Pilot testing report

Report to Environment Protection Agency, Liberia

Consultancy to Develop Liberia's National GHGI and MRV System

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Glossary

BUR	Biennial Update Report
CCCD	Cross-Cutting Capacity Development Project
CI	Conservation International
DOM	Dead organic matter
EKMS	Environmental Knowledge Management System
EPA	Environmental Protection Agency
FAO	Food and Agriculture organisation
FOD	First-order decay
FOLU	Forestry and other land use
GHG	Greenhouse gas
GIS	Geographic information system
HWP	Harvested wood products
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
LEC	Liberia Electricity Company
MCC	Monrovia City Corporation
MCF	Methane conversion factor
MoA	Ministry of Agriculture
MME	Ministry of Mines and Energy
MoT	Ministry of Transport
MPG	Modalities, Procedures and Guidelines
MRV	Monitoring, Reporting and Verification
NC	National Communication
NDC	Nationally Determined Contribution
NFI	National forestry inventory
QA/QC	Quality Assurance and Quality Control
SDG	Sustainable Development Goal
SOC	Soil organic carbon
UNFCCC	United Nations Framework Convention on Climate Change
UoL	University of Liberia

1 Introduction

This document has been prepared for individuals involved in Liberia's greenhouse gas (GHG) inventory and climate action monitoring, reporting and verification (MRV) system. It was prepared during the 2020 'Consultancy to Develop Liberia's National GHGI and MRV System' project funded by Conservation International.

1.1 Purpose of the pilot testing phase and report

The pilot testing phase of the project follows on from the baseline review phase. During the baseline review, information in Liberia's first Biennial Update Report (BUR1) and second National Communication (NC2) was reviewed. Recommendations were made for improving GHG emissions estimates for each GHG inventory sector, focusing on transparency, accuracy, consistency, completeness and comparability. Recommendations were also made for improving the monitoring, reporting and verification (MRV) systems in place in Liberia for the GHG inventory and climate action.

The aims of the pilot testing phase of the project are to:

- Identify individuals in the EPA, Liberian government ministries, University of Liberia or elsewhere to be involved in the project for each GHG inventory sector and for MRV systems
- Assess which of the recommendations from the baseline review can be addressed during this project, and which should be addressed in future projects
- Explore the methodological approaches, potential data suppliers, sources of expert knowledge and datasets required implement the recommended improvements, identifying key challenges and lessons learned
- Assess the time and resources needed for inventory compilation, and key training requirements.

This report summarises the progress made against these aims, for each GHG inventory sector and the MRV system. The training requirements identified as part of the pilot testing phase are described in the separate "Liberia GHG Inventory Training Plan" report, so are not described in detail in this report.

1.2 Activities undertaken

During the pilot testing phase, several activities were undertaken to engage with stakeholders in Liberia and assess recommendations for each GHG inventory sector and the MRV system. These included:

- Introductory 1-hour teleconference discussions with groups of key individuals in Liberia, who were involved with preparation of the BUR1 or NC2 and other key stakeholders. These were arranged separately for each GHG inventory sector during the week commencing 29th June 2020.
- 1-hour breakout sessions for each GHG inventory sector and MRV systems, held during the initial stakeholder workshop on 7th July 2020. These breakout sessions involved a wider group of stakeholders than in the introductory teleconferences, so allowed further analysis on the relevant activities that should be included in the GHG inventory and an initial exploration of potential data sources.
- All workshop participants were asked to complete an initial questionnaire, indicating which sector is of interest to them, their intended level of involvement, and knowledge and experience of GHG inventory compilation.

- Subsequently, sector leads from Aether have organised other forms of remote engagement, arranging further sector-specific teleconferences with key individuals and providing data collection templates for them to complete.

The rest of this report summarises progress and lessons learned for each individual GHG inventory sector and the MRV system.

2 Energy sector

2.1 Findings from the baseline study

A review of the latest greenhouse gas inventories that had been complied for the energy sector for the NC2 and BUR1 was undertaken and presented in the Baseline Report. Unfortunately, only draft reports were provided, and no accompanying data calculations files were made available. It was therefore recommended that further details were shared to enable further improvements to be undertaken. It was also recommended that further information was added to the United Nations Framework Convention on Climate Change (UNFCCC) reports to improve transparency. In particular, the following main sub-sector comments were made:

- Currently it appears that only emissions arising from the Liberia Electricity Corporation (LEC)'s diesel powered generators are included in the inventory. There is however a large share of electricity produced by Independent Power Producers. Emissions from this source are therefore currently missing from the NC2 and BUR1
- No emission estimates are currently made for solid fuel manufacture (i.e. charcoal manufacture, which is potentially a large source)
- The transport sectors that are included vary between the NC2 and the BUR1
- The other sources of fuel combustion (i.e. that consumed in the residential, commercial / institutional, agriculture / forestry / fishing sectors) vary between the NC2 and BUR1.

2.2 Lessons learned from the pilot testing phase

Liberia's first National Communication estimated that the energy sector was responsible for the largest amount of GHG emissions in the country and that it accounted for approximately 67.5% of the national total. Therefore, training on the energy sector will be a key priority.

The first stakeholder workshop took place during the pilot testing phase and provided a valuable opportunity to meet with national experts that will dedicate their time to the energy sector during the project. These individuals are discussed in more detail in the section below.

The pilot testing phase has identified that the availability of data will be a key limiting factor for estimating accurate GHG emissions for the energy sector. The International Energy Agency are in the process of working with Liberia to develop an energy balance, but it is unknown when this will be available. Some international datasets are available for Liberia, but the reliability of them is unknown. However, in the absence of other data being available they could be utilised. There are projects that have recently been completed which will improve the availability of national-level data for some sub-sectors and obtaining access to these will be the focus of the training sessions.

2.3 Planned approach and data sources by sector

The approach to the compilation of the energy sector is provided in the table below. This is an updated version of the baseline study summary considering the discussions and investigations that have been conducted during the pilot testing study. Specific data collection contact points have not yet been identified and collection of data is the most challenging part of the energy sector inventory.

The estimates will be calculated using a Tier 1 methodology, which means that default emission factors from the 2006 IPCC guidelines[1] will be applied to national energy consumption data on a sub-

[1] 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/

sector basis. The focus of the work will, therefore, be on data collection to support the development of a complete inventory in line with the best practice outlined in the IPCC Guidelines. Where activity data is not available, then estimates will be made using surrogate statistics (for example by using average consumption figures from neighbouring countries where data is available). The one exception to using a Tier 1 approach may be for the road transport sector, for which information on the fleet profile has now been made available.

