Crop and Livestock Institutional MRV System

Initiative for Climate Action Transparency (ICAT) – Consultancy Project(s) Capacity Building on application of Measure, Report and Verify (MRV) Greenhouse Gas (GHG) Emissions for Mitigating the Impact of Climate Change in Nigeria

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ICAT INITIATIVE FOR Climate Action Transparency

CITEPA

ghg management institute

Department of Climate Change
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Abbreviations

AD	Activity Data
DCC	Department of Climate Change
DALCCMS	Department of Agricultural Land and Climate Change Management Services
EF	Emission Factor
EFT	Enhanced Transparency Framework
FAO	Food and Agriculture Organisation
FAOSTAT	Food and Agriculture Organisation Cooperate Statistical Database
FMARD	Federal Ministry of Agriculture and Rural Development
FMEnv	Federal Ministry of Environment
GHG	Green House Gas
GHG-I	Green House Gas Inventory
IA	Institutional Arrangement
ICAT	Initiative for Climate Action Transparency
IPCC	Intergovernmental Panel on Climate Change
MRV	Measurement Reporting and Verification
NBS	National Bureau of Statistics
NDC	Nationally Determined Contributions
QA	Quality Assurance
QC	Quality Control
TNC	Third National Communication
TWG	Technical Working Group
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change

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Executive Summary

All Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are obliged to communicate information relevant to the implementation of the convention. This is necessary so that progress in responding to climate change, including the extent and trends of greenhouse gas (GHG) emissions and removals, can be measured at a global level and effective actions can be planned and evaluated. Communications to the UNFCCC have been gradually standardized. At a domestic level, measurement, reporting, and verification (MRV) guide a country to understand its GHG emissions and removals and provides data to inform mitigation strategies, to evaluate the impact of mitigation actions, to monitor the progress made in achieving climate goals, and to make climate and GHG emission data publicly available to national and international stakeholders. The Crop and Livestock Sector is one of the key categories in the IPCC guideline and major contributor of GHG emissions and high potential for mitigation in the country as reported in the TNC.

In the current UNFCCC framework, MRV relates to GHG emissions, emission reductions in relation to targets in nationally determined contributions (NDCs), adaptation, and financial, technology transfer and capacity-building support provided and received.

This framework focuses on MRV of actions relating to GHG emissions, emission reductions (mitigation and adaption) and support received. Here, MRV includes tracking of policies and measures with GHG effects and GHG emissions and emission reductions.

The need to identify national focal points with clear roles and responsibilities, the nature of data need and data flow, data coordination and management systems, stakeholder engagement and workplan was covered in the framework.

A model institutional framework was proposed at the end of the report to mirrow an ideal reporting hierarchy, data hubs, and clear roles and responsibilities.

The first chapter focused on the general overview of the GHG inventory system, and the types required under the UNFCCC reporting obligations of country. The ICAT–Nigeria project fully addresses the country's need to develop a robust MRV system and strengthen its capacity to fulfill UNFCCC reporting requirements, including compliance with the ETF in the Crop and Livestock sector, and track progress against priority actions identified in the updated NDC.

The second chapter discussed the mandates of various institutions that will play a key role in implementing the MRV program. An integral component of an MRV system is identifying the organization(s) responsible for compiling and management of the needed data. This role will involve agreeing on the provision of data from the network of stakeholders and data providers. Data management, analysis, and reporting are also key tasks in developing a sustainable MRV system. Strong Institutional arrangements (IA) are vital to enable countries to provide reliable, comprehensive, and regularly updated information that meets the enhanced reporting requirements and serves national decision-makers and action-implementing stakeholders. The Department of Climate Change under the Federal Ministry of Environment is the lead National Agency responsible for implementing and reporting climate action in the country. The Department of Agricultural Land and Climate Change Management Services is the focal department responsible for climate change mitigation and

adaptation activities within FMARD. They have been identified to lead GHG inventory coordination at the sectoral level.

The required expertise needed to build a sustainable robust national inventory system was extensively discussed. It has been established that the team of national experts should be capable of regularly gathering through workshops, zoom meetings etc. and processing data to produce the agreed outputs on time. The team should have suitable backup expertise and access to relevant training materials. There should also be effective recruitment, retention, and succession procedures in place that motivate the long-term and active involvement of experts in the reporting process.

The current and proposed data set and date flow was also discussed features in this data flow of information that can be improved to make it more efficient in terms of ensuring the consistency and coherence of data from the crop and livestock sector recommended. The sequence of data aggregation starts with verification by the DALCCMS that the reporting entities are still operational and are continuing to fulfill the request for data from the department and other entities. In addition, there is verification that the involved entities are preparing and delivering the data according to the disseminated procedures and templates. There are two data quality verification cycles, one done in the DCC and the other undertaken in cooperation with the DALCCMS to ensure that the final report of the GHG inventory is consistent and comprehensive according to the requirements of the applicable guidelines. Finally, the last stage is about sending the GHG inventory to the receiving entities.

Coordination, systems and tools are needed for efficient performance of the sector transparency system. The process will require continuous management of data collection activities, analysis, QA/QC, summarizing and archiving of data. The availability of these systems and tools will ensure that TWGs, national experts and host entity staff have access to the kind of activity data needed, able to manage the data flow, perform the required QA/QC and timely delivery of outputs. This gives opportunity for GHG inventory improvement plan to be implemented and monitored thereby leading to significant progress in quality of data delivered overtime. Primary data providers and coordinating entities will require a legal framework or data sharing agreement to effectively work together and achieve the needed objective within the set inventory workplan timelines. Data preparation and evaluation will be primarily carried out at the task group level, a harmonized dataset in the appropriate format will then be inputted into the IPCC datasheets or any other standardized customized datasheets provided for the assignment in the crop and livestock sector and subsequently worked in the IPCC software and database for the generation of the estimates. Once the estimates are generated, the groups can begin the report writing process and subsequent deposition of the estimates and data through the data management system to be provided for the activity.

