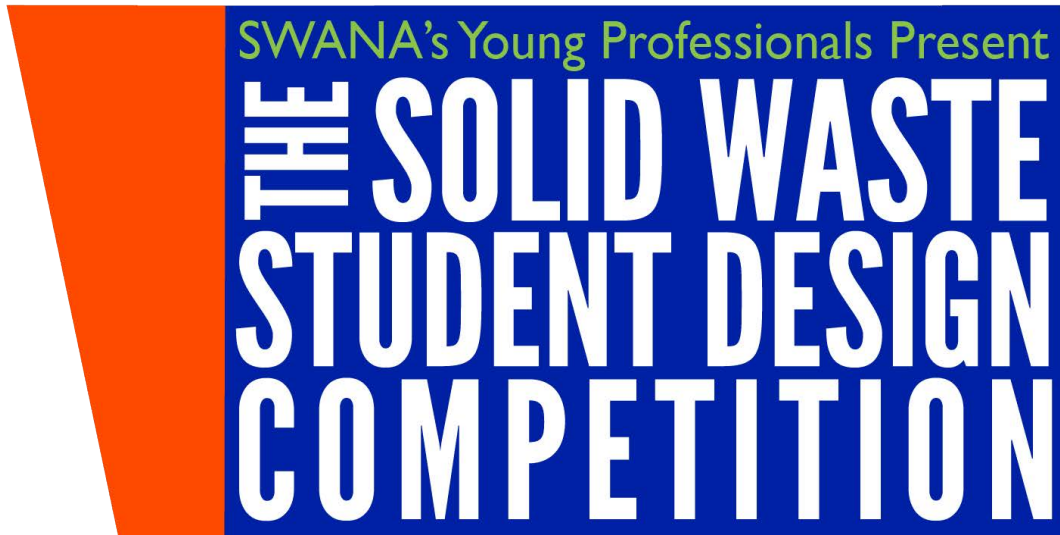


**SOLID WASTE DESIGN COMPETITION (SWDC)**  
*SWANA's International Student Competition*



**PROBLEM STATEMENT AND PROTOCOL**

**VIRTUAL EVENT**  
**March 2021**



## 1. Introduction

SWANA's International Solid Waste Design Competition (SWDC) is a student team competition focused on solving a "real world" problem faced by solid waste professionals. The competition aims at providing a professional experience to students pursuing an education and/or career in solid waste management. The goals of the SWDC are to:

- Encourage student involvement in SWANA's Annual National Conferences.
- Provide students with real world experience in solving complex solid waste management issues in a supportive and fun environment.
- Provide students an opportunity to display their talents.
- Establish a premier networking event for students to connect with potential employers.

This document outlines the problem statement and guidelines for the competition. **Participants are advised to read the entire document as guidelines detailed in this document must be followed.**

## 2. Problem Statement & Competition Format

The problem statement is provided under **Attachment 1**. In general, the SWDC is organized as explained below:

- Students to review problem statement and existing information. Interested teams to send completed team commitment form.
- SWANA will organize a telephonic kick-off meeting (or an online webinar) to explain problem statement and associated data.
- Students will be guided by the SWANA SWDC committee and paired with a mentor to assist teams with the project if requested.
- Student teams to present their solutions through poster, report and virtual presentation by meeting the deadlines (Section 4).

The solution to the problem statement must be detailed in a design report, poster and presentation. Guidelines for each of the three components are provided in Sections 6 through 8.

## 3. Eligibility to Participate

Participating teams must comply with the following criteria:

- Each participating team can have minimum of two (2) and a maximum of eight (8) team members. The recommended team size is a four (4) member team.
- Every participant must be enrolled as a full-time or a part-time student during competition enrollment. We understand that some students may be graduated or near graduation at time of the presentation. However, to ensure participation, **we require at least one student in the team be such that he or she anticipates graduation after the scheduled date for presentations.**
- Ideally, all team members should be from the same school/university; however, exceptions can be made. An exception request must be made using the *Team Commitment Form* provided as

**Attachment 2**, and the participant should reach out to the contacts provided for further discussion.

- The maximum number of student design teams is limited to ten (10) teams. The first ten (10) eligible entries received via *Team Commitment Form* will be entered into the competition.
- The *Team Commitment Form* must be signed by a school faculty member as their sponsor.

## 4. Deadlines

The deadlines for the competition are detailed below. Submissions must be made electronically (unless specified otherwise) to the contact person identified in Section 11.

- **Team Commitment Form:** Teams must submit the Team Commitment Form (**Attachment 2**) to participate in the competition. It is recommended to send the Team Commitment Form as soon as possible as the number of teams is limited to ten (10). Applications are due by September 21, 2020.
- The selected participants will be notified by September 25, 2020.
- A kickoff meeting will be held in early October 2020 to provide an overview of the competition, review the SWDC problem statement, requirements, and answer general questions. An additional follow up meeting will be scheduled for mid-January 2021. Further information will be provided to the selected teams.
- **Design Report:** The final design report must be submitted by February 12, 2021. The guidelines presented in Section 5 must be followed for the design report.
- **Poster:** Poster must be submitted by February 12, 2021. The guidelines presented in Section 6 must be followed for the poster.
- **Presentation:** The student design teams will present their solution virtually the week of March 15, 2021. The date and time for the presentation(s) are to be scheduled. The guidelines listed in Section 7 must be followed for the presentation.

Please note, these dates are subject to change due to the uncertainty of the COVID-19 pandemic. Selected teams will be notified accordingly if any schedule changes are made.

## 5. Design Report Guidelines

The Design Report must follow the structure listed below:

- Report must be submitted in pdf format.
- Font must be Times New Roman, 12-point font and double-spaced text.
- Recommended format for Citations/References: Chicago Style.
- The maximum number of pages is limited to 30 pages.
- Tables and figures can be provided as attachments in addition to the 30 page limit. There is no page limit on the attachments (tables and figures).
- The following outline is recommended for the report:
  - Introduction

- Solution for Closure of the Bakoteh Dumpsite
- Design for Developing a New Site Conclusion and Recommendations
- References
- Tables and Figures (provided as attachments, if additional space is required)

Refer to the judging sheet provided as **Attachment 3** to gauge expectation of the judges.

## 6. Poster Guidelines

The following guidelines must be followed.

- Poster shall be 24”H x 36”W (horizontal format)
- All posters must be created in a desktop page layout software (Adobe InDesign, Quark Express). Posters created in Microsoft Word or PageMaker will not be accepted.
- All art must be formatted as CMYK, hi-res images at least 266 dpi in RAW .jpg format.
- Final document must be saved as a hi-res PDF with all art and images embedded.
- Electronic poster file shall be submitted using Dropbox link or other similar online file sharing.
- Be clear and concise with poster design and content. Overcrowding a poster makes it difficult to read.
- Use fonts that are large enough to read at a distance. Your poster must include title, university represented, and all team member names. Figures, graphs, and tables should be uncluttered and simple and arranged in the sequence in which you want them to be viewed.
- Provide clear labels or headings for each section of your poster.
- Remember contrast. Put light-colored text on dark backgrounds and dark text on light-colored backgrounds so that your viewer can see your text clearly.
- Drawings, illustrations, and/or diagrams must be your own work.

### Tips for imbedded graphics:

- Use high-resolution images.
- Do not cut and paste art or screen-filled shapes from PowerPoint.
- Text may be copied and pasted from PowerPoint into the layout software, but it will require applying the “create to outline” setting after pasting.

Refer to the judging sheet provided as **Attachment 3** to gauge expectation of the judges.

## 7. Presentation Guidelines

Each of the participating teams will present their solution virtually. Presentation date(s) and time will be posted on the SWANA Website by the end of February 2021 and participating teams will be informed with further instruction. Presentation order will be chosen randomly. Plan for no more than a 20-minute presentation followed by 10 minutes for question and answer.

Presentation Guidelines and Tips:

- REMEMBER that the judges are your client and your firm is hired to solve their “real world” problem.
- The presentation needs to flow in a way that makes sense. Much as with writing a paper it should present the problem, discuss the alternatives and provide a solution.
- Don’t read word for word from the slides. Slides should contain a summary of what you will say.
- Don’t overwhelm the slide with too many images or complicated animations. Slides should be clean and easy to read with a common theme.
- Be sure to recognize team members that were not able to be present and thank anyone who provided mentorship throughout your project.
- Each speaker should have somewhat equal time presenting. It should not be mostly one person presenting and other people standing next to the only presenter. It is also nice to see everyone participating when responding to questions from the judges.
- Clearly state the main points, assumptions, and conclusions. You will have to make assumptions in the real world, so the judges need to see and understand your thought process.
- Understand that there is a balance to the amount of background information that should be presented. You can assume there might be people in your audience (including judges) that might not be familiar with the topic, so a little background is helpful, but it should be limited, since it is not the main purpose of the competition.
- Discuss the challenges that you were faced with and how that affected the outcome. Practice presenting and answering questions in front of an audience. The judges understand that you are a student, but like to see that you understand the basic engineering principles, and that you can think about their questions and come up with a reasonable answer.
- Consider videotaping yourself during a practice presentation and make notes of distracting mannerisms (i.e. saying “ummm” or “like” too often).
- Practice timing yourself. Make sure you dress for the part. You are presenting as though you are trying to win a job. Attire is business professional.

## 8. Judging

Judging sheet is provided as **Attachment 3**. The following Table provides a breakdown of the total points:

Item	Maximum Points
Design Report	100
Poster	25
Presentation	125
<b>TOTAL</b>	<b>250</b>

## 9. Award

Two team awards will be presented to the top teams with maximum overall scores. SWANA reserved the right to cancel all presentations if only one team or no teams are available to present – in that case winning teams will be based on overall scores for the Report and Posters.

The **minimum** award money is listed in the table below. In addition to these awards, every participating student will receive:

- a free conference registration for a SWANA Annual National Conference
- a free one year SWANA membership
- a free SWANA Young Professionals Webinar voucher

Rank	Prize
First Place Prize	\$2,000 (minimum)
Second Place Prize	\$1,500 (minimum)
Third Place Prize	\$1,000 (minimum)

The minimum awards are indicated above. In the past, awarded amounts were as much as double the advertised minimum amounts. Smaller monetary awards will also be given out for the best use of visual aids, best presentation, and most innovative and realistic solution. It may be possible for a team to receive more than one award.

## 10. Closing Remarks

Although most information may be available online, participants should note that additional information may require contacting vendors. If this is the case, please remember that you are acting as a consultant. Be professional, polite, persistent and concise in the requests to obtain necessary information.

At the end of the day, a consultant may need to contact the client for data requests. If you run into an issue that requires critical information that you believe is not provided, please contact the persons listed below.

## 11. Contact Persons

All submissions must be made electronically (unless specified otherwise) to **all contacts** listed below. Any question regarding the competition must be directed to Bridget or Nate.

- Bridget Wlosek ([wlosekbk@cdmsmith.com](mailto:wlosekbk@cdmsmith.com))
- Nathan Mayer ([nmayer@swa.org](mailto:nmayer@swa.org))
- Mateja Vidovic Klanac ([mvidovicklanac@scsengineers.com](mailto:mvidovicklanac@scsengineers.com))
- Karam Singh ([ksingh@hdrinc.com](mailto:ksingh@hdrinc.com))

## **ATTACHMENT 1 – Problem Statement**

# Solutions for Closing the Bakoteh Dumpsite and Supporting Changes to Modern Solid Waste Management in Kanifing, The Gambia

## Background Information:

The Bakoteh Dumpsite, is located about 15 km from Banjul, the capital city of The Gambia. Bakoteh is in the western side of Serrekunda, under the administration of Kanifing Municipal Council. The Bakoteh Dumpsite, which spans an area of about 17.8 hectares, is located on an old quarry.

The dumpsite is located in an area, which is densely populated and is visible to residents, passers-by and motorists. It is on the highway leading to the Tourism Development Area and forms an unsightly spectacle of strewn garbage as a result of indiscriminate and uncontrolled dumping of waste. The Bakoteh Dumpsite borders a busy highway for approximately 400 meters. Bakoteh Dumpsite has a negative visible impact on residents and tourists visiting The Gambia.

With the rapid population growth and subsequent land rush, the dump site is now at the center of a residential settlement. Open burning is prevalent and burning and smoldering garbage is a regular feature on the site. Trash is dumped along the edge of the site and an unbearable stench envelops the area. The Bakoteh dumpsite also has the following current issues:

- Potential environmental impacts related to groundwater contamination, gas migration, fires, air pollution, explosions, slope stability and global warming
- Unlined dumpsite with very little buffer between the edge of the dumpsite and residents
- No leachate management or gas collection system
- Health risks to municipal employees, waste pickers and surrounding residents
- Air quality and mosquito issues due to dumpsite for orphanage across the street
- Waste is not compacted or covered. As space decreases, the potential for slope stability issues are increasing
- Waste combustion is prohibited, but still occurs and is a source of air pollution
- No entrance fees at the dumpsite, waste management is underfunded
- No organized door to door collection, narrow and unpaved roads
- Medical (COVID-19) and battery waste is intermingled with residential and business waste
- Stormwater ponding occurs during rainy season
- Limited in-country dozer maintenance capacity
- Limited in-country solid-waste knowledge



In the Fall of 2019, the Kanifing Municipal Council (KMC), the Midwest Gooh Group (Madison, Wisconsin), and other entities developed a “Feasibility Study, Recommendations, and Request for Proposal” report to assist the KMC with solid waste infrastructure improvements related to the Bakoteh dumpsite.

Additionally, the International Solid Waste Association (ISWA), published an article discussing the importance of closing contaminated waste sites around the world. The KMC is attempting to obtain funding to build an engineered, sanitary landfill and subsequently close the Bakoteh dumpsite. In the past year, the KMC has made moderate capital improvements at the Bakoteh Dumpsite, which include the following actions:

- Installing a 6-meter high brick fence around the dumpsite to improve security and help to limit fires
- Hiring a dumpsite manager to improve the collection of tipping fees, site security, and help to manage the well-being of the waste pickers
- Awarding funds to youth groups to recycle old tires to build more collection containers across the municipality
- Beginning the use of rear load waste collection vehicles in combination with donkey carts. The expanded coverage of waste collection has helped to reduce waste in public areas

Additional background information can be found in **Attachment A**.

### **Closure of the Bakoteh Dumpsite:**

Following ISWA’s “Roadmap for Closing Waste Dumpsites”, found in **Attachment B**, the Student Design Teams are tasked with assisting the KMC in developing a Closure Plan for the Bakoteh Dumpsite. The ultimate goal is to close the Bakoteh Dumpsite in a way that protects human health and the environment while supporting the neighboring community and those who depend on the dumpsite for a living.

The Closure Plan should address how the site will be remediated, maintained, monitored, and developed, in a way that is economically feasible and beneficial for the community. The Plan shall include, but not limited to the following:

- Design of a dumpsite closure plan, including a cap, gas collection system, and groundwater pollution mitigation system. The design systems shall collect landfill gas and prevent lateral gas migration into adjacent neighborhoods, reduce potential impacts from groundwater contamination, be economically feasible and benefit the community.
- Evaluate options for future development of the site. For example, potential uses for the site include a safe and sustainable material recovery and waste transfer facility, community greenspace/park, renewable energy (solar), or hybrid, etc.
- Determine the funding needed and required operations of the new facility.
- Develop a brief financial analysis of the closure systems and new facilities.

- Capacity building to operate and maintain the gas collection system and maintain the integrity of the closed dumpsite
- Capacity building to conduct routine groundwater and gas probe monitoring to protect public health and welfare

### **Development of a New Site:**

Before the Bakoteh Dumpsite is closed, the KMC will need to move solid waste disposal operations to another location. The Student Design Teams will develop a preliminary design for a new waste disposal site. The new site will include a sanitary landfill and other disposal/recycling operations that will benefit the community and promote waste diversion. The new sanitary landfill will be sized appropriately based on population projections and estimated disposal rates. Include a phasing plan for the new sanitary landfill. Include a plan for consolidation and transfer of waste from the communities to the new landfill site. Include recycling opportunities. Address the socio-economic impacts of displacing the current waste pickers at the site. The design of the sanitary landfill will include a liner system, leachate collection system, and gas collection system. Teams will develop a brief cost estimate for the design.

The design of the new site will be cost effective, operable by members of the community, and improve regional sustainability, recycling and waste diversion. The Student Design Teams will be expected to think global, as technologies commonly used in America and Europe might not be suited for developing nations such as Kanifing.

### **Student Design Team Expectations:**

- Creativity in the design approach
- Strong critical thinking and teamwork skills
- Professionalism shown through communication and documentation

# Attachment A

BACKGROUND INFORMATION

## **The Gambia and Kanifing Municipal Council**

Kanifing Municipal Council is one of the eight Local Government areas of The Gambia. It has a population of 382,096 inhabitants (2013 census) representing about 24 percent of the total population of the country. With a land surface of 75.5 square kilometers and population density of 5,057.5 persons per square kilometer, the municipality is considered to be the most densely populated in The Gambia. Between 1993 and 2003, the population increased by 15 percent.

Projections from the Gambia Bureau of Statistics (GBoS) indicates that from 1973 to 1983 there was a 9.9 percent increase in the population, while from 1983 to 1993 there was a population increase of 8.4 percent indicating a reduction of 1.5 percent within the period. Between 1993 and 2003, there was a 3.5 percent increase in the municipal population. The trend witnessed in the last three decades is likely to continue considering the current levels of socio-economic development activities in the municipality, which are attracting migrants. In 2003, the number of migrants into the municipality was 47,022 representing 14.6 percent of the population while the number of refugees represented 5.9 percent of the population.

The municipality has a large youth population. The under-five population is estimated at 45,160. Women within childbearing age (15 -49) are estimated at 97,700 therefore constituting a little over 31 percent of the population.

### **Bakoteh Dumpsite Background and History**

The purpose of a solid waste disposal system is to immediately remove waste from the urban areas, reduce its volume, stabilize it and make it hygienic. The choice of an appropriate treatment and disposal method should take into consideration the geographical layout, the financial viability and accessibility of technology resources within the entity that manages the waste.

There is currently one official site in municipality, The Bakoteh Dump Site, located about 15 km from Banjul, the capital city of The Gambia. Bakoteh is in the western side of Serrekunda, under the administration of Kanifing Municipal Council. Bakoteh Dumpsite is along the Kotu-Manjai Kunda road, off the Serrekunda-Sukuta highway and the Senegambia highway.

The Bakoteh Dumpsite, which spans an area of about 17.8 hectares, is located on an old quarry. The site is not fenced nor is there a clearly defined boundary and can be accessed on foot from all directions. It undulates with mounds and troughs of garbage and because of the uncontrolled nature of dumping at the site, there is an unsightly stretch of garbage and strong stench across the dumpsite and along the 400 meters or so bordering the SOS highway.

The dumpsite is located in an area, which is densely populated and is visible to residents, passers-by and motorists. It is on the highway leading to the Tourism Development Area and forms an unsightly spectacle of strewn garbage as a result of indiscriminate and uncontrolled dumping of waste. Bakoteh Dump site has a negative visible impact on residents and tourists visiting The Gambia.

Another source of negative visual and health impacts is the smoke from burning debris, which at times covers parts of the residential areas and the main road linking Serrekunda to the Tourism

Development Area significantly reducing the visibility of motorists and pedestrians.

With the rapid population growth and subsequent land rush, the dump site is now at the center of a residential settlement. Open burning is prevalent and burning and smoldering garbage is a regular feature on the site. Trash is dumped along the edge of the site and an unbearable stench envelops the area.

Management operations at the dump site are minimal. The few KMC personnel stationed at the site try to direct vehicles to “suitable” tipping areas without much success. Waste pickers scour the site for materials of economic or personal value and the returns from the sale of these materials go to the waste pickers. There is no compaction of waste or application of cover material. There are dwelling shacks within the site, which are also used as storage areas for scavenged materials.

### **Site Location and Adjacent Land Use**

The Bakoteh Dumpsite does not conform to standards required for locating a landfill.

Despite this finding, it is not feasible to hastily close the site until a suitable alternative site is identified and properly developed. The decision to continue with the disposal of waste at the Bakoteh landfill contravenes established national and international environmental standards. This situation is not desirable since The Gambia is a party to a number of international conventions and agreements and the continued use of Bakoteh as a dump site does not reflect well on the country’s commitment to environmental protection.



Figure 1 – Map of the Gambia and Kanifing



Figure 2 – Aerial Map – Bakoteh Landfill



Figure 3 – Waste pickers scavenging through trash





Figure 4 – Example of donkey cart for waste collection



Figure 5 – No clearly defined boundary between the Bakoteh dumpsite and neighboring residents

### Waste Characterization Information

A total of 25 samples, totaling 2.498 tonnes were collected during a waste characterization study in 2015. Below represents an overview of the results.

Main material groups	%
Organics	36.45
Other	19.28
Plastics	15.22
Textiles	7.80
Paper and paperboard	5.81
Construction and Demolition	5.54
Hazardous Waste	5.22
Glass	1.35
Metals	3.32

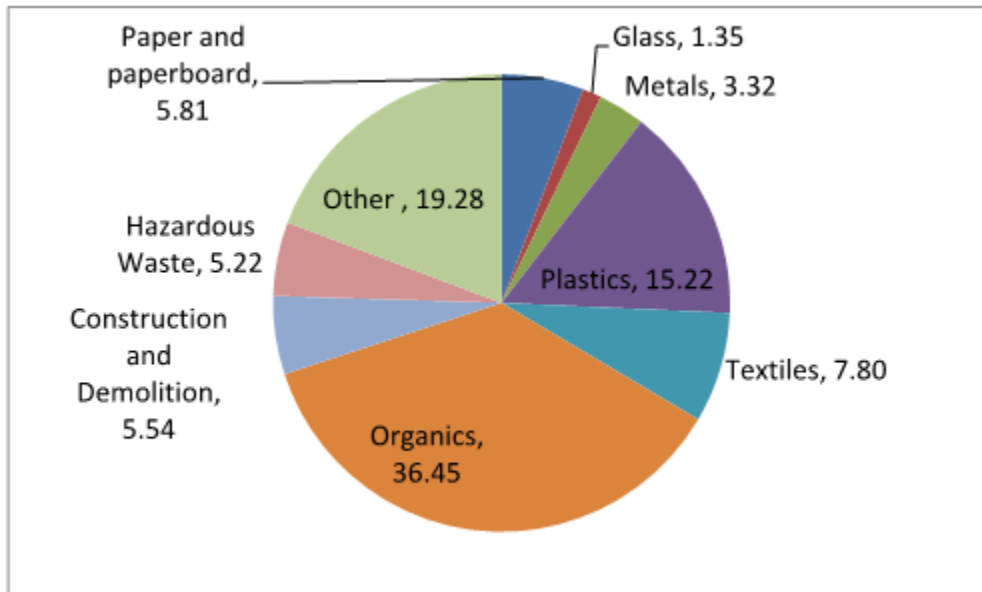


Figure 6: Waste Characteristic Analysis (WasteAid UK, 2015)

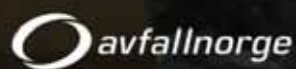
# Attachment B

ISWA A ROADMAP FOR CLOSING WASTE DUMPSITES

# A Roadmap for closing Waste Dumpsites

The World's most  
Polluted Places

With the support from:



# ISW



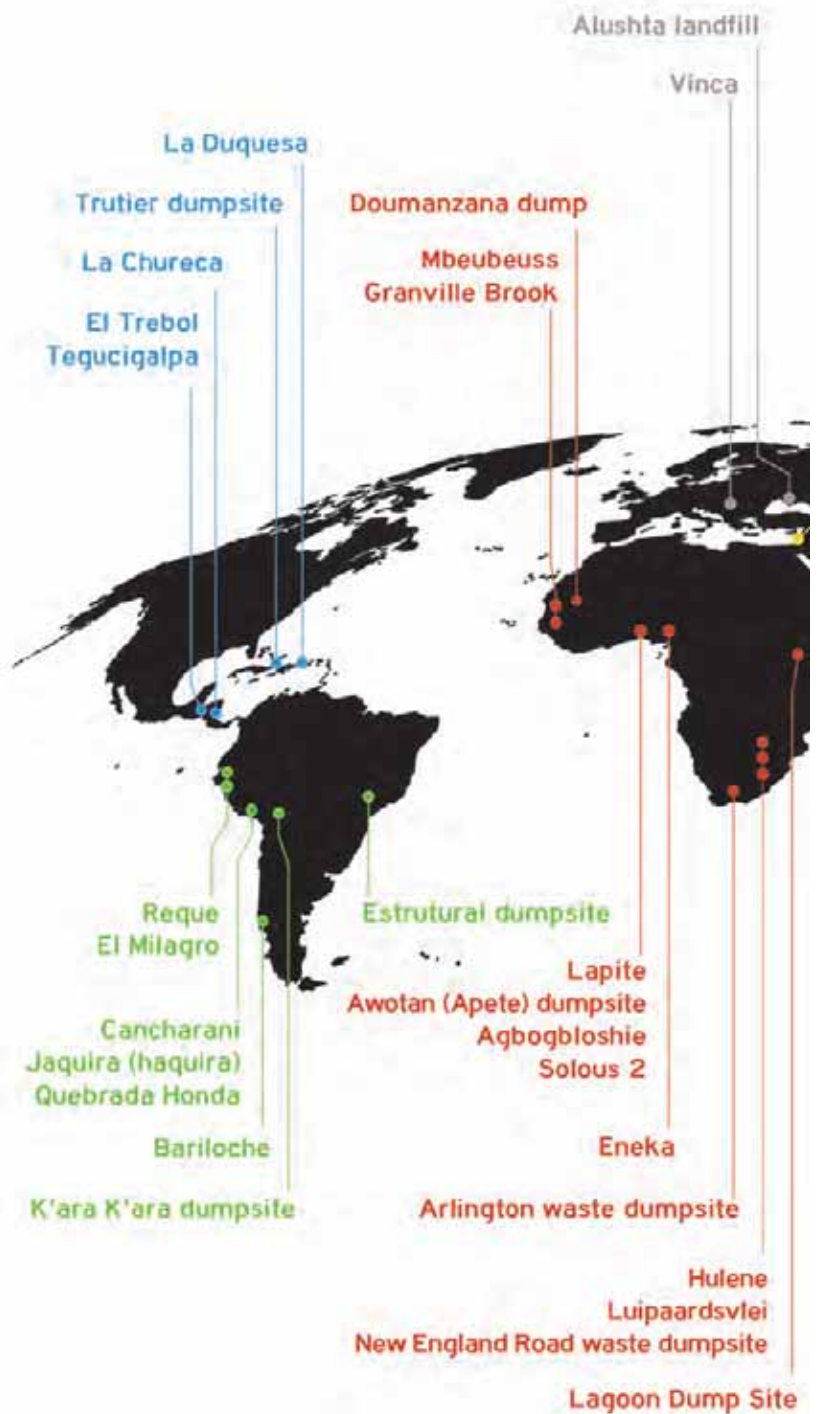
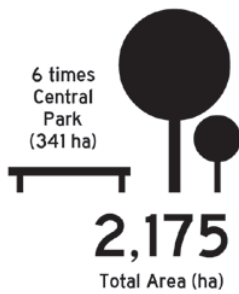
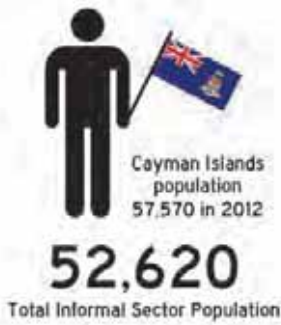
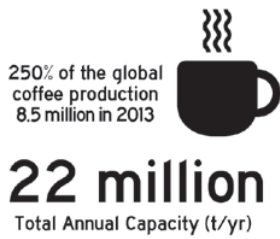
The International Solid Waste Association, is a global, independent and non-profit making association, working in the public interest to promote and develop sustainable waste management.

ISWA's objective is the worldwide exchange of information and experience on waste management. The association promotes the adoption of acceptable systems of professional waste management through technological development and improvement of practices for the protection of human life, health and the environment as well as the conservation of materials and energy as the conservation of materials and energy resources.

ISWA's vision is an Earth where no waste exists. Waste should be reused and reduced to a minimum, then collected, recycled and treated properly. Residual matter should be disposed of in a safely engineered way, ensuring a clean and healthy environment.