Table 1. Summary of planned approach by sub-sector for the energy sector

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
1A1a	Yes	Tier 1	The amount of fuel combusted per year by all electricity producers (i.e. LEC, Independent Power Producers and Private producers such as hotels, communities)	To be discussed in the training sessions	To collect or estimate fuel consumption data by type
1A1b	No – there is no petroleum refining in Liberia	Not applicable	Not applicable	Not applicable	Not applicable
1A1c	Yes	Tier 1	The amount of fuel combusted per year by all charcoal manufacturers	National Charcoal Union of Liberia?	It is recommended that the National Charcoal Union of Liberia is contacted to ascertain whether they could provide any data on annual fuel consumption by the charcoal manufacturers. If not, the amount of fuel consumed by the charcoal manufacturers could be estimated from the amount of charcoal estimated to be consumed in the country
1A2	Yes	Tier 1	The amount and type of fuel combusted per year by industries in Liberia. If this information is not available, then it may be possible to use international datasets	To be discussed	To discuss with colleagues at the Ministry of Mines and Energy. It is worth noting that the NC2 appears to have used activity data for these sectors so it would be useful to understand where this was obtained from
1A3a	Yes	Tier 1	The amount of fuel combusted annually by the domestic and international aviation sector	Airports in Liberia	To contact the airports to ask them for data on the amount and type of fuel supplied annually
1A3b	Yes	Tier 1 / 2	The amount and type of fuel combusted annually by the road transport sector in Liberia	The Ministry of Transport	To discuss with colleagues at the Ministry of Transport whether they have this information available
1A3c	Yes	Tier 1	The amount and type of fuel combusted annually by the rail sector	The Ministry of Transport	To discuss with colleagues at the Ministry of Transport whether they have this information available

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
1A3d	Yes	Tier 1	The amount and type of fuel combusted annually by the domestic and international shipping sector	The Ministry of Transport	To discuss with colleagues at the Ministry of Transport whether they have this information available
1A4	Yes	Tier 1	The amount and type of fuel combusted annually in the residential, commercial / institutional, agriculture/forestry/fishing sectors	The Ministry of Mines and Energy	To discuss with colleagues at the Ministry of Mines and Energy whether they have this information available. It is worth noting that the NC2 appears to have used activity data for all of the sectors so it would be useful to understand where this was obtained from.

2.4 Individual involvement and training needs

The training will be delivered by Melanie Hobson from Aether who will be the lead trainer for the energy sector. She will be supported by James McClain from the University of Liberia.

The energy sector training sessions will be delivered to individuals approved by the EPA who have provided a response to the initial questionnaire. This questionnaire ensures that the project team has contact details and confirmation of the level of involvement from individuals. Currently, this includes seven individuals (including James McClain) as summarised in the table below.

Table 2. Summary of individual involvement for energy industries

Name	Involvement level	Affiliation	Specific role / tasks assigned
James McClain	Compiler	UoL	Support across all sectors
Prince C Wilson	Unknown	MME	To be discussed
Victoria Weedor	Unknown	MME	To be discussed
James Collie	Compiler	MoT	Transport sector
Marvin Goah	Compiler	MoT	Transport sector
Precious Sampson*	Unknown	UoL	To be discussed
Lovetee N. Fayiah	Compiler	MME	To be discussed

*Questionnaire still to be returned

2.4.1 Summary of specific training needs

The level of GHG inventory experience is not currently known for all participants and this will be identified in the first training session undertaken in August. However, it is thought that in most cases, the trainees are new to GHG inventories. There is a good split between people attending from different organisations, which should help with the data collection aspects.

2.5 Recommendations for future improvements

Data collection will be the main challenge of ensuring a complete inventory can be compiled. Where it is not possible to collect relevant data, future work should focus on identifying and implementing the most efficient way for the necessary data to be collected and shared with future inventory compilation teams.

3 Industrial processes and product use (IPCC code: 2A – 2H)

3.1 Findings from the baseline study

Emissions from the Industrial processes and product use (IPPU) sector were not estimated in the NC1, so the draft BUR1 and NC2 are the first national IPPU inventories for Liberia. These are currently in draft form and are still being developed by the respective teams. The baseline study shows that the two teams are estimating emissions from different categories, which should not be the case, and are potentially allocating emissions to the IPPU sector in a manner that is inconsistent with the IPCC Guidelines.

The baseline study was conducted by assessing the draft NC2 and BUR1 reports. The underlying compilation spreadsheets and IPCC Software outputs were not made available to the project team. This reduced the scope and depth of the baseline study. The baseline study highlighted that there is likely to be considerable difficulty obtaining the relevant activity data and information for the national GHG inventory. Collecting activity data and understanding where there may be gaps will be a priority for the project.

3.2 Lessons learned from the pilot testing phase

The IPPU sector is currently a minor part of the national GHG inventory. However, Liberia intends to industrialise over the coming years. To support the sustainable development of the industrial sector, it is important to ensure that national experts have a good understanding of the sources of GHG emissions. This will support well-informed assessments of policy options. Because of this status of the IPPU sector in Liberia, it was identified during the pilot testing phase that the group of experts trained under the IPPU sector would likely be smaller than other more significant sectors.

The first stakeholder workshop took place during the pilot testing phase and provided a valuable opportunity to meet with national experts that will dedicate their time to the IPPU sector during the project. These individuals are discussed in more detail in the section below.

Throughout the pilot testing phase, it was clear that the availability of data would be a key limiting factor for GHG inventory compilation. It was also clear that international datasets would be difficult to obtain because Liberia does not yet have the institutional arrangements in place to provide such data to international organisations. There are initiatives and projects currently underway to improve the availability and publication of national-level data. These will not be completed in time to feed into this project.

It was not possible to obtain the national IPPU GHG inventory compilation files or underlying data from the NC2 or BUR1 teams. Hopefully, these will be made available during the next phase of the project to support the training sessions and compilation activities. Making these files available during this project will also help to ensure that the training is bespoke to the Liberia GHG inventory.

3.3 Planned approach and data sources by sector

The approach to the compilation of the IPPU sector is provided in the table below. This is an updated version of the baseline study summary considering the discussions and investigations that have been conducted during the pilot testing study. Specific data collection contact points have not yet been identified and collection of data is the most challenging part of the IPPU sector inventory.

The estimates will be calculated using a Tier 1 methodology, which means that default emission factors and assumptions will be applied to national production/import/consumption data. The focus of the work will, therefore, be on data collection to support the development of a complete

inventory in line with the best practice outlined in the IPCC Guidelines. From the activities conducted during the pilot testing study, it is not envisaged that a more complex and country-specific Tier 2 method will be used for any IPPU categories. However, the compilation team will endeavour to collect relevant data where possible.

Table 3. Summary of planned approach by sub-sector for IPPU

Sector – IPCC code	Occurs in Liberia	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
2.A.2: Lime production	Yes	Tier 1	National production of lime	To be discussed	Identify contacts and request data
2.A.3: Glass Production	Yes	Tier 1	National production of glass, cullet ratio	To be discussed	Identify contacts and request data
2.A.4.a: Ceramics	Yes	Tier 1	Mass of carbonate consumed	To be discussed	Identify contacts and request data
2.B.8.a: Methanol	Yes	Tier 1	National production of petrochemical	To be discussed	Identify contacts and request data
2.B.8.b: Ethylene	Yes	Tier 1	National production of petrochemical	To be discussed	Identify contacts and request data
2.B.8.c: Ethylene Dichloride and Vinyl Chloride Monomer	Unsure	Tier 1	National production of petrochemical	To be discussed	Identify contacts and request data
2.B.8.d: Ethylene Oxide	Unsure	Tier 1	National production of petrochemical	To be discussed	Identify contacts and request data
2.C.1: Iron and Steel Production	Yes	Tier 1 (steel rods)	National production of steel, share of steel produced in different types of steelmaking processes	To be discussed	Identify contacts and request data
2.D.1: Lubricant Use	Yes	Tier 1	National lubricant consumption	To be discussed	Identify contacts and request data
2.D.2: Paraffin Wax Use	Yes	Tier 1	National wax consumption	To be discussed	Identify contacts and request data
2.D.3: Solvent Use	Yes	Tier 1	National consumption of solvents, population	To be discussed	Identify contacts and request data

