Capacity building on monitoring, reporting and verification of the GHG emissions and actions in developing countries

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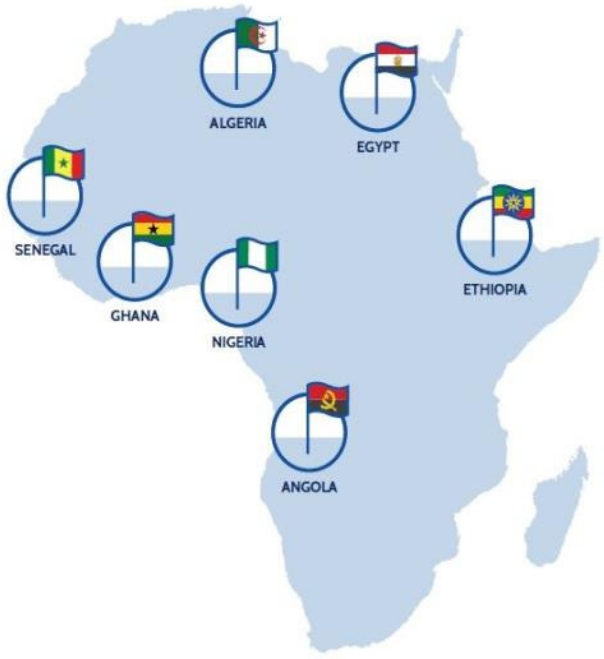

QA/QC Plan for Waste Sector

Description of Procedures

Egypt

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Receiver:

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Central Agency for Public Mobilization and Statistics (CAPMAS)

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1 RATIONALE AND OBJECTIVES

The implementation of quality assurance, quality control (QA/QC) and verification procedures is an important part of the development of national greenhouse gas inventories and accounting and reporting on GHG mitigation actions (hereafter commonly called 'GHG inventory'). As described in the IPCC 2006 Guidelines, an adequate QA/QC plan helps improve transparency, accuracy, consistency, comparability, completeness (TACCC principles), and accordingly less uncertainties and more confidence in national GHG inventories.

This QA/QC plan establishes procedural and technical issues to review a GHG inventory in the waste sector for a specific year y. This QA/QC plan directs activities and attention to ensure the quality of the inventory while it is being compiled. An effective QA/QC plan contains the following elements, which are covered in the chapters below:

1. Roles and responsibilities;
2. Procedures (general and sub-sector specific);
3. QA review procedures;
4. Reporting, documentation, and archiving procedures.

1.1 Principles

The GHG inventory is guided by 'transparency', 'accuracy', 'consistency', 'comparability', and 'completeness'. These are defined by IPCC 2006 Guidelines as follows:

- **Transparency -** means that the inventory compiler should provide sufficient and clear documentation and report a level of disaggregation that sufficiently allows individuals or groups other than the compiler team to understand how the inventory was compiled and assure it meets *good practice* requirements for national greenhouse gas emissions inventories. The transparency of emission reporting is fundamental to the effective use, review and continuous improvement of the inventory.

- **Accuracy** - means that emissions are neither overestimated nor underestimated, as far as can be judged. This implies all endeavors to remove bias from the inventory estimates.

- **Completeness -**means that estimates are reported for all pollutants, all relevant source categories and all years and within the entire territorial boundaries of the country. Where elements are missing their absence should be clearly documented together with a justification for exclusion.

- **Consistency -**means that estimates for any different inventory years, gases and categories are made in such a way that differences in the results between years and source categories reflect real differences in emissions. Annual emissions, as far as possible, should be calculated using the same method, and data sources for all years, and resultant trends should reflect real fluctuations in emissions and not the changes resulting from methodological differences. Consistency also

means that, as far as practicable and appropriate, the same data are reported under different international reporting obligations.

- **Comparability -** means that the national inventory is reported in such a way that allows it to be compared with national inventories of other countries. This can be achieved by following IPCC Guidelines and i.e. appropriate choice of key categories, using the reporting guidance, tables, classification and definition of categories of emissions as presented in IPCC 2006 Guidance, Volume 1, Chapter 8 on Reporting Guidance and Tables.

1.2 Definitions

The terms 'quality control', 'quality assurance', and 'verification' are often used in different ways.
In this document, the IPCC 2006 Guidelines definitions apply, as follows:

- **Quality Assurance (QA) –** a planned system of review procedures conducted by personnel not involved in the inventory compilation process. Independent reviews verify that measurable objectives were met, ensure that the inventory represents the best possible estimates of emissions given the current state of scientific knowledge and data availability, and support the effectiveness of the QC programme.
- **Quality Control (QC)** – a system of routine technical activities implemented to measure and control the quality of the inventory as it is compiled. It is performed by personnel compiling the inventory. The QC system is designed to provide routine and consistent checks to ensure data integrity, correctness, and completeness as well as identify and address errors and omissions. QC activities include general methods such as accuracy checks on data acquisition and calculations as well as technical reviews of categories, activity data, and emission factors.
- **Verification -** activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory. Verification refers specifically to those methods that are external to the inventory and apply independent data, including comparisons with inventory estimates made by other bodies or through alternative methods.