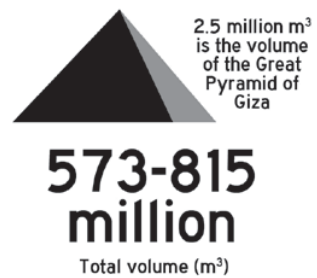
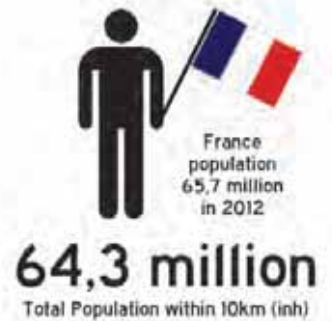
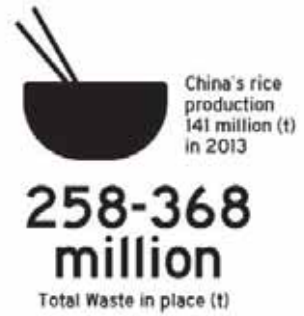
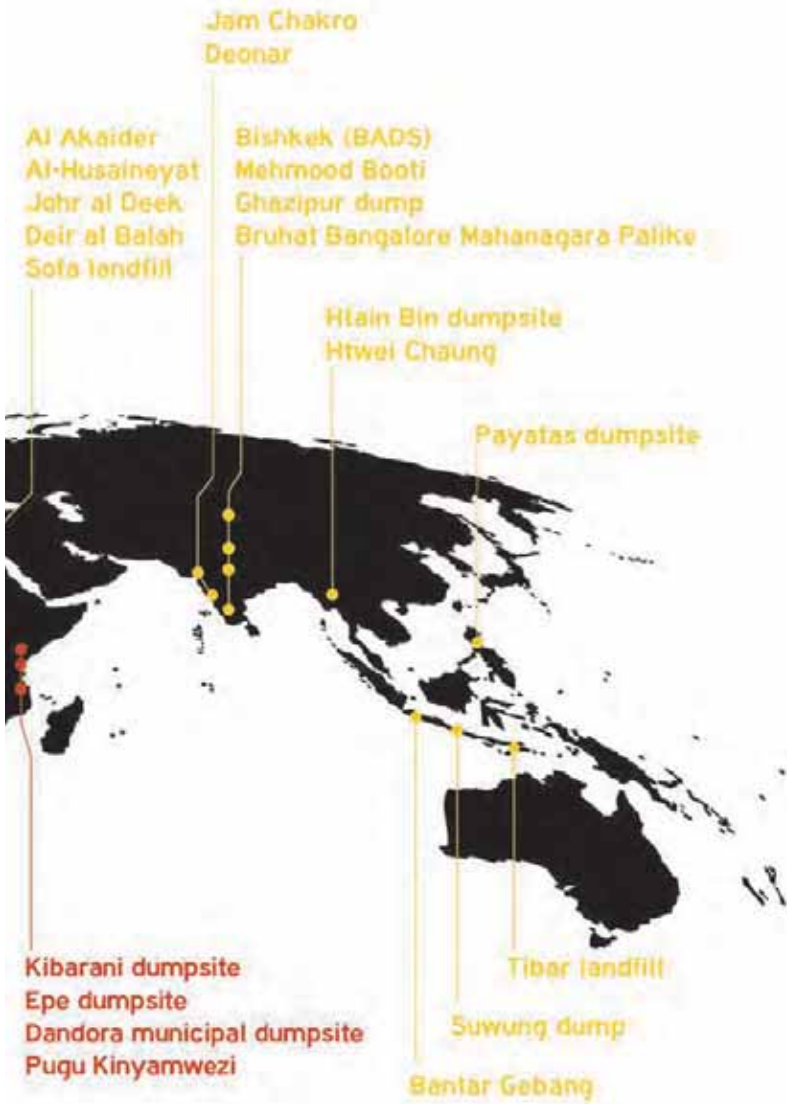
All people on Earth should have the right to enjoy an environment with clean air, earth, seas and soils. To be able to achieve this, we need to work together.

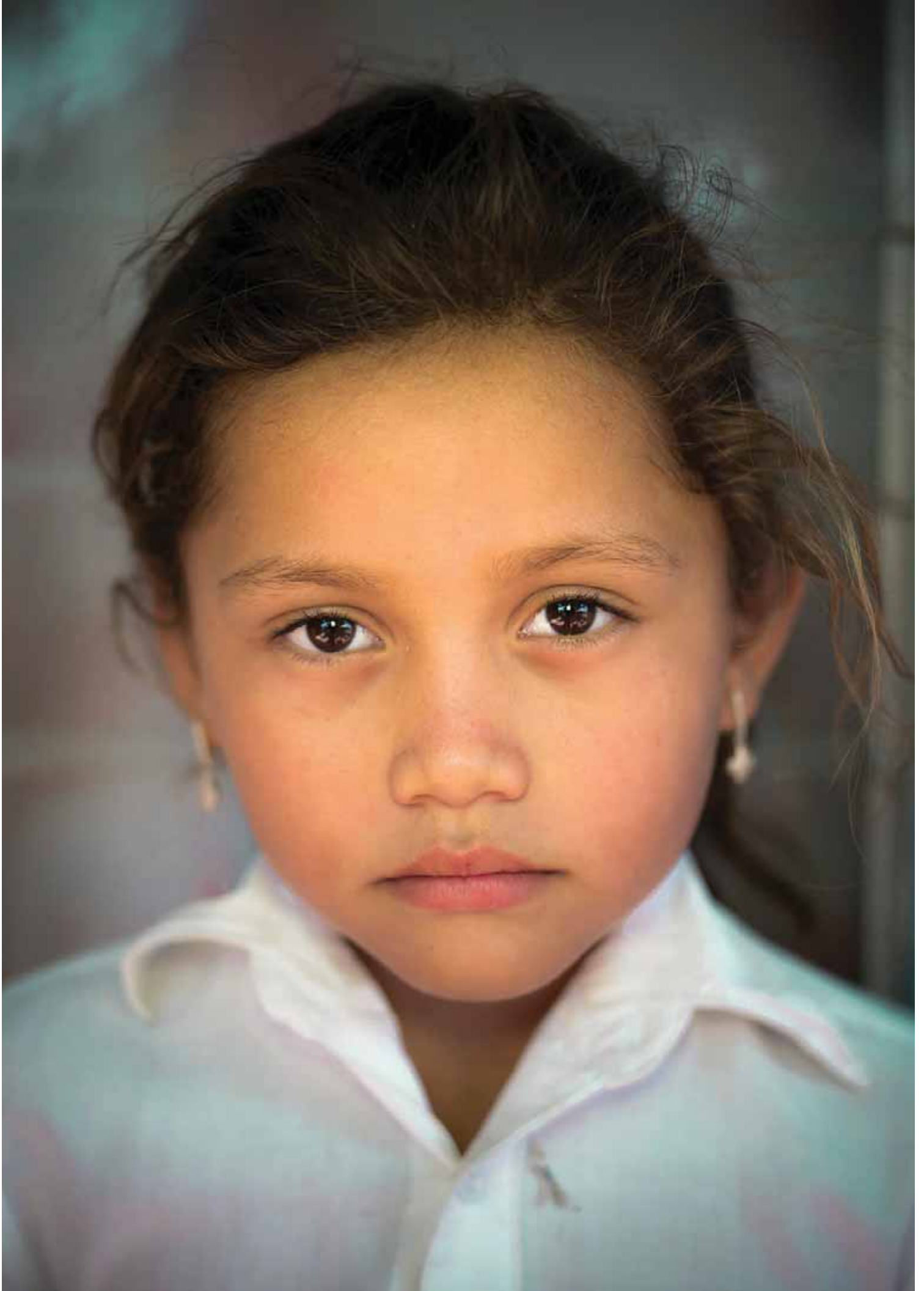
Fig. 1: Waste Atlas / Summarized





information of the 50 biggest active dumpsites





# Foreword

**Waste is about people. Our lives, the air we breathe, the water we drink, the food we grow and eat, the resources we cut down or out of the ground, the cleanliness of our environs and especially the cities we live in, are all impacted by poor waste management. No clearer example of a badly run city or town is shown by how poor is its waste management system. When waste is burning in open dumps, spreading dioxins over the landscape, black smoke billowing into the air, then you know that place is badly administered. When animals and children are living in waste dumps, you know you are in a situation where probably corruption is rife, the city has few financial resources, and the politicians have not got their priorities right: protecting the health and well-being of us, citizens living there.**

Because as this report, and the 2015 Global Waste Management Outlook (by UNEP and ISWA) make clear, doing the right thing is cheaper than allowing bad practice to continue over time. Yet even to well intentioned local administrators and ministers, it seems that doing the right thing is too expensive, an insurmountable barrier of political, social and economic opposition to overcome to make change happen.

Change can happen, and happily it happens more than we imagine. This report sets out how we can move from dramatically polluting sites to better, cleaner practices. Much of the report focuses on governance because good governance is key to getting the rest right. And the relationships with private enterprise, merchants, transport-

ers, informal collectors and scavengers, are dealt with in detail. We offer guidance on how to finance change, a daunting prospect in many places.

This report gives us hope that the international community will move forward on its recommendations to close the world's most polluting sites. We owe it to the people living in or near them, but we owe it to our children and their children too.

We thank the authors, I (David) thank the Board of ISWA for approving the project, Antonis for leading it and the Norwegian Solid Waste Association Avfall Norge, for their generous donation, which we hope, will be an encouragement for other countries to get involved in this critical matter immediately.

---

*David Newman*  
*ISWA President*  
*09.2012/09.2016*

*Antonis Mavropoulos*  
*ISWA President*  
*09.2016*



**Antonis Mavropoulos**



**Luís Marinheiro**



**Peter Cohen**



**James Law**



**Derek Greedy**



**Ana Loureiro**



**Sifis Plimakis**



**Timothy Bouldry**

# Team

This report has been prepared as a part of ISWA's Scientific and Technical Committee Work-Program 2015-2016.

The report is a collective work that was realized by the following team:

## **Antonis Mavropoulos**

ISWA STC Chair, CEO of D-Waste (Coordinator and Lead Author). More about Antonis at his website:

<http://wastelessfuture.com>

## **Peter Cohen**

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<https://br.linkedin.com/in/peter-cohen-b4168015>

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## **Luís Marinheiro**

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[www.linkedin.com/in/law-james-93076329](http://www.linkedin.com/in/law-james-93076329)

## **Ana Loureiro**

Member of ISWA's Working Group on Communication and Social Issues (Communication advisor). More about Ana at her profile:

<https://pt.linkedin.com/in/ana-loureiro-29266414>

The great photos of **Timothy Bouldry** have substantially advanced this report. Timothy is a photographer and activist that has been photographing, exploring and educating people about dumpsites and the people who live in them, for several years. Timothy is also the focal point for ISWA's Scholarship Program. His work is available at his website:

[www.timothybouldry.com](http://www.timothybouldry.com)



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Professor Mona Iyer

Dr. Ljiljana Rodic

Professor Costas Velis

Dr. Otto Simonett

Ainhoa Carpintero

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The great support and help received by ISWA's General Secretariat members Kata Tisza and Paul Stegmann.

*This report has also been made possible thanks to the generous financial support of the Norwegian Solid Waste Association, Avfall Norge - [www.avfallnorge.no](http://www.avfallnorge.no)*

# List of figures and tables

- 4 Figure 1:** Waste Atlas / Summarized information of the 50 biggest active dumpsites
- 27 Figure 2:** Dumpsites as a global challenge
- 30 Figure 3:** Integrated sustainable waste management framework from GWMO
- 40 Figure 4:** The social dimensions of waste management
- 53 Figure 5:** Steps required for working with informal recyclers
- 58 Figure 6:** Waste governance conceptual model and elements
- 67 Figure 7:** Policy roadmap towards integrated waste management of the government of the Republic of Sierra Leone
- 68 Figure 8:** Scale economies in landfill operational cost
- 81 Figure 9:** The structure of a PPP project
- 82 Figure 10:** A potential structure of financial instruments
- 85 Figure 11:** Summary of eligibility criteria
- 89 Figure 12:** Cost recovery conceptual model
- 118 Figure 13:** Prescriptive cover section profile
- 118 Figure 14:** ET cover section profile
- 119 Figure 15:** Upgrading liner section profile
  
- 34 Table 1:** Closing the dumpsites and SDGs
- 46 Table 2:** Actors categorization and possible impacts
- 95 Table 3:** Immediate improvements for dumpsites
- 112 Table 4:** Alternative financial instruments
- 116 Table 5:** Alternative cost recovery options



# Contents

- 15 Key-messages**
- 18 Introduction**
  - Scope of work
  - Next steps
  - ISWA's Scholarship Programme
- 24 Alarming signals**
- 28 What it means to close a dumpsite**
- 32 Dumpsites and the Sustainable Development Goals**
- 38 It's about People, not Waste**
  - The Social Dimensions of Solid Waste
  - Social Management of Dumpsite Closure
  - Stakeholder Analysis
  - Stakeholder Engagement
  - Communication and Awareness Raising Strategies
  - Informal Recyclers
- 57 Governance is the key for change**
  - A public interest issue
  - The systemic shift required
  - Elements of the systemic shift
  - Developing human resources and waste management departments
  - Transition period: the case of Bo City, Sierra Leone
  - The importance of regionalization
- 71 Financial and economic problems: Yes we can!**
  - A note on International Aid Tools and their efficiency
  - Negative economic impacts by dumpsites
  - Barriers for closing a dumpsite
  - Alternative schemes for financing a dumpsite closure & system upgrade
  - Alternative institutional forms
  - Eligibility criteria
  - Benefits from dumpsite closures and system upgrade
  - Cost recovery and tariffs
  - Suggestions for the International Aid tools
- 92 Technical challenges: there is a solution for every problem**
  - The need for immediate improvements
  - Long-term solutions
  - Closure Plan
  - Cover System
  - Cover Design Types
  - Key Issues & Tips for Successful Managing Technical Challenges
  - Guidance on Applying Closure Solutions
  - Site allocation for a new Sanitary Landfill
  - Basic steps of construction & operation of a new facility
- 112 Annex 1: Alternative financial instruments
- 116 Annex 2: Alternative cost recovery options
- 118 Annex 3: Cover Design Types
- 120 Annex 4: Site allocation criteria

# Acronyms

**BANANA:** Build Absolutely Nothing Anywhere Near Anyone

**EA:** Environmental Analysis

**GAHP:** Global Alliance on Health and Pollution

**GHGs:** Green House Gases

**GWMO:** Global Waste Management Outlook

**IHME:** Institute for Health Metrics and Evaluation

**ISWA:** International Solid Waste Association

**ISWM:** Integrated Sustainable Waste Management

**NIMBY:** Not in My Back Yard

**POPs:** Persistent Organic Pollutants

**PPPs:** Public Private Partnerships

**PSP:** Private Sector Participation

**SDGs:** Sustainability Development Goals

**SMCW:** Sound Management of Chemicals and Waste

**SWM:** Solid Waste Management

**UN:** United Nations

**UNEP:** United Nations Environmental Program

**WHO:** World Health Organization



# Key Messages

**From December 2015 to June 2016, in only seven months, ISWA has recorded more than 750 deaths related to poor waste management in dumpsites and several incidents with important health impacts (see chapter “Alarming Signals”). There is no doubt about it: dumpsites are a global health and environmental emergency.**

Dumpsites receive roughly 40% of the world’s waste and they serve about 3-4 billion people. As an example, the 50 biggest dumpsites affect the daily lives of 64 million people, a population the size of France. As urbanization and population growth will continue, it is expected that at least several hundreds of millions more people will be served by dumpsites, mainly in the developing world. If the situation follows the business as usual scenario then dumpsites will account for 8-10 % of the global anthropogenic GHG emissions by 2025.

The operation of dumpsites damages the health and violates the human rights of the hundreds of millions of people that are living in their surroundings or even inside them. As is demonstrated later in this report, closing the world’s dumpsites becomes a central element for the progress of the Sustainability Development Goals (SDGs). Ensuring proper sanitation and solid waste management sits alongside the provision of potable water, shelter, food, energy, transport and communications as essential to society and to the economy as a whole.

It is important to remember that closing down a dumpsite is neither a simple nor

an easy task. It requires an alternative waste management system, so it requires adequate planning, institutional and administrative capacity, financial resources, social support and finally political consensus. All of these conditions are really difficult and sometimes impossible to meet in countries where dumpsites are the dominant method of waste disposal and level of governance quality is questionable.

This report provides the guidance required, to each and every local authority or government, for the process and procedures required to close a dumpsite and develop an alternative sound waste management system. The report proves that all the elements for closing a dumpsite (technical, financial, governance and social) are proven and available.

The report proves that for each and every case, there is a Roadmap that drives to an improved waste management system with minimum environmental and health impacts.

However, it is well known that many poor countries face serious barriers in their efforts to attract International Development Assistance because usually they lack the minimum administrative structures and know-how to prepare the relevant paperwork and strategic frameworks. This results in an inconvenient truth: without a proper international community intervention, those countries will not be able to close their dumpsites and upgrade their waste management systems and the vast health and environmental impacts of dumpsites will only grow and expand.

Taking into account that some of the poorest countries of the world are the ones with the most rapid population growth, it is obvious that the health threats will be very important, especially in the world's emerging megacities. With the current level of interconnectivity, certainly this can't be considered as a local problem and the international community can't close its eyes in front of the frightening prospect of mega-dumpsites that will affect the lives of hundreds of millions of people.

ISWA believes that speaking about the change required is not enough anymore. Making reports, presentations and supporting local authorities and governments for a more sustainable waste management is a starting point, but more tangible and game-changing activities are required, like the recent ISWA's Scholarship Program.<sup>1</sup> The program targets kids who are sorting garbage in dumpsites called Nueva Vida and La Chureca in Nicaragua. The program provides funding and administration for removing 40 children from the dumpsites and providing them with a quality education for two years.

ISWA hopes that the program will be further expanded with the support of other organizations and donors.

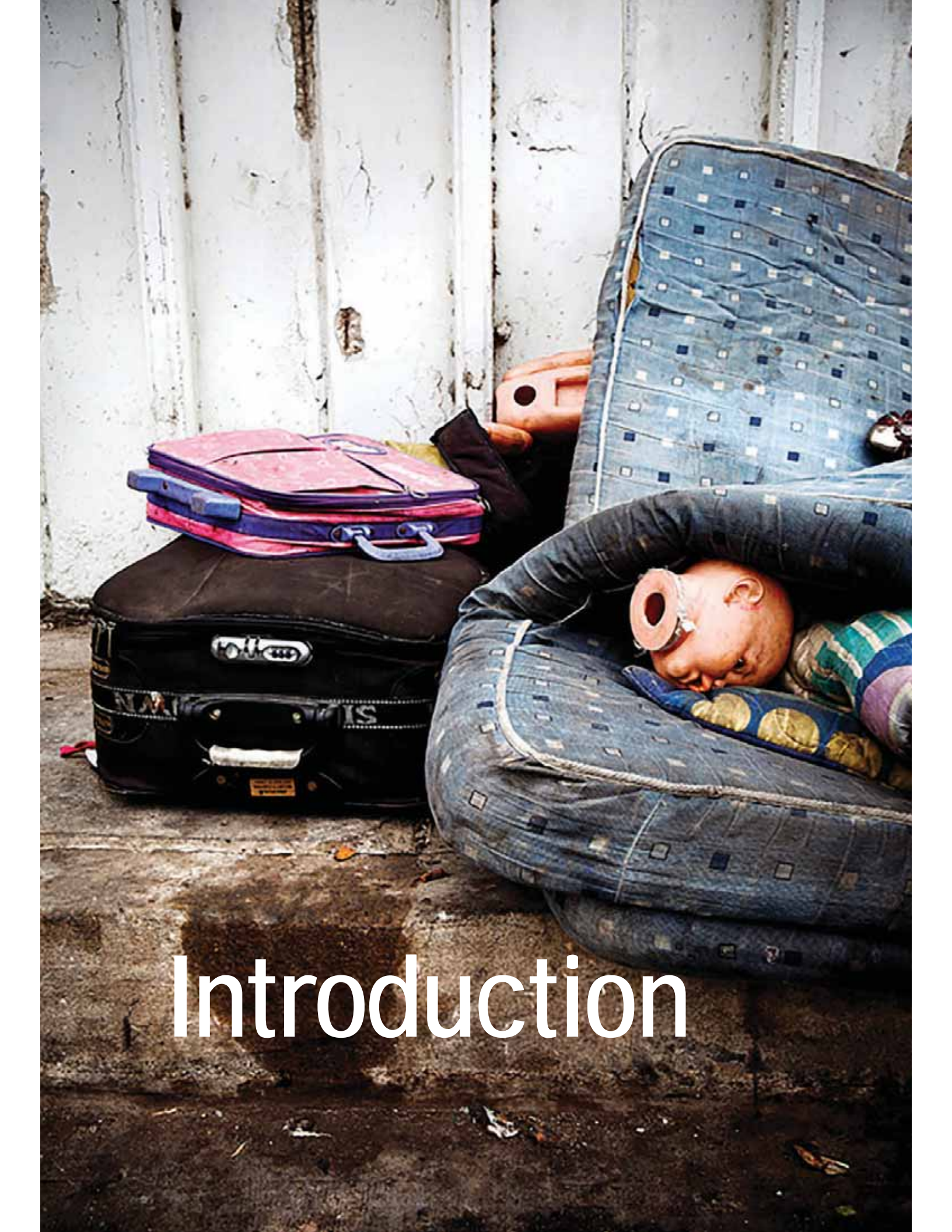
ISWA calls everyone to cooperate and contribute towards a world without dumpsites. As a first step, ISWA calls on the international community to cooperate, in every possible form, for the immediate closure of the 50 most polluting dumpsites of the world. This single, but not simple, target will immediately improve:

- # The health conditions of millions of people.
- # The quality of life for the millions living around and inside the dumpsites.
- # The business landscape in the developing world, as closing the dumpsites is a key-element for the development of new markets related to waste management and recycling services.

In addition, closing the world's dumpsites will provide substantial reduction of CO2 emissions and it will decrease the leakages of solid waste to the oceans, as many dumpsites are located near the coast or inland waterways.

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<sup>1</sup> See more about ISWA's Scholarship Program at [www.iswa.org/programmes/iswa-scholarship-programme](http://www.iswa.org/programmes/iswa-scholarship-programme)



# Introduction

**The term “open dump” (or dumpsite) is used to characterize a land disposal site where the indiscriminate deposit of solid waste takes place with either no, or at best very limited measures to control the operation and to protect the surrounding environment.**

A typical open dumpsite consists of waste from many sources, waste types and compositions. The waste deposited is also not covered or compacted and in most cases in these open dumpsites, waste remains susceptible to open burning. Exposed wastes are open to all weathers and needless to say are often not engineered at all, with no leachate management and no landfill gas (LFG) collection. In addition, they are poorly managed without any controls on accepting incoming materials or record keeping.

Open dumpsites often but not always permit scavengers or waste pickers for collecting recyclables without any protection measures and in most cases allowing even living within dump sites or sometimes even scavenging for food leftovers.

In this perspective, dumpsites pose significant health threats both to the people involved in the operations and to the general public living in the neighborhood.

The most important impacts of open dumps on the environment and to public health and safety are those relative to proximity to waterways, geological/hydrogeological conditions, climatic conditions, long-term contamination due to leachate or landfill gas migration, and of course the

greenhouse effect via emissions of carbon dioxide and methane, including open burning of waste releasing smoke, particulates, and gaseous contaminants into the atmosphere.

Burning directly releases toxic POPs into the atmosphere around dumpsites and, with wind carrying these, into the environment at long distances from their origin. Fauna, plants or vegetation can be impacted directly from these contaminants and often-dead vegetation and animals are associated with the zone of impact from direct contamination by waste or leachate, the migration of gases, or as a result of burning or smoke.

The potential for the spread of infection is large and is often related to direct contact with the waste by workers, scavengers and other unauthorized persons. The other transmission pathway is by vectors such as rodents, vermin, birds, flies and mosquitoes.

In order to protect the environment and to assure better public health and safety, open dumps have not been permitted in developed countries for the last 30 years at least. They have been replaced completely by engineered sanitary landfills and complimented with other waste disposal technologies and methods.

In 2014-2015, ISWA prepared and contributed to three major reports related to dumpsites and the conditions of waste management in the developing world. In 2014, ISWA contributed to the *Waste Atlas Report on the 50 biggest dumpsites*, which was the

first effort to register the biggest dumpsites of the world. In 2015, ISWA and UNEP published the emblematic *Global Waste Management Outlook* (GWMO), the first comprehensive and impartial in-depth assessment of global waste management. Also, in 2015, ISWA published the *Wasted Health Report*, an update regarding the health impacts posed by dumpsites.

All the reports provided the dramatic picture of the world's dumpsites and documented that their closure is a global health emergency. If the situation follows the business as usual scenario, then dumpsites will account for 8-10 % of the global anthropogenic GHG emissions by 2025, while creating important health risks and causing massive environmental degradation. With the increasing public awareness of environmental issues and the demand for a cleaner environment, including the current focus on sustainability, circular economy, and global climate change, open dumps have become an issue in developing countries.

Therefore, in many communities particularly in developing countries, discussion on closing or alternatively upgrading open dumps is a key issue. The closing or upgrading of open dumps is an essential step in reducing future environmental and public health impacts and avoiding future costs caused by waste disposal mismanagement as evident at all open dumps around the world.

Therefore, ISWA decided to elaborate a Roadmap for Closing Waste Dumpsites in order to help international stakeholders and local authorities assess the nature and

extent of work necessary to close down the dumpsites. At the same time, the Roadmap will serve as a first step towards the creation of a global movement for closing down some of the world's most emblematic dumpsites.

It is important to remember that closing down a dumpsite is neither a simple nor an easy task. In addition, many countries face serious barriers in their efforts to attract International Development Assistance, as ISWA's report *A Review of Development Co-operation in Solid Waste Management*<sup>2</sup> (part of the *Globalization and Waste Management*<sup>3</sup> project) has shown.

Taking into account that some of the poorest countries of the world are the ones with the most rapid population growth, it is obvious that the health threats will be very important, especially in the world's emerging megacities. With the current level of interconnectivity, certainly this can't be considered as a local problem and the international community can't close its eyes in front of the frightening perspective of mega-dumpsites that will affect the lives of hundreds of million people.

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<sup>2</sup> A Review of Development Cooperation in Solid Waste Management, available at [https://www.iswa.org/fileadmin/galleries/Task\\_Forces/TFGWM\\_Report\\_Review\\_International\\_DCSWM.pdf](https://www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_Review_International_DCSWM.pdf)

<sup>3</sup> Globalization and Waste Management, Final Report, available at [http://www.iswa.org/fileadmin/galleries/Task\\_Forces/TFGWM\\_Report\\_GWM\\_LR.pdf](http://www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_GWM_LR.pdf)



## Scope of work

The Roadmap is intended to be a crosscutting strategic document with a focus on the political, financial, technical, environmental and social requirements needed before, during and after the closure of dumpsites. More specifically, the project's objectives are:

1. To provide the Roadmap and the major milestones required to close the dumpsites at the national and local level
2. To highlight the key-challenges involved and the ways to manage them
3. To serve as a reference point for decision-makers worldwide when they design policies and measures aiming to close the dumpsites
4. To deliver an appropriate communica-

tions plan and materials regarding the need to close the dumpsites

5. To outline the Action Plans that must be implemented for closing dumpsites
6. To deliver a series of presentations that will serve as the basis for ISWA's relevant public outreach through workshops and seminars

The current report and its related materials cover objectives 1-3 and partially objective 6. Objectives 4 and 5 are subject to the next steps of the project.

