Information Matters, Ghana

Capacity Building for Enhanced Reporting and Facilitation of International Mutual Learning through Global Peer-to Peer Exchange

Training on data collection and management to improve GHG inventory compilation in the waste sector

Workshop documentation

Capital View Hotel, Koforidua, Ghana

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Information Matters
Transparency through Reporting

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
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Registered offices
Bonn and Eschborn, Germany
T +49 228 44 60-0 (Bonn)
T +49 61 96 79-0 (Eschborn)

Friedrich-Ebert-Allee 40
53113 Bonn, Germany
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de

Authors
Reka Soos, Brian McCarthy and Flaviu Pop (Resources and Waste Advisory Group)

Editors
Oscar Zarzo, Verena Schauss and Maria Lau (GIZ)

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Abbreviations

BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BOD	Biological oxygen demand
BUR	Biennial Update Report
C&D	Construction and demolition
CCAC	Climate & Clean Air Coalition
CH_4	Methane
CO_2	Carbon dioxide
COD	Chemical oxygen demand
DDOC	Decomposable degradable organic carbon
DOC	Degradable organic carbon
EPA	Environmental Protection Agency
FOD	First order decay
Gg	Gigagram (1 kt or 1,000 t)
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IM	Information Matters
IPCC	Intergovernmental Panel on Climate Change
MCF	Methane correction factor
MLGRD	Ministry of Local Government and Rural Development
MRV	Measurement, reporting and verification
MSW	Municipal solid waste
$MtCO_2e$	Million tonnes of carbon dioxide equivalent
NAMA	Nationally appropriate mitigation action
NC	National communication
NDC	Nationally determined contribution
NIR	National inventory report
N_2O	Nitrous oxide
RCC	Regional Coordination Council
SWDS	Solid waste disposal site
TOW	Total organically degradable carbon in wastewater
UNFCCC	United Nations Framework Convention on Climate Change

1. Background

1.1. Information Matters

In the context of the Information Matters (IM) project, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU), provides support to a number of selected partner countries to strengthen their in-country capacities for enhanced reporting under the United Nations Framework Convention on Climate Change (UNFCCC). IM is funded under BMU's International Climate Initiative (IKI). For more information, please refer to www.international-climate-initiative.com. The project focuses especially on the preparation of Biennial Update Reports (BURs) and the development and implementation of sustainable systems for measurement, reporting and verification (MRV). During a first project phase (2013-2016) support has been provided to Chile, the Dominican Republic, Ghana and the Philippines. For the second phase (2016-2017), Colombia, Egypt, Georgia and Viet Nam joined the project, allowing building upon the results, experiences and 'lessons learned' gained during the first phase.

A key feature of the IM project is the country-tailored approach. In consultation with the partner countries, specific needs and priorities for setting up MRV systems and greenhouse gas (GHG) emissions inventories are identified, prioritised and addressed through tailored in-country capacity building workshops and training events. These capacity building activities aim to enable the partner countries to analyse and define procedures, methods and responsibilities, with a view to systematically institutionalising their MRV systems and meeting reporting requirements under the UNFCCC.

Given that MRV systems are an essential element of the forthcoming Enhanced Transparency Framework under the Paris Agreement, the IM project also provides a sound basis for its partner countries to prepare for future post-Paris transparency requirements.

1.2. Project activities in Ghana

GIZ provided technical support to Ghana's Environmental Protection Agency (EPA), addressing its specific capacity building needs. Following the general project implementation steps, the project in Ghana started in 2013 with a stock taking exercise during which the strengths and gaps in the MRV system in place were analysed and assessed. At a subsequent kick-off workshop to review the stock take with key stakeholders, a roadmap for capacity building was developed.

After conducting five capacity building workshops (MRV domestic architecture, climate-relevant data management, quality assurance and quality control of GHG inventories, baseline scenario setting and training on the Intergovernmental Panel on Climate Change (IPCC) software, and preparation for the ICA and lessons learned from the first BUR preparation process), the IM project carried out a sixth workshop in February 2018 on data collection and management to improve GHG inventory compilation in the waste sector.

1.3. Purpose and objectives of the training

The training aimed to improve Ghana's climate data management system to ensure enhanced data gathering and to improve the quality of reporting in the waste sector for Ghana's GHG inventory. The main topics in focus in Ghana, as established with the EPA, were:

- introduction to the UNFCCC negotiation process and agreements and the reporting requirements and international policy instruments arising from them;
- introduction to the 2006 IPCC Guidelines for inventory development in the waste sector;
- waste data collection and management;
- in-depth insight into use of the Excel tools described in the IPCC Guidelines;
- waste characterisation method;
- defining and selecting mitigation actions and comparing mitigation scenarios;
- institutional framework for inventory compilation and data flows.

1.4. Training approach and content

The training approach was a mix of interactive lectures and group exercises. The lectures were delivered in such a way as to facilitate interaction, ensuring that there were pauses for questions. Time was set aside for questions and answers at the end of each presentation. There were two formal presentations delivered by the EPA to enhance understanding of the local situation and help the consultant adapt the training to local circumstances.

The training materials were adjusted to the local context, using local studies, policies and Ghana's inventory data. Annex 2 gives details on how the materials were adjusted to fit local circumstances in Ghana. A total of five exercises were carried out during the training. Four of these involved group work and were followed by presentation and discussion in plenary. One exercise involved short videos of disposal sites around the world and discussion of each video in a plenary session, with participants learning to use IPCC definitions together.

2. Activities and results achieved

2.1. Day 1

2.1.1. Setting the scene: Information Matters global project

Setting the scene included a presentation of past activities of the IM project in Ghana and an introduction to the agenda of the workshop (Annex 1).

The participants were asked to respond to a series of questions with a show of hands, which allowed the consultant to ascertain that the audience was largely made up of field practitioners from municipalities around the country and EPA representatives. Some of the participants were therefore highly knowledgeable on waste issues, and others on GHG inventories.

2.1.2. The UNFCCC processes

Developments in international climate policy

The timeline of UNFCCC negotiations and the most important milestones in the negotiations among countries were presented, as shown in the diagram below.[1] The presentation focused on points of interest to the participants in the training event, highlighting Conferences of the Parties at which decisions regarding reporting, national inventories and specific policy instruments for mitigation were made.

