NATIONAL GREENHOUSE GAS INVENTORY SYSTEM OF MALAWI

WASTE MANAGEMENT EMISSIONS CALCULATOR

Standard Operating Procedures

GINA ALTHOFF - PERFORM

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ACRONYMS AND ABBREVIATIONS

AD	Activity Data
EF	Emission Factor
GHG-IS	Greenhouse Gas Inventory System
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
EAD	Environmental Affairs Department
NSO	National Statistical Office
DHS	Demographic Health Survey
IHS	Integrated Household Survey
IOB	Incinerated Open Burning
MSW	Municipal Solid Waste
SWD	Solid Waste Disposal
PERFORM	Protecting Ecosystems and Restoring Forests in Malawi
USAID	United States Agency for International Development

1.0   INTRODUCTION

The Government of Malawi with USAID's Protecting Ecosystems and Restoring Forests in Malawi (PERFORM) has developed the Greenhouse Gas Inventory System (GHG-IS) to support Malawi's Low Emissions Development Strategy. The GHG-IS uses a series of Microsoft Excel emissions calculators that combine methods and data from Intergovernmental Panel on Climate Change (IPCC) Guidelines (2006) with Malawi-specific data to produce estimates of emissions from each sector (see box). These emission calculators are accompanied by Standard Operating Procedures (SOPs) which provide comprehensive guidance on using the calculators.

The Waste Management Emissions Calculator produces all necessary estimates for reporting annual emissions from the waste sector in Malawi. This SOP provides comprehensive guidance on the Waste Management Emissions Calculator and serves to: (1) provide overview of steps required to operate the Waste Management Calculator; (2) direct analysts through the collection and entry of activity data; and (3) guide the interpretation and reporting of resulting emission estimates.

Under the GHG-IS, emissions from the waste management sector in Malawi are accounted following the Intergovernmental Panel on Climate Change (IPCC) Tier 1 approach and accounts for emissions resulting from solid waste disposal, incineration and open burning of waste, and wastewater treatment and discharge. The greenhouse gases (GHGs) emitted from these sources include CO_2, CH_4, and N_2O.

The main Government entity responsible for the GHG-IS Waste Management Emissions Calculator is the Environmental Affairs Department (EAD). Personnel responsible for collecting, entering, and analyzing data for the GHG-IS will need to be assigned in accordance with the guidance set forth in the *GHG-IS Master Document* and will need to work with relevant government agencies to collect appropriate data for evaluating emissions from the waste management sector.

Sectors accounted for in Malawi's GHG-IS

Energy: Emissions resulting from production and use of fuels for energy.

Industrial Processes and Product Use: Emissions from producing cement, lime, and ceramics.

Agriculture, Forestry, and other Land Use: Emissions from livestock and agricultural soil management (i.e., fertilizer application), forests remaining forests (degradation from unsustainable fuelwood harvest), and land use change.

Waste: Emissions from wastewater treatment and discharge, incineration and open burning of waste, and solid waste disposal.

2.0 OVERVIEW OF THE WASTE MANAGEMENT EMISSIONS CALCULATOR

The Waste Management Emissions Calculator is currently built to accommodate data entry and estimate emissions from 2010 to 2040. It includes the following tabs (i.e., Excel worksheets):

Table 1 WASTE MANAGEMENT EMISSIONS CALCULATOR TABS

TAB NAME	PURPOSE
Workbook Overview	Provides an overview of the calculator and basic instructions on how to utilize the workbook
Change Log	Lists of all changes made to the calculator, and documents if they have been QA/QC'ed. The change log must be updated every time the calculator is updated or modified.
AD_Tracker	Displays all the AD that needs to be entered in the calculator, per year of inventory. Clicking on the name of the AD shows the tab where the AD must be entered. The staff responsible for updating the calculator with new data must update the table on this tab to indicate whether the AD on a given year was completed, assumed to be 0, partially entered, missing, or entered but still requiring validation and QA/QC - these options appear on a dropdown menu in each cell of the table.
Emissions_All	Total estimated emissions in CO_2e for waste management, based on the AD entered and the EF used. Results are reported by activity, sub-activity, and gas type. The green box on the 'Emissions by gas' section has a drop-down menu to select displaying emissions on the graph as t CO_2e per year or as t of original gas (CO_2, CH_4, and N_2O). The tab includes a 'Button' to copy automatically relevant values into the IPCC reporting tables of the Emissions Aggregator Calculator.
MSW_generation	AD and default factors needed to estimate annual municipal solid waste (MSW) generation. AD: Yearly population in Malawi. It should be updated as new AD becomes available each year.
solid_waste_disposal	Activity data, default factors, formulas, and coefficients for solid waste disposal (SWD). AD: Amount of CH_4 recovered from SWD in Malawi. Assumed to be zero, until this activity is practiced in the country. It should be updated or reviewed each year.
IOB_open_burned	Default factors, formulas, and coefficients for open burned (IOB) solid waste.
IOB_incinerated	Activity data, default factors, formulas, and coefficients for incinerated solid waste.