The sectoral framework for the GHG inventory system provides a live list of all stakeholders to be engaged in the GHG inventory compilation. It identifies the stakeholder roles, proposed details of their engagement with the GHG inventory activities, and provides an essential reference point for the coordination of future engagement activities. Connected to the list of stakeholders are the proposed work plan and opportunities for interagency collaboration and integration, data supply and utilization, data sharing, and reporting. Effective and smooth stakeholder engagement is considered as one of the key success factors for the ICAT-Nigeria MRV project. Without active participation and contributions from relevant stakeholders in the crop and livestock sector, the project will not be able to have access to accurate and reliable data and information, nor successfully develop a useful and comprehensive roadmap. Also, without stakeholders' buy-in, the roadmap will not be adopted and implemented. This will inevitably prevent the project from achieving the outcome of the

Government's and non-government stakeholders adopting the roadmap. The active stakeholder engagement can ensure that the project provides suitable capacity-building activities, as strengthening stakeholders' capacity is one of the project objectives. In addition, close engagement with relevant stakeholders can ensure smooth implementation of the project as they are aware of the implementation status and tends to be supportive and responsive to the project's requests. Needless to say, successful stakeholder engagement is an essential part of the project.

Developing a robust national inventory system requires a clear process with clear roles and responsibilities agreed and adopted across the network of key stakeholders and principal data providers. The main purpose of clear institutional arrangements is to enable national and sectoral policy to be operationalized for the program to achieve policy and program objectives, e.g., quality, transparency, consistency, efficiency. It also enables program resources to be efficiently deployed, e.g., data processing, quality management and continuous improvement. This was clearly shown in the flow chart presented in the report.

The sectoral report presented a proposed inventory workplan and roadmap to ensure sustainable implementation of the project going forward

Chapter One - Introduction

1.0 MRV Overview

All Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are obliged to communicate information relevant to the implementation of the convention. This is necessary so that progress in responding to climate change, including the extent and trends of greenhouse gas (GHG) emissions and removals, can be measured at a global level and effective actions can be planned and evaluated. Communications to the UNFCCC have been gradually standardized. At a domestic level, measurement, reporting, and verification (MRV) guide a country to understand its GHG emissions and removals and provides data to inform mitigation strategies, to evaluate the impact of mitigation actions, to monitor the progress made in achieving climate goals, and to make climate and GHG emission data publicly available to national and international stakeholders. The Crop and Livestock Sector is one of the key categories in the IPCC guideline and major contributor of GHG emissions and high potential for mitigation in the country as reported in the TNC.

> *"**M=Measure** (or monitor) data and information on emissions, mitigation actions, and support.*
>
> ***R=Report** by presenting the gathered data in the form of inventories and other standardized reports to make it widely accessible.*
>
> ***V=Verify** by carrying out an independent assessment of the reported data to confirm that it is accurate and contains all the required information"*

Countries report their greenhouse gas (GHG) emissions and removals from all sectors via national GHG Inventories, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in accordance with international climate policy agreements and technical guidelines developed by the Intergovernmental Panel on Climate Change (IPCC).
The agriculture sector (Crop and Livestock) represents a unique challenge for the national inventory compilers as seen in the TNC, due to significant difficulties in compiling and regularly updating national statistics for agriculture, the first necessary step in preparing national GHG estimates and leading to dependence on FAO data base and others for default estimates
The limited capacity to identify and collect reliable activity data and to quantify emissions by sources and removals by sinks, in Nigeria where agricultural activities are a key component of the national economy and a driver of employment, could furthermore lead to limited access to international climate finance of importance to rural development, and implementing the Nationally Appropriate Mitigation Actions (NAMAs)

MRV is a term that was introduced at the thirteenth Conference of the Parties (COP) in Bali in 2007. It refers to the UNFCCC reporting framework in the context of climate change mitigation. Mitigating climate change aims to reduce GHG emissions on a global level. Mitigation is carried out through a process of setting GHG emission reduction targets, implementing actions designed to reduce emissions, and then measuring the emission levels to see if the target reduction has been reached, before setting a new target and continuing the cycle.

MRV is carried out at the regional level, and at national and sub-national levels in every country which is a party to the UNFCCC. Although each country has a unique MRV system, there are, in many

countries, expectations on provinces, districts, cities, corporations, and facilities to measure their emissions and climate actions and to report this information and have it externally verified. Projects are also expected to carry out MRV. Within the country, local areas will contribute data so that the Government can measure the climate situation of the country as a whole. The data from every country, when aggregated, will show global progress on climate change mitigation, adaptation, the progress of the NDCs, and support needed and received to enable higher climate ambitions.

While MRV originated in the UNFCCC system, there are numerous reasons for a country to develop a strong MRV system. In addition to tracking emission trends and mitigation measures, MRV can assist in monitoring progress on the Sustainable Development Goals; provide data for national policy decisions; build national capacity; ensure transparency, good governance and accountability, and credibility of results; engage the private sector; improve access to funding; and contribute to wider national reporting on the state of the environment, climate issues and policy effects (de la Torre, 2018).

Box 1: Scope of the Sectoral MRV Framework Report

Article 13 of the Paris Agreement established an enhanced transparency framework for action and support (UNFCCC, 2018). In the current UNFCCC framework, MRV relates to GHG emissions, emission reductions in relation to targets in nationally determined contributions (NDCs), adaptation, and financial, technology transfer and capacity-building support provided and received.

This framework focuses on MRV of actions relating to GHG emissions, emission reductions (mitigation and adaption) and support received. Here, MRV includes tracking of policies and measures with GHG effects and GHG emissions and emission reductions.

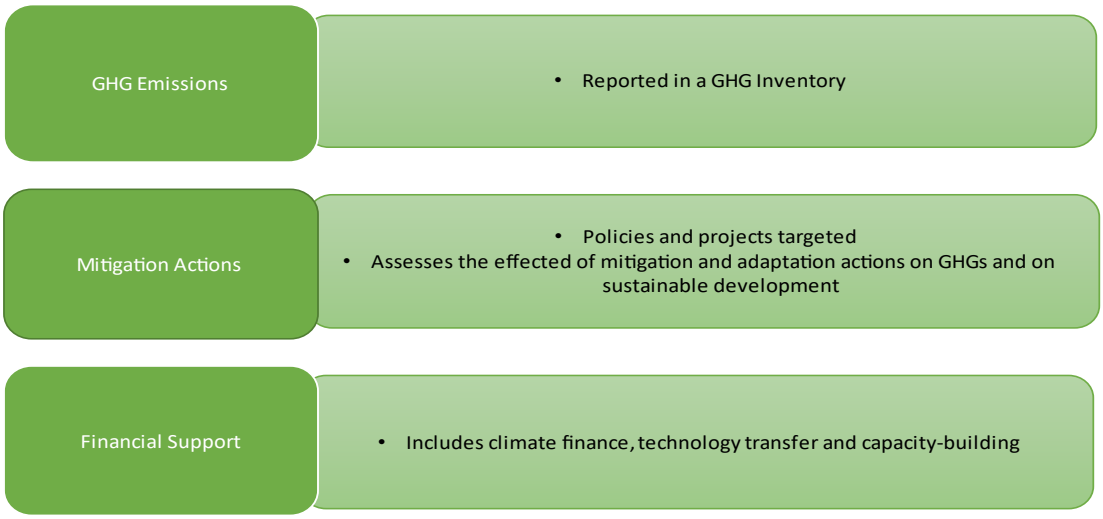
The need to identify national focal points with clear roles and responsibilities, the nature of data need and data flow, data coordination and management systems, stakeholder engagement and workplan will be covered in the framework.