Sector – IPCC code	Occurs in Liberia	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
2.D.4: Other (please specify)	Yes	Tier 1,	National use of asphalt for road paving	To be discussed	Identify contacts and request data
2.F.1: Refrigeration and Air Conditioning	Yes	Tier 1, 2006 GL worksheet	National import data of fluorinated gases, national import statistics of refrigeration and AC units, first year each refrigerant was used	To be discussed	Identify contacts and request data
2.F.2: Foam blowing	Yes	Tier 1, 2006 GL worksheet	National import data of fluorinated gases, national import data of foams with F-Gases, first year each refrigerant was used	To be discussed	Identify contacts and request data
2.F.3: Fire Protection	Yes	Tier 1, 2006 GL worksheet	National import data of fluorinated gases, first year each refrigerant was used	To be discussed	Identify contacts and request data
2.F.4.a: Metered Dose Inhalers	Yes	Tier 1	National import data of MDIs, share of MDIs using different propellants	To be discussed	Identify contacts and request data
2.F.4.b: Other	Yes	Tier 1	National import data of other aerosols, share of aerosols using different propellants	To be discussed	Identify contacts and request data
2.F.5: Solvents	Yes	Tier 1	National import data of fluorinated gases	To be discussed	Identify contacts and request data
2.G.1.b: Use of Electrical Equipment	Yes	Tier 1	National SF6 consumption data in electrical equipment	To be discussed	Identify contacts and request data
2.G.3.a: Medical Applications	Yes	Tier 1	National N2O consumption/import data for anaesthesia	To be discussed	Identify contacts and request data
2.G.3.b: Propellant for pressure and aerosol products	Yes	Tier 1	National N2O consumption/import data for use in food industry such as whipped cream	To be discussed	Identify contacts and request data
2.H.1: Pulp and Paper Industry	Unsure	Tier 1	National production of air-dried pulp	To be discussed	Identify contacts and request data
2.H.2: Food and Beverages Industry	Yes	Tier 1	National production of product such as bread, wine, beer, spirits, sugar, animal feed, coffee roasting	To be discussed	Identify contacts and request data

3.4 Individual involvement and training needs

The training will be delivered by Emma Salisbury from Aether who will be the lead trainer for the IPPU sector. She will be supported by Farkollie P. Sumo from the University of Liberia.

The IPPU sector training sessions will be delivered to individuals approved by the EPA who have provided a response to the initial questionnaire. This questionnaire ensures that the project team has contact details and confirmation of the level of involvement from individuals. Currently, this includes two individuals as summarised in the table below.

Mark E. Tambah is an experienced GHG inventory compiler and is working on the BUR1 for Liberia. He has successfully completed GHG inventory training courses and understands the fundamentals and some of the specific technical requirements for GHG inventory compilation. Daniel D. Gmah has not had practical experience in compiling a national GHG inventory but has undertaken GHG inventory training courses.

Both Mark E. Tambah and Daniel D. Gmah have confirmed that they will be IPPU GHG inventory compilers under this project, which means they will carry out the practical steps to estimate emissions from all IPPU categories relevant to Liberia.

Table 4. Summary of individual involvement for IPPU

Name	Involvement level	Job title / affiliation	Specific role / tasks assigned	Specific training needs
Mark E. Tambah	GHG inventory compiler	GHG coordinator, CBIT	GHG inventory compiler working closely with Daniel to ensure knowledge transfer	Technical inventory compilation requirements under the IPPU sector; possible training for categories that will be present in Liberia in the future
Daniel D. Gmah	GHG inventory compiler	Data Clerk, Ministry of Health	GHG inventory compiler working closely with Mark to ensure knowledge transfer	Basic GHG inventory training and cross-cutting issues; basic and more advanced IPPU sector training

3.4.1 Summary of specific training needs

The IPPU sector is a minor part of the national GHG inventory because Liberia does not yet have an extensive industrial sector. The two individuals being trained under this sector currently have different levels of expertise regarding the compilation of GHG inventories. This provides an opportunity for the project to support constructive knowledge transfer between national experts, which is the approach envisaged for all sectors in the coming years. The project trainers will focus on ensuring that the junior expert (Daniel D. Gmah) has opportunities to learn directly from the senior expert (Mark E. Tambah) with the continued support of the project team. It is noted that Mark E. Tambah's expertise lies in other inventory sectors, so there will be IPPU-specific training provided by the project team for the benefit of both national experts.

3.5 Recommendations for future improvements

Data collection will be the main challenge of ensuring a complete inventory can be compiled. Where it is not possible to collect relevant data, future work should focus on identifying and implementing the most efficient way for the necessary data to be collected and shared with future inventory compilation teams.

4 Agriculture (IPCC code: 3A & 3C)

4.1 Findings from the baseline study

The review of the NC2 (draft) and BUR1 (draft) resulted in the following key findings and recommendations:

- There is inconsistency in coverage and methodology used between the BUR1 and NC2, which should not be the case. It was recommended that work be harmonised to produce the inventory as efficiently as possible.
- The NC2 covers most of the emissions source categories expected to occur in Liberia, but there are some important sources missing:
  - Direct N_2O emissions from application of synthetic fertilisers and non-manure organic fertilisers (e.g. sewage sludge / compost)
  - Direct N_2O emissions from mineralisation of N in soil organic matter following management changes
  - Indirect N_2O emissions from manure management and agricultural soils
  - CO_2 emissions from liming and application of urea.

  It was recommended to establish if these sources occur in Liberia, and if so to locate suitable activity data from local or international sources. It is clear that there are significant challenges in collecting appropriate activity data.
- The source, quality or completeness of the data used in emissions calculations for the NC2 was unclear in some cases, in particular for livestock population and manure management systems and crop production. It was recommended that the underlying calculations be provided to enable an assessment of the data sources used.

4.2 Lessons learned from the pilot testing phase

Agriculture is a major sector in Liberia, employing up to 70% of the population. Most farmers undertake small scale agriculture for subsistence, as opposed to large scale commercial agriculture.

The stakeholder workshop and separate discussions with individuals provided an excellent opportunity to meet the national experts who will be involved in the project, and increase understanding of agriculture in Liberia, data availability and data suppliers.

4.2.1 Understanding of agriculture in Liberia

Discussions during the pilot testing phase provided some very useful information around occurrence / non-occurrence of activities in Liberia, as well as common agricultural practices, which can feed into inventory development. Individuals able to provide expert judgement to fill gaps in data availability were also identified, and indeed some useful expert assessments have already been made.

4.2.2 Data availability

During the stakeholder engagement undertaken in the pilot testing phase, it was repeatedly emphasised that in common with other sectors, data availability and completeness will be a key issue for the agriculture sector. Challenges with data collection include the lack of record-keeping of small-scale farmers, and inefficiency of data collection methods (e.g. lack of digital equipment).

