price Accra (Euro)
Copper fresh	3.80	3.10
Copper burnt	n.a.	2.90
Light iron	0.11	0.10
Heavy iron	0.15	0.10
Aluminium	0.90	0.60
Brass	1.20	2.00
Zinc	n.a.	1.00
Lead	n.a.	2.00
Motherboard	n.a.	1.30

In Dakar, according to APROSEN and IAGU 2009, metals recuperated at the dumpsite are sent to 'packs' (informal warehouses) and are then loaded into containers and exported to India or sold to local smelters (craftsmen) that produce kitchen utensils. These smelters operate on irregular plots of land but are represented by "the Association des artisans fondeurs" (Association of foundry workers). There are also some local industries that recycle

metals. Before Asians actors started their activities in Senegal, the metal scrap market was fully controlled by a company called Benex, managed by a French expatriate. The company bought metals at a very low price, according to waste pickers (0.03 Euros/kg). Indian businessmen instead currently buy scrap metal at prices indicated in Table 29.

Metal scrap is usually not further processed at dumpsites or scrap yards. The collection and sorting itself does not lead to significant environmental impacts. Nevertheless, if metal scrap is found in composites with plastics, it is often burned in order to remove the unwanted plastic parts. It can also be the case that certain metal containers still contain oil, chemicals or other hazardous substances, which are often disposed of on the unfortified ground without considering negative impacts on the environment or the health of the workers.

Organic waste

Organic waste is recycled in all large cities. Composting activities and the use of organic waste as animal food or fertilizer are found in Accra, Dakar and Lagos. In addition, in Accra, also the production of biogas exists.

On the dumping site of Mbeubeuss, some informal workers are specialized in composting. They are located on the former area of the dumping site. They gather a sort of mixture of waste and sand. They operate on the sides of the road that is passing through the dumping site. Compost specialists operate with spades and sifters. They frequently move from one place to another in search of mature compost. Most compost recyclers wear gloves, boots or second-hand sports shoes (in a very bad state). Very few wear glasses or masks, despite of the abundant dust on the site. After sifting the compost, the workers load it into carts or trucks to sell it to gardeners as fertilizer for vegetables. Some of the organic waste is also sold to pig breeders (APROSEN and IAGU 2009).

Glass

Recycled glass in Senegal is mainly sold to plants producing solvents, glue or varnish, drugstores, markets (food sellers or cosmetic sellers), and sometimes to other Western African countries (APROSEN and IAGU 2009).

Textiles

Recycled textiles are sold to plants (rags), car garages (to be used as rags), mattresses producers, tailors and dyers (APROSEN and IAGU 2009).

Semi-urban

In the semi-urban communities, no recycling activities take place with the exception of organic waste recycling. In Ido, Nigeria, on a small scale they collect and segregate organic waste and produce organic fertiliser through composting activities. The fertiliser is then sold locally. In the KEEA District and the City of Matam, most families keep sheep and goats, so these families feed their animals with some of the organic waste generated or they use it as a fertilizer on their land. There is however neither formal treatment of organic waste into secondary animal feed nor composting activities.

According to the KEEA District documentation, there are a number of reasons why recycling has not caught up within the community. One major reason is that the district assembly is seriously constrained with financial resources so the motivation to set up a recycling facility is practically not there. Furthermore, private companies have not found it attractive to set up recycling facilities because of the quality and quantity of waste generated which is rather poor and inadequate. However, there exists the informal separate collection of valuable waste

fractions. There are informal waste collectors that go from house to house to buy used car tyres and e-waste which they dismantle or burn to extract the useful parts. They tend to have collection points where anybody can walk in and sell any metal to them. Informal collectors then sell their fractions to bulk purchasers who come by with trucks and buy the material for further processing in the country or for export.

3.3.5. Final disposal practices and infrastructure

Agencies in charge of final solid waste disposal are the local waste management authorities, sometimes together with some private service contractors. In most of the cases documented, 70% - 90% of the municipal solid waste is disposed of in official dumpsites. The rest is irregularly or illegally dumped.

On the official dumpsites, the waste is compacted with trucks. None of the official dumpsites documented features installations for gas treatment or leakage water control. The leakage water in general runs to a nearby river. Only in Lagos it is indicated that the leakage water reaches a leachate pond.

Information on total and remaining capacities of official dumpsites could not be acquired.

The disposal costs vary from case to case. In Accra, the disposal cost on a public dumpsite is 3.7 Euros. In the KEEA District, service providers are not charged for dumping collected waste at dumpsites. The concessionaires in charge of waste disposal in Dakar are paid around 12 Euros per ton of disposed waste. This fee also includes the collection and transportation. There is no information available on compacting costs in the dumpsite.

A governmental report estimates that 3500 people work every day on the dumpsite of Mbeubeuss which includes waste pickers as such (approx. 2/3 of the total), people that recuperate marine sand for the building industry (approx. 1/3 of the total), some people working in the administration, trucks drivers and their assistants Most waste pickers working in Mbeubeuss are aged between 10 and 40, 20% of them are women. For other cases, no information on the number of workers is available.

Besides disposal on irregular or official dumpsites, municipal solid waste is often burnt. It is a very common practice for individual households to burn paper and plastic components of their waste. Also at irregular and official dumpsites, waste is often burnt in order to reduce the volumes.

In Dakar, a sanitary landfill is being built in the Region of Thiès next to Dakar. Dakar's waste will be sent there in the future. The landfill will be operated by a private company (GTA Environment). In addition, a transfer and separation station is being built in Mbao. There is currently a conflict regarding the geographical location of the landfill between the Ministry of the Environment, the APROSEN, the Entity CADAK-CAR and inhabitants of neighbouring areas in the rural communities of Sindia and Diass. The demographic growth of the Metropolis poses a real problem in terms of urbanism and sanitation.

In the City of Matam, the NGO Lux-Development is finalising a project including 3 transfer stations and a sanitary landfill for the final disposal of the municipal waste. Prior to the project, the city administration together with the inhabitants has carried out an environmental impact analysis.

The Accra Metropolitan Assembly is struggling to secure land for the construction of a sanitary landfill for the community. Residents are against the idea of constructing landfills close by because of the fear of the unbearable stench that is likely to emanate from the landfill and also the possibility of flies invading their homes

The case documentation on the KEEA District also highlights that there is the need for the Municipal Assembly to develop a well-engineered landfill site for waste disposal.

3.4. Plastic waste management

3.4.1. Main conclusions

Plastic waste, which accounts for around 15 – 20% of municipal waste, is rarely sorted at source but disposed of together the remaining waste fractions. Separate collection is carried out by informal collectors that sort, reuse and recycle plastics themselves or work together with a formal plastic recycler.

The main plastic types reused are sorted and washed Polyethylene (PE) and Polyethylene terephthalate (PET) bottles. Recycling of plastic includes PE, PET and Polypropylene (PP), but also some forms of Polystyrene (PS), Polyvinyl chloride (PVC), nylon and tyre. Both formal and informal plastic recycling exists that include sorting, shredding, washing, drying and extruding in order to produce pellets or flakes. There is little documentation on recycling processes and its resulting environmental impacts. There are plans to intensify sorting and recycling of plastics in some of the target countries.

Final disposal options are, as for municipal waste, official or irregular dumpsites. It is also quite common, that plastic waste, especially plastic bags or sheets, is openly burned in backyards, markets, at stadiums, railway stations and dumpsites which can leads to significant air pollution with dioxins and furans.

3.4.2. Plastic Waste characteristics

Plastic waste originates from households as well as offices, shops, little markets, schools etc. In the metropolis Accra and Lagos, households account for around 25 – 35 % of the total plastic waste generated. More detailed information on the origin of plastic waste is provided for the city of Lagos, Nigeria (see Table 30).

In the city of Dakar, plastic waste is mingled with household waste so it is not possible to determine its origin. The government is currently carrying out a pilot project on plastic waste in collaboration with APROSEN. Besides municipal waste, plastic waste also originates from around 40 plastic transforming companies.

For semi-urban regions, no specific data on plastic waste is available since plastic waste is neither collected separately nor further processed.

Table 30 Origin of plastic waste in %

Origin of plastic waste (%)	Accra	Lagos
Households	35	25
Commercial origin	65	35
Shops		30
Offices		5
Schools		5

The quantity of plastic waste in tons/year is available for Dakar, Accra and Lagos (see Table 31). These quantities, however, do not correspond to the total quantity of municipal solid waste generated and its respective plastic content (see Table 27). It is therefore assumed that the quantities indicated in Table 31 are only related to the plastic waste that is processed separately in a certain way.

Table 31 Quantity of plastic waste in tons/year, divided into different plastic types

Quantity of plastic waste (tons/year)	Dakar	Accra	Lagos
Total	9'500*	54'750	1'620
Packaging	n.a.	n.a.	810
Agricultural films			486
Bottles			324

* Includes plastic waste generated and recycled by plastic transforming industries

According to available data from Senegal, more than 14% of the household plastic waste is composed of plastic bags and around 4% account for bottles and old plastic shoes.

Plastic waste from municipal solid waste is not homogenous. It contains PP, PE, PET, PVC, PS, Low Density Polyethylene (LDPE) etc. In Lagos, LDPE accounts for around 60% of the plastic waste.

3.4.3. Collection and transportation practice and infrastructure

A separate collection of plastic waste only exists in Lagos, by using separate collection bins, skips, or bags. The collection is organised by LAWMA and some informal resource providers. Their collection rate reaches around 35% compared to the total plastic waste generated. 1500 workers are engaged in the plastic collection and transportation. For transportation, trucks and compactors are used.

In all other cases, plastic waste is formally collected together with municipal solid waste. Therefore, the collection frequency as well as the collection technology is the same as for household waste. There are though informal waste collectors that sort plastic waste out of municipal waste and sell it for additional income.

In Accra, about 8% of the total plastic waste generated is estimated to be recovered by a private initiative. How and where the plastic waste gets separated from the municipal solid waste could not be determined.

In the KEEA District, there are groups that deal with plastic waste who also operate collection points and sell the collected waste to bulk purchasers who come by with trucks and buy it for further processing in the country or for export. Others operate at the landfill and scavenge out any useful material from the rubbish heap and sell it to prospective buyers. All these activities happen informally, though on an increasing scale.

3.4.4. Plastic Waste Reuse practices

The main plastic types reused are PE and PET bottles.

In Dakar, reuse is a common practice. There are some organized practices of plastic reuse as it is indicated below:

- In Mbeubeuss, groups of women wash and clean plastic bottles for re-use. They sell the bottles to women merchants on the Thiaroye market.
- Also in Mbeubeuss, in Gouye Gui village, men sew plastic sheets to produce roofs for rural houses.
- In Baol, women recuperate material to make cushions, or refurbish handbags to sell them again.

- The Tolbiac street, also known as 'Rail-bi' in Wolof, is the main area where plastics are recovered, collected, sorted and recycled by the informal waste pickers and recyclers. It is ideally situated to collect plastics from industrial waste, close to the port, the industrial free zone, the Tilène market, the Petersen market and the Sandaga market.

Plastic bottles are bought by waste pickers in hotels and in craftsmen's workshops: big bottles containing beverages are bought at 0.25 Euro each, and waste pickers sell them in their shops called 'packs' at 0.30 Euro. Bottles not containing beverages (coming from workshops) are bought at 0.05 Euro each and sold at 0.06 or 0.07 Euros. Bottles are also recovered from households. Informal waste pickers specialized in bottles also work in collaboration with local industries such as WEHBE, SOBOA, and 3F. Information regarding number of workers engaged in plastic reuse is not available.

In Ghana, few companies reuse thermoplastic materials. In addition to PE and PET, they also reuse PP bottles. As a further example, Trashy Bags are produced from discarded plastic materials. Information on plastic reuse however is scarce.

In Nigeria, reused plastic wastes are mainly bags, bottles, barrels and films so it is again focused on PE and PET products. Organization and practices of reuse further include the reuse of carrier bags. There are around 2500 workers engaged in the reuse and recycling of plastics. Recycling and reuse awareness programs are launched in order to increase recycling and reuse activities.

3.4.5. Recycling practices and secondary markets

The main plastic types recycled are PE, PET and PP. Some forms of PS and PVC are also processed in Ghana and Senegal. In Nigeria, there is also nylon and tyre recycling.

In Dakar, recycling of plastics is mainly focused on PE and PP. After collection, the plastic is directly brought to the recycling plant. The treatment processes are quite simple and include manual sorting (PE and PP from the others), washing and drying of plastics. Mechanical recycling processes such as shredding or extruding are not common, with the exception of a women's plastic recycling cooperative called PROPLAST situated in Thiès. This cooperative is supported by the Italian NGO LVIA.

Case study PROPLAST INDUSTRIE

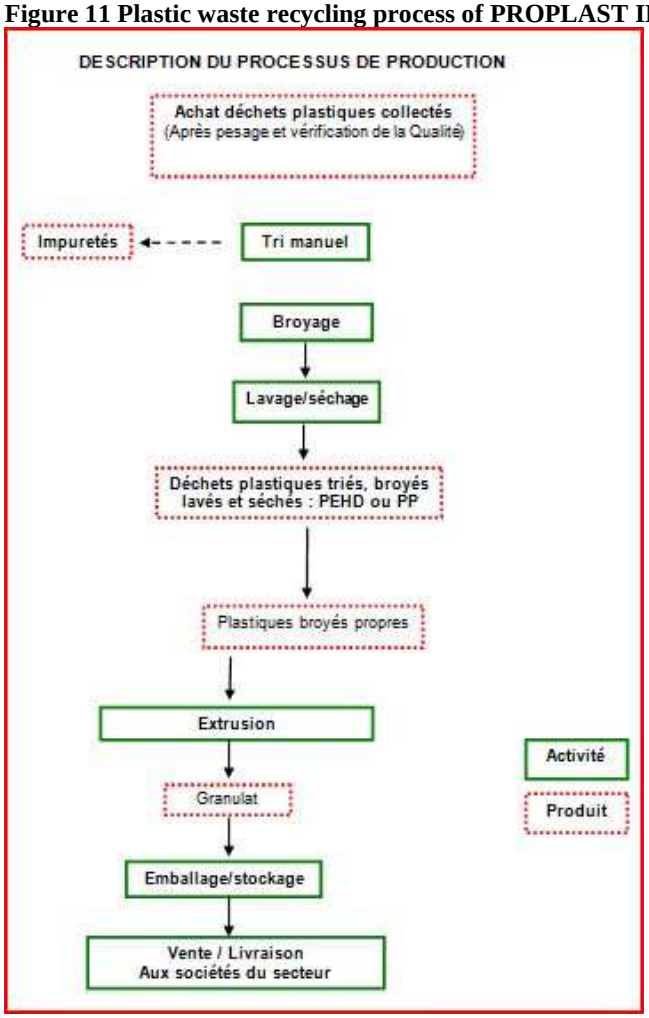
PROPLAST INDUSTRIE (PROPLAST; 2011) buys plastic waste from informal waste pickers once a week. Collected plastic waste is transported by a truck paid by PROPLAST from collection and recycling units for plastics waste set up in different cities. Then, plastic waste is checked (quality, nature), weighed and stored in a warehouse. Table 32 gives an overview of market prices for the most common plastic waste types PE, PP and PVC.

Table 32 Market prices for the most common plastic waste types PE, PP and PVC

Types of plastic waste bought	Price at which PROPLAST buys it from popular waste pickers
PE: bottles, beverages rack, fish racks	0.06 Euros per kg
PP: chairs, basins, buckets	
PVC : shoes	Shoes parts: 0.07 Euros per kg Brazilian shoes or tic-tic: 0.5 Euros per kg

The Recycling process, as indicated in Figure 11, includes manual sorting, mechanical shredding or grinding, washing of shredded plastic (washing line is also used for separation by the density of PP and PE from the other plastics), drying (in open air) and finally extruding of dried plastic flakes for the production of plastic pellets.

Figure 11 Plastic waste recycling process of PROPLAST INDUSTRIE



Source http://www.proplast-sarl.com

Case study JOK JOTNA

Women groups in the City of Ouakam located in the suburb of Dakar have formed an association called 'JOK JOTNA' and have been trained by Enda Ecopole and the Dutch artists Inge Van Hove on the technique of crochet work to recycle plastic bags. Plastic bags are cut into long pieces and this material is used as a substitute to cotton or wood threads. The start-up equipment consists of scissors, and a crochet. Example of objects produced are handbags, dolls, toys etc. (van Hove and Genard, 1996)

Recycled plastics in Dakar are sold to local plants, to households (e.g. recipients) or small merchants/street vendors (women that process fruit and vegetable, women that sell water, ice, honey, etc.), sometimes to building companies (e.g. rooftiles), local craftsmen, gardeners, etc. Some Western African countries buy recuperated plastics in Senegal. There are brokers specialised in such transactions.

The industrial demand for crushed plastic (25%), plastic pellets (50%) and plastic powder (25%) produced from plastic waste is between 5 to 50 tons/month. One company could use up to 150 tons/month of plastic pellets. Prices vary from 0.15 to 1 euro/kg according to the quality of the product and the level of processing.

In Accra, the main plastic waste materials recovered for recycling are PP, PE and PET. However, some forms of PVC and PS are also reused or recycled. There is currently no sorting plant available; however, there is one under construction by Zoomlion.

Few companies are involved in plastic recycling. They include: Blowplast, Progressive plastic, Focus plastic, Perbs Plastic Ghana limited, Iko Shei Allah recycling, Martha Aryee plastics, Petroplast and Kwalikwali plastics. The recycling process includes sorting, shredding, washing, drying and extruding. The resulting pellets are usually sold to other plastic companies or exported. Products manufactured from recycled plastics are e.g. buckets or chairs.

On a more informal scale, there are small plastic recyclers who scavenge for plastic materials at homes or dumpsites. Some of them melt the waste plastic to produce beads which are then sold on the local market.

In Lagos, in addition to PE and PET, also nylon and tyres are recycled. The recycling technologies applied include sorting, shredding, washing, drying and extruding in order to produce pellets, flakes and nylon.

The final products/applications obtained from recycled plastics are:

- Waste bags
- Shoes
- Chopping boards
- Hair extensions

As already mentioned in chapter 4.4 of section 3, around 2500 workers are engaged in plastic waste reuse and recycling.

The different case documentations provide not much information regarding environmental impacts. In the Lagos case documentation, it is stated that plastic recycling activities cause air

pollution. In the Dakar case documentation, the following negative impacts on the environment and health were mentioned:

- Chemicals and heavy metals: Exposition to light, heat or scratching can damage some polymers and turn them into monomers: styrene (PS's monomer) and vinyl chlorure (PVC's monomer) are the most toxic. Many additives in plastics contain heavy metals such as cadmium, lead, copper, that can be released to the environment or inhaled while working with plastic powder.
- Air contamination: Plastic crushing generates a lot of dust which is harmful for workers' respiratory system, especially tiny particles that are not filtered naturally, and the environment. Plastic processing with engines can generate carbon monoxide (CO) which can cause headaches, and tiredness, as well NO_x which can provoke nose and eye problems.

3.4.6. Final disposal practices

Final disposal practices are the same as for municipal solid waste for all cases documented. Plastic waste is disposed of in official landfill or irregular and illegal dumpsites. It is also quite common, that plastic waste, especially plastic bags or sheets, is openly burned in backyards, markets, at stadiums, railway stations, dumpsites etc.

Inappropriate disposal of plastic, especially plastic bags can lead to significant negative environmental impacts. Plastics are responsible for more than 30% of livestock mortality in Senegal in urban areas. Plastic bags in the fields prevent water from penetrating into soils. They are also swallowed by wild species what leads to their death.

In Dakar, within the next 3 years, 3 industrial methanisation plants should be operational in Dakar. This implies previous separation of non-organic waste. As there is no incineration plant projected, this is a future opportunity to organize separate plastic collection and recycling.

Note on contaminated plastic pesticide containers in Senegal

It is estimated that developing countries use 1/5 of pesticides in the world, yet 3/5 of all deaths due to unsafe use of pesticides occur in these countries.

According to the Food and Agriculture Organisation's (FAO) Programme on the Prevention and Disposal of Obsolete Pesticides, half a million tonnes of obsolete pesticides are scattered throughout the developing world, among which 289 tons of pesticide containers in Senegal (figures from 1999)[65].

The World Health Organisation (WHO) classifies pesticides by hazard into 4 classes, from extremely to slightly hazardous. In most African countries, labels cannot be read properly or pesticides have been transferred into other containers so WHO recommends that unidentified products should always be assumed to be of the highest WHO hazard class.

Most pesticides contain organochlorine, i.e. a combination of carbon and chlorine atoms. They are very toxic chemicals that remain in the environment for a long time which is why they are called Persistent Organic Pollutants, or POPs. FAO warns that as they move up through the food chain, they become more concentrated. The highest levels of organochlorines are found in human beings, fish-eating birds and marine mammals.

[65] Source : http://www.fao.org/agriculture/crops/obsolete-pesticides/where-stocks/africa-stocks/fr/

The Stockholm Convention on Persistent Organic Pollutants identified 12 chemicals for elimination. Of these, nine are pesticides: aldrin, chlordane, endrin, dieldrin, heptachlor, DDT (used as a repulsive against mosquitoes), toxaphene (campheclor), mirex and hexachlorobenzene.

Another type of insecticides is based on organophosphates. These pesticides are much less persistent than the organochlorines but they are also much more toxic and can attack the nervous system. Some of them are included the Rotterdam Convention.