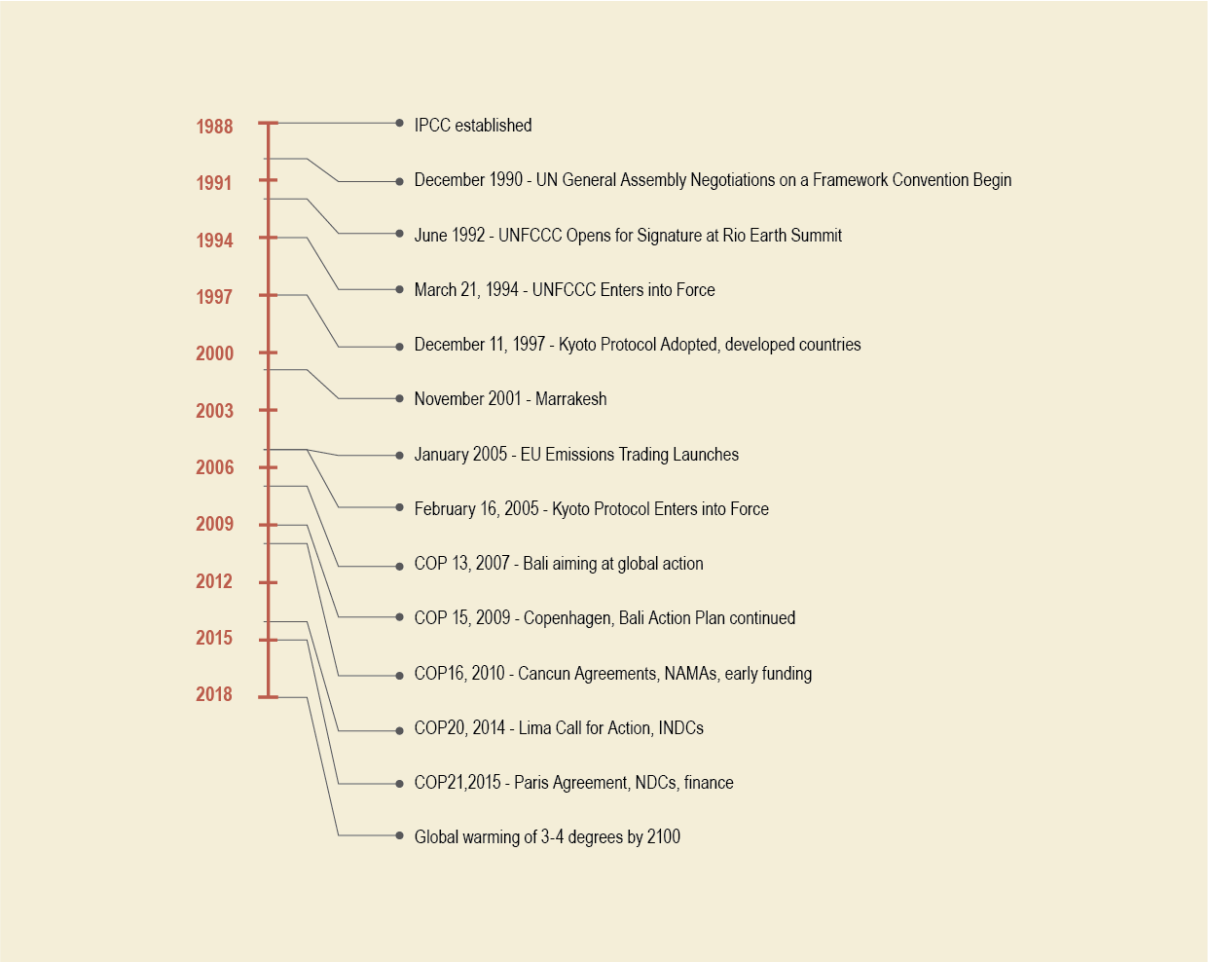


Figure 1: Brief history and current status of climate agreements and negotiations

Institutional roles in GHG inventory development in the waste sector[2]

The presentation distinguished between the institutional roles for GHG inventory development, including those concerned with inventory compilation and calculation, and the managers of different data sets and activity data collectors. The institutional arrangements for NCs and BURs are connected to the institutional roles already established for data collection and management.

[1] Largely based on the UNFCCC timeline available at http://unfccc.int/timeline/.

[2] UNFCCC Toolkit for Non-Annex I Parties on establishing and maintaining institutional arrangements for preparing national communications and biennial update reports.

Discussions and results

The following discussions arose during this session of the training:

- The abbreviations specific to UNFCCC negotiations, reporting and policy development processes were overwhelming and needed more clarification.
- The role of emissions trading in the current UNFCCC process was raised, and the standing of the emissions trading markets was discussed.
- Participants raised the issue that some emissions and waste generation in developing countries is due to second-hand equipment, cars and waste being exported from developed countries to developing countries. It was concluded that all countries need to develop and implement policies to prevent and control this. These emissions are not fully attributable to developing countries. The implementation of such policies requires resources.

Results

- An increased understanding of UNFCCC processes among participants.
- An understanding of why the GHG inventories need to be prepared.
- An understanding on how the inventories contribute to shaping policy for mitigation actions.
- A list of abbreviations was drafted and is included as part of this report on page 4.

2.1.3. Overview about 2006 IPCC Guidelines on waste

After this first session providing an introduction to UNFCCC reporting requirements, processes and policy instruments, attention turned to the content of the 2006 IPCC Guidelines for inventory development.

What is covered in the Guidelines?

The graph below shows the categories of activities covered in the GHG inventory for the waste sector. At the national GHG inventory level, it is important to understand the boundaries of the reporting system to avoid double counting. The Guidelines include instructions on allocating emissions to the different sectors.

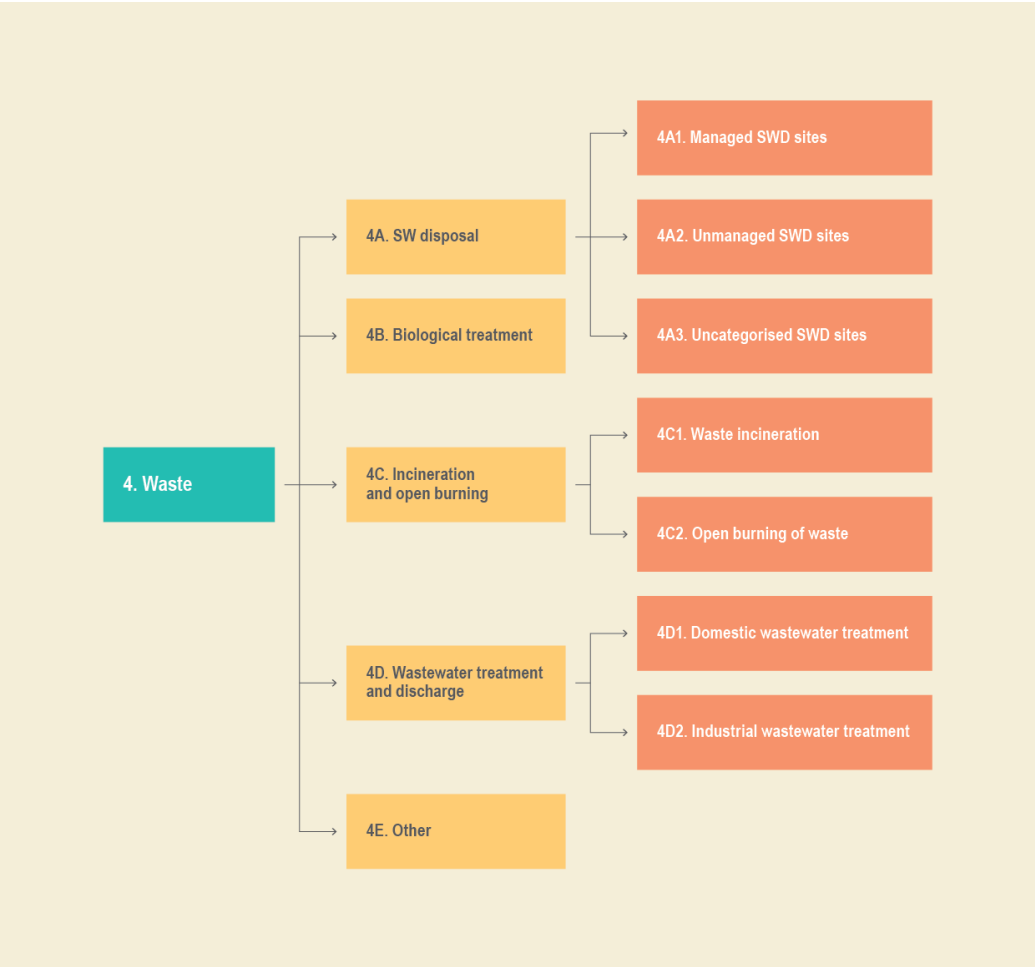


Figure 2: Sectors covered by the Guidelines

This part of the presentation was mainly based on the ***Good Practice Study on GHG Inventories for the Waste Sector in Non-Annex I Countries*** undertaken by GIZ.[3] For each emission category, information was given on sources of emissions, activity data and emission factors, and good practice examples from different countries were presented.

Solid waste disposal sites

The main pathways for GHG emissions from landfills are methane generation through anaerobic digestion of biodegradables. This methane is either oxidised in cover layers, released into the atmosphere or extracted for flaring or energy recovery. The methane generated at disposal sites is estimated based on the IPCC Guidelines for the purposes of the inventory. For determining methane emissions, the IPCC Guidelines recommend the use of the **first order decay (FOD) method** and provide Excel tools and software to carry out this assessment based on a series of input data.

Data needs:

- population data
- municipal solid waste (MSW) generation data

[3] GIZ, *Good Practice Study on GHG Inventories for the Waste Sector in Non-Annex I Countries*.

- historical waste generation data
- industrial waste generation data
- share of solid waste disposed of
- waste composition.

Biological treatment of solid waste
This section covers composting and anaerobic digestion. As decomposition of biomass during these treatments is much faster than at disposal sites, the emissions are estimated on an annual basis. In both cases, they are process emissions and are higher at poorly managed treatment sites than at well managed ones.

Amount of organic waste treated
- Default values in the Guidelines are scarce; national activity data should be used.
- Even if there is limited data reported by a limited number of sites, countries are encouraged to use the available data as a starting point and employ various methods to fill in the gaps.

Emission factors for treatment
- Default values are available; countries are encouraged to develop national emission factors (Tier 2) or measure emissions at sites (Tier 3).

Incineration and open burning
CO_2, CH_4 and N_2O are generated during the combustion process. The diagram below (Figure 3) depicts the process emissions that count towards the GHG inventory. Emissions from the burning of fossil fuel count towards the GHG inventory, while those from the combustion of biomass do not.

Incineration takes place in a relatively low number of controlled facilities. It is a common treatment for clinical waste in developing countries:
- waste burned per type, including municipal solid waste, industrial waste, hazardous waste, clinical waste and sewage sludge, and share of fossil carbon per waste type;
- amount of fossil liquid waste;
- site-specific data is often collected for controlled facilities; methodologies are available for gap filling, for example, estimating the amount of clinical waste based on the number of hospital beds.