	AD: Amount of incinerated solid waste in Malawi. Assumed to be zero, until this activity is consistently practiced in the country. It should be updated or reviewed each year.
wastewater_domestic	Activity data, default factors, formulas, and coefficients for incinerated solid waste. AD: Amount of sludge removed and CH_4 recovered in Malawi (assumed to be zero, until this activity is consistently practiced in the country), and urbanization fraction in the country. AD should be updated or reviewed each year.
wastewater_industrial	AD and default factors needed to estimate annual municipal solid waste generation. AD: Yearly industrial production of identified products in Malawi. It should be updated each year as new AD becomes available.
Lists	General coefficients used throughout this calculator.

The tabs and tables are color-coded to indicate their function following this key:

Table 2 COLOR KEY FOR TAB AND TABLE FUNCTIONS

TABLE COLOR	FUNCTION
Orange	Results of total yearly emissions estimates, either by sector or aggregated.
Yellow	Quality Control checks for specific data-entry tasks that are likely to have errors, and Activity Data Tracker.
Green	Activity data.
Blue	Default coefficient factors that contribute to emission factors. Should be periodically reviewed by sectoral experts and updated as new information are developed.
Grey	Products of equations that represent intermediary steps between activity data and final emissions estimates. For review only, should not need update unless the formula has been corrupted. To recover the formula, the calculator manager should visit the reference listed on the table heading (usually an equation from the IPCC Guidelines).

The tables within each tab of the Waste Management Emissions Calculator include a heading that describes:

- The IPCC-defined coefficient name (i.e., activity data, IPCC coefficient, etc.)
- A plain-language definition of the coefficient name
- Units of measurement
- Reference to where the coefficient is referred to in the IPCC 2006 Guidelines
- Frequency of review
- Notes where additional context is needed. Where deviations from IPCC 2006 Guidelines or assumptions have been made (see section 0) these will be noted here.

3.0 GHG ACCOUNTING USING THE WASTE MANAGEMENT EMISSIONS CALCULATOR

Malawi's GHG-IS is designed to allow for clear and consistent accounting for emissions by limiting data entry in the emissions calculators to activity data (AD)[1]. The process for collecting, entering, and reviewing those data are described below.

3.1. ACTIVITY DATA PRODUCTION

Data on waste management and disposal are developed by the <u>National Statistical Office (NSO) and the Economic Planning and Development Office</u>. The specific sectoral focal points to contact for these data are listed in the Annex I of this Sop and in the *GHG-IS Master Document.*

These data are produced <u>every year</u>. In accordance with the timelines and guidance set forth in the established master GHG-IS Calendar, data should be entered into the Energy Emissions Calculator during <u>the second trimester of the year,</u> <u>every year</u>.

AD for estimating emissions from the waste management sector include direct measurements of waste volume and proxy variables used to estimate waste volume in various streams. For the generation of solid waste, direct measurements of the volume of industrial waste generated are more likely to be available whereas the magnitude of municipal solid waste (MSW) requires proxy approaches, estimated based on population and per capita waste generation.