The last generation of insecticides is now characterized by synthetic pyrethroids derived from chrysanthemum flowers. They are less toxic but as they are more expensive, they are not very common in African countries.

A study carried out by the NGO Pesticide Action Network in Velingara, a rural area in the South East of Senegal in 2010, revealed that 74% of old pesticide containers are dumped into the fields, 19% are buried, 5% are burnt and 2% are re-used. 0% is returned to their manufacturing company, although FAO strongly recommends such take-back schemes PAN 2010). Therefore it can be concluded that most pesticide containers end up polluting the environment.

Pesticide containers re-use is very common in Senegal, and probably in a much higher proportion than shown by the PAN study, especially in the area of the Niayes (a vegetable production area from St Louis to Dakar), in the valley of the Senegal river and in the Anambé area in the South. They are most often re-used to condition food products, milk or water, for instance to be used in traditional wells.

When full, pesticide containers are stored in farmers' homes, sometimes in the same room where they sleep. Very often, they are used beyond the expiration date.

The Africa Stockpiles Programme[66] is a programme carried out by FAO since 2002 with the financial support of the Global Environment Fund (GEF) to help African countries to manage their old stocks of pesticides properly (inventories and trainings for proper disposal). FAO has issued handbooks on the topic that can be downloaded from the webpage: http://www.fao.org/agriculture/crops/obsolete-pesticides/resources0/en/

Figure 12: Senegalese Farmers with pesticides containers

Figure 13: Equipment for the safe disposal of pesticide containers donated by the FAO to Senegal in 2006

[66] For more information, see http://www.africastockpiles.net/

3.5. E-Waste management

3.5.1. Main conclusions

Waste electric and electronic equipment (WEEE) or e-waste originates mainly from households, corporate businesses, public institutions and repair businesses. There is no formal collection of e-waste, but due to its valuable content (iron, aluminium, copper etc.) it is often bought or collected by informal e-waste collectors who go from door to door but also sift through waste bins, visit landfills and other waste dumping grounds to search for e-waste. The quantity of e-waste is difficult to determine due to different product scope of existing studies. Ghana and Nigeria, which have received large quantities of second hand equipment in the past years, have showed a significantly higher e-waste generation than Côte d'Ivoire and Senegal.

Obsolete electric and electronic equipment (EEE) is often refurbished or repaired before it is disposed of. These activities in general do not lead to negative environmental impacts but contribute to the extension of the lifetime of equipment and therefore to a reduction of WEEE generated.

Recycling of e-waste mainly takes place at informal scrap yards where devices are manually dismantled and valuable substances are extracted, sorted and then sold to local smelters or exporters. Copper cables are often burnt to remove the plastic casings. 'Non profitable' fractions such as plastic casings are not recovered and usually dumped and eventually burnt in order to reduce the volumes of the dumpsites. Besides valuable substances, e-waste also contains many toxic substances (lead, cadmium, mercury, plastics with brominated flame retardants) that are released during the dismantling and burning process and lead to serious environmental impacts.

Final disposal of e-waste fractions often takes place on irregular or illegal dumpsites next to the scrap yards. There are no appropriate disposal options for hazardous substances resulting from e-waste recycling in none of the target countries.

3.5.2. E-Waste characteristics

The origins of waste electric and electronic equipment (WEEE) or e-waste are private households, corporate businesses, public institutions and repair businesses. In addition, in West Africa e-waste is also directly imported under the disguise of second hand electric and electronic equipment (EEE). According to the Ghana country documentation and Amoyaw-Osei et al. (2011), households account for over 50 weight-%, corporate and public consumers only for 6%, repair businesses for around 30% and imports for around 10%. The large share of e-waste generation in households is mainly due to the significant weight of large household appliances such as refrigerators and consumer electronics such as televisions, which are less used by corporate and public consumer. In other documentations, the origin could not be determined.

The quantity of e-waste is difficult to compare between the different country documentations (see Table 33). In Ghana, it is estimated that over 170'000 tons/year of all e-waste categories reaches the informal recycling sector. The region of Dakar indicates around 3'000 tons/year of e-waste from personal computers, printers, mobile phones, televisions and refrigerators, what accounts for around 1.25 kg per inhabitant and year (Wone and Rochat 2008). If this number is compared to Ghana, considering the same devices, Ghana reaches 1.6 kg per inhabitant and year. In the Côte d'Ivoire documentation, only e-waste from households (3'500 tons) and repairers (1525 tons) is considered (Messou et al. 2011). Numbers for Nigeria are not known but they are likely to be in the same order of magnitude as for Ghana or even higher.

Table 33 Summary of e-waste quantities

E-waste quantities	Côte d'Ivoire
All e-waste (tons/year)	> 5'000
E-waste from personal computers, printers, mobile phones, televisions and refrigerators (tons/year)	n.a.
E-waste from personal computers, printers, mobile phones, televisions and refrigerators per inhabitant (kg/year·inhabitant)	n.a.

The average age of discarded e-waste is estimated as the following:

- Large household appliances: 10 -12 years
- Small household appliances: 7 years
- Information and Communication Technologies: new: 8 years, second hand: 5 years
- Consumer electronics: new 8 years, second hand: 5 years

3.5.3. Collection and transportation practice and infrastructure

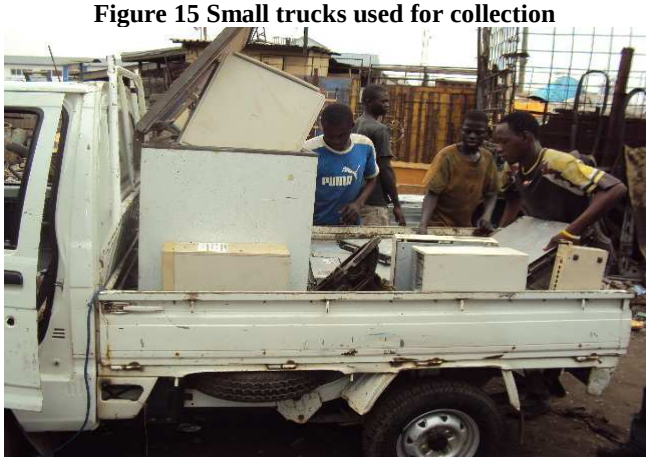
In general, there is no separate formal collection of e-waste. Collection is undertaken in all target countries by informal collectors. The differences between the target countries are that in Ghana and Nigeria, the informal collection is a lot more common and organised whereas in Senegal and Côte d'Ivoire, due to smaller amounts of e-waste generated, the informal collection is not very widespread.

Informal collectors are often young men that go from door to door to pick up or buy obsolete EEE. They also sift through waste bins, visit landfills and other waste dumping grounds during their search for e-waste. Since they receive money from the informal recyclers for every piece collected or they dismantle the devices themselves and afterwards sell the valuable fractions, they are able to pay the consumers for the discarded equipment.

Informal collection is usually done by handcarts, e.g. made from boards and old car axles. Some collectors also use trucks. There is no regular collection period of the informal collection.

Figure 14 Handcarts used for collection

Figure 15 Small trucks used for collection



Formal collection of WEEE is only done by very small scale formal recyclers. They have arrangements with the generators of WEEE which enables them to pick it up for free. Sometimes, WEEE in the streets is also recollected by sweepers and cleaners that are formally employed by public or private entities.

It is estimated that 5% of WEEE generated in Ghana ends up with the communal collection. It is further assumed that 95% of that WEEE enters again the informal sector through informal collectors / scavengers who collect them at the official landfill or directly dismantle the WEEE on site.

According to the Ghana country documentation, the total number of collectors and recyclers, who originate mostly from the northern part of the country, range between 4'500 and 6'000 people only in the city of Accra, in the whole country of Ghana between 6'300 and 9'600 people (Prakash et al. 2010) The number of workers in the formal sector is less than 10. In Dakar, there are approximately 800 waste pickers and recyclers working on the dumping site of Mbeubeuss which is one of the main spot for e-waste collection.

3.5.4. Refurbishment / repair practices

Refurbishment and repair of obsolete electric and electronic equipment is very common in all target countries. Nigeria features the largest refurbishment and repair sector with extensive markets where second hand products are repaired, refurbished and sold in the same or close by locations. These markets are informal but very well organised. In Ghana, there is an

association of repairers and technicians of EEE known as the Ghana Electronic Service Technicians Association (GESTA), which has countrywide membership. There is also the National Refrigeration Workshop Owners Association (NARWOA) for refrigeration and air condition repairers. In Côte d'Ivoire, the repairers are organised in the National Union of Electricians and Repairers (SYNEDCI).

The functional states of the stored equipment they receive vary widely. Some equipment cannot be repaired and will reach the recycling sector. Other appliances are repaired or refurbished and put back into consumption. In Ghana, repairers claim a repair success rate of 70%. Thus, the services are significant in helping to extend the lifespan of EEE. In Côte d'Ivoire, repairers are the largest provider of WEEE to scrap dealers. They usually have a close relationship and are sometimes located next to each other, exchanging materials according to their needs.

During refurbishment or repair of EEE, negative environmental impacts can hardly occur. An exception could be if refurbishers or repairers dispose of hazardous fractions resulting from their business in an inappropriate way. This would lead to the same impacts described in chapter 0 of section 3.

GESTA has 500 registered repairers in Accra, and estimates a total of 900 repairers in Greater Accra and also 1200 repairers in the whole country. Out of the number, 800 are involved in general repair (large and small household devices and consumer electronics) and 400 specialized in ICT repair. It is an informal economy and many of them are not registered with the Registrar General's Department as business entities. They however, pay income taxes to the respective Metropolitan/Municipal/District Assemblies (MMDAs).

According to (Prakash et al. 2010) in Accra, between 10,000 and 15,000 people are employed in the refurbishing sector, in the whole country of Ghana between 14,000 and 24,000 people. SYNEDCI claims to have 4000 members according to its last census three years ago.

3.5.5. Recycling practises and infrastructure

Organization and practices of e-waste recycling

The e-waste recycling sectors in the target countries are mostly informal. In Ghana, the hub of the recycling operations is the Greater Accra Region at the scrap yards Agbogbloshie as well as at Gallaway and Ashiaman, although smaller scrap yards that also dismantle WEEE are spread all over the country. The informal recyclers of the Agbogbloshie scrap yard are organized in the Agbogbloshie Scrap Dealer Association, which boosts about 3,000 members in the Accra metropolitan area. There are numerous small workshops within the scrap yard where a few recyclers work together or one recycler employs several people. In few cases, recyclers deal directly with end-processing units, such as smelters and refineries, for selling the recovered metals. In many cases, middle-men are responsible for collection of recovered fractions from the recyclers, and bringing them to end processing units.

In Senegal, informal recyclers usually are the same that also collect and repair equipment. There are 2 types of practices of e-waste collection and recycling: the workers in 'packs' disseminated all over Dakar, and the workers on the dumping site of Mbeubeuss. There are several 'packs' all over the City of Dakar that are specialised in e-waste: Thiaroye-gare, marché HLM, pack de Bopp, pack de Rebeuss, pack de Colobane, pack de Sébikhotane, pack de Keur Serignebi and the 'salle de vente' (specialised in all types of second hand equipment, in the centre of Dakar). The recycled materials are collected at the scrap yard by middle-men and are then sold within the country or exported. In Mbeubeuss, waste pickers

are also 'recyclers', in the sense that they destroy the material (by shredding or burning it) or dismantle some equipment to recover specific fractions (copper threads, aluminium) and sell it to craftsmen or middlemen that accumulate small stocks of metals to sell them to Indians.

In Côte d'Ivoire, the main scrap yards where the dismantling of WEEE takes place, are located in the municipalities of Kumasi and Marcory (Anoumabo). The workers are mostly located in small warehouses (shacks) acting as their workshop. There are both nationals and non-nationals. They are organized mostly in small groups according to their recycling skills. Each recycler is specialized in one category of devices or materials. On the same site there are all types of stakeholders (pre-collectors, collectors, repairers, recyclers and scrap dealers). They are mostly grouped into unions. Each site has a union official. The supply of e-waste comes from small repairers in the neighbourhood, from private customers wanting to dispose of their obsolete equipment, and from distributors of second hand equipment. As described above, recyclers work closely with repairers.

In Nigeria, in contrast to the large and well organised refurbishing and repair-sector, e-waste recycling activities are rather spread all over the large cities.

According to the country documentations, in each target country some formal recycling activities can be found. They usually get their equipment from corporate consumers. Fractions produced that cannot be further processed in the country itself are then exported to Europe. However, the account for a very small share of all e-waste recycled (in Ghana, it is less than 0.2‰).

The share of e-waste recycled related to total e-waste generated is difficult to estimate. Due to the informal door-to-door collection, it is assumed that in Ghana most of the e-waste generated is also recycled. It was estimated that around 30% of WEEE generated by consumers is stored first for a few years, before it reaches the collection and recycling. For the Dakar region, it is estimated, that of all the e-waste generated, about 20% is reused as spare parts, around 78% is recycled and 2% is disposed of without treatment. In Côte d'Ivoire a large share of obsolete equipment is stored and only a small amount is reaching the recycling sector.

The recycling activities are similar in all target countries. E-waste is manually dismantled, sometimes by crude methods such as smashing or treating with a chisel, sometimes with more sophisticated tool such as screwdrivers etc., and then again manually sorted into metals and other fractions. Copper cables are often burnt to remove the plastic casings. Insulating foam from obsolete refrigerators, primarily polyurethane and/or old car tyres are the main fuels used to sustain the fires. The monitor screens and other 'non profitable' fractions such as plastic casings of all kinds, keyboards, capacitors, dry batteries, etc. are not recovered and usually dumped and eventually burnt in order to reduce the volumes of the dumpsites.

Environmental impacts of e-waste recycling

The e-waste recycling activities often lead to significant negative impacts on the environmental and human health.

Emission to soil

The recycling activities within the scrap yard often take place directly on unfortified ground. Harmful substances released during dismantling therefore lead directly to discharges to soil. If fractions are burnt, the burning operations are creating an accumulation of ash and partially burned materials. Insulating foam from dismantled refrigerators, primarily polyurethane, or old car tyres are the main fuels used for the fires, contributing itself to acute chemical hazards and longer-term contamination of the burning sites. In addition, lead, cadmium, mercury, plastics,

plastics with brominated flame retardants, leaded glass, and glass among others enter the environment without treatment in significant volumes trough informal dumping. Brigden et al. (2008) tested the soil and ash samples at the e-waste burning sites in the Agbogbloshie scrap yard, and proved the deposition of exorbitantly high concentrations of toxic metals, such as lead and cadmium, and halogenated chem cals, such as phthalates, polybrominated diphenyl ethers (PBDEs).

Emission to water

In Ghana, the Agbogbloshie market is situated on flat ground alongside the Odaw River. During periods of heavy rainfall much of the site becomes flooded and it is likely that surface dusts and soils, along with any chemical contaminant they may contain, are carried into the adjacent, lower-lying lagoons and the Odaw River which ultimately flows into the ocean. The sample of sediment collected from a shallow lagoon located near the WEEE disposal and open burning areas within the Agbogbloshie market contained a very similar profile of metal concentrations and organic chemicals to those in the more contaminated soil and ash samples. These similarities suggest the migration of pollutants away from the burning sites into surface waters, probably as a result of heavy rainfall and flooding (Bridgen et al. 2008). Also in Côte d'Ivoire, worthless fractions are often dumped into nearby rivers or in the same lagoon as people are swimming and fishing.

Emission to air:

Within the Ghana e-waste country assessment (Amoyaw-Osei et al. 2011), the amount of dioxin emissions from cable burning in the Greater Accra Region was estimated by brief surveys conducted at the Agbogbloshie, Gallaway, Kokompe and Ashaiman scrap yards, within the framework of the country assessment. From the survey it was calculated that around 625 tons of cables are burnt in one year.

About 10 - 20 % of these cables were associated with WEEE, while the rest originated mainly from old vehicles. The composition of cables was assumed to be the following:

- ~38% plastic = 235 tons / year
- ~62% copper = 390 tons / year

The preliminary estimation of total dioxin (PCDD/F) emissions to air from open cable burning in the Greater Accra Region amounts to a source strength of ~3 g / year.

This result can be extrapolated to more countries, assuming as a rough estimate that cable burning is done in the same way in all urban regions in West Africa and the extrapolation can be done along the population numbers. With the estimation that 4 million people live in the Greater Accra Region and about 100 million people in urban regions in the countries Côte d'Ivoire, Senegal Nigeria and Ghana, the estimation of total dioxin (PCDD/F) emissions to air from open cable burning in the mentioned countries amounts to a source Strength of ~75 g / year. This equals to approximately 3% –7% of total dioxin emissions to air in Europe.

Figure 16 Emissions from cable burning

Other emissions to the air are generated during the recycling of lead from liquid batteries or the manufacturing of kitchen utensils from aluminium scrap.

Impacts on human health

Diseases and symptoms expressed by workers include respiratory infections, continuous feeling of fatigue, cough, headache, diarrhoea etc. They are illustrative of the direct exposure to hazardous substances that workers are subjected to.

The informal scrap yards are often located within the city with a very high population density. Thus, the pollution of soil, water and air can have direct impact on health, especial of residents close to the scrap yard.

It is estimated that in Ghana a total of between 6'300 – 9'600 people work in the informal WEEE sector (including collection) of the country, with a dependent population of between 121'000 – 201'600. For Senegal, the only available figure on the number of informal recyclers in Dakar is the one from a study carried out by Enda in 1990: approximately 2500 informal recyclers had been identified at that time but the figure does not take into account all the actors involved in recuperation (craftsmen, children etc.). The same study had identified 300 workers on the dumping site of Mbeubeuss in 1990. Today there are more than 800 people living on the site. This gives an idea of the general trend. For Côte d'Ivoire and Nigeria, the number of workers engaged in e-waste recycling could not be determined.

3.5.6. Secondary markets and downstream processors

Produced fractions from e-waste recycling include the following:

- Valuable Fractions sold: Ferrous metals, aluminium, copper, brass, bronze, printed wiring boards, processers, rubber
- Hazardous or unsellable fractions, mostly dumped or burnt: plastics (partly with brominated flame retardants), glass, leaded glass from CRT screens, batteries, capacitors
- By-products, except toxic pollutants such as dioxins and furans are not produced

The amount of fractions produced is difficult to estimate. According to the general composition of e-waste, it can be assumed that about 42 weight% can be recovered and around 58% is dumped or burned.

If spare parts can be sorted out, they are sold to repairers/refurbishers specialised in TV, radio, computer equipment such as private formal companies, informal workers or even middlemen hoping to sell the spare parts for a better price in the town centre.

Prices in Senegal vary a lot. They depend on the client, on the urgent needs of the seller (cash needs for the family, food, health expenses), on the state of the spare parts and on the incomes of the previous days. In general, prices for metal scrap recovered from e-waste are similar to the ones mentioned below).

In Ghana, steel and aluminium are often sold to local smelters. Lead is informally smelted and copper exported. Printed wiring boards are either sold to Asians or Nigerians or dumped (details see below).

In Côte d'Ivoire, these materials are sold to other collectors or sold directly to local craftsmen, local industries such as container manufacturers or factories (METECOS, METAL ICs, and other Lebanese, Syrian, Chinese businesses) or foreign exporters (mostly Indians). Iron, aluminium, brass and zinc are sold to blacksmiths for making pots, wheelbarrows, etc. The local market can fully absorb these fractions appropriately. Brass, copper and lead are sold to Lebanese, Indian or Chinese businesses for export or exploitation. Printed circuit boards are generally sold by the kilo to foreign buyers who export them to recover precious metals. The price paid for the boards is extremely low compared to the price of these materials on the market, so that the existing informal sector is somehow deprived of the economic value of the materials it collects. It also seems that some miners buy the circuit boards to extract gold using techniques similar to those seen in China or India. Plastics are sold to certain local industries for making shoes, recipients etc. Foam is used for the manufacture of containers and cold rooms.

In Senegal, the informal metal-scrap sector is widely controlled by traditional small scale smelters, who focus on aluminium for the production of cooking items, and on lead for the production of weights for the fishing industry. In addition, the recycling of copper, steel, glass and plastics is also developing in the informal sector, and absorbs fractions providing from e-waste dismantling. The recovery of precious metals from printed circuit boards has not been observed.

3.5.7. Final disposal practices

E-Waste is observed in disposed municipal solid waste in all target countries but it is normally collected at the official dumpsites and then brought to the informal scrap yards for dismantling or dismantled at the dumpsite itself. Non-valuable or toxic fractions resulting from e-waste recycling such as cases and leaded glass from CRT screens, batteries, capacitors etc. are disposed of together with municipal waste on illegal or official dumpsites, in garbage bins, on the outskirt of municipalities or in reservoirs, rivers, lagoons or lakes.

Since there is no controlled sanitary landfill for municipal solid waste in none of the target countries, there is also no infrastructure for the final disposal of non-valuable or hazardous fractions available.

3.6. Health care waste management

3.6.1. Definition of health care waste

Health-care waste includes all the waste generated by health-care establishments, research facilities, and laboratories. Most of the waste produced by health care providers is non-risk or 'general' health care waste (75 - 90%), coming from the administrative and housekeeping functions of health care establishments. This waste can be dealt with by the municipal waste disposal mechanisms (WHO 1999). For hazardous health care waste such as infectious waste, pathological waste or sharps, special treatment and disposal options should be available.