A model institutional framework will be proposed at the end of the report to mirror an ideal reporting hierarchy, data hubs, and clear roles and responsibilities.

1.2 MRV – Types and Relevance

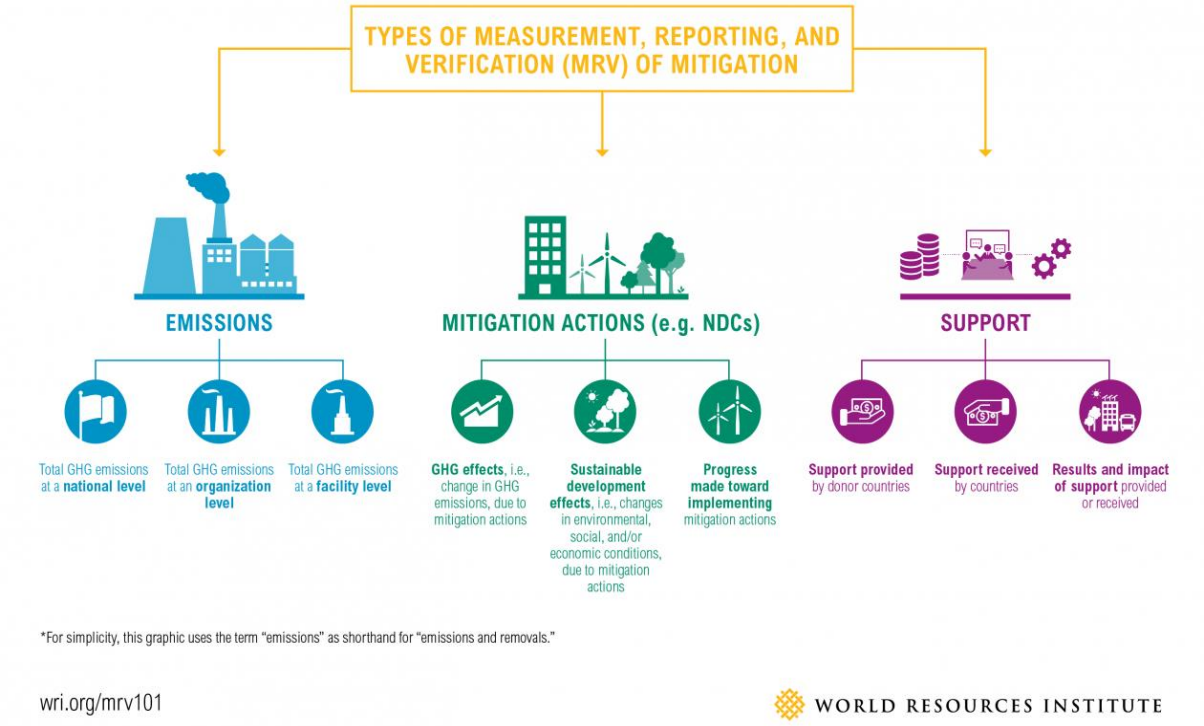
There are three separate climate-related aspects that MRV is carried out on which the report seeks to cover. These are shown in Figure 1. Each one has different activities and processes.

Figure 1: MRV Classes/Types Reported by countries.



The challenge is that MRV can mean a lot of different things, and accordingly, has been used in many different ways. This infographic shows the 3 types of MRV and the different levels at which they can be undertaken.

Figure 2: Types of Measurement, Reporting and Verification (MRV) of Mitigation



MRV of GHG Emissions and Removals

At a national level, the total human-induced GHG emissions and removals in the country are measured, reported, and verified. To support national GHG inventories, the Intergovernmental Panel on Climate Change (IPCC) released guidelines in 1996. An updated version released in 2006 is the current reference. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (referred to hereafter as the 2006 IPCC Guidelines) are supplemented by the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

UNFCCC guidance advocates the identification of key sectors in a country. These are the sectors that are responsible for a high proportion of a country's emissions. The major sectors responsible for emissions and removals in Nigeria remains energy; industrial processes and product use (IPPU); agriculture, forestry, and other land use (AFOLU); transport and waste. To the best of their capacity, non-Annex 1 countries[1] are required to report separately on emissions and removals of three GHGs. These are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The countries are encouraged to report on several other GHGs if they can. While many sectors contain GHG emitting activities, the AFOLU (comprising of Crop and Livestock Sector and Land Use and Land Use Change (LULUCF) sector is the only one that also removes GHGs from the atmosphere. This happens when plants remove CO_2 from the atmosphere in the process of photosynthesis.