Key activity data needs are outlined in Table 3 below. The full list of activity data needs and activity data sources are detailed in Annex III of this SOP and on the *GHG-IS Master Document.*

Table 3 : KEY ACTIVITY DATA NEEDS AND SUGGESTED SOURCES

ACTIVITY DATA	TYPE	USED FOR CATEGORY	UNITS	TAB
Population (P)	proxy	solid waste, open burned, domestic wastewater	*persons*	MSW_generation
CH_4 recovered at SWDS (R_T)	direct	solid waste	*Gigagrams per year (Gg yr^{-1})*	solid_waste_disposal
Solid waste incinerated (SW_i)	direct	Incinerated waste	*Gigagrams per year (Gg yr^{-1})*	IOB_incinerated
Sludge removed from domestic wastewater (S)	direct	Domestic wastewater	*Kilograms (Kg BOD)*	wastewater_domestic
CH_4 recovered from domestic wastewater treatment (R)	direct	Domestic wastewater	*Kilograms of CH_4 (Kg CH_4)*	wastewater_domestic

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[1] The magnitude of human activity resulting in emissions or removals taking place during a given period of time
https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/definitions

Urbanization fraction	direct	Domestic wastewater	*fraction*	wastewater_domestic
Industrial production (P_i)	proxy	Industrial wastewater	*Tonnes per year (t y⁻¹)*	wastewater_industrial
Sludge removed from domestic wastewater (S_i)	direct	Industrial wastewater	*Kilograms (Kg COD y⁻¹)*	wastewater_industrial
CH₄ recovered from domestic wastewater treatment (R_i)	direct	Industrial wastewater	*Kilograms of CH₄ (Kg CH₄)*	wastewater_industrial

3.1.1. MUNICIPAL SOLID WASTE – SOLID WASTE DISPOSAL AND OPEN BURNING

The amount of MSW produced is the primary AD for the following categories, and is therefore a particularly influential coefficient on the estimate of total emissions:

- 4C1: Incineration (partial – MSW only)
- 4C2: Open Burning
- 4A1: Managed solid waste disposal sites (partial – MSW only)
- 4A1: Unmanaged solid waste disposal sites (partial – MSW only)

The Waste Management Emissions Calculator estimates AD for MSW generation through a proxy approach applying data on the national population and the fraction of population at large thought to utilize various disposal methods. Both population and urbanization fraction coefficients can be readily derived from either national or international statistics. In either case, it is important that a consistent source be used for all years.

3.1.2. SOLID WASTE DISPOSAL

The only AD required for SWD beyond what is already provided in the **MSW generation** tab is an estimate of the amount of CH₄ recovered at solid waste disposal sites (SWDS). If CH₄ recovery practices are undertaken during the reporting period, records should be obtained from site managers on the mass recovered.

3.1.3. IOP OPEN BURNED

There are no additional AD required beyond what is in the **MSW generation** tab. It is assumed that only MSW would realistically be open burned, thus no direct measurements of industrial waste are required.

3.1.4. IOP INCINERATED

AD for this source must be derived wholly from direct records of incineration facilities and disaggregated from the other waste classes. Key waste categories suggested by the IPCC 2006 Guidelines potentially relevant to Malawi are Clinical Waste, Municipal Solid Waste, and Hazardous Waste.

3.1.5. DOMESTIC WASTEWATER

In addition to population, domestic wastewater requires estimates of urbanization fraction, as well as recovery of CH₄ and extraction of organic sludge from water treatment facilities. The urbanization fraction of population influences estimates of the fraction of domestic wastewater diverted to various

treatment systems (municipal, latrine, none, etc.). Sludge and CH_4 recovery ensure that these materials are not double-counted in other sectors.

3.1.6. INDUSTRIAL WASTEWATER

Industrial wastewater accounting presumes that industrial wastewater is treated on site and not comingled with domestic wastewater. Because direct measurement of all industrial effluent is not feasible, a proxy method is employed that estimates discharge on the basis of production. Thus industrial production is the single most important AD for this source. As with domestic wastewater, data on sludge and CH_4 recovery must also be collected where this is practiced. Again, the presumption is that industrial wastewater treatment is occurring on-site, so sludge and CH_4 recovery should be disaggregated by industry.

3.2. ACTIVITY DATA ENTRY

Once EAD personnel have collected the activity data for the reporting period, they must be entered into the following green activity data tabs in the Waste Management Emissions Calculator:

- **MSW_generation**
- **Solid waste disposal**
- **IOB_incinerated**
- **Wastewater_domestic**
- **Wastewater_industrial wastewater**

The following steps offer a further elaboration of activity data entry under the Waste Management Emissions Calculator:

1) Enter the national population into the cell representing the current year in table P on table 'MSW_generation'.

2) On tab 'solid_waste_disposal,' enter data for current year on CH_4 recovery in table RT. Ensure that the units entered are in Gg (or 1000s of tons).