For further information see '*IPCC 2006 Guidelines, Volume 1, Chapter 6 on Quality Assurance/Quality Control and Verification'*.

2 QA/QC PLAN

The purpose of the QA/QC plan is to organize, plan and ensure implementation of QA/QC activities and verification measures. The QA/QC plan consists of:

1. An outline of QA/QC activities and procedures pertinent to all stages of the reporting process, which include data gathering, data documentation, and calculations
2. A description of the institutional arrangement and corresponding responsibilities for the implementation and execution of QA/QC activities, i.e., QA/QC personnel
3. A schedule for the implementation and completion of QA/QC activities

In short, to ensure proper implementation of QA/QC activities and procedures, the QA/QC plan should answer the central question of WHO should do WHAT, HOW, WHEN and WHY. To clarify more this concept, it is assumed that there is a case study where it is required to enhance the accuracy of the data regarding the collected waste in the Egyptian landfill/dumpsites in order to have better estimation for the resulting GHG emissions. For every question, an example is given relative to this case study:

- **WHO** - This provides the reference to the role concept: A certain person is responsible (e.g. the landfill/dumpsite site managers are responsible to improve the data about collected waste in Egypt)

- **WHAT** - This provides the reference to the object that is to be improved (e.g. data about the collected waste in landfill/dumpsites in Egypt)

- **HOW** - This provides the tool used to achieve that action(e.g. by filling in a monthly data collection form)

- **WHEN** - This provides the reference to the time by which the improvement must be completed, pursuant to the inventory plan (e.g. the forms are to be filled in monthly and compiled by the end of each year)

- **WHY** - This provides the reference to the origin of the necessary action (e.g. to continue working on the country's approach of having more accurate estimations for the GHG national emissions)

The plan is subject to future improvements and is binding to the subsequent inventory preparation.

The following section describes the proposed institutional arrangement for the implementation and execution of the QA/QC plan that Egypt plans to follow to ensure a high quality national inventory with focus on the waste sector.

3 QA/QC PERSONNEL

The QA/QC personnel consist of a GHG inventory QA/QC coordinator, a lead for the waste sector, and external experts. The GHG inventory QA/QC Coordinator is the main person responsible for implementing the QA/QC plan for the all the GHG inventory sectors including the waste sector. This is achieved by communicating the QA/QC responsibilities and ensuring timelycompletion of the QA/QC checklist and related activities. The QA/QC coordinator is affiliated to the Climate Change Central Department (CCCD) in the Egyptian Environmental Affairs Agency (EEAA), which has been selected as the competent authority responsible for coordinating activities for the GHG inventory compilation.
The lead of the waste sector is responsible for compilation of data, and external experts are responsible for review of inventory. Table 3.1 lists individuals and corresponding affiliations and responsibilities for the implementation and execution of the QA/QC plan. Appendix I provides an example for a checklist that the QA/QC coordinator can use to check the degree of completion of the different activities.

Table3-1: Personnel responsible for QA/QC activities[1]

Title	QA/QC Responsibility	Individual (initial, last name)	Institution	Contact Information
Inventory QA/QC Coordinator	▪ Clarifies and communicates QA/QC responsibilities to inventory members and to the entities responsible for data collection (e.g. CAPMAS in the waste sector).Manages and provides Inventory team with documentation of QA/QC activities implementing the overall QA/QC plan. ▪ Ensures the timelines are kept. ▪ Coordinates external reviews of the inventory document and ensures that comments are incorporated into the inventory. ▪ Distributes QA/QC plan to all team members working on the inventory. ▪ Conducts a “kick-off” meeting with all of those working on the inventory and on data collection to introduce the work plan, responsibilities and required documentation. ▪ Provides memos to the team members to remind them of their QA/QC responsibilities and overall schedule.		CCCD-EEAA	

[1] When the exact contact persons are defined, their data will be filled inside the table and circulated among the team

Waste Sector Lead	▪ Collects Inventory data (shown in next section). ▪ Implements waste sector QA/QC procedures.		CAPMAS	
External Expert(s)	▪ Expert review of the inventory calculations			

4 QUALITY ASSURANCE AND CONTROL PROCEDURES

This chapter clarifies the general data flow for GHG inventory in the waste sector and includes templates of forms for data collection and reporting (the ones agreed upon with the sector stakeholders), outlines QA/QC activities to be performed, the schedule for completing these activities, as well as defines the external review process and the protocols for archiving documents.

4.1 Data Management

Data flow

After meeting with the sector's stakeholder, it was agreed to have some modifications to the current data flow structure. The following paragraph provides the newly agreed upon structure.

Activity data (mainly waste amount) used for the compilation of the inventory is collected and compiled on three levels. At level 1, data pertinent to waste collection and disposal for districts (hay) and villages (qarya) is collected by district and village councils in forms distributed by the governorate's Central Statistics Department (named Form 2)[2]. Since such data are usually sourced from the vehicle service centre (garage) of the district/village, they can also be called as "garage" data. At the same level, the landfill/dumpsites will report the collected waste amounts in forms distributed by the governorate's Central Statistics Department (named Form 1).