Notably, it was discussed that the Ministry of Agriculture (MoA) does not currently undertake regular agricultural surveys or censuses with representative national coverage, which would be the ideal basis for providing suitable activity data and other parameters for the GHG inventory. It was indicated that such regular data collection is planned by MoA in the near future, but the timescale

for implementation is unknown. Nevertheless, useful data is available from ad-hoc surveys undertaken when funding is available, from non-governmental research organisations and cooperatives engaging with farmers, and from administrative sources within Liberia. The UN Food and Agriculture Organisation database (FAOSTAT) provides useful data in some cases, but the reliability of these estimates is unclear.

So far, the team has not been able to follow-up with individual data suppliers to request data, and assess the suitability for the emissions inventory, so this will be a priority for the next phase of the project. Individuals from EPA, MoA and elsewhere have been assigned specific sub-sectors to follow up.

4.2.3 Methodological experience

It is not yet clear how familiar the agriculture team is with understanding the concepts behind and implementing IPCC 2006 Tier 1 methods for agriculture. IPCC software was used to prepare the BUR1, so they are unlikely to have experience of implementing the relevant calculations in spreadsheets. Although Aether will provide spreadsheet templates to implement calculations, one likely area of methodological understanding to develop is for indirect N_2O emissions; during discussions it was highlighted that these emissions were not estimated due to difficulty in implementing the calculations.

4.2.4 Identification of national experts

Good contact has been made during the stakeholder workshop and other activities with the team responsible for compiling the BUR1, and several members of this team have committed to agriculture sector compilation as part of this project (see Section 4.4 below). However, so far, no conversations have been possible with the team responsible for the NC2 compilation. This will be a key priority in the next phase of the project, to make sure work for this 2017-2019 inventory is harmonised as far as possible with estimates for the BUR1 and NC2 for earlier years.

Underlying data and compilation files for the BUR1 and NC2 have not yet been provided to Aether, due to IPCC software being used to compile all sector estimates for the BUR, and compilers of the NC2 not being present at the workshop or other engagement activities.

Further notes on planned methodology and data availability for each sub-sector of agriculture are provided in Table 5.

4.3 Planned approach and data sources by sector

The approach to the compilation of the agriculture sector is provided in the table below. This is an updated version of the baseline study summary considering the discussions and investigations that have been conducted during the pilot testing study. As described in Section 4.2.2, contact points for data supply have been identified for some sub-sectors, but corresponding datasets have not yet been obtained or assessed for suitability.

In general, the estimates will be calculated using a Tier 1 methodology as outlined in the 2006 IPCC Guidelines, using default emission factors and assumptions for the most part. Where default parameters are not available, expert judgement of the Liberian situation or values used in GHG inventories in similar countries will be used. Potential exceptions to the use of Tier 1 methodology may be for enteric methane emissions from cattle, where a Tier 2 methodology has been attempted as part of the BUR1, and for methane emissions from manure management, if the IPCC characterisation of regional manure management systems is not appropriate for Liberia. The choice

of Tier 1 or Tier 2 for these sources will be reviewed depending on the availability of suitable data and parameters.

1. *Table 5. Summary of planned approach by sub-sector for agriculture*

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
3.A.1: Enteric fermentation	Yes (but not all livestock types)	Tier 1, Tier 2 if possible for cattle. Specialised dairy cattle do not occur, nor do buffalo, camels, ducks/geese or fur animals.	**Livestock population** MoA, BRAC, FAOSTAT	**MoA:** Joseph R. N. Anderson / 0886540023 / 0777361200. Joeelson2007@gmail.com **BRAC:** Aisha Nansamba +231886589539 bracliberia@brac.net	Contact data providers and obtain data, assess relative suitability of sources.
3.A.2 and 3.C.6: Manure management direct and indirect emissions	Yes	Tier 1, but for methane Tier 2 if IPCC regional characterisation is not suitable for Liberia.	Livestock population as above.	As above	As above
			Typical animal mass No data source yet identified, but default values are available in the IPCC Guidelines.	None yet identified	Identify possible data source, or use default values
			Proportion of manure in different manure management systems No systematically collected data, but expert judgement is available. Discussions indicate most manure is deposited whilst grazing so is not managed, but some large pig and poultry units exist where animals are confined and manure stored in solid or liquid systems.	Benjamin Karmorh provided expert judgement. Further details may be obtained from Dr. James McClain (UoL) (mcclainj@ul.edu.lr), Sam R Yoryor (MoA) (royal40335@yahoo.com), Mark Tambah (CI) (mtambah@conservation.org) and Isaac Nyaneyon Kannah (EPA) inkteah@gmail.com.	Contact large pig and poultry units to estimate fraction of animals this represents, and whether solid or liquid handling.

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
3.C.1.b: Biomass burning in croplands	Yes	Tier 1	**Crop production** – see 3.C.4 and 3.C.5 **Burning practices –** no data source yet identified, but needs to be coordinated with LULUCF compilation. Expert judgement may be required	Mr. Aseh N Kaneh, who works with LULUCF data in EPA (email pending)	Track down the data source used in NC2. Contact Aseh N. Kaneh to coordinate with LULUCF sector
3.C.2: Liming	No	Will not be estimated	N/A	N/A	Confirm non-occurrence with AGRO import dealer
3.C.3: Urea application	No	Will not be estimated	N/A	N/A	Confirm non-occurrence with AGRO import dealer
3.C.4 and 3.C.5: Direct and indirect N2O emissions from managed soils	Mostly, but not for all N sources	Tier 1	**Manure applied to soils and deposited on pastures:** Livestock population as above	As per livestock population	As per livestock population
			Crop residues: Crop production (tonnes) MoA, BRAC (Aisha Nansamba), Central bank of Liberia, FAOSTAT, Major cash-crop producers (Golden Veroleum, Sime Darby)	**BRAC:** Aisha Nansamba +231886589539 bracliberia@brac.net No contact details for other potential suppliers, but Sam R. Yoryor and Francis Hney will find internal MoA contacts.	Contact potential suppliers to assess suitability of data held.
			Synthetic fertilisers applied to soils (mass of nitrogen) Ministry of Commerce (MoC), AGRO import dealer may be able to provide suitable import / export balances from which consumption can be inferred. Major cash-crop producers may have direct records of quantity consumed, but unlikely for smallholders.	**MoC**: Alex Saye Wou 0777505449 / 0886417068 s.sayewou1@gmail.com **AGRO-import dealer**: Emmanuel Johnson, Ma Bendu Farm, 0886268378 / 0777141574; and Prince Kollie, Grow Green, Capital Bye Pass, 0777481993	Contact potential suppliers to assess suitability of data held.

