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## Collection Operating Guidelines

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## 5. List of acronyms

AFECAMCI: Association of Informal Sector Artisans

CoJ: City of Johannesburg

DEA: Department of Environmental Affairs

EU: European Union

ISWM: Integrated Sustainable Waste Management

MSW: Municipal Solid Waste

UNA: University Nangui Abrogoua

PARO-CI: Sanitation and Recycling programme – Côte d'Ivoire

R-SNDP: Sixth National Development Plan

ZEMA: Zambia Environmental Management Agency

COGTA: Department Of Cooperative Governance & Traditional Affairs

WEEE: Waste of Electronic and Electric Equipment

EEE: Electric and Electronic Equipment

## 6. Foreword

Most African countries are currently encountering so many challenges with E-waste collection and management. In fact, the lack of appropriate infrastructures, collection facilities and legislative frameworks does not permit a formal WEEE management.

Baseline scenarios in Abidjan, Kisii, Johannesburg and Choma show the WEEE collection is still dominated by the informal sector, which actually bring expertise in this field but against a poor awareness of the impacts e-waste management do have. As a consequence, many cases of human health and environmental pollutions are identified.

In order to have a good WEEE management system, specific measures should be taken by government, municipality and key stakeholders to ensure the implementation of waste management Plan including binding laws, collection, transportation and disposal of WEEE, capacity building, education and awareness raising, and facilities building, among others.

Collection is very important step, because it is the starting point of the whole waste value chain. After we identified common challenges linked to collection in African context, hypothesis of solutions are developed to help in improving the collection systems in Africa.

## 7. Executive summary

The present document has been developed from the Expert Modelling Workshop on Collection which was held on 7<sup>th</sup> and 8<sup>th</sup> December 2015 in Mintek premises in Johannesburg, South Africa.

The goals of this Collection Operating Guidelines are stated as follows:

- ✓ Provide and share a picture of e-waste management Collection in Johannesburg, Kisii, Choma and Abidjan;
- ✓ Provide hypothesis of solution and strategies for the improvement of E-waste management from the standpoint of collection in the targeted areas;
- ✓ Set operating guidelines for the targeted areas

The Collection Operating Guidelines intends to lay on valuable contributions aiming at improving collection system in African contexts.

## 8. Scope of Collection

The Collection Workshop is part of the Work Package 2 including also Technology, Finance and Legislation and Closing the loop. The scope of. Collection Workshop includes:

- Geo-demographic factors (demographic weight, demographic density, prevailing milieu, prevailing settlement typology, general infrastructure in the urban space, road, sanitation service, etc.)
- E-waste actually collected
- Existing Collection facilities and infrastructures
- Take-back scheme
- Stakeholders involved in e-waste Collection (roles, responsibilities, inverse logistics, etc.)
- Informal sector
- Health and environmental issues
- Second hand, reuse, refurbishment practices
- Existing E-waste Collection initiatives ( NGOs, producers, retailers, private sector, etc)

## 9. Part 1

### a. Introduction

The Collection workshop was held on 7<sup>th</sup> to 8<sup>th</sup> December 2015 in Mintek premises in Johannesburg, South Africa. This included two days workshop led by UNA as Expert Leader and dedicated to the description of the scenarios of Collection in Choma, Kisii, Johannesburg and Abidjan highlighting the common challenges to address through the E-

waste Implementation Toolkit. Discussions were initiated on key points of Collection towards the development of the Collection Operating Guidelines.



Fig1: Collection Workshop at Mintek premises



Fig2; Presentation by Expert Leader, UNA

## b. Collection in Choma

### i. Baseline scenario

The increasing scale of wholesale and retail trading in Choma has attracted street vending, leading to an increasing amount of waste generation. In addition, the pronouncement and transformation of Choma into a provincial headquarters has attracted high mobility and growing population and consumption, and as a result an increased amount of waste generation.

Currently there is no accurate data in Choma about waste generation. The United Nations University estimated an average per capita generation of E-waste in Zambia at 0.9 kg in 2014. Applying this generation rate, the amount of E-waste generated in total in the District of Choma would be approximately 220 tons in a year. However, due to increased activities and population the figures should be much higher by now.

There are 6 primary storage areas in the form of refuse bays in Choma and one open dump for municipal solid waste. There is no waste segregation at any point therefore all wastes are mixed and disposed of except for those sold privately by households or businesses to private collectors or recyclers.

Twenty four tons of municipal solid waste is collected daily by the solid waste collection team of the Choma Municipal Council and is transferred to the dump site. This is estimated at between 10% - 20% of waste generation. There are informal waste pickers on the open dump who are scavenging all sellable recyclables including E-wastes.

Generally there is lack of awareness on the health and environmental impact of waste management in the public. Littering and open burning of waste is prevalent on roadsides and dump site, posing severe risks of health and environmental consequences. This is linked to the fact that no fee is charged to the citizens for waste collection service, leaving households in a vacuum of knowledge on waste management in the city.

Information and data about E-waste and general municipal waste in the District of Choma are largely lacking. Currently only the formal collection of municipal waste is quantified. There is hence a dire need to establish an information management system in order to obtain better knowledge of waste flows.

### ii. Challenges and opportunities

Proper management of human generated waste is one of the biggest environmental problems in Choma Municipal Council today. Some of the challenges include inadequate finances and equipment, lack of appropriate specialised equipment, lack of waste avoidance, lack of resource recovery system, lack of waste treatment facilities, poor waste disposal practices, illegal dumping, and lack of waste information management.

The opportunities include readily available labour force, Government willingness and creation of enabling environment for the involvement of the private sector in solid waste management, Councilors willingness to participate and support the e-waste management project, availability of repair shops where heaps of electronic waste can be collected from for recycling business and the already existing dismantling companies in Lusaka.

### iii. Solutions and strategies

#### 1. Principles and concepts

In order to improve the current waste management and specifically collection, Choma Municipal Council intends to develop the following measures:

- Privatize solid waste management services
- Involve the communities in the management of solid waste by introducing Community Based Solid Waste Management.
- Regulate recovery of recyclable materials through legal contracts that would define the quantities and type of waste delivered and the charging systems to be applied.
- Develop economic instruments which will be used to ensure that the costs of providing waste management services are recovered, as well as to influence the behaviour of waste generators and to ensure the preferred direction of the waste stream, i.e. disposal or recycling.
- Educate communities and run awareness campaigns on waste management issues CMC will also put in place centres where electronic waste would be brought in by communities through incentives.

#### 2. Goals

The two highest goals of Choma drawing from the Master Plan defined as EWIT Deliverable 1.2 are the ones identified below:

- Protection of human health
- Conservation of resources, benefiting from their economic values from E-waste

#### 3. Policy tools

Policies exist at national and local levels to address solid waste management. These policies are defined as it follows:

- The revised Sixth National Development Plan (R-SNDP) aims to develop Zambia toward a low emission climate resilient pathway;
- The National Solid Waste Management Strategy which was produced by the Zambia Environmental Management Agency (ZEMA) in 2004;  
The “Make Zambia Clean and Healthy Programme” which is a Multi-Sectoral Programme initiated to clean cities, towns and villages and to improve the health standards of the people;  
A National Water Supply, Sanitation and Solid Waste Management Policy is currently being developed.

There is no specific policy to improve the E-waste management system in Choma. E-waste is treated as part of solid waste in general.

For further legal framework, policies and legislations on E-waste, CMC suggested that following points should be taken into account to develop an efficient E-waste management system in Choma. They are:

- EPR (Extended Producer Responsibility)
- Eliminate open burning of E-waste
- Establish producer pays principle



- Set obligation of data and information provision and recording
- Establish operational standards as conditions of obtaining permits and licenses to perform collection, transportation, storage, treatment and disposal services
- Establish quality standards for imported or donated E-products
- Update the National Solid Waste Management Strategy and establish Choma's Solid Waste Management Strategy/Master Plan

#### 4. Operative tips

Tips to improve the E-waste collection management system in Choma are basically organized as following according to the Master plan for the city.

- To retain more economic benefit from the conservation of valuable materials in E-waste
- To provide more jobs and business opportunities
- To improve horizontal and vertical institutional cooperation and coordination
- To showcase a good E-waste management system
- To regulate E-waste sector
- To promote Extended Producer Responsibility scheme
- To train and formalize informal sector
- To avoid bad reputation for donating E-waste
- To avoid costs for taking back and processing unaccepted goods
- To increase public awareness on environmental issues

#### 5. Indicators

In order to monitor efficiently the Collection system, the following indicators from Choma Master Plan will be considered

- Total E-waste collected per capita (tones)
- Overhead collection cost
- Number of collection sites
- Adherence of the populations to collection initiatives

### c. Collection in Kisii

#### i. Baseline scenario

E-waste was pointed out as part of a solid waste management problem in Kisii County. With a population of about 1.2 million according to Population Census in 2009, Kisii County currently generates approximately 480 tons of solid wastes per day. About 33 tons of solid wastes are generated per day in Kisii Town alone. Like most African cities, there are no specific figures given for the quantity of E-waste within Kisii County.

The good management of E-waste generated in Kisii County is hindered by the lack of infrastructure/capacity for recycling and proper disposal. Kisii County's capacity for dealing with E-waste is limited to pre-processing of materials. The large quantity of materials is exported out of Kenya for complete recycling.