At level 2, the completed forms of all districts (hay), villages (qarya) and landfills/dumpsites are compiled by the Central Statistics Department in each governorate and transferred to the CAPMAS representative office in every governorate. At level 3, the compiled data of individual governorates is transferred to the central office of CAPMAS, which is responsible for the compilation and documentation of data at the national level (level 3). The compiled data of each governorate will be documented by CAPMAS in Form 3. As will be shown later, Form 3 will also contain data about waste generated and data from the municipal waste recycling plants. The compiled national data is then transferred to the national entity performing the calculations of emissions (CCCD-EEAA). The flow of data collected across the 3 levels is illustrated in Figure 4.1.

Data collection/reporting frequency

At level 1, data pertaining to waste amounts from landfill sites and waste collected by district and village councils are collected monthly in forms 1 and 2 respectively. At level 2, data is compiled on a monthly basis and transferred to level 3. At level 3, data from forms 1 and 2 is compiled into form 3 on a yearly basis (by compiling the monthly forms).

The data collection for the GHG inventory takes place at the national level on a yearly basis using the data compiled by CAPMAS for the waste sector**.**

[2]For the urban areas, some districts (hay) can be a standalone, and some others are affiliated to cities. For the rural areas, usually a group of small villages have a central administration under the name of "Villages conglomerate" (wehda qaraweya). Accordingly, the reporting can be on the district level or on the city level for urban areas, and on the "Villages conglomerate" level for rural areas.

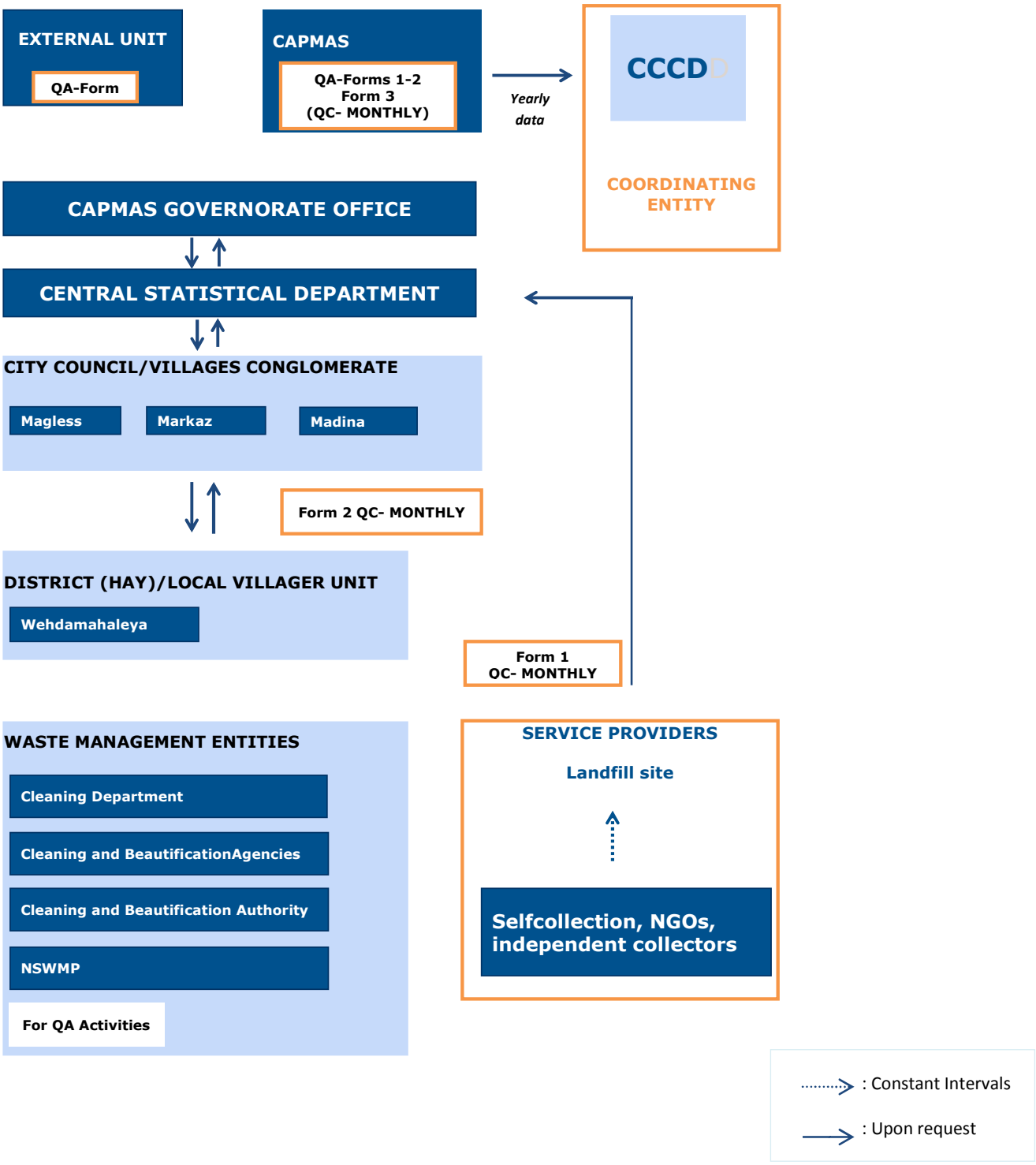

Figure 4-1: Data flow pertinent to solid waste

Data sources and corresponding responsible entities are presented in Table 4.1.