3) On tab 'IOB_incinerated,' enter data for current year on the mass of solid waste disposed per category in the table SWi. Ensure that units entered are in Gg (or 1000's of tons), and that this value represents the wet mass of waste.

4) On tab 'wastewater_domestic':
   a. Enter data on sludge removal in kg BOD into table S for current year,
   b. Enter data on CH_4 recovery from domestic wastewater treatment plants into table R for current year,

   c. Enter data on national urbanization fraction into table U for current year. Percent values must be expressed as fractions (e.g. 45% is entered as 0.45).

5) Update the status of the AD entered on the AD_Tracker tab.

6) On tab 'wastewater_industrial':
   a. Enter data on industrial production in units of tonnes into table Pi for current year,
   b. Enter data on sludge removal, by industry, in kg COD into table Si for current year,
   c. Enter data on CH_4 removal in units of kg CH_4 Ri for current year.

7) On tab 'Change log' enter your name and the date of any updates. Add a note describing what

change was made.

8) For new changes, set the value for the 'QAQC_status' column to 'not assessed'.

9) Save the file as a new file (do not overwrite existing versions) with a name indicating today's date.

The grey and blue tables in the tabs will populate automatically, according to the equations and assumptions indicated in each table heading. Once AD are entered, total emissions are automatically calculated multiplying AD by corresponding emission factors (EFs). The Emissions_All tab compiles the information generated on emissions from Waste Management, by management activity and sub-activity, in tons of CO_2e or original gas produced (CO_2, CH_4, or N_2O) for each year. This tab also generates a series of graphs to visually describe the information offered in the Emissions_All tables.

When the calculator has been updated and/or the AD has been entered, rename the file to be saved file with today's date. **Do not overwrite existing versions**. For example, "Waste Management Emissions Calculator – July_17_2018".

3.3. QA/QC & APPROVAL OF EMISSIONS ESTIAMTES

It is imperative that quality assurance/quality control measures are undertaken to ensure data are correctly entered. The following steps must be followed by the individual responsible for QA/QC every time AD are entered into the Waste Management Emissions Calculator.

1. Whenever a change or a series of changes are made to the emissions calculator, review the new version of the workbook by reading entries in the **Change Log** tab.

2. New data entered should be reviewed considering the following:
   - Ensure data appear correct and plausible. If there is a large discrepancy in values since the previous reporting period, make sure the reason for this difference has been identified and documented in the **Change Log** notes.
   - Confirm the QA/QC tables (yellow) produce an 'OK' output for each year. If it does not show 'OK', trace the error in the corresponding coefficient (blue) table and correct it.
   - Several AD are assumed to be zero given it is not applicable to the Malawi context (i.e., CH_4 recovery from solid waste disposal, amount of solid waste incinerated, and amount of sludge and CH_4 recovered from domestic wastewater). Confirm that this is still the case for the year under review.
   - Ensure the following coefficients have been appropriately converted from original units as reported on source documentation into units specified, also summarized in Table 4 below:

Table 4 ACTIVITY DATA COEFFICIENTS AND REQUIRED UNITS

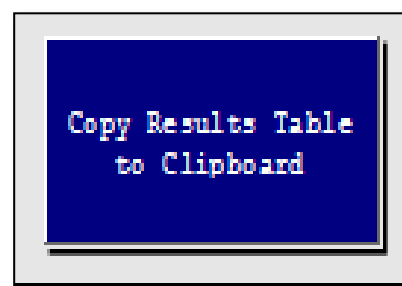| ACTIVITY DATA COEFFICIENT	REQUIRED UNITS
R_T	Gg
SW_i	Gg (wet basis)
S	kg BOD
R	kg CH_4
U	decimal fraction
P_i	t

S_i	kg COD
R_i	kg CH_4

- For all activity data coefficients, the original source documentation includes the same reporting entities as previous year. For example, if a previous year included industrial production (Pi) for 'fish processing,' this year should also include activity data for that sector unless it is verified and noted that this sector did not engage in that activity this year.

3. On the emissions reporting tab (orange), confirm that all emissions estimates for the current year are within a reasonable range (± 20%) from previous year. If a change over this threshold is observed, the reason must have been identified and documented in the **Change Log** by the person responsible of entering the data. Note in the **Change Log** tab any comments related to changes that have been QA/QC'd. If any errors were resolved, note the change and set the status to 'OK'd'.