In Kisii County, the informal sector plays a very important role in E-waste collection. But the current management of E-waste by this sector raises an environmental and human health concern which is exacerbated by the lack of collective awareness on E-waste issue in general.

## ii. Challenges and opportunities

Major challenges of setting up a suitable E-waste management system in Kisii County are linked to the identification of roles and responsibilities, lack of infrastructures, lack of legislation to date, poor knowledge on the value chain and regarding recycling processes, poor awareness on E-waste issue and status of the informal sector.

Opportunities are described as follows: E-waste management capability development in the informal sector to address poverty alleviation, EPR application involvement of manufacture in taking responsibility for E-waste management, government policy development, creation of links amongst stakeholders and different market operators, involvement of women and academia in the sector.

## iii. Solutions and strategies

### 1. Principles and concepts

As part of solutions to enhance collection and improve the E-waste management system in Kisii County, the following measures are required:

- The establishment of registered collection centers which will work as the catalyst of the operational system
- Clear development of roles and responsibilities of different actors
- Development of institutional capacity (government, informal sector, stakeholders) to efficiently deal with collection and E-waste management.

### 2. Goals

Under the Master Plan definition, were identified five principal goals for Kisii County, described as follows:

- Provide effective and efficient e-waste services
- Provide high quality e-waste recovery infrastructure
- Develop regional and strategic partnerships on e-waste management
- Ensure sustainable e-waste services through review, monitoring, innovation and improvement
- Be a community leader in e-waste management

### 3. Policy tools

In 2013, the Government of Kenya has developed a draft form of specific regulations addressing e-waste within the country. These regulations include Extended Producer Responsibility (EPR), the creation of an e-waste registry and the establishment of a compliance scheme at national level.

### 4. Operative tips

A formal and legally binding framework has been in progress and it will define incentives and mechanisms and management of WEEE across Kenya. For the time being, details are not available.

### 5. Indicators

According to the Master Plan of Kisii, key indicators to monitor current and future scenario in Kisii County are not defined yet. They are planned to be developed as specific operational plans to be described in the final Action Plan.

## d. Collection in Johannesburg

### i. Baseline scenario

The European Commission Directive 2002/96/EC defined E-Waste as any EEE which is waste, including all components, subassemblies and consumables, which are part of the product at the time of discarding.

In South Africa, the Department of Environmental Affairs (DEA) defined and grouped E-waste into eight categories whose common characteristic is that they all use electric power supply to perform their functions and have been discarded by the owner.

Electrical & Electronic Equipment (EEE) Category	Description
Large household appliances	Washing machines, refrigerators, dryers, air conditioners, stoves
Small household appliances	Vacuum cleaners, coffee machines, toasters, irons
Office, information and communication technology (ICT) equipment	PCs, laptops, mobile phones, fax machines, printers and photocopiers
Consumer electronics and entertainment equipment	Televisions, VCR/DVD/CD players, hi-Fi sets, radios, train sets, coin slot machines, parking equipment
Lighting equipment	Fluorescent tubes and lamps, sodium lamps
Electrical and electronic tools	Drills, electric saws, sewing machines, lawn mowers, large stationary tools, machines
Security and healthcare equipment	Surveillance & control equipment, medical instruments & equipment
Mixed waste electrical & electronic equipment	Various WEEE

Table 1: E-waste categories, South Africa, 2013

The availability and quality of e-waste statistics are major challenges in South Africa and in the City of Johannesburg.

There is no accurate and verifiable data on:

- Installed capacity of EEE in government, business and households.
- Imports and sales data of EEE is not available in the public domain.
- Storage and refurbishment rates of EEE are unknown.

E-waste statistics on South Africa from international agencies (UNEP, StEP, EMPA) and e-WASA vary widely, not easily verifiable and in some cases conflicting. Municipalities and recycling companies are not required by law to record and submit E-waste-statistics to regulatory authorities.

The bulk of the E-waste generated in South Africa is held in storage by government, business organization and households. A study by Widmer & Lombard in 2008 established that South Africa is producing between 1.1 million and 2.1 million tons of E-waste per year. The reasons for storage of e-waste include the difficulties in writing off assets from asset registers, fears relating to data security in big corporate entities (SARS, Transnet, Vodacom, ABSA Ltd, Standard Bank) and belief that obsolete EEE technology has some residual value.

The storage rather than disposal or refurbishment of obsolete EEE is a crucial factor impacting on the generation of E-waste and the subsequent recycling processes indeed.

In the absence of credible E-waste generation data, the amount of e-waste that was collected for processing by the main collector Pikitup is assumed to be equal to the amount of e-waste generated in the City.

Approximately 13,801 tons of E-waste are estimated to have been generated and collected for further processing and treatment from households in the City of Johannesburg in 2014.

Screens and monitors accounted for 4,416 tons (32%) while large household equipment and temperature exchange equipment accounted for 2,485 tons (18%) and 2,070 tons (15%) of total e-waste volumes that were generated in 2014 respectively

#### ii. Challenges and opportunities

The challenges of collection in the CoJ basically result from the lack of awareness of the vast public, lack of legislation, missing data on WEEE and the insufficient drop off points in the city. Besides, there are no licensed facilities for E-waste and EPR scheme is inexistent. The lack of education of the informal sector is also a major issue.

As for opportunities, there exists in Johannesburg a rooted network of stakeholders involved in E-waste management. We also note that collection facilities are already in place and that there are local formal initiatives towards collection which are developed in schools and other public places. The presence of cooperatives, private sector and informal sector are an important asset for the city.

#### iii. Solutions and strategies

##### 1. Principles and concepts

Let's note that local E-waste collection management in Johannesburg also lay on some key concepts which are defined as stated below

- Establishing Public Private Partnership (PPP) to ensure a collaboration and involvement of both sector in E-waste collection initiatives locally
- Developing Extended Producer Responsibility models toward the development of an integrated management system
- Establishing registered and collection points

##### 2. Goals

The E-waste management goals for the CoJ are as follows:

- Strengthening of the collection systems, transportation, storage and disposal of E-waste.
- Increased separation of waste into recyclable and non-recyclables at source.
- Increasing household awareness on E-waste consumption, waste minimization, recycling and disposal to encourage behavior change and grow e-waste collection volumes
- Development of a better e-waste data management system to understand the origins, pathways, immediate and final sinks of E-waste materials along the value chain.

- Upgrade of the security at garden sites to enable secure collection and storage of E-waste materials at these sites.
- Development and strengthening of partnerships between the CoJ, higher learning institutions and neighbouring cities to share knowledge on E-waste management and achieve economies of scale.

### 3. Policy tools

There is no specific law which deals with E-waste in the city of Johannesburg. E-waste is treated as part of hazardous waste and is regulated under hazardous waste regulations.

The E-waste management activities in the city of Johannesburg are structured by the city's by-laws gazetted in 2013. The by-laws serve as instruments to enforce the segregation of waste towards recycling.

### 4. Operative tips

Operative tips to improve collection system are defined as indicated below

- Delivery of waste collection and disposal services in municipalities
- Collection, treatment and disposal of e-waste in COJ, waste management revenues
- Protection of human health and preservation of the environment, recovery of secondary materials from waste
- Funding of entrepreneurial projects in recycling sector profitability
- EPR fees, e-waste recycling infrastructure development
- Development of e-waste strategy, waste management revenues
- E-waste sector growth
- Promoting awareness and behaviour change with regards to e-waste
- Compliance with the law, protection of human health and the environment, low cost of compliance and convenience

### 5. Indicators

The Master Plan of CoJ stated that Indicators to ensure monitoring activities will be the following:

- Volumes collected per capita (tonne)
- Collection operational cost
- Awareness of the populations
- Collection facilities available
- Interest and participation of the population in collection events
- Total collection sites

## e. Collection in Abidjan

### i. Baseline scenario

Abidjan District is the most important region of Côte d'Ivoire. Approximately 80% of the national industrial activities are concentrated in this area which also hosted the two main national universities. The population is estimated to be about five million-inhabitants and in continual growth, which explains the growth rate noticed in the consumption of electronic devices.