Open burning is common practice, especially in rural areas; detailed consideration of this category is therefore recommended:
- population burning waste and waste generation among this population;
- fraction of waste burned; open burning is an incomplete process, and the default value is that 60% of waste is actually oxidised and 40% remains as ash on site;
- the population not served by a collection service and the quantity of waste going to open pits are possible starting points for estimating the quantity of waste openly burned.

Emission factors depend on the fossil carbon content of the waste for CO_2, while for CH_4 and N_2O they depend on the combustion technology. Default values are available.

Wastewater treatment and discharge
Methane emissions occur in deep and slow-moving waters and can be found in both treatment and discharge pathways.

In order to estimate CH_4 and N_2O emissions in this category, the total organically degradable material in wastewater (TOW) needs to be determined. Biological oxygen demand (BOD) is the most common way to measure TOW content of the wastewater.

Domestic wastewater:

- determine the total organically degradable material in wastewater (TOW);
- determine or choose the default value for emission factors for each pathway of the system; default values are available for domestic wastewater based on the carbon discharged per person;
- determine the relative share of each pathway in the system; systems may be distributed based on rural, urban high-income and urban low-income populations.

Industrial wastewater:

- the main industries to consider for emissions from industrial wastewater are pulp and paper, food and beverages and the organic chemical industry;
- activity data is based on production output from the relevant industries and chemical oxygen demand (COD) per unit of output for each industry;
- for N_2O emissions, the value for protein intake per person is required; protein intake may be available from nutritional statistics or international organisations.

Discussions and results

The following discussions arose during this session of the training:

- The rationale for converting GHGs to CO_2e was discussed, and it was explained by the trainers that this is a common denominator for accounting purposes and is used as the currency of GHG accounting, measurement, reporting and verification and trading. The global warming potential of gases is expressed in terms of the global warming potential of CO_2.
- A discussion arose about upward trends in methane emissions in Ghana and in the developing world in general. It was explained by the trainers that this is due to growing consumption and population and waste generation patterns and also to the shift from disposal at aerobic sites to sites that are better managed and more likely to create anaerobic conditions.

Results

- An increased understanding of the IPCC Guidelines on waste among participants.
- An understanding of all the emission sources in all waste-related subsectors.

2.1.4. Ghana's current GHG inventory on waste

Current waste management in Ghana

The current waste generation rates in Ghana range between 0.2 and 0.8 kg/person/day, while the total estimated amount of waste produced is estimated at 13,500 tonnes per day. Waste composition is dominated by organic materials (approximately 60%). The coverage of waste collection services in urban areas has increased from 68% in 2004 to approximately 80% in 2010. As of 2015, there are five operational engineered sanitary landfills in Ghana as well as 172 official dumpsites. There are about seven medium to large operational and non-operational composting facilities in Ghana with capacities ranging from 1,000-110,000 tonnes/year.

Data collection and management

Sources of data for the compilation of the inventory include published national reports, Ghana Statistical Service, the Sanitation Directorate of the Ministry of Local Government and Rural Development (MLGRD), the World Bank Country Database, private waste management companies, the Civil Engineering Department of the Kwame Nkrumah University of Science and Technology (KNUST), EPA, Ghana Heath Services, MLGRD and the National Industry Survey.

Filling of data gaps

The data gaps were filled as per the IPCC methodology and included:

- solid waste disposal – trend interpolation method to address missing data on annual per capita solid waste generation;
- waste water discharge and treatment – interpolation and extrapolation methods to address missing data on income classification and interpolation to address the distribution of population to different waste treatment facilities.

Improvement plan

The improvement plan includes tasks to increase data quality for solid waste disposal (solid waste generation rates and waste composition), the classification of disposal sites, the share of solid waste treated biologically and industrial and domestic waste.

Methodology for emission estimation

- 2006 IPCC Guidelines for estimating CH_4 emissions from solid waste disposal sites (SWDSs) (Excel spreadsheet):
    - default values for Western Africa (tropical wet) on delay time, oxidation factor, CH_4 generation rate constant, degradable organic carbon (DOC) and DOCf (fraction of DOC that can decompose);
    - methane correction factor – three types of landfill in Ghana (unmanaged deep, unmanaged shallow and managed anaerobic).
- Biological treatment of waste: in 2012, 187.47 gigagrams (Gg) or 3.7% of the total national solid waste generated.
- Incineration and open burning: in 2012, 33.26 Gg of waste incinerated and 133.06 Gg openly burned.
- Wastewater treatment and discharge: in 2012, BOD was 16.43 kg/person, and protein intake was 26.5 kg/person.

In 2012, total GHG emissions in the waste sector amounted to 4.52 $MtCO_2e$, which represented 14.6% of total national GHG emissions. Total emissions from the sector increased from 1.3 $MtCO_2e$ in 1990 to 2.3 $MtCO_2e$ in 2000 and further to 4.52 $MtCO_2e$ in 2012. One of the key challenges is data across the time series.

2.1.5. Exercise 1: Identifying key categories, scope of inventory and issues with quality of the data based on a 3 scenarios mass balance

Key category analysis and double counting was covered in the introduction to this part of the training. Handouts on mass balance flows were distributed and questions put to groups.

Avoiding double counting

The issue of avoiding double counting is central to GHG inventories, and the Guidelines contain detailed instructions on how to do this.

The diagram below illustrates the activities included as emission categories in the Guidelines as well as other treatment options and technologies in production, consumption and waste management processes that are not counted towards the waste sector. Activities included in the GHG inventory are those marked with a red circle.

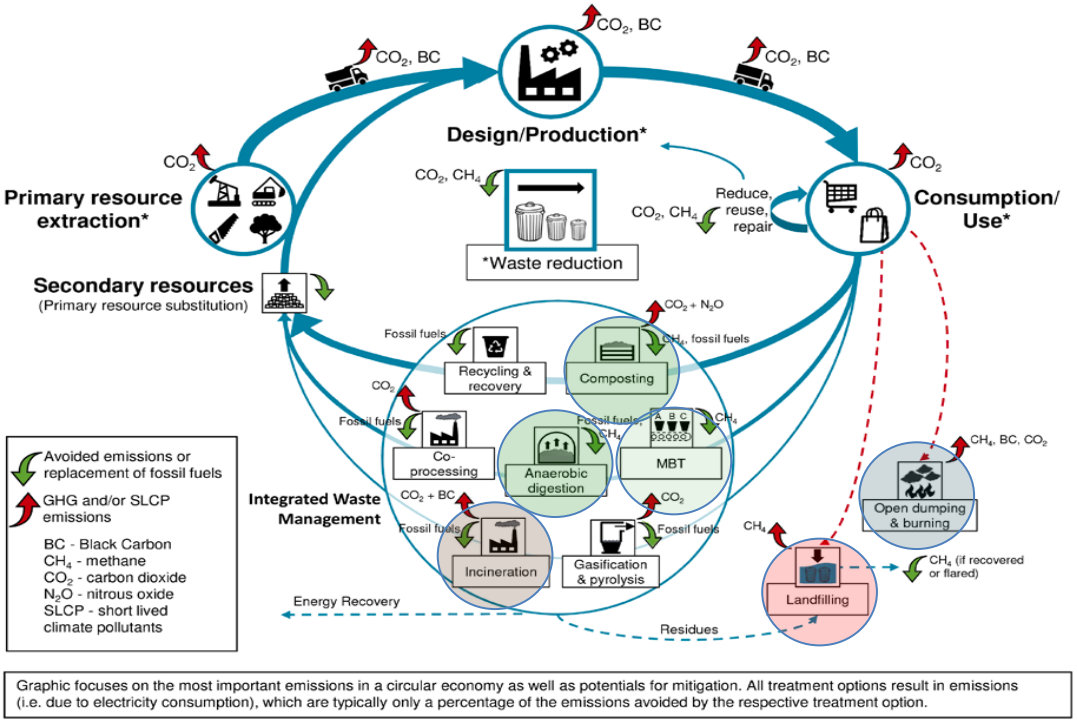


Figure 3: Waste management activities included in the waste sector inventory (marked with a red circle)[4]

Key category analysis

Key categories are those data source categories that contribute the most to absolute emissions (level assessment) and/or to the change in GHG emissions over the years (trend assessment). One of the following methods can be used to identify key categories (IPCC, 2006):

- qualitative assessment,
- based on previous emissions estimates,
- based on previous emissions estimates and uncertainties.

In the case of waste management data, given that the largest sources of emissions are methane generation resulting from solid waste disposal, data for key categories is often the amount and composition of the waste collected and disposed of. However, if significant changes are expected in waste diversion to an advanced treatment technology, another data source may become crucial, for example, composting if the country is focusing on a significant increase in composting.