Table 4-1: List of data sources and personnel responsible for data flow[3]

Data Type	Form	Institution	Individual (initial, last name)	Contact Information
Activity data				
Amount of waste collected[4]	**1-2**			
SWDS	1	Landfill site supervisor		
Vehicle service center (garage)	2	City council manager/Villages conglomerate council manager		
Monthly collected waste details per governorate	**1-2**	- CAPMAS governorate level - Central Statistics Department		
National waste details	**3**	Central CAPMAS(Public Utilities and Trading Department)		
Emission factors and parameters				
Emission Factors		EEAA/CCCD		
Emissions estimates				
GHG Emissions resulting from the waste sector		EEAA/CCCD		

[3] When the exact contact persons are defined, CAPMAS will be responsible for filling in their data on a governorate-level

[4]CAPMAS already has data collection forms for recycling plants. These forms will be used to get the data pertinent to each municipal waste recycling facility including the annual waste received, and the annual produced amounts of RDF and compost

Specifics on data collection forms 1-3 are presented in Tables 4.2-4.4.

Table 4-2: Data flow details on form 1

Required Data	Quantity of waste collected per district (hay) and/or village (qarya). This also includes the share of the NGOs, independent collectors, and the governmental collection.
Data Source	**Site: Solid waste disposal site (landfill/dump site)**
Frequency	Monthly
Collection Tool	**Form 1 (Landfill forms) + annexes**
Data Collection	- Landfill supervisor - QC by landfill supervisor
Data Review	- QA by Central CAPMAS (Department of Public Utilities) - QA by Governorate's Cleaning department/Cleaning and Beautification Authority (since they frequently request the landfill/dumpsite data)

Table 4-3: Data flow details on form 2

Required Data	Quantity of waste collected per district (hay) and/or villages conglomerate (wehda qaraweya)
Data Source	**Site: vehicle service center-garage (daily registers)**
Frequency	Monthly
Collection Tool	**Form 2 (vehicles service center-garage form)**
Data Collection	- Cleaning director affiliated to the City council/village conglomerate council - QC by City council manager/ village conglomerate council manager[5]
Data Review	- QA by Central CAPMAS (Department of Public Utilities) - QA random monthly spot checks by waste management entities (Cleaning department/Cleaning and Beautification Authority)byverification of registers in garages and stamped proofs obtained from the landfill/dump sites.

Table 4-4: Data flow details on form 3

Required Data	Quantity of waste collected per governorate per month
Data Source	**Solid waste disposal site (landfill) andgarage facility (compilation forms 1-2)**
Frequency	Monthly
Collection Tool	**Form 3-compilation forms 1-2**
Data Collection	QC by central CAPMAS
Data Review	QA by external unit (not affiliated to CAPMAS)

[5]City council / village conglomerate council will be named hereinafter as "local unit" for simplicity

Table 4-5: Proposed form 1 template for landfill site data collection (including annex 1)

Characteristics of ( ) disposal site at( ) governorate

1. Landfill/disposal site name:

2. Governorate information

Governorate	
Month	

3. Data about collected waste

Total amount of waste collected through independent collectors, NGOs and governmental self-collection(tons)	Total amount of waste returning to landfill/disposal site rejected from recycling facilities (tons)

4. Landfill/ disposal site characteristics

Depth of accumulated waste		Covering material?	Waste Compaction?	Waste grading?	Comments
Less than 5 m 	More than 5 m 				

Annex 1: Information on ( )local unit[6]

1. Information on district/local villager unit

Governorate	
City/Village conglomerate	
District/Local villager unit	
Month	

2. Information on waste disposed

Amount of waste disposed (tons)		
Governmental self-collection	**NGOs**	**Independent collectors**

[6] Number of annexes is equivalent to the number of local villager unit/districts served by the landfill/dumpsite

Table 4-6: Proposed form 2 on waste collection data for vehicle service center (garage)

Information on ()local unit

1. Information on district/local villager unit

Governorate	
City/Village conglomerate	
District/Local villager unit	
Month	

2. Information on collected waste

Rated Truck capacity (m^3)	**Number of trucks**	**Total km traveled[7] (km)**	**Distance between main collection point and disposal site (km)**	**Density of waste**		$\boldsymbol{Amount\ of\ waste\ (ton)} = \boldsymbol{Truck\ capacity\ (m^3)} \times \boldsymbol{number\ of\ trucks} \times \boldsymbol{number\ of\ trips} \times \boldsymbol{density\ of\ waste\ (ton/m^3)}$ $\boldsymbol{Number\ of\ trips} = \frac{\boldsymbol{Total\ km\ traveled}}{\boldsymbol{Distance\ between\ collection\ point\ and\ disposal\ site\ (km)}}$
				Regular 0.350 ton/m^3	*Compressed 0.550 ton/m^3*	
6						
15						
20						
30						
				TOTAL		