3.6.2. Main Conclusions

Health care waste constitutes a problem in all four target countries. Most often, no proper segregation of health care waste takes place and it is often mixed with household waste. Very few facilities segregate their waste, mostly large hospitals in major cities. They separate sharps, infectious, but not sharp waste and anatomical waste, sometimes using a colour code system. Infectious waste is sometimes treated with bleach, sterilized in autoclaves or incinerated. But most health care facilities do not have access to such treatment facilities such and if they exist, they are often dysfunctional or out of operation. Anatomic waste such as placentas are often delivered to the belonging families for burial.

Besides the few treatment options, most of the health care waste ends up at official or informal dumpsites together with the municipal waste.

3.6.3. Côte d'Ivoire

The current management of health care waste in Ivory Coast is a significant problem for public health and the environment.

The major producers of medical waste are from the public sector: university hospitals, regional hospitals, general hospitals, urban health centres, urban clinics, rural health centres, rural clinics, urban and rural maternity services and school health centres. Regarding the private sector, health care waste is produced by private hospitals and private clinics. In Côte d'Ivoire, the amount of medical waste produced nationally is estimated at about 1.8 kg per person per day. In total, 3800 tons of medical waste is produced yearly in hospitals. The 1398 public health facilities existing in Côte d'Ivoire are estimated to produce around 8750 kg of medical waste per day or about 3194 tons per year, the 1212 private hospitals produce around 600 tons per year.

In hospitals, primary collection of medical waste is carried out by untrained personnel, that is not sensitized regarding the characteristics of health care waste. However, some hospitals have contracts with private companies whose staff are cleaning specialists. Within the hospital, health care waste is transported by wheelbarrow, cart or hand. In most cases, the off-site transport is done by private contractor’s formal operations of the municipality or by private contractors that have signed contracts directly with the health facilities. Sometimes, informal operators are also involved.

Regarding the management of medical waste, sorting at source is neither done in a systematic way nor is it widespread in all existing structures. Often, special needles and body parts such as placentas are sorted. Some wastes are recovered after sorting: the glassware of laboratories, empty vials containing chemicals in laboratories and radiology films. However, the silver that these films contain is not recovered. All glassware is reused after rinsing with

bleach and sterilisation in an autoclave. The equipment used during surgery (forceps, scissors, etc..) is autoclaved, soaked in bleach and reused. Certain types of cardboard packaging and plastic from the pharmacy are found in the final storage site showing that no reuse and recovery is performed at this level.

Regarding the treatment of non-recyclable health care waste, some facilities use open burning, incineration in locally built equipment or burial in informal disposal sites. Regarding anatomical waste, placentas are either delivered to their parents or sent to landfills that are often uncontrolled or informal; derivatives from surgery (large pieces) are sent to municipal cemeteries and buried through the morgues.

The majority of health care waste follows the same path as the municipal waste and are thus disposed of in uncontrolled landfills such as that of Akouédo for the District of Abidjan. In some structures such as the University Hospital of Yopougon, there is a concrete site for the reception of wastes of all types.

3.6.4. Senegal

General Information

Existing information on health care waste management in Senegal bases on a feasibility study on the management of healthcare waste carried out in 2005 by IAGU for the company AMA-Sénégal, which was at that time the company in charge of waste management in Dakar. The Regional Centre of the Basel Convention also contributed to the study (IAGU 2005).

The available information concentrates on the city of Dakar, considering the following figures:

At the national level:

- In the public sector: 7 national hospitals, 10 regional hospitals, 53 health centres (in French: *centres de santé*), 754 small health centres (in French: *postes de santé*), 614 maternities.
- In the private sector: 2 hospitals, 306 pharmacies, 76 small health centres and 414 clinics.

In the city of Dakar:

- In the public sector: 4 hospitals, 9 health centres, 31 small health centres.
- In the private sector: 2 hospitals, 22 clinics, 77 dispensaries (in French: *officines*) and 7 laboratories for medical analyses, among which is the 'Institut Pasteur'.

The main conclusion of the study was that apart from syringes, health institutions rarely separate waste and their staff is not enough sensitized and trained. Storage, transportation and final disposal systems are weak, which explains why most of healthcare waste ends up mingled with household waste on dumping sites (IAGU 2005).

The following scheme is from the Basel Convention of healthcare waste management (SBC 2003).

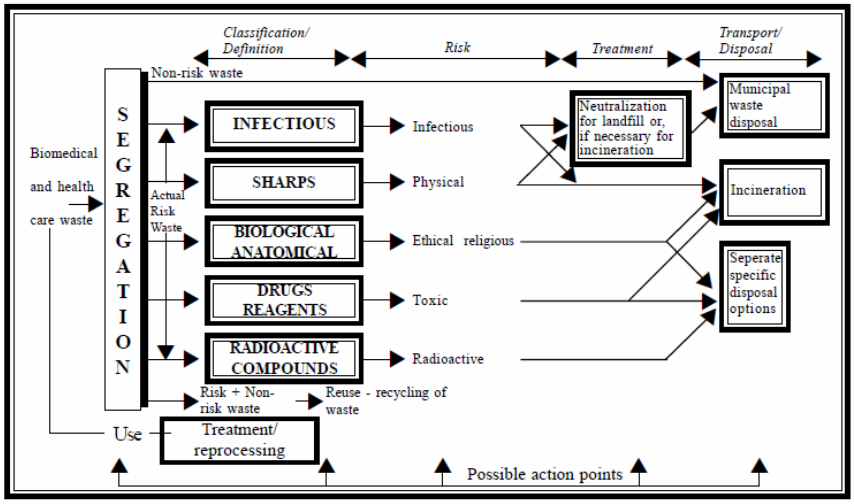


Figure 17 Ideal health care waste management system (SBC 2003).

3.6.5. Characterization of healthcare waste in Dakar

The annual production of healthcare waste by health institutions in the city of Dakar is estimated at 269.3 tons (IAGU 2005).

Anatomical waste is the smallest healthcare waste flux in Dakar, for cultural reasons. For instance, placenta, foetus, body parts are given to the patient's family. Families bury the placenta in the family's square in the cemetery to preserve the fecundity of the woman.

Sharp waste is mainly composed of syringes and broken bulbs or glass containers. Drugs are found in small quantities. The most common infectious waste comes from laboratories.

Waste separation practices

When there is waste separation, it is usually carried out according to 3 categories:

- Sharp waste
- Infectious, but not sharp waste
- Anatomical waste

In the surgery room of the Hôpital Le Dantec, there is a code of colours:

- Red for infectious waste
- Black for waste that can be mingled with household waste
- Green for food waste.
- Anatomical waste is put into plastic bags.

In some places, the IAGU team noticed that syringes are separated but then mingled with household waste at the collection step (IAGU 2005).

In the majority of places, there are adequate recipients (plastic bins and plastic bags), however there is rarely an appropriate storage area except in the Hôpital Principal and in the Institut Pasteur. On the premises of the health institution, healthcare waste is moved from one place to another with wheelbarrows except in the Hôpital Principal where carts are used.

Waste collection and final disposal

The waste collection is generally subcontracted to the same private companies that work on household waste, so healthcare waste collected by these companies ends up on the *Mbeubeus*s dumping site.

Some institutions carry their healthcare waste themselves, such as the Laboratory Bio 24 that uses the incinerator of the Institut Pasteur.

Only 17% of the health institutions studied carry out a chemical or vapour treatment (using eau de javel, formol or autoclave).

Infectious waste is sometimes buried by laboratories after autoclave (vapour) treatment.

In some health centres, incinerators are very rudimentary. The most modern incinerators are to be found in the Hôpital Principal, in the Hôpital Dantec and in the Institut Pasteur. Ash is then put together with household waste and carried to the dumping site.

Current costs of healthcare management for health institutions in Dakar

The following table presents the annual costs corresponding to all the steps of healthcare management (staff and technical costs).

Table 34 Annual costs of the health care management in Senegal.

Type of health institution	Annual cost in FCFA	Annual cost in euros
Hospitals	7 500 000 - 30 300 000	11 434 - 46 192
Health centres	915 000 - 1 550 000	1 395 - 838
Small health centres	35 000 - 1 075 000	53 - 1 639
Clinics	1 100 000 - 8 300 000	1 677 - 12 653
Laboratories	800 000 - 3 290 000	1 220 - 5 016
Private doctors (in French : cabinet médical)	10 000 -205 000	15 - 31

Legal framework

The Decree 74- 338 of April 4th 1974 on waste collection and final disposal and the Law 83-71 providing for the Code of Hygiene in its article L 33 both forbid *"to mingle household waste with anatomical or infectious waste, as well as pharmaceutical waste and any other toxic waste or waste from slaughterhouses"*. Article L 34 of Law 83-71 forces all health institution whatever their status *"to eliminate their waste by incineration".* However, this article is no longer valid due Article L 30 of the law providing for the Code of Environment which recommends ecologically sound waste management.

3.6.6. Ghana

In Ghana, medical waste is generated by large and small health care facilities, home health care, drugs users, research activities and industrial operations. These waste present high risk to human health and the environment because of the hazardous characteristics of some of its components.

Hospital waste refers to all residues produced in hospitals during performance of their institutional functions. However medical waste and hospital waste are two terms used interchangeably in health facilities in Ghana.

Classification of Medical Waste

In practice, it is difficult to identify and segregate every article in the solid waste stream which has hazardous properties, because the hazardous potential of a particular kind waste cannot necessarily be determined by appearance, hence it is more practicable when the classification is by definition. A survey conducted in Ghana by Dietrich Hueber (1992), classified medical waste into five main categories; waste types A through to E (see Table 35).

Although incineration, sterilization by heat, disinfection by steam, microwave disinfection, autoclave and chemical disinfection may be a best practice treatment or means of disposal, especially for waste type C, D and E; it is widely accepted that most health care facilities do not have access to these treatment facilities or, if they exist, they are often dysfunctional or out of operation. These hospitals employ close–system combination of such waste and burry it. Type E waste is estimated to represent about three per cent (3%) of the total health care waste.

The average generation rates for the different types of waste ranged between 0.05 -0.8 kg/bed/day (see table below). This compares very well with the amount reported in other countries such as 0.60 kg/bed/day with Limpopo, South Africa (Nemathaga et al. 2008) and 0.84 kg/bed/day with El-Beheira of Egypt (El-Salam 2010). It was indicated that around 22,127 beds are available in Ghana as of 2008, which could account for about 33,190 kg/day of Health Care waste that is produced in Ghana at a maximum of 1.5kg/bed/day.

Table 35 Health care waste type classification.

Type	Source	Examples	Treatment or Disposal	Generation kg/ bed/day
Waste Type A	Administration, Stores, Shops and Kitchen	cleaning service, papers, cardboard, plastics, kitchen waste, food leftovers, glass, swept-up litter	Stored and transported to landfill	0.80
Waste Type B	Inpatient ward, outpatient examination room and first aid areas.	Wrappings, newspapers, cotton wool, used bandages, dressing and other disposal materials contaminated with blood or other putrefiable materials substances.	Special storage and onward transportation to landfill	0.45
Waste Type C	Isolated wards, clinical laboratories for microbiological investigations, surgical rooms.	Sharps contaminated with infectious disease, infectious blood and excretion, cadavers of animals used for experimentation with infectious- contiguous diseased.	Special transportation and containment, for an enclosed burning or burying.	0.15
Waste Type D	Operating theaters, delivery rooms, morgues, autopsies, etc.	organic tissues, placentas and amputated limbs	Special transportation and containment, for an enclosed burning or burying	0.05
Waste Type E	Pharmacy, departments, radiography, X-ray services, clinical and research laboratories, etc.	Acids, solvents, chemicals, expired medicines, explosives, inflammable materials, photographic developer and fixer solutions, toxic substances, combustible liquid, radioactive materials and others.	The radioactive components of the waste have short half-life and are also low-radioactive so store in special containers until their radioactivity has decayed, after which they are treated as in either type C & D or A & B.	0.05

Table 36 Health Facilities by Type and Ownership, 2007 Source: CHIM/PPME-GHS

SUMMARY OF HEALTH FACILITIES - ALL REGIONS - 2007																				
REGION	**TEACHING HOSPITALS**	**REGIONAL HOSPITALS**	**PSYCHIATRIC HOSPITALS**	Hospitals					Poly Clinic	Health Centre And Clinics					Maternity Homes			CHPS		Grand Total
	Govt.	Govt.	Govt.	CHAG	Govt.	Islamic	Private	Quasi Govt.	Govt.	CHAG	Govt.	Islamic	Private	Quasi Govt.	Govt.	Private	Quasi Govt.	Govt.	Private	
Ashanti	1			17	22	3	48	2		32	140	2	161	9	3	105		4		549
Brong Ahafo		1		9	7	1	6			8	123	0	18	4	3	37		11		228
Central		1	1	3	8	1	8	1		9	68	0	62	2		34		43		241
Eastern		1		5	12		5	3		19	165	0	63	7	1	47		44		372
Greater Accra	1	1	2	3	7	2	79	6	7	5	42	1	232	16	2	55	1	4		466
Northern		1		4	8		1	2		25	120	0	5	3		9		10		188
Upper East		1		1	4					15	54	0	11	1		2		55		144
Upper West		1		2	3	2	1			14	60	3	4	0		6		39		135
Volta		1		8	11		7	1	1	9	192	0	23	0		24		19		296
Western		1		3	11	1	1	7	2	20	95	2	109	22		60		56	2	392
Grand Total	**2**	**9**	**3**	**55**	**93**	**10**	**156**	**22**	**10**	**156**	**1059**	**8**	**688**	**64**	**9**	**379**	**1**	**285**	**2**	**3011**

CHAG:Christian Health Association

CHPS: Community Health Planning Services

3.6.7. Nigeria

Logistical and Technical elements of Healthcare Waste Management

Healthcare waste has become a serious health hazard in many developing countries such as Nigeria where many health concerns are competing with limited resources. As a result, many health care institutions are engaged in careless and indiscriminate disposal of this waste. Health care waste (HCW) is a by-product of healthcare activities that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. Poor management of HCW exposes healthcare workers, waste handlers and the community who come in contact with it to infections, toxic effects and injuries. In many states in Nigeria, health care waste is deprived of the special attention it deserves in the waste management system. Despite its hazardous nature, it is managed like all other municipal waste.

Health related wastes in Nigeria source mainly from University, general and private hospitals, healthcare and immunisation centres, dispensaries, maternity clinics, sick bays from schools, medical research facilities, clinical laboratories, blood banks and blood collection centres, pharmaceutical and chemical stores and homes (e.g. injection needle and syringes).

Healthcare waste generation and collection

Storage of healthcare waste within the hospital should be done in labelled, colour-coded bins and bags in secured, balanced, easily washable covered containers that do not have any sharp edges (WHO 1999, see Figure 18). In Nigeria, no proper segregation of healthcare waste takes place and it is often mixed with household wastes. Very few facilities segregate their waste. Most healthcare providers in Lagos practiced segregation of waste, the majority of which is done at the points of generation using colour coded bins and injection safety boxes made of cellulose material (Figure 1). In most of the facilities in other states including Ibadan, healthcare waste are collected at the point of generation into metal dust bins, drums, plastic bins, baskets, pans, cartons, buckets or bowls before been transferred into larger or final disposal containers (Coker et al., 2008; Oketola et al., 2011). The waste handlers are not usually kitted to prevent health hazards associated with their job. Table 37 shows the generation of healthcare waste in Lagos and Ibadan

Table 37: Generation of healthcare waste in LGAs in Lagos and Ibadan from a study carried out in 2009.

LGAs	No of HCFs	Average general waste (kg/day)	Average infectious waste (kg/day)	Average sharp waste (kg/day)	Total waste (kg/day)	Average No of patient per day	Waste generation (kg/patient/day)
Lagos							
Agege	4	6.64±7.0	3.30±4.1	1.19±1.7	11.1	18	0.62
Alimosho	7	4.87±5.9	5.85±4.2	1.66±1.5	12.4	23	0.54
Ojo	6	2.75±0.3	4.33±0.3	1.13±0.1	8.21	15	0.55
Oshodi/ Isolo	7	7.12±11	6.91±7.3	1.92±2.3	16.0	20	0.80
Shomolu	9	3.91±3.0	1.68±0.8	0.9±0.9	6.49	7	0.93
Surulere	5	2.99±1.8	1.06±0.8	0.42±0.2	4.47	6	0.75
Ibadan							
IB N/E	5	2.85±0.3	1.20±0.5	0.52±0.3	4.57	7	0.65
IB S/E	4	1.99±0.9	0.63±0.2	0.26±0.1	2.88	26	0.11
Lagelu	7	2.12±0.8	1.35±0.1	0.54±0.1	4.01	9	0.45
Oluyole	6	0.97±0.1	0.43±0.1	0.19±0.1	1.59	10	0.16
Ona-Ara	4	1.35±0.3	0.25±0.1	0.71±0.1	2.31	12	0.19

Source: (Oketola et al., 2011)

(a) Infectious waste bin

(b) Safety boxes for sharp wastes

(c) Container for general waste

(d) Waste containers in a HCF

Figure 18 Containers for waste segregation in healthcare facilities in Lagos, Nigeria.

Transportation

Transportation of waste within the hospital premises in most of the facilities in Nigeria was not done in a sustainable manner as waste was usually carried through the patient care areas and the containers for carrying the waste have no wheels. Waste handlers in most of the facilities opt to carrying waste containers on shoulders, with bare hands or closer to chest. In some government owned tertiary facilities, pushcarts, as well as wheeled plastic bins are provided to facilitate easier and safer waste transfer (Coker et al., 2008). Presently in Lagos, there is a medical waste management unit in Lagos State Waste Management Authority (LAWMA). The unit involved Private Sector Participation (PSP) in the operation in medical waste collection and disposal. Collaboration with Health Facilities Accreditation Management Authority (HEFAMA) to ensure HCFs conforms to the Polluter Pays Principle. The agency has also installed an autoclave with shredder for treatment of healthcare waste. There is an increase in the number of PSP Operators from 4 to 15 servicing all HCFs daily (LAWMA, 2008).

Treatment and Disposal

Healthcare wastes produced in the country do not undergo any form of recycling in many parts of the country but they are usually co-disposed with municipal domestic wastes in open dumpsites without any prior treatment except in Lagos where the waste is shredded and the original volume is reduced by 80%. The shredded waste is heated at temperature of 135^0C and 4 bar pressure. The final products are then disposed of with other general waste (LAWMA, 2008). Storage media include skips etc. are provided in some of the healthcare facilities. Unregulated and open dumping and burning is the main practice in the country. A few of private and government hospitals operate incineration of healthcare waste in locally built incinerators to reduce the volume of the waste, see Figure 19. The incineration residues (secondary waste) obtained from such practices are disposed

of in the open dumpsites without adequate protection of the environment. This form of treatment is also capable of releasing hazardous substances such as furan, dioxins, PCBs and PAHs to the environment. Other forms of treatment include burial in the hospital premises, burning in open pits, and disposal at the municipal dumpsites (Bassey, 2006; USAID/Nigeria, 2009; Ngwuluka et al., 2009).

Figure 19 A locally built incinerator at one of the healthcare facilities in Ibadan (Source: Oketola et al., 2011).

Recycling

Presently, there is a factory in Port Harcourt, River State called BOSKEL Thermal Factory that is involved in the incineration of expired pharmaceutical products and ARVs in a high temperature rotary kiln incineration (Iyortim et al., 2011). There is no form of healthcare waste recycling in most part of the country.

Legal and Institutional Elements of Healthcare Waste Management

Waste management policy embodied in the national policy on the environment formulated in 1989 and revised in 1999 only alludes to hazardous wastes and does not refer to medical wastes (FME, 2006). Yet the number of healthcare facilities in the country at large is on the increase. However, a national law on healthcare waste management may stand alone or may be a part of a more comprehensive legislation such as (a) law on management of hazardous wastes, (b) law on hospital hygiene and infection control, (c) national policy on injection safety and healthcare waste management (Lambo, 2007).

3.7. Industrial waste management

3.7.1. Definition of industrial waste

Industrial waste can be defined as solid or liquid waste from any industrial undertaking or organisation. In some countries industrial waste may be more specifically defined by legislation (Skitt, 1992). Industrial waste may result from factories, mines and mills.

Industrial waste considered in Task 2.4 comprises only industrial solid waste which poses mayor environmental problems and for which disposal is not existing or unsatisfactory.

The relevant waste types from Côte d'Ivoire, Senegal, Ghana and Nigeria will be described regarding its origin from different industries, characteristics, collection, transport, treatment, recycling and final disposal.

3.7.2. Main conclusions

Data availability on industrial waste is rather scarce in all target countries. Relevant industrial waste types include e.g. waste from chemical industries, waste from petroleum industries, wood waste, mining waste and packaging waste. The quantities of waste generated by these industries vary widely and therefore also the environmental problems posed by its disposal.

Industrial waste is often collected either together with municipal waste, by informal waste collectors or is not collected but stored on site. Formal separate collection is uncommon.

Both formal and informal recycling activities only exist for valuable industrial waste such as metal scrap or glass and plastic bottles. These recycling activities are on the whole the same as for municipal waste.

Hazardous waste not containing valuable substances is disposed of either together with municipal solid waste, left untreated on site or on irregular dumpsites nearby the industrial estate. These practices lead to serious pollution, especially in areas where industries are very concentrated.

There are some laws regulating the management of industrial waste but the enforcement in general is very weak.