4. If any errors could not be resolved immediately, change the status to 'needs resolution' while a solution is determined. Seek out the expertise of teammates to resolve unexplained errors. Once resolved, update the change log again for this entry and change status to 'OK'd'.

5. Update the status of the AD entered on the **AD_Tracker** tab.

3.4. REPORTING EMISSIONS FROM WASTE MANAGEMENT

Once reviewed, appropriate EAD personnel should enter the emissions estimated using the Waste Management Emissions Calculator into the **Emissions Aggregator Calculator**, which compiles all sectoral emissions for UNFCCC reporting purposes. The total emissions calculated will also need to be included in Malawi's GHG Inventory Annual Report, both as total tons of CO_2e and per GHG (i.e., CO_2, CH_4, and N_2O), if applicable.

To facilitate the entry of the sectoral emission results into the IPCC reporting tables, the Waste Management Emissions Calculator includes a 'Button' that automatically selects and copies the results that are needed as inputs in the sectoral reporting table of the **Emissions Aggregator Calculator**. As instructed in the Emissions Aggregator Calculator and its SOPs, the calculator manager would only need to paste these values in the indicated cells of the Emissions Aggregator Calculator; the Emissions Aggregator Calculator will automatically create graphs and tables for reporting purposes once values from the Waste Management Emissions Calculator are pasted in the Emissions Aggregator Calculator.

Copy Results Table to Clipboard

This button is located in the Emissions_All tab of the Waste Management Emissions Calculator, next to the summary graph of the Emissions by Gas section.

3.5. ASSUMPTIONS MADE IN ACTIVITY DATA, COEFFICIENTS, AND EMISSIONS FACTORS

While the IPCC 2006 Guidelines were followed when choosing equations and default factors, it was necessary to make some additional assumptions for Malawi due to data gaps or expert opinion. To ensure transparency and consistency, these assumptions are listed in the 'Notes' cell of the relevant coefficients and are further elaborated in Table 5 below.

Table 5 ASSUMPTIONS MADE IN WASTE MANGEMENT EMISSIONS CALCULATOR

COEFFICIENT	ASSUMPTION
Fraction of population using each waste treatment method (WF$_{treatment}$)	From Malawi's DHS HIS (Demographic Health Survey Integrated Household Survey) Report 4, table 7.9, assumptions made: Rubbish bin + Public rubbish heap = 'managed' waste; rubbish pit + other = 'unmanaged' waste, none = 'not disposed' waste.
Per capita municipal solid waste generation (MSW$_p$)	Value taken from 'Africa' from IPCC table 2.1 (i.e. 0.29 t person y^{-1}), converted to kg^{-1}person day^{-1} by factor the 1000/365.
Mass fraction of municipal solid waste by component, in wet weight (WF$_j$)	Defaults adopted from 'Eastern Africa' from IPCC table 2.3. 'Unknown' category added from IPCC categories to ensure all rows added to 100%.
Decomposable DOC remaining in SWDS at the end of 2009 (DDOC$_{MAT-2009}$)	Mass of DDOCmat in SWDS as of 2009 based on IPCC 'waste model' tool, and world bank population data. Managed/unmanaged disaggregated by %19 managed, 81% unmanaged, following ratios used in solid waste generation (WF$_{treatment}$) as of 2018. The year 2009 is selected because the Waste Management Calculator annual GHG estimates start in year 2010.
Degradable organic carbon by waste component (DOC$_i$)	Wet basis was chosen based on guidance in equation 3.7.
Fraction of degradable organic carbon that decomposes (DOC$_f$)	Recommended default is 0.5, under the assumption that the SWDS environment is anaerobic and the DOC values include lignin.
Methane correction factor (MCF)	For managed and unmanaged, the means of each of 2 options per site type are used here
Methane oxidation factor (OX$_T$)	Assumed to be 0 unless Malawi adopts practice of applying CH4 oxidizing material to SWDS
Methane generation rate (K)	Taken from 'bulk waste, Tropical-Dry' entry in table 3.3.
Fossil carbon fraction of waste carbon (FCF$_j$)	Defaults adopted from 'Eastern Africa' from IPCC table 2.4.
Dry matter content of wet waste (dm$_i$)	Figures calculated from water content in IPCC table 2.6 (mean of range).
Carbon fraction of waste (CF$_i$)	Figures back-calculated form IPCC table 2.6 to express in terms of fraction of dry-mass (rather than fraction of wet waste mass).
CH4 emission factor for incinerated waste, in wet basis (EF-CH4)	MSW assume batch type.
N2O emission factor for incinerated waste, in wet basis (EF-N2O)	No value for clinical waste, adapted from MSW (batch type); hazardous waste assumed to be industrial waste.