[7] Assumption: distance comprises round trip to and from main collection point and disposal site only

3. Final destination of the collected waste

Is the waste collected from the local unit directed to an operational landfill/dump site?[8]	Yes	No

If the answer is No, please fill in the following table

Population	Waste generation rate (kg per capita per day)[9]	Total amount of generated waste (ton/month)

[8]Operational landfill/dumpsite refers to a location which records the data of the waste trucks entering

[9]For rural area, use 0.5. For urban area, use 0.7

Table 4-7: Proposed form 3 on waste data collection and generation on governorate level

Information on () governorate

1. Governorate details

Governorate	
Month	

2. Information on generated and disposed solid waste

City/Village conglomerate	Rural/urban	Disposed waste details				Generated waste		
		(1) Amount of waste in landfills through governmental self-collection (ton)	(2) Amount of waste in landfills through independent collectors (ton)	(3) Amount of waste in landfills through NGOs (ton)	(1)+(2)+(3) Total amount of waste disposed in landfills (ton)	Population	Waste generation (kgper capita per day)	Total amount of generated waste (ton)

3. Recycling facilities waste details

Recycling facility name	Amount of waste entering facility (ton)	Amount of RDF generated (ton)	Amount of compost generated (ton)	Amount of waste rejected from facilities and returned to landfill (ton)	Name of landfill accepting rejected waste from recycling facility

4. Amount of solid waste reported through self-governmental collection(based on Form 2)

City/Village conglomerate	Amount of waste (ton)

General and quick QA/QC activities applicable at the data compilation stage at CAPMAS national level

- ✓ Verify that document ID is completed
- ✓ Verify completeness of reported information- all relevant data is inputted
- ✓ Verify accuracy of reported data by monitoring discrepancies based on historical data (usual daily amount entering landfill, number of vehicles and corresponding trips) and comparisons between quantity of collected waste, and estimated generated quantity
- ✓ Verify documentation procedure- adequate storage of forms in folders and electronic files

More detailed QA/Qc activities are discussed in Table 4-10.

4.2 QC Procedures

This section lists routine QC activities and corresponding procedures applicable throughout the preparation of the GHG inventory for all categories of the waste sector. Routine QC activities focus on the processing, handling, and documenting of procedures common to all categories based on Tier 1 and Tier 2 IPCC 2006 GL, in addition to TACCC data quality objectives. Compliance and non-compliance with quality objectives are assessed against a checklist consisting of QC activities. The general and category specific QC activities checklists envisaged for Egypt's waste sector are presented in Tables 4.8 and 4.10, respectively; date, status of completion of the activities, QC personnel, corrective measures, and supporting documents, if any, are also reported. Summary tables for general and category specific QC checks are presented in Tables 4.9 and 4.11, respectively.

Table 4-8: Checklist of general Tier 1 QC activities

QC Activity	Procedures	Date Due	Responsible Entity/Personnel	Task Completed			Corrective Measure Taken		Supporting Documents (List Names)
				Date	Individual (initial, last name)	Errors (Y/N)	Date	Individual (initial, last name)	
Data Gathering, Input, and Handling Checks									
Check that assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters aredocumented.	▪ Cross-check descriptions of activity data, emission factors and other estimation parameters with information on categories and ensure that these are properly recorded and archived.		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Check for transcription errors in data input and reference.	▪ Confirm that bibliographical data references are properly cited in the internal documentation. ▪ Cross-check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors.		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Identify spreadsheet modifications that could provide additional controls or checks on	▪ Utilize electronic data where possible to minimize transcription errors. ▪ Avoid hardwiring factors into formulas. ▪ Use cell protection so		• CAPMAS • Landfill supervisor • Waste sector inventory expert under coordination						