3.7.3. Côte d'Ivoire

Relevant industrial waste types

Cote d'Ivoire is dependent on agriculture and related activities, which engage roughly 68% of the population. It is the world's largest producer and exporter of cocoa beans and a significant producer and exporter of coffee and palm oil (CIA, 2011). The Ivorian industries are mainly comprised of the food, energy, chemical, petrochemical and textile sectors. These sectors account for about 80% of all enterprises. More than 80% of the major industries are concentrated in the capital Abidjan and about 10% are located in other big cities. Relevant industrial waste types are listed in Table 38.

Table 38 Relevant industrial waste types in Côte d'Ivoire.

Industrial Sector	Waste type
Paint production industry	Solid Waste: Bags and drums containing raw materials Liquid waste: process water, washing residues from the production of lacquers and paints containing solvents, sludge from the production process.
Unit packing and distribution of pesticides and herbicides	Solid Waste: Empty containers Liquid waste: Process waste water from site cleaning
Unit preparation of pesticides and herbicides packaging	Solid Waste: Soiled metal containers, soiled plastic containers, out of use chlorine cylinders Liquid waste: Process water, sludge from water treatment process

Industrial Sector	Waste type
Printing	Solid Waste: Obsolete equipment soiled with ink, protective ink, polychrome products, products of photogravure Liquid waste: Organic solvent, organic ink
Rubber Industry	Solid Waste: Rubber residue
Tannery	Solid Waste: Leftover skins Liquid waste: Effluent
Galvanoplasty	Liquid waste: Partially treated liquid effluent
Oil refinery	Solid Waste: Spent catalysts, sand polluted by dumping hydrocarbon Liquid waste: Oil sludge, effluent water polluted with hydrocarbons
Pharmaceutics	Hazardous medical waste
Battery fabrication	No data
Mining	No data
Agriculture and food processing	No data
Textiles	No data

Source: (MECU, 1991)

Industrial waste in general is considered a serious problem due to the large quantities of different waste types generated and their environmental impact. The above mentioned waste types contain many different hazardous substances, as listed in Table 39.

Table 39: Toxic substances in industrial waste

	Waste generated	Toxic substances
Oil Refinery (Ivorian Company Refining)	Catalysts from reactors	Cobalt, nickel, molybdenum and other heavy metals
Unit preparation of pesticides and herbicides packaging	Metal Container soiled	Organophosphates, patrazine and methachlore
	Soiled plastic containers	Atrazine; methachlore, kerosene and naphtha.
Paint production industry	Bags and drums containing raw materials	hite spirit, toluene, methyl ethyl ketone, methyl isobutyl ketone, chromium oxide, zinc stearate and biocides (acticide and fungicides).

According to the Ministry of Environment, Water and Forestry, in 2001, 150'000 tons of industrial solid waste have been generated. A study from 1991 by the Ministry of the Environment, Building and Housing, evaluated the quantities of waste produced by industries in Côte d'Ivoire more in detail (see Table 40).

Table 40 Quantity of industrial waste generated in Côte d'Ivoire per industry sector (tons/day)

	Waste generated (tons / day)
Paint, varnish, glue	200
Agro-Pharmaceutical	200
Cleaning	800
Oil refinery	500
Manufacture of batteries	100
Manufacture of Acetylene	2500
Textile	2000
Metal Processing	100

Source: ***(MECU, 1991)***

General industrial waste management

There is no formal separate collection of industrial waste in Côte d'Ivoire. It is either collected together with municipal waste, financed by the government or by informal waste collectors. Recycling of industrial waste does not exist according to the country documentation. It is though assumed that industries itself recycle their production waste if possible.

Industrial waste is mainly disposed of together with municipal waste or it is irregularly dumped.

Prioritisation of industrial waste problem situation

Prioritized industrial waste streams in Côte d'Ivoire are waste from the chemical industry and from the petroleum industry.

Chemical Industry

In Côte d'Ivoire, waste from the chemical companies results from the companies that import chemicals (STEPC, SIVOA, Hoechst, Polychim etc.), production units of paint, preparation units of pesticides and herbicides, packaging, packaging units and distribution of pesticides and herbicides, dyes units, units of manufacturing batteries, etc. Waste from the chemical industry may be non-hazardous waste, special waste or toxic waste.

The paint waste is mainly produced by the paint companies (e.g. the production unit "Seigneurie IPL"). The physical characteristics (liquid, solid, muddy and pasty) and composition (fillers, pigments, extenders, etc.) varies widely. Paint waste constitute of bags or metal drums that are contaminated by a number of substances (white spirit, toluene, methyl ethyl ketone, etc.) used as inputs of sludge from the production process and solvents. The amount of metal drums and contaminated sludge is estimated at respectively 12 and 9 tons per year. The total amount of waste from production industries of paint is estimated at 200 tons / year (MEEF, 2009). There are no industry specific collection and transport of waste from production activities of paint. Some waste paint is recovered and reused by people. The waste such as sludge from the production process are not going to informal and uncontrolled landfill of Akouédo, but are stored in drums at the site of the company.

Chemical wastes from pesticides preparation and packaging of herbicides are produced by the "Company Tropical Fertilizer and Chemicals-STEPC" and those from packaging and distribution of pesticides and herbicides are produced by the unit "Syngenta". The waste generated by these units constitutes of contaminated metal and plastic containers, (15 tons / year), chlorine tanks that are out of service and sludge from water treatment processes (50 tons / year). There is no industry specific transportation and disposal of these wastes. Parts of it are removed together with the municipal waste to a controlled landfill that receives all the garbage of the District of Abidjan. These include paste-like or solid products (sludge) and containers contaminated with chemicals. Other waste such as bottles of chlorine is typically stored on site, waiting for a correct solution for recycling or disposal.

Petroleum industry

In Côte d'Ivoire, the Ivorian Refining Company (SIR in French) mainly produces organic waste, namely hydrocarbon residues, tar, and solvents. The SIR processes 3 million tonnes of crude oil per year. The solid waste produces constitutes mainly of catalysts from reactors (10 tons / year), sludge from tank bottoms (50 tonnes / year), oil spill polluted sand (600 tons / year). Each type of waste generated by the refinery industry has its own collection, transport and disposal solution. Spent catalysts are collected and transported to France for recycling. Sometimes they are recycled in situ. The tank bottom sludge's are stored on the site of the refinery. For this type of waste, there is currently no appropriate treatment process. The sand polluted by oil spills is treated with lime by the company "ITI" and sent to the open landfill of Akouédo.

3.7.4. Senegal

Relevant industrial waste types

The Senegalese industry mainly relies on food processing (peanut, sugar) and chemicals. Obtained information from the Central Intelligence Agency emphasizes phosphate mining, fertilizer production and commercial fishing as the key export industries (CIA, 2011). The country is also working in the field of iron ore and oil exploration. A study has been conducted on household and industrial waste in 2009 in which 315 industries have been interviewed in the region of Dakar to study their structure and waste streams generated (APROSEN and IAGU, 2009). The area between Dakar and Rufisque concentrates more than 95% of the Senegalese industry and is heavily polluted by industrial waste because of the concentration of industries (free zone) for 30 years. It can be regarded as the most polluted area of the country.

The 315 companies interviewed generated mainly six types of waste accounting for more than 70% of their total waste generation:

- 17% of paper and cardboard waste
- 16% of wood waste
- 16% of rubber and plastic waste
- 15% of metal waste
- 10% of liquid and semi-liquid waste (industrial fluids)
- 7% of glass waste

Industrial waste in Senegal can be classified in three categories:

- Non-organic waste with acids, alkaline, used water contaminated with heavy metals, contaminated solid waste (containers)
- Organic waste (solvents, paint residuals, out-of-date pesticides)
- Miscellaneous waste (mainly oil waste).

In addition, the report established a list of hazardous industrial waste:

- waste generated by pharmaceutical manufacturing companies
- used mineral oil (liquid petroleum)
- mixed water and hydrocarbon
- objects contaminated by polychlorinated biphenyl's (PCB)
- Waste containing heavy metals (lead, hexavalent chromium, arsenic, copper, mercury, cadmium, beryllium)
- objects contaminated by pesticides
- Explosive or inflammable waste.

Another research carried out by the Senegalese Ministry of Environment in 1999 (National Plan, 1999) that led to the publication of a national action plan for hazardous waste management, had studied 120 actors of mainly industries and health institutions. They identified the following hazardous waste types generated (see Table 41).

Table 41 Types of waste related to industrial sector in Senegal

Industrial sector	Types of waste
Agriculture and food processing	Liquid waste: Mineral oil, small amounts of gas oil and fuel, hexan, NH3, malathion, dicrotophos, parathion ethyl, endrine, fenitrothion, arsenic, out-of-date pesticides (methylene bromide, carbaryl etc.)
Chemicals	Liquid waste: Caustic soda, weed killers, solvents, paraffin
Mining	Liquid waste: Phosphogypsum (by-product of processing phosphate into fertilizer with sulphuric acid), used oil

Industrial sector	Types of waste
Energy production	Semi-liquid waste: Lead sludge, acid tar, oil sludge
Foam and plastics	Semi-liquid waste: Barrels soaked with toluene (methyl benzene)
Material, leather and wood	Liquid waste: Solvents, white spirit, contaminated rags, glaze containing heavy metals
Metal processing	Solid waste: AA R6 batteries, R20 batteries
Non-metal minerals refining	No data.
Pharmaceutics	No data.
Miscellaneous	Liquid waste: Methylene bromide Solid waste: Plastic waste

Source: *(National Plan, 1999)*

General industrial liquid waste management

Industrial liquid waste is an issue not covered by the present report in detail but that is of utmost importance for the waste management system due to the lack of operational sanitation plants for the industry in Senegal. In the Region of Dakar, 175'000m^3 of liquid waste (both from households and industrial sources) is generated every day and 100'000m^3 is directly dumped into the sea without any treatment. Industrial liquid waste ending up on the beaches in the Region of Dakar represents 5'028'700m^3, originating from 26 plants/sites.

In January 2009, the European Investment Bank (EIB) and the French Agency for Development (AFD) announced that they had accepted to fund a program aiming at building sanitation plants for each industry around the bay to restore the quality of water of the Bay, and also aiming at setting up a 'polluter-pay' tax negotiated with local industries.

The oil waste is also a major challenge. The study carried out by APRSOEN and IAGU concluded that Senegalese legislation is inappropriate: there is a Decree from 1982 on oil waste that gives the monopoly of oil waste recycling to the SRH (Société de Régénération des Huiles) but this company is from a practical point of view not in a position to carry out what is expected from them, whereas other companies could contribute to oil waste recycling but are not authorized by the legislation. This decree is supposed to be revised by the Ministry of the Environment.

General industrial solid waste management

There is very little data on the quantities of industrial waste generated in Senegal. In 2008, an environmental audit conducted at the Port of Dakar acknowledged that they could not find any figure on the quantity of waste generated by the activities of the Port (Experts Associés Sûreté, 2008). Table 42 lists some official estimations on certain types of industrial waste, based on a survey conducted by the Senegalese Ministry of Environment in 1999:

Table 42 Quantity of different industrial waste types generated in Senegal in 1999 (tons/year)

Type of industrial waste	Tons per year (in 1999)
Out-of-date pesticides	1'045
Used oil and assimilated waste	1'546
Contaminated packaging	9'174 units (no data on weight)
Dust and fumes	42'530
Contaminated oil sludge	26'329
Plane plugs	120 units (no data on weight)
Batteries	300'000 units (no data on weight)
Other solid waste	11'515
Phosphogypsum	1'600'000 mm

Type of industrial waste	Tons per year (in 1999)
Fluosilicic acid	85'000
TOTAL	> 160 000

Source: (République du Sénégal, Ministère de l'Environnement et de la Protection de la Nature, 1999)

The formal industrial waste management includes the following:

- Internal re-use or recycling, for instance re-use of small metal pieces or solvents, or re-use of wood wax as fuel for wood drying ovens.
- Internal final disposal (incineration or own landfill)
- External re-use or recycling, which consists in selling valuable materials to the informal sector, very rarely to other formal industries
- External final disposal (50% of companies resort to it mainly through incineration in 94% of the cases and through landfill in 6% of the cases).

Examples of industrial waste used as a fuel:

- Food processing compagnies SONACOS and CSS use organic waste generated by their activity to produce their own electricity.
- SOCOCIM, a cement company, produces 32% of its fuel with peanut shell waste (3 tons/hour in 2009), oil waste, used oil (provided by SAR/Total) as a substitute to coal .

The informal industrial waste management has been developed in the absence of appropriate legislation and public control/organization of industrial waste collection and treatment infrastructures. In Dakar, some waste pickers are itinerant and circulate in the streets all day long in search of valuable materials and some of them work permanently on the Mbeubeuss dumpsite. The collected waste comes from very varied sources and is sorted and sold to varied actors. The main sources of waste collected by popular waste pickers and recyclers are: small businesses (bars, restaurants, hotels, shops, and markets), building companies (building waste), industries, the port (boat wrecks, car wrecks, and imported e-waste). All across the city, there are so-called 'packs' (a sort of small warehouse for recyclable material and goods that can be repaired or re-used), that are organised as 'transit stations' where waste is sorted to be loaded in containers (20 tons in average) that are then sold to brokers.

Prioritisation of industrial waste problem situation

Prioritized industrial waste streams in Senegal are waste from the phosphate industry, from the pesticides industry, from metal waste and packaging waste. In addition, waste from the sugar processing is described in order to give a good example on how industrial waste can be recycled.

Due to the increase of metal prices and the high need for metals in Asia, the recycling sector of industrial metal waste is very dynamic at the moment even if most of the added value of recycling is not in Senegal but abroad, because this sector relies on exportation (sorted, valuable metals are exported to Asia by Indian brokers who were contacted during the study but refused to give information on their activity). There is a lack of industrial infrastructures to process recyclable metals in Senegal.

Paper and cardboard as well as organic waste were not selected because they do not pose major environmental problems. Wood waste is usually recycled in Senegal as fuel for the transformation of fishery products. Paper and cardboard serve as food for animals, chicken litter or egg trays. Organic waste serves as fertilizer.

Waste from the phosphate industry

Senegal has large stocks of phosphate which have been exploited since the 60s. USA, China and Morocco are the world leaders in terms of phosphate production yet Senegal accounts for 1% of the global production (2005 figures[67]).

The Industries Chimiques du Sénégal (ICS) exploit the Taïba mining area situated 100km at the North of Dakar. There are 2 mines : Keur Mor Fall and Tobène.

The production capacity of Taïba mining area is 2 million ton of per year. Stocks are estimated between 60 and 70 million tons[68].

The phosphate ore is 7 to10 meters thick and is to be found under a 30 to 40-meters sand layer. The ore is made of phosphate, sand, clays (also called « schlamms ») and flint.

Phosphate is processed into phosphoric acid (which requires using sulphuric acid) in the Darou plant, not far away from the Taïba mining area. Some of the phosphoric acid is used to make granulated fertilizers (which requires mixing it with sulfuric acid and ammoniac) in a plant in Mbao 18 km away from Dakar. However, a large quantity of phosphate is exported, in particular to India, without being processed.

Phosphate mining has major impacts on the environment :

- Air pollution due to the large quantities of dust resulting from rocks fragmentation and removal, as well as from crushing and grinding of materials.
- Deforestation around the mine and disturbance of biodiversity (Butaré, I. and Keita, S 2009): phosphates are usually to be found in small quantities in water and soils, and are useful, but in excessive quantities, they destroy soil balance. Plants that are grown with phosphate-based fertilizers cannot longer assimilate phosphorus unless they receive new and massive quantities of phosphates.
- Extracting and washing the ore with acids increases the percentage of solid matters in suspension and water turbidity, which is a big threat for aquatic life[69]. In addition, high concentrations of phosphates are a direct cause of eutrophication of surface waters. This is why, following a regulation of the European Parliament and Council, the French Decree n°2007-491 bans selling and using phosphates in dom estic detergents in France from July, 1st 2007 onwards.
- Producing 1 ton of phosphoric acid generates 5 tons of waste. This waste is made of hydrated calcium sulfate, also known as phosphogypsum slurry or gypsum waste (in French: phosphogypses) and which contains radioactive elements (Association robin des Bois 2009), as well as calcium, sulphur, phosphorus, and in small quantities, arsenic, baryum, cadmium, chromium, lead, mercury, selenium and fluorine[70].

In Senegal, phosphogypsum slurry is simply piled up. Its composition and quantities are not known. Quantities are estimated at 166 million cubic meters. Washings the phosphogypsum slurry heaps with rainwater during the rainy season provokes acidification of the soils.

Several researches have shown that gypsum waste could be recycled:

- to make cement or in road building, when mixed with vulcanic tuffs (Basir Diop et al. 2008).

[67] Source : International Fertilizer Industry Association

[68] Source : Industries Chimiques du Sénégal http://www.ics.sn/minier.html

[69] Ibid, page 5

[70] Source : Institut de recherche agronomique du Sénégal (ISRA), cité dans l'article « Sénégal : des engrais gratuits mais contestés », SYFIA, 1er novembre 1999, http://www.syfia.info/index.php5?view=articles&action=voir&idArticle=762

- to regenerate salty soils. Salinity penetration into agricultural land is a major concern in Senegal in the areas where mangrove is getting rare (Sine Saloum and Casamance). Mixed with organic compost, gypsum waste could, according to the Senegalese National Soil Institute (Institut National de Pédologie) contribute to reduce the salinity of soils[71]. It is to be noted, however, that the French Reseach Institute for Development (Institut de Recherche pour le Développement - IRD) indicates, on the contrary, that it increases salinity of soils and the concentration of heavy metals. The Senegalese Institute for Agronomical Research (Institut sénégalais de la recherche agronomique - ISRA) also says that gypsum waste is « an industrial sub-product with a low value ».

Nonetheless, these researches have not been systematized and gypsum waste is until today not valorized in Senegal.

Metal scrap

Metal melting used to be a very dynamic sub-sector of the Senegalese recycling sector. For instance, aluminium used to be collected locally and processed locally to produce cooking equipment exported to Cabo Verde, Guinea and Mali. But the arrival of Indian brokers that collect aluminium and copper to export it to Asia is a serious threat to this sector.

According to APROSEN and IAGU 2009, metal waste generated by metal industries is mainly composed of iron (77.3%) and aluminium (13.6%). Cast iron and copper account for only 4.5% each. Metal scrap often contains heavy metals.

Metal scrap is collected informally by itinerant waste pickers or sorted at the Mbeubeuss dumpsite.

There are a few examples of metal recycling at an industrial scale taking place in Senegal. According to a report published in 2002 (Enda RUP, Praxis 2002), the activity around metals recycling is relatively well organised compared to plastics recycling. The potential is estimated at 19'500 tons/year. 3 companies export the majority of collected metals, estimated at 11'200 tons/year. Approximately 8'400 tons of steel are recycled locally by an industrial founding plant ('Société Sénégalaise de Transformation' (SOSETRA), situated between Dakar and Rufisque) that produces reinforced concrete. Various metal scraps are used by the 'Fonderie et Manufacture du Sénégal' (FOMSEN) to produce sewer plates, and various cast-steel and cast-iron objects. Aluminium is mainly recycled by informal recyclers, for instance to produce cooking pots. The quarter of Colobane, in Dakar, concentrates more than 300 informal metal smelters.

The main metals recuperated are:

- ferrous metals: heavy iron, light iron
- non-ferrous metals: copper, bronze, aluminium, nickel, zinc

Recycling activities that are probably most dangerous to health and the environment are the recuperation of metals though burning of used tyres (to recuperate the iron) and the recuperation of lead in car batteries with acids. The burning activities also cause inconvenience for the neighbourhood because of the toxic fumes generated by burning of plastic coated metals and smelting of metals. There has been a sanitary scandal in 2005 where children got poisoned by lead contained in vehicles batteries that are dismantled in Dakar, in the Thiaroye area.

In the industrial area of Dakar which concentrates more than 95% of the industries of the country, the landfill of Mbeubeuss serves both for municipal and industrial waste, as stated in the survey conducted by the Ministry of the Environment in 1999. The landfill of Mbeubeuss is therefore the main infrastructure for final disposal of industrial solid waste, whereas the Bay of Hann is the final disposal of industrial liquid waste.

[71] Source : Site internet de l'Institut National de Pédologie, Sénégal, page consultée le 4 juillet 2011, http://www.inp-senegal.com/gdt/gdt.php

Exceptions to this rule are one private dumping site owned by a company producing sheet metal containing asbestos, one private dumping site owned by a company producing chemical fertilizers and a private incinerator owned by a battery-manufacturing company.

Packaging waste

Packaging waste, especially plastics and glass containers are generated in large quantities. There is no data on the quantity generated. Packaging waste from industrial processes often contain toxic substances. Plastic waste is not very valuable at the moment because of the low prices of oil that permit to produce cheap plastics in great quantities.

There is little information available on industrial waste collection and transportation. Major industries are supposed to organize their own collection and transportation systems with their own vehicles. Sometimes they sub-contract private formal companies to transport waste to the Mbao transfer site, from where waste is then transported on the Mbeubeuss dumping site by informal, smaller vehicles. If packaging waste is informally collected by itinerant waste pickers and reaches the informal sector, it follows the same process described in chapter 3.4.4 and 3.4.5 of section 3.