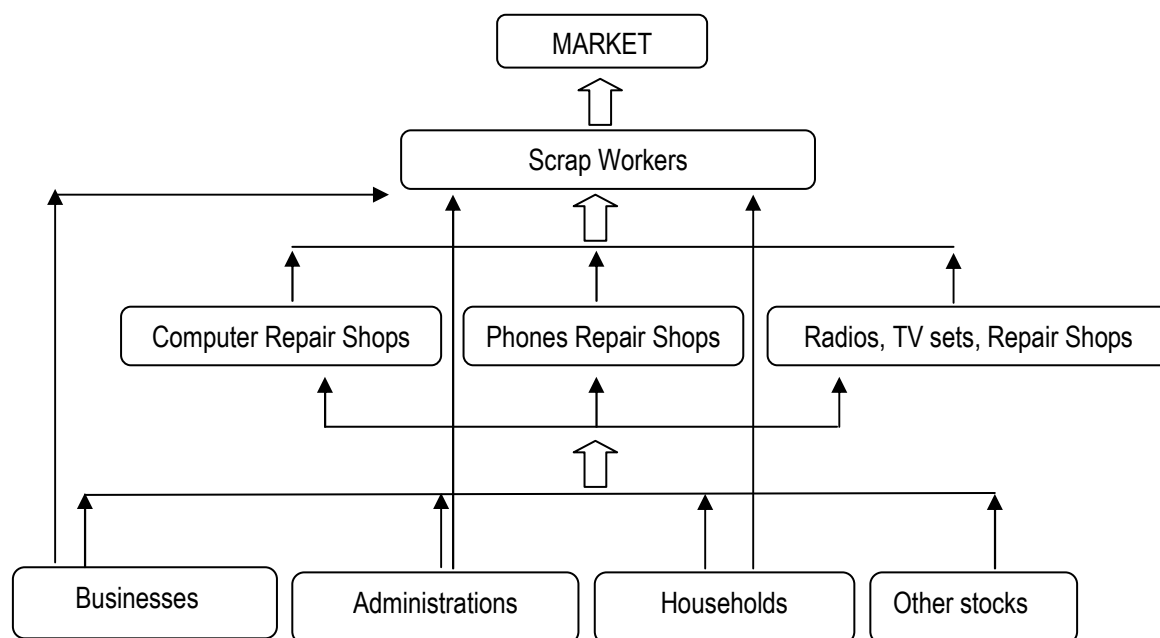
The fact that a large proportion of the population still live in poverty reveals the main reason why there is a general preference for second hand equipment because of their low costs. An important second hand electronics market is thus developed and very prosperous and attractive in the district.

According to a study of the Secretariat of Basel Convention, about 25,000 tons of E-waste are imported in the country and approximately 20,000 tons of E-waste are generated per year. In reality, these figures are thought to be inaccurate and thus not admitted.

Around the important pool of used materials in the Abidjan District a set of small business are organized in an informal way. And the lack of specific national legislation to regulate the sector has progressively led to very serious environmental challenges.

Today, there is a large quantity of E-waste in Côte d'Ivoire, but it is rather difficult to provide accurate statistics on them due to the lack of formal initiatives intending to this.

The informal sector is the main actor in collecting E-waste in Abidjan District and the collection model is organized as described below:



**Fig3:** E-waste collection System in Abidjan District (source PARO-CI)

The lack of technology, suitable facilities and regulations gave way to a set of uncontrolled and dangerous practices initiated by the informal sector. The collection, transportation and storage of E-waste are done in very precarious conditions as there are no appropriate infrastructures and logistics for that. As a matter of fact, informal recyclers use traditional techniques to extract valuable parts of E-waste which cause lots of environmental and human nuisances.

.In 2014 a national waste action plan and strategy was put together for implementation between 2016 and 2020. It is based on a broad political support but some signatures are still expected.

## ii. Challenges and opportunities

Setting a formal E-waste management in Abidjan District is the main challenge. This requires responding to the major needs of the sector in terms of finding answers to Insufficient legislative measures, administrative delays, lack of financing, informal initiatives formalisation and principles establishment.

Opportunities range from the Improvement of informal workers health situation to legal framework on E-waste in progress, Basel and Bamako Convention, Protection of environment and health measures, the existence of a skilled and organized informal sector and an informal economy.

## iii. Solutions and strategies

### 1. Principles and concepts

In order to have an efficient collection system in Abidjan District, some key concepts were developed and described as follows:

- Set up Consultative Committee of Stakeholders where important issues including collection are discussed and formalized.
- Develop Extended Producer Responsibility as a regulation to get the producer involved in the collection and management activities.
- Establish registered collection centers to set up a well structured collection system.

### 2. Goals

The goals of E-waste management in Abidjan District take into account the following points:

1. Protecting the environment and public health
2. Promoting the circular economy locally
3. Enforcing the respect of laws (E-waste management rules and regulations)
4. Positioning Côte d'Ivoire as the leader of E-waste management in West Africa
5. Taking into account the informal sector when defining global policy of efficient E-waste management.

### 3. Policy tools

There is no specific regulation on E-waste at national level. Beside Basel and Bamako conventions that the government has ratified which provide general guideline on E-waste management at international level, importations and exportations of hazardous waste for recycling have been regulated so far by Act n°00710 of April 15<sup>th</sup> 2008 imposing a strict control by governmental services. But it is still difficult to have an efficient E-waste management system.

In order to respond to this, the government took more responsibility in 2014 to propose new national policies on E-waste management with strong resolutions including:

- ✓ Extended Producers Responsibility
- ✓ Establishment of eco-innovative framework including financial, operational and good governance provisions for efficient services.

- ✓ Reduce, Reuse, Recycle (3Rs) policy
- ✓ Take-back scheme
- ✓ Enforcement of regulations in the E-waste management sector

#### 4. Operative tips

Operative tips to better the collection and E-waste management system are based upon key points described as below:

- Advocacy
- Sensitizing the population
- Medias to raise awareness
- Defining a policy, a strategy and a schedule for sensitization activities
- Promoting the existing mechanisms and financing opportunities
- Promoting the legal framework contents
- Enforcing the respect of the regulations
- Training/certificates/ more trade – raising the image of the job as a profession through training and accreditation
- Formalisation through standards and qualifications
- Proper and adequate spaces for small informal workers

#### 5. Indicators

Indicators contained in the Master Plan to evaluate the present and future scenarios in the Abidjan District are described as follows:

- Number of trainings provided per year on health and security
- Growth throughput volumes collected (Collection rate and volumes)
- Number of collection sites
- Number of collection initiatives
- Typology of actors involved in collection operations
- Adherence of the population in collection initiatives
- Operational costs for collection
- Availability of collection infrastructures
- Availability of regulations (by-laws) which favor collection events



## 10. Part 2

The 4 baseline scenarios considered in this study paint out the situations in most African countries. Features identified from the case-studies are also some prevailing facts in African general context. This analysis goes from specific characteristics to general situations in Africa.

Y: Availability of Collection infrastructures for E-waste

X: Typology of milieu

	1a	1b	1c
Advanced			
Developed	2a	2b	2c Johannesburg
Basic	3a Choma	3b Kisii	3c Abidjan
	Rural	Mixed	Urban

Table 2: Cities classification

A rigorous analysis of the baseline collection scenarios in Choma, Kisii, Abidjan and CoJ has led to the identification of shared issues. Discussions held by experts and key stakeholders have indeed indicated that there are some challenges which are experienced by all the African cities taken into account in EWIT project. So were then considered as common issues these indicated problems.

The table below showcases the major points discussions were based on and how some of them were pointed out as common issues through an analytical methodology.

IDENTIFIED ISSUES	CHOMA	KISII	CoJ	ABIDJAN
<b>Typology of Milieu</b>	Rural	Rural+Urban	Metropolitan	Urban
<b>Functioning of Basic infrastructure</b>	No	No	Yes	Yes
<b>Density of settlement</b>	Low	Low	High	High
<b>Density of population</b>	Low	Low	High	High
<b>Collection facilities for waste (LA)</b>	Limited (only urban areas are served)	Yes	Yes	Limited
<b>Collection facilities for waste (Other channels)</b>	No	No	No	No
<b>Collection facilities for e-waste (LA)</b>	No	No	Yes	No
<b>Collection facilities for e-waste (Other channels)</b>	No	Yes	Yes	No

IDENTIFIED ISSUES	CHOMA	KISII	CoJ	ABIDJAN
Refurbishment activities in place	Limited	Extensive	Extensive	Extensive
Data base on EEE PoM	No	No	No	No
Data base on EEE import	No	No	Yes	Yes
Data base on WEEE generated	No	Estimate	Estimate	Estimate
Data base on WEEE collected by municipalities	No	No	Yes	No
Data base on WEEE collected by other channels	No	Yes	No	No
Take-back scheme dedicated to e-waste	No	No	Yes	No
WEEE collection by LA	No	No	Yes	No
WEEE collection by the informal sector	Yes	Yes	Yes	Yes
(W)EEE collection by repairing/refurbishment shops	Yes	Yes	Yes	Yes
Health and environment issues due to e-waste collection	Yes	Yes	Yes	Yes
Organised Informal Sector	No	No	No	Yes
Competition with the formal sector	Potential	Potential	Yes	Potential
Competition within the informal sector	Yes	Yes	Yes	No
Logistic link to treatment facilities	No	Yes	Yes	Yes
Land availability for collection sites	Yes	Yes	Yes	Yes

Table 3: Identification of Common Problems

### a. Introduction: shared solutions for common challenges

The table below describes the common patterns of E-waste collection issues in the four identified contexts. This analytic table lays out common challenges and then proposes practical solutions to every shared problem.

All the information contained in this table resulted from experiences sharing sessions and very structured discussions of experts and key stakeholders.