quality	fixed data cannot accidentally be changed. Build in automated checks, such as computational checks for calculations, or range checks for input data.		of the Inventory QA/QC Coordinator						
Check that parameter and emission units are correctly recorded and that appropriate conversion factors are used.	▪ Check that units are properly labeled in calculation sheets. ▪ Check that units are correctly carried through from beginning to end of calculations. ▪ Check that conversion factors are correct.		• CAPMAS • Landfill supervisor • Local unit manager • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Check the integrity of database files.	▪ Confirm that the appropriate data processing steps are correctly represented in the database. ▪ Confirm that data relationships are correctly represented in the database. ▪ Ensure that data fields are properly labeled and have the correct design specifications. ▪ Ensure that adequate documentation of database and model structure and operation		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	are archived.								
Check for consistency in data between categories.	▪ Identify parameters (e.g., activity data, constants) that are common to multiple categories and confirm that there is consistency in the values used for these parameters in the emissions calculations.		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Check that the movement of inventory data among processing steps is correct.	▪ Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. ▪ Check that emissions data are correctly transcribed between different intermediate products (e.g., calculation of MCF, DOCs.)		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Data Documentation									
Review of internal documentation and archiving.	▪ Check that there is detailed internal documentation to support the estimates and enable duplication of calculations. ▪ Check that every primary data element has a reference for the source of the data. ▪ Check that inventory data, supporting data,		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	and inventory records are archived and stored to facilitate detailed review. ▪ Check that the archive is closed and retained in secure place following completion of the inventory ▪ Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.								
Emission Calculation Checks									
Check emissions calculations correctness	▪ Reproduce a representative sample of emissions/removals calculations. ▪ If models are used, apply a simple approximation method that gives similar results to the original and more complex calculation to ensure that there is no data input error or calculation error.		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Check time series consistency	▪ Check for temporal consistency in time series input data for each category. Verify that explanations for values varying by more than 10% across a year are provided. ▪ Check for consistency in the algorithm/method		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	used for calculations throughout the time series. For SWDS, verify that FOD model has replaced mass balance method. ▪ Check methodological and data changes resulting in recalculations. ▪ Check that the effects of mitigation activities have been appropriately reflected in time series calculations.								
Check completeness	▪ Confirm that estimates are reported for all categories and for all years from the appropriate base year over the period of the current inventory. ▪ For subcategories, confirm that the entire category is being covered. ▪ Check if units are properly labeled and correctly carried through from beginning to end of calculation. ▪ Check that conversion factors are correct. ▪ Check that known data gaps that result in incomplete category emissions/removals estimates are documented, including		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	qualitative evaluation of the importance of the estimate in relation to total net emissions (e.g. subcategories classified as 'not estimated').								
Check trend	▪ For each category, compare current inventory estimates to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any difference. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors. ▪ Check value of implied emission factors (aggregate emissions divided by activity data) across time series. Are changes in emissions or removals being captured?Check if there any unusual or unexplained trends noticed for activity data or other parameters across the time series (e.g., waste disposal amounts, composition, population data, DOC)		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	Source: This list has been adapted from IPCC Good Practice Guidance and the 2006 IPCC Guidelines for National GHG Inventories.

Table 4-9: Summary of QC checks and corrective measures

Summary of results of checks and corrective measures taken:	
Suggested checks to be performed in the future:	**Any residual problems after corrective measures have been taken:**

Table 4-10: Checklist for Tier 2 Category Specific QC Activities

QC Activity	Procedures	Date Due	Responsible Entity/Personnel	Task Completed			Corrective Measure Taken		Supporting Documents (List Names)
				Date	Individual (initial, last name)	Errors (Y/N)	Date	Individual (initial, last name)	
Emission Factors and Parameters Quality Checks									
Assess representativeness of IPCC default factors and parameters given national circumstances	▪ Evaluate whether national circumstances (e.g., disposal practice management level, climatic conditions) are similar to those used to develop the IPCC default values for factors and parameters for the following categories: a. SWDS: DOC (weight fraction and dissimilated, which are associated with waste composition), CH_4 generation rate constant (associated with climatic conditions of Egypt), MCF (associated with the type of landfill, e.g., managed, semi-managed etc.) b. Biological treatment by composting or anaerobic digestion: emission factors for CH_4 and N_2O (associated with		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	amounts of waste) c. Incineration and open burning: emission factors for CO_2 (associated with waste composition) and CH_4 and N_2O (associated with incineration technology) ▪ Consider options for obtaining country-specific factors from entities such as statistics department, external agencies, research universities etc. ▪ Report and document results of this assessment.								
Compare country-specific factors to alternative factors (e.g., IPCC default, cross country, literature)	▪ Verify implementation of QC activities pertinent to data used to develop the country-specific factor. ▪ Assess whether secondary studies used to develop country-specific factors were verified against at minimum Tier 1 QC activities (or evaluate referencing and QA/QC activities associated with secondary data. Verify that QC/QA activities cover QC activities at the Tier 1 level.) ▪ Compare country-		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	specific factors to IPCC defaults; document any significant discrepancies. ▪ Compare country-specific factors to site or plant-level factors. ▪ Compare to factors from other countries having comparable national conditions to Egypt's waste sector (using IPCC Emission Factor Database). ▪ Document results of this assessment.								
Search for options for more representative measurements	▪ Consider waste composition measurements determined by waste management entities (e.g., Qalyubia waste management entity and collaboration with Cairo University).		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Activity Data Quality Check									
Review national level activity data	▪ Check applicability of data. ▪ Determine the level of QC performed by the data collection /compiling agency, i.e., CAPMAS. If inadequate, consider alternative data sources such as IPCC defaults and international data sets. Adjust the relevant		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						

	uncertainty accordingly. ▪ Compare activity data from multiple reference sources such as peer reviewed academic journals. a. SWDS: waste disposal amounts, composition, population data b. Bio treatment: DOC, waste disposal amounts, composition c. Incineration-open burning: DOC, waste disposal amounts, composition ▪ If activity data such as quantity of waste is based on measurements on site, verify site equipment records for calibration etc. ▪ The national agency in charge of statistics in this case CAPMAS should construct, if resources permit, national mass balance on the waste generated, collected and disposed annually) ▪ Waste quantities should be compared with those reported in country profile reports such as SWEEP Net to identify inconsistencies.								