The re-use of plastic bottles has a positive environmental impact in the sense that it saves the production cycle of new plastic bottles and also in the sense that it reduces the amount of plastic ending up in dumping sites, in nature or being incinerated

In terms of occupational health and safety, plastic containers recuperation is safer than glass containers recuperation because plastic containers do not break as easily as glass containers. In the Tolbiac street, some workers are specialized in the recuperation of industrial glass bottles coming from chemical industries. They spend the whole day scratching the bottles to take off the labels, inhaling chemicals without any protection.

Popular waste pickers sell recuperated plastic bottles that are then re-used. Their main clients are local merchants that use the bottles as containers for cosmetics (creams), water, ice, honey, palm oil, peanut butter, incense, lemon.

Glass bottles are increasingly challenged by plastic containers. However, glass containers are still very appreciated by some craftsmen to store special products such as glue or solvents. Women that are in the food processing business (jam, vegetables, syrups…) use glass containers after washing them and sticking their own label on the container.

Informal waste recyclers recycle plastics and rubber to produce bags and shoes.

The landfill of Mbeubeuss is the main infrastructure for final disposal of both domestic and industrial solid waste.

Waste from sugar processing industry

Definition

Bagasse (Sugar cane residues) is the first residue of sugarcane after juice extraction disorder mellitus. It is the fibrous matter that remains after sugarcane are crushed to extract their juice. It is currently used as a biofuel and as a renewable resource in the manufacture of pulp and paper products and building materials.

Bagasse is an extremely inhomogeneous material comprising around 30-40% of "pith" fibre which is derived from the core of the plant and is mainly parenchyma material, and "bast", "rind" or "stem" fibre which comprises the balance and is largely derived from sclerenchyma material. These properties make bagasse particularly problematic for paper manufacture and have been the subject of a large body of literature.

Case of the Compagnie Sucrière Sénégalaise - CSS) of Richard Toll, Senegal

A) Composition storage and composition

Since bagasse is a by-product of the cane sugar industry, the quantity of production in each country is in line with the quantity of sugarcane produced.

A typical chemical analysis of bagasse might be (on a washed and dried basis):

- Cellulose 45–55%
- Hemicellulose 20–25%
- Lignin 18–24%
- Ash 1–4%
- Waxes <1%

The high moisture content of bagasse, typically 40 to 50%, is detrimental to its use as a fuel. Generally, bagasse is stored prior to further processing. This gives about 300 kg of bagasse (45% water) per ton of cane. And the potential availability of bagasse at the sugar processing factory (Compagnie Sucrière Sénégalaise -CSS) of Richard Toll is evaluated to 250,000 tons (for the period 1996-97).

Over 40 years of existence, the company has an annual capacity of over 1 million tons of sugar cane, producing over 100,000 tons of sugar and a turnover of 57 billion CFA, the CSS continues to increase its production capacity and potential, giving it a leading position in the sugar industry in West Africa. The entire sugar industry consists of a cane crushing unit, a sugar mill, refinery, city and a distillery to produce ethanol. Of the 8800 hectares of cane already developed, 8,600 hectares are allocated to sugar production, with average yields of more than 130 tons of cane per hectare. The additional areas are reserved for nurseries, and for experiments (research purposes).

The plant was originally built to grind 2,500 tons of sugar cane per day, and the successive investments, have achieved 6,000 tons per day. The industrial site has produced for the 2008/2009 marketing year, more than 100,000 tons of sugar, operating at continuous fire from November to May. And sugar is produced through several phases of transformation. These steps are represented by the treatment of juices, purification and refining, crystallization, centrifuging and finally drying. The entire process is subject to strict controls on manufacturing quality which are made directly in the laboratories of the CSS.

B) Treatment and use

Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare. To this end, a secondary use for this waste product is in cogeneration, the use of a fuel source to provide both:

- heat energy, used in the mill, and
- electricity, which is typically sold on to the consumer electricity grid.

Use as a fuel: bagasse is used in its entirety as energy source boilers of the CSS for the operation of the mill sugar. The production of bagasse is not even enough to meet the annual energy needs of the plant.

Moreover, in view of diversifying its products, the CSS has developed a production of ethanol. A distillery that produces 8 to 12 million liters of ethanol .This unit can produce 8 to 12 million liters of pure alcohol from sugar molasses after refining the juice of sugar cane. The ethanol could contribute to the emergence of the use of biofuels in Senegal. In the meantime, the distillation unit is oriented towards production of alcohol for the pharmacy, perfumery and other sectors.

There is today practically no concurrent use of bagasse in Senegal. However, in the past, composting trials were attempted but, also, no action undertaken.

The results of the past investigations have shown a lack of availability of bagasse for new reuse option, it follows that any development project of bagasse as a domestic fuel is not feasible.

3.7.5. Ghana

Relevant industrial waste types

Ghana's natural resources and agriculture accounts for roughly one-third of its GDP and employs more than half of the workforce, mainly small landholders. The services sector accounts for 50% of GDP (CIA, 2011). Due to the fast industrialization process, different manufacturing industries have been developed, such textiles, wood, chemicals, pharmaceuticals and food. Gold and cocoa production and individual remittances are major sources of foreign exchange (CIA, 2011). Mining of gold remains important. The Environmental protection agency reports that eleven large scale mining companies are operating in the Western Region of Ghana. The first study on industrial waste has been carried out in 1994 by the National Toxic Waste Task Force. Another study in 1996, supported by a German consultant and the World Bank, covered the industrial branches listed in Table 43.

Table 43 Relevant industrial waste types in Ghana

Industrial sector	Types of waste
Food and beverage	Crown corks, labels, cardboard, spent grains, broken bottles, fruit fibre, fat, blood, bones, horns, fish waste
Textiles	Cotton cut-offs, empty containers, cotton cleaners, wastewater containing urea/formaldehyde and aromatic hydrocarbons
Chemicals	Cardboard, plastic bottles, empty drums, wooden pallets, metal scrap and damaged tyres
Rubber	Synthetic rubber, defective tyres
Palm oil	Shells and fibres, wastewater
Metal	Ferrous and non-ferrous metals, pallets, drums, graphite rods, brick mouldings and dust
Paper	No data
Wood processing	Saw dust, wooden cut-offs and low grade wood
Mining	Scrap metals, dust, etc.

Source: (GOPA 1996)

Table 44 Typical waste segregation and disposal methods.

Category	Type	Source/description	Interim Management
Non-Hazardous	Glass	Bottles and jars etc	Landfill, Return to supplier (eg. Drink bottles)
	Grease	used cooking oil and galley, Grease from oil separation	Add micro/ enzymes to Grease traps.(resource reduction) landfilling
	Metals	Ferrous and non- ferrous, including drinking cans (steel and aluminium)	Reclaim/re-use/Recycled
	Paper and card	Paper, magazines, office paper etc.	Landfill
	Plastics	Bottles and mixed plastics	Landfill
	Residual mixed Waste	Domestic types, food from galley, packaging, bin waste	Landfill

Category	Type	Source/description	Interim Management
		etc.	
	Wood	Pallets, crates, furniture	Recycle, re-use, Landfill
Hazardous	Batteries, Chemicals, Various	Lead acid, lithium ion, etc. Solvents or contaminated chemicals.	Storage, Return to supplier, Re-use. Inventory management to prevent expiry.
	Medical/ Clinical	Swabs, dressing, old medicine etc.	Medical grade incinerator
	Oil contaminated Materials	Filters, oily rags	Storage
	Used oil	It cannot be mixed with crude export.	Treated in oily waste water treatment.
	Tank bottom Sludge	Tank clean out and un-pumpable Sludge	Treated in oily waste water treatment plant.
	Various Types	Fluorescent tubes & bulbs, Glycol, Filters, paints solvents cleaners	Storage of liquid waste, Metals recycled
	Water, slops	Oil contamination etc	Treated in oily waste water treatment plant

Additionally statistics were available from the Ghana Statistical Service, who carried out a census of industrial establishments in Ghana in 2003 and 2004 and published in 2006. In Table 44, the typical waste segregation and disposal methods are summarized.

The Environmental Protection Agency is also engaged in the collection of industrial waste and is mandated to ensure strict compliance of companies and industries of the countries laws. In the country documentation provided saw dust from wood processing industry and scrap metal were of relevance due to its large quantities generated and its impact on the environment.

Prioritisation of industrial waste problem situation

The country documentation prioritized wood waste, mining waste, petroleum waste and and metal scrap. However, detailed information on mining wastes, which could have a significant and devastating impact on the environment, is rather scarce and difficult to obtain. The prioritization is primarily based on how widespread the environmental problems related to the mentioned waste types are and on the amount of people are that are affected.

Wood waste

Most large wood processing industries are located in Ashanti, Brong Ahafo, Western and Eastern Regions where the bulk of Ghana's forest lies. A few ones can be found in the Northern part of central region. Small scale saw mills and carpentry shops are however spread nationwide. In addition to this, there is a thriving secondary market for wood products thus carpentry shops and small wood markets can be found in all urban settlements in the country. All these generate substantial amounts of wood waste which is neither properly disposed of nor recycled but rather dumped in open places or in river bodies thus contaminating the river body.

There is no data on wood waste generated in the country. However using data from wood experts, about 35 % of the total log input ends up as waste in the form of sawdust (15 %) and Bark, Slabs and Edging (20 %). It is estimated that nearly 1 million m^3 of logs are felled annually (it is important to note that this is a conservative figure as quite a substantial quantity of logs do not go through the formal system and are thus not accounted for). In total therefore about 350'000 m^3 of wood waste

in the form of sawdust (150'000 m^3), wood bark, slabs and edgings (200'000 m^3) are generated in the country.

Sawdust from wood processing firms is likely to contain toxic substances because of the kind of preservatives used. It is in itself a valuable resource which can be used as a good source of energy, or as a primary resource for the production of other goods such as packaging boxes, tables, the sole of shoes, etc.

Wood waste is either collected together with municipal waste or not collected at all.

Recycling of wood waste includes mainly the recovery of energy. Some wood processing firms have procured boilers that use sawdust as a fuel to produce steam which is used for power generation or drying the wood. In the past there have also attempts in converting sawdust into briquettes as a fuel in domestic and industrial establishments. This could however not be sustained due to various problems. With regards to the use of sawdust as a fuel in boiler operations, the most likely environmental impact results from the smoke from the chimney. An efficient combustion should produce carbon dioxide and ash as the main by-products. However, an inefficient combustion leads to the generation of carbon monoxide and particulate carbon which is carcinogenic. No test has been carried out to determine the toxicity of smoke in Ghana yet.

Wood waste that is not used for energy recovery is mainly disposed of in irregular or illegal dumpsites, what leads to various negative environmental impacts. First of all, the sawdust most often contains fine dust particles. If it is not properly disposed of, it can affect the air quality. Secondly, some industries burn the sawdust in an uncontrolled manner, what produces carbon monoxide, nitrogen oxides and particulate matter, which again affect the air quality. Lastly most wood industries and carpentry shops are located along flowing water bodies. They often dump their waste into the water bodies to have their waste carried away. This raises the biochemical oxygen demand (BOD) of the water body and thereby affecting aquatic life and water quality for people downstream who depend on it. A classic example is the water Subin water body which passes through the city of Kumasi. This river is heavily polluted by carpentry shop owners at Anloga Junction who dump their waste directly into the river.

Mining waste

Ghana is endowed with rich mineral resources. Notable among them are gold, diamond, bauxite, iron, manganese, etc. Of all these mineral resources mined in Ghana, gold mining is very important as Ghana is ranked the second gold producer in the world after South Africa. The mining sector in Ghana is regulated by legislative instruments such as Act 703, Minerals and Mining Act of 2006, Minerals Commission Act 1993, Environmental Protection Act, Act 490 of 1994, Environmental Assessment Regulation of 1999, LI 1652 etc.

Mining operations is noted to impact negatively on the environment as it generates a lot of wastes. The waste streams generated from gold mining operations in Ghana are:

- Mine Tailings: - mine tailings are waste products from the mining industry. It is made up of slurry of a finely ground material and water left over in containment areas or discharged to receiving waters after valuable metals are extracted.
- Waste Rocks: - waste rocks are large rocks obtained from the earth crust that do not contain the gold ore. They are usually dumped or stack in water bodies or open drains.
- Office waste: - this type of wastes includes paper, left over foods, printer inks & cartridges, etc.
- Chemical wastes from the environmental laboratories, metallurgical section, assay departments. The type of waste usually generated are containers.

The Mining and Minerals Act, Act 703 of 2006 recognize that the disposal of the above wastes from mining operations may impact negatively on the environment, though there is no specific provision in the Act that deals with waste from mining. Section 18 of the Act state that "(1) Before

undertaking an activity or operation under a mineral right, the holder of the mineral right shall obtain the necessary approvals and permits required from the Forestry Commission and the Environmental Protection Agency for the protection of natural resources, public health and the environment". Sub – section two (2) of section 18 of Act 703 0f 2006 is more definite on the protection of the environment which include sustainable and efficient manner of waste disposal. It states as follows "(2) Without limiting subsection (1), a holder of a mineral right shall comply with the applicable Regulations made under this Act and any other enactment for the protection of the environment in so far as relates to exploitation of minerals".

Petroleum waste

Petroleum waste is of less a problem to Ghana. Until recent discovery of oil in commercial quantities in Ghana, petroleum waste could only be a problem to filling stations and refinery centres (Tema Oil Refinery). Most used oils from automobiles are refined by a special company situated in Tema. Automobile shops, Filling stations and other centres where these used oils are deposited collect the waste in bigger containers and sell it to the company for refining.

In Ghana, Tullow partners started drilling the Jubilee oil field in 2006 and production in November, 2010. This field has a total of seventeen wells (17). It is estimated by the Ghana National Petroleum Corporation that drilling of a well produces 40 tonnes of wastes, 10 tons of which is hazardous. Thus, the jubilee field is estimated to have produced 620 tonnes of waste, 170 tonnes of which is hazardous during the drilling stage. The hazardous component was stored and exported for treatment in nearby countries where treatment facilities exist since treatment facilities are now being acquired in Ghana. The non-hazardous waste may be dumped offshore or treated as per other non-hazardous waste. The waste components at the drilling stage are mainly dug mud, produced water, chemicals, drill cuttings, etc.

Tullow the main managers of the Jubilee field had outlined that the type of waste that is produced at the production stage and the action plan for treatment is according to Table 44.

Metal scrap

The other industrial waste of high importance is metal scrap. Scrap metal waste from old and broken down vehicles, old broken down domestic appliances and industrial machines is found in almost every corner of country.

There is no official statistics on the quantities of scrap metallic waste generation in Ghana. Until recently there was virtually no incentive to collect it, however, with the advent of strong demand from China for scrap metals to feed their metal industries and thus a rise of the prices paid, there are now strong incentives to collect metal scrap for export. To avoid this practice, Ghana has banned the export of scrap metal. However, it is assumed that there are still ships depart the port labelled as Shea nuts for export but contain scrap metal.

Scrap metal waste generation is estimated at 20'000 tons/year. This is a conservative figure based on the production capacities of the main steel companies in the country.

Metal scrap can contain toxic substances such as heavy metals, especially if it is found in composite products such as electronic equipment (see chapter 3.5 in section 3).

Metal scrap is separately collected mostly by informal collectors. Scavengers comb homes, abandoned industrial set-ups, magazines and abandoned vehicles to collect the waste on trolleys. The collected waste is then transported to central collection points where they are weighed and sold to merchants. The merchants then transport the scrap in trucks to Tema Harbour for export or sold to recycling companies like Tema Steel Company Limited for recycling.

Considerable quantities of metal scrap are recycled in both the formal and informal sector. Five steel companies namely Tema Steel Company, Ferro Fabric Industries, Wohome Steel, depend solely on scrap metal as their main raw material. Separation of steel from the other metals is first carried out. The steel metal is then smelted before being remoulded into new products. In the

informal sector there are large numbers of foundries in Kumasi, Accra, Tema and Sekondi-Takoradi who make use of metal scrap as raw materials in their production techniques. The technology employed in these foundries is basic sand casting to produce iron plates. Other informal groups use scrap metal to produce waste bins, cooking pots, coal pots for cooking and even cutlery (spoons and forks). By products in the recycling of scrap metal are slag and unneeded metals. These are dumped dump sites in the municipalities.

Unofficial metal scrap recycling, especially from burning rubber tyres, releases dioxins and furans as well as other hydrocarbons. This poses significant negative health impact to the worker and residents close by and causes significant air pollution.

The final disposal path for scrap metal is the same as for municipal waste.

3.7.6. Nigeria

Relevant industrial waste types

About 35% of the country′s gross domestic product (GDP) is depending on the oil sector. However, more than 60% of Nigerians are involved in agriculture. In rural areas, 90 % of the people rely mainly on subsistence farming (Department for foreign Affairs Germany, 2011). Hence, import substitution plays an important role and strongly dominates the manufacturing sector in the country.

In Nigeria, industrial development is pursued with vigour but without adequate care for the environment. Textile plants, breweries, sugar refineries, pulp and paper plants, and petro-chemical industries have all discharged their raw untreated or inadequately treated liquid effluents and solid wastes into open drains, streams, channels and lagoons. Past efforts of governments including States and local governments have led to a number of environmental laws. (Odubela et al).

The problems of industrial pollution are enormous. Nigeria has about 5,000 registered industrial facilities and some 10,000 small scale industries operating illegally within residential premises. In places like Kano, Kaduna and Lagos, coloured, hot and heavy metal-laden effluents especially from the textile, tannery and paints industries are discharged directly into open drains and water channels, constituting direct dangers to water users and biota downstream. Also disturbing is the practice whereby some industrial facilities bury their expired chemicals and hazardous chemical wastes in their backyard threatening the ground water quality (Nigeria's Country profile, 1997).

The industries operating in the country vary in process technology, size, nature of products, characteristics of the wastes discharged and the receiving environment. Presented in the table below are the major Industrial Categories readily noticeable in Nigeria according to a report by the Federal Ministry of Environment, Nigeria (faolex.fao.org/docs/texts/nig18380.doc).

Table 45 Relevant industrial waste types in Nigeria.

Industrial sector	Types of waste
Petroleum exploration, refining and Petrochemicals	Oily chemical sludges, spent catalyst, discarded packaging materials, off speck products :(carbon black: polypropylene chunks) drilling mud, drilling cuttings produced, sand domestic wastes.
Automobile battery	Battery slag
Brewery	Spent oil, materials and labels, defective packaging, broken bottles
Textile industries	Sludge, high suspended solid
Food and Beverage, e.g. hot beverages, dairy, brewery, soft drink bottling factories, hot beverages, seasonings, convenience foods, confectioneries, noodles etc.	Broken bottles, packaging waste, labels, spent grains, sludge

Industrial sector	Types of waste
Agricultural sector e.g. food processing Sugar, cashew nut and palm oil processing,	Press Cake, bagasse (i.e. waste straw left after the extraction of juice from sugar cane), Shells, fruit peels from the dressing of fruits for canning,
Metal working, plating and finishing e.g. Iron and steel	Sludge containing metals, metal slag
Mining and metallurgy	Generation of waste rock and mine/mill waste Flue dust, sludge.
Agrochemicals industries e.g. Phosphates, Nitrogenous and Pesticides producing companies.	High volume gypsum
Plastic materials and synthetics	Waste plastic products
Pulp and paper	High volumes of bark (i.e. waste from debarking of trees before pulping), sawdust and clarifier sludge.
Soap and detergent	Packaging material
Leather Tanning and Finishing	Solids from screening, sludge (hair, fleshings, shavings, splits, hide/skin trimmings, leather trimmings, buffing dust, leather finishing residues)
Cement, Lime, Gypsum and Asbestos	
Wood and wood products	Sawdust
Service industries	Rags, wood, soil impregnated with oil or oily wastes due to spills or accidents

Prioritisation of industrial waste problem situation

Industrial waste in general is considered a serious problem mainly due to their negative environmental impact on land, air and water. Prioritized industrial waste streams in Nigeria are wastes from the oil sector, waste from the food and beverages industry, wood waste and packaging waste.

Waste Management in Oil Sector

The oil industry in Nigeria is a sector that has raised environmental concerns, especially soil degradation resulting from oil spills, poor waste management and inadequate implementation of environmental regulations.This environmental concern has also led to protests of affected communities against these unhealthy practises. The oil industry is primarily located in the Niger Delta where it has been a source of conflict with local groups protesting the degradation of their environment and also seeking a share of the oil wealth.

The exploration and production activities in the Petroleum Industry have various stages. At each stage of operations, gaseous, liquid and solid waste materials are produced and discharged into the environment with grave consequences of serious pollution if not properly managed or controlled

The stages are as hereunder:

1. Exploration
2. Production
3. Terminal Operations
4. Hydrocarbon Processing
5. Oil Transportation
6. Marketing Operations

Each of these six stages produces and generates wastes, hazardous materials and toxic chemicals, which are normally transported, treated and disposed of.

Management of solid waste within the Nigerian oil sector

In the exploration of oil, solid waste in the form of drill cuttings is generated. In the refineries; more hazardous solid waste is generated. Incinerable hazardous solid wastes is generated from both wastewater treatment and petroleum process units, tank bottom sludges from crude product storage tanks, Non-incinerable hazardous solid wastes consist mainly of catalysts that are used in many processing operations in the refineries (Jadea. S et al, 2008).