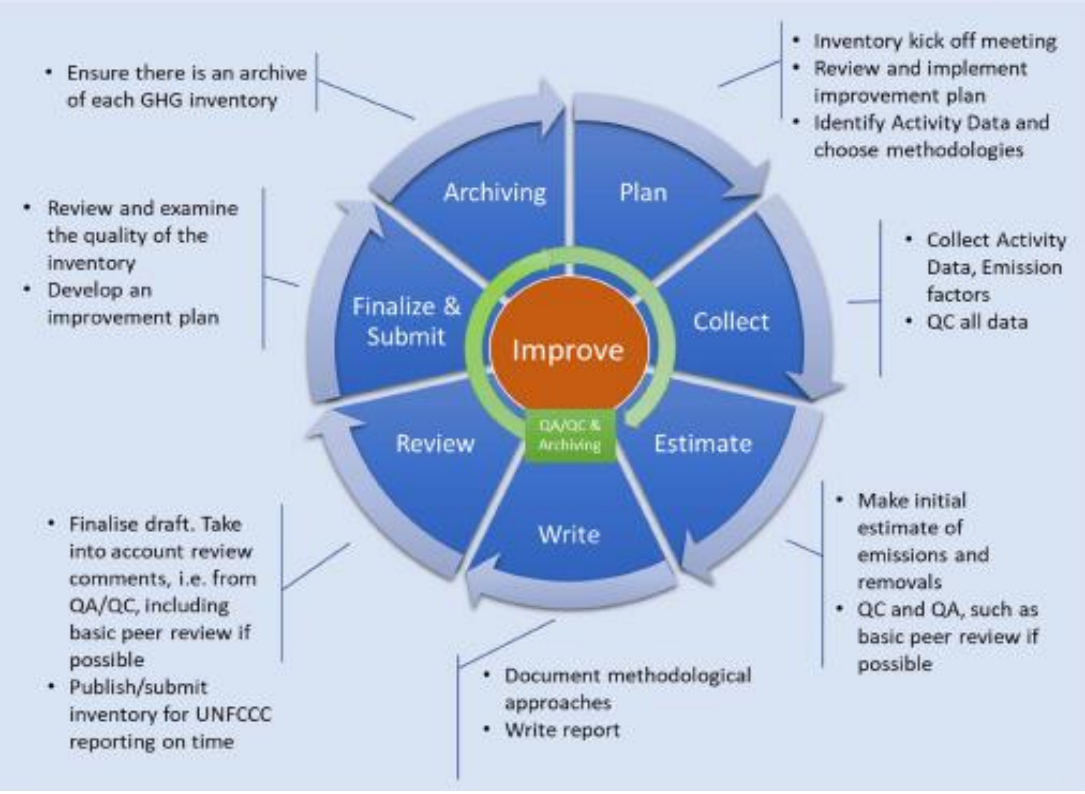
[1] Under the UNFCCC, Annex 1 countries include the industrialized countries that were members of the Organization for Economic Co-operation and Development (OECD) in 1992, plus countries with economies in transition (EIT). Non-Annex 1 countries are mostly developing countries. Nigeria is included in this group.

The process of measuring GHG emissions involves identifying the sectors which are responsible for emissions. Within those sectors, the activities which produce emissions are identified. For each activity, an attempt is made to determine the amount of GHG emitted. This value, representing the quantity of emissions, is called the emissions factor. The more data that is available about the activity, the more accurate the emissions factor is likely to be. In cases in which localized data is unavailable, countries should use default estimates of GHG emissions for a range of human activities as currently adopted for the crop and livestock sector in Nigeria. These estimates are found in the 2006 IPCC guidelines. The use of default emission factors is the most basic method of measuring emissions. Methods are grouped into three tiers where Tier 1 involves this most basic method, Tier 2 uses more complex methods which provide more accurate data and Tier 3 is the most complex, providing the most accurate data. The three-tier system is designed to allow for countries' common but differentiated responsibilities.

To measure and report in the form of a GHG inventory, there is a need to develop a system of data collection that stretches across relevant sectors and levels, and which has a focal agency with the responsibility of collating the data. The process is a continuous round of activity that begins a new inventory as soon as the previous one is finalized. This process of emission estimation is part of what this report seeks to achieve. An example is shown in Figure 3 below.

Aside from UNFCCC reporting requirements, countries may require smaller entities such as subnational and large cooperation to report on their emissions. In recent years, there has also been increasing recognition of the role that sub-national entities play in GHG emissions, and there is a movement of cities that are reducing their emissions through the use of tools and platforms developed and adapted for the purpose.

Figure 3: GHG Inventory Cycle (EPA Toolkit 2020)



MRV of Mitigation Actions

Mitigation actions include policies, strategies, and projects which are designed to lower overall GHG emissions. MRV can assess:

- the changes to the level of GHG emissions or removals as a result of the mitigation action;
- sustainable development effects, referring to changes in environmental, social, and/or economic conditions that occur as a result of mitigation actions; and
- implementation progress of the mitigation action (Singh, 2016).

In the context of mitigation actions, there may be some MRV data that is also required for the monitoring and evaluation (M&E) of projects. In this case, the same data may be included in reporting to different streams. Although MRV and M&E both require data collection and reporting, the term M&E usually refers to climate change adaptation actions, while MRV refers to mitigation. MRV is more standardized across the world, as GHG emission is a measurable and comparable activity. Adaptation, on the other hand, is specific to the local context and there are currently no standard measures for it.

MRV of Technical and Financial Support

There is a range of mechanisms for countries to be provided with technical, financial, and capacity-building support. This is a crucial aspect of global climate response. Through their MRV systems, developing countries measure the financial and technical support needed to meet their climate action targets. The support needed is reported to the UNFCCC through standardized reports. In this way, the needs of developing countries are transparent to UNFCCC bodies and potential developed country donors and funds. MRV keeps account of the amount of support that has been provided and of the mechanisms through which it has been provided. Conversely, the amount received by recipient countries is recorded and an evaluation is made of the impact that the support has generated. Through MRV an ongoing check is made of the effectiveness of climate support.

> "A **mitigation goal** is a commitment to reduce, limit the increase of, or enhance the removal of GHG emissions, or to reduce GHG emissions intensity by a specified quantity, to be achieved by a future date.
>
> **Mitigation policies** include laws, directives, and decrees; regulations and standards; taxes, charges, subsidies and incentives; information instruments; voluntary agreements; implementation of new technologies, processes, or practices; and public or private sector financing and investment; with the aim of reducing GHG emissions.
>
> A **mitigation project** is a specific activity or set of activities intended to reduce GHG emissions, increase the storage of carbon, or enhance GHG removals from the atmosphere".

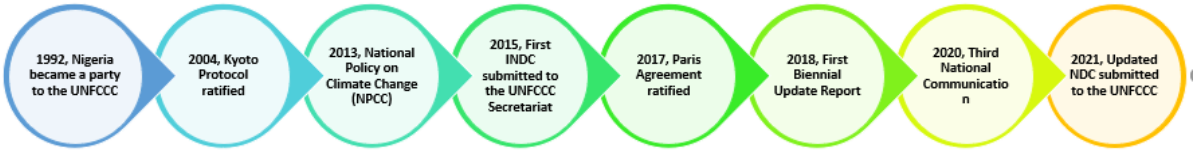
1.3 Setting Up Crop and Livestock MRV system

An improved monitoring and reporting system is fundamental for the correct implementation and tracking of Nigeria's NDCs. Developing the national MRV system complemented with the ETF requirements responds to the obligations of the Paris Agreement and increases the chances that the country's NDC commitments will be achieved. A robust MRV framework for the agricultural sector will closely link to and integrate with other key priority sectors and therefore lead to a better understanding of the mitigation and adaptation opportunities in the sector, given its important carbon sequestration capacity.