[4] Adapted from GIZ, *Sectoral implementation of nationally determined contributions (NDCs): Circular economy and solid waste management*, 2017.

Discussions and results

There were three main categories of questions that gave rise to the following discussions and results:

- Identification of key categories was useful; the different groups identified different key categories based on the scenarios. The result of the exercise was to showcase how different data will be useful in different waste management systems.
- Identification of the scope of the inventory in terms of categories was useful, and the options given in the handout were helpful. Participants identified and discussed emissions and activities that were outside the scope of the waste sector inventory.

Results

- A better understanding of how key categories are identified and how they can change depending on the waste management system, priorities, policies and trends.
- An understanding of the importance of avoiding double counting in the context of national inventories.
- Increased capacity to identify the basket of gases that would be measured for GHG inventory compilation in the sector.

2.1.6. Waste management data

Waste data collection

Waste management services are delivered at sub-national level, either at sub-national government authority levels (e.g. regional, provincial, municipal, etc.) or at NGO (interest group), corporate, facility or project levels.

Understanding this diversity of stakeholders and their different data requirements is important to determine how to obtain the data that is needed and interpret and validate it correctly. There are commonalities that can be exploited, and efforts to improve this aspect should be given priority.

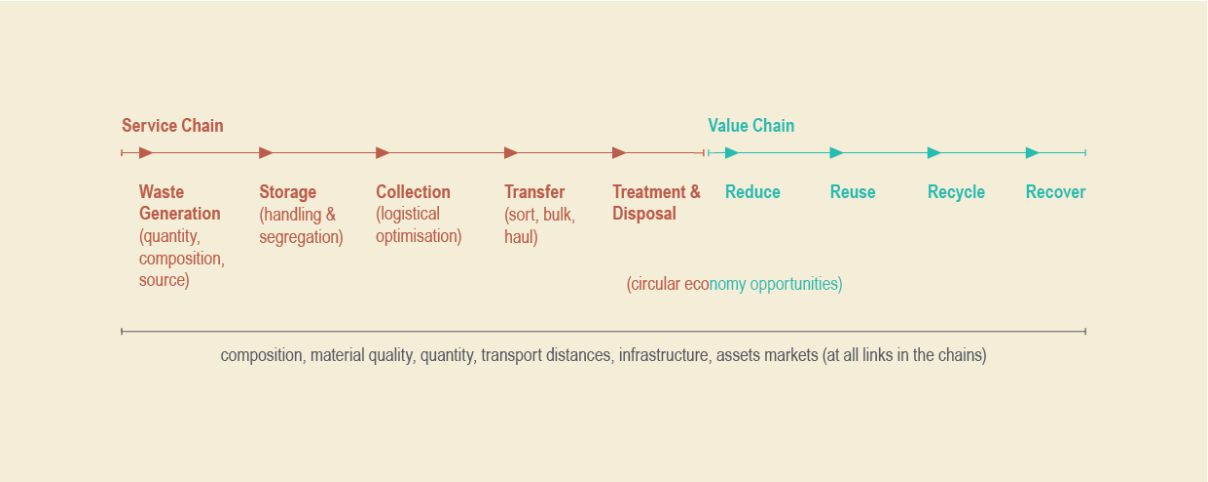


Figure 4: Typical integrated solid waste management service chain

The figure above illustrates a typical integrated solid waste management service chain, showing core local service provision, i.e. collecting and transporting waste. The value chain is also a key focus, introducing circular economy thinking to retrieve value from waste resources. At an

operational level, waste management practitioners, who produce the raw sub-national data, focus on delivering their services based on these factors.

Waste data management

The IPCC Guidelines provide default values for waste generation, mass and composition that assist in preparing GHG inventories when data is missing.

The two graphs presented in figure 5 illustrate the composition of municipal solid waste in two different South African municipalities. It demonstrates how composition can vary between locations within a country along with variances in generation.

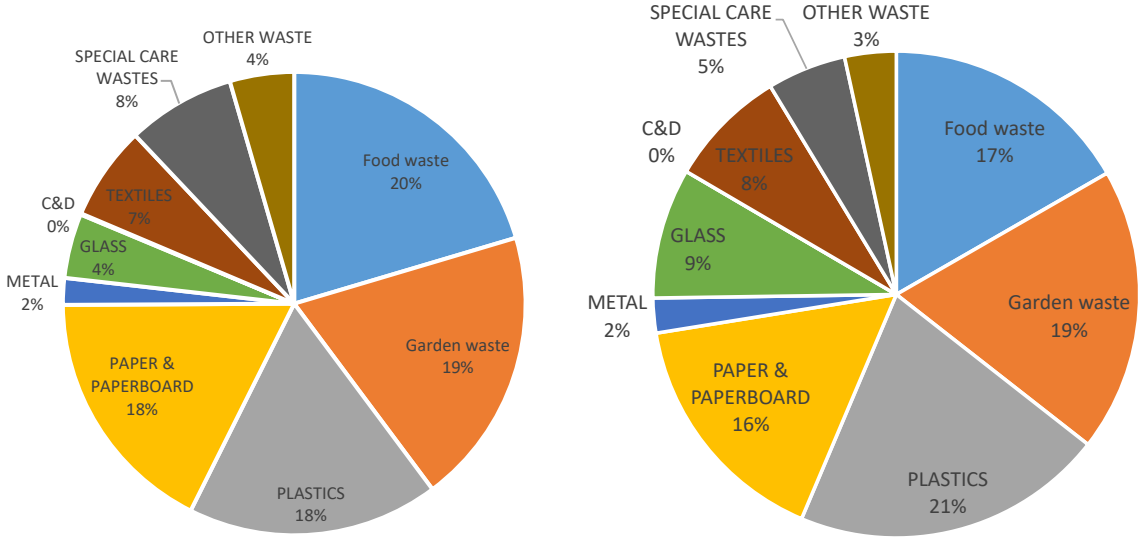


Figure 5: Comparison of MSW composition in two different South African cities

Figure 5 highlights the variance that exists between the 2006 IPCC Guidelines default MSW composition figures for Southern Africa and data collected in South Africa in 2017. There is a substantial difference between the two which when combined with the variances in generation rates and added to the national level can result in significant emission calculation variance.

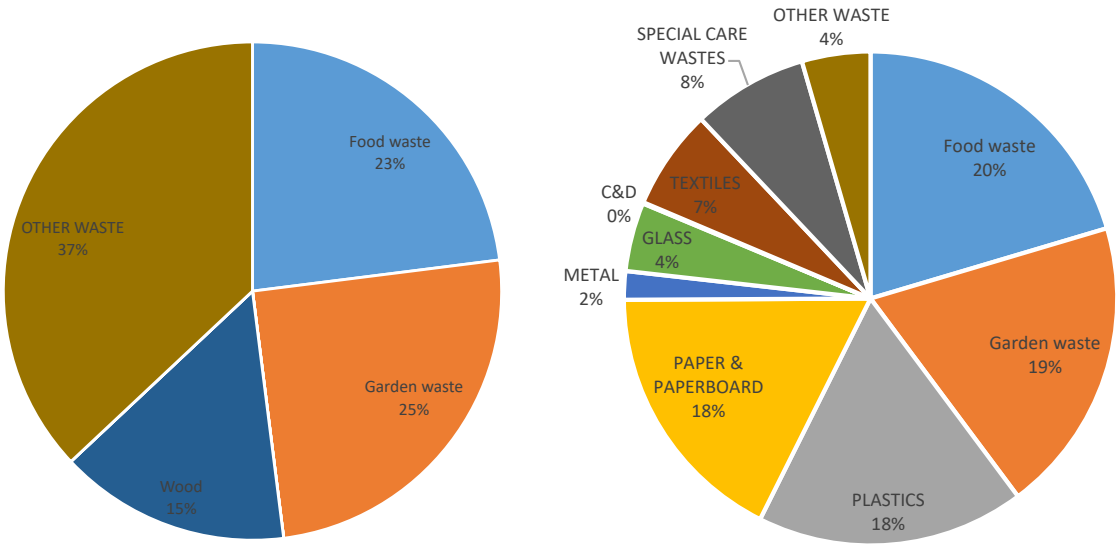


Figure 6: Variance between the 2006 IPCC Guidelines default MSW composition and data collected in South Africa in 2017

Given the diversity of stakeholders and their varying data needs, the best way to maximise accuracy and minimise the reporting burden on practitioners in the field, data duplication and inconsistencies is to establish a standardised national waste reporting system.