Also, petrochemical plants generate solid waste and sludges, some of which may be considered hazardous because of the presence of toxic organics and heavy metals. Accidental discharges as a result of abnormal operation, especially from polyethylene and ethylene oxide-glycol plants in a petrochemical complex, are major environmental hazards, releasing large quantities of pollutants and products into the environment (Israel, A.U et al 2011).

Ideally, solid waste management in the oil sector in Nigeria is supposed to be carried out as follows; the oil industry arranges its own waste management. Solid waste is collected professionally by the industry and it is transported to treatment facilities in special containers, where it should be incinerated. The operational incinerators and Thermal Disruption Units (TDUs) service the oil and gas industry and are used for the disposal of hydrocarbon-contaminated wastes. The cost of treatment is paid by the industry.

However in reality, in the Niger Delta, though oil companies are responsible for the clean-up of most oil industry pollution, the system does not work effectively and there is insufficient government oversight. Clean-up is frequently slow and inadequate. Oil spills, waste dumping, and gas flaring is notorious and endemic. Effluent and waste from the oil industry which should be treated is dumped and finds its way into the surface water of the Delta. The waste material, which can be radioactive, is often dumped in the rivers and sea, where chemicals and particulate matter can contaminate water supplies and degrade water quality. Up to 300,000 gallons of drilling waste can be ejected each day in the process of oil production.

Oil spills and waste dumping have seriously damaged agricultural land. Long-term effects include damage to soil fertility and agricultural productivity.

National laws on waste management/pollution in the Nigerian oil sector

The oil sector is guided by relevant environmental laws and regulations. For example, According to the The Nigerian Petroleum Act, wastes from drilling and work over activities from offshore, near shore and inland areas, spent water–based mud/fluids, well treatment wastes, oil and water based drill cuttings, brine, deck drainages or residues – shall be treated to the satisfaction of the Director of the Department of Petroleum Resources. Part of the means of managing the waste in the oil environment is to have in place the necessary laws, regulations and guidelines. Several laws and policies have been taken in managing industrial wastes from the oil sector at national levels. The philosophy behind the Nigerian Laws in the Petroleum Industry is that the licencee/lessee or operator is expected to be responsible for hazardous materials, wastes and toxic chemicals from cradle to grave.

Nigeria has laws and regulations that require companies to comply with internationally recognized standards of “good oil field practice”, and laws and regulations to protect the environment but these laws and regulations are poorly enforced. However, relevant national laws are in effect.

Waste from food and beverages industry

Nigeria, a populous and developing nation is fed mainly by the Nigerian food and beverage industry and agricultural sector. The industry is growing at a fast rate. The food and beverage industry in Nigeria is involved in the manufacturing of dairy products, hot and cold beverages, seasonings, convenience foods, confectioneries, fruit juices and staple foods such as bread, pasta and noodles. The leading manufacturers of food and beverage products in Nigeria are e.g. Nestle Nigeria Plc, Unilever Nigeria Plc, Cadbury Nigeria Plc, Flour Mills Nigeria Plc and Fumman Agricultural Products Factory. The Dairy segment in Nigeria is dominated by Friesland Campina

WAMCO Nigeria Plc. Nigerian Brewery, Coca-Cola and 7-Up Bottling Companies take care of cold beverages.

Effluent and sludge form a bulk of industrial wastes generated by these industries. Some of the raw materials (e.g. orange, grape, guava, sugar, phosphates) that are used for production of the beverages may enhance the organic load of the wastewater.

Sludge, depending on the source can contain potentially dangerous substances such as microbes, or inorganic and organic chemicals which can cause pollution and contamination of receiving environmental media particularly water bodies such as lakes, rivers, oceans and groundwater. Apart from contaminating water bodies, sludge can also alter physical-chemical parameters of the water bodies like colour, odour, acidity, alkalinity, conductivity, dissolved oxygen. On the other hand, it can as well contain nutrients such as nitrogen and phosphorus which are capable of initiating eutrophication in water bodies.

In Nigeria, there is no special treatment for industrial sludge. Sludge generated in the effluent treatment plants at the production sites of the food and beverage industries are discharged first into drains to get rid of water. Thereafter, the dried sludge is collected by a private waste collector who disposes it of at various municipal dumpsites of the states where the industries are located. Direct discharge of effluent into water bodies is practiced by many industries.

Waste from wood industry

Nigeria is blessed with substantial forests as such various industries exist in the wood industry. These includes sawmills, paper mills and furniture manufacturers. This industry however contributes significantly to environmental pollution. A number of saw mills are located by the banks of water bodies. Lagos and Delta states in the south on Nigeria are common examples. As a result waste from their activities such as wood shavings and saw dust end up in the water bodies or are incinerated openly, causing air pollution. These wastes often contain significant spectrum of organic substances capable of producing adverse effects on the environment or indirectly affect human health. This habit has led to sever pollution of the Lagos lagoon. This has also lead to other negative impacts on the environment, contamination and destruction of fishes and their habitats. (Arimoro et al. 2006).

The gravity of this environmental challenge had prompted the Lagos state government to identify alternate location to relocate some of the saw millers located at Oko-Baba area of the state. Air inversion with its accompanying foggy dispersion and visibility reduction to less than 20 meters is sometimes experienced in the Oko-Baba mid-section part of the Third Mainland Bridge in Lagos where saw millers burn away sawdust and other wood shavings. The huge financial implication has however stalled the plans of the Lagos state government.

Saw dust is a waste material that can be turned to wealth. Energy can be generated from saw dust and it can be compacted and used to make furniture etc. Some organizations are in the process of encouraging entrepreneurs to make brickets from saw dust for energy generation. This will especially have a significant impact on climate change, as tree felling will be discouraged, especially in the rural areas. This process is however still in its infancy, as currently the lagoons are being daily polluted by saw dust and the air by incineration of wood waste.

Plastic waste / packing waste (PET-bottles and water sachets)

Drinking water is not readily available in most parts in Nigeria. Entrepreneurs have therefore cashed in on this identified need by packaging water in PET bottles and sachets made of low density polyethylene (LDPE) for sale to the public. In addition, a number of drinks are also packaged in PET bottles for sale to the public. This local intervention is however accompanied by negative impact on the environment due to improper disposal. Used water sachets and used PET bottles are littering the streets, nooks and crannies of various communities in Nigeria. Due to the light weight of these used items, they are easily dispersed by wind, ending up blocking drains, on the streets causing aesthetics nuisance etc. This improper disposal usually leads to flooding during

the raining season, which usually leads to loss of lives, destruction of property, injury of persons etc. To compound the issue, these used polyethylenes are non-biodegradable. They therefore pose serious environmental problems to inhabitants especially where solid wastes are deposited in towns (urban areas) and villages (rural areas) (Owolabi et al., 2010).

Polyethylene has a wide range of uses which includes various bags, bowls, caps, baskets, lids just to mention a few. However the proportion that ends up being reused is small compared to the quantity generated. Recycling of polyethylene is carried out in Nigeria but not on a large scale. The informal sector in the waste management chain does most of the collection and sales of used polyethylene packages to reusers of PET bottles and recyclers for a fee.

Though there are recyclers for these used wastes, they have some constraint, a major one being cost of transportation. Because of its bulk, used PET bottles require large vehicles for transportation. The cost of hiring these vehicles sometimes outweighs the revenue got from its sale, thus making it unattractive.

This results in a large quantity of polyethylene waste being left to cause environmental nuisance.

4. SECTION 4: ANALYSIS OF MAIN BARRIERS AND OBSTACLES FOR INTEGRATED SOLID WASTE MANAGEMENT IN THE TARGET COUNTRIES

In this section the main barriers for integrated solid waste management in the target countries will be presented based on the research results of the previous sections, further literature review and expert knowledge.

4.1. Lack of good governance in order to implement and enforce ISWM

As the results in Section 2 of this report demonstrate environmental legislation on ISWM is in place to a varying extent in the target countries. Nevertheless, at the very beginning it must be pointed out the deficits of the legal framework (written laws and regulations) for ISWM itself are one problem but an uniform and overarching barrier for the enforcement of ISWM throughout the four target countries is a lack of good governance.

Good governance following an OECD definition understood as participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive as well as following the rule of law.[72] Firstly those elements of good governance shall be described which appear to be lacking regarding the implementation of ISWM in the target countries:

- "Participation": can take place either through legitimate intermediate institutions or representatives and participation needs to be informed and organized.
- "Transparency": means that decisions taken and their enforcement are done in a manner that follows rules and regulations. It also means that information is freely available and directly accessible to those who will be affected by such decisions and their enforcement. It also means that enough information is provided and that it is provided in easily understandable forms and media.
- "Effectiveness and efficiency": means that processes and institutions produce results that meet the needs of society while making the best use of resources at their disposal. The concept of efficiency also covers the sustainable use of natural resources and the protection of the environment.
- "Accountability": not only governmental institutions but also the private sector and civil society organizations must be accountable to the public and to their institutional stakeholders. Who is accountable to whom varies depending on whether decisions or actions taken are internal or external to an organization or institution. In general an organization or an institution is accountable to those who will be affected by its decisions or actions. Accountability cannot be enforced without transparency and the rule of law.
- "Rule of Law": requires fair legal frameworks that are enforced impartially. Impartial enforcement of laws requires an independent judiciary and an impartial and incorruptible police force.

The consequences of deficits in good governance are mirrored in the following barriers to the implementation and enforcement of ISWM in the target countries:

4.1.1 Barrier 1: Missing of a coherent legal framework

[72] Definition of OECD 2001, "Citizens as Partners - Information, Consultation and Public Participation in Policy-Making".

The concepts of Integrated Waste Management are not widely acknowledged in the target countries, i.e. waste management is not seen as a total system from generation, through collection, treatment to reuse and recycling or disposal. Consequently, a central piece of legislation laying down the principles of waste management for a broad range of waste streams - like the waste framework directive in the EU - is missing. Moreover decrees are missing giving concrete advice on how general terms for waste management shall be implemented in detail.

Ghana

In the case of Ghana for example commendable efforts have been made in the past concerning the legal approach to managing waste. Despite that fact there is no fixed/uniform legislation which regulates the management of waste (see chapter 2.2.1.3 of this report). On the contrary Metropolitan, Municipal and District assemblies in Ghana have byelaws on environment and sanitation that are regulated by the EPA. These bye-laws aid to simply the main policy frameworks and legislations for domestic waste management in Ghana. The policies are embedded in the National Environmental Policies (1990); the Local Government Act, the Environmental Protection Agency (EPA) Act, the Environmental Assessment Regulations and the Environmental Sanitation Policy.

Nigeria

Nigeria has an existing legislative framework for the management of the environment pursuant to which solid waste is managed including the regulation of industrial and hazardous waste. The snag however, is that the laws are lax in enforcement and compliance level is almost at a zero level.

Limitations on the interpretation of waste issue by personnel at state and local government levels responsible for waste management.

Non implementation of the national guidelines on solid waste management and lack of awareness/training on the guidelines in some states of the country

In Nigeria regardless of the type of waste management system selected, no amount of urban planning nor municipal solid waste management strategy be effective unless the legal framework is clear and understandable by the respective stakeholders. Government must also be willing to support with necessary infrastructure (see chapter 2.3.3).

Senegal

In Senegal some laws and regulations are out of date The decree n°74-338 on domestic waste transportation and disposal dating from 1974 is out of date because of the evolution of the environmental, socio-economic and political context and also because it does not mention the possibility to recover energy or recyclable materials from waste, whereas it is now widely recognised that such options have a great potential. The decree focuses on waste elimination processes (sanitary landfills, incineration, see article 10).

Some laws and regulations are not formulated clearly, e.g. the Environmental Code barely mentions “ecologically sound management” of waste without providing further criteria for its implementation.

Furthermore a huge enforcement gap exists as none of the laws and regulations are actually being implemented properly. For example the application decree of the Code of Hygiene is still not operational. The national Service of Hygiene has very limited action means and staff to implement a credible national hygiene policy at individual and public levels.

The official legislation does not encourage waste recycling: according to the Environmental Code all activities related to waste management must be authorised by the Minister of the Environment, especially concerning industrial waste. But waste recyclers are very numerous and their activity is mainly informal which means that implementation of these articles is impossible.

No sanctions are executed towards industrial waste producers, waste management companies and household waste producers that do not comply with the legislation (see chapter 2.4.1.3).

In Senegal the status of waste storage and treatment sites with regard to local land law is unclear. Despite of provisions contained in the Urban Planning Code, some waste storage sites and craftmen´s workshops are often established on residential areas or on roads. The Code is not implemented properly which creates or reinforces opportunistic behaviours and a divorce between the “legal country” and the “real country”.

Côte d’Ivoire

A lack of legislation or inapplicability of existing legislation is a major challenge as there is no decree implementing the waste management legislation Law n° 96-766 providing for Environmental Code (see chapter 2.5.1.3).

Although the demand for energy is increasing in the target countries and renewable energy receiving increased attention waste management is not integrated in the energy policy. Opportunities for the double benefits of energy generation and waste treatment could be better explored.

Another strategic problem is the lack of planning. This is not only within the waste management sector, but a general lack of urban spatial planning. Issues that arise are lack of land for treatment facilities. Difficulties in acquiring land for landfills are widespread, and are larger in major cities. However, also less land-demanding treatment options such as composting plants have difficulties in acquiring land. This is related to a generally dysfunctional spatial planning in these countries.

4.1.2.Barrier 2: Missing of organizational coherence regarding ISWM

Institutional and organizational coherence relate to the location of the solid waste function situated within the municipality, the ultimate responsibility for solid waste, and the degree of consolidation in the organogram. Where one entity is responsible for the vision, implementation and monitoring of solid waste, there is more coherence than when waste functions are spread across different departments so that no one is ultimately accountable.

Ghana

In Ghana there is an absence of legal enforcement capacity and collaboration between relevant governmental ministries working on this matter.

There is also a serious lack of collaboration between the various offices such as the GAEC, MEST, Ghana Standards Board, Ministry of Trade and Industry and the few environmental NGOs which work on toxic waste trade regulation. For instance, the EPA in the MEST, is the principal ministry for implementing legislation which regulate the management of chemicals and generally control pollution, as well as other environmental problems, which *inter-alia*, result from mismanagement of chemicals and toxic waste in the country.

Compounded with the abovementioned laws and policies, ministries, departments and agencies are tasked with the provision of environmental sanitation infrastructure and services. While the Local Government Act, 1993 (Act 462) and Local Government Service Act, 2003 (Act 656) seek to effectively transfer the functions and offices of central ministries, departments and agencies to the Assemblies, this has not happened and many still exist and function as central government dependencies.

Nigeria

In Nigeria the institutional framework is uncoordinated. There is no clarification of relationship between NESREA, SEPAs, Ministries and LGA with respect to policy development, enforcement and implementation.

4.1.3 Barrier 3: Lacks in relation between local authorities and policy environment

Following the notion that waste collection is usually best provided at the lowest appropriate level of municipal administration a process of decentralisation of ISWM has taken place in some of the target countries (see the boxes infra). But regionalization alone will not help to solve the ISWM problems. The process must be supported by:

- a clear and transparent national or regional policy framework:

In the target countries the national policy framework is shaped by environmental ministries, inspectorates and agencies, by national and international health, economic and finance institutions; by rule of law. Against this background of diverse interests and – possibly – diverging policy goals a clear and transparent policy framework is critical for ISWM, and guides the local authorities in the processes related to planning an implementation.[73] Clear policy goals, e.g. rates for waste collection and recovery supported by a clear legal framework going beyond general regulations will help the local authorities to translate the objectives and targets into their plans (waste management plans) and budget.

- institutional coherence:

A severe barrier exists where the responsibility for municipal solid waste management is institutionally fragmented and lacks administrative coherence. As a consequence responsibility or accountability cannot be clearly assigned. Indicators are traditional organizational structures missing clear lines of responsibility in the organogram, the number of different budgets that contribute to solid waste expenditures.[74]

- Regionalization and inter-municipal cooperation

Furthermore the success of regionalization, in practice, depends on institutional capital and skills for cooperation, e.g. for inter-municipal cooperation. Besides clear and transparent processes for inter-municipal cooperation, political party differences between municipalities and hierarchy problems between national/regional and local authorities form important barriers.[75]

Ghana

Waste management in Ghana has been decentralized. At the national level the Environmental Health and Sanitation Directorate of the Ministry of Local Government and Rural Development initiate polices, and technical guidelines as well as capacity building of environmental health and sanitation officers in the regions and the districts to effectively implement all the policies regarding waste management in Ghana.

Whilst the Regional Environmental Health Officers coordinate the activities of the metropolitan/municipal/district assemblies Environmental Health and Sanitation Officers who are directly involved in waste management at the local level. The policy is that waste generated at the local level is the property of the municipal/metropolitan/district assembly. However, most of the municipal/metropolitan/district assemblies at the local level are not able to management the solid

[73] UN HABITAT 2010, p.185.

[74] UN HABITAT 2010, p. 195.

[75] UN HABITAT 2010, p. 186.

waste generated effectively and as such have invited some private entities (see chapter 2.2.1.1 of this report).

Nigeria

In Nigeria within the current environmental management and protection framework, Local Governments are excluded from participating in the legislative review, revision and redrafting process. This limits local level inputs into the legislative process, but alas well as decreasing local-level institutions awareness of and ownership over environmental management and protection (see chapter 2.3.1.3 of this report).

Senegal

In Senegal the decentralisation is still on-going. One of the main weaknesses of the Local Government Code of Senegal is the absence of budget heading for waste management in the chart of accounts of local governments. In the Region of Dakar, a solution was found by creating the entente CADAK/CAR which is in charge of financial management. However, this also created a risk of opportunistic behaviours on how to share the available funds equitably among the member cities of the entente CADAK/CAR. For instance, the president of the Entente CADAK/CAR is also the Mayor of Dakar and sub-contracted a concessionary company (Veolia) for the Plateau and the Médina central neighbourhoods (see chapter 2.4.1.3 of this report).

Côte d'Ivoire

The ordinance N°2007-585 of October, 4th 2007 trans fers the responsibility of waste management to the Ministry of Cities and Urban Salubrity. Cities no longer have the responsibility of solid waste management.

Cities should be authorised to be responsible for waste management, with a coherent legal framework and adapted means. In Abidjan, one solution could be to set up an association of cities (in French: une intercommunalité) with a common fund. The project has been drafted and submitted to the Mayors of the cities for them to amend it if necessary (see chapter 2.5.1.3).

4.1.4 Barrier 4: Implementation of policy through public participation

Legislation alone, e.g. regulating the duty for households to separate waste will not lead to substantial changes in the implementation of integrated solid waste management. Rather the stakeholders in waste management (amongst the providers and economic actors, sub-groups of waste generators like restaurants or schools and the households) must participate in the decision making process at local level as well as in prevention strategies like home compositing.[76]

Ghana

There is no legislation that requires residents to sort out the waste generated and also to ensure that residents pay for waste disposal services. However, most Assembly and Unit-Committee representatives have in recent times played an active role in household waste management in their communities. The metropolitan, municipal and district assemblies bye – laws do not cover electronic and industrial waste which are emerging problems in the waste stream in Ghana.

[76] UN-HABITAT 2010, p. 143.

As there are no harsh penalties under the existing hazardous waste regime in Ghana, it is practically very easy for people to disobey waste management laws on purpose or unintentionally. In the absence of stringent punitive measures, the likelihood of disobedience on the part of the populace to any legislative instrument becomes high.

Nigeria

In Nigeria most people believe that it is the responsibility of the government to manage solid waste and hence exhibit carefree attitudes towards the SWM activities. There is a need for proper re-orientation to change this perspective (see chapter 2.3.3).

Côte d'Ivoire

The Environmental Code mentions the Polluter-Payer Principle but this cannot be implemented because the tax basis and collection systems have not been defined.

Concerning household waste, households are supposed to pay a collection tax but the tax basis has not been defined. It is therefore difficult to identify proper compliance with the Environmental Code. As a consequence, sanctions provided for in the legislation are not implemented.

Awareness-raising campaigns are rare and not all towns have a policy on salubrity. Therefore, most of the legislation concerning environment in general and waste management in particular can not be implemented (see chapter 2.5.1.3).

4.2.Inadequate funding

4.2.1.General analysis

Financial sustainability in solid waste management is a major issue for cities all over the world. In developing and transitional country cities, solid waste management represents a significant proportion of the total recurrent budget of the city, with figures of 3 to 15 per cent (UN Habitat report, Solid Waste Management in the World's Cities, 2010).

Across the world, public finance for urban infrastructures and service delivery typically accrues from municipal tax revenues, user fees and government transfers. For many African municipalities, property tax is the major source (UN Habitat report, State of African Cities, 2010).

Property tax is now widespread in African cities and ranks among the most significant municipal revenue sources. But they still generate only a fraction of their potential. Africa's urban taxation problems are mainly due to poor property valuation and low collection rates. Municipal valuation rolls are often incomplete and out of date (UN Habitat report, State of African Cities, 2010). In addition has to be taken into account that of all the regions, Africa has the lowest level of investment of World Bank funds in the solid waste sector (Johannessen et al., Overview of Solid Waste Landfills in Developing Countries, 1999; Achankeng, Globalization, Urbanization and Municipal Solid Waste Management in Africa, 2003).

Nevertheless experience has shown that service users are prepared to pay for their waste to be removed when they agree with the service levels, when the charging system is transparent and when services are provided for locally acceptable prices. Even in slum areas, people are generally willing to pay for appropriate primary collection services. Moving from a position where solid waste management is paid for through general revenues, to one where it is paid for entirely from user charges, is likely to be a gradual transition, particularly if the overall costs are rising at the same time. So, at least in the medium term, a significant proportion of the total cost will still have to be

paid for by the municipality or the national government from general revenues, as part of its public health and environmental protection responsibilities (UN Habitat 2010, Solid Waste Management in the World's Cities).