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
				No contact details for major cash-crop producers.	
			Other organic fertilisers applied (mass of nitrogen) No data sources yet identified. May require expert judgement	Not yet identified	Identify possible data or expert judgement.
			Mineralisation of soil N in mineral soils Derived from estimates of loss of soil organic carbon, from LULUCF team in EPA	Isaac Nyaneyon Kannah inkteah@gmail.com	Contact Isaac Nyaneyon Kannah. Suitable estimates may only become available during the project, as the LULUCF inventory is improved.
			Area of organic soils cultivated May not occur in Liberia. As above – LULUCF team in EPA may provide suitable data. FAOSTAT data is available	Isaac Nyaneyon Kannah inkteah@gmail.com	Confirm occurrence / non-occurrence. Suitable estimates may only become available during the project, as the LULUCF inventory is improved.
3.C.7: Rice cultivation	Yes	Tier 1	**Area of rice harvested** MoA, Central Agricultural Research Institute (CARI), FAOSTAT	**MoA**: Edward Perry (Ministry of Agriculture) – 0777011985 / 0886455838, eperry@moa.gov.lr **CARI**: Sundesco Clarke, internal auditor. +231886826846 sundesclarke@gmail.com	Contact potential suppliers to assess suitability of data held.
			Time under cultivation and cultivation conditions Uncertain whether data is available, but also potentially from same data sources as area harvested	As above	As above

4.4 Individual involvement and training needs

The training will be delivered by Richard German from Aether who will be the lead trainer for the agriculture sector. He will be supported by James McClain from the University of Liberia. The list of individuals to be involved in the training and compilation is yet to be finalised, but the table below summarises those individuals who have indicated their interest in taking part.

Table 6. Summary of individual involvement for agriculture

Name	Involvement level	Job title / affiliation	Specific role / tasks assigned	Specific training needs
Sam R Yoryor III	Not yet assigned	Director for food security and nutrition, MoA	Not yet assigned	Not yet known
Njangu Lewis Aldo Jr.	Compiler	National Consultant, EPA	Not yet assigned	Improved expertise in emissions estimation methods, Excel
Vannah Gbelley Johnson	Compiler	University of Liberia, and EPA consultant for GHG	Livestock data	Improved expertise in emissions estimation methods, Excel
Arbeh Payegar	Unknown	To be confirmed	Rice production	Not yet known
Francis Hney	Participant	Data clerk, MoA	Contact with farmers and growers associations	Improved awareness of GHG inventory methods
Rufus Monbo	Observer	Data officer, MoA	Not yet assigned	Not yet known

4.4.1 Summary of specific training needs

From the responses received so far, key training needs appear to be the understanding of specific methodologies associated with sub-sectors in the IPCC 2006 Guidelines and working with spreadsheets. Practical elements of data collection, evaluation of suitability, entry into the template spreadsheets, understanding of how the sheets function and conducting quality assurance and quality control (QA/QC) procedures will be the main focus of the practical training sessions, in order to develop the national GHG inventory as part of the process. Further details are provided in the training plan report.

4.5 Recommendations for future improvements

In addition to the actions identified to be addressed during this project above, the main priority for future improvement will be to establish the institutional arrangements required to maintain a regular, nationally representative data collection programme of agricultural statistics. The data thus collected would have a great many other uses, in addition to supporting the GHG inventory compilation process.

5 Forestry and other land use (IPCC code: 3B, 3C1a, 3C1c & 3D)

5.1 Findings from the baseline study

Overall, only limited information on the data and methodologies applied for calculating emission/ removal estimates from the forestry and other land use (FOLU) sector is available from the BUR1 and NC2. The information presented in the draft NC2 and BUR1 is not consistent, and it is therefore unclear what national data is available. The primary focus for updating and improving the LULUCF sector should be to review the available land use data and compile as comprehensive land use change matrix as possible, ideally across multiple years.

5.2 Lessons learned from the pilot testing phase

During the pilot testing phase, additional information was gathered through a meeting on 2nd July with members from the BUR1 team and during the Stakeholder Workshop on 7th July. From these meetings it became clear that there is a poor connection between the BUR1 and NC2 teams and that the NC team had ownership of the most comprehensive land use area database in Liberia. A number of individuals with prior experience in inventory compilation who could contribute to this project were identified (see **Section 5.4**). During these meetings, the tools to be used for the inventory compilation were discussed. It was agreed that the IPCC software could be a helpful tool for the inventory compilation, but for the purposes of training and developing an understanding of how to compile estimates, Excel spreadsheets would be used to compile the inventory. The ALU software[2] was also discussed as a possible tool for compiling the inventory, but as explained above, compilation in Excel spreadsheets is considered to be the best option for facilitating training. The use of other software packages for the final compilation will be discussed with the inventory team.

To date, it has not been possible to obtain the national FOLU GHG inventory compilation files or underlying data from the NC2 or BUR1 teams. It is hoped that the land use area database, together with other key input data, will be made available during the next phase of the project to support the training sessions and compilation activities.

5.3 Planned approach and data sources

An overview of the planned approach and potential sources for the main data elements is provided below and this information is summarised in **Table 7**.

5.3.1 Land Use Data

During the meetings held during the pilot testing phase the available land use data was discussed. The National Forestry Inventory (NFI) has recently been completed[3] and it was confirmed that the NC team has access to the land use area database. It is proposed that this data, together with any additional information form the NFI is used to compile land use matrices for the timeseries. The NFI contains data for 2017, 2018 and 2019 as well as some country-specific factors. It is assumed that the IPCC **Approach 1** to land representation will be implemented and that assumptions will have to be made to disaggregate between the "land remaining" and "land converted" categories. It is proposed that this data is used to compile estimates using a Tier 1 gain-loss approach with some Tier 2 parameters. Unless country-specific information can be provided, Tier 1 assumptions for the dead organic matter (DOM) and soil organic carbon (SOC) pools will be applied. It is expected that a complete dataset on wood removals for fuelwood will not be available, in particular wood harvesting

[2] https://www.nrel.colostate.edu/projects/alusoftware/home
[3] Confirmed by Chief Konikay Nimely during the Stakeholder Workshop, 7th July 2020

for charcoal production is unlikely to be tracked. A potential data source for this is the National Charcoal Union.

5.3.2 Biomass burning (excluding cropland, see agriculture)

It is expected that some activity data on burnt areas of forest land is available. However, it is currently unclear whether this will be in a format useful for the inventory. Similarly, it is unknown what data is available for grassland burning. Wildfires in forest land are not common in Liberia, but controlled burning of forest plantations does occur. Next steps are defined in the table below for confirming the data availability for biomass burning.

Biomass burning on cropland is considered in the agriculture sector.

5.3.3 Harvested wood products

Estimates from harvested wood products (HWP) have not previously been included in the inventory. Data from the FAO will be used in this inventory unless data can be provided directly by the NFI.

Table 7. Summary of planned approach by sub-sector for FOLU

Sector – IPCC code	Occurs in Liberia (Y/N	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
3B	Y	Tier 1 gain-loss method proposed, 11 land use classes based on country definitions	Annual areas by land use class, land conversions, climate and soil type	Mark Tambah to contact NC team to get access to land use database Chief Konikay Nimely to provide data from the National Forestry Inventory	Waiting for a response from Mark. Waiting for the NFI report to be validated (Chief to provide the report)
3C1a	Y	Tier 1 method proposed but it is unclear what data is available	Area of forestland burnt, no data available	Mark Tambah volunteered to follow up on data requests	Follow up with potential data providers to confirm data availability, waiting for a response from Mark
3C1c	Y	Tier 1 method proposed but it is unclear what data is available	Area of grasslands burnt, no data available	Mark Tambah volunteered to follow up on data requests	Follow up with potential data providers to confirm data availability, waiting for a response from Mark
3D	Y	Tier 1, IPCC default stock-change method	Harvest wood and fuel wood removal data (referenced in the BUR1 but not used to compile estimates, not references in the NC2)	FAO (international data)	Follow up with potential data providers to confirm whether any national data is available, waiting for a response from Mark

5.4 Individual involvement and training needs

The training will be delivered by Rosie Brook from Aether who will be the lead trainer for the FOLU sector. She will be supported by Emmanuel T. Olatunji from the University of Liberia. The list of individuals to be involved in the training and compilation is yet to be finalised, but the table below summarises those individuals who have indicated their interest in taking part.