A methane correction factor (MCF) is a value assigned to each type of SWDS classified according to the IPCC which accounts for the fact that unmanaged SWDSs produce less CH_4 from a given amount of waste than anaerobic managed SWDSs.

2.1.7. Exercise 2: Classification of SW disposal sites

Different videos showing an aerial view of several disposal sites around the world were used as a tool to supplement the training programme. The purpose of this exercise was to provide an extra level of insight on the topic of classifying SW disposal sites and to help the participants convert information into knowledge. The participants were asked to identify the classification of solid waste disposal sites and the default oxidation factor. Answers to each of the examples were provided by the audience, and their choice was further discussed with the trainers. The examples included waste disposal sites in Ethiopia, Senegal, South Africa and Cyprus.

2.1.8. Exercise 3: Data needs – what data, from where and why?

An exercise was conducted to increase understanding of data needs at each step of the waste process flow and the way waste composition and quantity change at each step. To this end, the participants were given a generic process flow and technical options in the form of waste cards to choose from for each process element.

The first task for participants was to construct their own waste flow, ensuring flow balance. The diagram below depicts a flow that could have been chosen by the participants from primary storage to collection and transfer through to final disposal.

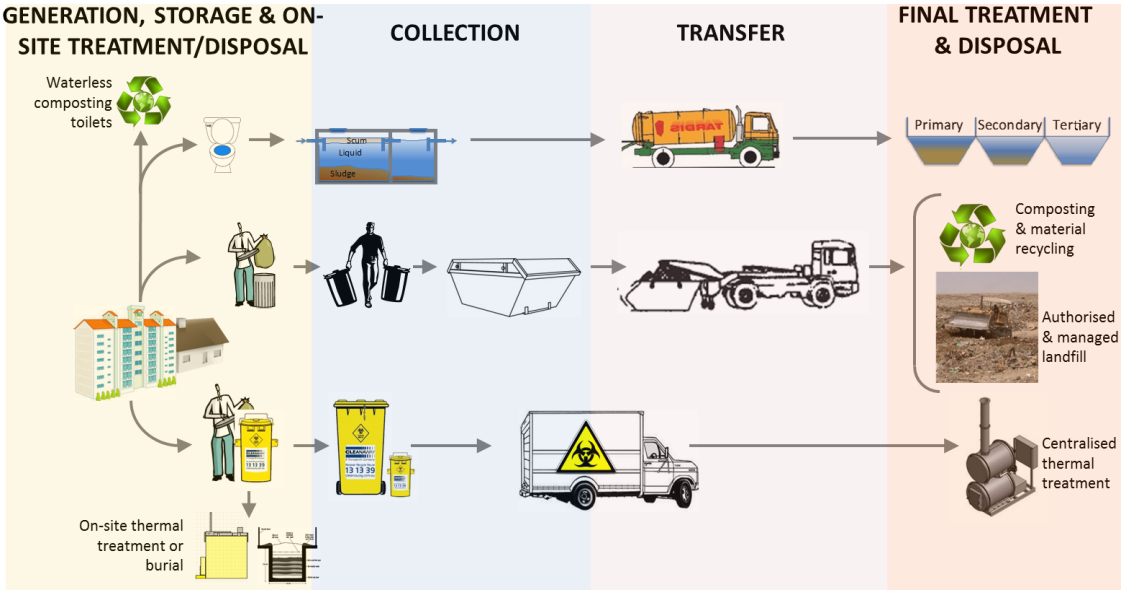


Figure 7: Solid and liquid waste process flows

Examples of the cards distributed for choice of collection method are shown below.

Figure 8: Examples of cards illustrating steps or processes in the waste sector

The participants then calculated input and output in terms of quantities and composition at each process step.

Discussions and results

Discussions related to estimating waste generation

- Waste generated in markets is difficult to estimate. Trainers pointed out that it is possible to track a sample of trucks collecting waste from the market and estimate the amount and composition based on that information.
- Besides open burning, there are other practices, such as waste burying and illegal dumping, that make estimating generation rates difficult. This is done in Ghana by means of a census, but the information it provides should be treated with caution, as it may be biased, given that open burning and other forms of on-site treatment of waste are not viewed as good practice and may be subject to penalty. Potentially, the amount of waste burned or treated otherwise on site may be underestimated.

Losses in the process flow

- Moisture loss during composting and other treatments of biological waste should be taken into account.
- If the collection is frequent, then moisture loss in the containers and primary storage point is not an issue.
- Other losses may be due to informal sector activities.
- Losses occur already in the first step of the waste management system, especially when there is a community-based container and a bring system rather than door-to-door collection.
- In the discussions following Exercise 3, many group presentations included the estimated percentages of losses at different steps of the process flow, with between 30% and 60% disposal of the generated waste.

Waste composition

- Differences between the composition of the waste generated and the waste disposed of were highlighted by several teams in the discussions following Exercise 3.
- Plastic and biomass are often openly burned, and this changes the composition of the waste from the point of generation to collection.
- The fact that there is no international standard on defining waste categories (i.e. municipal solid waste) and no international standard composition methodology was highlighted. It was observed that this makes it difficult to compare and contrast different waste composition study results, and a recommendation was made to establish national best practice, norms and standards for waste characterisation and composition analysis.

Wastewater treatment and discharge

- There were discussions about ditch depth and the likelihood of anaerobic conditions and methane generation occurring. It was clarified that deep and stagnant waters are worse discharge options from the point of view of GHG emissions than other options such as open defecation. However, open defecation may be worse from a public health point of view.
- It was clarified that an open sewer is a means of collecting wastewater from homes, institutions and businesses. Examples were shown in pictures to convey the different wastewater discharge and treatment pathways (this highlighted a further example of where local industry terminologies differed from IPCC Guidelines terminology).

Clarifications concerning waste disposal site categories

- The water table is high if the waste is almost permanently in contact with the water.
- Managed landfills must comply with at least one of a series of criteria, not all of them.

- In terms of managed and unmanaged disposal sites, there is a difference between IPCC categories and waste managers' terminology and categorisation.

Results

- A thorough understanding of waste data collection and data management tasks and how these relate to GHG inventory compilation in the sector.
- An increased understanding of IPCC terminology and definitions regarding key categories of disposal sites and the related influence on methane generation.
- Good understanding of the waste management process flow and insight into technical options along the process flow.
- Good understanding of the sources of emissions in wastewater treatment and discharge pathways and ability to compare and rate different pathways in terms of climate change impact.

2.2. Day 2

2.2.1. IPCC waste model

The IPCC waste model implements the FOD method for estimating emissions from solid waste disposal sites. According to this method, the rate of CH_4 generation depends on the amount of CO_2 remaining in the waste over the several decades it takes for the content of the degradable organic fraction of the waste to slowly decay. There are several ways in which the model can be used by countries to compile inventories, depending on the tier used. The Tier 1 method uses a set of default data for all the parameters of the model, which means that there is no need for any country-specific activity data.

Figure 9: Country-specific data needed for the three tiers in the waste model

CH_4 emissions from SWDSs

CH_4 is generated under anaerobic conditions as a result of the degradation of organic material. It can be recovered for energy use or flared, in which case it is subtracted from the amount generated. The part that is not recovered will be subject to oxidation in the cover material.

Data on decomposable degradable organic carbon (DDOC) from waste disposal
CH_4 generation potential can be estimated based on the amount and composition of waste and waste management practices at disposal sites. DDOCm, the mass of decomposable DOC deposited, is the fraction of the organic carbon deposited that will degrade under anaerobic conditions.

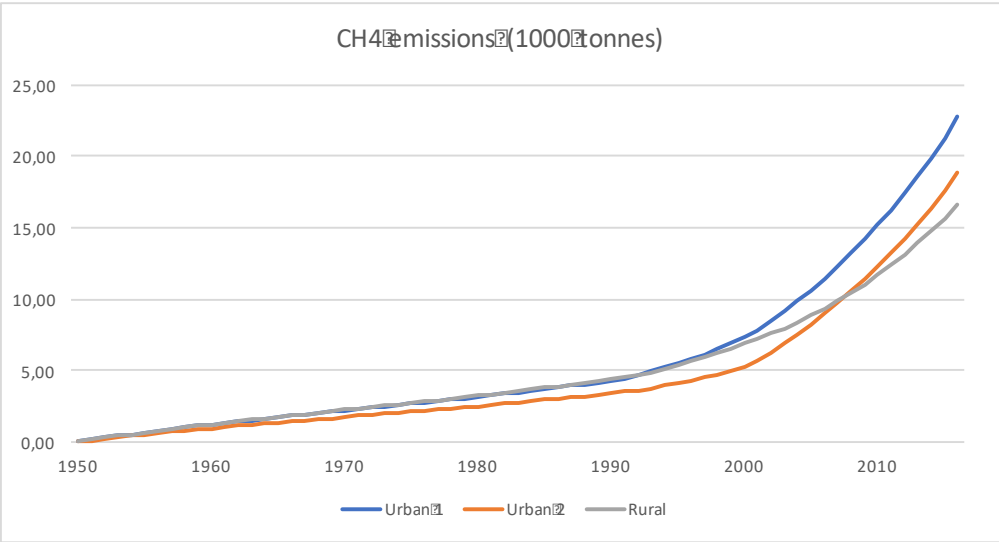
Methane generation potential
The methane generation potential is related to the DDOCm that will degrade at the disposal site. Landfill gas is approximately 50% methane, with the remainder being mostly carbon dioxide.