In this perspective, the ICAT–Nigeria project fully addresses the country's need to develop a robust MRV system and strengthen its capacity to fulfill UNFCCC reporting requirements, including compliance with the ETF in the Crop and Livestock sector, and track progress against priority actions identified in the updated NDC. The project's outputs are drawn directly from the priorities outlined in Nigeria's NDC and are highly consistent with the requirements of UNFCCC communications, including National Communications (NC) and Biennial Update Reports (BUR)/ Biennial Transparency Report, as well as with other economic and social priorities of Nigeria.

Figure 4: Nigeria Reporting Progress

Process (Journey so far)



Nigeria submitted its first INDC to the UNFCCC Secretariat in September 2015. The NDC is based on existing national regulations and policies on issues related to climate change, agriculture, and land use, including namely: the National Policy on Climate Change (NPCC), National Environmental Policy, National Action to Combat Desertification, National Biodiversity Strategy, and Action Plan, National Policy on Erosion, Flood Control and Coastal Zone Management, National Forest Policy, National Adaptation Strategy and Action Plan (NASPA), National Policy on Drought and Desertification and several others

Aligning with several national priority MRV related projects and activities being implemented to either develop or improve the monitoring and reporting in various priority sectors including the agriculture sector, the ICAT-Nigeria MRV project was designed to complement ongoing efforts towards common goals. Integrating the ETF dimension, this project aims to develop and also strengthen Nigeria MRV capacities in the crop and livestock sector, including inventories of greenhouse gases by sources and sinks, mitigation actions and support received, and information necessary to track progress against priority actions identified in the country's NDC.

The Federal Ministry of Environment through the Department of Climate and ICAT agreed to develop a sectoral MRV system for the key three priority sectors (Agriculture sector inclusive). To this purpose, a stakeholders' inception workshop was held in April 2021, gathering about 70 participants from public, private, research, and international organizations. The workshop allowed the gathering of stakeholders' input while adopting the project and further stepdown interactive sessions with the sector experts on the project's goals and objectives

Key stakeholders

- **The Federal Ministry of Environment (FMEnv)**: is the key ministry to develop, update and implement climate-related policies.
- **Department of Climate Change (DCC)**, within the FMEnv: is the project's key executing partner. DCC is the executing entity tasked with the development of Nigeria's NC and BUR/BTR and is responsible for GHG inventory at the national level. DCC is also responsible for the coordination of climate change gap analysis, policy guidance, and project implementation.

- **The Federal Ministry of Agriculture and Rural Development (FMARD)**: is the main ministry in charge of agricultural projects, policies, and implementation in the country.
- **Department of Agricultural Land and Climate Change Management Services:** the key department with the mandate of implementing climate change mitigation and adaptation activities.

Other national institutions active in other sectors, universities and research institutes, resource partners, civil society and the private sector also play a key role in the process.

Major Component of Institutional Arrangement

For Nigeria to have a robust, efficient and sustainable MRV system for the crop and livestock sector, there is need to develop strong institutional framework. The institutional arrangements are policies, systems, and processes that governments and organizations use to legislate, plan and manage their activities efficiently and coordinate with others in order to fulfil respective mandates.

Institutional arrangements encompass the responsible MDAs, their human resources, funding, equipment and supplies, leadership, effectiveness, and the communication links within and among the crop and livestock sector. Strong Institutional arrangements will support the key stakeholders in translating the MRV complex technical findings into methodologically information that can be used for policy relevant purposes.

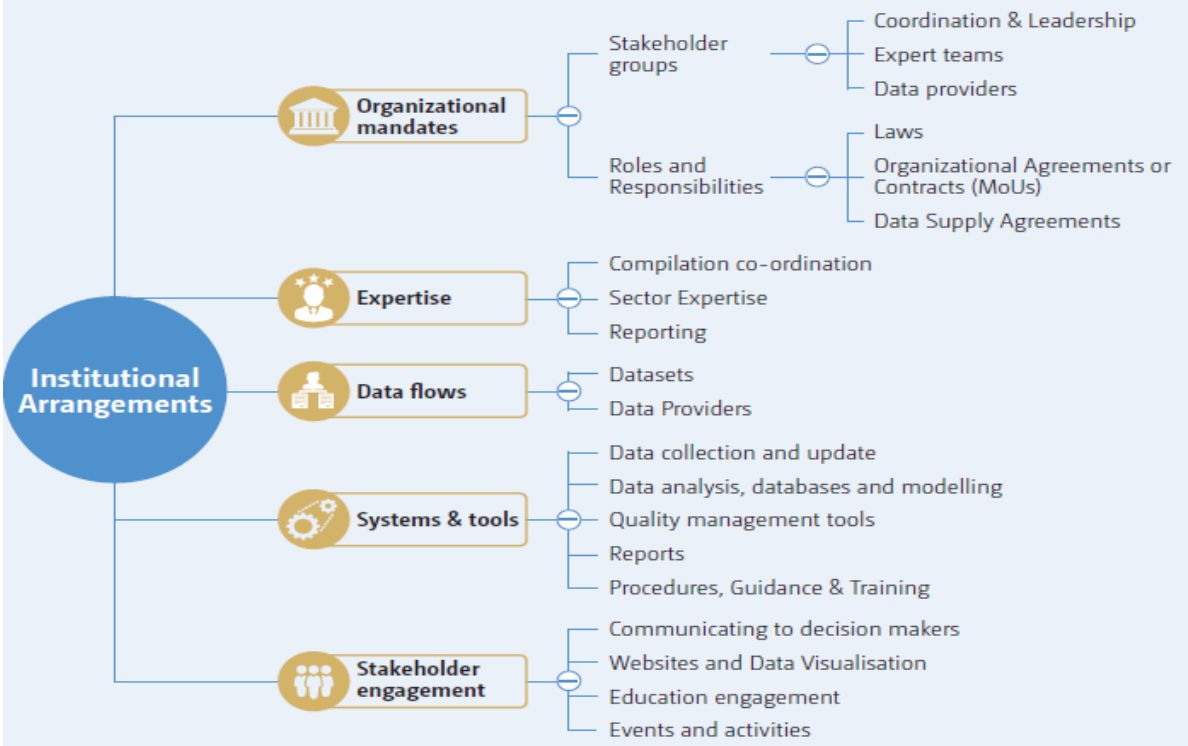
The UNFCCC has published a handbook on institutional arrangements to support MRV/transparency of climate action and support which provides technical support and advice to developing country parties for implementing MRV arrangements under the Convention and the ETF under the Paris Agreement.