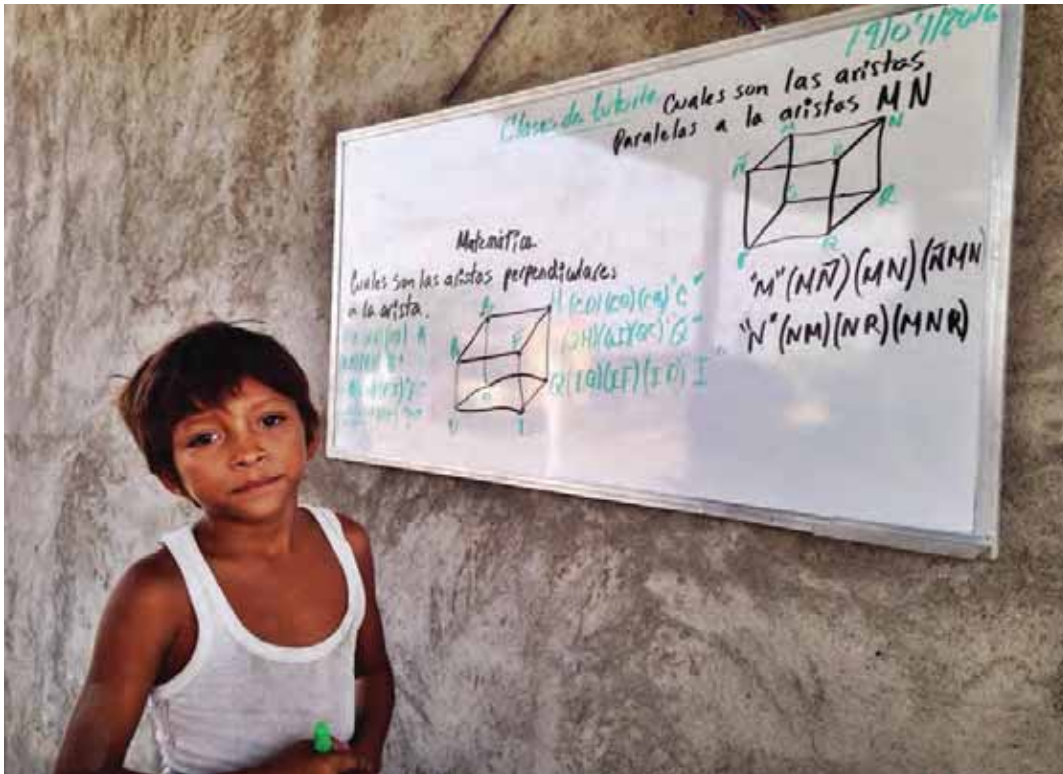


## Next steps

This report is the first step of a global campaign to close the biggest dumpsites of the world. In this view, this report is not a stand-alone document but the start of an effort that will stimulate a global movement for closing down some of the world's biggest dumpsites. ISWA would like to act as a catalyst that will push potential donors or lenders to mobilize the necessary financial resources and support countries to close the dumpsites and create alternative waste management schemes capable to deliver a sound level of health and environmental protection. ISWA will cooperate with local authorities, governments and international stakeholders for strengthening the capacity of local waste management bodies so they will be able to tackle the problems involved in the efforts to close the dumpsites.

After the publication of this report, the following steps will take place:

1. ISWA will call its national members to provide specific good and bad experiences from their efforts to close dumpsites, in a specific template. The scope is to create a collection of real case studies that will be available for the waste management community, worldwide.
2. ISWA will develop a proper communication plan with materials that could be easily localized – the communication plan will involve global, national and local – regional issues. Based on that, ISWA will organize a global campaign with events in all continents for promoting the emergency of closing the dumpsites and introducing the ways to do that.
3. ISWA will cooperate with its national members to localize the report introducing their own data and examples and translate the report in their own language. ISWA wants to deliver the message to each and every government that dumpsites must close as soon as possible, as a global health and environmental emergency.
4. ISWA will arrange meetings with all the major international stakeholders trying to raise awareness for the importance of closing the biggest dumpsites. ISWA will try to raise funds for a) monitoring the world's biggest dumpsites and their health and environmental impacts and report annually on the progress made for their closure, and b) for identifying the emblematic dumpsites that are easier to close and provide technical assistance for their closure. The overall scope is to create an Action Plan for closing some of the world's biggest dumpsites.



## ISWA's Scholarship Programme

The current report is also linked with ISWA's Scholarship Programme. In 2015 ISWA started a plan for the futures of 15 young informal recyclers from 2 trash dumps, La Chureca and Nueva Vida, both in Nicaragua. It was then that the idea for The ISWA Scholarship Programme was born<sup>4</sup>.

The concept for the program is to search out children, who are currently informally recycling in open dumpsites, that have a willingness to leave for an education in the plan that it will break the cycle of generational informal recycling and offer the children broader opportunities. Dumpsite Photographer and Program Director, Timothy Bouldry<sup>5</sup>, runs the ISWA Scholarship Programme in Nicaragua and already in it's first year the program has expanded to 40 students. The program offers educa-

tion in various schools appropriate to the individual students, tutoring classes 3 times a week, English classes twice a week, a sponsor program where people can communicate and help with the children, as well as, their families and a bedding program to offer kids who are currently sleeping on the ground a constructed bed made from newly recycled crates. The program is currently expanding by offering food during the tutored classes, sport activities and a talent search.

<sup>4</sup> <http://www.iswa.org/programmes/iswa-scholarship-programme/>

<sup>5</sup> <http://www.timothybouldry.com/iswa/>



# Alarming Signals

**In 2013, the Waste Atlas report<sup>6</sup> about the 50 biggest dumpsites in the world revealed that they affect the lives of almost 65 million people, a population the size of France.**

In 2015, the GWMO report<sup>7</sup> estimated that at least 2 billion people do not have access to regular waste collection and they are served by dumpsites.

In 2015, the Wasted Health report<sup>8</sup> highlighted that exposure to open dumpsites has a greater detrimental impact on a population's life expectancy than malaria and that in addition to human/environmental impact, the financial cost of open dumpsites runs into the tens of billions of USD.

If those references are not enough to persuade everyone of the importance of the health and environmental impacts posed by dumpsites, have a look at this indicative collection of recent incidents<sup>9</sup> (it is mentioned that this is just what has been published in the international press, the actual incidents and accidents are probably much more and the chronic diseases involved unaccountable).

# December 2015: A dumpsite landslide killed 73 people and left four others missing in Shenzhen, China, in December 20. The accident on Dec. 20 destroyed 33 buildings with direct economic losses at 880 million yuan (132 million USD).

# January 2016: According to Zimbabwe's 2015 statistics, released by the Ministry of Health and Child Care, diarrhoea accounted for 502-recorded deaths and 521,573 treated cases across the country. In epidemiology, it is well established that all diarrhoeal diseases are regarded as environmental diseases, which are

those that can be directly attributed to environmental factors, especially with water pollution due to poor waste management. They are also known as diseases of poverty because they affect poor communities more than the wealthier ones. Many local environmentalists point to poor waste management as the major cause of these diseases.

# February 2016: At the beginning of February 2016, a big fire started in Deonar, Mumbai's 132 hectares dumpsite that receives 4,000 tons of waste per day. The smoke emitted was so thick that it blotted out the sun and the relevant health risks for the neighboring residents were high. The fire was so big and intense that it was also visible from space, as seen on NASA's released satellite images.

# February 2016: A yellow fever outbreak in Angola (that began at the end of 2015) killed 158 people in February 2016, as deaths from the disease transmitted by mosquitoes accelerate, according to a World Health Organization official. According to local health officials, there has also been an increase in malaria, cholera and chronic diarrhoea in Luanda and other cities, partly due to a breakdown in sanitation services and rubbish collection. The situation was worsened as soon as the rainy season began as

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<sup>6</sup> The World's 50 biggest dumpsites, Waste Atlas, 2013, available at <http://www.atlas.d-waste.com/Documents/Waste-Atlas-report-2014-webEdition.zip>

<sup>7</sup> Global Waste Management Outlook, UNEP - ISWA 2015, available at <http://unep.org/ietc/ourwork/wastemanagement/GWMO>

<sup>8</sup> Wasted Health – The tragic case of dumpsites, ISWA 2015, available at <http://www.iswa.org/nc/home/news/news-detail/article/wasted-health-the-tragic-case-of-dumpsites/109/>

<sup>9</sup> Wasteless Future News and Blogs at <http://wastelessfuture.com>

heavy storms wash discarded waste and contaminated water into supplies used for washing and drinking.

# March 2016: In Jamaica, thick, noxious smoke blanketed Jamaica's capital on Thursday March 12, as a wind-fanned fire burned at a sprawling, open-air waste dump on the city's outskirts that has seen repeated blazes. Schools closed and the government advised residents to stay indoors and close windows. Before this incident, the last major fire at the dump, in April 2014, burned for nearly two weeks and sent an increased number of people with respiratory distress to health clinics.

# April 2016: In India, the mammoth ticking garbage bombs of Ghazipur and Bhalswa landfills are spewing toxic gases by the minute into Delhi's already foul air because the national capital does not have a proper waste management system. On April 22, locals say that Bhalswa has been simmering like a volcano for decades. The recent fire in New Delhi's dumpsite created serious air pollution incidents to India's capital. According to other sources, the biogas trapped beneath makes Ghazipur dumpsite, which also serves New Delhi, a ticking time bomb.

#April 2016: In Guatemala City, a massive dumpsite landslide killed four people on April 26 at least 24 more people were missing. Almost all of them were informal recyclers. This happened at the Guatemala City garbage dump, the largest dump in all of Central America & certainly one of the most notorious in the world, where at least 7,000 people, including children, work from dawn to dusk, 365 days a year collecting plastic, metal, & other recyclables to resell.

# May 2016: In Spain, just 50 km from Madrid, on May 12, 2016, a fire at an illegal dumpsite with 75,000 tons of used tyres created such a thick toxic fume that clouds of thick black smoke could be seen for 20 miles. Despite the efforts of the firefighters to contain the fire (something that seemed to be managed 3 days later) the authorities ordered the evacuation of the Quinon de Sesena area, where 9,000 people live, saying human health might be at risk.

The list above could be much longer, but definitely it is indicative of the problems involved. All relevant evidence makes clear that:

# Dumpsites are a global health emergency that needs urgent and coordinated response.

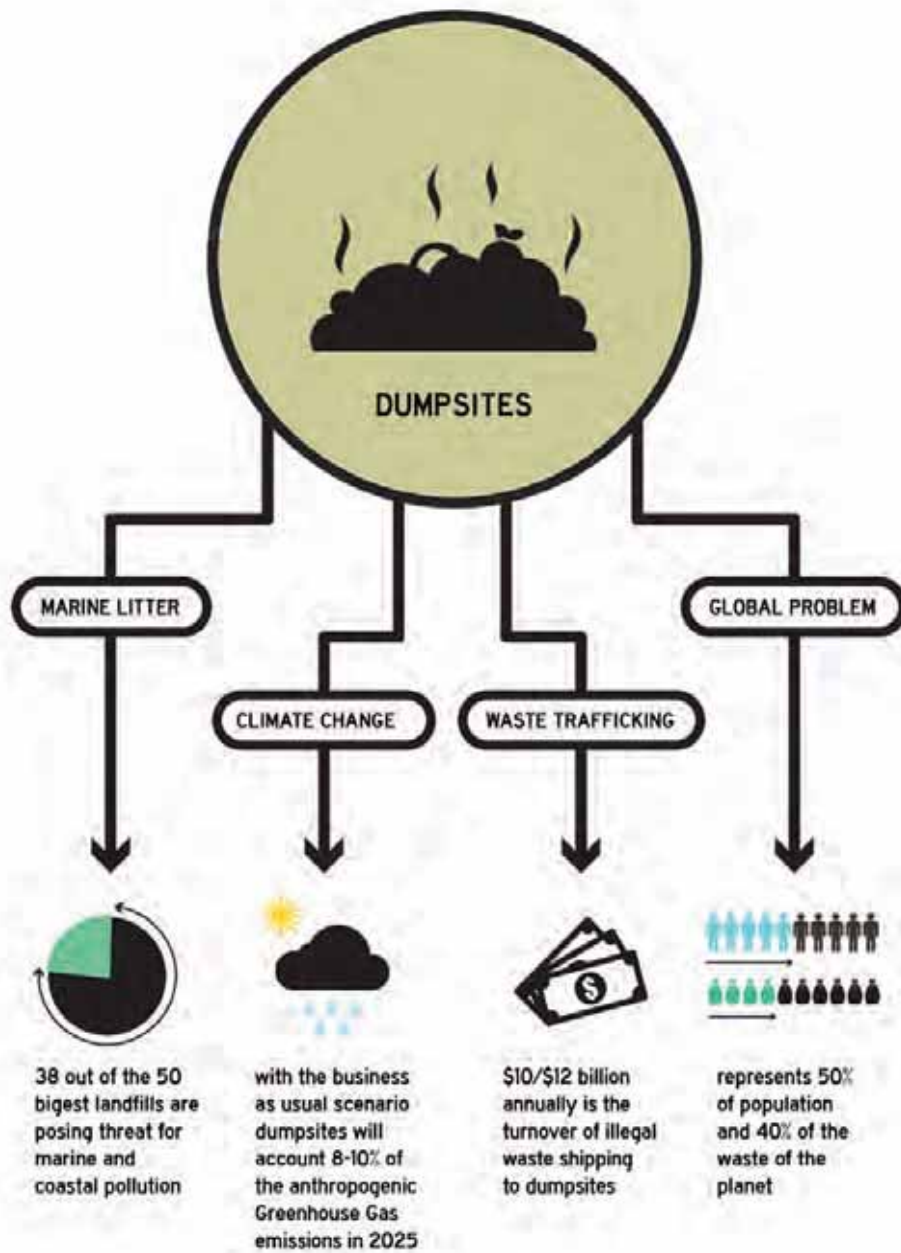
# The problem concerns both the currently used dumpsites (mostly, but not exclusively, in the developing world) and the historical dumpsites that were in use (in developed and developing countries).

Figure 2 explains why dumpsites are a global health and environmental emergency<sup>10</sup>.

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<sup>10</sup> Wasted Health – The tragic case of dumpsites, ISWA 2015, available at <http://www.iswa.org/nc/home/news/news-detail/article/wasted-health-the-tragic-case-of-dumpsites/109/>

Fig. 2 Dumpsites as a global challenge



A photograph of a slum area. In the foreground, there is a large pile of discarded white plastic bottles, many with green and red labels. In the middle ground, a woman in a vibrant, multi-colored sari stands with her hands on her hips, looking directly at the camera. To her left, another woman in a colorful sari sits on a wooden log structure, holding a white bowl and a plastic bottle. To the right, a young girl in a light-colored, patterned dress stands looking towards the camera. The background shows a light blue building with windows and pipes, and a grey corrugated metal wall on the left. The text "What it means to close a dumpsite" is overlaid in white, sans-serif font across the center of the image.

What it  
means  
to close  
a dumpsite



**There are many potential problems related to the closure of open dumps. These problems typically relate to what closure method to use, how and who is going to pay for it, and what would be the best new waste disposal method to replace the open dump situation.**

**It would be a real challenge trying to close an open dumpsite while still using it and without putting a new waste disposal facility in-place. Therefore a new waste disposal facility must be provided to accept the incoming waste and to enable the old site to be completely off access to the users and hence enforcing its complete closure once any new, upgraded site is available.**

To understand the role of dumpsites from a systemic point of view, it is important to adopt a common analytical framework for waste management systems. In this Roadmap, the view adopted is the one that is presented in GWMO<sup>11</sup>, namely the Integrated Sustainable Waste Management (ISWM), which is a simplified form of the model, first developed for UN-Habitat's Solid Waste Management in the World's Cities<sup>12</sup>.

ISWM involves three broader dimensions for analysing a waste management system, namely the physical elements, the stakeholders and the strategic aspects. The term "physical elements" refers to the infrastructure of the system from waste generation through storage, collection, transport, transfer, recycling, recovery, treatment and disposal.

The term "stakeholders" refers to all the involved parties including municipalities; regional and national governments; waste generators / service users; producers; service providers; civil society and non-governmental organizations (NGOs); international agencies; etc. Finally the term "strategic aspects" concerns all the political, health, institutional, social, economic, financial, environmental and technical facets.

In next page, the first triangle in Figure 3 comprises the three primary physical components ("hardware") and the second displays the "software" or governance components. This systemic description that involves both the "hardware" and the "software" of waste management and is very useful for decision makers.

Actually this description says that each and every "hardware" arrangement is functional only with specific "software" tools and vice versa. So, you can't just simply upgrade or change your "hardware" keeping the same "software".

Then for each triangle, there are three elements. In the first triangle ("hardware"), the reader can identify the following elements:

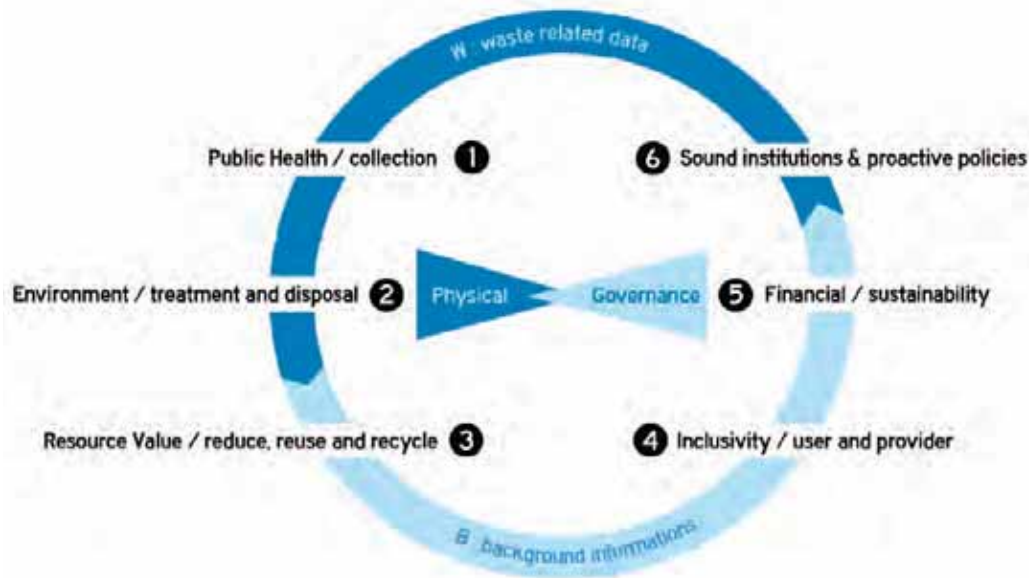
1. Waste collection, driven primarily by public health;
2. Waste treatment and disposal, driven primarily by environmental protection; and

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<sup>11</sup> Global Waste Management Outlook, UNEP - ISWA 2015, available at <http://unep.org/ietc/ourwork/wastemanagement/GWMO>

<sup>12</sup> Solid Waste Management in the World's Cities, UN Habitat 2010, available at <http://mirror.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2918>

Fig. 3 Integrated Sustainable Waste Management Framework from GWMO



3. The 3Rs – reduce, reuse, and recycle, driven by the resource value of the waste and more recently by closing the loop in order to return both materials and nutrients to beneficial use.

In the second triangle (“software”), the reader can identify three more elements:

- 4. Inclusivity of stakeholders: focusing in particular on service users and service providers;
- 5. Financial sustainability, requiring the system to be cost-effective, affordable and well financed; and
- 6. Sound institutions and proactive policies, including both the national policy framework and local institutions.

In this Roadmap, when we refer to a dumpsite closure / upgrade project, we mean either that:

- a) a specific dumpsite is shut down and a sanitary landfill (maybe with source separation and some kind of treatment) is used for the disposal of residues; or
- b) a dumpsite is upgraded and becomes controllable and less risky for human health and environment, as a first step for the broader improvement of the waste management system.

In many cases, especially in poor countries, the second option is the only realistic one; however, there are experiences from several countries in which the first case has also happened.

The adoption of this framework has an important consequence. It means that closing a dumpsite (either by substituting it with a new alternative waste management system or by upgrading it to a controlled disposal site) is a serious systemic change that affects all the dimensions of the ISWM.

Closing down a dumpsite is neither a simple nor an easy task. It requires adequate planning, institutional and administrative capacity, financial resources, social support and finally political consensus.

All of these conditions are really difficult and sometimes impossible to be met in countries where dumpsites are the dominant method of waste disposal.

In all cases, there are social, technical, economic – financial and finally governance challenges to be managed.

This Roadmap provides, in brief, guidance for local authorities, governments and international stakeholders on how to manage those challenges.

Often, the problem of closing a dumpsite and delivering a sound waste management system that protects human health and environment is not understood in the right way.

This is not a simple technical problem, but a political and social one.

This is not simply a matter of limited financial resources, but it is a matter of administrative structures, legal frameworks and regulations that can actually be implemented.

This is not simply a matter of preparing the right documents and attracting funds, it is mainly a challenge to create sustainable operational entities in all the governance levels.

This is not just an issue of better resource management; the main challenge is to create the human resources that will undertake the long-term improvement of the local waste management system.

Last but not least, this is not just a matter of fixing waste problems, but it is actually a matter of protecting public health and environment, it is a matter of improving the quality of lives for billions of the Earth's inhabitants. It's about people, not waste!



# Dumpsites and the Sustainable Development Goals



Waste management is well embedded within the Sustainable Development Goals (SDGs) being included either explicitly or implicitly in more than half of the 17 goals. Sound management of chemicals and waste (SMCW) is a specific target under SDG12 on Sustainable Consumption and Production. It is also referred to under SDG 3 on Good Health and Well-being and SDG 6 on Clean Water and Sanitation.

However, given that chemicals and waste affect almost all aspects of development, SMCW is relevant for, and supports the implementation of many other, if not all SDGs. SMCW is therefore of significant relevance for implementing the 2030 Agenda for Sustainable Development. Goals and targets in the area of food security, health or sustainable cities,

for example, cannot be reached without SMCW. Upgrading industrial processes based on the principles of green chemistry can help to achieve SDG 9 on Industry, Innovation and Infrastructure. The flip side of the SDGs/SMCW interface is equally important: Some SDGs, such as those addressing access to information, inclusive institutions, or justice and partnerships, help create an enabling environment that could support the minimization of the adverse effects of chemicals and waste.

In this particular context, it is important to highlight the main linkages between the targets for closing the dumpsites with the SDGs.

Table 1 describes the linkages in brief.

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Table 1: Closing the dumpsites and SDGs

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**#SDGs**

**Linkages with the closure of dumpsites**

**#1: End poverty in all its forms everywhere**

In urban settings, the poor often reside in areas close to landfills, incinerators, hazardous or other wastes dumping sites, or other industrial zones/polluting activities. There is a lot of evidence for the famous poverty – environmental degradation nexus.

The informal recovery of lead from car batteries and the open burning of lead-containing wastes are very important sources of environmental lead contamination in low-income countries.

**#2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture**

Dumpsites are the places where animals are attracted, many times purposefully by their owners, in order to have access to food, for free. That usually results in food-chain pollution.

In addition, closing the dumpsites is a first step that, in many cases, can be combined with proper food waste management and composting programs. The use of good compost can reduce the use of chemical fertilizers, contributing to a more sustainable agriculture.

**#3: Ensure healthy lives and promote well-being for all at all ages**

Dumpsites are a global health emergency. The WHO, IHME and GAHP calculated that in 2012 exposures to polluted soil, water and air resulted in an estimated 8.9 million deaths worldwide —8.4 million of those deaths occurred in low-and middle-income countries. By comparison, HIV/AIDS causes 1.5 million deaths per year and malaria and tuberculosis fewer than 1 million each. More than 1 in 7 deaths are the result of pollution. In addition one-third of the world's urban population live in slums, where people lack basic infrastructure and services and are exposed to environmental and social health risks such as indoor and outdoor air pollution, lack of water and sanitation, and poor working conditions. One-quarter of the global burden of disease can be attributed to environmental risks, including climate change and exposure to toxic chemicals.

## #SDGs

## Linkages with the closure of dumpsites

**#4: Ensure inclusive and quality education for all and promote lifelong learning**

Certain types of dumpsites' chemicals, such as persistent organic pollutants (POPs) can build up to dangerous levels in humans and wildlife causing adverse reproductive, developmental, immunological, hormonal, and carcinogenic effects with varied impacts on vulnerable groups of the population.

Exposures to toxic chemicals can reduce a child's ability to learn by causing mental and physical impairment. For instance, children are particularly vulnerable to the neurological effects of lead exposure.

**#5: Achieve gender equality and empower women and girls**

Poor pregnant women and children in developing countries are particularly vulnerable to dumpsites' toxics and their exposure to certain chemicals can compromise the ability of children to escape poverty through education and work.

**#6: Ensure access to water and sanitation for all**

Groundwater around the world is threatened by pollution from dumpsites. Besides the organic load of leachates, hazardous pollutants include the trace metals such as cadmium, lead and mercury, pesticides such as dichlorodiphenyltrichloroethane (DDT), chlordane and their by-products industrial chemicals and open-air combustion by-products.

**#7: Ensure access to affordable, reliable, sustainable and modern energy for all**

Closing a dumpsite can be easily combined with biogas recovery programs. Biogas is a cheap renewable form of energy that can contribute towards the elimination of energy poverty, especially in the areas around big dumpsites.

**#8: Promote inclusive and sustainable economic growth, employment and decent work for all / #16: Promote just, peaceful and inclusive societies**

Dumpsites are places where millions of informal recyclers are working. Closing the dumpsites and delivering an alternative system that will involve informal recyclers is a step towards a more inclusive and sustainable economic growth.

## #SDGs

**#9: Build resilient infrastructure, promote sustainable industrialization and foster innovation /  
#11: Make cities inclusive, safe, resilient and sustainable**

**#10: Reduce inequality within and among countries**

**#12: Ensure sustainable consumption and production patterns**

**#13: Take urgent action to combat climate change and its impacts**

## Linkages with the closure of dumpsites

Many dumpsites in the developing world are located on or near the coast, thus they are really vulnerable to the rise of sea level due to climate change. In addition, dumpsites are directly related with fires that can have catastrophic impacts. Closing those dumpsites and developing a sound waste management system will definitely improve the resilience of the urban areas.

As mentioned, there are several countries that lack the resources and the structures required to close their dumpsites and protect the public health and the environment. A universal effort by the international community to help those countries to close their dumpsites and create alternative waste management systems will definitely contribute to reduce the inequality between countries. In addition, improving the life conditions of the populations surrounding dumpsites ' reduces the inequality within a country.

Dumpsites are the global symbol of unsustainable consumption and production. Urban waste generation is projected to increase dramatically in the next 12 years, from 1.3 billion tonnes per year today to 2.2 billion tonnes per year by 2025, with high increases in middle-income developing countries. Such a scenario will result in increasing water and air pollution, land and forest degradation, waste generation and the use of harmful chemical substances. Economic growth will have to be decoupled from resource use and environmental degradation, so that inclusive socio-economic development can be sustained.

If the situation follows the business as usual scenario then dumpsites will account for 8-10 % of the global anthropogenic GHG emissions by 2025. Closing the world's dumpsites will result in substantial reduction of the CO2 emissions related to waste management.



## **#SDGs**

**#14: Conserve and sustainably use the oceans, seas and marine resources**

**#15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss**

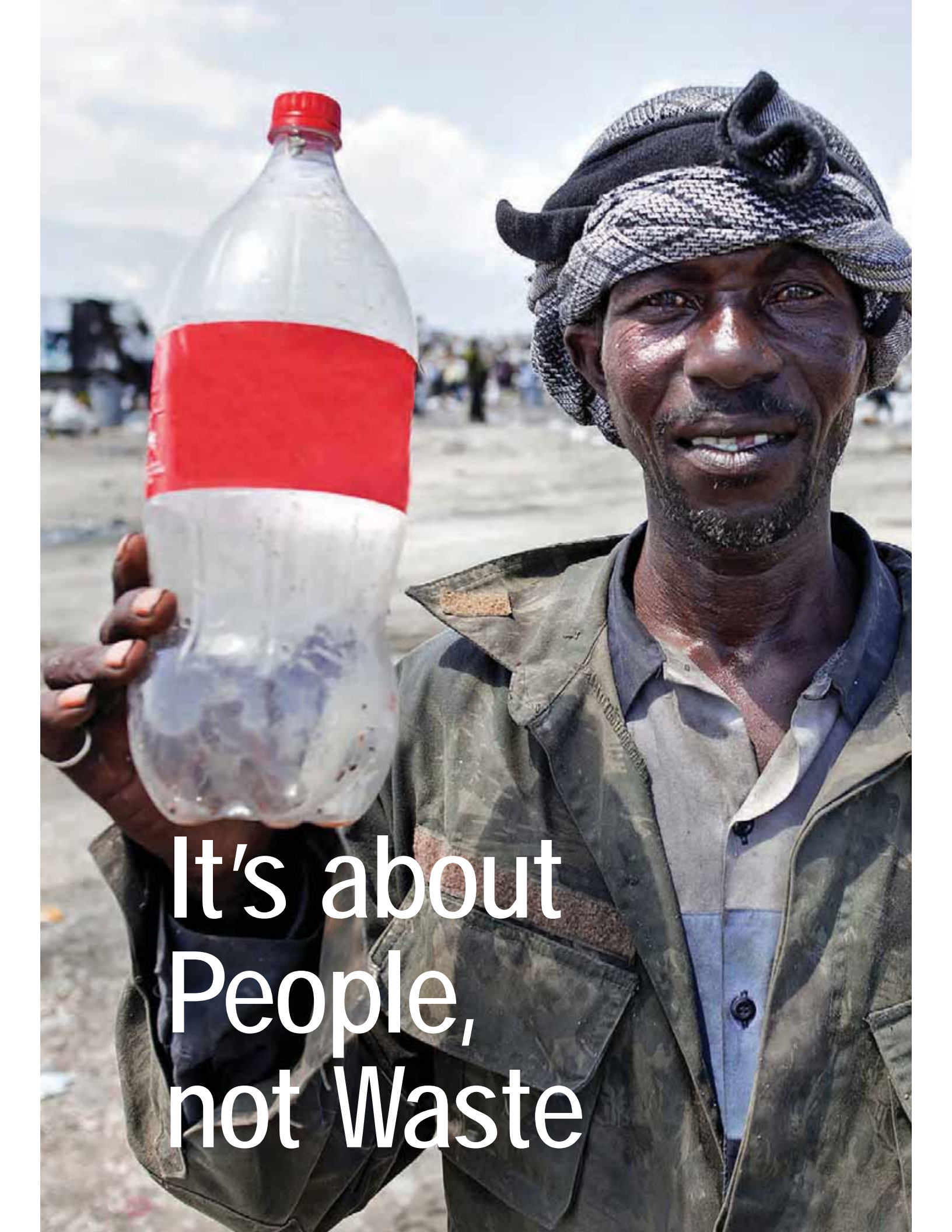
**#17: Revitalize the global partnership for sustainable development**

## **Linkages with the closure of dumpsites**

Dumpsites are considered to be a major source of ocean plastic pollution and marine litter because a lot of them are located on waterways and nearby the seashore.