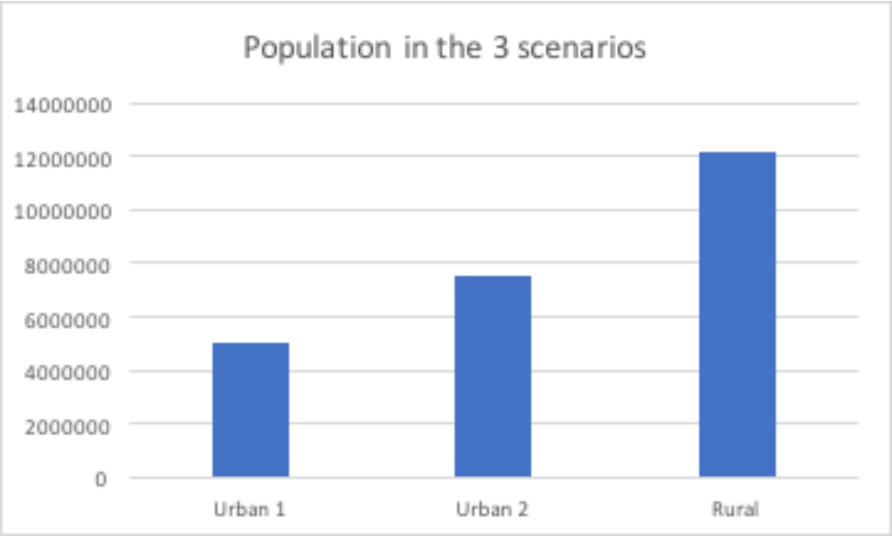
2.2.2. Exercise 4: Understanding the impact of different data sets on GHG emissions. Default data versus country-specific data

The purpose of this exercise was to show how country-specific data can be obtained by modelling existing data (IPCC parameters and activity data), thus moving from IPCC default Tier 1 data to country-specific Tier 2 data. The exercise was conducted in three different country scenarios, and the results obtained were then compared, cumulated and interpreted.

As the IPCC waste model is quite rigid in modelling data and requires specific inputs (total MSW generated, no breakdown between urban and rural population, etc.), an additional spreadsheet was provided in order to show real examples of data modelling to produce the specific inputs required by the IPCC waste model.

Results
The results for the three scenarios, as discussed, are presented in the graphs shown below. The exercise showed how the emissions change in the three scenarios and that even though the population in rural areas is much higher than in the low or high-income scenarios, the related emissions are not much higher. Participants gained an understanding of the different factors that contribute to methane emissions and learned how to use the IPCC waste model.





2.2.3. Identification of mitigation actions in the waste sector

GHG accounting at project level versus national level requires a change of mind-set. While in national GHG inventory development the focus is on avoiding double counting and making sure that emissions are correctly allocated to sectors, in the case of projects the focus is on understanding the total GHG mitigation impact of a project. Therefore, the approach and methodologies available for project impact assessment tend to include all activities and all gases and are often based on a life cycle approach.

In order to understand the complete GHG impact of activities, the life cycle approach is used in emission estimating methodologies. This means that activities and materials downstream and upstream of certain core activities are also considered when looking at the mitigation impacts.

National policy development for mitigation
While waste management contributes about 3% to global GHG emissions, it has the potential to mitigate between 15% and 20% of emissions if we consider all the mitigation impacts the circular economy and resource recovery can yield.[5]

The two main policy instruments arising from the UNFCCC Conference of the Parties (COP) are Nationally Appropriate Mitigation Actions (NAMAs) and Nationally Determined Contributions (NDCs).

A **NAMA** is any action that reduces emissions in developing countries, prepared under the umbrella of a national governmental initiative. They can be policies directed at transformational change within an economic sector or actions cutting across sectors for a broader national focus. NAMAs are supported and enabled by technology, financing and capacity building and aim to achieve a reduction in emissions relative to the 'business as usual' scenario by 2020.

NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each Party to prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties must pursue domestic mitigation measures, with the aim of achieving the

[5] *Global Waste Management Outlook*, 2015

objectives of such contributions. NDCs are powerful policy instruments that set national mitigation and adaptation targets.

Identifying and implementing mitigation actions
Driven by national policy or by local initiatives, local plans, master plans and feasibility studies aimed at waste sector improvements may take into consideration mitigation impacts and potential as a decision-making factor.

Mitigation approaches and technologies
When selecting mitigation options, the waste management hierarchy and technical, financial and legal considerations together with mitigation impact will play a role. Lastly, the cumulative impact of each scenario considered for the different material streams will be considered.

Impact assessment of technical options and scenarios
The best-known and most commonly used methodologies for emission accounting in the sector include the SWM-GHG Calculator (GIZ/IFEU), the Climate & Clean Air Coalition (CCAC) waste sector tool, the GHG Protocol sector tool and the ICLEI Recycling and Composting Emissions Protocol. These tools help users to compare scenarios based on input data, with all the equations, emission factors and gap fillers in place in case there is data missing on any aspect of the project.

Setting baselines correctly is very important in estimating the mitigation impact of a project. Setting baseline emissions unrealistically high is a potential source of bias in scenario assessment.

Climate finance for mitigation
Waste sector development and, by extension, mitigation actions rely heavily on public financing, and sources of financing are scarce. The private sector may be attracted to financing parts of waste management development projects under public-private partnerships, but these usually require long-term contracts and guaranteed gate fees for waste amounts. Municipalities rarely have the credit rating and debt-to-finance ratio to be eligible for private financing even in countries with a relatively well-developed banking sector.

Discussions and results

Mitigation

- Discussion of mitigation (deducted or avoided emissions) and emissions (occurred emissions, added to the balance).
- Composting has positive emissions in the impact assessment of mitigation actions because of the process emissions associated with composting.
- It was clarified that home composting is just one example of mitigation technologies available for anaerobic digestion. The decision to pursue one mitigation option or another should not depend solely on the GHG impact but also on other technical, financial, social and environmental considerations.

Results

- Increased understanding of the difference between national and project-based GHG accounting.
- Understanding of the importance of defining the ‘business as usual’ scenario and how to conduct scenario assessment.
- Introduction to the concept of avoiding emissions and the net emission impact of projects.

2.2.4. Waste analysis and characterisation and waste audit methodology

Waste analysis and characterisation consists of two parts:

- Solid waste generation survey:
  - daily generation rates in kg/person/day for residential waste and in kg/m^2/day for commercial waste;
  - bulk density of solid waste generated in kg/m^3.
- Solid waste composition survey:
  - composition of solid waste generated as a percentage by weight.

The main steps are:

- Pre-survey:
  - Includes defining the geographical area of the municipality, region or country intending to undertake the waste analysis and the objective of the study.
- Analysis design and planning:
  - Involves defining the type of sampling methodology for the geographical area and objective identified for the study and determining the practical sample collection design; it should take into account seasonality and stratification.
- Execution of waste analysis:
  - Includes the logistics required to collect, name and number the samples, locating and resourcing the physical sorting and analysis of the samples, recording the data, ensuring data accuracy and quality and safely disposing of the samples once the analysis has been completed.
- Evaluation of waste analysis:
  - The evaluation includes compiling results and entering them into a spreadsheet for calculations, disaggregation and comparisons with existing data sets (i.e. weighbridge data or past analysis), extrapolating the results against strata and area summaries and presenting the results in a format compatible with the established objectives and target audience.

2.2.5. Exercise 5: Institutional functions

A brief introduction on data flow and institutional roles was followed by a group exercise, plenary presentation and intense debate among participants, signalling an interest and eagerness on the part of the Ghanaian waste sector and climate sector stakeholders to cooperate in improving the GHG inventory for the sector.

Institutional roles for GHG inventory development include inventory compilation and calculation functions and also the roles of managers of different data sets and activity data collectors. Institutional arrangements for the preparation of NCs and BURs are closely associated with the institutional roles already established for waste data collection and management systems.