Table 8. Summary of individual involvement for FOLU

Name	Involvement level	Job title / affiliation	Specific role / tasks assigned	Specific training needs
Isaac Nyaneyon Kannah Teah	Unknown	Unknown	Experienced GHG Inventory compiler	Not yet known
Mark Tambah	Data provider	CBIT GHG Coordinator, Conservation International	Data collection	Not yet known
Emmanuel Lewis	Unknown	Forestry Development Authority	To be discussed	Not yet known
Chief Konikay Nimely	Participant	Unknown	Experienced GHG Inventory compiler	Not yet known
Mahmoud Soloman	Compiler	EPA	To be discussed	Not yet known
Ansumana Turay	Compiler	EPA	To be discussed	Not yet known

5.4.1 Summary of specific training needs

The specific training needs identified during the meeting on the 2nd July are as follows:

- Practical Excel training to develop skills and gain a better understanding of how emissions and removals are calculated
- Gap filling land use area data
- Generating land use change matrices from the available land use area data.

5.5 Recommendations for future improvements

In addition to the training that will be provided under this project, some additional training needs have been identified. The priority for future training of the FOLU team should be on GIS analysis and translating the available geographic information system (GIS) data into land use change matrices to be used in the inventory.

6 Waste (IPCC code: 5A – D)

6.1 Findings from the baseline study

Currently in the BUR1 and NC2, there is limited emission estimates provided for this sector. The waste sector categories may not be key categories even if estimated using Tier 1 methods based on the Decision Trees of the 2006 IPCC guidelines. However, every effort should be made to engage the key waste management stakeholders to provide estimates to establish the emission levels at the present state of development in the sector. This is because waste sector emissions are largely driven by population and government waste management policies and measures. It is a key development monitoring indicator of population growth, and impact of governments policies and programs for water, sanitation and health towards the attainment of the UN's Sustainable Goals – for example: SDG 6 (water and sanitation) ; SDG 3 (health and well-being; and SDG 12 (waste resources efficiency based on reduce, recycle, recovery, reuse).

Waste sector emissions inventory should be considered as a key development indicator while meeting completeness criteria of the modalities, procedures and guidelines (MPGs) reporting requirements of the enhanced transparency framework under Article 13 of the Paris agreement.

The baseline study identified the need to facilitate a discussion between the BUR1 and NC2 inventory compilers to share data and knowledge so that improvements can be made.

6.2 Lessons learned from the pilot testing phase

The pilot testing phase identified some activity data reported in the BUR that could be used with justifiable expert judgment. The existing data include:

- Population estimation based on 2015 baseline population census data (interpolated for non-census years) and adjusted for socio-economic factors
- Fraction of solid waste which is open burnt was calculated by multiplying the total solid waste estimated by the percentage of the population whose wastes are so treated as evidenced from the MCC 2015 statistics
- Amount of sludge generated per capita for 2015-2027 estimated using that 2015 baseline data for Paynesville and Monrovia Cities Council
- Households and population by main type of toilet facility (%) namely uncollected and untreated.

The use of this data would have very high uncertainty values. Nonetheless, they will serve as reasonable data based on justified expert judgement, that could be refined through the involvement of the key stakeholders in the waste sector (see Table 9).

6.3 Planned approach and data sources by sector

A presentation was purposefully made at the waste sector breakout group during the stakeholder workshop on the use of *decision trees* in the 2006 IPCC guidelines. Based on the decision trees, participants were made aware of the possibility of estimating waste sector emissions by both default activity data as well as default emission factors for most of the categories. It also highlighted the role of high-quality country-specific data in reducing the uncertainty of the expert judgment when based on default parameters.

In addition, it was emphasized that expert judgement on significance must be based on estimated values compared with the total national emissions where a methodology exists in the 2006 IPCC Guidelines. The threshold of not applicable (NA) or not significant is correspondingly very low for a

country with low total emissions. With that understanding at the pilot breakout session presentation and discussion, it was generally agreed to adopt the decision tree approach.

The breakout session also emphasized the need to have estimated values based on the default activity data and default emission factors, because initial estimates act as the basis of determining how Liberia will achieve the NDC projected emission reduction in the waste sector, as waste management improves and data quality is improved. This is because emissions in the waste sector generally increase if not combined with gas recovery and use as a country improves its water, sanitation, and health in waste resources management (WASH). These include:

- Transition to sanitary landfills will increase emission over the years
- Transition to biological treatment such as biogas increases emissions
- Incineration with high plastic content increases emissions.

On the basis of the pilot testing presentation and engagement, interest was generated in use of Decision Trees to select appropriate Tier 1 methods based on the default activity and default emission factors for most of the categories in the waste sector. The planned approach to the GHG inventory has been outlined in Table 9. This desired capacity building will be achieved through the course as outlined in the Training Plan.

Table 9. Summary of planned approach by sub-sector for Waste

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
4.A.1 Managed Waste Disposal Sites	Yes	Tier 1, IPCC First-order decay (FOD) method	Population	**Liberia Institute of Statistical and Geo-Information Services (LISGIS):** To be identified	Emissions from the category is not estimated (NE) in 2015-2017 in the BUR. Based on the Figure 3.1 Decision Tree for CH4 emissions from Solid Waste Disposal Sites of the 2006 IPCC Guidelines, Tier 1 method can be applied. Using the IPCC FOD method, parameters are mainly default activity data and default parameters. Appropriate tables of default data as well as other countries could also be used.
			Per capita solid waste generation	**Monrovia City Corporation (MCC)/ EMUS project:** Derick D. Perkins (delay30@gmail.com)	
			Mass of waste deposited at solid waste disposal sites by various practices	As above	MCC would be engaged by EPA and UoL to construct the national material balance based on limited data in the BUR and expert judgment. UoL should involve the students to improve the data values derived and to determine the MCF.
			Collection efficiency	**University of Liberia / Waste resources management:** J. Boima Kiazolu (boisky1@gmail.com)	
			Waste composition	**Environmental Protection Agency:** Margaret Beslow (mbeyslow@epa.gov.lr) **Private Sector waste contractors:** To be identified **Ministry of Public Works:** To be identified	
4.A.2 Unmanaged Waste Disposal Sites	Yes	Tier 1	See 4.A.1	**Department of Waste, Environmental Health and Sanitation:** To be identified	Identify suitable contact
4.A.3 Uncategorized	Yes	Tier 1	See 4.A.1	See 4.A.1	See 4.A.1