Dumpsites are directly related with forest fires. When they are closed the risk for fires will be substantially reduced. In addition, when proper waste management systems will be developed, source separated organic fraction and food waste management can be easily combined with the fight against desertification, through decentralized composting and anaerobic digestion projects.

If we are looking for an opportunity to revitalize the global partnership for sustainable development and make it deliver tangible results, then let's start from closing the world's biggest dumpsites. This is an achievable, realistic and tangible target for the next 10 years and it will create positive impacts for billions of people!



It's about  
People,  
not Waste

**While one can analyze a municipal solid waste system from multiple perspectives (environmental, technical, financial), it is ultimately intended for, operated by, and managed by people. A solid waste system is thus in a very real sense a social system, linking different human actors in various types of relationships via differential sets of constraints and incentives.**

**The very need for a solid waste system is a product of human behavior, which produces waste, and human behavior shapes every aspect and step of the process, from consumption to domestic waste handling to final disposal. Finally, the manner in which the system is managed has both direct and indirect impacts on individuals, communities, institutions, and practices.**

**The social aspects of a final disposal site and its closure or upgrading should thus not be approached as a stand-alone or add-on, but rather as a transversal dimension to be integrated into all levels and phases of the intervention, which should include a careful assessment of the relevant social context and implications at every stage of the waste stream and every phase of the process, a meaningful multi-actor participation process, and the use of both of these as inputs into design, execution and later operation<sup>13,14</sup>.**

This Chapter will begin by outlining the basic types of social issues associated with dumpsite closure and related changes to the broader waste system. Next, it will examine in greater detail the most critical social dimensions of the intervention process, and particularly as related to stakeholder analysis and engagement. Finally, it will focus on the most significant social issue affecting most dump closures: the presence of informal recyclers or “waste pickers”<sup>15,16</sup>.

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<sup>13</sup> Bernstein, J. 2004. Toolkit: Social assessment and public participation in municipal solid waste management. Urban Environment Thematic Group. Washington, DC: The World Bank

<sup>14</sup> Wilson D. C., Araba AO, Chinwah K, et al. 2009. “Building Recycling Rates through the Informal Sector,” *Waste Management* 29:629–635

<sup>15</sup> Cohen, P., J. Ijgosse and G. Sturzenegger. 2013. *Preparing Informal Recycler Inclusion Plans: An operational guide*. Washington, DC: Inter-American Development Bank.

<sup>16</sup> Scheinberg A. . 2015. *Valuing Informal Integration: Inclusive recycling in North Africa and the Middle East*. GIZ

## The Social Dimensions of Solid Waste

The social dimension of Solid Waste Management systems, shown also in

Figure 4, can be categorized as follows:

1. Public awareness
2. Cost recovery
3. Local resistance
4. Involuntary resettlement
5. Informal sector
6. System inertia

*Public Awareness* involves the analysis and modification of waste-related behaviors within the general public, from consumption to generation and disposal<sup>17</sup>. *Cost Recovery* involves end users' ability and/or willingness to pay for new or improved services and the development of optimal payment schemes for the given socio-economic context. Upgrading of disposal is directly related to 'priced disposal' and the creation of new institutional, legal and financial mechanisms to make new disposal and recycling practices financially viable. *Local Buy-in* refers to the acceptance by local communities of the siting of waste infrastructure in their area, in the face of such common reactions as NIMBY (*Not In My Back Yard*) and BANANA (*Build Absolutely*

*Nothing Anywhere Near Anyone*), usually associated with such indirect impacts as noise, odour, dust, increased truck traffic or falling real estate values. *Involuntary Resettlement* specifically involves direct (as opposed to indirect) impacts on local residents of new waste infrastructure, including physical displacement, loss of or damage to property, and loss of income,

livelihoods and/or access to resources. *Informal Sector* involves<sup>18</sup> the impact of the closure of open dumps and the analysis, engagement and integration of existing informal waste and recycling activities and actors into new or upgraded systems. *System Inertia* refers to the (often lacking) capacity of public and private collection systems to adapt to improved disposal system.

### Benefits and Challenges

The upgrading of existing solid waste disposal sites or their closure for replacement by improved infrastructure provides a range of benefits, but also implies challenges, including costs that are often disproportionately borne by certain actors. These benefits and challenges must be carefully assessed, together with the risks and negative impacts identified and mitigated, and the benefits equitably

Fig. 4: The social dimensions of waste management



shared. Benefits of a new disposal site can be of various kinds, affecting the environment, the economy, agriculture production, public health, worker safety, and local quality of life.

Environmental benefits may include reduction in system leakage and resulting contamination, reduction in illegal dumping, and reduction in extraction of natural resources due to an increase in the recovery of recyclables. Financial benefits may include improved cost recovery; lower operating costs due to increased efficiency, and outsourced costs due to the involvement of the private sector. Public health benefits can include cleaner streets, neighborhoods and public spaces due to improved collection, sanitation and water quality, and a reduction in waste-related diseases.

Benefits to worker safety can include reduction in health and safety risks to site and other system workers. Benefits to quality of life can include reduced noise, odour, dust, vectors (rats, mosquitoes), congestion from trucks, and more convenient end-user disposal. Social challenges to dumpsite closure or upgrading may include resistance from local communities to the siting of new infrastructure, resistance from private sector actors to changes that negatively affect them, resistance from informal recyclers to impacts on their access to recyclables, resistance from intermediaries/middlemen to schemes that may bypass or override them, and resistance from the general public to schemes that may increase user fees or taxes.

Failure to adequately incorporate social aspects into the design and implementation of a dump closure carries multiple

risks. Examples of common risks include<sup>19</sup>: rejection of proposed facilities due to local opposition (*once rejected, rejected forever*), failure of operation of new facilities due to excessive operational costs and/or unwillingness/inability to pay gate and user fees, higher collection costs, modification of established routines (e.g., more limited hours of operation or more thorough waste acceptance procedures), higher collection, treatment and disposal costs for special and hazardous waste, failure of separate collection schemes due to inadequate equipment, recycling plants or sustainable markets for recyclables (with a resulting loss of public trust and unwillingness to cooperate in future initiatives), social turmoil due to the diversion of recyclables from the established informal sector, lack of monitoring capacity of local authorities, and failure of remedial works at closed dumps due to inadequate control of access (inadequate or no planning for post-closure care and use).

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< <sup>17</sup> Dias, S. M. 2010. Overview of the Legal Framework for Social Inclusion in Solid Waste Management in Brazil. Cambridge, MA: WIEGO<sup>14</sup> Wilson D. C., Araba AO, Chinwah K, et al. 2009. "Building Recycling Rates through the Informal Sector," Waste Management 29:629–635

< <sup>18</sup> Gerold, A. and Frankfurt, A.M. 2009. Integrating the Informal Sector in Solid Waste Management Systems: Basic aspects and experiences. GTZ.

^ <sup>19</sup> Wilson, D. C., A. Whiteman, and A. Tormin. 2001. Strategic Planning Guide for Municipal Solid Waste Management. Washington, DC. The World Bank.,



## Social Management of Dumpsite Closure

Management of the social impacts, risks and opportunities of dumpsite closure involves several core activities, which must be built into planning, integrated into the timeline and budgeted for.

These include:

1. Stakeholder identification, mapping and engagement (including local councils and grievance redress mechanisms)
2. Assessment, diagnostics and analysis
3. Development and discussion of proposals
4. Implementation of solutions
5. Complimentary activities (such as training)
6. Operation and maintenance
7. Monitoring and evaluation

### Social Impact Assessment

Any major dumpsite intervention should include a comprehensive analysis of social impacts as an essential input to both design of the new system and the closure/upgrading process.

The main social impacts of dumpsite upgrading or replacement include<sup>20</sup>: physical displacement, direct effects to housing, land, property, economic activities and access to recyclables<sup>21</sup> and/or other resources, broader effects on local economies, real estate values, the poverty-environmental degradation nexus, and impacts related to the negative social perceptions of disposal sites and other waste infrastructure. These impacts may further result in the kinds of social risks and challenges outlined above.

### Broader Social Analysis

The assessment of social aspects is critical not only to identification and avoidance of risks but also to the identification and optimization of opportunities.

Key questions to ask at each stage and phase include: What are the social constraints upstream? How will the proposed solution affect or be affected by them? What actions can support desired outcomes? How can identified risks and opportunities best be managed?

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<sup>20</sup> Bernstein, J. 2004. Toolkit: Social assessment and public participation in municipal solid waste management. Urban Environment Thematic Group. Washington, DC: The World Bank

<sup>21</sup> Chaturvedi, B., A. Luthra and A. Short. 2013. Chintan's Assessment Tool for Informal Sector Inclusion (CATISI) in Solid Waste Management. New Delhi: Chintan Environmental Research and Action Group

## Stakeholder Analysis

Stakeholder analysis consists in identifying, mapping and assessing each of these categories and their relationships to one another and to the system as a whole. Having strong buy-in from all key stakeholders is critical to the success of an inclusive waste and recycling initiative and failure to secure buy-in from key actors can be a deal-breaker. In the broader sense, “stakeholders” includes everything from municipal authorities to waste pickers, and all of these actors and their relationships need to be taken into account in order to understand the social and political dynamics involved, including the various incentives and interests, and the alliances, competition or conflicts that may exist among various actors. Typical stakeholders in a dumpsite intervention can include<sup>22</sup>:

- # The Municipality
- # State and Federal government agencies
- # Site operators and service providers
- # Private sector actors (producers, clients, partners, competitors for materials)
- # Local communities (including land and property owners) and their representative leaders or organizations
- # System end-users
- # Informal recyclers
- # Intermediaries
- # NGOs and civil society

### **Affected, Interested and Third Parties**

For analytical purposes, identified stakeholder groups may further be divided into three (3) main categories: (1) affected parties; (2) interested parties; and (3) third parties. Affected parties are individuals, groups or communities who may be directly impacted, whether positively or negatively, by the intervention. These may include residents, taxpayers, landowners or informal sector actors. In some cases, it may be preferable to include them in the consultation process via legitimately elected representatives. Interested parties are individuals or groups who have expressed support or concern regarding the intervention. These may include waste operators, contractors, local business owners or public health and environmental NGOs. Third parties are stakeholders who may have an influence on the system and/or intervention even though they might not be directly affected or interested. These may include public agencies not directly responsible for the system or intervention whose involvement is necessary for the effective mitigation of impacts or environmental enhancement of the project. These may include municipalities or state or federal government agencies. A good stakeholder analysis should make this distinction between actors with influence on the intervention, actors affected by it, and actors who may be both.

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<sup>22</sup> Cohen, P. 2014. “Resettlement and the Human Dimension: Lessons from an informal recycler inclusion project,” in IAIA14 Conference Proceedings Impact Assessment for Social and Economic Development 34th Annual Conference of the International Association for Impact Assessment 8-11 April 2014, Viña del Mar, Chile.



## Stakeholder Engagement

Stakeholder engagement should be a part of all social components of an SWM system or project. Each of the social dimensions described above involves some form of dialogue with key system actors<sup>23</sup>. As strong buy-in from all key stakeholders is a critical factor of success, all actors must be positively and appropriately engaged. The form of engagement, however, will differ according to the type of actor.

The goals of the stakeholder engagement process for a dumpsite closure are generally: a) to prevent and manage social risks (NIMBY and BANANA); b) to enhance environmental and social performance of the new system; and c) to strengthen sustainability. In order to achieve these goals, it is important to:

- # Ensure that all risks and potential impacts to affected parties have been duly identified and assessed
- # Consider a broader range of expertise and perspectives from interested parties
- # Ensure the effective mitigation of negative impacts and/or the environmental and social enhancement of the project with the engagement of third parties
- # Establish control mechanisms (e.g., GRMs, control panels, environmental compliance, etc.) to ensure good relations with local communities and other affected parties)
- # Ensure adequate budgeting for negative impact mitigation and inclusion work.

In practice, the various aspects of stakeholder engagement work together, as each system or project phase and aspect involves risks and impacts, key stakeholders and management/mitigation strategies. Obviously, the way specific issues affect various actors may differ by type of stakeholder (e.g., affected parties, interested parties, third parties).

Different aspects of the intervention may affect different stakeholder categories and these may in turn be differentially affected by and/or involved in the intervention. Table 2 shows how this might play out in a project setting.

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<sup>23</sup> Ahmed, S. A. and S. M. Ali. 2004. "Partnerships for solid waste management in developing countries: linking theories to realities," *Habitat International* 28:(3):467-79

Table 2: Actors categorization and possible impacts

Actor category	Types of actors	Impacts (direct/indirect)	Remarks
<b>Affected Parties</b>	<ul style="list-style-type: none"> <li>· Residents</li> <li>· Landowners</li> <li>· Farmers and other land users</li> <li>· Informal recyclers.</li> </ul>	<ul style="list-style-type: none"> <li>· Physical displacement</li> <li>· Damage to or loss of property</li> <li>· Loss of livelihood</li> <li>· Noise</li> <li>· Odour</li> <li>· Traffic</li> <li>· Air and water pollution</li> <li>· Land depreciation</li> </ul>	<p>Prevention and mitigation or compensation measures for unavoidable negative impacts should be carefully assessed and consulted with the relevant stakeholders.</p>
<b>Interested Parties</b>	<ul style="list-style-type: none"> <li>· Environmental organizations</li> <li>· Taxpayers</li> <li>· Waste operators (formal and informal)</li> </ul>	<ul style="list-style-type: none"> <li>· Environmental organizations</li> <li>· Taxpayers</li> <li>· Waste operators (formal and informal)</li> <li>· Environmental impacts (positive and negative)</li> <li>· Cost increases</li> <li>· Waste delivery restrictions</li> <li>· Waste diversion</li> </ul>	<p>Although the local impacts of a waste management facility may be negative, the overall impact may be positive. It is therefore important to highlight how any proposed system changes positively affect the system by rigorously comparing them to all major potential alternatives (including the “Zero Option”)</p>
<b>Third Parties</b>	<ul style="list-style-type: none"> <li>· Local municipality</li> <li>· Local power utility</li> <li>· Public works agencies</li> <li>· Water supply and sewage companies</li> <li>· Federal and/or state environmental agencies</li> <li>· Local Fire Department</li> <li>· Relevant Public Health agency</li> </ul>	<ul style="list-style-type: none"> <li>· Siting</li> <li>· Energy consumption/generation</li> <li>· Use of proposed infrastructure</li> <li>· Land use (present and future)</li> <li>· Water pollution</li> <li>· Leachate treatment</li> <li>· Environmental control systems</li> <li>· Disaster and risk management.</li> </ul>	<p>The correct and timely involvement of third parties in design aspects of the proposed system changes can help to:</p> <ul style="list-style-type: none"> <li>• Verify the feasibility of any planned system changes</li> <li>• Maximize expected results and the use of the available resources</li> <li>• Coordinate plans and programs</li> <li>• Homogenize techniques and technologies; and</li> <li>• Establish joint intervention protocols (environmental control, disaster management...)</li> </ul>



### **Social Instruments and Processes**

Standard instruments and processes for addressing specific social aspects of dump closures include:

- # Communication/Public Awareness Plans (aimed at waste generators, end users);
- # Specific communication processes (for local communities with NIMBY issues);
- # Resettlement Plans (for persons affected by resettlement impacts);
- # Informal Recycler Inclusion Plans (for informal recyclers affected by site closures).

### **Monitoring and Evaluation**

It is important to be able to reliably track and measure social performance along with other aspects of an intervention.

This involves the establishment of comprehensive and reliable baseline data in the diagnostic phase, the development of a limited number of meaningful core indicators in the design phase, strong monitoring during the implementation phase and serious ex-post evaluation following the intervention.

The use of participatory monitoring, as one aspect of the empowerment of informal recyclers and other key actors, is highly recommended.

### **Planning and Timing**

Stakeholder engagement should be carefully planned to correspond to each stage of the technical process of dump closure, namely:

1. Preliminary design and Environmental Assessment (EA)
2. Definitive design and EA
3. Construction
4. Testing and commissioning
5. Operation
6. Site closure (or change of use)
7. Post-Closure
8. End of intervention or system change process

Recommendations for stakeholder engagement for each of these stages follow.

#### **1. Preliminary Design and Environmental Assessment**

Stakeholders should be engaged early and their feedback incorporated into design and the EA process.

This initial work may include: a preliminary presentation of the system change/intervention to and discussion with affected and interested parties; separate discussions with third parties, request for technical assessment/input/involvement; amendment of preliminary design and inclusion of advice/suggestions from all parties; revision of the EA; and presentation (retroalimantation) and discussion of the results with affected and interested parties for their approval and feedback.

It should be explained in the retroalimantation process which stakeholder suggestions were incorporated and how, and which were not incorporated and why.

## **2. Definitive Design and Environmental Assessment**

Both final design and the EA should incorporate the results of an on-going stakeholder engagement process.

## **3. Construction**

In cases where significant changes are being made to design that affect already-assessed impacts; the procedure outlined above should be totally or partially followed.

Third parties should be involved in the final inspection, testing and approval of the Project or relevant parts thereof.

## **4. Testing and Commissioning**

No specific social actions necessary. Local residents and civil society should at least be informed (affected parties).

## **5. Operation**

Grievance Mechanism, Control Panels and an Informal Recycler Inclusion Plan (affected parties). Development of operational plans and rules, and consultations in cases of changed routines or procedures (interested parties).

Control of relevant aspects and implementation of Contingency Plans (third parties). In case of significant changes to the Closure Plan, the procedure outlined in 1 should be followed.

## **6. Closure**

No specific social actions necessary. Local residents and civil society should at least be informed (affected parties).

## **7. Post-Closure**

Post-closure site after-use (interested parties). Monitoring of relevant aspects and implementation of Contingency Plans (third parties).

Technical and environmental bodies can be involved in the assessment of the end of After-Care period (interested and third parties).

Local residents and civil society should at least be informed (affected parties).

## **8. End of Project / Process**

The process may be deemed fully completed when the competent technical authorities determine that the site no longer likely pose significant risks to the local environment (interested and third parties).

Local residents and civil society should at least be informed (affected parties).

## Communication and Awareness Raising Strategies

The design of Communication strategies for dumpsite closures should take into account the relevant social characteristics of the target group, such as age, education, and access to information. They generally aim to: a) inform the public on the risks of the existing situation and the advantages of closure; b) maximize buy-in for the proposed infrastructure; and c) enhance public participation in source separation, recycler recognition and other desirable waste-related attitudes and practices. Public information on risks marks the starting point for enhancing of public awareness on the environmental and public health impacts of solid waste mismanagement. Information on the characteristics of average households waste (organic, inorganic, and special waste), leachate production and its effects on water quality, agricultural production and public health should also be considered. Increasing

buy-in for the new system can be achieved via visual tools, such as plans and diagrams on the technical aspects of the landfill (e.g., leachate treatment) and dump closure (e.g., coverage with a green layer). Public participation in source separation and separate collection should be direct and simple; usually starting with the separation of household waste in two streams (organic/inorganic, or wet/dry) and information on the days and times of separate collection. Recognition of recyclers can also be addressed in this process, such as identification of the recyclers, frequency and time of day they work their routes, etc. Communication strategies may vary depending on the social and economic characteristics of the target population, and may include community workshops, radio ads, use of megaphones, posters, pamphlets and other printed materials, music, street theatre, video, etc.



## Informal Recyclers

The most important and complex social dimension of dump closure is usually the presence of informal recyclers and their incorporation into the new or upgraded waste system in a way that is fair, technically viable and financially sustainable<sup>24</sup>.

The term “informal recycler” refers to persons engaged in the recovery and sale of recyclable materials in the municipal waste stream. “Informal recycler” is category of actor defined by their work, and in practice informal recyclers tend to be independent entrepreneurs.

Informal recyclers may operate at any point in the waste stream, but we are concerned here mainly with those who operate at the affected dumpsite itself.

Although often seen by local authorities as a problem, informal recyclers are often in fact the most efficient and cost-effective means of providing recyclables collection, sorting, and other services and they can generate multiple social, economic and environmental benefits<sup>25</sup> (e.g., removing materials from the waste stream, extending landfill life and reducing transport and other system costs; producing income to support families, secondary businesses and local economies<sup>26</sup>; supplying the productive recycling chain, reducing the cost of raw materials and need for extraction; and reducing environmental damage, such as raw materials extraction and GHG emissions).

Informal recyclers are also a vulnerable group that faces multiple risks, including poor health and safety conditions, exploitation by intermediaries, lack of access to social services, rights and benefits, and social stigma and marginalization. These can be mitigated in a well-conceived Infor-

mal Recycler Inclusion Plan. Their choice of occupation is generally a response to broader economic conditions and social exclusion. Oft-expressed goals and aspirations of informal recyclers in solid waste interventions include:

- # Equal or greater access to recyclables
- # Equal or higher incomes
- # Continued work in the waste/recycling sector
- # Improved working conditions
- # Preservation of their existing business model (self-employed, flexible hours, paid for materials sold rather than fixed wages, working near home...)
- # Recognition and respect

The various benefits and drawback of the existing informal system around the dumpsite to be closed should be carefully assessed in a detailed social assessment prior to design, so that the new system will be able to build on what already exists, preserve what is working, and determine what is being lost in the intervention and thus must be restored or compensated.

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<sup>24</sup> Gerdes, P. and E. Gunsilius. 2010. The Waste Experts: Enabling conditions for informal sector integration in solid waste management: Lessons learned from Brazil, Egypt and India. Eschborn: GTZ

<sup>25</sup> Medina, M. 2008. The Informal Recycling Sector in Developing Countries: Organizing waste pickers to enhance their impact. PPIAF-The World Bank 44:1-3. Washington, DC: The World Bank

<sup>26</sup> Scheinberg, A., M. H. Simpson, Y. Gupta, et al. 2010. Economic Aspects of the Informal Sector in Solid Waste. GIZ: Eschborn, Germany

### **Informal Recycler Inclusion Plan**

Work with informal recyclers in a dump closure is generally structured around the preparation and execution of an Inclusion Plan, which sets forth the key aspects the actions to be taken with affected recyclers. An Inclusion Plan generally consists of the following components<sup>27</sup>:

1. Introduction
2. Objectives
3. Target Population
4. Eligibility and Cut-off Date
5. Legal and Policy Framework
6. Results of Consultations
7. Grievance Redress Mechanism
8. Institutional Arrangements
9. Time-line
10. Budget
11. Monitoring and Evaluation

The Inclusion Plan may be more or less elaborate depending upon the scope and nature of impacts, the number of recyclers involved, and other aspects of the situation.

### **Goals**

The general goal of a Recycler Inclusion Plan should normally be to improve – or, at minimum, maintain or restore – the livelihoods and standards of living of all affected recyclers to pre-project levels. Where national legislation and/or donor safeguard policies demand it, this goal is mandatory, elsewhere it is advised). Specific goals should include:

- # Ensuring adequate, reliable, and safe access to recyclables;
- # Developing viable alternatives where such access is impossible;
- # Improving health, safety and security of working conditions;
- # Increasing effectiveness, efficiency and profitability;
- # Providing formalization, recognition and access to benefits;
- # Strengthening capacity, skills and collective organization;
- # Ensuring Gender equity and addressing the special needs, capacities and aspirations of women and vulnerable groups;
- # Eradicating child labor in a responsible manner.

### **Steps**

The work with informal recyclers during a dumpsite closure may itself be divided into several phases that, although to some degree overlapping, are best done in the following order:

1. Engaging the recyclers
2. Conducting a census, socio-economic studies and consultations

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^ <sup>27</sup> Cohen, P., J. Ijgosse and G. Sturzenegger. 2013. Preparing Informal Recycler Inclusion Plans: An operational guide. Washington, DC: Inter-American Development Bank.

> <sup>28</sup> C. Velis, D. Wilson, Ond. Rocca, St. Smith, A. Mavropoulos & Chris Cheeseman An analytical framework and tool ('InteRa') for integrating the informal recycling sector in waste and resource management systems in developing countries, Waste Manag Res 2012 30: 43, available at [http://wmr.sagepub.com/content/30/9\\_suppl/43.full.pdf+html](http://wmr.sagepub.com/content/30/9_suppl/43.full.pdf+html)



3. Developing a set of viable inclusion options
4. Supporting the recyclers in the discussion, analysis and final selection of options
5. Implementing the options
6. Providing any necessary technical support and follow up
7. Monitoring implementation and evaluating results
8. Developing and applying an exit strategy
9. Development of networks of interested actors (e.g., government, intermediaries, dump and street recyclers...)

tation process); and c) the socio-economic and political context (including existing and potential market challenges and opportunities).

No recycler population is homogeneous, but rather tends to demonstrate multiple types of internal diversity.

This heterogeneity should be taken into account in diagnostics, consultation, and the development of solutions (which should themselves generally be multiple to account for the diversity of actors in a given recycler population).

Figure 5 outlines the required steps.

### Diagnostics

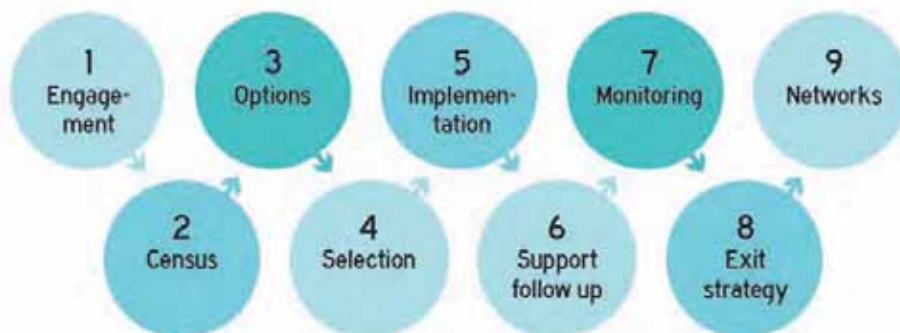
Strong, timely and relevant data are critical to developing viable options to incorporate recyclers into new waste and recycling systems. Three key data streams<sup>28</sup> should serve as inputs to the development of options: a) the recyclers, their skills, experience and potentials; b) their opinions (normally as expressed through the consul-

### Modes of Incorporation

Incorporation of informal recyclers into waste and recycling systems can follow several strategies. The basic lines of support for increasing profits and supporting the development of viable and sustainable institutions include:

- # Increasing scale;
- # Adding value;
- # Moving up the recycling chain (to doorstep or bulk collection, separation, transport, transformation and even commercialization);

Fig. 5: Steps required for working with informal recyclers





- # Improving effectiveness and efficiency;
- # Expanding the range of goods and services offered;
- # Building legitimacy, social recognition, commercial partnerships, and incentives.

### Options

Typical options for informal recycler incorporation can be grouped in the following categories:

- # Access, registration and rules
- # Health, safety and security
- # Gender, youth and vulnerability
- # Working conditions and access to materials
- # Efficiency, productivity and profit
- # Organizations and capacity
- # Policy reform

This list is not exhaustive, but gives an idea of range and variety of actions that can be developed. It is advisable to include at least three options in any given plan. These need not be mutually exclusive, but can be complementary, overlapping or mutually reinforcing, and combined in multiple ways according to the particular situation. They should also include at least one alternative outside the existing system (with the understanding that, as a general rule, risk tends to increase the farther people are moved from their habitual mode of work). Where possible, solutions should be low-tech, low-cost (both initial and operational), simple (to operate and maintain), and incremental, taking the form of a phased and gradual process.