Common issues	Solution - 3A	Solution - 3B	Solution - 3C	Solution - 2C
<b>Lack of basic infrastructures in rural areas</b>	Explore existing distribution channels	Explore existing distribution channels		
<b>Limited collection facilities (waste)</b>	Build collection facilities	Build collection facilities	Improve collection facilities	Improve collection facilities
<b>Lack of formal waste providers</b>				
	Implement the existing waste management plan	Draft a waste management plan	Improve the waste collection service	
	Engage all the potential stakeholders	Engage all the potential stakeholders	Engage the community	
	Build capacities	Build capacities	Build capacities	
<b>No / limited collection facilities (e-waste)</b>				
	Set criteria for e-waste collection sites, with consideration of ownership	Set criteria for e-waste collection sites, with consideration of ownership	Set criteria for e-waste collection sites, with consideration of ownership	Integrate the informal sector
	Proximity to e-waste generation	Proximity to e-waste generation	Proximity to e-waste generation	Differentiate the sites depending on the size of the e-waste
	Differentiate the sites depending on the size of the e-waste	Differentiate the sites depending on the size of the e-waste	Differentiate the sites depending on the size of the e-waste	
	Security of the site	Security of the site	Security of the site	
<b>Lack of formal e-waste collection providers</b>				
	Organise informal pickers in cooperatives	Foster social inclusion	Recognise the informal pickers as official waste managers	Recognise the informal pickers in the formal system
	Track the volume of e-waste collected and set up a formal invoicing system	Track the volume of e-waste collected and set up a formal invoicing system	Include the informal pickers officially into the value chain	
<b>Lack of quality/professional refurbishment service</b>				
	Provide training (vocational)	Provide training (vocational)	Provide training (vocational)	

Common issues	Solution - 3A	Solution - 3B	Solution - 3C	Solution - 2C
	Provide more technologically-advanced tools	Provide more technologically-advanced tools	Provide more technologically-advanced tools	
<b>Lack of data on EEE and WEEE</b>	Set up a legal framework for e-waste management	Engage academia in retrieving data on WEEE (surveys, etc.)	Engage academia in retrieving data on WEEE (surveys, etc.)	Recover data from the informal sector
<b>Lack of take-back scheme (WEEE)</b>	Provide incentives to get from the informal actors also non-valuable parts of the stream	Explore alternative incentives for non-valuable parts	Explore alternative incentives for non-valuable parts	Extend the methods of collection, to include the informal sector
<b>Lack of separate collection</b>	Education and incentives	Reinforce education and incentives	Education and incentives	Reinforce education and incentives
<b>Health and environmental issues</b>	Awareness raising and education	Awareness raising and education	Awareness raising and education	Reinforce awareness raising and education
<b>Non-organised informal sector</b>	Start cooperatives	Start cooperatives		Organise the informal sector
<b>Upgrading the informal sector</b>	Capacity building (training, health equipment, etc.)	Capacity building (training, health equipment, etc.)	Capacity building (training, health equipment, etc.)	Capacity building (training, health equipment, etc.)
<b>Competition with the formal sector</b>		Incorporate the informal sector into the formal sector		Envision an agreement between the informal and formal sectors
<b>Competition within the informal sector</b>		Organise them in cooperatives		Reinforce cooperation among the various players/actors
<b>Security issues related to the collection activity</b>	Plan for security measures of envisioned collection sites	Plan for security measures		Implement security measures
<b>Lack of logistic links to treatment facilities</b>	Plan for the logistics	Extend the system	Plan for the logistics	Increase the logistics already in place
<b>Land issues related to the provision of suitable collection sites</b>	Plan for security/safety of the sites	Plan for responsibility	Plan security/safety of the sites	Reorganise the available sites

Table 4: Shared solutions for common challenges

## b. To know about Collection

### 1. Lack of basic infrastructures in rural areas

Rural areas pose a special challenge in waste management planning and implementation activities. These can be summarised under (a) the ratio of distance travelled in order to collect a certain amount (either per number of units or mass) of WEEE and (b) accessibility of rural areas.

Waste characteristics and quantities generated in rural areas vary considerably compared to urban agglomerations. Typically, per capita quantities of municipal solid waste generated in rural areas are lower than in urban settings. This is related to (in average) lower income, welfare and availability of products and services. The availability and affordability of products (basket of goods) will look different in rural areas compared to cities. Furthermore, connectivity to a reliable electricity supply is often not available and thus fewer Electrical and Electronic Equipment (EEE) are used. Therefore, the amounts of generated WEEE is assumed to be lower in rural areas.

In addition to a lower per capita generation rate, population density is per definition low in rural settings, thus the efforts needed to collect a certain amount of WEEE are more resource intensive compared to urban ones. The collection and transport activities related to waste management are resource intensive and costly due the related higher efforts. It is well known, that waste collection consumes a large share of municipal budgets, especially in areas with low population density. This is the reason why the “median collection coverage is still around 50% in low-income countries. (...) It also drops sharply in the more rural areas of many countries. It is estimated that at least 2 billion people worldwide still lack access to solid waste collection” (UNEP, 2015). These problems are mainly related to Choma and Kisii with lower population densities (34 and 1,667 inhabitants per km<sup>2</sup>) compared with Abidjan and Johannesburg (2,594 and 4,400 inhabitants per km<sup>2</sup>).

The lack of good, well maintained country roads, and often poor connections to urban hubs make transport of any collected goods to a more centralised transfer station or treatment centre difficult. Rural roads can be exposed to seasonal disruptions, such as flooding, which might make it difficult to use with heavier vehicles. Thus having a smooth and reliable flow of material from rural settings to a central hub can be challenging. It also needs to be considered that poor transport infrastructure will lead to more damage and breakage in waste goods and thus can cause uncontrolled emission of potentially hazardous substances, e.g. mercury from broken fluorescent lamps.

A potential approach to tackle this issue with respect to WEEE is to carefully assess the value chains regarding the supply of goods. The exploration of existing distribution channels might display options for synergies, e.g. regarding the transports of goods (or probably raw materials, consumables and supplies) that are delivered to rural areas from urban hubs (cities, harbours etc.) it might be possible to take back either WEEE or certain components from dismantling activities to urban areas where WEEE / components can be further processed. Such private-public partnerships should be of mutual benefit. The goal is to minimise transport costs, nevertheless it has to be secured that special precautions measures are taken when WEEE / components containing hazardous substances are transported or if certain WEEE types / components require special transport conditions (e.g. refrigerators). It is also important that these synergies have to be adjusted in terms of types of products and WEEE / components are transported, e.g. to avoid that one way edibles are transported and the way back hazardous substances.

Setting up of appropriate interim storage facilities to collect WEEE could be explored, from which material is transferred in regular intervals to more central locations.

Establishing local rural facilities for treatment is in general not feasible due to the lack of sufficient input waste flows as well as the lack of markets for output materials. Moreover, any waste materials e.g. coolants, oils, fluorescent powders would need to be transported to appropriate treatment and disposal sites and the transport requires significantly better transportation infrastructure compared to waste devices.

## **2. Limited collection facilities (waste)**

### **2.1-Build collection facilities**

The analysis of the four African partner cities showed that especially the rural areas are lacking in waste collection facilities for municipal waste (Choma and Kisii), whereas the situation in the urban areas is a little better. For household waste it is important to build up adequate collection systems and the related facilities, especially where no such systems are in place.

For waste collection it is additionally important to have people-centred approaches. This means that appropriate technology here not only has to be cost-effective and environmentally sound, but also has to be accepted by the users, i.e. the waste generators. It is important to consider the local practices in waste disposal, meaning who is responsible for waste disposal at household level and what are the preferred options. Collection facilities have to be designed in order to fit the local circumstances. (e.g. the profile of people involved in collection). Also the vehicles have to be chosen carefully reflecting waste characteristics and types: e.g. compaction vehicles make no sense in the case the bulk density of the collected waste is high (e.g. due to a high share of organic waste). Also the geographical situation plays a crucial role, such as availability of paved roads, road size etc.

### **2.2-Improve collection facilities**

Waste collection services come in a wide variety of shapes and forms (UN-Habitat, 1988). Waste collection and the related transport and storage services may be delivered by the formal sector (public utilities or private sector operators), but on the other hand by community based organisations (CBOs), non-governmental organizations (NGOs) or micro-enterprises. In case there are no formal assignments for these services, then the stakeholders carrying out these services are informal. As the informal sector is widely involved in providing also collection services in low-income countries, it is important to consider its activities when planning new or adapting existing collection systems. As informal players usually have developed an informal recycling value chain (usually dealing with recyclables) it is recommended to assess this, as it could be helpful to build up on existing structures.

Coffey and Coad (2010) give an overview on waste collection in developing countries: depending on waste types to be collected, the characteristics and properties of the wastes it is important to design the optimal timing of collection (frequency and time of day) and collection points. Collection points could be:

- in the streets, e.g. via community containers (municipal collection points) or block collection systems;
- at the property boundary (kerbside collection) or

- inside the property.

For WEEE it is important to consider the different categories: whereas smaller appliances can be easily transported by waste generated, bulkier items are more difficult to transport. Especially in less densely populated geographical areas it is therefore important to provide pick-up services, e.g. once or twice a year as people probably do not have vehicles on their own. In urban areas it might be interesting to provide drop-off points for WEEE, this could be at schools, markets, public buildings, repair shops and the like. Also one might consider to include already established (informal) structures for pick up services.