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
Waste Disposal Sites					
4.B Biological Treatment of Solid Waste	No	Will not be estimated	N/A	N/A	N/A
4.C.1 Incineration of hazardous clinical Waste	Yes	Tier 1 – CO_2	Default Amount of waste incinerated	**Environmental Protection Agency**: Aaron Smallwood (aaronsmallwood25@yahoo.com)	Emissions from waste incinerated and openly burned was not estimated (NE) in the BUR for 2015-2017. A significant amount of waste openly burned is however reported in the BUR.
			Default data on characteristic parameters for clinical waste (dry matter content, carbon content and fossil carbon fraction, plastic waste fraction)	**University of Liberia / Waste resources management**: J. Boima Kiazolu (boisky1@gmail.com)	Increasing waste of fossil origin (e.g. plastics, certain textiles, rubber, liquid solvents, and waste oil) needs to be estimated, to enable the calculation of non-biogenic emissions. It is also reported in the BUR that it is common in Liberia to incinerate hazardous clinical waste. Based on the Figure 3.1 Decision Tree for CO2 from Incineration and Open Burning of Waste (2006 IPCC Guidelines), Tier 1 method can be applied using IPCC default values of the parameters.
			Default biomass materials (e.g., paper, food, and wood waste) contained in the waste as biogenic emissions	**Department of Waste, Environmental Health and Sanitation:** To be identified **Ministry of Health:** To be identified	The UoL, EPA and DWEHS and MCC would be engaged to improve the data quality and reduce uncertainty.
4.C.2 Open Burning of Non-	Yes	Tier 1 – CH_4, CO_2	Default Amount of waste open-burned	**University of Liberia / Waste resources management**: J. Boima Kiazolu (boisky1@gmail.com)	See 4.C.1

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
hazardous and hazardous waste					
4.C.2.a Non-biogenic	Yes	Tier 1	Default data on characteristic parameters of MSW & clinical waste (dry matter content, carbon content and fossil carbon fraction, plastic waste fraction)	**Monrovia City Corporation (MCC)/ EMUS project:** Derick D. Perkins (delay30@gmail.com)	
4.C.2.b Biogenic	Yes	Tier 1	Default biomass materials (e.g., paper, food, and wood waste) contained in the waste as biogenic emissions	**University of Liberia / Waste resources management**: J. Boima Kiazolu (boisky1@gmail.com) **Private Sector waste contractors:** To be identified **Ministry of Public Works:** To be identified **Department of Waste, Environmental Health and Sanitation:** To be identified	
4.D.1a Methane emissions from waste water	Yes	Tier 1	Mass balance of wastewater sources based on the wastewater treatment systems and discharge pathways	**Liberia Water and Sewer Corporation (LWSC) (Collection and Disposal of Liquid waste)**	Emissions are not estimated from DWW handling practices in the BUR for 2015-2017. However, the disposal pathways are documented in the BUR. They include population connected to a sewer system, septic tanks/ cesspool systems and use of pit latrines. Based on Figure 6.2 Decision Tree for CH4 emissions from domestic wastewater of the 2006 IPCC Guidelines, Tier 1 is applicable. Appropriate Default values for the emission factor and activity parameters
			Mass of wastewater fractions collected and	**Department of Waste, Environmental Health and Sanitation:** To be identified	

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
			untreated (open and closed sewers)		of the handling practices are available for the wastewater pathways identified in the BUR. MCC, UoL, EPA, and DEWHS would be engaged to improve the mass balance of wastewater sources based on the documented handling practices and discharge pathways of uncollected and untreated (open and closed sewers) and modes of discharge.
			River discharge	**Environmental Protection Agency:** Aaron Smallwood (aaronsmallwood25@yahoo.com) and Lucia Yah Paye-layleh (lpayelayleh@gmail.com)	
			Mass of wastewater fractions uncollected and untreated (septic tanks, Open pits/Latrines, River discharge)	**University of Liberia / Waste resources management**: J. Boima Kiazolu (boisky1@gmail.com)	
			Fraction of population in income group (rural, urban) in inventory year	**Liberia Institute of Statistical and Geo-Information Services (LISGIS):** To be identified	
4.D.1b Indirect Nitrous Oxide emissions from waste water	Yes	Tier 1	P = human population	**Liberia Institute of Statistical and Geo-Information Services (LISGIS):** To be identified	See 4.D.1.a
			Protein = annual per capita protein consumption, kg/person/yr	**Food and Agriculture Organization(FAO)** Note/ FAO data may not include game meat if there is law to report game	
			FNON-CON = factor for non-consumed protein added to the wastewater (Default)	**Ministry of Agriculture:** Joseph R. N. Anderson / 0886540023 / 0777361200. Joeelson2007@gmail.com	
			NEFFLUENT = total annual amount of nitrogen in the wastewater effluent, kg N/yr	As above	

Sector – IPCC code	Occurs in Liberia (Y/N)	Proposed methodology: Tier and other notes	Activity data needed and source	Data contact details	Next steps
4.D.2 Industrial Wastewater Treatment and Discharge	Yes	Tier1 CH_4	Industry point sources wastewater generation	**Environmental Protection Agency:** Aaron Smallwood (aaronsmallwood25@yahoo.com) and Lucia Yah Paye-layleh (lpayelayleh@gmail.com)	To be decided
			Industry production data	**University of Liberia / Waste resources management**: J. Boima Kiazolu (boisky1@gmail.com)	
			COD of point sources wastewater discharge	**Liberia Institute of Statistical and Geo-Information Services (LISGIS):** To be identified **Department of Waste, Environmental Health and Sanitation:** To be identified **Private sector contacts in fish processing, slaughter houses, meat conditioning houses, tanneries, breweries and industry association reps:** To be identified	

6.4 Individual involvement and training needs

The training will be delivered by Philip Acquah from Aether who will be the lead trainer for the FOLU sector. He will be supported by J. Boima Kiazolu from the University of Liberia. The list of individuals to be involved in the training and compilation is yet to be finalised, but the table below summarises those individuals who have confirmed their interest in taking part and their level of involvement.

Table 10. Summary of individual involvement for Waste

Name	Involvement level	Job title / affiliation	Specific role / tasks assigned	Specific training needs
Margaret Beslow	Compiler	Assistant Manager, Environmental Research and Standards, EPA	4A Solid waste disposal	Not yet known
Aaron Smallwood	Compiler	EPA	4D Wastewater treatment and Discharge	Not yet known
Alvin F. Terry	Compiler	National Expert, EPA	Not yet assigned	Not yet known
Prince Mentuah Benson	Compiler	EPA	Not yet assigned	Not yet known
Franklin Cooper	Participant	UoL - Student	4A Solid waste disposal	Not yet known
Alfreda Togba	Participant	UoL - Student	4C Incineration	Not yet known
Thomas J. Weeks	Participant	UoL - Student	4D Wastewater treatment and Discharge	Not yet known

6.4.1 Summary of specific training needs

- Embracing Waste Sector GHG Inventory management system that will work together to deliver improving data access and data collection
- Appropriate use of Notation Keys to improve the presentation in the BUR
- University of Liberia involving the student participants to collect data with uncertainty assessment at source
- Application of 2006 IPCC Decision Tress in methodological choices of Tier 1 approach where there are country data availability challenges
- Use of IPCC Inventory software and IPCC First Order Decay model for sectoral inventory estimation and compilation.
- Quantitative Uncertainty assessment based on IPCC default values.