Figure 10: Institutional roles for data collection, management and reporting

Institutional roles in GHG inventory compilation

It is recommended that a single body be designated to be responsible for the overall coordination and management of the process of preparing NCs and BURs. The compilation and submission of National Inventory Reports (NIRs), as shown below, is a complex cyclic process that restarts almost immediately after a report is finalised.

As part of this exercise, participants were asked to draw a data flow diagram and institutional structure that, in their view, would be best suited for collecting, reporting and aggregating the activity data needed for GHG inventory compilation.

Discussions and results

Institutional setup

- Those stakeholders who are responsive and provide data are invited to participate and continue to be part of the working groups. Some operators have been more responsive than municipal departments and have gained an important role as data providers.
- The role of the Regional Coordination Council (RCC) was discussed, and the participants raised the question of whether municipal departments should be directly linked to the national level or continue to report through the RCC as they do at present. Following a heated discussion, the consensus reached seemed to be that current systems should be reinforced rather than reinventing the wheel. The RCC's role should therefore be maintained and strengthened.
- Various specialised working groups carry out inventory compilation. Questions related to the size and composition of the groups were clarified by Ghana EPA.

Data management instruments

- The idea of sharing data on a web-based platform was proposed.
- Means of financing and reducing the costs of waste composition and characterisation studies mainly consist of sourcing donor funds and involving research institutions or universities in the process.

2.2.6. Closing remarks

The workshop closed with a summary of the most important topics covered and the main learning points addressed over the two days.

The head of Ghana EPA emphasised the importance of continuously improving the GHG inventory for the waste sector and implementing mitigation actions. Participants were encouraged to collect and communicate better field data, implementing the knowledge and skills they had learned during the training.

3. Outputs and outcomes

The training aimed to improve Ghana's climate data management system to ensure enhanced data gathering and to improve the quality of reporting in the waste sector for Ghana's GHG inventory.

The authorities responsible for GHG inventory compilation now have sound experience and knowledge of good practices and are aware of the methods and tools available to improve inventories.

Given that the majority of the trainees were data managers and waste management practitioners who are knowledgeable about the existing waste management systems at the municipal level but are not aware of the exact requirements of a GHG inventory, the main outcome of the training was to facilitate communication with the authorities responsible for the GHG inventory and make the trainees aware of data requirements for a GHG inventory.

There was a lively debate during one of the last sessions, focusing on institutional arrangements and data flow. As the waste management practitioners are at the base of the data management pyramid and have an important role in sourcing the information needed for GHG inventories, the knowledge gained during the training will contribute to improving the quality of GHG waste data and making communication channels more effective towards the top of the pyramid.

The training workshop created a platform for discussion with different institutions on how to strengthen the design of the data collection and management systems in order to improve the quality of the data.

4. Recommendations

As a result of the training, waste management practitioners are more aware of data needs for the GHG inventory and have gained knowledge and skills in this field and also in collecting data. Field practitioners, namely the waste management departments at local and district level, are expected to actively and regularly collect data, assess the disposal sites in their areas, according to IPCC data, and start reporting the data needed for the inventory. This group of participants are expected

to share the information and knowledge they have gained with other members of the waste and municipal service departments in their organisation.

Furthermore, there was significant interest on the part of practitioners in understanding mitigation pathways and using climate impact criteria for identifying priority technical options and measures in the sector. Further training, capacity building or dissemination of information is needed on mitigation options and how to assess them in the waste sector.

It is recommended that communication channels between the working groups compiling the GHG inventory and local municipalities be reviewed and strengthened, building on existing communication channels through regional authorities. Discussions during the training showed an eagerness on both sides to share data and information, although there seem to be bottlenecks in communication between the different institutions involved.

It is crucial that regional authorities responsible for data management and aggregation and communication between national and local levels of government are informed about data needs and that they receive information on the contents of the training. Ideally, meetings should be held in person with the representatives of regional authorities to actively engage them and facilitate data flows.

Last but not least, at the national level, the EPA is encouraged to enhance the quality of GHG reporting by streamlining data collection, conducting a review of the activity database and the inventory as a whole and identifying opportunities for enhancement. Best practices were shared during the training for activity data sourcing and also for gap filling and points for quality checks. If outsourcing the review is not possible, then the EPA could conduct an internal review, using the training manual and the *Good Practice Study on GHG Inventories for the Waste Sector in Non-Annex I Countries*.

5. Annexes

Annex 1: Workshop agenda

Information Matters
Transparency through Reporting

On behalf of
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
of the Federal Republic of Germany

Training on data collection and management to improve GHG inventory compilation in the waste sector

Venue: Capital View Hotel, Koforidua, date: 14th – 15th February

The training aims to improve Ghana's climate data management system to ensure enhanced data gathering and to improve the quality of reporting in the waste sector for Ghana's GHG inventory. The training will give insight to the work and role of all stakeholders involved in data collection, data management and the compilation of the inventory.

Agenda

TIME	ACTIVITY	RESPONSIBLE
	Day 1	
8:30 – 9:00	Registration	GIZ
9:00 – 9:15	Opening Remarks and Introduction of Participants	EPA/ GIZ/ All
9:15 – 9:30	**Setting the Scene:** IM Global Project	Information Matters (IM), Verena Schauss
9:30 – 9:45	Levelling-off on Level of Knowledge/Experience; Expectations Check Program and methodology of the workshop	Resources and Waste Advisory Group (RWA)
9:45 – 10:15	**Introduction:** UNFCCC reporting requirements, GHG mitigation goals: NDC formulation and implementation related to waste management	RWA
10:15 – 10:30	***Coffee break***	
10:30 – 11:30	**Overview about 2006 IPCC Guidelines on waste:** • Solid waste disposal • Biological treatment of solid waste • Incineration and open burning • Waste water treatment and discharge Focus will be on practical examples and good practices as highlighted in the Good Practice Guideline from the countries analysed involving participants in sharing Ghana's experience on each issue.	RWA

TIME	ACTIVITY	RESPONSIBLE
	Day 1	
11:30 – 12.30	**Ghana's current GHG inventory on waste:** • Current figures / emissions, time series and trends for GHG emissions from waste • Strengths and gaps in data collection and management • Discussion	EPA, Joy Ankomah Hesse
12:30 – 13:30	***Lunch Break***	
13:30 – 14:15	**Exercise 1: Identifying key categories, scope of inventory and issues with quality of the data based on a 3 scenarios mass balance**	RWA and all participants
14:15 – 14:30	Presentation of results	All participants
14:30 – 15:00	**Waste Management data (Data Needs – what data, from where and why? Including group exercises)** • Mass balance • Waste data collection – what data, from where and why? • Service chain vs value chain • Waste composition • Waste data management	RWA
15:00 – 15:15	***Coffee break***	
15:15 –16:00	**Exercise 2. Classification of SW disposal sites**	All participants, facilitated by RWA
16:00 – 17:15	**Exercise 3. Data Needs – what data, from where and why? Incorporating group exercises** • Data collection practical exercise using an urban scenario presenting waste composition, population, and process flow chart to extrapolate required information • Presentation of results in the plenum	All participants, facilitated by RWA

TIME	ACTIVITY	RESPONSIBLE
	Day 2	
8:30 – 9:00	Presentation of results	All participants
9:00 – 9:15	Recap of Day 1	RWA, GIZ
9:15 – 9:45	**IPCC waste model:** • Introduction • Tiers • Calculation methods	RWA

TIME	ACTIVITY	RESPONSIBLE
Day 2		
09:45 – 11:00	**Exercise 4:** Understanding the impact of different data sets on GHG emissions. Default data versus country specific data.	All participants, facilitated by RWA
11:00 – 11:15	***Coffee Break***	
11:15 – 11:45	**Identification of mitigation actions in the waste sector**	RWA
11:45 – 12.15	**Waste analysis and characterization, waste audit methodology** (International best practice; lessons from South Africa, Ethiopia and Senegal)	RWA
12:15 – 13:00	**Institutional Functions (part 1):** • Presentation on institutional arrangements for waste management, waste data and GHG data collection	EPA, Juliana Bempah
13:00 – 14:00	***Lunch Break***	
14:00 – 14:45	**Institutional Functions (part 2):** **Exercise 5: Institutional roles in GHG reporting and data management**	All participants, facilitated by RWA
14:45 – 15:00	**Wrapping-up** • Final notes **Closing** • Way forward • Workshop Evaluation	RWA/ GIZ, all participants