Important for recovering WEEE is public awareness and communication with the waste generators. On the one hand it is important to inform the public on the hazards of fly-tipping WEEE, but also on the necessity to recover important resources. The WEEE generators have to gain knowledge on when, where and how they can dispose of their WEEE. For storage or drop off points it has to be secured that sites are equipped with impermeable surfaces and should be weatherproof. According to Onderi (2010), a licensed e-waste collection facility (LCF) should:

- Enable household e-waste to be collected from the LCF in streams of either large household appliances other than cooling appliances and display equipment containing CRTs amongst other waste.
- Be accessible to members of the public.
- Have signs to direct members of the public to deposit e-waste to the relevant container or area in order to prevent mixing of e-waste with other waste or allow contamination with hazardous material.
- State the maximum quantity that can be deposited on the site.
- Have impermeable surface with a sealed drainage and impermeable drains which do not leak to ensure that all liquids are in a sealed sump except where they may be lawfully discharged.
- Have a weatherproof cover.
- Have a Collection Point and Storage Facility adequate to serve the geographical area and the volume of separated e-waste tonnage captured.
- Have adequate collection points and storage facilities to serve the population size.
- Be located where it meets the requirements of the collection option identified (i.e. retailer take back collection centre, municipal collection centre or other) and able to handle the number of trucks or trailers of different capacities required to transport the e-waste.

To optimise collection systems, the use of GPS and GIS, or even route optimisation software, may be relevant for large municipalities.

### **3. Lack of formal waste providers**

#### **3.1-Draft a waste management plan**

The development of a waste management plan is the starting point of a good policy to get waste properly management. In the context there is none, it is necessary to draft a plan in which strategies to ensure a sustainable waste services are clearly defined with priority actions and objectives in short, medium and long terms including indicators to measure progress.

### 3.2- Implement the existing waste management plan

In case a waste management plan already exists, additional measures are required to ensure its implementation. These measures are to define roles and responsibilities of key players through binding laws and permanent monitoring and evaluation systems.

### 3.3-Improve the collection service

In order to improve WEEE collection services, collection points equipped with safety and security standards are to be established at close and convenient places for consumers to visit them. The places may be for instance markets, business areas, schools and churches. Incentive should be provided to encourage populations to bring their E-waste to the collection points. This should be accompanied by the establishment of transfer facilities to ensure the removal, transportation and storage of the collected E-waste.

### 3.4-Engage all the potential stakeholders and the community

As first step in planning activities it is recommended to apply the concept of **Integrated Sustainable Waste Management (ISWM)**. In the context of a city ISWM can be used for two main purposes:

- (1) To assess and monitor existing WM systems.
- (2) To plan a new WM system, including the selection of appropriate technologies, making sustainable investment decisions.

The main idea of ISWM is to involve all stakeholders in the integrated planning of all waste system elements (i.e. the technical components of a waste management system from waste generation until the final point of disposal) including all steps of waste reduction, recycling, re-use and resource recovery in between these points and addressing all system aspects (e.g. institutional, financial, regulatory, social and environmental aspects). ISWM promotes technically appropriate, economically viable and socially acceptable solutions.

Van de Klundert and Anschutz (1999) state that “most problems [remark: in waste management] are not only related to money and equipment. Problems have to do with the attitude and behaviour of citizens, waste management staff, private enterprises and informal waste pickers. Other problems are related to managerial (in) capacities, the institutional framework, the environment, or the social or cultural context. In these cases, it is not money or equipment that provides solutions, but rather changing social, institutional, legal or political conditions.”

Van de Klundert (2001) describes three dimensions of the concept of ISWM that provide a framework for a comprehensive analysis of all activities related to solid waste:

- (1) Technological components (waste system elements) of a waste management system
- (2) Sustainability aspects of a waste management system and the
- (3) Stakeholders in a waste management system.

Waste management plans considering the concept of ISWM need to address clearly the roles and responsibilities of all stakeholders, and provide adequate communication, education and training on a continuous basis. A legal framework that regulates any collection activity and recognises this sector is important.

The European Commission (2003) and the United Nations Environment Programme (2009) supports with documents on how to develop waste management plans. Beside this it is important to engage all stakeholders and the community in the planning and implementation process and continuously develop capacities at different stakeholder levels.



### **3.5-Build capacities**

Capacity building will reduce the risk of contamination by hazardous substances of WEEE and related consequences. When clearly developing safety measures to observe, the risks involved in handling hazardous substances of WEEE and the harmful effects on the environment and human health, we encourage the appropriate collection and management of WEEE towards the formalization of WEEE providers.

## **4. No / limited collection facilities (E-waste)**

### **4.1-Criteria for WEEE collection sites, with consideration of ownership:**

- Official WEEE Collection Sites should be established, approved and registered with the appropriate permits and licences by the responsible authorities;
- WEEE collection sites –large enough to store the largest WEEE on the territory – should be placed in proximity to, but separate from, existing primary storage areas / refuse bays;
- In order to ensure that they do not endanger the surrounding soil or water sources, the stored WEEE should be protected by a roof, and the ground the sites are established upon should ideally be covered by a protective layer;
- Collection sites should be easily accessible both to the general public (not too far from household concentrations), and to the collection trucks;
- In order to avoid hazardous and/or valuable materials from ending up in dumpsites, areas that are already used for general solid waste collection such as market places and business areas should be equipped with separate and covered WEEE collection areas, containers and bins for smaller electric and electronic items;
  - o This area should be supervised by certified personnel, gated and protected;
  - o WEEE should not be transported along with other general waste;
- An itinerant collection system could be implemented,
- In order to maximise population reach, other public gathering places, such as schools, shopping centres and churches should be equipped with protected bins/containers to store smaller WEEE;
- Encourage people to differentiate their waste appropriately;
- All sites should provide useful information (leaflets, signs, etc.) regarding WEEE: safety hazards, environmental dangers, proper handling, benefits of separate collection, repair shops information, local services, location of other collection points.

### **4.2-Proximity to generation**

- In order to facilitate and encourage WEEE separate collection, collection points (at least for smaller items) shall be close and convenient for consumers, for example in common gathering spots, such as market places, business areas, schools, shopping centres and churches;
  - o All collection points must be equipped to meet basic health, safety and security standards;
- In the interest of maximising outcomes, collection points/sites should be signalled well and advertised.

#### **4.3-Differentiate the sites according to size of e-waste**

- In all collection points and sites, items shall be stored separately according to type in order to facilitate subsequent treatment/dismantling;
- Large items, such as large household appliances, shall be brought to collection sites with space availability for the items;
  - o It should be made easy to evaluate the most suitable collection point/site according to amount/size of the items.

#### **4.4-Security of the site**

- To the extent that capabilities allow, and in the interest of avoiding safety hazards, looting, minimize damage to items and ensure security, collection sites should be closed, gated and supervised;
  - o Guards should be trained to understand and deal with safety hazards related to WEEE;
  - o Only certified personnel should be allowed inside the collection site;
  - o Outsiders/visitors shall be supervised by certified personnel to ensure their safety and the security of the site;
- All collection sites should be equipped with fire extinguishers (number depending on size of the site);
- All collection sites should be equipped with first aid kits (number depending on size of the site).

#### **4.5- Integrate the informal sector**

- The informal sector carries out important operations and fill a gap in formal capabilities, but these workers are more often than not, not educated or trained formally, and are therefore probably unaware about the hazards related to working with WEEE – both to themselves and to the environment;
  - o Local authorities or private entities supporting the development of an e-waste management system should offer trainings, awareness and educations programs for members of the informal sector free of charge;
  - o In order to ensure their safety and that of the environment, they should be supported in the establishment of general guidelines, and health and safety standards;
- It is important that the informal sector is included in the integration process, with a view to ensuring their needs and perspectives are taken into consideration and addressed;
  - o Propose round-table discussions that include all stakeholder in defining the new organization/system;
- Informal workers could be incentivised to formalize their activities and organise themselves into cooperatives through financial incentives and/or tax breaks;
- All actions and requirements related to registration, licensing and fiscal processes should be streamlined and simplified;
- In order to help informal workers make the transition to the formal market, they should be given access to formal funding, either through micro-credit services, or regular commercial banks;

- Informal trainings and apprenticeships should be gradually recognized and formalized;
- Labour standards, benefits and social protection should be extended to members of the informal sector once they begin the formalization process;

## 5. Lack of formal e-waste collection providers

One of the fundamental problems for the collection system is to directly involve the wide range of informal pickers whose work is dirty, risky, inefficient and poorly paid which could instead be organized, equipped and involved in execution a job that could improve their economic conditions, but also make an important contribution to the interception of E-waste.

## 6. Lack of quality/professional refurbishment service

### 6.1- Provide training (vocational)

The following approaches could be used to provide trainings to increase the level of professional dismantling and refurbishment centers. In general, trainings should be hands-on, accessible to workers with low education, rich in practical and visual advices and easy-to-follow. Trainings can help to increase the quality and the variety of repaired items, generate additional income for the informal/formal sector through reputation effects as well as higher selling prices and protect the environment by increasing the percentage of refurbished items.

- Given the nature of the knowledge, trainings on the ground in the respective facility seem to be the most promising approach. By doing so, trainings can be tailored to the local conditions, existing knowledge base of the workforce and the availability of refurbishment tools. A special focus should be put on training-the-trainers, i.e. enabling a small group of refurbishers to act as trainers for further co-workers and refurbishment centres in different, more rural parts of the city. Refurbishment centers should cooperate with (technical) schools, universities and the private sector to gain a deeper understanding about the functioning of electronic equipment. Furthermore, collaborations with government institutions, NGOs (e.g. WorldLoop) and international organizations (UNIDO/UNEP) can help to conceptualize structure and implement these trainings.
- If internet access is available, websites that provide free repair and dismantling guides to electronic articles can be useful to ramp up the knowledge of safe and environmental-friendly refurbishment activities of the workforce.