### The importance of incentives

Informal recyclers earn income while focusing on a relatively limited number of types of waste fractions (i.e., those that are in sufficient demand on the private market to be profitable). Public systems, however, have a different mandate (i.e., to protect public health and the environment), and thus need to separate a wider range of recyclables than is of financial interest to recyclers<sup>29</sup> (whether due to low prices, excessive work requirements, or overly volatile markets). Diagnostics<sup>30</sup> should therefore consider, in cooperation with system design, the savings (minus transport, transfer and disposal costs) that could potentially be generated by the diversion of these materials and consider the creation of reasonable incentives for the recyclers based on those savings (the public system being the 'buyer' in this case). To take an example, cardboard is often priced low and requires a large amount of time and work to generate a reasonable profit, yet cardboard recycling saves municipalities money through reduced transport, transfer and disposal costs (which are higher due to the low density of the material). A basic assessment of these savings might justify the public sector "buying" cardboard at a higher price than the normal market price so as to make it interesting for the recyclers. Such local and national policy changes should be considered wherever they can directly benefit the system<sup>31</sup>.

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<sup>29</sup> Terraza, H. and G. Sturzenegger. 2010. *Dinámicas de Organización de los Recicladores Informales: Tres casos de estudio en América Latina*. Nota Técnica no. 117. Washington, DC: The Inter-American Development Bank

<sup>30</sup> GIZ (2011) *Role of Informal Sector in Solid Waste Management and Enabling Conditions for its Integration*

<sup>31</sup> Samson, M. (ed.). 2009. *Refusing to be Cast Aside: Waste Pickers Organizing Around the World*. Cambridge, MA: WIEGO.



Governance  
is the key  
for change



**Waste is a global issue. If not properly dealt with, waste poses a threat to public health and the environment. It is a growing issue linked directly to the way society produces and consumes. It concerns everyone. As the GWMO report mentions:**

*“Waste management is one of the essential utility services underpinning society in the 21st century. Particularly in urban areas, waste management is a basic human need and can also be regarded as a basic human right.*

*Ensuring proper sanitation and solid waste management sits alongside the provision of potable water, shelter, food, energy, transport and communications as essential to society and to the economy as a whole. Despite this, the public and political profile of waste management is often lower than other utility services.*

*Unfortunately, the consequences of doing little or even nothing to address waste management can be very costly to society and to the economy overall. In the absence of waste regulations and their rigorous implementation and enforcement, a generator of waste will tend to opt for the cheapest available course of action. For example, household solid waste may be dumped in the streets on vacant lands or into drains, streams or other watercourses, or it may be burned to lessen the nuisance of accumulated piles of waste”.*

## A public interest issue

As documented in the GWMO report, waste management is a domain of high public interest. So, waste management requires public policy to be developed, establishing its general goals, and stipulating guiding principles and decision-making criteria to inform the process of preparing waste strategies for achieving the established goals.

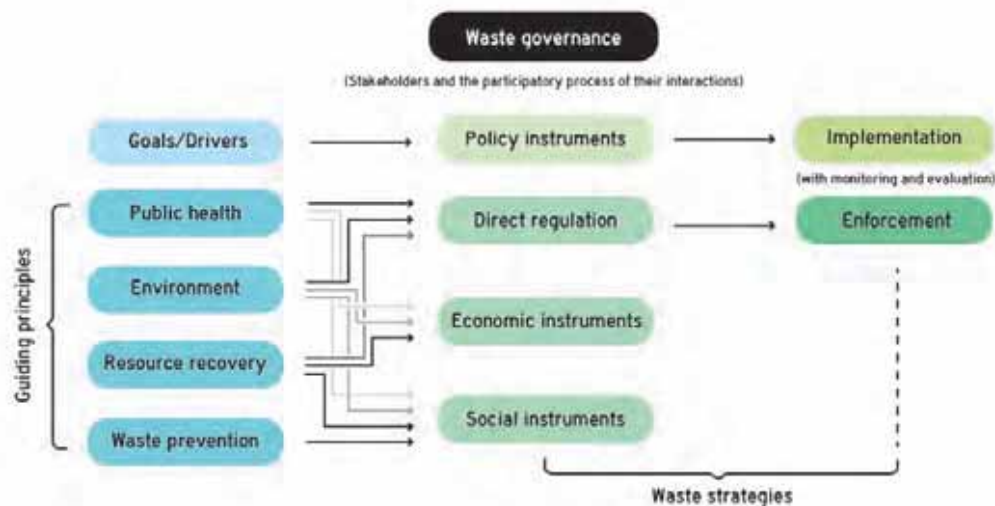
*“The general goals<sup>32</sup>, or driving forces (drivers) behind the policy formulation, include the protection of public health and the environment, as well as the recovery of resource value from discarded products and waste materials. The guiding principles in waste policies in various countries include several of the following: waste prevention, duty of care, polluter pays principle, universal service coverage, inclusivity, subsidiarity principle, precautionary principle, cost recovery, proximity and self-sufficiency. The articulated guiding principles may not necessarily be mutually consistent or compatible; hence their translation into instruments may require*

*additional effort to clarify the priorities among them”.*

Accordingly, waste governance is as much about the role of government and policy instruments as it is about the interests and roles of an array of other stakeholders in the system, and how these roles and interests are represented. Governance is also about responsibility, expressed through various legal and financial obligations, but also through a sense of “ownership” of waste-related issues, which translates into involvement and care about the cleanliness of the open spaces in the community as well as protection of the broader environment and natural resources. The latter means that good waste governance goes beyond street cleaning and waste handling and into the realms of production and consumption. Figure 6 (from the GWMO report) describes the waste governance conceptual model.

<sup>32</sup> Global Waste Management Outlook, UNEP - ISWA 2015, available at <http://unep.org/ietc/ourwork/wastemanagement/GWMO>

Fig. 6: Waste governance conceptual model and elements



## The systemic shift required

Deciding goals and developing strategies is at the core of the waste governance process.

While waste management services around the world have developed out of necessity, often in response to a crisis, strategic planning enables the decision-makers and practitioners to go beyond the unstructured mode of operation and take a good look not only at the waste system itself but also at the developments in a broader societal context which may impact on that system.

This is particularly valuable under circumstances of limited financial and other resources, so as to accomplish allocation to the most beneficial purposes, in terms of particular facilities or activities. Importantly, a long-term vision is needed, as it will take many years to plan, build and repay the investment required for improved facilities, meaning that waste planning may well go beyond the duration of a typical political cycle.

A national waste management strategic plan can be of considerable value giving guidance for those involved which is based on profound knowledge and understanding of the local circumstances, including both constraints and the existing strengths.

In other words, a strategic plan will be substantially better if it acknowledges local realities including waste composition, climate, culture, customs, characteristics of the local commodities market, level of technical expertise, availability of financial resources, and other relevant factors in the societal context.

Although there may well be collection and storage facilities in the cities where there are the larger dumpsites this may not be true for the smaller communities in developing countries. The only storage that exists is likely to be the small container within the household itself. Due to its size, this will require frequent emptying resulting in it being taken to the local dumpsite. There will be no transport available so the waste will be taken to the nearest piece of wasteland that is available. This leads to a proliferation of small-uncontrolled dumpsites.

To bring about change, systems will have to be in place to allow safe storage and efficient and effective collection.

Perhaps of greatest importance is that this should be regular and reliable requiring investment in the necessary infrastructure.

Storage facilities will need to be strategically positioned and accessible to the collection service, whether this will be using handcarts or sophisticated waste collection vehicles.

Other elements such as the state of the art highway network, narrowness of the streets and pedestrian only areas will all need to be taken into account if there is to be the required strategic change in direction.

Waste prevention, waste minimization, re-use and recycling will be important goals for any institutional change. This will require good communications, the need to facilitate involvement and to engage in dialogue with all stakeholders

in the system. It cannot be expressed too strongly the need to spend time on building citizen and stakeholder engagement into the policy-making processes.

Success in implementing any change will only come about if all of those involved in the process are fully committed to the changes required.

Unfortunately there are innumerable calls on the insufficient funding for local authorities in developing countries so it is essential that funds for good waste management services are ring - fenced to allow the service to continue uninterrupted.

It is likely that the most effective way to do this is to create a standalone waste management department, which has its own budget.

Fees from households and businesses can then be paid directly to the waste management department ensuring that it will be used for the purpose intended.

It is important to ensure that the waste management department has the sole responsibility for all aspects of the solid waste management service. This will include all personnel and the storage and collection infrastructure and vehicles.





## Elements of the systemic shift

To facilitate any systemic change in solid waste management operations it is fundamental to have an understanding of the existing situation. Understanding the waste composition is of fundamental importance to determining treatment and disposal options. All too frequently this is forgotten and then, inappropriate treatment solutions have been implemented resulting in serious problems and resource mismanagement.

As an example incineration for food waste rarely works without supplementary fuel whereas composting or anaerobic digestion does. It has been mentioned several times<sup>33</sup> that conventional technological approaches to waste management are not working in emerging and transitional countries because they involve imported solutions that are centralized, bureaucratic and suitable for different socio-economic conditions and so the possibility of decentralized models must be examined<sup>34</sup>.

There also has to be a good understanding of how the current waste streams are being managed. For instance, is there already recycling taken place at source which may result in material processing and product re-use. This may be an informal activity which may or may not be suitable to be part of any strategic plan developed for the particular community but will clearly need to be taken into account. To plan for these activities directly could prove to be an unnecessary distraction but operational improvements and the rationalization of funding may be necessary. If there is to be a systemic shift from the current use of open dumpsites then there will need to be an effective waste management system in place. This will require a coherent mix of policy instruments comprising legislation accompanied by avid enforcement,

economic instruments, providing incentives and disincentives for specific waste practices and 'social' instruments, based on communication and interaction with stakeholders. Above all else, the system must be adequately funded and without the possibility of funds earmarked for solid waste management being diverted elsewhere. Incidentally, this happens in developed countries too, with the UK "rates" system an example of how waste management funding is just part of all local authority spending and therefore one of the first to be cut in times of spending reviews.

Also taxes, such as the landfill tax, often get incorporated into the overall government or regional budgets and diverted away from spending on waste systems- Italy and UK are notable examples. Although environmental awareness and social responsibility will be a driver for change, there is no doubt that this will need the support of direct regulation. This will serve to protect the common interests in a society, such as public health and the environment. It is this combination of legislation (laws, bye-laws and derived regulations) and the credible and consistent enforcement that has resulted in the waste industry as is known today in developed economies.

Without this political, environmental and social structure in place waste would continue to be dumped at the lowest cost. Certainty is an essential ingredient if there

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<sup>33</sup> Martin Medina, 2000, Globalization, Development and Municipal Solid Waste Management in Third World Cities, El Colegio de la Frontera Norte, Tijuana, Mexico, [http://depot.gdnet.org/cms/conference/papers/5th\\_pl5.2\\_martin\\_medina\\_martinez\\_paper.pdf](http://depot.gdnet.org/cms/conference/papers/5th_pl5.2_martin_medina_martinez_paper.pdf)

<sup>34</sup> Antonis Mavropoulos, Megacities, Sustainable Development and Waste Management in the 21st century, Proceedings ISWA 2010, available at [http://www.iswa.org/uploads/tx\\_iswaknowledgebase/Mavropoulos.pdf](http://www.iswa.org/uploads/tx_iswaknowledgebase/Mavropoulos.pdf)

is to be a systemic shift from where we are today with the open dumps. There has to be certainty for both the waste generators and the waste management industry. The generators have to be certain that there are the facilities to manage their waste in such a way that there is no detrimental impact on the environment and for businesses the protection of their corporate image.

To plan their operations and investments into the future, they need “regulatory certainty”. This requires the passing of coherent and clear legislation (laws and derived regulations, including incentive and sanction measures) and above all fair and consistent enforcement. It also needs a clear and long-term strategic plan to enhance the certainty for all stakeholders. It is of great importance to secure that there needs to be the strong “buy in” of all stakeholders.

This starts at the National Government level where good laws have to be introduced. Then local administrations will lead at the local level ensuring that there are adequate financial provision and human resources to deliver and enforce the requirements of the waste management system. Where private operators are providing the service they too will have to ensure that they have the human and financial resources required to fulfill their duties. They too will need to be certain that they will receive payment for the services that they are providing for and on behalf of the local administration.

This systemic change is often opposed by many stakeholders — the introduction of fees to fund waste systems finds opposition from householders, private enterprises and merchants. Indeed, major corporations globally are opposed to the introduction of fiscal responsibility through systems

such as Extended Producer Responsibility; many of the larger corporations also avoid paying taxes in many domains, depriving governments of finance; it requires strong government to overcome such opposition in the name of the common good.

The public too will have to change their “habits of a lifetime” and embrace any new system that is implemented through social instruments. Dumping and littering will become a thing of the past. Communications will play a major role in creating the awareness for change. Not just a one-off communications campaign but also one that is continuous throughout the longevity of the plan. Social instruments rely on communication, awareness raising and positive interaction between the government institutions, the public and other stakeholders.

Providing information alone will not change people’s attitudes and behavior. Encouraging people, engaging with communities and leading by example are as important. There will of course be casualties as there is the systemic shift from open dumps to controlled landfilling and resource recovery. There will be no room for the informal worker working as they are today in this new dimension for good solid waste management. However their plight must not be forgotten and consideration must be given as to how they might fit into this new era for solid waste management.

Employment is an obvious option but may not always be desired by the informal worker. The suggestions involved in the chapter regarding social challenges (It’s about People, not Waste) provide more guidance regarding the engagement with informal recyclers.



## Developing human resources and waste management departments

If there is to be systemic change in moving away from the open dumps it is essential that human resources are made available. There will be a need for engineers, scientists, finance managers, waste managers as well as a workforce able to operate the specialist plant and machinery necessary for effective waste processing and treatment/disposal. It is unlikely that any of these specialist professions will be fully appraised with waste management practices. So it is essential that a relevant training program should take place for putting together the skills necessary.

Clearly the individuals will have their own specialist skills but the skills for managing leachate, for managing landfill gas, for landfill engineering, for composting and for the operational practices for whatever technologies are adopted will all have to be learned as it is unlikely that these skills will be sitting on the shelf.

Ideally these resources will be housed in a standalone waste management department, as this is likely to be the only way to ensure that the financial resources are ring fenced and available to run an efficient and effective solid waste management service. Despite being a standalone department they will still be accountable to the municipality administration.

Developing proper human resources is an element of the broader change required. So, it is important to remember the four steps for effective change management regarding human resources<sup>35</sup>.

### 1. Overcoming resistance:

Although employee resistance is a natural reaction to widespread organizational changes, you can overcome that resistance by focusing on several key strategies like:

- # Clearly and consistently communicate about the change well in advance of its implementation.
- # Help employees better understand the need for the change and the rationale behind the decisions, as well as the ways the change may affect them.
- # Ensure that the change management team includes change “champions” who can help spread positive messages about the change, as well as take the temperature of employee reactions to the change.
- # Provide strong support for the changing environment, such as ensuring that managers are provided with the training and information they need to answer employee questions.

### 2. Engaging employees:

Employees who are engaged in the change are more likely to put in the effort necessary to help implement the change and ensure a positive outcome for the organization. Help create high levels of employee engagement during your change process by:

- # Developing a team approach that includes employees’ perspectives from a variety of departments and levels;

- # Assigning and clarifying roles and responsibilities;
- # Increasing your focus on the workers who are affected most by the change;
- # Understanding and taking into account the different motivational factors for each employee.

### 3. Implementing change in phases:

For systems planning a major change initiative, taking a phased approach can help ensure that the transition to a new system or process is as smooth and seamless as possible. It is usually suggested to identify three phases:

- # Prepare for change – By taking steps such as defining your change management strategy, developing your change management team, and outlining key roles;
- # Manage the change – By creating and executing change management plans that include communications, operations and resistance management;
- # Reinforce the change – By collecting and analysing feedback and implementing corrective actions where needed.

### 4. Communicating change:

Failing to tell employees in advance about organizational changes can increase employee misconduct by 42%<sup>36</sup>. An integral part of every stage of the change manage-

ment process, communication must be a two-way process in order to ensure the success of the organizational change.

- # Think quality over quantity when it comes to communicating with employees, and consider these communication strategies for successful implementation:
- # Pre-and post-surveys allow for feedback both before and after the change has been implemented, which can enhance the overall process;
- # Be clear, consistent and explicit, especially when it comes to timeline and responsibilities;
- # Use both formal and informal communication approaches, including email, intranet, in-person meetings, signage and voice mails;
- # Offer opportunities for employees to provide feedback into the process, and then be sure to use the input to inform the plan;
- # Gather employees to explore worst-case scenarios and then develop strategies to address them.

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< <sup>35</sup> Henry Hornstein, The need to integrate project management and organizational change, IVEY Business Journal, March – April 2012, available at <http://iveybusinessjournal.com/publication/the-need-to-integrate-project-management-and-organizational-change/#.VLgT-ivF9HQ>

^ <sup>36</sup> Maarten Westermann, Bad communication leads to employee misconduct, Business Works, June 2013, available at <http://www.biz-works.net/index.php5?SID&fl=y&pgid=bp&art=524&st=bad-communication-leads-to-employee-misconduct>

## Transition period: the case of Bo City, Sierra Leone

Clearly to move from the open dump to improved controlled solid waste management will take time. This can take anywhere between five to ten years to deliver which is ably demonstrated by the case study for Bo City, Sierra Leone which follows. Although many will consider this to be a long time frame it should not deter from the ambition to close the open dumps. In the case of Bo City there are a number of unavoidable circumstances that created inevitable delays, which included the worldwide financial crisis and latterly the Ebola outbreak in the region. It is therefore likely that ten years is a worst-case scenario but it does bring life back to reality in that it just might not be all plain sailing.

Bo City Council through its links with One World Link in the UK and being inspired by the United Nations Millennium Development goals for a healthy environment took the bold step to improve solid waste management in its city. It recognized that poor waste management was a real threat to the health and wellbeing of its residents and it also saw it as a threat to the expansion of its business base.

In 2007 a recognizance visit was undertaken to obtain a clear view of what the situation was like on the ground. This included a waste audit as well as a review of the resources available.

As a result funding was sourced from the UNDP, which resourced the purchase of a backhoe loading shovel, a skip lorry and a number of skips. The backhoe loader would be used to prepare and operate at an engineered landfill.

The skips to be located strategically throughout the city to then transport the waste to the landfill. Waste was to be

segregated into an organic fraction for composting and the remainder as “inert” waste for landfilling.

Funding was finally secured in Spring 2009 with the backhoe loader being delivered in July 2009. Training was then given by the supplier to a number of plant operatives. Landfill and leadership training in August 2009 followed this training. The worldwide financial crunch then took hold and it was not until April 2010 that the skip lorry and 8 skips were delivered and the micro pilot project launched. Unfortunately because of the delays and through political inertia the project ground to a halt for a number of years and it was only resurrected in 2013 when a successful bid was put to the UK’s Department for International Development (DFID). Funding was agreed early in 2013 which rekindled the belief in the project and from here it has gone from strength to strength.

A waste management plan was produced for Bo City to cover the period 2014 – 2020. This set a number of objectives that would help to deliver the project plan agreed by and funded by DFID. Youth groups under the overarching umbrella of Klin Bo were established to undertake a pay as you throw collection system. Transit points were established to locate the skip with the acquisition of two further skip loaders to service them.

A Memorandum of Understanding (MoU) was signed with the youth groups. The MoU clearly defined their responsibilities, one of which was to ensure the segregation of the compostable organic waste from the rest of the waste stream.

In July 2015 a community Law was implemented which was to ban all open dumpsites.

This allowed the Metropolitan police to impose fines or even look to secure imprisonment through the courts for failure to comply with the law.

City Council early in 2016 agreed to the formation of a semi-autonomous waste management department with funds from central government for the funding for waste management to be transferred directly to it.

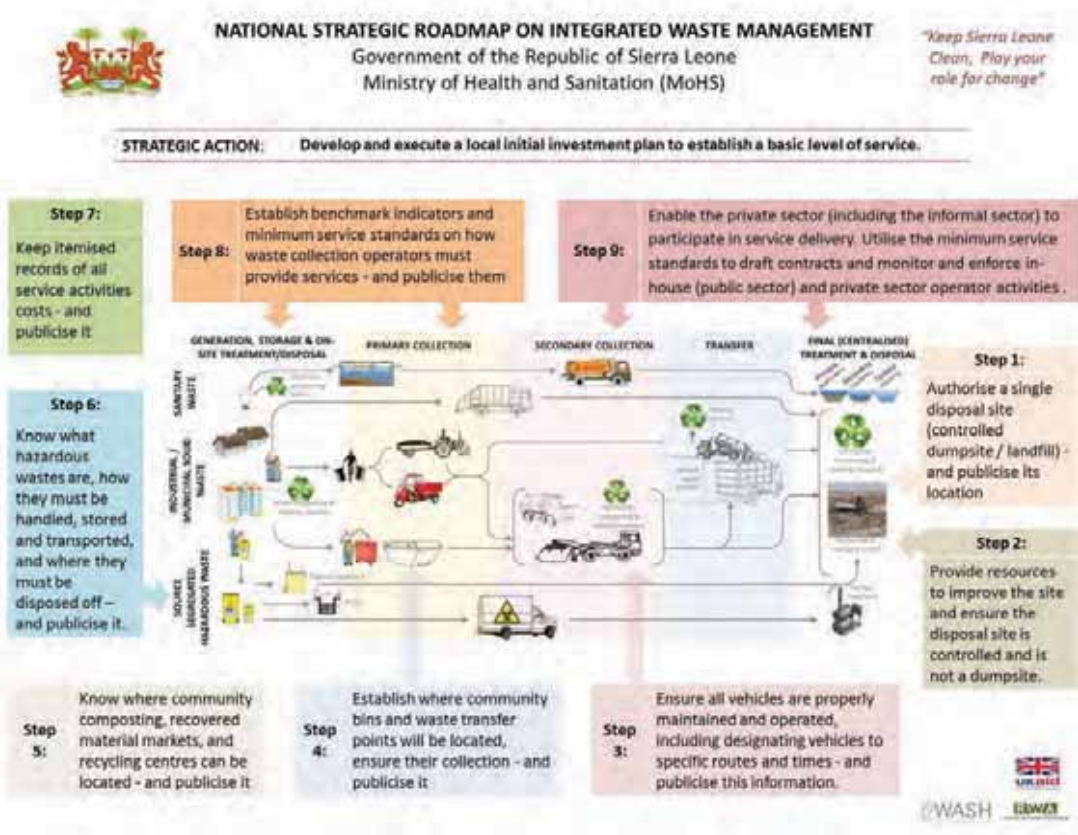
The Council however maintained an overarching interest in its affairs by being a signatory to the department's bank account. Currently detailed designs are

being prepared for the development of the landfill and the composting facility.

The procurement of a weighbridge and green waste shredder are now progressing. The completion of this will mean that the open dumping of waste will cease and a controlled waste management program established. Although there is still some way to go the project is on schedule for completion in March 2018.

Figure 7 presents the roadmap on integrated waste management of the Republic of Sierra Leone, as it was elaborated during the planning stage.

— Fig. 7: Policy roadmap towards integrated waste management of the government of the Republic of Sierra Leone —



## The importance of regionalization

The setting up of a proper and sound municipal solid waste management system in compliance with higher standards — including the construction of new, modern facilities as well as the organization of the service itself — is prohibitively expensive for most of the municipalities in the developing world. The environmental standards that modern landfills have to meet, including the provision of plastic linings, drainage networks, monitoring wells, leachate treatment facilities and landfill gas management systems, as well as other indivisible elements such as compactor vehicles, fencing, weighing stations, permanent guards etc., make small, local landfills unfeasible. The costs can only be commercially justified and borne by a large number of users. It is therefore the environmental standards and technology costs that trigger

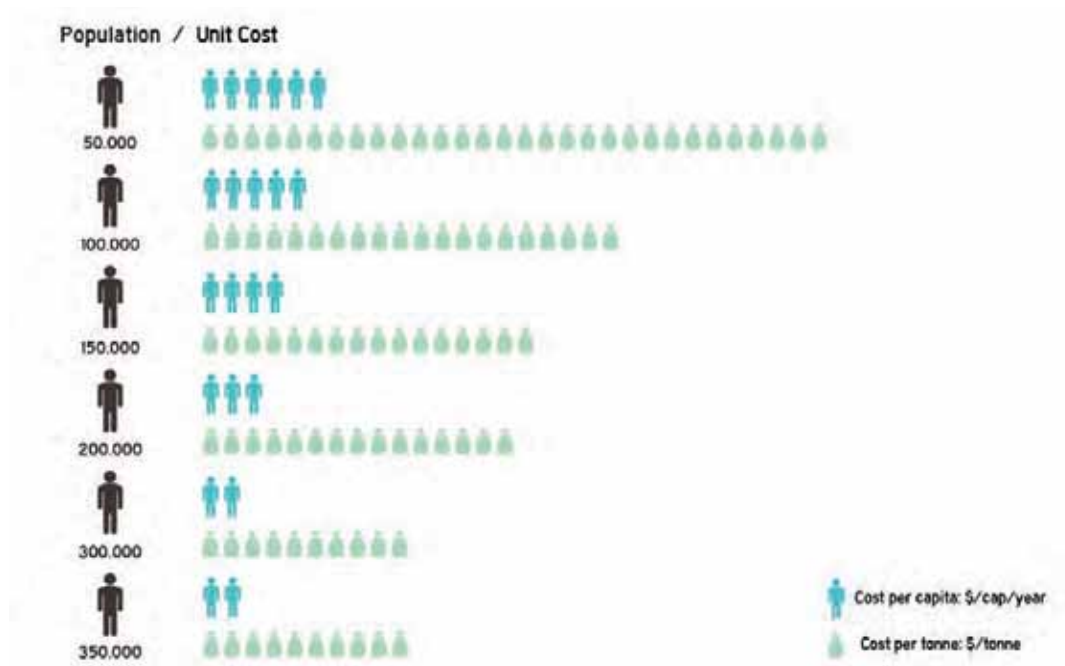
economies of scale and the regionalization of SWM systems, unless one municipality is large enough to economically justify a solid waste management system with individual state-of-the-art disposal, which is usually the case in capital cities. Apart from technical improvements to the MSW management system, there is certain policy, legislative, economic, financial and institutional prerequisites<sup>37</sup>.

Figure 8 shows the impact of scale to the operational cost of a sanitary landfill, in cost per tonne and cost per capita.

In advanced waste management systems, the evolution in waste management

<sup>37</sup> REC, Speeding Up Investments in the Waste Sector, a manual for waste utilities in South Eastern Europe, Hungary, 2009

Fig. 8: Scale economies in landfill operational cost<sup>33</sup>





from local to the regional level has taken decades. As municipalities are mainly responsible for MSW management, most of them started with a municipal approach before practice proved that a regional approach is more viable financially.

The planning of integrated MSW management is challenging since there is no uniform definition of a region. However, the size of the waste management regions established should be in a range that enables the installation of technical solutions providing financially viable economies of scale.

The regionalization of waste management operations greatly depends on the geographical and topographical structure of the project area, which influences the operational costs for regional sanitary landfills.

Experience in transition suggests that the closure of dumpsites is a precondition for regionalizing MSW management. Without the enforced closure of uncontrolled landfills and dumps, municipalities will always prefer to dispose of waste in their own backyard.

With their limited financial resources, they will naturally oppose the transportation of waste to landfills further away, for which their often-obsolete vehicles are not equipped. The government's role is to set environmental and other standards for landfills, according to which it has the right to mandate the closure of non-compliant landfills.

The regional landfill should be located reasonably close to the largest population center. The regional landfill concept is therefore tailored to each situation, depending on the number of population centers, the

geographic spread of the population, and the haulage distances and journey times. All these factors influence the capital and operating costs of infrastructure elements and need to be assessed in order to evaluate the various regionalization options (including the existing "fragmented" local approach) and to select the most feasible one.

The sharing of long-distance transportation costs among participating municipalities can be implemented by integrating them into a uniform gate fee to be paid directly at the landfill or at the transfer points.

Another option is to deduct the transportation costs from the gate fee so that the closest municipalities pay a higher price for disposal. Both approaches allow for equal access to the regional facilities: the municipalities should state their preference in the agreements and subsequent legal acts defining the cost elements and financing methods of the operations.



Financial  
and economic  
problems:  
Yes we can!



The sustainability of each and every waste management system depends on its financial and economic structure and performance. In general terms, affordability is likely to be a key constraint, and securing sustainable sources of revenue to improve the level of service provided is likely to be challenging. But even in high-income countries, raising the necessary investment finance for new, environmentally sound waste management facilities is still a challenge.

## A note on International Aid Tools and their efficiency

According to ISWA's report *A Review of Development Cooperation in Solid Waste Management*<sup>38</sup> an estimated \$4 billion was committed to development cooperation in SWM between 2003 and 2012.

The proportion (3-year average) of development finance for SWM has more than doubled from 0.12% to 0.32% over the 10 years.

However, this is still only a tiny proportion of overall development finance. Considered in terms of the population of the countries receiving SWM development finance in 2012, it equates to just \$0.09 per capita. This compares with per capita levels of \$2.43 in the water and sanitation sector, and \$31 for all development finance.