	▪ Check methodology for data extrapolation to complete time series when data is not available annually. ▪ Provide observations on the completeness of the data set.								
Activity Data Quality Check: Site-specific Data									
Verify accuracy of data transcribed between forms	▪ Ensure total amount of waste recorded in monthly form 1 equals sum of quantities of waste reported in the annexes of form 1 ▪ Ensure monthly amounts of waste collected from all sources, namely, independent collectors, NGOs, and waste units in form 3 correctly correspond to amounts reported in Form 1 (landfill) ▪ Ensure that the amount of waste residues returned back to each landfill from recycling plants reported in form 3 are equivalent to values reported in Form 1		Landfill supervisor CAPMAS CAPMAS						
Verify accuracy of calculations	▪ Ensure daily calculations are correct(Form 2 (city council)) ▪ Ensure that monthly values reported in form 2		Local unit manager Local unit manager						

	correspond to the summation of the daily values (reported in daily registers at vehicle service centers. Random QA checks on daily register should be carried out) ▪ Ensure that for every district, the summation of waste collected from the different categories is done correctly (Form 3) ▪ Form 3 (CAPMAS): Ensure that the ratio between the waste generated and waste collected is logic for every local unit[10]		CAPMAS CAPMAS						
Compare total amount of waste derived from different sources (landfills and vehicle service centers-garage)	▪ Ensure total waste quantities reported in Form 3 in tables 2 and 4 (derived from form 1 pertaining to disposed in landfills and form 2 collected by vehicles, respectively) do not differ by more than 10%.		CAPMAS						
Perform random checks on data collection sites registers, i.e., landfill site and vehicle service	▪ Perform random monthly checks by ”Waste management entities” to validate amounts of waste calculated and reported in Form 2 by checking: ▪ original registers of		Waste management entities						

[10]By logic, it is meant that the ratio falls within its normal average for this local unit (e.g. if the normal average is 0.65, it is not logic to have it 0.3 in certain month)

center-garage	the "garage" ▪ "stamped proofs" from the landfill for randomly picked vehicles								
Assess site-specific activity data	▪ Verify waste collection data with waste disposal data (cf. CAPMAS reporting tables for solid waste) ▪ Determine if national or international (e.g., ISO) standards were used in estimates ▪ Compare aggregated site-specific data (e.g. amounts of waste collected and disposed) to national statistics/data. ▪ Provide observations on the completeness of the data set. ▪ Check for inconsistencies across similar sites (e.g., compare landfills within a governorate) ▪ Compare top-down and bottom-up estimates for similar orders of magnitude		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Calculations Quality Check									
Emission comparisons	▪ Compare historical data for the source. Check for changes in year-over-year estimates (> 10%). ▪ Checks against		Waste sector inventory expert under coordination of the Inventory						

	independent estimates or estimates based on alternative methods such as Land GEM etc. ▪ Checks against independent estimates or estimates based on alternative methods.		QA/QC Coordinator						
Check spreadsheets	▪ Clearly reference to the data source of any numbers typed into the spreadsheet. ▪ Provide subsequent calculations, in the form of formulas, so that auditing tools can be used to track back from a result to the source data, and calculations can be evaluated by analyzing the formulae. ▪ Document the spreadsheet itself specifying its name, version, authors, updates, intended use and checking procedures so that it can be used as a data source of the derived results and referenced further on in the inventory process.		• CAPMAS • Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator						
Completeness	▪ Have all relevant GHG emissions (i.e. CH_4 and N_2O) been considered? Where elements are missing their absence should be clearly		Waste sector inventory expert under coordination of the Inventory QA/QC						

	documented together with a justification for exclusion.		Coordinator						
Uncertainty Related Quality Check									
QC uncertainty estimates	Apply QC techniques to uncertainty estimates ▪ Review uncertainty calculations and make sure they are well documented. ▪ Document uncertainty assumptions ▪ For uncertainty estimates involving expert judgment, the qualifications of any experts consulted should be documented		Waste sector inventory expert under coordination of the Inventory QA/QC Coordinator	.					

Table 4-11: Summary of category-specific QC activities

Summary of results of checks and corrective measures taken:	
Suggested checks to be performed in the future:	**Any residual problems after corrective measures have been taken:**

4.3 QA Procedures for Waste Sector Inventory Estimations

External review

It is good practice tocarry out a review involving national experts and stakeholders in the different fields related to emissions from the waste sector.The objective of QA implementation is to involve reviewers who can conduct an unbiased review of the inventory and who may have a different technical perspective.This review will identify potential problems and make corrections where possible. The review should contain a review of calculations and assumptions by experts in relevant technical fields and is typically accomplished by reviewing the documentation associated with the GHG inventory. The list of external experts who will be nominated to review the waste sub sector can be presented in a format like the one used in Table 4-12.