A useful example is [ifixit.com](http://ifixit.com). It provides easy step-by-step guides with photographs explaining every step for a wide range of electronic and electrical articles. The guides can be printed out and distributed/displayed at the refurbishment centers to provide an offline solution. Another promising upcoming online source is [RECDEV.eu](http://RECDEV.eu). This project aims at developing self- and distance learning training courses with multimedia material and 3D-material familiarizing learners/users with the disassembly of electrical and electronic devices and the identification of types and qualities of materials embodied. It targets low level workforce (disassembly), aiming at strengthening employability, safety at work and developing skills as well as higher employers (materials identification).

### 6.2-Provide more technologically-advanced tools

The provision of more technologically-advanced tools is often connected with a high investment in machinery that is difficult to be provided by informal refurbishers and refurbishment centers in rural areas. Thus, a focus should be put on vocational training measures to support people in using the tools already available. In addition, the provision with basic dismantling and refurbishment tools that help to increase safe and effective handling should be supported.

Nevertheless, it is important to support the formalization of the informal sector in order to give e-waste collectives and cooperatives the opportunity to jointly invest into advanced technology that can be used by all the members of the cooperative. Also, mobile solutions including trucks with necessary machinery that drive around different refurbishment centres or building up local hubs for advanced processing of certain e-waste streams should be considered.

## 7. Lack of data on EEE and WEEE

Waste-related data are an important prerequisite for waste management planning and monitoring activities. Good quality data on waste quantities and composition serve as input for planning and adapting waste collection, treatment and recycling infrastructure and therefore have influence on the costs. The fulfilment of waste prevention and recycling targets as well as the capacity planning of treatment and recycling facilities require a sound and comparable database.

In terms of municipal solid waste (MSW), Dahlén et al. (2009) for example report sixteen sources of error and uncertainties in the interpretation of official waste collection data.

The authors grouped these into:

- (A) general data problems,
- (B) data uncertainties related to specific waste categories;
- (C) unreliable data from recycling centres; and
- (D) household waste component analysis data not comparable.

Regarding waste-related data the Global Waste Management Outlook reports (UNEP, 2015):

“The available estimates are diverse, not verified or reliable, and often rather dated. Thus transforming waste data into reliable waste statistics has proven difficult.” Furthermore, the authors describe the major areas of concern as following:

**1. Lack of standard definitions and classifications.** The definitions of waste streams such as MSW, construction and demolition waste, agricultural and forestry wastes and mining and quarrying wastes vary widely among countries, including within the European Union (EU). Arguably, it is unrealistic to suggest that a single global definition of waste could or indeed should be applied in all countries. At the same time, it is realistic to ask that each country's definitions be clear and applied consistently.

**2. Absence of measurement and of standard methodologies for measurement.** The weighing of wastes is both relatively recent and still not universally practised. Many cities in the developing world still rely on estimates of MSW based on the volume of the vehicles used for collection and disposal. Here, as with many other aspects of waste assessment,

there is a lack of standard methodologies. For example, it is often unclear at what point estimates or measurements have been made and whether the data refer to MSW or to all waste in the city, or whether it is waste as generated, or as collected, or as delivered to a disposal site (has some separation of materials for recycling already taken place before the measurement was made?). Measurement and assessment also tend to be limited to the official or formal waste management system. Activities outside of that system, including uncontrolled (and often illegal) dumping or burning, as well as recycling by the informal sector, are neither measured nor reported. Waste composition data are even more uncertain, even in high-income countries, as measurement tends to be occasional and not carried out on a comprehensive or consistent basis.

**3. Lack of standard reporting systems.** Statutory reporting systems for waste management in a standard format are still the exception. While tracking systems for the transboundary movement of hazardous wastes are mandatory under the Basel Convention, data collection and reporting of total quantities generated are only advisory and thus patchy. National data collection systems do exist for MSW; however, for other waste streams including C&I and C&D wastes, the reporting systems are not uniform even among high-income countries. So although data are reported to and collated by both the EU (Eurostat) and the OECD, there are both gaps in the data and questions over their inter-comparability. Double counting is one issue, as often when waste is processed, the output from the treatment facility is counted again as a 'new' waste. As a result, not only tallying the total quantities but also tracking a particular item of waste from its origin to its final destination is difficult. For developing countries, the availability of any data beyond MSW, never mind reliable data, is rather uncommon. Given these many interrelated challenges, there is an urgent need for clear and consistent methodologies for waste assessment. Any approach needs to be underpinned by carrying out as much fieldwork 'on the ground' as possible. It is also essential to gather information from as wide a range of 'actors' in the city's waste and resource management system as possible. Two additional pieces of advice would be to go as far as is practicable to establish at least a rough mass balance, including estimates of unmeasured 'losses' from the system, and to document carefully all of the assumptions and estimates made and the 'rules of thumb' used, so that the assessment process is transparent and able to be audited. Some guidance is already available on the more detailed 'how' of data collection in order to establish the baseline situation in a developing country city.

A well-established system of data on WEEE-generated is of paramount importance for setting up new or adapt existing e-waste collection, dismantling and recycling systems. Generally, the situation in the partnering cities related to data on generated WEEE is difficult, as these data are not or just partly existing.

Currently, existing models to estimate WEEE-generation might be a starting point for initial estimates of generated e-waste quantities. This is more complex, as EEE are considered as durable goods, with different lifespans depending on the categories. For these durable goods such as EEE, a study was conducted by Baldé et al. (2015). The authors calculated the e-waste generated per country, year and product category by extracting statistical data from the United Nations Comtrade database. This was done for 175 countries for a time series of 1995 to 2012. By considering import and export at national level the sales data for different EEE were determined and the number of sold units were converted to weight using the average weight data per appliance type. In the end the e-waste generated by country was determined by applying the "Sales – Lifespan Distribution" method with empirical lifespan data. Lifespan data is obtained from the 28 EU Member States using the Weibull

distribution. This modelling shows that it is possible to directly link sales data and calculate waste generation rates.

Such estimates, based on modelling e-waste generation need officially recorded data on import, export and national sales and the level of equipment at household level (or at the level of other larger generators such as schools, ministries, universities etc.) for different EEE-categories. Beside data availability, it is challenging to obtain necessary data at regional level. Usually the data are existing at national level, allowing only average national estimates. Other reasons why such models just have to be considered as estimates are:

- Transboundary movement of devices (new and second hand)
- Storage of old devices (it is difficult to assess why and how long EEE are stored at household level)
- Use of devices for other purposes, e.g. old coffin freezers as coolbox
- Increase of EEE per household as connectivity to power supply increases
- Donations of second hand devices
- Sales not officially registered, e.g. on the black market
- Life span of devices

An additional prerequisite is to set up a legal framework for waste definitions and classifications (including waste lists and catalogues) aiming at clear definition of waste types. A legal framework also has to clearly set out definitions of what is waste and when an item has to be considered as waste. This is important in order to distinguish between “waste” and “re-usable” items. In the following, a waste tracking system supports to “follow” certain waste streams (usually the starting point are hazardous wastes) from the point of generation (or collection) until the wastes reach their final recycling, treatment or disposal. This is related to administrative efforts and needs proper enforcement activities. Waste tracking systems might be established in pilot phases for certain e-waste categories.

Need to set up an independent tracking and monitoring system across all waste streams, include all stakeholder and start with few key indicators which over time can be refined and increased, once the system has been rolled out and taken up. Appropriate infrastructure, e.g. bridge scales or weighting points at hand over places should be provided.

It is of importance to engage academia in retrieving data on WEEE (e.g. by conducting surveys, etc.). Also it is important to recover data from the informal sector.

## **8. Lack of take-back scheme (WEEE)**

### **8.1-Explore alternative incentives for non-valuable parts**

In Africa, only valuable parts of WEEE are collected by the informal sector which dominates the sector. The non-valuable parts are jettisoned and create major environmental and health problems. In order to have access to entire WEEE it is necessary to explore alternative incentives for non-valuable parts. One way of doing this is to establish a minimal financial incentive to encourage the informal sector to collect them as well for recycling.

### **8.2-Extend the methods of collection, to include the informal sector**

Through an information campaign spread “house to house”, using the work of same collection operators, that can be also informal waste pickers coops. As was done in some cases in the province of Gauteng (Benoni- Actonville and Wattville: project Nets Africa) in the case of recycling of dry waste (paper, cardboard, plastic, glass and cans), it’s possible to reinforce the separate collection education and increase the participation and involvement of

citizens. To promote instead the direct contribution of citizens to a Collection Center (Garden Sites) or to minor structures (like “Eco Points”), will be adopted reward systems based on the volume or weight of waste delivered directly by the people, through patronage or gadgets with acquisition of points related to win consumer goods.

## **9. Lack of separate collection**

### **9.1-Education and incentives**

Lack of separate collection can be addressed through education and incentives.