Annex 2: Adapting the training to special circumstances in Ghana

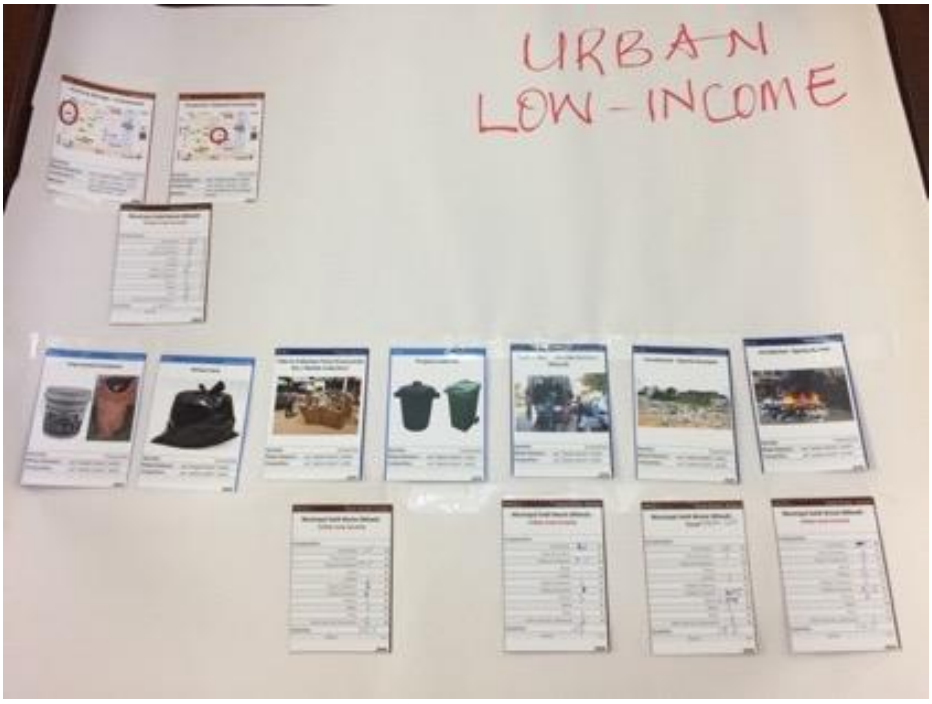
When developing the presentations and exercises for Ghana, RWA took into consideration the documents listed below.

Report	Use in training preparation
Ghana's Third National Communication Report to the UNFCCC, National GHG Inventory Report (2015), Ghana's First BUR	Reading the NC, BUR and NIR as part of the official reports submitted by Ghana helped us understand: • the parameters and activity data used for calculating emissions in the four categories specified in the 2006 IPCC Guidelines; • the choice of tiers, assumptions and methods for gap-filling data; • the institutional framework for inventory preparation; • the sources of activity data and the type and reliability of activity data available. This allowed us to adjust the level of information and target the materials to the issues that can be improved in Ghana, such as: • using different activity data for rural, urban high-income and urban low-income population; • methods for estimating waste generation and waste composition; • field data collection and management as part of the institutional framework.
Kodwo Meziah, Kwasi Obiri Danso, Zsofia Kadar, Bernard Fei-Baffoe and Moses Y. Mensah, 'Municipal solid waste characterization and quantification as a measure towards effective waste management in Ghana', *Waste Management*, 2015	The scientific article was used as a source for generation rates in the different regions in Ghana. The paper includes a breakdown per metropolitan, municipal and district areas as well as a geographic breakdown into Northern Savannah, Forest Zone and Coastal Zone. Composition data is also available in the paper. This information was used as input for the activity data exercise on the use of the IPCC waste model Excel tool.
Information from official	Data for population, population growth in different

statistics	settlements and GDP growth was taken from internationally reported statistics, the results of the latest census and the World Bank Database. This statistical information was used as input for the activity data exercise on the use of the IPCC waste model Excel tool. • Worldometers, • Ghana Statistics Department • World Bank Database
GoogleEarth image of disposal site at Tema, Ghana	The photo was used as one of the examples in the exercise on the identification of IPCC solid waste disposal site categories.

Annex 3: Photo report

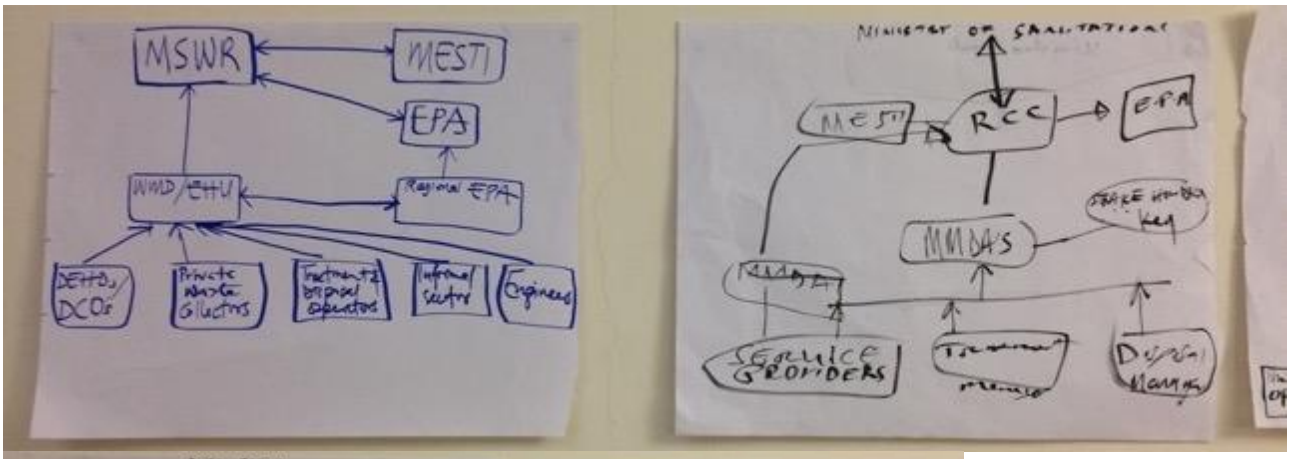
Exercise 3. Data needs – what data, from where and why with card game

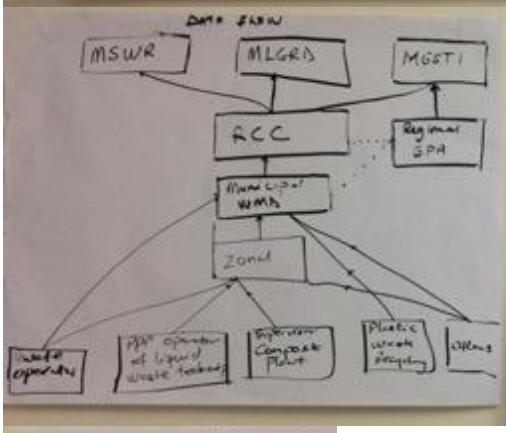


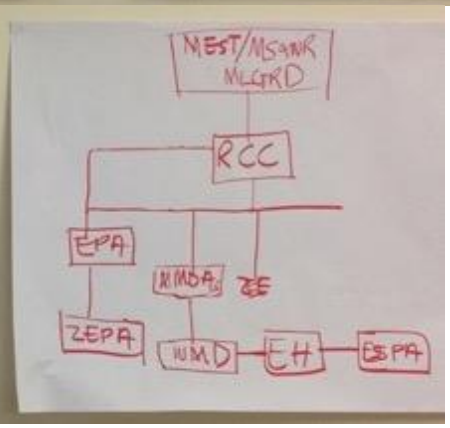
Exercise 4. Understanding the impact of different data sets on GHG emissions

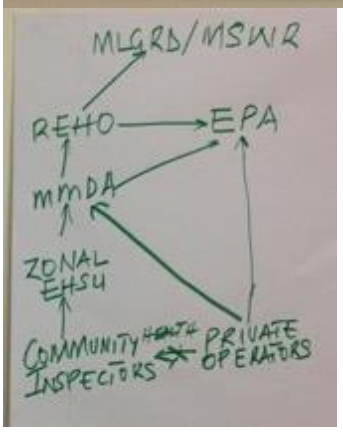
Presentation by the EPA on institutional structure

Exercise 5. Institutional roles in GHG reporting and data management


MSWR
MESTI
EPA
WMD/EHU
Regional EPA
DCOs
Private waste Gluctors
Informal sector
Engineers
MESTI
RCC
EPA
MMDA'S
SERVICE PROVIDERS


MSWR
MLGRD
MGSTI
RCC
Regional EPA
Zonal
Composting Plant


MLGRD
RCC
EPA
MMDA
ZEPA
WMD
EH
EPA


MLGRD/MSWR
REHO
EPA
mmDA
ZONAL EHSU
COMMUNITY INSPECTORS
PRIVATE OPERATORS

Closing remarks

Registered offices
Bonn and Eschborn, Germany
T +49 228 44 60-0 (Bonn)
T +49 61 96 79-0 (Eschborn)

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0