The majority (70%) of this support has been in the form of lending from development banks, amounting to \$2.8 billion over the 10 years from 2003 to 2012.

This has provided access to capital in low and middle-income countries and helped develop much-needed SWM infrastructure, particularly collection systems and engineered landfill capacity.

Grant-funded support is the other key element of development co-operation, amounting to an estimated \$1.2 billion between 2003 and 2012, comprising over 3,000 grants.

Around three quarters of total grant funding has been used to increase local skills and capacity and to provide other technical assistance on issues such as the informal recycling sector, private sector participation, cost recovery, awareness raising and climate change. The remaining grant funding has been used to fund

the purchase of refuse collection vehicles and containers; and to provide SWM in the aftermath of natural disasters or as part of conflict-related relief efforts.

Following the failure of a number of high profile SWM infrastructure projects at the preparation stage, there was a general move amongst the major donors active in SWM in the early 2000s to an approach focused on increasing local capacity and skills.

Since that time, the systems-based approach of ISWM has become increasingly established in development cooperation, an approach that seeks to ensure that both the physical and governance issues of SWM are addressed in a holistic way.

There have also been significant changes in the wider development co-operation landscape, with emerging economies, such as China and Brazil, becoming key development co-operation partners and an increasing expectation that financial support provided to low and middle income countries will require the blending of finance from official sources with philanthropic, commercial and private sector sources.

Importantly, the replacement for the Millennium Development Goals, perhaps in the form of a new set of Sustainable Development Goals, will set the agenda in the post-2015 development co-operation landscape.

The geographical spread and distribution of SWM loan funding between 2003 and 2012 is very uneven: one country (China) received 12 loans with a total value of \$510 million (18% of total development finance lending for SWM). The top ten countries for

SWM-focused development finance are all middle-income countries, and account for over two thirds of the total value of both grants and loans over \$4M (in descending order: China, India, Morocco, Turkey, Azerbaijan, Vietnam, Venezuela, Ukraine, Tunisia and Argentina). Overall, low-income countries appear to have received significantly less financial assistance - only ten Sub-Saharan countries received grants or loans of more than \$4 million, together accounting for less than 5% of the total.

This uneven geographical distribution may be because middle-income countries are better able to access and absorb development finance but it is certainly an issue that needs to be considered carefully to ensure that development finance on SWM is targeted appropriately.

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< <sup>38</sup> A Review of Development Cooperation in Solid Waste Management, available at [https://www.iswa.org/fileadmin/galleries/Task\\_Forces/TFGWM\\_Report\\_Review\\_International\\_DCSWM.pdf](https://www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_Review_International_DCSWM.pdf)



## Negative economic impacts by dumpsites

It is very important to highlight that uncontrolled dumpsites operations pose serious negative economic impacts on both the economy and the society. Negative economic impacts are spread through various sectors as waste management, recycling, job creation attracting inward investments, environmental protection, public health and quality of citizens' life. The negative economic impacts from dumpsites and the lack of a national policy for their upgrade and/or closure in developing countries could be identified in the following areas.

### **Increased economic costs**

Although in most of the cases decision makers and authorities continue to operate dumpsites because they seem the cheapest option, the truth is that dumpsites are actually substantially more expensive than an integrated waste management system. The economic costs of not addressing waste management problems exceed the financial costs of environmentally sound waste management. This is obvious once the cost of environmental degradation and the costs posed to health systems are taken into consideration<sup>39</sup>.

### **Environmental costs**

Dumpsites create long-term environmental impacts like surface and groundwater pollution, threats to terrestrial and marine environments, GHGs emissions, and direct atmospheric pollution from open burning etc. The cost of environmental degradation, although it is usually ignored, becomes more obvious when hundreds of millions

of dollars must be spent for clean-up and dumpsite rehabilitation projects must be spent. Typical examples are a) the famous Fresh Kills dumpsite in New York, where the cost of closing and isolating the East Mound (one of the four disposal areas) is about 250 million dollars, and b) the cost of closing and rehabilitating the Hiriya dumpsite in Israel, which is above 100 million dollars up to now and it is estimated to go around 250 million dollars when the project will be completed.

### **Increased social costs**

There are several social costs involved that are usually either ignored or underestimated like the potential for employment, business and economic growth, the improved livelihood and health & safety conditions for informal recyclers, the cost of land and property devaluation etc.

### **Increased disposal costs**

The creation and operation of thousands of dumpsites, without any technical and scientific documentation about their allocation and their necessity drives increased operational unit costs on a national or regional level due to the unplanned and frequently unreasonable use of equipment and staff. GWMO details that the cost of inaction is something between 3-7 times that of the cost of delivering a proper waste management system.

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<sup>39</sup> Cointreau, S. & C. Hornig (2003), Global Review of Economic Instruments for Solid Waste Management in Latin America. Inter-American Development Bank (IDB)

## Barriers for closing a dumpsite

A policy for financing dumpsite closure should be part of a broader policy for the introduction of integrated waste management systems. The closure of dumpsites in developing countries faces important and serious financial barriers. Most of the times, those barriers are the result of the lack of a specialized policy for the effective and viable financing of dumpsite closure and system upgrading projects. It is also usual to observe a huge financial gap in waste management policies that undermines policy's overall performance. More specifically, the financial barriers include the following.

### **Lack of public financial resources**

Government's financial capacity is also affected negatively, due to the limited collection of taxes from sector's enterprises.

The impact becomes much higher when it is compared to the potential revenues in the case of existence of a competitive, national level market for waste management & recyclables.

Apart from these taxation losses, governments are also losing revenues from the exploitation of waste management products (e.g. use of compost instead of importing some fertilizers) and the use of the available funds for the finance of waste management projects, coming from international institutions<sup>40</sup>. In addition, the lack of a proper waste management and recycling policy reduces the attractiveness<sup>41</sup> of the country for investors with strict environmental compliance schemes and high sustainability standards.

### **Lack of coherent policies and coordination**

The lack of a specialized policy for financing a system upgrade and dumpsites closure programs results in the appearance of a gap between the actual needs and the availability of the necessary funds. Furthermore overlapping and duplication problems appear, due to the lack of coordination and specialization of funding. International and national organizations, national and regional waste management agencies should have an integrated and results-oriented strategy, based on projects per case needs and their incorporation to the broader regional and national strategy for the support of integrated waste management policies, through the closure of dumpsites and upgrade of the existing waste management systems<sup>42</sup>.

This multi-level and results-oriented reorganization of financial policies for dumpsites closure / upgrade will contribute to the development of economies of scale in project's financing and the strengthening of financial resources impact, through the limitation of overlapping and weak coordination<sup>43</sup>.

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<sup>40</sup> Asian Development Bank, (2001) Guidelines for the Financial Governance and Management of Investment Projects Financed by the Asian Development Bank

<sup>41</sup> Helm, D.R. (2005). Economic Instruments and Environmental Policy. The Economic and Social Review

<sup>42</sup> Eggers, William D. & Tom Startup (2006) Closing the Infrastructure Gap: The Role of Public-Private Partnerships

<sup>43</sup> Finnveden, G., M. Bisailon, M. Noring et al. (2012). Developing and evaluating new policy instruments for sustainable waste management

### **Regulation gaps and problems**

The existence of regulatory gaps and problems regarding dumpsites closure / upgrade policies implementation in developing countries creates important obstacles regarding the sector's development and reform. Quality of regulation in developing countries creates ineffective implementation of the initiatives and a limited interest for Private Sector Participation (PSP) in waste management projects. Lacks of policies that promote transparency and competition in the waste management sector cause the restrain of private sector investment interest<sup>44</sup>.

Another usual problem is the absence of a clear framework for private enterprise participation in waste management and the safeguarding of their investments. In another view, a clear regulation that is characterized by increased levels of compliance can contribute to the reduction of investors risk and will guarantee the implementation, operation and viability of their investments<sup>45</sup>.

Regulatory reform for the promotion of alternative finance and PSP for dumpsites closure / upgrade projects in developing countries will have a positive impact on waste management policy's implementation and effectiveness.

Introduction of better regulatory frameworks on waste management will boost alternative finance schemes, but it still needs to be combined with other initiatives, that will focus on the creation of financial incentives for the attraction of alternative financial resources for funding waste

management projects. For the creation and promotion of the necessary financial incentives to attract alternative financial resources, the baseline is the protection of investments through an upgrade, simplified and standardized regulatory framework<sup>46</sup>.

### **Limited access to financial instruments and tools**

The limited access of waste management authorities to financial instruments and tools is another crucial financial barrier to the effective implementation of dumpsites closure / upgrade policy reforms. This is due to a) the absence of a valid and certified financial capacity of the relevant authorities, and b) the lack of specialized financial instruments.

The majority of the waste management authorities and agencies in developing countries haven't got any certification of their financial capacity, or in the best case have a certified but limited financial capacity, which excludes them from the access to financial resources and loans. The usually limited collection of any service fees and the lack of accountability in their operations contribute negatively to their financial capacity and long-term viability. Another dimension of the same problem is that in most cases the authorities are not capable of assessing the financial value of

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<sup>44</sup> Greyson, J. (2007). An economic instrument for zero waste, economic growth and sustainability

<sup>45</sup> Kessides, I. (2004), Reforming Infrastructure: Privatization, Regulation, and Competition

<sup>46</sup> World Bank Toolkit, (2000) Private Sector Participation in Municipal Solid Waste Management: Guidance Pack



their existing and forecasted assets and products, due to the lack of data and proper evaluation methodologies. This inability creates additional obstacles to their access to finance.

This results to a great difficulty of ensuring a) the access to financial resources, b) the repayment of the provided finance, and c) the proper use of this finance. In this regard, a possible solution could be to introduce a kind of financial capacity certification for the involved authorities and agencies, but in a more flexible, but still standardized way, which will guarantee the management and return of the provided loans, but in the same time will support the access of the institutions to the financial market<sup>47</sup>.

#### **Limited administrative capacity of waste authorities**

Limited operational & administrative capacity of the relevant authorities constitutes one of the most important barriers for the implementation of the related policies in developing countries.

The usually low administrative capacity can be addressed through capacity building and training activities, proper organizational design, and the promotion of their effective coordination in national and regional networks.

Improvements should also incorporate specific actions regarding the management of the available financial resources, financial audit & control of the operations, and the introduction of accountability in the services provided

#### **Restricted markets for waste management & recyclables**

The extensive use of dumpsites restricts or even eliminates the prospects for the establishment of a viable waste management and recyclables market.

A market for waste management and recyclables is also restricted from the absence of an effectively enforced national policy for the promotion of recycling and the exploitation of waste products in the economy, for example for the production of energy or the use of compost in agriculture. From this point of view, it's obvious that the absence of an organized and effectively performed solid waste and recycling policy eliminates any entrepreneurial interest for investing in waste management and leads to the appearance of a vicious circle of ineffective treatment of waste and the repletion and expansion of dumpsites<sup>48</sup>.

This is because it does not allow the large-scale utilization of the resources involved in waste, thus itself acts as a barrier for attracting the financial interest of international organizations, funds and banking institutions for the provision of loans and funds.

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<sup>47</sup> World Bank (2014), Public – Private Partnerships reference guide: Version 2.0, available at <http://documents.worldbank.org/curated/en/2014/01/20182310/public-private-partnerships-reference-guide-version-20>

<sup>48</sup> Harris, Clive (2003), Private Participation in Infrastructure in Developing Countries: Trends, Impacts, and Policy Lessons



## Alternative schemes for financing a dumpsite closure & system upgrade

Alternative financing for dumpsites closure and waste management upgrade projects is among the most important challenges regarding the implementation of waste management policies in developing countries.

Most of the times, a proper financing scheme requires the structural reorganization of the existing model for waste management policies and implementation mechanisms in developing countries. A coherent and multi – level structural reorganization is required in order to support policy's effectiveness and increase the attraction of alternative sources of funding<sup>49</sup>.

The new philosophy and orientation in waste management policies should focus on the creation of economies of scale, through the consolidation of small scale dumpsites projects and the interconnection of dumpsites closure and upgrade projects with the exploitation of potential products (for example biogas production and/or compost) and with the exploitation of recyclables that now are ending up in dumpsites, which could create some profit making activities.

The combination of economies of scale with some revenues from products creates an initial incentive that makes Private Sector Participation (PSP) more attractive.

Of course, the overall goal of the provision of financial incentives for the attraction of alternative financial resources for dumpsites closures / systems' upgrade in developing countries refers also to the establishment and development of a market for services, which will multiply and sustain the financial interest for private sector enterprises. Complementary to the reform of regulatory framework and creation of economies of

scale, it is necessary to design and deliver accessible financial tools specialized to national waste management enterprises requirements (both public and private).

A new policy model should address the existing models' inefficiencies and promote the concept of circular economy in waste management. It should manage the limited access of national enterprises and stakeholders to financial resources and instruments and the lack of stakeholders' and involved national authorities' capacity for the effective implementation of the projects. Coordination in alternative financial resources management and development of co-financing tools should be the base for the organization of a new policy model for dumpsites closure and upgrade in developing countries<sup>50</sup>.

A new and innovative policy model for the effective and viable finance of relevant projects, from microfinance projects to megaprojects, through the promotion of PSP could incorporate the following issues (in different policy mixtures and combinations):

- # Promotion of co-finance through the development of joint ventures and bonds for waste management projects;
- # Provision of different financial products, including (apart from loans from commercial banks and international organizations) co-finance instruments' combined with grants;

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<sup>49</sup> Asian Development Bank, (2012), handbook on public – private partnerships

<sup>50</sup> Brook, Penelope, and Suzanne Smith (editors). 2001. Contracting for Public Services: Output based Aid and Its Applications

# Financing of whole life – cycle projects, based on a complementary approach and according to national/ regional waste management strategy goals

# Strengthening public – private sector collaboration and partnering in the implementation of the financed projects, through standardized and flexible – accessible institutional forms<sup>51</sup>

# Financing the development of a national market for waste management and recycling products, through the promotion of competition, transparency and by strengthening the entrepreneurship at different levels<sup>52</sup>

# Support the creation of economies of scale in projects’ financing, through the establishment of local / regional partnerships as a condition for providing grants and loans

# Incorporation of strategic planning principles, as the participatory regional and local waste management planning, the result oriented finance, the introduction of circular economy principles and the use of life – cycle approach in waste management

# Provision of financial resources – grants for the technical support and capacity development of PPP projects

Figure 9 shows the process for preparing a Public Private Partnership<sup>53</sup>.

Based on the above principles a coherent model / mechanism for dumpsites closure and upgrade should be designed, tailor-made to each and every different case.

The organization of the proposed financial mechanism could be implemented according to two different alternative forms:

# In the first form, different – independent financial institutes or international organizations, under a commonly agreed and monitored set of standards and principles, fund a dumpsite closure / upgrade project

# In the second form, the different contributors develop a common co-financing mechanism for waste management projects finance. All the potential financial contributors (national, international, donors etc.) participate in the management of this mechanism. This is a model that is strongly advised because it contributes to the capitalization of co-finance and partnership benefits, creating with this way the necessary synergies and economies of scale in project finance and implementation. Such a model drives the adoption of a coherent and participatory approach in waste management policies finance in developing countries.

Apart from the selection of the financial mechanism’s proper institutional form, an important parameter regarding its adjustment to developing countries socio-economic environment is the parallel

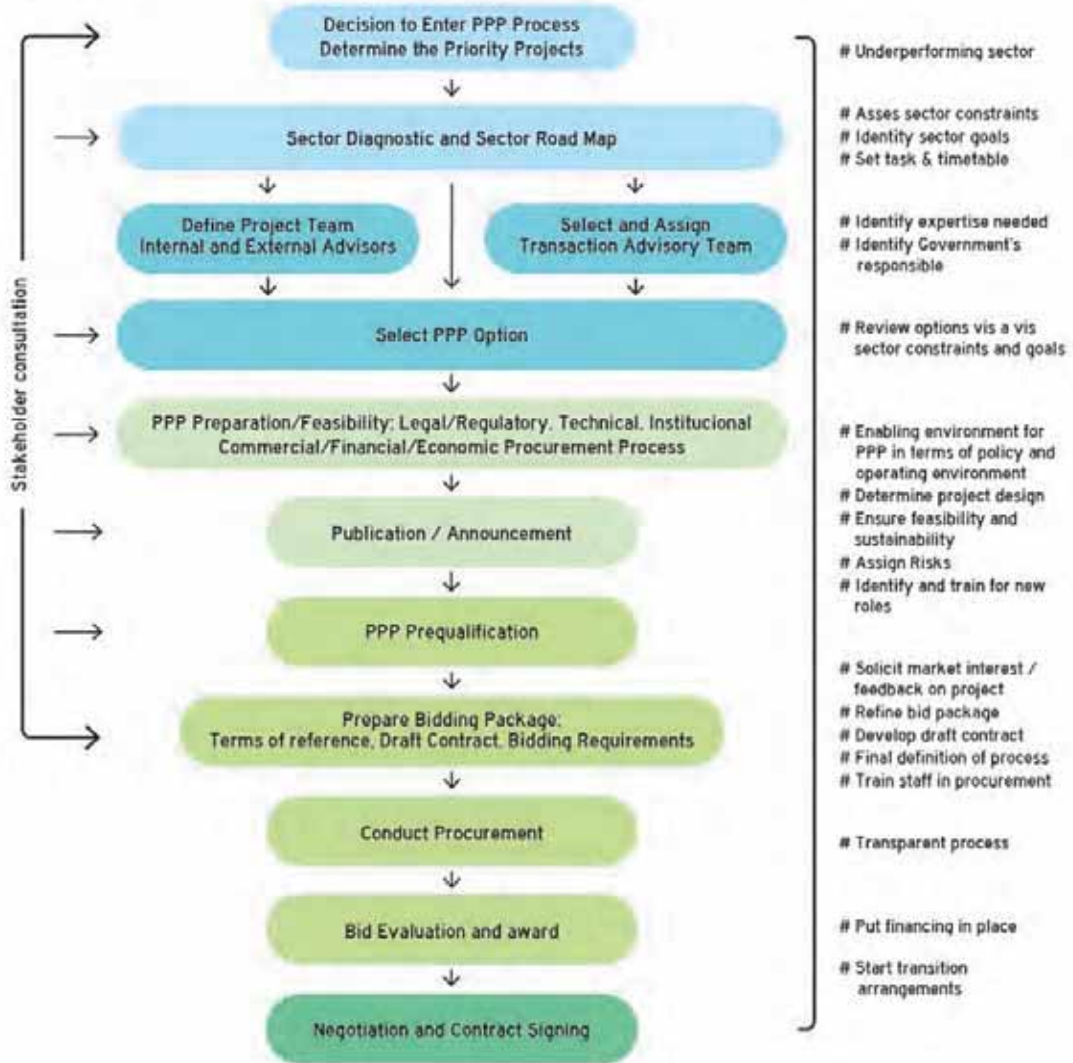
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<sup>51</sup> Markgraf, Claire (2014). Review of World Bank Solid Waste Projects & Activities World Bank and the Global Partnership for Output-Based Aid (GPOBA), (2014) Results-Based Financing for Municipal Solid Waste

<sup>52</sup> Calcott, P. & M. Walls (2005). Waste, recycling, and “Design for Environment”: Roles for markets and policy instruments

<sup>53</sup> Asian Development Bank, (2012), handbook on public – private partnerships

Fig. 9: The structure of a PPP project



and complementary provision of specialized financial products, as grants and loans. Grants and loans should be oriented to the support of PSP and the promotion of public – private partnerships<sup>54</sup>. In principle, there are two kinds of special instruments:

- # Specialized loans for dumpsites closure / upgrade from commercial financial institutes (private banks)
- # Specialized grants for dumpsites closure / upgrade, preparation and then implementation, provided from international organizations and non – commercial / international development banks

Except from the provision of both specialized loans and grants for the finance of dumpsites closure / upgrade projects, their complementary nature could be further supported, through:

- # The combination of specialized grants for projects preparation and maturation, through the finance of the necessary feasibility studies with specialized loans for the implementation of dumpsites closure / upgrade projects

# The repayment of the provided grants for waste management project preparation / maturation, from projects contractors / implementation authority, after the financial approval of the project from the financing authority, through the introduction of specialized regulations in contract award

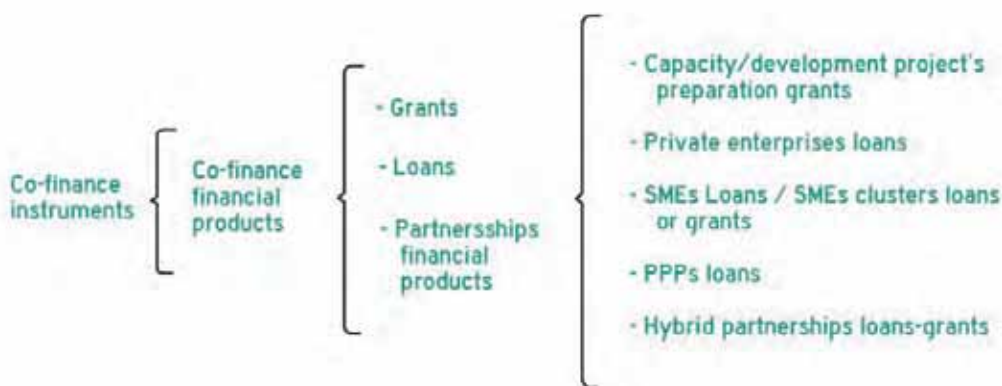
# The formal introduction of feasibility studies and capacity building activities, as a precondition for the financial approval of relevant projects, through commercial or non – commercial / international development financial institutes

Figure 10 provides a potential structure of the relevant financial instruments.

Independently from its institutional model and the form of provided finance, the new mechanism for dumpsites closure / upgrade should provide diversified financial tools for different forms of waste management enterprises as:

- # Specialized loans and grants for public – private partnerships

Fig. 10: a potential structure of financial instruments



# Specialized loans and grants for waste management cooperatives

# Specialized loans for private waste management enterprises and waste management SMEs

# Specialized loans for clusters of national and especially SMEs, waste management enterprises

# Specialized loans for public waste management enterprises and inter – municipal waste management enterprises

The effective promotion of alternative schemes for dumpsites closure/upgrade requires the selection and standardization of different financial instruments that will support the introduction of strategic planning, cross sectorial collaboration, alternative finance, finance for results and community involvement principles and values in projects design, finance and implementation<sup>55</sup>.

The proposed financial instruments should support the development of public – private partnership projects and private sector participation in waste management sector. They could include the following:

# Performance bonds

# Leasing loans

# Green bonds

# Carbon funds

# Equity Contributions

# Bond/Capital Markets Financing

# Equity funding

# Crowd-funding bonds

# Venture capitals

# Debt-buy loans

# Syndicated loans

# Mezzanine financial bonds

# International financial cooperation guarantees

# SMEs bonds

# Municipal / inter-municipal waste management / dumpsites management bonds

The selection of the most appropriate instrument, or even better the best mix of instruments, depends a lot on the local conditions, the financial needs and the profile of the projects that requires finance. In any case, this is one of the most difficult components of a successful project<sup>56</sup>. Annex 1 provides more detail about the above-mentioned instruments.

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< <sup>54</sup> Weitz, A., R. Franceys, editors, (2002), Beyond Boundaries: Extending Services to the Urban Poor. Manila: ADB.

^ <sup>55</sup> Finnveden, G., M. Bisailon, M. Noring et al. (2012). Developing and evaluating new policy instruments for sustainable waste management

^ <sup>56</sup> JRC – European Commission,(2011), Supporting Environmentally Sound Decisions for Waste Management

## Alternative institutional forms

For the successful management of all the alternative financial instruments, alternative institutional models should be also developed.

Alternative institutional models should be harmonized with financial instrument regulations for project financing and provide incentives and guarantees, whenever is required.

The key factor for the increase of private sector and community organizations access to finance is the creation of partnerships and synergies between public - private sector and local communities<sup>57</sup>.

In many cases, especially when informal recyclers are playing a central role, it might be useful to think creatively and deliver innovative partnership models that involve community cooperatives, in an attempt to strengthen the partnerships' impact through the promotion of community engagement.

An expansion of the traditional PPP models potential partners might be necessary, in many cases.

A good practice considers the building of partnerships through the organization of public consultation actions, in order to harmonize partnerships' goals with the real community needs.

Public engagement activities including public consultation actions, community awareness campaigns, training and capacity building activities and the organization of community stakeholders should be also

eligible for finance. Alternative organizational models for the promotion of PSP should provide the necessary institutional framework for the financing and implementation of waste management projects and entrepreneurial initiatives for the exploitation of waste by-products<sup>58</sup>.

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<sup>57</sup> Franceys, Richard and Almud Weitz, (2003), Public-Private Community Partnerships in Infrastructure for the Poor

<sup>58</sup> OECD, (2007) OECD Principles for Private Sector Participation in Infrastructure



## Eligibility criteria

According to the selected alternative funding and implementation schemes, it is necessary to identify and standardize eligibility criteria for projects. Such criteria are usually the capital requirements, the investment's viability, the level of projects' financial revenue, and the project's contribution to the accomplishment of national, regional and local waste management goals<sup>59</sup>. Additional criteria for the selection of the optimal / alternative institutional model are also the regulatory requirements, the technical feasibility of the proposed projects, the environmental impacts assessment and the related social considerations. It should be mentioned that the optimal selection of alternative financial schemes and instruments is based on the comparative evaluation of the proposed

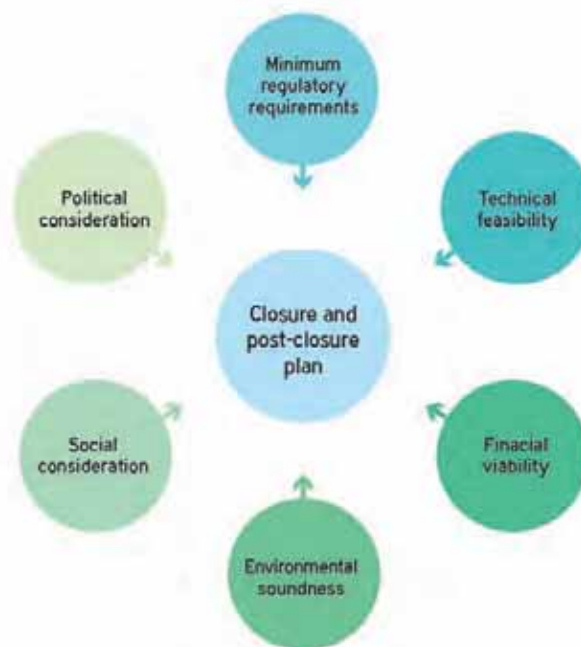
projects' viability and effectiveness, so it is usually a competitive procedure<sup>60</sup>. The social support and acceptance of the proposed project is a particularly important factor for the eligibility of the projects.

The key role of social acceptance and support to PPP models emphasizes the necessity for the strategic incorporation of public consultation and engagement tools as an integral part of dumpsites closure / upgrade strategies. The eligibility criteria are summarized in Figure 11.

<sup>59</sup> World Bank, (2013), Value-for-Money Analysis □ Practices and Challenges: How governments choose when to use PPP to deliver public infrastructures and services, Washington, D.C

<sup>60</sup> Pearce, D, Atkinson, G and Mourato, S. (2006), Cost-Benefit Analysis and the Environment

Fig. 11: Summary of eligibility criteria



## Benefits from dumpsite closures and system upgrade

The incorporation of strategic planning and alternative financial schemes concepts in dumpsites closure/upgrade projects in developing countries, will deliver a net improvement of the national, regional and local waste management policies effectiveness.

Net improvement will be measured by the minimization of waste that ends up in dumpsites, the strengthening of the existing waste management and recycling infrastructures and the promotion of recycling activities.

For the maximization of the economic benefits resulting from similar projects, it is important to link them with a broader policy for waste management systems improvement.

The major economic benefits include:

- # The creation of “green” jobs, from the development of national – regional waste management and recycling sector market
- # The positive economic impact from the increase of international organizations and financial institutes funds utilization
- # The maximization of recovery of valuable materials
- # The strengthening of a viable and competitive national market for waste management by-products, with a positive impact both at taxation, employment rates and private – foreign investments attraction
- # The limitation and the rationalization of waste management costs, through the utilization of scale economies

# The limitation of public health costs and expenditures associated with local population health problems related to dumpsites

# The reduction of environmental emissions and external costs associated with dumpsites

# The improvement of citizens quality of life and promotion of social cohesion & social consensus

# The reduction of funding needs for the elimination of dumpsites’ negative environmental impact to the local environmental, water resources and ground assets

# Creates an improved environment for business developments



## Cost recovery and tariffs

Municipal solid waste management is a core utility service provided by or on behalf of a city to its citizens, and can be considered as a basic human right. The costs are often met from the municipality budget, and the municipality may raise the income required from a user charge, a local tax or a transfer from national funds or a mixture of these. All of these revenue sources can work well, so long as the system is transparent and fits with local custom and tradition and the service fits customer needs.