Table 4-12: List of external reviewers for waste GHG inventory

Individual (initial, last name)	Institution	Area of Expertise	Timeline for review	Contact Information
		[Waste Details]		
		[Waste Disposal Methods]		
		[Emission Factor]		
		[GHG Emissions]		

After the identification of the external reviewers, setting and agreement on review schedule, it is good practice that the reviews are compiled and reported inan electronic format like the one used in Table 4-13.

Table 4-13: Summary of review findings

Individual Area of Expertise		
Finding #1	Date	Corrective measure proposed
Finding #2	Date	Corrective measure proposed
Finding #3	Date	Corrective measure proposed

After collecting and compiling review comments, the compiled comments should be delivered to the inventory coordinator in order to update the inventory, as appropriate based on comments.

4.4 Verification of Waste Sector Inventory Estimations

Verification activities provide information to improve the GHG inventory and are part of the overall QA/QC process. Comparison between the GHG inventory and independent estimates increases the confidence and reliability of the GHG inventory estimates by confirming the results. Significant differences may indicate weaknesses in either or both of the datasets.

An ideal condition for verification is the use of fully independent data as a basis for comparison. It is good practice to reflect the results of the verification in the QA/QC report and incorporate recommendations for inventory improvement into the QA/QC plan. The table 4.14 provides a data comparison table.

Table 4-14: Data Comparison Table

Data Type	Initial source of information (institution name)	Verification source (institution name)	Summary of Findings	Recommendations
Generated waste Amounts				
Waste Composition				
Waste Disposal Details (e.g., amounts, site/technology details)				
Emission Factor				
GHG Emissions				

After finalising the verification, the comments should be compiled and handed to the inventory coordinator in order to update inventory, as appropriate based on comments.

4.5 Archiving

It is *good practice* to document and archive all information relating to the planning, preparation, and management of inventory activities. Archiving should be done at two levels: Central CAPMAS for raw data and at CCCD under EEAA level for GHG inventory data.
This includes among others:

Method:

- Methods used, including those used to estimate uncertainty and those used for recalculations.
- Rationale for choice of methods.
- Assumptions and criteria for the selection of activity data and emission factors.
- Changes in data inputs or methods from previous inventories (recalculations);

Data:

- Emission factors and other estimation parameters used, including references to IPCC or published papers/ other documentation for other emission factors used in higher tiers.

QA/QC plans:

- Records of QA/QC plan and procedures.
- Final inventory report and any analysis of trends from previous years.

To establish an archiving system at minimum the questions in table 4-15should be answered.

Table 4-15: Questions to define a Basic Archiving System

Question	Archiving System
How are the data stored?	
Where is the data stored?	Create official archive located in: *insert location of master versions of hard copy and electronic files by [insert name of person(s) in charge of master files*
Are they stored electronically or in hardcopy? In both formats?	
How are the files named?	*For example, save files with IPCC category name, inventory year, type of file, file version i.e. date the file was last save (Solid waste 2016 GHG Calculation 18_07_2017.xls)*
How are the names/files changed to reflect updates?	
What is the storage mechanism?	Duplicate copies of the archive files are stored in: *insert location, address, etc. by [insert name of person(s) in charge of copied files].*
How to communicate the archiving system to the GHG inventory team?	
Whois the Archiving Coordinator?	*(S)he is responsible for ensuring that all archiving procedures are performed for the inventory and all supporting documents and spreadsheets are retained appropriately.*

5 REFERENCES

This QA/QC plan bases on the below documentation:

- EMEP/EEA Emission Inventory Guidebook 2009. Inventory management, improvement and QA/QC. Goodwin J. and Pulles T. EMEP/EEA.

- IPCC 2006. Guidelines for National Greenhouse Gas Inventories, Volume 1 General Guidance and Reporting. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). IGES, Japan.

- U.S. Environmental Protection Agency. Developing a National Greenhouse Gas Inventory System. Template Workbook. Template 3: Description of QA/QC Procedures. US EPA.

- U.S. Environmental Protection Agency. Developing a National Greenhouse Gas Inventory System. Template Workbook. Template 4 : Description of Archiving System

Appendix I
QA/QC Coordinator Checklist

Activities	Task Completed	
	Name	Date
• Clarify and communicate QA/QC responsibilities to inventory team members.		
• Distribute QA/QC checklist to appropriate inventory team members, namely, waste sector lead and set deadline for completion.		
• Ensure the timely and accurate completion of QA/QC checklists and related activities by checking in with team members.		
• Collect completed QA/QC checklists and forms.		
• Review completed QA/QC checklists and forms for completeness and accuracy.		
• Deliver documentation of QA/QC activities to the inventory lead and archive coordinator.		
• Coordinate external reviews of the inventory document and ensure that comments are incorporated into the inventory. Steps to coordinating external reviewers include: (1) Identify external reviewers (e.g. through category leads). (2) Set review schedule. (3) Establish review format (e.g., digital mark-up in Word or Excel). (4) Contact external reviewers informing them of the schedule and expectations. (5) Distribute Inventory draft for review. (6) Collect and compile review comments. (7) Deliver compiled comments to inventory and document/archive coordinator (8) Update inventory, as appropriate based on comments.		