6.5 Recommendations for future improvements

The technical sustainability of this program in the future when the project support funds ends shall be determined to a very large extent by the sectoral GHG Inventory management system that will evolve out of this capacity building support.

The key stakeholders listed in Table 10 should be encouraged to form the core waste sector inventory management system: inventory compilers, source data providers, data providers, and the regulator (EPA).

It is therefore recommended that every effort should be made to institutionalize the sectoral GHG inventory management system with all the identified key stakeholders. The members should be actively involved in the hands-on training exercises throughout this capacity building support.

7 Monitoring, Reporting and Verification system

7.1 Findings from the baseline study

The baseline study provided a comprehensive review of the NC1 and draft BUR1 and NC2 which outlined the roles and responsibilities for the GHG inventory compilation. However, these documents lacked detail on the coordination of the work between the different project-based teams (BUR1/NC2/CBIT). Institutional structures are in place to support GHG inventory reporting, for example the sectoral NDC Hubs or the National Climate Change Steering Committee (NCCSC). However, the NCCSC is only periodically active and could be more effective in steering the national conversation about climate change.

There is limited discussion in any UNFCCC reporting about the roles, responsibilities and legal framework supporting reporting on climate action or tracking progress against Nationally Determined Contributions (NDCs). The BUR1/NC2 drafts include information on climate actions however data reporting is informal and ad-hoc, with improvements to mandates needed to formalise and institutionalise the flow of information on climate actions.

With regards to existing systems and tools, the NC1 proposed the development of a GHG archiving system for collecting and tracking inventory data however this has not yet been implemented. The most significant development in terms of knowledge or data management systems is the development of the **Environmental Knowledge Management System (EKMS)**[4] under the GEF funded Cross-Cutting Capacity Development Project (CCCD). However, based on the information publicly available, it was unclear as to whether EKMS has the functionality to host long term climate action tracking.

The BUR1/NC2 both highlight a key gap in public awareness of climate change issues as well as a low-level awareness from decision makers.

7.2 Lessons learned from the pilot testing phase

Based on feedback from key individuals during the stakeholder workshop and follow up conversations, the project team learnt the following information about the MRV system roles, responsibilities, legal framework, data systems and tools, and national capacity:

- **Roles and responsibilities are well defined but not well coordinated between support programmes and lack legal mandates for continuous reporting.** Individuals are aware of their role within the national MRV system generally, however it is unclear how training and capacity building activities overlap between support programmes under the BUR1/NC2/CBIT programmes. Another key challenge is the lack of overarching legal framework to ensure defined jobs get done, this would require a mandate for continuous supply, management, and analysis of data.
- **NDC Hubs and protocol committee should represent the focal points for sectoral expertise.** The hubs bring together a cross-cutting group of experts to be deployed for various climate change MRV activities. Individuals working through these hubs should be clearly defined. The EPA should track and drive

[4] Available here: https://ekmsliberia.info/

improvements through the MRV system supported by the right tools and systems. The NCCSC has a positive impact but only meet periodically.

- **Data providers not aware of relevant data that they possess.** Stakeholders in key institutions for all sectors are generally unaware of the data requirements for climate change MRV and which datasets hold value.
- **There are significant challenges with IT infrastructure and skills.** Internet connectivity across the country is generally poor. Government ministries lack a centralised system for storing data and files, all relevant data is generally held on individual laptops which is challenging for archiving data and maintaining institutional memory. Only 30 – 40 % of staff feel confident in working with Microsoft software such as Excel. The University of Liberia potentially has an important role in supporting the public sector with technical training and maintaining institutional memory with regards to IT.

7.3 Planned approach and data sources

The baseline study included a long list of recommendations and next steps. However, based on the stakeholder workshop and follow up conversations it is apparent that there are a few key outcomes that should be prioritised. These outcomes will guide the training and capacity building over the course of the project. These **key outcomes** are:

1. Roles, responsibilities and legal frameworks identified and mapped in relation to the **GHG Inventory and climate action tracking**, including the roles of the NDC Hubs, BUR and NC coordination teams to ensure one coordinated voice.
2. Mapping of the **data flow for climate actions**.
3. **Database tool for tracking climate actions** and engagement with the data management and coordination team.
4. Development of an **Improvement Plan**, a list of identified improvements for the MRV system to help coordinate future support programmes.
5. Facilitate a meeting with the NCCSC.

The development of the MRV system and continued success of the system will require an engaged and proactive **coordination team.** It will also require a knowledgeable and skilled **support team** of technical experts and IT staff. These two teams will engage with and coordinate designated **sectoral focal points**. Individuals who attended the stakeholder workshop and put themselves forward for engagement with the MRV system development have been assigned to one of these three groups. These groups will define the level of engagement and the role over the course of the project. The table below summarises the individuals who have expressed an interest in MRV and have been identified for engagement in the project.

Table 11. Summary of individual involvement for MRV

Name	MRV role	Organisation	Experience / link to the MRV system	Involved in key outcomes
Charles Asuman	Coordination team	EPA	Project Coordinator (Lead) BUR and Energy expert for the SNC	1,2,3,4,5
Aaron Smallwood	Coordination team	EPA	Unknown	1,2,3,4,5
Arthur Becker	Coordination team	EPA	National Focal CBIT and Project Officer, MEAs	1,2,3,4,5
Benjamin Karmorh	Coordination team	EPA	Coordinator, MEAs and National Focal Point-UNFCCC	1,2,3,4,5
Christopher Kabah	Coordination team	EPA	Unknown	1,2,3,4,5
Prince Wilson	Sectoral focal point (Energy)	MME	Unknown	1,2,3,4
Nanlee Johnson	Sectoral focal point (Energy)	MME	Worked on BUR; Energy sector expert. Focal person in Liberia's 5 NDC sectors: Energy/Waste/Forestry/Agriculture/Transport	1,2,3,4
Mark Tambah	Sectoral focal point (IPPU)	CI	Cross-sectoral experience with GHG data	1,2,3,4
Mahmoud Salomon	Sectoral focal point (FOLU)	EPA	Consultant- BUR (supervisor) & SNC (FOLU)	1,2,3,4
Albert Sherman	Sectoral focal point (Transport)	MOT	Focal person in Liberia's 5 NDC sectors: Energy/Waste/Forestry/Agriculture/Transport	1,2,3,4
Sennay Carlor III	Sectoral focal point (Waste)	MCC	Focal person in Liberia's 5 NDC sectors: Energy/Waste/Forestry/Agriculture/Transport	1,2,3,4
Dereck Perkens	Sectoral focal point (Waste)	MCC	Unknown	1,2,3,4
J. Komoty Gee Zean	Support team		EKMS project team	2,3,4
Ujay Vah	Support team	EPA	IT Technician, EKMS	2,3,4
Dr Kolleh Bangura	Support team		Project Manager, CCCD Project and Consultant	2.3,4
Aaron Wesseh	Support team	EPA	Knowledge Officer, EKMS	2.3,4

7.4 Recommendations for future improvements

The baseline study provides a long list of potential improvements and next steps within each component of the MRV system. These will be refined and captured in the Improvement Plan to help coordinate future MRV development beyond the scope of this project.

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