For most cities in low- and middle-income countries, the coming years will see increased waste, more people, more vehicles, more labour needed for collection, more transfer stations, more separated waste types of collection and more administration. As the city spreads and standards improve, suitable sites for landfills will be scarcer, further from the city centre, and (much) more expensive. Making service delivery more efficient should free up some resources, but many cities can expect to see costs rise substantially. It will therefore be imperative to find both regular sources of revenue and significant amounts of investment finance. Where international donors, or other investors, are involved in providing finance to cities for new waste management vehicles, equipment or infrastructure, one precondition is often that the city can demonstrate that they are able to pay both the recurrent costs and to repay any capital that has been borrowed. This usually involves discussion both on establishing the full current costs of providing the service, which is commonly underestimated by up to 50 per cent, and on the introduction of user fees, which in turn raises the issues of equity, affordability and willingness to pay. Discussions with international donors are often complicated by their internal rules, which may restrict them to funding waste facilities that meet the latest international environmental standards, which may make them unaffordable to the city.

One of the difficulties with investment financing is that it is often tied to the priorities of the giver. Grants may look like 'free money,' but they very often have conditions and requirements that limit the receiver's scope for making independent decisions. In this, perhaps the most risky grants are those for specific technologies or equipment, and it is wise to take a long and critical look before accepting these – or indeed any – grants. Another issue to be mentioned in connection with financing is the extent to which planning and service reliability are hampered by the way that finances are transferred from central municipal funds to the SWM service. In conclusion, cost recovery is part, but not all, of the sources of funds story, especially in low- and middle-income countries (UN Habitat report, Solid Waste Management in the World's Cities, 2010).

In addition there is a kind of "intellectual deadlock" in the area of funding schemes. The investment needs are estimated based on 'internationally recognizable' standards and environmental protection; but such solutions are not affordable for the governments in developing countries and their people. The result is that many consultants and experts produce studies that present strategies, action plans and investment projects that the cities cannot afford, and so the preparation work does not convert into actions on the ground. Or sometimes when it does, the result is an investment in a processing facility that the city cannot afford to operate. The organizations which could provide the necessary finances are generally just not available. Solid waste budgets largely come from national governments, but they do not have the funds necessary to invest in new infrastructure. This leaves the international financial institutions and private investors, who bring a range of conditions and prerequisites; most, if not all, require 'international' standards on which they are not allowed to compromise, and which are not affordable to the recipient (UN Habitat report, Solid Waste Management in the World's Cities, 2010).

If the donor capital is a grant, two issues arise. The first is the capacity of the city to operate and maintain the equipment or facility as it was designed, whether a collection vehicle, a landfill site or a treatment plant – the world is littered with examples of donated compactor trucks or incinerators which don't work, and landfill sites which have reverted to open dumps because the city cannot afford to run them or to repair them. Even if this first challenge can be met, the second remains: how to replace the vehicle or the landfill site at the end of its life. Grant funding may be helpful in the right circumstances and if the vehicle or facility is appropriate in the local circumstances; but it is not a long-term solution. If the investment is a loan, then the issue is not just about operational cost, it is also about debt servicing. A city can only afford to borrow a certain amount if it is to meet the repayments, so solid waste must compete with other funding priorities, such as health and education (UN Habitat report, Solid Waste Management in the World's Cities, 2010).

4.2.2.Analysis for the target countries

The report gives examples for the need of improved funding in all of the targeted countries in Western Africa.

Nigeria

The situation in each of the zones of Nigeria represented in this report is characterised by low funding but increasing costs for collection, transportation and recycling. For instance the State Environmental Protection Agencies in the South eastern zone of Nigeria are still in an infant stage of operation and require more funding by government and also private sector participation.

Ivory Coast

In Ivory Coast the World Bank has provided funding in 2009 and 2010 for an emergency programme to build urban infrastructure. The specific challenge is to think beyond emergency situations and ensure the sustainability of waste management systems. Cities should be authorised to be responsible for waste management, with a coherent legal and regulatory framework and adapted means. In Abidjan, one solution could be to set up an association of cities with a common fund. The project has been drafted and submitted to the responsible authorities.

The cities of the rural areas of the Ivory Coast are not able to pay for waste collection and final disposal with their own budget, thus municipal waste collection and transportation equipment is obsolete. The situation has become worse after the political crisis of 2002. In several cities situated in the North and the West, the municipal technical services currently went out of business.

Senegal

With regard to the waste management in Senegal and corresponding funding systems there is information available for the capital Dakar and the small city Matam.

The current waste management in Dakar is characterised by deficits at institutional, financial and technical level. The institutional responsibility is still provisory (transition period). A new collection, cleaning and waste transportation system, within a Public-Private-Partnership is being discussed. After several responsible agencies during the last decades now a specific organisation based on the association of suburbs is in charge of the waste management in Dakar. The organisation receives a yearly grant 10 billion FCFA (more than 15 million EUR) from the central government to work in collaboration with private operators organized by areas. Further financial support is given by various organizations to design an appropriate funding scheme for the region of Dakar.

The city of Matam on the other hand has some decentralised cooperation with several French cities that provide advice and help to mobilise technical, human and financial means.

Ghana

The results of the questionnaires responded for Ghana outlined that the responsible authorities are aware of investment regarding equipment, human resource, public education, transportation and landfill management. Specific information for financial systems is not available.

Summary

In summary has to be secured that a major obstacle to waste management is financial constraints. There are several aspects of this:

- Potential financial resources are not raised.
    - For example, there is a willingness of households and business to pay for regular waste collection services. There is a trend in Ghana, as well as in other countries in the region, towards procuring fees for waste collection from the waste generation.

This can be arranged as door-to door collection or as “pay-as-you-dump”, when fees are also charge at communal collection points.

- Another potential source for funding is CDM, clean development mechanism of the Kyoto protocol (this possibility for financing was not mentioned in any of the case studies for the targeted countries).
- Recycling is a source for economic value from waste which has not been well developed in the region. There is a recycling market, including informal waste buyers who go from door to door, waste pickers at collection points and disposal sites, and a largely informal, but partly formal market for recycled materials. The market is most developed for metals and e-waste, which have the highest market prices, but there is also recycling markets for plastics, paper and organic waste, primarily as compost.

- Limited financial management capacity for ministries and assemblies, which make funding of activities difficult, even in cases when there is funding available, for example from international donors.
- Limited access to credit:
  - Even potentially profitable activities have difficulties, due to lack of access to credits, and high interest on loans.
- Spending money considering the local conditions and the local needs:
  - For example, due to the project-oriented nature of international donor funds, it is easier to raise funding for construction of procurement of new infrastructure (collection vehicle, treatment facilities etc.) than for operation and maintenance.
  - Large funds are spent on expensive vehicles and equipment with large needs for expensive fuels and spare parts. Technologies relying on simple technologies and manpower are less promoted in the formal economy.
- Opportunities for synergies are rarely exploited:
  - An example of where this has been found is Ghana, where the National Youth Employment funding has been used to employ waste collection and street sweepers in all districts, and activities that has created employment opportunities as well as improved the cleanliness of the urban environments.

4.2.4.Deficits in personnel know-how at the technological and organizational level

Due to the widespread informal structures regarding the waste management of municipal solid waste, e-waste and industrial waste in Senegal, Côte d’Ivoire, Nigeria and Ghana many deficits in personnel know-how at the technological and organizational level are confirmed by the results documented mainly in the Sections 2 and 3 of this IWWA report. Within the informal recycling sector in most cases the state of training and competences of the staff are limited and the knowledge about environmental impacts of insufficient waste treatment procedures are underexposed. For instance the absence of adequate penalties for abusing laws related to waste management is underlined in the case of Ghana. The conclusions of the results for Nigeria – for instance – highlight the lack of appropriate urban planning and municipal solid waste strategy due to the unclear and non-transparent legal framework.

Nevertheless it should be mentioned from the results in Section 2 of this report that in Ghana for instance besides the informal activities a formal private sector has been established in the waste management sector in the last years. Especially the Zoomlion Ghana Limited company, the largest waste company in the company (3000 core staff and 65,000 field workers) has got a “critical mass” to get a change to improve the standards of waste management against the former practices. This

conclusion is backed by the scale of the technical equipment (50,000 collection trucks and tricycles, 1500 communal containers etc.) of this company. An interesting detail is the note that Zoomlion plan to sart the operation of a compost plant in the Greater Accra region, which would be a real progress regarding waste management.

The lack of skills and knowledge in the target countries is partly a result of lack of research and development in the sector. There are very little funds devoted to R&D in waste management in Ghana and other African countries. There is also lack of support to develop capacity in areas such as CDM which has seen little progress among countries such as Ghana, Nigeria, Senegal and Ivory Coast.

Furthermore a lack of systems analysis, life cycle thinking and comparative environmental assessment could be detected. Systems analytical tools are necessary for guiding integrated solid waste management. In Europe, life cycle assessment has become an important tool guiding decision-makers in waste management (Pires et al 2011). Life cycle assessment is a standardized method for quantifying the resource use and environmental emissions of a product during its entire life cycle. LCA has its drawbacks, it is a very time-demanding technical method requiring specialized expertise, but it is helpful in comparing orders of magnitude of various environmental effects of different waste management options. LCA has been very helpful in setting priorities, by showing how much emissions can be reduced by substituting landfill of biodegradable waste with other treatment options such as composting, anaerobic digestion or incineration (Mendes 2004). Systems analysis has not yet been established in waste management in West Africa, though it has been used in a few research projects in Ghana (IWWA Task 2.2).

4.2.5.Missing waste characterization & data on collected and recovered waste

Municipal solid waste

Due to the current political crisis in the Côte d'Ivoire no information could be collected on municipal waste characterization and data for this country. Nevertheless the results for Ghana, Nigeria and Senegal described in Section 2 of this IWWA report has delivered a quite good picture for the target countries regarding municipal solid waste. The characterization of waste (kg/day and inhabitant, waste composition) is not a main problem for the target countries. Of course, the data could be further improved – especially for the areas outside the main cities. But the data on collected or even recovered waste is much poorer in the target countries. The widespread informal structure of waste collection – again more important outside the capitals – is an obstacle regarding good quality data on collected and recovered waste. No statistics on waste collection could be reliable in areas with a dominant informal sector. Furthermore the very common practices to dump or just burn up municipal solid waste could falsify waste data or could lead to an underestimation of the total waste flows. As a conclusion for the target countries it could be stated that the information concerning waste characterisation are more or less satisfying but the data quality concerning collected or even recovered waste is insufficient to get an overview about the total countries and the different regions (especially outside the main cities).

E-waste

The waste characteristic for e-waste is a tough task in the target countries. Despite information for distinguished categories of e-waste (PCs etc.) mainly for the large cities a satisfying statistic on the total e-waste is not available. The calculation of mass flows is challenged by large differences between urban, semi-urban and rural regions as well as very high growth rates for all types of e-waste in West Africa. That means that data even just a few years old could lead to a relevant underestimation of the current situation. Furthermore taking planning for the future into account predictions for the next years are challenging, too. The competition between re-use and recycling of e-waste in the target countries also hampers sufficient data on the collection and recycling of e-

waste or components of e-waste. Nevertheless all the data problems regarding e-waste are not he main barriers for ISWM because it is evident that e-waste is an already very important issue for waste management in the target countries and will be even more important in the near future due to the rapidly growing mass flows of e-waste.

Industrial Waste

For industrial waste the data situation concerning waste characterisation and waste collection is very weak and totally insufficient to develop nationwide strategies. Many industrial waste producing companies seems to dispose their waste itself or request the service of formal or informal actors. The authorities are not really aware about the mass streams and the negative potential of the single waste flows produced in the different sectors of the industry. So for the industrial waste missing waste characterisation and missing data on collected and recovered waste is really a main barrier for an integrated solid waste management.

4.2.6.Lack of reliable waste collection service and waste segregation (role of the informal sector)

Municipal solid waste

Waste collection and recycling is a source for economic value from waste as well as environmental protection. There are waste management markets, including informal waste buyers who go from door to door, waste pickers at collection points and disposal sites, and a largely informal, but partly formal market for recycled materials. The market is most developed for metals and e-waste, which have the highest market prices, but there is also recycling markets for plastics, paper and organic waste, primarily as compost. Despite this fact a lack of involvement of the informal sector in the waste management policy of the target countries (waste management provider inclusivity) must be noted:

Although most of the recycling activities are performed by the informal sector this is normally not accounted for in planning, policy formation or implementation of formal waste management. Furthermore the legal backing for waste-pickers is missing, i.e. guaranteeing their customary rights to access, sort and recycle waste and their legitimacy to compete in the waste recycling business.

Another barrier lies in the fact that local authorities lack the knowledge necessary to conduct their duties even if waste management is contracted out to formal/informal entrepreneurs. In case a municipality decides to stop operating its collection system, it may close its operational division. But it should be not misunderstood that the local authority remains reliable for the functions of service provider, comptroller, regulator and adjudicator as public cleanliness and public health are a “public goods”.[77]

Ghana

The integration of the informal sector into solid waste management systems in Ghana is characterized as following: These actors do not have any agreement with the local authorities. In recent time their activities conflict with that of the formal private sector when zoning of waste collection started, especially in the metropolitans (Accra, Kumasi, Tema, Tarkoradi and Tamale). There is ongoing dispute as to allow this sector to operate as it is, integrate or organize them or stop their activities all together.

With respect to the integration of the formal sector into solid waste management systems in Ghana in urban areas their activities are estimated to be 80%. The companies are having an agreement with the Metropolitan Assemblies to collect waste from certain public places in the cities. Zoomlion has this agreement with all the MMDAs in Ghana to provide various waste management services

[77] UN HABITAT 2010,p. 196.

to the local authorities. There are franchise form of agreement and other forms of contract. Notable among the waste companies is the house to house collection of which residences are to bear the full recovery of cost. Hence, it the client's responsibility to pay for the services of these private companies involved. Apart from this, government or MMDAs have agreement with some private companies to provide public cleansing, lifting of waste from communal containers, desilting of storm drainage and beach cleaning.

Senegal

In Senegal agreements between formal private companies and local authorities concerning waste collection and disposal exist. The involvement of private sector in the public service of waste management is not a recent phenomenon in Dakar. The first time dates back to the setting up of the very first cleaning municipal service at the beginning of the 20th century. In 1920, the cleaning service was placed under direct municipal supervision again because the subcontracted company was not able to deliver the service effectively

There are two major limitations in the agreements between the local authorities and the formal private sector in Dakar:

1. The selection of companies has never been carried out in compliance with the rules on public procurement notably transparency and fair competition.

2. The agreements only concern domestic waste and not officially waste from shops or services. However, they are collected in the reality, which leads to important logistical problems. Concerning industrial waste, it seems that industries located in Dakar organise the management of their waste directly with the private sector.

Nigeria

In Nigeria there is non-formalization of the entire activities of the informal private sector in ISWM, and these results in non-regulation and coordination by government and her agencies.

Côte d'Ivoire

The integration of the informal sector into solid waste management systems is lacking: Informal workers get paid directly by households when they deliver the service based on moral / oral agreements with households. They do not respect law and regulation, e.g. get rid of the collected waste wherever they can (waste grounds, ravines, lagoon…). Informal workers are frequently in conflict with formal waste management companies approved by the authorities.

Regarding the integration of the formal sector into solid waste management systems: Private companies are now selected by a call for tenders issued by the Ministry of Cities and Urban Salubrity. They sign agreements with the Ministry through its implementing agency, the Agence Nationale de la Salubrity Urbaine (ANASUR).

Measures necessary to reinforce the private sector:

- Involvement of the private sector in building or management of infrastructure traditionally under direct governmental supervision will facilitate investment.
- Involvement of the private sector in environmental management. Currently, waste management companies collect 63% of produced waste.

To attract new investors and increase the performance of waste management companies: Setting up a "groupement d'intérêt économique" so as to better manage the available funds to support waste management; Using the "Build-Operate-Transfer" (BOT) system for future waste management; infrastructure projects (sanitary landfills, transfer sites…); setting up a "waste stock

exchange" so that waste be not longer seen as a nuisance but rather a valuable resources, which will help mobilize investment in modern technologies.

E-Waste

As outlined in the IWWA Deliverable 2.1 (Section 3: evaluation of solid waste management practices and technologies in target countries) by EMPA and further IWWA-partners there is for all target countries (Senegal, Côte d'Ivoire, Nigeria and Ghana) almost no formal e-waste collection and recycling sector existent. Some exceptions are reported from the business to business (b.t.b.) sector, but those collected and recycled mass flows of e-waste don't count compared to the large increasing formation of e-waste from manifold applications (TVs, PCs etc.). The fact that informal collection and recycling activities are dominant in the target countries is a crucial point which explains main barriers and obstacles for integrated solid waste management.

The negative effects of informal activities on collection and recycling rates coupled with significant and alarming environmental as well as heath impacts (toxic emissions to soil, water, air etc.) are well investigated and described in the other sections of the IWWA Deliverable 2.1 and numerous other studies and in-depth analysis with the focus on e-waste in West-Africa (see for example Pucket 2005; Widmer et al 2005; Osibanjo et al. 2007, Kuper et al. 2008, Buchert et. al 2009; Manhart 2011).

It could be stated that the totally insufficient collection and recycling situation for e-waste in the target countries is a clear result of the informal business practices in the target countries as well as the lack of reliable legislation, implementation and enforcement by the authorities. These informal practices are mostly characterized by an unsuitable management and treatment of hazardous components and substances and unsustainable working conditions including child labour. The statement is justified by the current IWWA results as well as by the external sources that a widespread informal collection and recycling sector is a main barrier for integrated solid waste management in the target countries. The statement should be documented with the important example "cable burning".

Very common activities within the informal recycling business on e-waste in West-Africa are cable burning with open fires. These practices take place mainly in urban regions in West Africa with the purpose to "dispose" the cable coating (PVC) and to harvest the valuable copper content. The disastrous consequences for the environment and the health of the people are described in detail in Section 3 of this report. This example is very demonstrative to prove the problematic role of the informal e-waste recycling sector, because the use of fire (here open fires) is not necessary at all to separate copper and plastic from cables. Instead mechanical treatment with suitable small and medium-sized shredders is state-of-the-art for the pre-treatment of cables. These shredders are not in the class of high-tech-equipment at all. In other words for the purpose of copper recycling from cables the use of open fires is dangerous as well as not necessary. But within informal recycling structures investments in suitable shredder technology as well as the availability of trained stuff to operate and maintain the machines is very unlikely.

For all four target countries there is a tremendous lack of reliable waste collection service and waste segregation concerning e-waste. Most of the activities are covered by informal structures and segregation of waste-fractions means in the most cases the use of fire and the pollution of soil, groundwater and rivers. The waste pickers and recyclers are acting as "cherry pickers" with a focus on valuable materials like copper or lead. But this means on the other hand side that the e-waste-components with negative economic values (most relevant are plastics and cathode ray tubes) are burned and dumped with the worst environmental impacts. The problems are intensified by the fact that the most of those activities are carried out in areas with high densities OF population. It should also be mentioned that since some years scrap dealers e.g. from China and India are visible in West Africa who focus to buy circuit boards for metal recycling in their home countries. Nevertheless the recycling standards in those countries for e-waste are not or at least not much better than West Africa.

Industrial waste

Section 2 of this report also describes the current situation for the collection and recycling of industrial waste in the four target countries Senegal, Côte d'Ivoire, Nigeria and Ghana. Industrial waste means here a widespread pattern of different waste types like packaging materials (e.g. metal scraps, plastics etc.), organic waste from food processing and different types of hazardous waste as for instance out-of-date pesticides, waste from metal processing, rubber industry and tanneries. Again a large scale of informal collection and recycling activities could be detected which means very often a common disposal of municipal waste and industrial waste on landfills. Formal recycling activities are also described for some cases regarding industrial waste but due to the insufficient pre-treatment, recycling and disposal infrastructure this doesn't mean waste management in an environmental sound manner. Like for the e-waste streams the informal as well as the formal waste collectors focus mainly on valuable fraction from industrial waste like metal scraps.

Overall there is also a tremendous lack of reliable waste collection service and waste segregation concerning industrial waste. This poor situation is impaired by the lack of good governance in the target countries in order to implement and enforce ISWM and large gaps in waste statistics on industrial waste.

4.2.7.Land availability for landfills and transport-problems to landfills

Running modern landfills to donor standards is often beyond the capacity of municipal governments (UN Habitat report, Solid Waste Management in the World's Cities, 2010).

Thus it is essential to say that whatever technologies and equipment are used, they should be appropriate for and adapted to the local conditions (both geographical and economic; UN Habitat report, Solid Waste Management in the World's Cities, 2010; Johannessen et al., Overview of Solid Waste Landfills in Developing Countries, 1999).

On the other hand taking into account the local conditions it is important to focus on realistic objectives. This includes an adjusted approach accepting appropriate standards for daily covering of waste. This landfill approach may imply accepting partial collection and treatment of leachate and partial controlled release for attenuation, dilution, and dispersion.

The status quo and planned landfill sites

In most of the cases documented, 70% - 90% of the municipal solid waste is disposed off in official dumpsites. The rest is irregularly or illegally dumped.