One thing must be considered as 100% certain: raising service standards and passing from a dumpsite to safe and environmentally sound disposal increases costs.

As a result, as standards improve pressure intensifies on cities to increase direct cost recovery from service users. This is possible where there is a demand for a service and a tangible benefit to the service user (e.g. primary waste collection which cleans up the neighborhood) but it is substantially more difficult if activities are policy driven, such as a transition to more environmentally sound treatment and disposal options.

It is possible to increase payment rates and cost recovery through smart enforcement mechanisms and by providing support for those who cannot afford to pay.

Full cost recovery is more affordable to the users when income levels are higher, even though the absolute costs also increase.

The GWMO report describes the problem like this *“Affordability is a significant constraint on municipal solid waste management services in lower- income countries. Short-term solutions must be financially sustainable, and ambitions must*

*be tailored to what is affordable. Low and lower-middle income countries can often barely afford current municipal solid waste collection costs, so even the first steps of extending collection coverage and eliminating uncontrolled disposal and burning will raise affordability issues”.*

It has been suggested that a practical upper limit or a simple rule of thumb for affordable waste management costs is 1% of the per capita income level. In low-income countries, with an income level below about 1000\$ per capita per year, this means roughly 10\$ or less per capita per year.

Thus, it should come as no surprise that some low and middle-income countries set their user charges below full cost recovery rates.

For example Belo Horizonte, Brazil, and Chile as a whole, deliberately keep fees low and affordable to everyone, while at the same time striving to provide 100% waste collection coverage and getting all users to pay at least some contribution towards the costs.

The application of a viable cost recovery and tariff reform system is a very important parameter regarding the economic viability and the finance of any waste management project.

Cost recovery and tariff reform determine the financial impact of any proposed system, thus a number of parameters should be taken into account and evaluated in order to select the most proper solution<sup>61</sup>. There are two important questions regarding the design of the selected cost recovery instrument. a) What is the real cost of the current and the proposed system? b) Does

the selected cost recovery instrument cover the real cost of the current and the proposed system?

The proposed cost recovery model should be simple and easily understood; ideally it should also support the waste generators' desired behavior. In order to increase users payments, all the different waste management fees must be integrated into one fee only and only the responsible waste management entity should collect these fees<sup>62</sup>.

A usually successful approach is to incorporate waste management fees into important public utilities fees, as water supply or electricity, in order to increase their collection level. Some of the different available options include:

- # Taxes for waste management
- # Special purpose taxes for using dumpsites
- # Rehabilitation levies
- # Property rates taxes
- # User fee systems
- # Public cleansing charges
- # Deposit systems
- # The full cost-recovery system
- # Extender Producer Responsibility programs

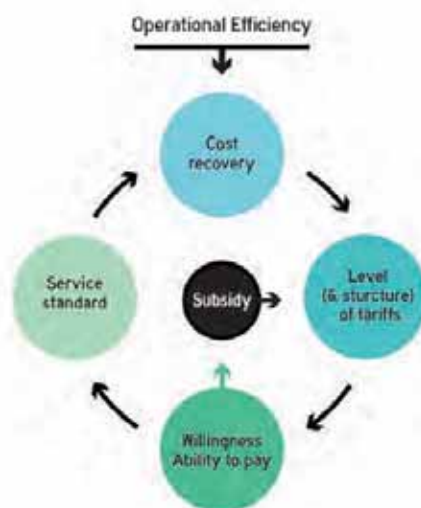
Taking into account the particular social, institutional and economic conditions that shape waste management in developing countries, a combined approach is suggested regarding the cost recovery and tariff reform. A proper model should

combine the collection of single – consolidated payments through taxation, but with a gradual shift to a limited user fee system, based on the progress and participation in local recycling services. The overall target is to create a balance between the securities of tax collected incomes with the risky approach of user fee systems and tax rewards for local population participation in recycling policies<sup>63</sup>.

Annex 2 describes several alternative cost-recovery options in details. Figure 12 visualizes the cost recovery conceptual model.

< <sup>61</sup> Dole, David and Ian Bartlett, (2004) Beyond Cost Recovery: Setting User Charges for Financial, Economic, and Social Goals  
 ^ <sup>62</sup> Steiner M, (2014), How to design a proper waste tariff? The 10 Golden Rules of Fee Making  
 ^ <sup>63</sup> Salga A, Bala S, (2011) : Draft Transparent Tariffs Setting Tariffs: a guide for Local government in South Africa, Namibia and Botswana

Figure 12: Cost recovery conceptual model



## Cost Suggestions for the International Aid tools

SWM-focused development cooperation has the potential to play a key role in:

- # Helping communities in the poorer parts of the world develop the capacity, systems and infrastructure they need to manage waste;
- # Protecting human health and the environment;
- # Creating jobs; and
- # Conserving resources.

Development finance in the form of grants to build local skills and capacity, and concessional lending to provide much needed capital, will be an essential element of this activity.

ISWA has suggested the following key-issues for a better utilization of International Development Assistance tools.

### **Raise the importance of SWM in local and global agendas**

Prioritizing SWM does allow numbers of SDGs to be tackled in an integrated way. There is also potential for using SWM itself (i.e. a clean city) as a proxy-indicator for good governance.

SWM needs to be recognized as a key element of international efforts to reduce poverty and environmental degradation.

In particular, a better evidence base is needed to illustrate how SWM can assist in meeting development goals and serve as an essential element of post 2015 development targets.

This evidence base needs to include information on the full economic costs and benefits of SWM in a developing world context, including external economic costs (e.g. health and environmental impacts), so

as to provide the evidence base to donors and development banks for funding and supporting development co-operation in SWM.

### **Emphasis on capacity building and good governance**

Much has been achieved to date on this issue but more needs to be done to ensure that communities have the necessary institutions and skills to deliver sustainable, locally appropriate waste management systems. It is important that the issues continue to receive support and grant funding.

### **Access to capital finance for major infrastructure**

Improving access to capital finance will be essential to help develop the necessary infrastructure for managing increasing levels of waste in low and middle income countries.

This will need to include improving access to loan funding from development banks but also the use of development finance to facilitate and leverage investment from private investors, and from philanthropic and climate finance sources. The reach of the majority of development finance on SWM also needs to be extended beyond a small number of middle income countries to the lowest income countries that need it most.

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<sup>64</sup> A Review of Development Cooperation in Solid Waste Management, available at [https://www.iswa.org/fileadmin/galleries/Task\\_Forces/TFGWM\\_Report\\_Review\\_International\\_DCSWM.pdf](https://www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_Review_International_DCSWM.pdf)

### **Understand the needs better**

Comprehensive information on the need for support and investment on SWM in low and middle-income countries is also lacking.

Work by the World Bank suggests that waste management costs in low and middle income countries is likely to increase significantly over coming years, but there is no clear picture of the level and distribution of investment that will be needed.

This data will be critical to plan ahead and to ensure that funding is directed appropriately.

### **Create new dynamic partnerships**

As the nature of development finance changes, the blending of finance from different sources will become increasingly important. For these approaches to be successful, effective partnerships between donors, philanthropic organizations, NGOs, the private sector and local and central government will be essential. The SWM sector also has excellent operator models for illustrating how the private sector and civil society can both be engaged to deliver better services, access investment, protect communities and the environment, and create jobs.



A large flock of black birds, possibly frigatebirds, is gathered on a massive pile of colorful plastic waste. The birds are seen in various poses, some standing on the trash, others in flight against a clear blue sky. The trash consists of numerous plastic bags, bottles, and other debris in various colors like red, blue, yellow, and white. The overall scene suggests a significant environmental problem related to plastic pollution.

Technical  
challenges:  
there is  
a solution for  
every problem





The most usual technical problems and challenges of open dumpsites are:

- # Widely dispersed uncovered waste
- # No application of cover soil, or minimal cover that forms access roads
- # Open fires and/or waste periodically on fire
- # No control of waste placement
- # No compaction of waste
- # No recording or inspection of incoming waste
- # Scavenging at site<sup>65</sup>
- # No security fence or check points
- # Presence of vermin, dogs, birds and other vectors
- # No leachate management or treatment system in-place
- # No odour control or landfill gas management system

It is also typical that there are no planning or engineering measures (such as a liner system, leachate collection and treatment, etc.) that have been implemented prior to the placement of waste, such as in a sanitary landfill environment<sup>66</sup>.

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<sup>65</sup> ISWA Working Group on Landfill. 2007, "Key Issue Paper: Waste Scavenging at Dumpsites in Economically Developing Countries". Rodic-Wiersma, L., Wilson, D.C., Greedy, D. Available at: [http://www.iswa.org/uploads/tx\\_iswaknowledgebase/Scavenging.pdf](http://www.iswa.org/uploads/tx_iswaknowledgebase/Scavenging.pdf)

<sup>66</sup> ISWA Working Group on Landfill. 2011, "International Guidelines for Landfill Evaluation", ISWA. Available at: [http://www.iswa.org/index.php?eID=tx\\_bee4memberships\\_download&fileUid=98](http://www.iswa.org/index.php?eID=tx_bee4memberships_download&fileUid=98)

## The need for immediate improvements

For many reasons of environmental protection and public health and safety of the on-site users and scavengers at concerned sites, the preliminary measures during transit period should contain certain immediate actions and improvements to be made at open dumpsites around the world.

Even though the suggested preliminary steps towards the closure of an open dump may pose short-term technical or financial difficulties, it is an important objective that should be promoted worldwide such that the on-going open dump operations should be discontinued and long-term care and monitoring should be implemented to prevent future contamination.

Immediate actions and improvements to any open dumpsites should be implemented in a way that future potential contamination and clean-up costs can be kept to a minimal level. They should be always based on a proper site investigation<sup>67</sup> and risk assessment<sup>68</sup>.

Thus, before the development of the long-term solution, it is important to identify and implement a package of immediate improvements such as the ones in Table 3. The improvements include measures for health protection<sup>69</sup>, for reducing the environmental impacts<sup>70</sup> and for preparing the new system<sup>71</sup>.

### Expected Results

From the immediate actions and improvements as mentioned above, here is a list of expected results:

1. Reduce leachate generation and thus less surface and groundwater contamination.

2. Cleaner air and atmosphere from less or elimination of open burning.
3. Less contaminants in surrounding soil and water bodies.
4. Reduce potential for infectious diseases.
5. Reduce operational and site accidents due to site control, improved management and good practices.
6. Better quality of living for the people living nearby.

The above expected results may not be enough for the protection of the environment and public health and safety but it will serve as a catalyst in considering a safer and more long term sustainable waste management solution in handling of waste as well as protecting the environment and public health and safety<sup>72</sup>.

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<sup>67</sup>A. Mavropoulos, D. Kaliampakos, "Uncontrolled landfill investigation: a case study in Athens", *Waste Research and Management* 1999, 17, 159-164

<sup>68</sup> A. Mavropoulos "Landfill design using limited financial resources", *Proceedings of 8th International Waste Management and Landfill Symposium (Sardinia 2001 conference)*

<sup>69</sup> Law, J., Ross, D. 2012. "Dump Site Redevelopment and Reuse: Technical Issues and Case Studies." *ISWA World Congress 2012, Florence, Italy, 17 – 19 September, 2012*

<sup>70</sup> Greedy, D., Marinheiro, L. 2012. "Landfill Gas: Destruction and Utilization". *ISWA/APESB Beacon Conference on Africa Sustainable Waste Management, Lobito, Angola, July 23 – 25 July, 2012*

<sup>71</sup> Marinheiro, Luís. 2013. "Waste Transfer Stations: Role in Modern Integrated Waste Management and Evolution", *5th Australian Landfill and Transfer Stations Conference & Expo, Waste Management Association of Australia, WMMA/ISWA, Queensland, Australia. 5 – 7 August, 2013. Available at: <http://www.wmaa.asn.au/event-documents/2013cdf/papers/0808/marinheiro,l.pdf>*

<sup>72</sup> Greedy, D., Thrane, J. 2008. "Closed for business - A look at the closure of open dumps", *Waste Management World. Available at: <https://waste-management-world.com/a/closed-for-business-a-look-at-the-closure-of-open-dumps>*

Table 3: Immediate improvements for dumpsites

Health protection	Environmental impacts	Prepare the new system
<ul style="list-style-type: none"> <li>• Inspect and record incoming waste</li> <li>• Stop all open burning by educating and outreaching programs</li> <li>• Provide security fence to minimize unauthorized people and animals to the dumpsite</li> <li>• Designate work area for scavengers or waste pickers</li> <li>• Apply daily cover</li> </ul>	<ul style="list-style-type: none"> <li>• Compact waste placement in thin lifts.</li> <li>• Provide intermediate soil cover at inactive and side slope areas</li> <li>• Provide temporary leachate management measures such as pump stations to collect leachate contaminated surface water and seeps to a lined pond on-site or haul off-site to designated wastewater treatment facility</li> <li>• Collect landfill gas at visible locations with gas wells and either flare it at the well head or transport to a temporary flare station for destruction</li> </ul>	<ul style="list-style-type: none"> <li>• Separate recyclable material at sources and diverse various waste streams from the site, such as: plastics, paper, metals, glass and other recyclables, and hazardous waste streams (including WEEE and healthcare waste)</li> <li>• Manage activities related to collection, transportation and landfilling (such as establishing transfer stations, improving collection services, maintenance of existing vehicle fleet, odour management, pest control, etc.)</li> </ul>

## Long-term solutions

Currently, there are three methods<sup>73</sup> of closing an open dumpsite and each considered being a long-term solution:

1. Closure by Upgrading into a Controlled Sanitary Landfill
2. In-Place Closure by Covering the Waste
3. Closure by Removing Waste from the Dump

### Closure by Upgrading Method

Closure by upgrading of an open dump includes the use of a low permeability cap and a topsoil layer over the existing waste mass, which can then be vegetated. It is necessary to install a basic landfill gas collection system, which can either be passive or active gas collection system. Capping and re-grading will reduce the leachate generation potential from the waste in contact with surface runoff. Should there be a leachate seeps on sideslope, simple leachate collection point can be installed to gather leachate and pumped onto a truck for off-site disposal and treatment.

In this method, it is assumed that there is available space adjacent to the existing open dump where new waste can be deposited in properly engineered and lined cells with leachate collection system.

This lined cell essentially is engineered as a sanitary landfill, which will increase the cost of disposal considerably, due to its construction costs of liner, costs to manage leachate and landfill gas, and long-term environmental controls such as groundwater monitoring wells. When choosing a closure by upgrading method, the key

consideration should always be to try to keep things simple and sustainable in a local context (local construction method and local available construction materials), while maximizing the environmental improvement and performance.

### In-Place Closure Method

In-place closure is the most commonly used method, especially when there is no more space for additional waste placement. The existing waste is left in-place and covered with a layer of local soil and re-vegetated. The thickness of the soil layer will depend on the local site and climatic conditions. A basic landfill gas collection system, which can be passive or active, can be installed, depending on the gas generation volume estimated, the waste composition, and the age of the waste. In addition, depending on the local conditions, there might be a possibility to remove some leachate from areas that it has been accumulated. This method will:

- # Reduce waste exposure to wind and vectors
- # Minimize the risk of fires
- # Prevent people and animals from scavenging
- # Control infiltration of rainwater/surface water and thus reducing leachate generation
- # Control odour and gas migration

The in-place closure cap system will serve as a growth medium for vegetation and, also support suitable post-closure passive end-use activities such as ball-fields and park.

### Removal of Waste Method

This method involves the removal of the waste mass from the open dump and the disposal of it off-site, typically to a proper sanitary landfill.

The removal of waste activities can be combined with sorting the waste for recyclable material recovery and separation of some hazardous waste. This may potentially lead to odour problems to the neighborhood and will need to be managed accordingly.

After the removal and clean-up, the former land use as a waste dump should be noted in land records and the land can be treated as a brownfield redevelopment site or as a passive recreation park facilities.

If the site is located in the vicinity of high-priced real estate district, the land value can be significantly higher than the

costs of waste removal and associated disposal costs, not to mention the real estate end-use value.

For each site-specific situation, it is prudent to select the method of closing an open dump based on a study that takes other considerations such as sustainability and affordability of different waste management technologies in addition to site improvement and the potential environmental effects and benefits. It is often that the most advanced technical solution may not necessarily be the right solution but the simple and sustainable one would, when analyzed by the site performance and environmental impacts.

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< <sup>73</sup> ISWA Working Group on Landfill. 2006. "Key Issue Paper: Closing of Open Dumps", ISWA, Available at: [http://www.iswa.org/index.php?eID=tx\\_iswaknowledgebase\\_download&documentUId=93](http://www.iswa.org/index.php?eID=tx_iswaknowledgebase_download&documentUId=93)



## Closure Plan

A closure plan should be written to assess potential impacts and to inform, train and educate users. This should be done prior to closing an open dump and before starting a new facility and/or a new sustainable disposal option. The plan should involve all the social, governance and financial challenges involved, as described in the previous chapters. On a technical level, the plan should address the following at the minimum:

1. Choose a closure method (using risk-based assessment).
2. Choose a cap or cover system.
3. Meet regulatory requirements per site-specific conditions.
4. Select a leachate and LFG management system, if applicable.
5. Construction Quality Control & Quality Assurance Program.

The purpose of installing a cap or cover system is to stop people from continuing using the site as an open dump. But more importantly it minimizes risk of infectious diseases carried by animals and it also controls infiltration of rainwater that becomes leachate. With a cap system installed, the risk of fires will be eliminated since the pathway of oxygen to the waste mass is cut off. However, landfill gas generation continues and there is a need of some kind of gas collection system to control gas migration and emission to the atmosphere. The later will contribute to the greenhouse effect if not burnt. A closure cost estimates should also be included in the closure plan, typically based on a selected cover system in dollars, or euros, per unit area.

## Cover System

It is essential to be understood that a cover system (chosen for a specific region and specific site) keeps the surface water (from rain or stormwater run-on) infiltration to a minimum in order to minimize leachate generation, reduce the risk of slope instability and control gas migration and odour. This is typically accomplished through design and evaluation process considering a combination of cover soil types, thickness, slope and vegetation.

US EPA HELP Model is typically used for selecting the right cap section for a particular site using local climatic conditions<sup>74</sup>.

For developing countries, soil cap remains to be a better choice when compared to other soil/geosynthetic cap sections using commercially available geosynthetic materials.

This is because using locally available materials is far cheaper and less long-term maintenance and problems with trespassers trying to salvage cap for building materials.

Unless where there is no cover soil available, then geosynthetic cap should be considered and properly engineered<sup>75</sup>.

Final grading of the closed dump should be done in accordance to the slope stability and the surface water and erosion consideration in the post-closure period.

Aftercare regulations states that aftercare (or post-closure care) has to be carried out until the landfill no longer poses a threat to human health and the environment, in which case some inert waste landfills may

be exempt or require limited aftercare. Many regulations require provisions for a minimum post-closure period of 30 years, and operators usually consider 30 years by default.

There is an on-going discussion by many solid waste associations around the world that the long-term care and management of a dumpsite after this post-closure period should continue indefinitely unless waste mound becomes stabilized and inert from generation leachate or gas.

The goal of the post-closure care includes the following:

1. Maintain functioning of the cover system through regular inspection and evaluation of its settlement, cap subsidence and erosion, slope instability and vegetation cover conditions.
2. Stormwater run-off / run-on drainage controls.
3. Operate, monitor and maintain, if any, the leachate management system, landfill gas controls and wells, and groundwater monitoring wells and stream sampling (if any).

When designing a cover system for the closure of a dumpsite, it is beneficial to incorporate suitable post-closure end-use activities of the dumpsite<sup>76</sup>, which adds values and quality of life to the communities around the dumpsite.

However, the access to monitoring and control systems of the closed facility should be protected and restricted to authorized personnel only.

For a successful installation of a quality cover system, it is important to implement a good construction quality control and quality assurance program (CQC/QA) during construction.

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< <sup>74</sup> Law, James. 2008, "HELP Model – Demonstrating the Potential Impacts of Leachate Migration from Open Dumps." ISWA from Open Dumps to Sanitary Landfill Workshop, ISWA/WMRAS World Congress 2008, November 2008, Singapore

< <sup>75</sup> Pantini, S., Law, J., Verginelli, I., Lombardi, F. 2013, "Predicting and Comparing Infiltration Rates through Various Landfill Cap Systems Using Water- Balance Models – A Case Study", 2013 ISWA World Congress, Vienna, Austria, 7 – 9 October, 2013

^ <sup>76</sup> Law, James. 2007. "Closed Landfill End-Use and Redevelopment: Technical Considerations and Case Studies." 2007 City of Beijing Solid Waste Facilities & Material Handling, Recycling and End-Use Conference Proceedings, Beijing, China, June 6, 2007

## Cover Design Types

The purpose of a cover design is to isolate the underlying waste from the environment and to reduce risk to human health while protecting the environment.

For the purpose of closing open dump situations, two types of cover design can be considered:

# Resistive or Prescriptive Cover

# Evapotranspiration (ET) Cover

There is also a third case to upgrade a current cover with liners so new waste can be safely put on top.

### **Resistive (Prescriptive) Cover**

The resistive cover is designed with a barrier layer, which will resist the downward movement of the infiltrated water.

This barrier layer is typically a low hydraulic conductivity soil barrier layer or a geosynthetic flexible geomembrane such as PVC or LLDPE geosynthetic material.

It is also called a “prescriptive” cover as referenced in the US EPA 40 CFR Part 258. Annex 3 presents more details about it.

### **Evapotranspiration (ET) Cover**

The ET cover consists of a single monolithic soil layer or multiple layers acting as a system.

The ET cover is also referred to as a “store and release” cover and is designed to store infiltration within the layer until it can be released to the atmosphere by ET.

The cap section thickness will depend on the site-specific soil type used and the climatic and vegetation conditions.

The cap section profile should be also designed to address the site-specific open

dump situation, including potential release vectors from the landfill, or leachate and gas control and management standpoint.

A typical ET cover system is shown in Annex 3.

One condition of selecting this cover system is that the potential evapotranspiration must significantly exceed the precipitation.

### **Upgrading Cover with Liner**

For the upgrading method, a new liner will be installed above the existing waste mound and will separate the existing and new waste

where the leachate will be collected above the liner system and treated on-site<sup>77</sup> or hauled off-site. More details are described in Annex 3.

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<sup>77</sup>Law, J., Goudreau, M., Fawole, A., Trivedi, M. 2013. “Maximizing Landfill Capacity by Vertical Expansion – A Case Study for an Innovative Waste Management Solution”, 2013 ISWA World Congress, Vienna, Austria, 7 – 9 October, 2013





## Key Issues & Tips for Successful Managing Technical Challenges

The following are key issues and tips for successful managing technical challenges of an open dumpsite.

### A. Leachate Management

Leachate derives from precipitation, surface run-on from adjacent areas, liquids disposed of in the waste mass and the decomposition of organic material in the waste itself. As leachate forms and passes through the waste, organic and inorganic compounds become dissolved and suspended in the leachate.

So if not collected and treated, leachate can migrate from the point of generation and contaminate soil, groundwater, and surface water.

The following measures are recommended to prevent, minimize, and control leachate generation from a closed open dumpsite<sup>78</sup>:

1. Leachate pipes should be installed previous to capping and to collect the leachate for subsequent treatment. However, this will depend on several factors such as depth of the waste, topography of the area, underlying soil, and age of the deposited waste.
2. Leachate seepage at and around the surface of the disposal site has to be intercepted by constructing canals/ditches to collect the leachate. The collected leachate must then be channeled towards a leachate retention basin/pond located lower than the site.
3. To intercept leachate movement below ground, an interceptor trench, cut-off wall, and collection pipes may be constructed and maintained downgradient of the disposal site.

4. Piping interconnection should be designed to provide for movement since HDPE pipe expands and contracts with changes in temperature. Rigid connections must be designed with appropriate supports to prevent failure.

Collected leachate is usually treated using biological, chemical or membrane methods (or a combination of several)<sup>79</sup>. After closure, and if the protecting systems are well designed, constructed and maintained, leachate quantity will reduce with time and its quality will change, becoming less biodegradable.

Selection of the most appropriate option at a particular site will depend on a range of factors including<sup>80</sup>:

- # Site location relative to wastewater treatment works
- # Volume and strength of leachate generated
- # Climatic conditions
- # Nature of the waste
- # Availability of land for on-site treatment
- # Capital and operating cost considerations

Due to variability of leachate composition and flow rate a portable treatment unit, with a robust and flexible system like the membrane methods are, may be a good solution.

### B. Landfill Gas (LFG) Management

The landfill gas collection and management system should be designed based on the remaining amount of gas generation basis and potential for gas migration to the adjacent properties.

It can be either a passive (collect gas and discharge into the atmosphere) or active (collect gas and destroy at a blower and flare station) collection system<sup>81</sup>. The following are considerations that need to be taken into account to collect and manage landfill gas recovery at a closed open dumpsite:

1. All collection system piping needs to be graded to proper slopes sufficient to prevent accumulation of liquids and provide drainage to the condensate sumps and/or traps. It is recommended that the piping be secured with supports to prevent excessive movement due to changes on temperature.
2. Piping interconnection should be designed to provide for movement since HDPE pipe expands and contracts with changes in temperature. Rigid connections must be designed with appropriate supports to prevent failure.
3. Bentonite or geosynthetic well bore seals need to be installed around all LFG extraction wells to prevent air intrusion or LFG escaping around the well casing at the surface of the well bore. Placing a soil cone around the well casing helps keep stormwater away from the well and limits air intrusion and LFG emissions.
4. Wellhead must be designed to provide monitoring ports for LFG quality and LFG flow monitoring. In addition the wellhead must be equipped with an appropriate valve to control vacuum at the well.
5. Liquids discharged must be away from the well area into a leachate structure to prevent leachate infiltrating through the cover material.

6. Extraction well field density must be appropriate.
7. Well laterals must be sloped away from the well to provide free flow of gas. If this is not an option then wellheads must be design to provide liquid flow into the well avoiding accumulation of condensate in low points.
8. A check valve needs to be installed in all condensate sumps to prevent air intrusion when there are no liquids in the condensate sump.
9. Condensate sumps and or traps need to be installed to drain liquids from low spots along the main header.
10. Installation of isolation valves at key locations in the system will permit that certain sections of the system be shut down without having to shut down the entire gas collection system to make repairs or maintenance.

### C. Stormwater Management

Stormwater management is a key issue to minimize erosion and leachate created by stormwater infiltration through the cover system. It is important that the closed

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< <sup>78</sup> ISWA Working Group on Landfill. 2005. "Landfill Operational Guidelines". 2nd Edition. ISWA. Available at: [http://www.iswa.org/index.php?eID=tx\\_bee4memberships\\_download&fileUid=98](http://www.iswa.org/index.php?eID=tx_bee4memberships_download&fileUid=98)

< <sup>79</sup> Marinheiro, L., Law, J., "Leachate Management". Landfill Training Workshop, ISWA World Congress 2015, Antwerp, Belgium, September 7 – 9, 2015

< <sup>80</sup> Marinheiro, Luis et al. 2015, "Masterclass: Landfill Leachate Advanced Treatment", 22nd April 2015. XV International Congress of Final Deposition of Waste and Environmental Perspectives, Bucaramanga, Colombia

^ <sup>81</sup> Marinheiro, L., Greedy, D. 2012, "Landfill Gas: Concepts and Collection". ISWA/APESB Beacon Conference on Africa Sustainable Waste Management, Lobito, Angola, July 23 – 25 July, 2012.

dump is designed with adequate slopes and runoff features (ditches, benches, etc.) to avoid ponding of water and excessive erosion.

#### **D. Site Revegetation and Long Term Management**

It is best to revegetate a closed dumpsite with local vegetation and plant species for better survival in the local climatic conditions<sup>82</sup>.

Long-term management activities of the closed surface should involve problems due to potential settlement and subsidence, slope instability observation<sup>83</sup>, grass mowing at least twice a year, erosion problems or damage to stormwater management control features, groundwater monitoring wells and gas system maintenance and monitoring for potential release

on regular basis.

Settlement should be evaluated for the final cover system design, as it would impact the stormwater management performance and control features. Typically, the final cover will settle up to 10% of the final waste thickness, but it is influenced by waste compaction and in-place density.

The final slope should be designed for less than 1(V):4(H) or 25% maximum. If side slope benches are used in the design, the effective slope angle is most likely to be approaching 1(V):4.5(H).