Fraction of utilization of treatment/discharge pathway for each income group (T)	Values for 'Kenya' used, from IPCC table 6.5.
Annual per capita BOD production (BOD)	Assumed IPCC table 6.4 default value for 'Africa'
Methane conversion factor (MCF)	IPCC values from table 6.3: latrine = mean of dry climate 'small family' and 'communal' latrine values; none = 0 (not accounted as an emission); other = not defined and set as 0; septic tank = 'septic system'; sewer = 'centralized aerobic plant, not well maintained'.
Maximum methane production capacity (B_o)	IPCC default is 0.6 for all BOD-denominated measurements (BOD, biological oxygen demand).
Correction factor for additional industrial BOD (I)	One (1) is the default for uncollected discharge.
Chemical oxygen demand (COD)	Industrial degradable organic component in wastewater.
Methane correction factor (MCF)	All assigned on basis of mean of 'aerobic treatment plant' (0.3) and 'untreated' (0.1) equaling 0.2. Better values should be assessed by a specialist on this matter.
Maximum methane production capacity (BO_i)	IPCC default is 0.25 for all COD-denominated measurements.

4.0 UPDATING DEFAULTS AND EMISSION FACTORS

It is not expected that the GHG-IS operators will be responsible for refining or updating default values or emission factors. However, developments in the availability of information and new research may justify updating coefficients to allow emissions estimates to better reflect national circumstances. The process through which equations or default factors are be updated may involve a combination of expert review, literate review, original research, and comparison to neighboring countries. Guidelines for updating these factors are not provided here. However, in the event that any factors require updating, the following steps should be followed:

1. Decide if the update should apply to all or only some years. Applying to all years (including past) may necessitate the recalculation of emissions from past years. For example, the availability of new research that offers a more accurate way to account for emissions may necessitate recalculating emissions from past years, whereas changes related to new economic developments in Malawi should only be applied to years that these developments are believed to significant (including future years if appropriate).

2. Directly change the values in the corresponding emission factor table for the appropriate years.

3. For additions or removal of strata (i.e., components of municipal solid waste):
    a. Changes to a single table must be made to all tables that reflect that stratification.
    b. An appropriate value for each coefficient relevant to that strata must be developed or adopted.
    c. Add a row by inserting a new row across the entire workbook intersecting with the table.
    d. Ensure all formulas are copied into new row for that table.
    e. Check intermediary tables (grey) and final results (orange) to ensure that change causes an anticipated result.

4. Document any changes in the **Change Log** tab.

5. Update the status of the AD entered on the **AD_Tracker** tabs.

6. Deliver any documentation, studies, references etc. that support why the particular change was made to EAD, including a summary of the rationale for the change.

5.0 EXTERNAL REOSURCES

2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5. Waste, available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html.

 National Greenhouse Gas Inventory System of Malawi. Master Document. October 2018.

ANNEX I. SECTORAL FOCAL POINTS

The sectoral focal points as presented below reflect institutional arrangements implemented for the 2017 Annual Greenhouse Gas Inventory. Future cycles may necessitate adjustments to the table to accurately reflect personnel changes.

Sector	GHG-IS Calculator name	Primary EAD Focal Point	Secondary EAD Focal Point	Sectoral focal point Institution	Primary Sectoral Focal Point	Secondary Sectoral Focal Point
Waste	Waste Management Calculator	Boniface Chimwaza	Cathy Musa	National Statistical Office; Economic Planning and Development Office	Masauto Wachepa	Hanna Chabwera

ANNEX II. SAMPLE DATA REQUEST LETTER

[EAD letterhead]

[name of primary sectoral FP]
[position]
[name of secondary sectoral FP]
[position]
National Statistical Office and Economic Planning and Development Office
[address]

[date]

Dear [name of primary sectoral FP] and [name of secondary sectoral FP],

Through this letter, Environmental Affairs Department formally requests that you share sectoral data necessary to estimate annual greenhouse gas emissions from the livestock sector. As you know, Malawi has now formalized its annual greenhouse gas accounting and reporting, managed by the Environmental Affairs Department, and we reach out to all sectors every year seeking their collaboration to complete the annual multisectoral greenhouse gas emission estimates.