- Education

Sensitization programs are a powerful means to get populations understand the necessity to segregate their waste and have E-waste collected separately. Focus must be put on the hazardousness of E-waste and the urgent to treat them with caution.

- Incentives

Incentives to provide to citizens to get them involved in separate collection can include

- A better health
- Potential economic benefit of depositing E-waste properly
- More job and business opportunities

### **9.2-Reinforce education raising and incentives**

Through an information campaign spread “house to house”, using the work of same collection operators, that can be also informal waste pickers coops. As was done in some cases in the province of Gauteng (Benoni- Actonville and Wattville: project Nets Africa) in the case of recycling of dry waste (paper, cardboard, plastic, glass and cans), it’s possible to reinforce the separate collection education and increase the participation and involvement of citizens. To promote instead the direct contribution of citizens to a Collection Center (Garden Sites) or to minor structures (like “Eco Points”), will be adopted reward systems based on the volume or weight of waste delivered directly by the people, through patronage or gadgets with acquisition of points related to win consumer goods.

### **9.3- Build local institutions capacities**

It is also an important point to enable local institutions (in charge of E-waste management) to promote separate collection. Building their capacities can help in increasing the role they can play in establishing a waste segregation model at local scale. Besides, these institutions should supervise the works of different stakeholders towards separate collection.

## **10. Health and environmental issues**

### **10.1-Awareness raising and education**

Raising awareness and educating is fundamental to address health and environmental issues. Local NGOs involved in E-waste management can work on sensitization models to get the populations aware of the risks of E-waste mismanagement. Another complementary measure is for example to insert in the school training curriculum a subject on E-waste management so students understand far better how WEEE can affect the environment and the human health if their hazardous substances are not managed properly. The awareness growing will undoubtedly impact the attitude of the citizens towards E-waste collection and management.

### **10.2-Reinforce awareness raising and education**

The involvement of the informal pickers, who usually work in precarious conditions in landfills, with high risk to their health and with heavy consequences for environmental pollution, will be a key part of the training to be provided, especially to those who already are working in these conditions and will cover mainly:

- Safety conditions at work;
- The risks involved in handling hazardous substances;
- The risks involved in adopting criteria craft selection and treatment of electronic and electric waste;
- Harmful effects on the environment related to incorrect processing of waste.

Such training shall be provided as a complement to the organizational policies, technical and economic management of a new model of work organization, focusing on the form of Cooperative, encouraged and assisted by the government of South Africa through the COGTA (*Department Of Cooperative Governance & Traditional Affairs*).

## **11. Non-organized informal sector**

### **11.1-Start cooperatives**

Grouping the informal worker into cooperatives is an excellent way to value them and work efficiently with them. Usually, the informal sector encounters so many challenges and is offered only little perspectives. By creating cooperatives, it becomes possible to improve their poor conditions and provide them with more opportunities.

As a cooperative, the informal sector can also have strong voice in policy making as they become representative stakeholders to consult by government when making decisions.

In Côte d'Ivoire, the E-waste informal recyclers are grouped in an association called AFECAMCI. The new organizational structure of this informal sector opened a wage of opportunities to members who now live in business communities and develop small craft industries.

Starting cooperative informal sectors will also allow the shift from an informal status to a formal one which favors the establishment of a formal economy.

### **11.2-Organize the informal sector**

As already experienced on other occasions, one of the most effective, in terms of social, economic and environmental, is to improve the organization and training of informal sector



(waste pickers). This category is in fact very common in developing countries and constitutes both a problem and an opportunity for economic growth and social development of these areas. The goal is to involve the current informal collectors and reclaimers, providing them with the necessary training and equipment for a different work organization that favors, on one side better working conditions, the other a better income than today perceived. Cooperatives thus formed of informal reclaimers, will work through an agreement with the municipalities, micro-business doing work safely and efficiently, drawing income from the sale of recovered materials, carrying out activities similar to that of other private contractors.

## **12. Upgrading the informal sector**

Concerted action is needed to improve the working conditions of the informal sector with regards to incomes, health and safety issues. Sustainable capacity building measures can make a big difference, when embedded into proper institutional support and access to affordable financing is available.

Training needs should be assessed to tailor the material and the content to the respective informal stakeholder group (collectors, women, youth, refurbishers...) and account for local specifications. Fostering improvements from within the existing system is generally the preferred option. Locations of capacity building measures should be chosen that are highly frequented by informal waste collectors and refurbishers (at waste collectives, dismantling & refurbishment facilities). Provision of basic safety equipment (gloves, breathing masks,..) and tools (screwdrivers, collection boxes,) can already help to improve the working conditions of informal workers.

Cooperation with the private sector, producers of electronic and electrical equipment, international organizations, regional government institutions and NGOs are recommended to structure and finance the capacity building measures.

## **13. Competition with the formal sector**

### **13.1-Incorporate the informal sector into the formal sector**

Informal sector should be incorporated in the formal sector to avoid any uncontrolled competition. This can also be done if the informal sector has a minimum internal organization. Starting cooperatives in the informal sector is one of the best ways to go into further planning of cooperation through formal partnership. The formal sector can mobilize the informal sector and employ it in formal structures, but this can also be possible if previously there were already interventions to sensitize and to group informal workers who are accustomed to working individually into cooperatives.

### **13.2-Envision an agreement between the informal and formal sectors**

The involvement of the informal sector in the organizational structure of collection and sorting of E-waste, at a time when the official asset is recognized only and exclusively towards the company delegated to waste collection, it needs for an initial phase, to be managed directly by the municipality. The "official" entrance of the cooperatives of informal pickers will be placed as a form of mentoring and collaborative activities already in place. The legal and economic relations and forms of cooperation between the two parties should be regulated by a legal act in the form of the Convention. First to legalize the legitimacy of cooperatives of informal pickers to do this work; second to protect the rights of both subjects in an economic activity aimed at increasing the quantity of e-waste collected and started to recycling.

## **14. Competition within the informal sector**

### **14.1-Organize informal sector in cooperatives**

Grouping the informal worker into cooperatives is an excellent way to value them and work efficiently with them. Usually, the informal sector encounters so many challenges and is offered only little perspectives. By creating cooperatives, it becomes possible to improve their poor conditions and provide them with more opportunities.

As a cooperative, the informal sector can also have strong voice in policy making as they become representative stakeholders to consult by government when making decisions to better their living conditions.

Organizing informal sectors into cooperatives will also allow the shift from an informal status to a formal one which favors the establishment of a formal economy

### **14.2-Reinforce cooperation among the various players**

The competition within the informal sector can be overcome through the example set by the new organizational model as a cooperative. After starting the first experience of cooperation between the municipalities, the new informal coops and the waste company, will emerge in a clear manner the advantages, economic, organizational and productive that the informal coops will towards others informal pickers, who continued to manage its activities in a non-organized way. These differences will cause progressively also other informal pickers to organize themselves into a cooperative, expanding participatory basis of the agreement governed by the municipality. As a result, over time, to phase selection activities at the landfill, to increase the quantities of E-waste sent for recycling and to give birth in micro entrepreneurial activities useful for the social and economic development of the urban areas.

## **15. Security issues related to the collection activity**

### **15.1-Plan for security measures of envisioned collection sites**

Collection site must be equipped with strong measures aiming at meeting security and safety standards. People working on these sites need to be trained to security measures as well and equipped with basic safety equipment (gloves, breathing masks...) and tools (screwdrivers, collection boxes ...). Collection sites should be controlled and evaluated on a regular basis to ensure security and safety provision are strictly respected.

### **15.2-Implement security measures**

The training and provision of appropriate equipment for conducting the activities of collection, sorting and transportation of E-waste, particularly among those sectors most exposed today, as one of the waste pickers, will produce the effect of a natural implementation of security measures during the work, through the use of the basic principals such as high visibility jackets, gloves, sturdy shoes, etc. The picture of the risks to the manipulation of E-waste will also have attitudes more aware and alert during the collection and selection.

## **16. Lack of logistic links to treatment facilities**

### **16.1-Plan for logistics**

The success of collection initiatives also depends on available logistics. In order to have a good collection required basic logistics including:

- For Collection: collection boxes, containers, screwdrivers, gloves, breathing masks, etc
- For Transportation: vehicles, motorbikes
- For storage: Warehouse equipped with security measures

### **16.2-Extend the system**

### **16.3-Increase the logistics already in place**

As for the logistics of the actions to be taken it is to increase the places for the direct award of e-waste, differentiating them into two types:

- Collection Centers

Collection centers are to be achieved in open areas through the installation of roll-off containers of large size (5 to 30 cubic meters), the direct contribution (from the people) of waste electrical and electronic large size (refrigerators, washing machines, televisions, dishwashers, monitors, computers, printers, etc.). The same centers may be used as operating centers for the collection teams, realizing the economies of scale are important for the optimization of transport and use of the media.

- Eco points

Eco points are to be implemented in public places, such as schools, community centers and administrative offices, shopping centers etc. These Eco Points should be realized and managed in collaboration with direct owners of the site and will consist of covered areas equipped with small containers (bins, containers, lockers, etc.), capable of collecting small appliances such as: hair dryers; smart-phones; electronic lamps; blenders; electric shavers; A4 scanner; small printers etc. In the same Eco points you will be awarded also other types of hazardous waste such as, batteries, medicines, containers for paints, exhausted oils etc.