The guide ensures that institutional arrangements are designed to help individual Parties ensure that appropriate procedures for collecting, processing, reporting, and archiving required data and information are established, and that relevant stakeholders from the public and private sectors are involved in meeting the reporting requirements of the Convention, as well as addressing the broader issues of ETF both at the sectoral and national level. The guideline was adopted in the development of the crop and livestock sector Institutional framework.

The major component proposed in the handbook include

- Organizational mandates
- Expertise
- Data flows
- Systems and tools
- Stakeholder engagement

Figure 5: Major Components of the Institutional Arrangements



Source: UNFCCC Handbook, 2020

Chapter Two – Organizational mandates

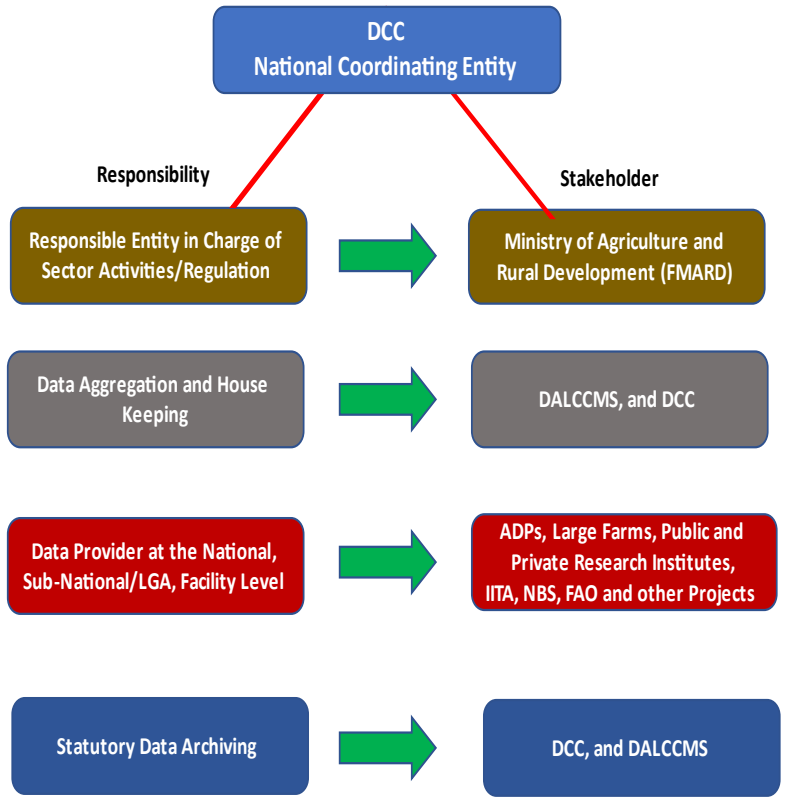
2.0 Overview

An integral component of an MRV system is identifying the organization(s) responsible for compiling and management of the needed data. This role will involve agreeing on the provision of data from the network of stakeholders and data providers. Data management, analysis, and reporting are also key tasks in developing a sustainable MRV system. Strong Institutional arrangements (IA) are vital to enable Nigeria's agricultural sector provide reliable, comprehensive, and regularly updated information that meets the enhanced reporting requirements and serves national decision-makers and action-implementing stakeholders.

2.1 GHG Inventory

A well-structured organizational mandate plays a key role in aligning key stakeholders during implementation of inventory plans. A clear mandate will help institutions to understands their roles, hierarchy of reporting, data flow and management when developing inventories at the sectoral level. The figure below shows a brief summary of organizational mandates within the crop and livestock sector.

Figure 6: Flow Chart of Organizational Mandate in the Sector



Description of Mandates

Department of Climate Change (DCC): The current IA has the Department of Climate Change (DCC) as the lead National Agency responsible for coordinating, implementing and reporting climate action. The DCC comprises of four divisions comprising GHG-Inventory Division, Vulnerability and Adaptation Division, Mitigation Division, as well as Education, Training, Public Awareness, and other information Division coordinating activities within various components. The DCC also convenes and chairs the Inter-Ministerial Committee on Climate Change (ICCC).

The Federal Ministry of Agriculture and Rural Development (FMARD): is the main ministry in charge of agricultural projects, policies, and implementation in the country. The Ministry is made up of about, 17 departments, 6 Regional Offices, 37 State offices, 11 Agencies, 15 research Institutes, 14 Colleges of Agriculture, and several Universities of Agriculture.

The ministry has the following mandate:

- Creating a conducive environment to stimulate greater sector participation in agriculture to enable the business side to assume its appropriate role as the engine of economic growth.
- Increasing agricultural production through the promotion of supportive and service-oriented sub-sectoral activities to enhance production, productivity, and marketing opportunities.
- Developing the seed industry and technology as the foundation of sustainable practice.
- Promoting the research and development of appropriate agricultural technology including biotechnology to transform agricultural production and productivity
- Promoting agro-processing, preservation, and storage to reduce pre- and post-harvest losses to the barest minimum.
- Promoting the timely availability of adequate and quality agro-inputs to enhance production.
- Developing an efficient competitive and self–sustaining production, health, and management of improved livestock species in the country to meet the protein needs of the populace and the raw materials requirements of industries.
- Intensifying settlement programmes for pastoralists by providing necessary facilities at the grazing reserves and supporting ranching facilities.
- Increasing the level and widening the scope of insurance coverage of agricultural production to reduce risk and losses attendant to agricultural production.
- Maintaining the Strategic National Food Reserve Programme for purposes of food security and market stability.
- Promoting an efficient and effective credit administration system.
- Coordinating agricultural and rural development data and information management systems.
- Inventorying land resources and controlling land use and degradation, as well as promoting climatic change adaptation and resilience practices.
- Building capacity and vocational skills to impact agricultural best practices to all stakeholders.

Department of Agricultural Land and Climate Change Services is the focal department responsible for climate change mitigation and adaptation activities within FMARD. They have received basic capacity building on GHG inventory preparation, nature of activity data needed and reporting requirement of the sector. Engaging the department to take the lead coordinating the data aggregation, processing and arching for the sector.