We request that you kindly share with us the annual national population count, as well as the urban population and the population living in slums for [year]. We also request that you provide the amount of fish catches, available in the recently released Annual Economic Report, and amount of organic chemicals, alcohol refining, plastic and resins, soap and detergents, and starch production.

Please share this data in an excel format.

Do not hesitate to reach out to us if this request raises any questions or concerns. We appreciate your collaboration and thank you in advance for your prompt reply to this request.

Regards,

[signature]

[name]
[position]
Environmental Affairs Department

ANNEX III. ACTIVITY DATA NEEDS & SOURCES USED IN 2010-2017

Activity Data (AD) needed	GHG-IS Calculator Name	AD subcategories	Required AD input units	AD relevant in Malawi (2010 - 2017)	Source (2010-2017)
Population	Waste Management Calculator	population	number of people, national level	yes	Data shared by NSO directly via Excel file; also available from World Bank if needed[2]
CH4 recovered from solid waste disposal systems	Waste Management Calculator	managed and unmanaged solid waste disposal systems	Gigagrams (Gg) of CH4	no, assumed to be zero until activity is practiced in Malawi	not available
Solid waste incinerated (reported as wet weight)	Waste Management Calculator	clinical waste, municipal solid waste, hazardous waste	Gigagrams (Gg) of incinerated solid waste, wet basis	no, assumed to be zero until activity is practiced in Malawi	not available
Organic component of domestic wastewater removed as sludge	Waste Management Calculator	amount BOD	kg BOD	no, assumed to be zero until activity is practiced in Malawi	not available
CH4 recovered from domestic wastewater systems	Waste Management Calculator	amount CH_4 recovered	kg CH_4	no, assumed to be zero until activity is practiced in Malawi	not available
Urbanization fraction	Waste Management Calculator	rural, urban low income, urban high income	fraction of the total population	all	Data shared by Department of Trade National Statistics Office (NSO) directly via Excel file; also available from World Bank if needed[3]

[2] https://data.worldbank.org/

[3] https://data.worldbank.org/

Industrial production	Waste Management Calculator	amount of alcohol refining, beer and malt, coffee, dairy products, fish processing, meat and poultry, organic chemicals, petroleum refineries, plastic and resins, pulp and paper, soap and detergents, starch production, sugar refining, vegetable oils, fruits and vegetables and juices, wine and vinegar	tons (metric) of amount produced per industry	all except pulp and paper, vegetables and fruits and juices, and wine and vinegar.	- Petroleum refineries AD calculated from Energy Calculator (row 35 tab "Fossil Fuel Produced & Imports"), transformed to tons. - Annual economic report data: fish processing ('fish catches'). - NSO report data: Organic chemicals ('dissolved acetylene' and 'other' AD), alcohol refining, plastic and resins, soap and detergents, and starch production. - FAO stats data[4]: beer and malt ('beer of barley'), coffee ('green coffee'), dairy products ('milk production'), meat and poultry, sugar refining ('sugar cane'), vegetable oils, and vegetables and fruits. - Industries in red indicate no data being collected in Malawi."
Organic component of industrial wastewater removed as sludge	Waste Management Calculator	amount COD from alcohol refining, beer and malt, coffee, dairy products, fish processing, meat and poultry, organic chemicals, petroleum refineries, plastic and resins, pulp and paper, soap and detergents, starch production, sugar refining, vegetable oils, fruits and vegetables and juices, wine and vinegar	kg COD	no, assumed to be zero until activity is practiced in Malawi	not available
CH4 recovered from industrial wastewater systems	Waste Management Calculator	CH_4 recovered from alcohol refining, beer and malt, coffee, dairy products, fish processing, meat and poultry, organic chemicals, petroleum refineries, plastic and resins, pulp and paper, soap and detergents, starch production, sugar refining, vegetable oils, fruits and vegetables and juices, wine and vinegar	kg CH_4	no, assumed to be zero until activity is practiced in Malawi	not available

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[4] http://www.fao.org/faostat/en/#data