- Eco vans

These are identified as mobile Eco Points, made by van cabs can accommodate small light containers for the same types of waste mentioned above. These will stop at the outdoor market areas, shopping malls and other venues, periodically, properly publicized and will welcome waste delivered directly by the citizens.

## **17. Land issues related to the provision of suitable collection sites**

### **17.1-Plan for security/safety of the site**

Collection site must be equipped with strong measures aiming at meeting security and safety standards. People working on these sites need to be trained to security measures as well and equipped with basic safety equipment (gloves, breathing masks...) and tools (screwdrivers, collection boxes ...) Collection sites are to be controlled and evaluated on a regular basis to ensure security and safety provision are strictly respected.

### **17.2-Plan for responsibility**

Roles and responsibilities must be defined clearly in a site management plan. The stakeholders can optionally be trained on the good delivery of services resulting from their responsibilities.

### **17.3-Reorganize the available site**

The availability of areas suitable for creating the collection points and Eco points shall be agreed with the administration of the municipality. The latter, in the case of Garden Site, to enhance these facilities in the area, will be made available to areas of municipal property, granting free use of the managers of the collection. These areas would have to meet safety criteria, be paved, fenced and equipped with services (toilet and changing rooms, office and meeting room).

As for the Eco Points, the municipalities will have to play an active role to induce the private and the owners of hosting this facility, offering any discounts or rebates on waste fees.

## 11. Part 3

### a. A step-by-step guide to support policy makers in Collection

The following five key steps can be helpful in defining policies to improve the collection scenario.

<b>STEP 1</b>	To establish a framework for E-waste collection towards recycling
<b>STEP 2</b>	To raise general awareness on E-waste issues  To ensure all stakeholders are fully involved to make collection operations successful
<b>STEP 3</b>	To create favorable conditions for investments and technical expertise transfer  To create licensing and certification systems via international standard for collection and recycling  To develop operating collection and recycling initiatives including EPR and CSR models
<b>STEP 4</b>	To stimulate competition in the collection and recycling systems to drive cost effectiveness
<b>STEP 5</b>	To enforce legislation strengthen monitoring and compliance mechanisms

Table 5: Guiding support for policy makers

### b. The E-waste Toolkit: A ‘tree of decision’ for collection in view of the toolkit

Input information and output recommendations arose during the workshop needed to be re-structured in a form which could suit the EWIT Toolkit. It was to set a logical ‘decision tree’ which both respected the contents covered by the ‘Collection’ Pillar and the logic implied in the EWIT wizard.

In particular, given the thematic areas included in the scope of ‘Collection’, a double tree has been defined. From the one side one for ‘general context information’ useful to comprehend what is the context of interest from a generic geo-demographic standpoint: recommendations would then be generated accordingly. From the other side, a proper tree of decision for Collection has been built considering as main input information: 1) data on e-waste; 2) data on facilities of collection and 3) data on the informal sector. A specific section about awareness has been considered as cross-pillar item. The overall result of this configuration generated a decision tree which takes the form displayed in figure 4.

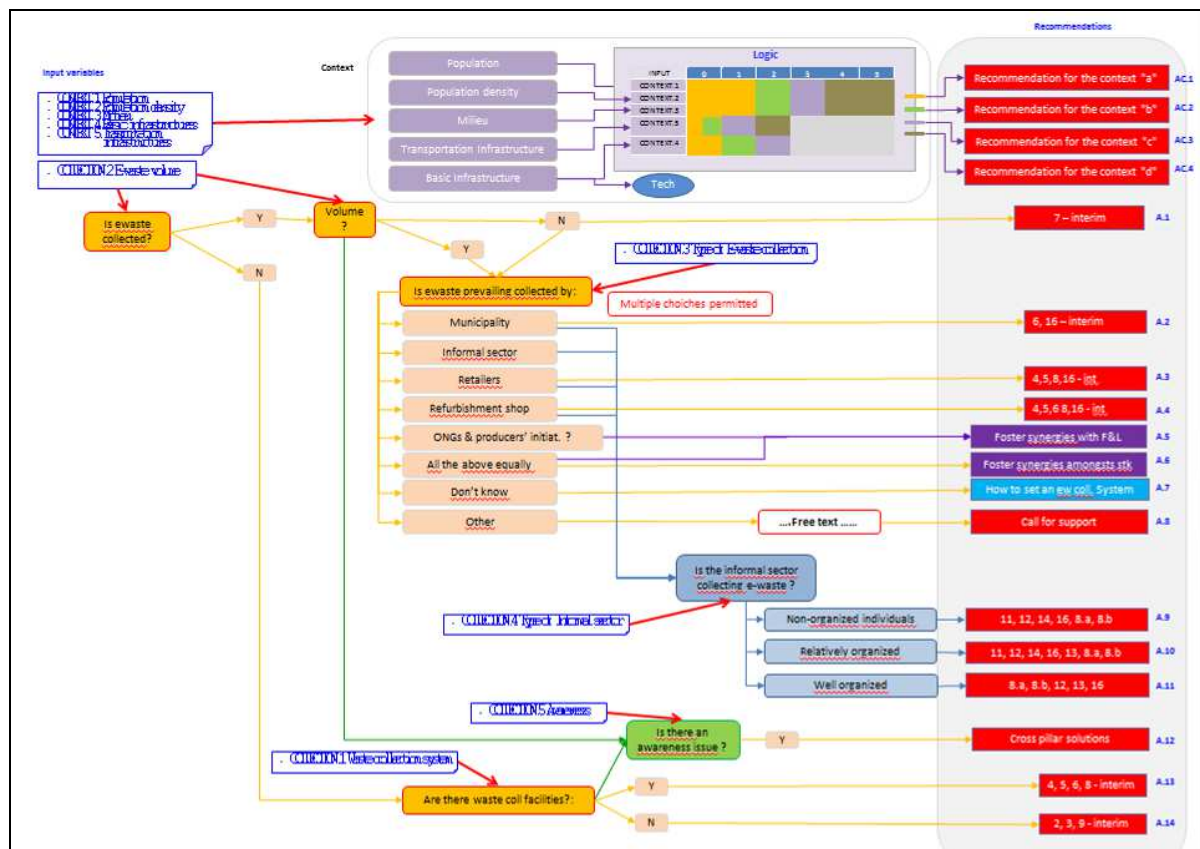


Fig 4: Decision Tree for Collection

Next steps will be crossing such decision trees with those generated by the other pillars so to have a complete diagram covering all the thematic areas of EWIT and make it suitable for the Toolkit.

## 12. Conclusions

There are many challenges related to waste collection in Africa. In order to fix these problems, a good waste management plan is required. This plan including key strategies and priority actions will contribute to the establishment of a new operating model involving key stakeholders to have a formal and eco-innovative management system adapted to African context.

This deliverable about collection is an analytic document which contains important tools and directives aiming at improving the collection service.

## References

- Baldé, C.P., Wang, F., Kuehr, R., Huisman, J., 2015. The global e-waste monitor – 2014. United Nations University, IAS – SCYCLE, Bonn, Germany, p. 80.
- Coffey, M., Coad, A., 2010. Collection of municipal solid waste in developing countries, in: Coad, A. (Ed.). United Nations Human Settlements Programme (UN-HABITAT), Nairobi :.
- Dahlén, L., Åberg, H., Lagerkvist, A., Berg, P.E.O., 2009. Inconsistent pathways of household waste. *Waste Management* 29, 1798-1806.
- European Commission, 2003. Preparing a Waste Management Plan - A methodological guidance note Environment DG, European Topic Centre on Waste and Material Flows, p. 53.
- Hazeltine, B., Bull, C., 1998. *Appropriate Technology; Tools, Choices, and Implications*. Academic Press, Inc.
- Onderi, V.N., 2010. *Guidelines for E-Waste Management in Kenya*. National Environment Management Authority, Kenya (NEMA).
- UN-Habitat, 1988. *Refuse collection vehicles for developing countries*. United Nations Centre for human settlements (UN-Habitat).
- UNEP, 2015. *Global Waste Management Outlook*. United Nations Environment Programme.
- United Nations Environment Programme, 2009. *Developing integrated solid waste management plan - training manual*. United Nations Environment Programme (UNEP), Division of Technology, Industry and Economics International Environmental Technology Centre Osaka/Shiga, Japan.
- van de Klundert, A., 2001. *Integrated Sustainable Waste Management. A Set of Five Tools for Decision-makers.*, in: WASTE (Ed.), Gouda, The Netherlands.
- van de Klundert, A., Anschutz, J., 1999. *Integrated Sustainable Waste Management: the selection of appropriate technologies and the design of sustainable systems is not (only) a technical issue*, CEDARE / IETC Inter-Regional Workshop on Technologies for Sustainable Waste Management, Alexandria, Egypt.
- United Nations University STEP initiative 2016. *Solving the E-Waste Problem*, Ruediger Kuehr, United Nations University, Germany.
- EWIT Master Plans of Choma, Kisii, Johannesburg and Abidjan District.
- Reports of EWIT Twin City Workshops in Choma, Kisii, Johannesburg and Abidjan District.