On the official dumpsites, the waste is compacted with trucks. None of the official dumpsites documented features installations for gas treatment or leakage water control. The leakage water in general runs to a nearby river. Only in Lagos it is indicated that the leakage water reaches a leachate pond.

Besides disposal on irregular or official dumpsites, municipal solid waste is often burnt. It is a very common practice for individual households to burn paper and plastic components of their waste. Also at irregular and official dumpsites, waste is often burnt in order to reduce the volumes.

Ivory Coast

The dumping site in the district of Abidjan is not a controlled landfill. All types of waste are transported there without any previous treatment or recycling. The accumulation of waste for more than 34 years in this area has created gas emissions and must now be controlled to ensure the population's safety. Sanitary risks are high, as Thousands of tons of waste are not collected and just dumped in the streets resulting in water pollution and air pollution (during incineration). There is a technical landfill in project to replace an old landfill that would be situated just above Abidjan's

underground water reserves. It is therefore urgent to reconsider waste management policy in Abidjan.

None of the secondary cities of Ivory Coast has a controlled landfill. Due to the current political crisis, it is very difficult to get information concerning solid waste generation and collection in secondary cities in Ivory Coast.

Ghana

Ghana had plans to build its first properly sited, designed, and constructed landfills in three of its major cities (Johannessen et al., Overview of Solid Waste Landfills in Developing Countries, 1999). The Accra Metropolitan Assembly is struggling to secure land for the construction of a sanitary landfill for the community. Residents are against the idea of constructing landfills close by because of the fear of the unbearable stench that is likely to emanate from the landfill and also the possibility of flies invading their homes.

The case documentation on the KEEA District also highlights that there is the need for the Municipal Assembly to develop a well-engineered landfill site for waste disposal.

The EPA is the regulatory body in waste management of Ghana. In the area of solid waste management, the agency's role is to monitor and regulate activities of the final disposal sites. The agency prepares technical guidelines for the metropolitan, municipal and district assemblies to be effective in their waste management activities, (Appiah Boamah, 2011). It was also discovered that there are only two engineered landfill sites in the country, located in Kumasi and Tamale. The remaining disposal sites are improved dump sites, (dump sites with minimal engineering operations), where ordinary dumping is practiced. These sites are mostly old quarried sites, which the assemblies, formerly in charge of final waste disposal sites, found convenient to fill with wastes, (Appiah Boamah, 2011).If an old quarry site is to be used as a dump site, approval has to be given by the EPA. A detailed management plan, showing how the site of operation is going to be managed has to be prepared, whiles a decommissioning plan, detailing measures to be put in place has to be submitted to the EPA, during the closure of a dumpsite. In practise however, these requirements are hardly done, with the excuse of inadequate resources, (Appiah Boamah, 2011). Oteng-Ababio (2010), reports that in the Accra Metropolitan Assembly, the public sector remains the sole operator of dump-sites. However in contradiction with the findings of (Appiah Boamah, 2011), it was discovered that the three major waste disposal dump-sites located at Saba, Gbawe, and Abokobi within the AMA zone, are managed by the private waste management companies. There were ongoing construction of houses, and some commercial activities (food vendors especially) around the dumpsites in Accra. Oteng-Ababio (2010), indicated that the dumpsites are a violation of existing sanitary laws, and yet these are tolerated, due to lack of proper landfills.

Figure 120 A smoky final disposal site located at Saba, Accra, showing proximity of houses to the final disposal site

Source: Appiah Boamah, 2011

Again similar observations were made at the New Juaben Municipal Assembly (NJMA), where the land fill site was not constructed for the purpose of disposing waste. An interview with both the Municipal Environmental Health Officer and Principal Program Officer of the EPA, NJMA, indicated that the final disposal site was a natural excavation, which the assembly thought appropriate to fill with waste; no Environmental Impact Assessment (EIA) was done before the place was used as a dump-site,(Appiah Boamah, 2011)

A study conducted by Appiah Boamah, (2011) indicated that most of the drivers of the waste management companies in Accra preferred to work during the night to avoid intense traffic on the road. For example, a 15 kilometres journey from Chokor, one of the waste collection points, to the final disposal site in Oblogo, took about four hours. The truck driver indicated that this would have been a one hour journey in the absence of traffic. This is one of the major operations costs to the waste management companies, especially the smaller ones (Appiah Boamah, 2011). During the transportation, most of the waste trucks are uncovered, making some of the waste to fall from the vehicle as well as producing a stench. This caused a discomfort to the road users and the truck drivers themselves.

Nigeria

The Lagos state case is a good representative of good efforts towards municipal solid waste management in Nigeria. It features house to house collection and the commencement of recycling programmes and includes as well leachate management for the landfill site in the Lagos region. Responsible for the Lagos municipal waste management is the Lagos waste management authorities (LAWMA). Drawbacks of the system are the inefficiency of operations, partly due to bad road and weather conditions.

Neither of the two largest cities in the south, Port Harcourt and Warri, have sanitary landfills. They rely on open dump sites and river dumping. Given the high social costs of improper disposal of municipal solid wastes, the future benefits of intervening are relatively high. The costs of appropriate management programs involving sanitary landfills, waste collection, and separation of selected wastes for recycling, are generally moderate in comparison to the benefits.

Senegal

In the suburb of Dakar is situated the only landfill for the Region of Dakar. This landfill receives approx. 475.000 tons of waste every year. The only organised “treatment” on this landfill consists in compacting waste transported by trucks after it has been weighted.

The agglomeration around the landfill site has a high demographic growth which poses many problems of cohabitation with the landfill in terms of land planning, housing, sanitation, environment, health and education.

Waste transportation in Dakar cannot be carried out everywhere with collection trucks. In several neighbourhoods and cities animal-driven carts are used for the transportation of waste due to the narrow streets and spontaneous land occupation.

Operational landfills in secondary cities are simple landfills and former quarries.

In Dakar, a sanitary landfill is being built in the Region of Thiès next to Dakar. Dakar’s waste will be landfilled there in the future. The landfill will be operated by a private company (GTA Environment).

In addition, a transfer and separation station is being built in Mbao. There is currently a conflict regarding the geographical location of the landfill between the Ministry of the Environment, the APROSEN, the Entity CADAK-CAR and inhabitants of neighbouring areas in the rural communities of Sindia and Diass. The demographic growth of the Metropolis poses a real problem in terms of urbanism and sanitation.

In the City of Matam, the NGO Lux-Development is finalising a project including 3 transfer stations and a sanitary landfill for the final disposal of the municipal waste. Prior to the project, the city administration together with the inhabitants has carried out an environmental impact analysis.

Analysis for the target countries

The case studies identify problems with regard to the availability of land for landfill sites especially in major cities.

A serious strategic problem is the lack of planning. This is not only within the waste management sector, but a general lack of urban spatial planning. Issues that arise are:

- Lack of land for treatment facilities. Difficulties in acquiring land for landfills are widespread, and are larger in major cities. This is related to a generally dysfunctional spatial planning in these countries.
- Ad hoc project based development. Since waste management is not guided by any realistic long-term strategic planning with clear priorities, and services are inadequate and underfinanced, many activities occur in the form of projects that give investments that tend to have too much focus on imported technical solutions that are not appropriate for the local situation, that do not have a realistic long-tem financial plan, that promise an easy technical solution to a problematic situation that is to a large extent caused by a deficient institutional capacity and lack of human resources.

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ANNEXES

ANNEX 1: EXISTING STUDIES ON SOLID WASTE MANAGEMENT

Côte d'Ivoire

Municipal solid waste

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Sané, Y. , 1999. A city meets its waste: a geographical problem of pollution in Abidjan (Côte d'Ivoire), Ph.D. Thesis, University Laval, Quebec, 290 p.

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E-waste

Messou, A. et al., 2011. 'Rapport technique d'étude de diagnostic sur la gestion des DEEE en Côte d'Ivoire by. CECAF International. Not yet available.

Specific waste streams, including industrial waste

Betio S., Koné B., Betsi N. A., J. Weth G. Cissé, Centre Suisse Research scientists in Côte d'Ivoire (CSRS), (Ivory Coast), 2007. Upgrading of solid waste plastics in the industrial zone of Yopougon (Abidjan / Cote d'Ivoire) and associated health risks, 8 pages.

Republic of Côte d'Ivoire, Ministry of Health and Public Hygiene, 2009. National Plan for medical waste management in Cote d'Ivoire 2009-20011.100 pages.

United Nations Environment Programme (UNEP), 2009. Evaluation of environmental data relating to the generation of hazardous waste in the District of Abidjan, 46 pages. http://www.unep.org Republic of Côte d'Ivoire, Ministry of Environment, Water and Forests, 2008. Updated National Profile on chemicals management in Cote d'Ivoire, 80 pages.

United Nations Industrial Development Organization (UNIDO), 2001. Industrial sector and sustainable development in Ivory Coast, 34 pages.

United Nations Environment & International Maritime Organization & Secretariat of the Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and-dice their Disposal & Government of Côte d'Ivoire. The port of Abidjan- the evaluation report, 36 pages.

Senegal

Municipal solid waste

APROSEN, with technical support from the IAGU, 2009, Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la région de Dakar.

Diawara A.B., 2010. Les déchets solides à Dakar. Environnement, sociétés et gestion urbaine. Thèse de doctorat en sciences, Université Michel de Montaigne - Bordeaux III (09/12/2009), http://tel.archives-ouvertes.fr/tel-00466516/fr/;

IAGU/Coopération Belge / UN-Habitat, 2009, *Profil Environnemental de la Ville de Matam*, 124 pages, http://193.55.175.48/eatlas-francophonie/espace-documentation/developpement-durable/agenda-21-matam/profil-de-matam-version-2.pdf/download

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http://www.openthesis.org/documents/Contribution-de-la-gestion-des-275667.html

République du Sénégal, Société Apix SA, CADAK-CAR, 2008, Cadre de politique de réinstallation – Projet autoroute à péage Dakar Diamniadio – Fermeture de la décharge de Mbeubeuss, Rapport final, Dakar, 58 pages.

PAN, 2010. Communities in peril : Global report on health impacts of pesticide use in agriculture, Pesticide Action Network (PAN-Germany). 200 pages.

Other informations:

- The Canadian Cooperation (IRDC) currently provides financial support to the IAGU to assist the Entente CADAK-CAR to elaborate a strategic plan for integrated and sustainable waste manage-ment. The objectives are: to mobilize all stakeholders, to carry out an in-depth analysis of the cur-rent waste management system, to carry out SWOT studies, to elaborate a common vision, a 3-year action plan, a communication plan, a monitoring and evaluation system, to carry out pilot projects in waste recycling.
- In the framework of its PRECOL programme, the World Bank provides financial support to the En-tente CADAK-CAR to carry out a feasibility study to re-organise the dumping site of Mbeubeuss ;
- The French Cooperation (Agence Française de Développement - AFD) provides financial support to the Entente CADAK-CAR to elaborate a prospective study for the re-organisation of inter-city organisations and to design an appropriate funding scheme for the region of Dakar.

E-waste

Basel Action Network, 2005, *The Digital Dump: Exporting re-use and abuse to Africa*, 43 pages.

http://www.ban.org/Library/TheDigitalDump.pdf [78]

CF2M (Centre de Formation 2000), 2006, *Etude de faisabilité pour la mise en place d'une filière intégrée de collecte, de démantèlement et de valorisation des déchets informatiques à Dakar entre partenaires d'économie sociale du Nord et du Sud,* 64 p[79].

Diop O., Wass, E., 1990, *Economie populaire du recyclage des déchets à Dakar*, in « Des déchets et des hommes », Environnement Africain n°29-30 vol ume VIII, Enda, Dakar[80].

Grippa C., 2004 : *Etude des filières de récupération et de recyclage du matériel informatique à Dakar (Sénégal),* Travail de Fin d'Etudes en vue de l'obtention du grade académique de Diplômée d'Etudes Spécialisées en Gestion de l'Environnement, UNIVERSITÉ LIBRE DE BRUXELLES, IGEAT(Institut de Gestion de l'Environnement et d'Aménagement du Territoire)[81].

Institut des Sciences de l'Environnement (ISE), Faculté des Sciences et Techniques, Université Cheikh Anta Diop de Dakar (UCAD) (2009) : *Etude sur la gestion et la valorisation des déchets d'équipements électroniques et informatiques en Afrique de l'ouest : cas du Mali, du Bénin et du Sénégal).*

A comparative study on WEEE management in Mali, Benin and Senegal.

UNEP, 2009, *Recycling – from e-waste to resources*, 90 pages.

http://www.unep.org/PDF/PressReleases/E-Waste_publication_screen_FINALVERSION-sml.pdf

The study's scope is very large, there is only a small section concerning Senegal and it is merely a summary of Salimata Wone's and David Rochat's study, but it contains valuable information on e-waste in general.

Umweltbundesamt (Deutschland), Sander, K., Schilling, S., 2010, *Optimirung der Steuerung und Kontrolle grenzüberschreitender Stoffströme bei Elektroaltgeräten / Elektroschrott*, 19 pages.

http://www.umweltdaten.de/publikationen/fpdf-l/3769.pdf [82]

Wone, S, Rochat D., 2008. Rapport technique de l'état des lieux de la gestion des e-déchets au Sénégal.

[78] The study focuses on Nigeria's case but its analysis of the mechanisms that cause e-waste dumping in poor countries can apply to Senegal.

[79] A feasibility study to set up a collection, dismantlement, refurbishing and recycling system for computers in Senegal. The study was carried out by ENDA and a Belgian social company, and financed by the Belgian government (Cellule Economie Sociale du Service Public de Programmation Intégration Sociale, Lutte contre la pauvreté et économie sociale).

[80] A study on popular waste recyclers in Dakar, very detailled, on the informal circuits for glass, metals, plastics recuperation. Also available in English « Man and Waste ».

[81] A study on recuperation and recycling of computer equipment in Dakar.

[82] This study was carried out by the German Ministry of the Environment in the Port of Hamburg and revealed that there are huge quantities of e-waste that is being exported more or less illegally from Germany to Western Africa, especially to Côte d'Ivoire and Nigeria.

Wone, S, Rochat D., Gassama C.I.D., Kane C., 2008. Senegal: e-waste country assessment. Conference Proceeding, WasteCon Durban. Available at: http://www.ewasteguide.info/SY_2008_WasteCon

Specific waste streams, including industrial waste

IAGU, APROSEN, 2009. *Etude pour le développement de filières de récupération et de valorisation des déchets solides ménagers et industriels banals de la Région de Dakar,* 90 p.

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République du Sénégal, Commission Nationale du Développement Durable, 2009. Rapport National sur le Développement Durable : Contribution du Sénégal aux 18ème et 19ème sessions de la Commission du Développement Durable des Nations Unies (CDD-18/19), 62 p. : http://www.un.org/esa/dsd/dsd_aofw_ni/ni_pdfs/NationalReports/senegal/Full_Report.pdf

Enda Tiers Monde / RUP, Praxis, 2002. Le secteur du recyclage au Sénégal pour les filières métal et plastique - Etat des lieux et perspectives en vue d'un transfert de technologie de recyclage Vietnam / Sénégal, 42 p.

Ndiaye M. B., 2006. Ecole Centrale de Lyon (France)/Ecole Supérieure Polytechnique (Sénégal). Le recyclage de métaux d'origine industrielle au Sénégal, 270 p., http://bibli.ec-lyon.fr/exl-doc/mbndiaye.pdf

République du Sénégal, Centre de Suivi Ecologique/Ministère de l'Environnement et de la Protection de la Nature, Rapport sur l'état de l'environnement au Sénégal en 2005, 214 p., http://www.cse.sn/documents/Rapport_Etat_Envi.pdf

Ghana

Municipal solid waste

Blay, 2011. Fee and performance based solid waste collection services (Polluter-pays-principle). Personal communication. Accra Metropolitan Assembly (AMA), Accra, Ghana

Anomanyo, E., 2004. Integration of Municipal Solid Waste Management in Accra (Ghana): Bioreactor Treatment Technology as an Integral Part of The Management Process. Msc. Thesis submitted to the department of Environmental Science, Lund University.

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E-waste

Bridgen et al., 2008. Chemical contamination at e-waste recycling and disposal sites in Accra and Korforiua, Ghana. Greenpeace Research Laboratories, Technical Note 10/2008. Available at: http://www.greenpeace.org/international/en/publications/reports/chemical-contamination-at-e-wa/
A Greenpeace report on the chemical contamination at e-waste recycling and disposal sites in Accra and Korforiua.

Prakash S., Manhart, A., Amoyaw-Osei, Y., Agyekum, O., 2010. Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana. Accra. Available at: http://www.resourcefever.org/detail/items/socio-economic-assessment-and-feasibility-study-on-sustainable-e.html
A socio-economic assessment and feasibility study on sustainable e-waste management in Ghana by the Öko-Institut and Green Advocacy Ghana.

Amoyaw-Osei et al., 2011. Ghana e-Waste Country Assesment. Secrectariat of the Basel Convention e-Waste Africa Project. Accra. Not yet available
Ghana e-Waste Country Assessment by Green Advocacy Ghana, supported by Empa.

Industrial waste

In recent times there has not been any study on industrial waste management in the country. The first time a study of that sort took place was in 1994. This was carried out by the National Toxic Waste Task Force. They were tasked to compile data on industrial waste in Accra and Tema, the most sensitive industrial areas in Ghana. Subsequently, in 1996, GOPA a German consulting firm was carried out a similar task building on the results of the earlier survey. This was funded under the world bank financed Ghana Environmental Resource Management Project.

Nigeria

According to the country and case documentations, no recent studies regarding waste management in Nigeria exist.

The information on studies, statistics and changes in the industrial management remained rare in comparison with Senegal or Côte d'Ivoire. Outcomes from the interviews in this report may not be representative for Nigeria.

ANNEX 2: EXISTING STATISTICS ON SOLID WASTE MANAGEMENT

Côte d'Ivoire

E-waste statistics are not collected. Import Data on new and second hand electric and electronic equipment (EEE) are collected by Customs (Direction des statistiques de la Direction Générale des Douanes, de la Direction de l'information et des statistiques du Ministère du Commerce). UN Comtrade also collects data on import of selected EEE (refrigerator, personal computer, television, and air-conditioner).

There are no statistics available for industrial waste collected on a regular basis. This is perhaps due to several political crises in the past.

Senegal

Available statistics on municipal waste management in Dakar mainly concern the amount of waste unloaded at the dumpsites. In the City of Matam, the GIE 'Jardin – Espaces compile regular statistics on collected municipal waste.

E-waste statistics are not collected. Import Data on new and second hand electric and electronic equipment (EEE) are collected by customs and harbour administrations based in the harbours from where e-waste is imported from Europe to Senegal. One of the major challenges posed by the statistical system in Senegal is that the Senegalese customs do not disaggregate data on new/second hand/waste imports and thus the data is not allowing traceability of e-waste ending up in Senegal. UN Comtrade also collects data on import of selected EEE (refrigerator, personal computer, television and air-conditioner).

Official, regular and updated statistics on waste are inexistent in Senegal according to the organizers of a workshop on Environment Statistics held in 2005 in Dakar with the Economic Community of West African States (ECOWAS), the United Nations Statistics Division (UNSD), the Economic Commission for Africa (ECA), and the United Nations Environment Programme (UNEP) which are the main public actors that gather statistics on the environment in Western Africa.

In Senegal, primary data is supposed to be produced by the Ministry of the Environment and the *Direction de la Prévision et de la Statistique*, based in the Ministry of Finance (www.ansd.org). The *Centre de Suivi Ecologique* (www.cse.sn) which is an association of public utility under the responsibility of the Ministry of the Environment of Senegal produces a « State of the Environment Report ».

Apart from the survey carried out in 1999 by the Senegalese Ministry of Environment in the process of the writing of the National Action Plan on Hazardous Waste, and the survey carried out by UNEP on POPs in 2006, there are no detailed statistics available on industrial waste in Senegal.

Ghana

The waste management department within the AMA collects and analyses service delivery statistics on municipal waste management. This is done to check the performance of service providers in their allocated zones. In addition, the Research and Development department of Zoomlion conducts monthly statistics on the waste collection done by Zoomlion over Accra and the country. In the KEEA District, municipal waste statistics are compiled through collaboration between the waste department, Zoomlion Ghana Limited and KEEA Environmental Sanitation and Health Unit.

e-Waste statistics are not collected. Import Data on new and second hand electric and electronic equipment (EEE) are collected by Customs, Excise and Preventive Service (CEPS). However, the data did not seem trustworthy for equipment such as mobile phones and air conditioners. UN Comtrade also collects data on import of selected EEE (refrigerator, personal computer, television and air-conditioner)

The Ghana statistical Service carried out a national census of industrial establishment in Ghana in 2003 and 2004 and published in 2006. Even though this survey did not report on industrial waste it serves as a useful reference material on the distribution of industries in the country.

http://www.statsghana.gov.gh/docfiles/2%20Phase%20I%20&%20II%20Report.pdf

http://www.statsghana.gov.gh/docfiles/3%20Phase%20III%20Report.pdf

Nigeria

In Lagos, landfill trip counts for all public sector participants' operators are conducted. These statistics include municipal waste and most probable also industrial waste.

The information on studies, statistics and changes of the industrial management are scarce in comparison with Senegal, Côte d'Ivoire or Ghana. Outcomes from the interviews in this report may not be representative for Nigeria.