National Bureau of Statistics (NBS) is the main National Agency responsible for the development and management of official statistics, the authoritative source and custodian of official statistics in Nigeria. Other national institutions active in other sectors, universities and research institutes, resource partners, civil society and the private sector also play a key role in the process.

Table 1: GHGI Roles and Responsibilities

Inventory Task	Lead Institution	Roles
Approval and submission of the inventory report	Federal Ministry of Environment	• Reviews and approves of national inventory report. • Uses inventory estimate to inform policy. • Provides overall policy direction to the national inventory compilers.
Designated National Entity (DNE)	Department of Climate Change (DCC)	• Overall technical oversight and coordinates timely deliverables. • Develops programs and strategies which will ensure long-term improvements in the inventory system. • Dissemination and awareness creation on all the inventory products.
National Inventory Coordinator	UNFCCC Focal Point Director Department of Climate Change	• UNFCCC Focal Point acts as the inventory coordinator to oversee the entire inventory on behalf of the Department and Ministry. • Plans the preparation of the inventory and provides operational, management, and technical oversight. • Reports directly to the Permanent Secretary for onward transmission to the Minister of Environment. • Manages all MoUs, contracts, and information agreements to facilitate the efficient delivery of all contracts, data, tasks, and agreements.
Compiler	Department of Climate Change, (Lead, Mitigation Analysis, and Reporting)	• Reports directly to the UNFCCC focal point and works with the GHG working teams. • Creates schedule based on the inventory cycle timelines and all the inventory preparation steps that need to be completed before, and after, the due date, taking into account the time needed to complete each of those steps. • In the event of the inventory undergoing review (internal or external), the compiler will interface between reviewers and the inventory experts. • Responsible for data and document management, which is critical to the long-term improvement of the inventory. • Act as the receiver of inventory files from the working groups – all worksheets and text and would be responsible for putting the pieces together into one unified inventory document.

Inventory Task	Lead Institution	Roles
		• Doubles as the generalist for the inventory. This implies that the complier ensures that all the inventory activities, which border on issues such as decisions and choices to undertake recalculation, key category analysis, completeness and reporting are consistent with IPCC GPGs both at the level of the inventory and also at the sector level. • Ensures new developments concerning the inventory are thoroughly discussed and implemented. The compiler works closely with the sector experts to make the sector inventory internally consistent.
QA/QC	DCC, DALCCMS	• Responsible for the planning and implementation of QA/QC activities. • Together with the inventory complier design and oversee the implementation of QA/QC plan.
Uncertainty Management	DCC, DALCCMS, NBS	• Design and perform tier-1 and tier-2 uncertainty assessment of the entire inventory and at least for the key categories. The design must be fully consistent with the 2006 IPCC. • Generates simple-to-implement worksheet that inventory sectors will use with great utility, in the estimation of sector-level key category uncertainty estimation. • Based on the 2006 IPCC, produce simple steps for the management of uncertainties in the sectors and at the inventory levels.
Documentation and Archive	DCC and DALCCMS	• Design and ensure complete references for all data in line with QA/QC protocols. • Document all responses to internal and external review comments. • Ensure all information and data are collected consistently for purposes of later reference and archived with other inventory materials. • Design data storage and documentation procedures for the inventory. • Implement and manage the central database infrastructure that will be put in place. • Ensure sector group leads complete the documentation-tracking log for onward transmission to the inventory compiler.
Sectors Leads and Experts	FMARD Department of Agricultural Land and Climate Change Management Services, In-country experts, consultants	• Conduct a comprehensive assessment of GHG data requirements of the sector, identify the sources and access them with the support of the inventory coordinator/compiler using appropriate channels and document all the data and processes involved. • Collect, collate, process and update all GHG and related data in the sector, and take final decisions on which processed data qualifies to be used in the inventory on the basis of agreed conditions in the QA/QC plan. • Submit all processed data and any other data to the central database hosted at the DCC and

Inventory Task	Lead Institution	Roles
		keep back-ups in the department for future reference. • Liaise with the inventory compiler at DCC to undertake a comprehensive review of available methodological choices and make sound methodological choices based on its applicability to the estimation of GHG emissions. • Estimate GHG emissions for all categories and gases under the crop and livestock sector using appropriate factors/ GWPs and ensure that the processes/assumptions for the estimation, including the software used, are consistent with the IPCC guidelines and fully documented. • Conduct key category analysis for the sector and uncertainty assessment in collaboration with the generalist and the uncertainty management lead. • Compile the sector estimates in the worksheets into "detailed" and "synthesis" reports, including clearly prioritized plans for improvements to be incorporated into the national inventory report. • Create and maintain hard and soft copies of all information, data, and estimates at the sector level and for onward transmission to the Department of Climate Change as the inventory documentation and archiving depository. • Consult with the inventory compiler to discuss and agree on the cost involved in activities that can be done within the quarter in the inventory year. The rate and mode for requesting funds will be discussed and agreed upon ahead of every inventory cycle.

2.2 Mitigation

The mandate of key institutions identified during the stakeholder scoping showed that organizations are required to design and implement mitigation and adaptation projects which reflect in their annual budget and workplan. These projects can also be in partnership with other donor organizations or international funding partners (World bank, FAO, IFAD, GEF etc). Agriculture is one of the few sectors that can both contribute to mitigation and sequestration of carbon emissions and accounting for agriculture's carbon footprint is necessary, particularly since agriculture was included in greenhouse gas reduction commitments in the Nigerian NDC. However, the range and variability of estimates, and the complexity and uncertainty of accounting for indirect emissions remain to be resolved.

Strong policies will play a key role in enhancing the ability of the sector to adapt to climate change, while also contributing to other environmental goals.

The following organizations will play a key role in tracking mitigation and adaptation actions in the sector

Agricultural Development Project is designed to complement the key priority projects of FMARD at the subnational level through stepping down interventions in the sector, robust extension services and capacity building of farmers. This role enables them to interface directly with project beneficiaries and ehance quality data collection, processing and reporting for various donor funded projects.

Department of Agricultural Land and Climate Change Services is the focal department responsible for climate change mitigation and adaptation activities within FMARD. They have received basic capacity building on GHG inventory preparation, nature of activity data needed and reporting requirement of the sector. Engaging the department to take the lead.

National Bureau of Statistics (NBS) is the main National Agency responsible for the development and management of official statistics, the authoritative source and custodian of official statistics in Nigeria

Department of Climate Change (DCC): The current IA has the Department of Climate Change (DCC) as the lead National Agency responsible for coordinating, implementing, and reporting climate action. The DCC comprises of four divisions comprising GHG-Inventory Division, Vulnerability and Adaptation Division, Mitigation Division, as well as Education, Training, Public Awareness, and other information Division coordinating activities within various components. The DCC also convenes and chairs the Inter-Ministerial Committee on Climate Change (ICCC).