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<sup>82</sup> Marinheiro, Luis, "Landfill Sustainability and Aftercare". International Landfill Practices. SWANA Landfill Symposium. New Orleans, USA, 16 – 19 March, 2015

<sup>83</sup> Law, James, "Major Parameters that Affect Outcome of Landfill Slope Stability Modeling" ISWA World Congress 2015, Antwerp, Belgium. September 7 – 9, 2015



## Guidance on Applying Closure Solutions

The following presents general guidance on how and in which situations to apply the three closure methods.

### Closure by Upgrading

- # There is available open space adjacent to the existing open dump.
- # Existing waste mound is stable condition.
- # Distance to the closest population or a perennial stream or shallow aquifer is not an issue.
- # No issue with flood plain.
- # Distance to an airport.
- # It is not a hazardous waste commingled with MSW waste site.

### In-place Closure

- # Easiest and maybe the cheapest closure method.
- # Need to find an alternate waste handling facility.
- # Need to find a new sanitary landfill site.
- # Address groundwater or landfill gas issues and install control and monitoring system.

### Waste Removal and Relocation

- # Costly method.
- # Odour and transportation issue.
- # Find another waste handling facilities to take the waste.
- # Site cleanup.
- # Potential for closure end-use of the dumpsites.

## Site allocation for a new Sanitary Landfill

Upgrading dumps may temporarily lengthen their life span; however, most municipalities will need to plan for new landfill sites due to population growth projection<sup>84</sup>. It is prudent to find an ideal site location when considering for a new landfill site. To identify an appropriate site, a systematic selection process needs to be followed and prioritized based on site-specific conditions, including political and cultural environment.

The site selection process is usually one of the most critical steps in the entire decision making cycle of waste management. The direct public involvement, the economic impact in the surroundings of a landfill and the need for combination of technical, social and legislative issues are some typical factors that increase the difficulties for a successful site selection.

In many countries the site selection process could last five years or more depending on the specific local circumstances. Especially when the site selection is correlated with the design criteria of the facility the process can take up to ten years due to the detailed geological and hydrogeological studies that have to be completed before the final decision. In the case of a large facility with remarkable environmental impacts, a site selection process may cost hundreds thousands dollars. On the other hand, a successful site selection process may reduce the capital and operational cost of a

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<sup>84</sup> ISWA Working Group on Landfill. 2014, "Key Issue Paper: The Role of Landfills in the Transition Toward Resource Management", Scharff, H., Hansen, J., Thrane, J., ISWA. Available at: [http://www.iswa.org/index.php?eID=tx\\_bee4memberships\\_download&fileUid=215](http://www.iswa.org/index.php?eID=tx_bee4memberships_download&fileUid=215)

landfill affecting the design of some expensive parts like liners, biogas collection and management systems, leachate collection and management systems and monitoring details.

Numerous factors have to be evaluated in order to place a landfill. An adequate landfill should have minimum environmental impacts and social acceptance. Besides, an adequate landfill should be in accordance with the respective regulations. A site selection process usually proceeds with an approach of phases.

It begins with the use of regional screening techniques to reduce the examined area to a manageable number of discrete search areas. Screening is based on exclusion criteria that have to be defined. Because of this screening, the resulted areas have higher probabilities to contain suitable sites. After the initial screening, the discrete areas have to be evaluated in more detail and the candidate sites will be identified.

Finally, a detailed evaluation of the candidate sites should be implemented, based on a site specific level of analysis and the most suitable site will be selected. The overall site selection process is thus one of increasingly intensive analysis of progressively smaller areas<sup>85</sup>.

It is obvious that the phased approach methodology is widely used for the inceptive site selection, because of its simplicity and the economy of time and money that provides.

Besides that, in most of the cases, especially in the developing countries, the lack of the appropriate data and the requirement for a rapid site selection lead to directions where phased approach is the best available solution.

The goal of selecting a good candidate site is to minimize environmental impacts and operational problems, which include movements of water, soil, traffic, and waste to and from the site. Annex 4 describes a set of criteria for the process of a sanitary landfill allocation from a Guidance published by the World Bank<sup>86</sup>.

Up to date several Geographic Information System (GIS) methodologies have been used for the selection of a landfill, as GIS provides the decision maker with a powerful set of tools for the manipulation and analysis of spatial information. Using a GIS, it is possible to process a huge amount of spatial data in short time and so the screening is much easier.

GIS can help to reduce remarkably the areas that have to be examined on site, although the final decision has to be taken after field studies. However, the application of a GIS methodology requires geographic data and software. Therefore, the use of the GIS methodologies is more convenient in large-scale analyses (national level) where one can benefit from the economy of scale.

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<sup>85</sup> A. Mavropoulos, A. Karkazi, T. Hatzichristos, B. Emmanouilidou, Ahmed Elseoud "Landfill siting with GIS and Fuzzy Logic", Proceedings Sardinia 2001

<sup>86</sup> Cointreau, S. 2004, "Sanitary Landfill Design and Site Criteria". Guidance Published in May 1996 by the World Bank as an Urban Infrastructure Note, updated November 2004, World Bank. Available at: <http://siteresources.worldbank.org/INTUSWM/Resources/463617-1202332338898/landfillsitingdesign.pdf>



## Basic steps of construction & operation of a new facility

The basic steps of designing and constructing and operating a new sanitary landfill facility are typically involving engineering, planning, and operating of such facilities:

### A. Engineering

1. Design a sanitary landfill that has a leachate and gas collection and treatment systems, storm water management system, waste sorting for recyclables and yard waste for composting operation.
2. Apply daily cover soil or an alternate daily cover material to all uncovered waste.
3. No open fires and/or waste periodically set on fire intentionally.
4. Record and inspect incoming waste.

5. Limit size of a working face area to control waste placement.
6. Apply compaction to waste in thin lifts.
7. Implement leachate and gas collection and management

### B. Planning

1. Organize and control scavenging at planned location each day, if allowed by local jurisdiction.
2. Implement site security from unauthorized personnel and public access.
3. Control and implement sustainable waste management practice.
4. Control rodents, vermin, dogs, birds and other vectors.
5. Keep good public relation with neighbors.





6. Establish and charge users disposal fee by tonnage through scale house.

### **C. Landfill Operations**

1. Establish survey control with longitude, latitude and elevation for the landfill property. All drawings and construction activities should be controlled by the survey control.
2. Complete periodic (i.e. annually) topographic surveys of the waste fill areas to determine the average waste density for the year. This information can assist in determining the effectiveness of waste placement operations. The surveys should be accurate to about 0.5 meters or less if possible.
3. Waste should be placed in maximum 1 to 2 meter lifts and compacted in place. The compactor should go over each lift at least 4 times. Thicker lifts will result in lower densities and lower overall compaction.
4. Waste should be placed on a level surface of the landfill or deposited and pushed up-slope, not down slope, before compaction.
5. Daily cover soil should be applied at the working face area at the end of the day and definitely in inactive area, apply another soil cover. This will decrease leachate generation and the contamination of storm water with leachate.
6. The active daily waste fill area should be as small as possible, but large enough to keep waste lifts within the range noted above. The area needed should be established prior to waste placement. This will increase compaction, reduce leachate generation, and control storm water run-off.

7. Leachate should not flow beyond the limits of the geomembrane lined landfill area and should be collected for treatment and disposal. Suggested ways to assist in this is using soil diversion/containment berms, decreasing landfill gas pressure, covering waste more frequently, increasing the removal of leachate from the landfill, and diversion of storm water from un-covered waste.

ISWA has produced a set of Landfill Operations Guidelines<sup>87</sup>, which define good operational practice that can be used when managing all types of landfill from the simple upgrade of an “open dump” through to a fully engineered “sanitary landfill.”

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<sup>87</sup> ISWA Working Group on Landfill. 2005. “Landfill Operational Guidelines”. 2nd Edition. ISWA. Available at: [http://www.iswa.org/index.php?eID=tx\\_bee4memberships\\_download&fileUid=98](http://www.iswa.org/index.php?eID=tx_bee4memberships_download&fileUid=98)



# ANNEXES



## ANNEX 1: Alternative financial instruments

Table 4: Alternative financial instruments

<b>Financial tool</b>	<b>Description</b>
<b>Equity Contributions</b>	Project sponsors are the investors in the project company that are likely to be providing expertise and some of the services to the project company (such as construction or operations services). Sponsor funding is generally through equity contributions in the project company through share capital and other shareholder funds. Equity holds the lowest priority of the funding contributions in a project, therefore the other contributors (such as lenders) will have the right to project assets and revenues before the equity contributors can obtain any return; or, on termination or insolvency, any repayment. Equity contributions bear the highest risk and therefore potentially receive the highest returns.
<b>Debt contributions</b>	Debt can be obtained from many sources, including commercial lenders, institutional investors, export credit agencies, bilateral or multilateral organizations, bondholders and sometimes the host country government. Unlike equity contributions, debt contributions have the highest priority amongst the invested funds (e.g. senior debt must be serviced before any other payments are made). Repayment of debt is generally tied to a fixed or floating rate of interest and a program of periodic payments. The source of debt will have an important influence on the nature of the debt provided. This section will focus on some of the characteristics of project debt.
<b>Performance bonds</b>	A performance bond, also known as a contract bond, is a surety bond issued by a bank to guarantee satisfactory completion of a project by a contractor. A job requiring a payment and performance bond will usually require a bid bond, to bid the job. When the job is awarded to the winning bid, a payment and performance bond will then be required as a security to the job completion
<b>Leasing loans</b>	Financial leasing is a modern financing method that allows enterprises / partners to own and make use of certain assets for medium to long term financing periods in return for previously-set interim payments.

Financial tool	Description
<b>Green bonds</b>	Green bonds are fixed income, liquid financial instruments that are used to raise funds dedicated to climate-mitigation, adaptation, waste management and other environment-friendly projects
<b>Carbon funds</b>	Carbon funds are a new branch of Environmental finance. Carbon finance explores the financial implications of living in a carbon-constrained world, a world in which emissions of carbon dioxide and other greenhouse gases (GHGs) carry a price. Financial risks and opportunities impact corporate balance sheets, and market-based instruments are capable of transferring environmental risk and achieving environmental objectives. Issues regarding climate change and GHG emissions must be addressed as part of strategic management decision-making. The general term is applied to investments in GHG emission reduction projects and the creation (origination) of financial instruments that are tradable on the carbon market
<b>Equity funding</b>	A <b>private equity fund</b> is a collective investment scheme used for making investments in various equity (and to a lesser extent debt) securities according to one of the investment strategies associated with private equity. Private equity funds are typically limited partnerships with a fixed term of 10 years (often with annual extensions). At inception, institutional investors make an unfunded commitment to the limited partnership, which is then drawn over the term of the fund. From the investors' point of view, funds can be traditional (where all the investors invest with equal terms) or asymmetric (where different investors have different terms)

<b>Financial tool</b>	<b>Description</b>
<b>Crowd-funding bonds</b>	<p>Crowd-funding is the practice of funding a project or venture by raising monetary contributions from a large number of people, today often performed via internet-mediated registries, but the concept can also be executed through mail-order subscriptions, benefit events, and other methods. Crowd-funding is a form of alternative finance, which has emerged outside of the traditional financial system. The crowd-funding model is based on three types of actors: the project initiator who proposes the idea and/or project to be funded; individuals or groups who support the idea; and a moderating organization (the "platform") that brings the parties together to launch the idea</p>
<b>Venture capitals</b>	<p>Venture capital is money provided by investors to startup firms and small businesses with perceived long-term growth potential. This is a very important source of funding for startups that do not have access to capital markets. It typically entails high risk for the investor, but it has the potential for above-average returns</p>
<b>Debt-buy loans</b>	<p>A debt buyer is a company, sometimes a collection agency or a private debt collection law firm, that purchases delinquent or charged-off debts from a creditor for a fraction of the face value of the debt. The debt buyer can then collect on its own, utilize the services of another collection agency, repackage and resell portions of the purchased portfolio or any combination of these options.</p>
<b>Bond/Capital Markets Financing</b>	<p>Bond financing allows the borrower to access debt directly from individuals and institutions, rather than using commercial lenders as intermediaries. The issuer (the borrower) sells the bonds to the investors. The lead manager helps the issuer to market the bonds. A trustee holds rights and acts on behalf of the investors, stopping any one investor from independently declaring a default. Rating agencies will assess the riskiness of the project, and assign a credit rating to the bonds, which will signal to bond purchasers the attractiveness of the investment and the price they should pay. Bond financing generally provides lower borrowing costs, if the credit rating for the project is sufficiently strong. Rating agencies may be consulted when structuring the project to maximize the credit rating for the project.</p>

Financial tool	Description
<b>Syndicated loans</b>	<p>A syndicated loan is a loan offered by a group of lenders (called a syndicate) who work together to provide funds for a single borrower. The borrower could be a corporation, a large project, or sovereignty (such as a government). The loan may involve fixed amounts, a credit line, or a combination of the two. Interest rates can be fixed for the term of the loan or floating based on a benchmark rate such as the London Interbank Offered Rate (LIBOR). Typically there is a lead bank or underwriter of the loan, known as the "arranger", "agent", or "lead lender". This lender may be putting up a proportionally bigger share of the loan, or perform duties like dispersing cash flows amongst the other syndicate members and administrative tasks</p>
<b>Mezzanine financial bonds</b>	<p>Mezzanine financing is a hybrid of debt and equity financing that is typically used to finance the expansion of existing companies. Mezzanine financing is basically debt capital that gives the lender the rights to convert to an ownership or equity interest in the company if the loan is not paid back in time and in full. It is generally subordinated to debt provided by senior lenders such as banks and venture capital companies.</p>
<b>SMEs bonds</b>	<p>SME finance is the funding of small and medium-sized enterprises, and represents a major function of the general business finance market – in which capital for different types of firms are supplied, acquired, and costed or priced. Capital is supplied through the business finance market in the form of bank loans and overdrafts; leasing and hire-purchase arrangements; equity/corporate bond issues; venture capital or private equity; and asset-based finance such as factoring and invoice discounting</p>

## ANNEX 2: Alternative cost recovery options

Table 5: Alternative cost recovery options

<b>Cost recovery alternative</b>	<b>Analysis</b>
<b>Financing of all solid waste services through property rates</b>	<p>Under this approach all municipal solid waste services are funded from general rates. The full cost of the service is determined and an appropriate charge is included in the general property rates to recover this cost.</p>
<b>Solid waste services funded by user charges</b>	<p>This option is premised on the view that the solid waste operation is a separate, “ring-fenced” service, which is expected to recover all its costs from user charges.</p> <p>The various user charge options associated with this approach are:</p> <ul style="list-style-type: none"><li>a) Charges based on a proxy for amounts of waste generated - In this approach a proxy, typically stand size, is used as the basis to distinguish the solid waste tariff.</li><li>b) Charges based on service level - In this tariff structure tariffs are based on the level of service provided to the consumer.</li><li>c) Charges based on actual amounts generated (pay as you throw) – This approach requires a detailed recording of the amounts of waste collected from a site and establishes a charge per amount of waste generated</li></ul>
<b>Combined approaches</b>	<p>A combined approach is aimed at recovering the private component through user charges, while the public component is recovered either through a universal flat charge or through an explicit solid waste component incorporated into the property rates.</p>
<b>Non-residential tariffs</b>	<p>Property rates: If the general approach chosen by the municipality is to finance the public cleansing elements of the waste management service from property rates then these property rates will apply to non-residential and residential consumers.</p> <p>Public cleansing charge: A public cleansing charge is preferred if there is a strong imperative to ring-fence the waste management service. For horizontal equity reasons the charge can be designed in such a way that it is somewhat reflective of the scale of the enterprise.</p>



## Cost recovery alternative

### Analysis

Proportion of user charges: It will be difficult for the municipality to recover public cleansing costs from non-residential consumers through user charges. The municipality will not be providing all non-residential consumers with a waste removal service and therefore will not be billing all consumers.

## Disposal charges

Those municipalities that manage their own disposal sites will need to establish waste disposal charges. Disposal charges should be established to recover both the capital and operating costs of waste disposal facilities and will therefore be based on the costs of disposal per ton of waste calculated. It is generally best to charge for solid waste disposal on a mass basis as the mass of waste disposed bears the most direct relationship to airspace costs.

**Pricing basis:** the pricing of disposal services is strongly influenced by the manner in which capital costs are estimated and recovered from consumers. The average historical costs of disposal are often used as the basis for pricing. In many ways this is a sensible approach as it is easy to estimate and provides the required cash-flow for municipalities in the current period.

**Differentiation of waste types:** disposal charges can allow for the differentiation of waste types. For example, waste that can be used as cover material may qualify for reduced charges, while waste that imposes additional operating costs, such as wet waste, may incur a higher charge.

**Minimising illegal dumping:** some municipalities allow a certain amount of waste to be disposed of at no charge. In this way it is hoped to minimize illegal dumping. If illegal dumping is a problem in a municipal area this is an approach that is worth investigating.

## Rehabilitation levy

In most municipalities the costs of closure and rehabilitation of the disposal site are not included in the disposal charge. This leaves the municipality with a large future cost with no associated revenue. Some municipalities have begun to impose a small rehabilitation levy. This levy is set-aside in a fund, which will be used to finance the environmentally sustainable closure of the disposal facility.

## ANNEX 3: Cover Design Types

### Resistive (Prescriptive) Cover

The resistive cover is designed with a barrier layer, which will resist the downward movement of the infiltrated water. This barrier layer is typically a low hydraulic conductivity soil barrier layer or a geosynthetic flexible geomembrane such as PVC or LLDPE geosynthetic material. It is also called a “prescriptive” cover as referenced in the US EPA 40 CFR Part 258.

A typical prescriptive cover is shown in Figure 13.

The minimum prescriptive cover requirements include the following:

1. A barrier layer having a saturated hydraulic conductivity of less than or equal to that of natural subsoils present (or the bottom liner if present), or no greater than  $1 \times 10^{-7}$  m/sec, whichever is less [40 CFR Part 258.60(a)(1)]

2. An infiltration layer with thickness of a minimum 450 mm of earthen material above the barrier layer [40 CFR 258.60(a)(2)]

3. An erosion layer with thickness of a minimum 150 mm of earthen material that is capable of sustaining native plant growth [40CFR258.60(a)(3)]

### Evapotranspiration (ET) Cover

The ET cover consists of a single monolithic soil layer or multiple layers acting as a system. The ET cover is also referred to as a “store and release” cover and is designed to store infiltration within the layer until it can be released to the atmosphere by ET.

The cap section thickness will depend on the site-specific soil type used and the climatic and vegetation conditions. The cap section profile should be also designed to address the site-specific open dump situa-

Figure 13: Prescriptive Cover Section Profile

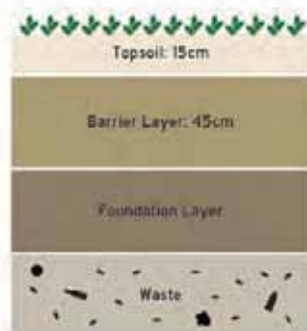
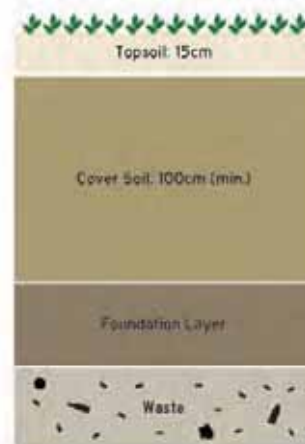


Figure 14: ET Cover Section Profile



tion, including potential release vectors from the landfill, or leachate and gas control and management standpoint. A typical ET cover system is shown in Figure 14.

One condition of selecting this cover system is that the potential evapotranspiration must significantly exceed the precipitation. It is recommended that the minimum prescriptive cover should be at least 0.6m and the ET cover should be at least 1m in thickness. Cracking of the cover soil in certain climatic conditions for the ET cover system and thereby reducing the effective hydraulic conductivity is a concern.

And veneer slope instability of a prescriptive cover on side slope situation is also a concern. In certain situations, a composite barrier layer comprised of both a clay barrier layer and a synthetic geomembrane can be considered.

However, local environmental regulations should be consulted for minimum cover profile requirements.

### Upgrading Cover with Liner

For the upgrading method, a new liner will be install above the existing waste mound and will separate the existing and new waste where the leachate will be collected above the liner system and treated on-site or hauled off-site. The minimum section requirements include the following and shown in Figure 15.

1. A foundation layer above the existing waste surface.
2. A soil barrier layer having a saturated hydraulic conductivity of less than or equal to  $1 \times 10^{-9}$  m/sec.
3. A geomembrane using a 1.5 mm HDPE liner or a 0.75 mm PVC liner.
4. A drainage layer of either geocomposite drainage net or a 150 mm of sand with a hydraulic conductivity of greater than  $1 \times 10^{-4}$  m/sec.
5. A protective soil cover thickness of a 300 mm of earthen material.

Figure 15: Upgrading Liner Section Profile



## ANNEX 4: Site allocation criteria

The minimum prescriptive cover requirements include the following:

The following criteria should be considered when choosing a new landfill site, as directly quoted from Guidance published by the World Bank<sup>88</sup>:

1. Adequate land area and volume to provide sanitary landfill capacity to meet projected needs for at least 10 years, so that costly investments in access roads, drainage, fencing, and weighing stations are justifiable.
2. Preferably, a site accessible within 30 minutes travel time (a function of road and traffic conditions) is to be sought, even if it means buying land, because of the need to avoid adversely affecting the productivity of collection vehicles. At distances greater than 30 minutes travel, for collection operations to be economic, investment in either large capacity collection vehicles (5 tonnes per load or greater) or transfer stations with large capacity vehicles (20 tonnes or greater) would be necessary.
3. If transfer stations are required, the landfill should be accessible within 2 hours of travel time (one-way) by transfer trucks from the transfer station. Otherwise, for longer distances, transfer by rail or barge directly to the landfill site needs to be considered. Siting of rail or barge transfer sites within the refuse collection area may be difficult. Double handling by truck transfer and by rail or barge transfer units should be avoided because of costs.
4. Accessible from a competent paved public road, which has an adequate width, slope, visibility and construction to accommodate the projected truck traffic. To minimize landfill development costs, the requirement for new access road construction generally should be less than 10 km for large landfills serving metropolitan areas and less than 3 km for small landfills serving secondary cities.
5. A gently sloped topography, preferably amenable to development of sanitary landfill by the Cell (Bund) method, with slopes, which minimize the need for earthmoving to obtain the correct leachate drainage slope of about 2%.
6. Groundwater's seasonally high table level (i.e., 10 year high) is at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development. A minimum depth of 1 meter of relatively impermeable soils above the groundwater's seasonable high level exists (preferably, less than 10<sup>-9</sup> meters/second permeability when undisturbed). If these criteria are not met, use of impermeable clay and/or plastic liners may be required to protect groundwater quality.

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<sup>88</sup> Cointreau, S. 2004, "Sanitary Landfill Design and Site Criteria". Guidance Published in May 1996 by the World Bank as an Urban Infrastructure Note, updated November 2004, World Bank. Available at: <http://siteresources.worldbank.org/INTUSWM/Resources/463617-1202332338898/landfillsitingdesign.pdf>

7. Availability on-site of suitable soil cover material to meet the needs for intermediate (minimum of 300 mm depth) and final cover (minimum of 600 mm depth), as well as bund construction (for the Cell method of landfill). Preferably, the site would have adequate soil to also meet daily cover needs (usually a minimum of 150 mm depth of soil). However, daily cover needs can be alternatively met by using removable tarps, other relatively inert materials (i.e., compost residuals), or by removing the previously laid daily soil cover at the start of each day for reuse at the end of the same day. For purposes of siting, assume that at least 1 cubic meter of daily, intermediate, and final compacted soil cover is needed for every 6 cubic meters of compacted refuse. In most developing countries with highly organic wastes and warm climates, compacted refuse (after one year of natural consolidation and decomposition within warm and wet climates) achieves a density of 800-1000 kg/cubic meter.
8. None of the areas within the landfill boundaries are part of the 10-year groundwater recharge area for existing or pending water supply development.
9. No private or public drinking, irrigation, or livestock water supply wells within 500 meters downgradient of the landfill boundaries, unless alternative water supply sources are readily and economically available and the owner(s) gives written consent to the potential risk of well abandonment.
10. No environmentally significant wetlands of important biodiversity or reproductive value are present within the potential area of the landfill cell development.
11. No known environmentally rare or endangered species breeding areas or protected living areas are present within the site boundaries. If this criteria is not met, alternative habitats of comparable quality for relocation of the species would need to be available.
12. No significant protected forests are within 500 meters of the landfill cell development area.
13. No open areas of high winds, otherwise windblown litter will not be readily manageable.
14. No major lines of electrical transmission or other infrastructure (i.e., gas, sewer, water lines) are crossing the landfill cell development area, unless the landfill operation would clearly cause no concern or rerouting is economically feasible.
15. No underlying limestone, carbonate, fissured or other porous rock formations which would be incompetent as barriers to leachate and gas migration, where the formations are more than 1.5 meter in thickness and present as the uppermost geologic unit above sensitive groundwater.

16. No underlying underground mines which could be adversely affected by surface activities of landfilling, or minable resources, which could be rendered less accessible by landfilling, unless the owner(s) gives explicit consent.
17. No residential development within 250 meters from the perimeter of the proposed landfill cell development.
18. No visibility of the proposed landfill cell development area from residential neighborhoods within 1 km. If residents live within 1 km of the site, landscaping and protective berms would need to be incorporated into the design to minimize visibility of operations. Curving of the access road is recommended to avoid visibility of the active portions of the landfill from the main road.
19. No perennial stream within 300 meters downgradient of the proposed landfill cell development, unless diversion, culverting or channelling is economically and environmentally feasible to protect the stream from potential contamination.
20. No significant seismic risk within the region of the landfill, which could cause destruction of berms, drains or other civil works, or require unnecessarily costly engineering measures, otherwise side slopes may need to be adjusted to be gentler than the maximum of 2.5:1.
21. No fault lines or significantly fractured geologic structure within 500 meters of the perimeter of the proposed landfill cell development, which would allow unpredictable movement of gas or leachate.
22. No siting within 3 km of a turbojet airport and 1.6 km of a piston-type airport. For sites located more than 3 km and less than 8 km from the nearest turbojet airport (or more than 1.6 km and less than 8 km from the nearest piston-type airport), no consideration is to be given unless the aviation authority has provided written permission stating that it considers the location as not threatening to air safety.
23. No siting within a floodplain subject to 10-year floods and, if within areas subject to a 100-year flood, must be amenable to an economic design, which would eliminate the potential for washout.
24. Avoid siting within 1 km of socio-politically sensitive sites where public acceptance might be unlikely (i.e., memorial sites, churches, schools) and avoid access roads, which would pass by such culturally sensitive sites.





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## ATTACHMENT 2

### Team Commitment Form



## Form 1 – Team Commitment

Name of School: \_\_\_\_\_

Team Members and Contact Information:

<u>Name</u>	<u>Email</u>	<u>Phone</u>	<u>Anticipated Graduation (MM/YY)</u>

(Maximum team members = 8)

Chosen Name of Your Consulting Firm: \_\_\_\_\_

Designated Team Contact (Captain): \_\_\_\_\_

School Faculty Name/Phone Number/Email: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

School Faculty Signature: \_\_\_\_\_

**Any Requested Exception to Section 4 Criteria:** Yes  No

If NO, we understand that the participant comply with requirements of Section 4. If YES, briefly state the requested exemption and reason below:

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**ATTACHMENT 3**  
**Judging Form**

<b>Design Report (Maximum Points = 100)</b>			
<b>Description</b>	<b>Max. Points</b>	<b>Awarded</b>	<b>Comment #</b>
Introduction	5		
Solution for Closure of the Bakoteh Dumpsite	35		
Design for Developing a New Site	30		
Conclusion and Recommendations	10		
References	5		
Formatting & Appearance	5		
Grammar, Spelling & Overall Technical Writing	5		
Visual Aids (Graphs, Pictures etc.) presented clearly	5		
<b>Poster (Maximum Points = 25)</b>			
Proposed solutions are clearly described and interpreted	5		
All components of problem given appropriate level of attention	5		
Poster “stands alone” requiring no additional explanation	5		
Visually attractive, text legible, effective use of figures, tables, & graphic devices	5		
Easy to follow, focused, and organized	5		
<b>Presentation (Maximum Points = 125)</b>			
Clear introduction, sets stage for presentation	15		
Main points are developed, organized, and well formulated	15		
Material presented at an appropriate level and pace for audience, yet includes relevant detail and clarity	10		
Visual aids are clear, well-constructed, and effective, aiding in understanding	15		
Realistic solution to problem with high likelihood of success	10		
Solution considers broad range of impacts such as environment, economics, society, and sustainability	15		
Questions answered competently, all members demonstrate a clear understanding of topic	20		
Team presents a professional image, projecting enthusiasm and competence	15		
Timing (presentation rehearsed and less than 20 min.)	10		