The Federal Ministry of Agriculture and Rural Development (FMARD): is the main ministry in charge of coordinating agricultural policies and implementation of federal projects in the country. The Ministry is made up of about, 17 departments, 6 Regional Offices, 37 State offices, 11 Agencies, 15 research Institutes, 14 Colleges of Agriculture, and several Universities of Agriculture.

Chapter Three – Expertise

3.0 Preamble

Building a sustainable robust national inventory system requires the engagement of a team of national experts. The team has to be convened from various institutions and their capacity built to be able to manage the national inventory process.

The team of national experts should be capable of regularly gathering through workshops, zoom meetings etc and processing data to produce the agreed outputs on time. The team should have suitable backup expertise and access to relevant training materials. There should also be effective recruitment, retention, and succession procedures in place that motivate the long-term and active involvement of experts in the reporting process. These aspects depend on suitable organizational mandates, as described in chapter 2 above. In this early phase of developing sectoral institutional arrangements, it will be helpful to contract external support to train and mentor the team of national experts. The team of national experts may also wish to bring in temporary additional support for new developments from time to time.

3.1 GHG inventory

The national relevance of an efficient and sustainable MRV system requires that national experts and teams should have the needed skills to coordinate and manage the activities in the inventory cycle. The following skills are require for the GHG inventory experts in the crop and livestock sector.

National experts

National experts are responsible for collecting, processing, and arranging the data and information for reporting of transparency themes. These experts often specialize in one or more of the transparency themes or sub-themes (e.g. GHG inventory, sectoral vulnerability assessment). In general, national experts should:

- Have good relationships with data providers;
- Be comfortable with data analysis and calculations, and associated science and methods, including IPCC guidelines;
- Have a good understanding of the benefits and limitations of the data sets.

National GHG Inventory Compilers

- Experts should have an understanding of the agriculture sector which requires good knowledge of the activity data and data sources, IPCC methodologies and GPG. Clear understanding of the inventory cycle and timeline is also required to ensure timely delivery of outputs.
- Experts should ideally be knowledgeable about the development of historical (e.g. from 1990 or 2015) and projected (e.g. to 2040 or 2050) time-series of estimated emissions and removals;
- Experts should be good with numerical data and data processing and analysis tools and models;
- Experts should have a thorough understanding of the IPCC guidelines and the international reporting and review processes under the Convention and the Paris Agreement;
- Experts undertaking projections should have a good understanding of national policy and economic development and any sectoral economic, production, or impact models;

- Experts should be able to clearly articulate the gaps and resource constraints facing the data-collection process and have the capacity to prioritize and address these gaps.

Technical Working Group (TWG)

GHG inventory Technical Working Group can be envisioned as the nucleus of connections to focal points for sources of information to the sector GHG data hubs. The GHG inventory TWG would therefore collect activity data, determine emission factors, and generate calculations in line with principles of inventory quality, as well as timeliness and adherence to the UNFCCC reporting guidelines**.** This is made up of group of experts drawn from key institutions that will play major roles at different stages of the inventory cycle. They are expected to be knowledgeable about the Nigerian NDC commitment, GHG inventory requirements, nature of activity data required and sources of such data and good knowledge of analytical tools such as IPCC GHG calculator, etc.

Quality Assurance and Quality Control

QA/QC is required at different stages of the inventory cycle to ensure quality data collection, analysis and reporting. An expert knowledge of inventory methodologies and IPCC guideline is required at this stage. The QA/QC expert is predominately concerned with quality assurance/ quality control coordination and can as well be responsible for overall data and document management. Multifunctional profiles are also possible and efficient in this type of activity, as for example, a QA/QC coordinator can be also a sectoral expert in crop and livestock sector and still cover both tasks simultaneously.

3.2 Mitigation

Mitigation and Adaptation: climate action planning, tracking, and policy experts

- Experts should have an awareness of national and sectoral strategies, mitigation and adaptation projects, their status, and their investment/support needed/provided;
- Experts should understand the options and impacts (including benefits) of actions and the indicators to track the progress of implementation;
- Strong links with government departments, the private sector, NGOs, and policy think tanks that can provide input on the feasibility of implementing action and input on tracking the progress of implementation;
- Well connected to decision-making on national and subnational strategies and policy implementation;
- Good understanding of the financial, technological, and capacity-building support provided for climate actions (e.g., which projects have received support or funding, how much has been provided, how much is still needed, and from who) from a bottom-up (by project) and top-down (by fund) perspective.

Adaptation: climate impact monitoring and analysis experts

The national expert team may include many individuals from different institutions. Collectively, they need to be able to perform analyses of climate trends and their impacts, translating these to vulnerability and climate change impact assessments. More specifically:

- Experts must have a comprehensive understanding of the sectoral or overall risks, vulnerabilities, and impacts of a changing climate;
- Cross-cutting sectoral experts should be knowledgeable about disaster response, hydro/meteorology, and thematic areas that are impacted by climate change such as agriculture;

- Sectoral experts should have a thorough understanding of the social and economic development issues of their sector (e.g. a thorough understanding of the impacts of drought on agricultural yields);
- The experts should have a broad knowledge of trends in climate and extreme weather events and their impacts on the physical environment.
- Disaster response teams who focus on preventative measures need an understanding of the causes of natural disasters and how to avoid their impacts;
- Experts should be well connected with policy officers and stakeholders who have a solid understanding of planned, ongoing, and completed climate change adaptation projects to inform priorities.
- Experts should have a thorough understanding of the IPCC reports and guidelines on adaptation planning and reporting and the reporting guidelines on adaptation for NCs and adaptation communications under the Paris Agreement.

Chapter Four – Data flows

4.0 Overview

In the crop and livestock sector data is sourced from many organisations, institutes, associations, companies, subnational entities, and ministerial branches. At this stage, there is a lack of legal and formal procedures for obtaining data and compiling the GHG emission inventory. It is an established fact that is common amongst non-Annex 1 countries. The crop and livestock sector input data are obtained on a voluntary system and relies on good relationships which have been built up over time. This system is however, not sustainable should relationships turn sour or if key data compilers or contacts leave their organizations.

Box 5: Quality attributes of GHG inventories

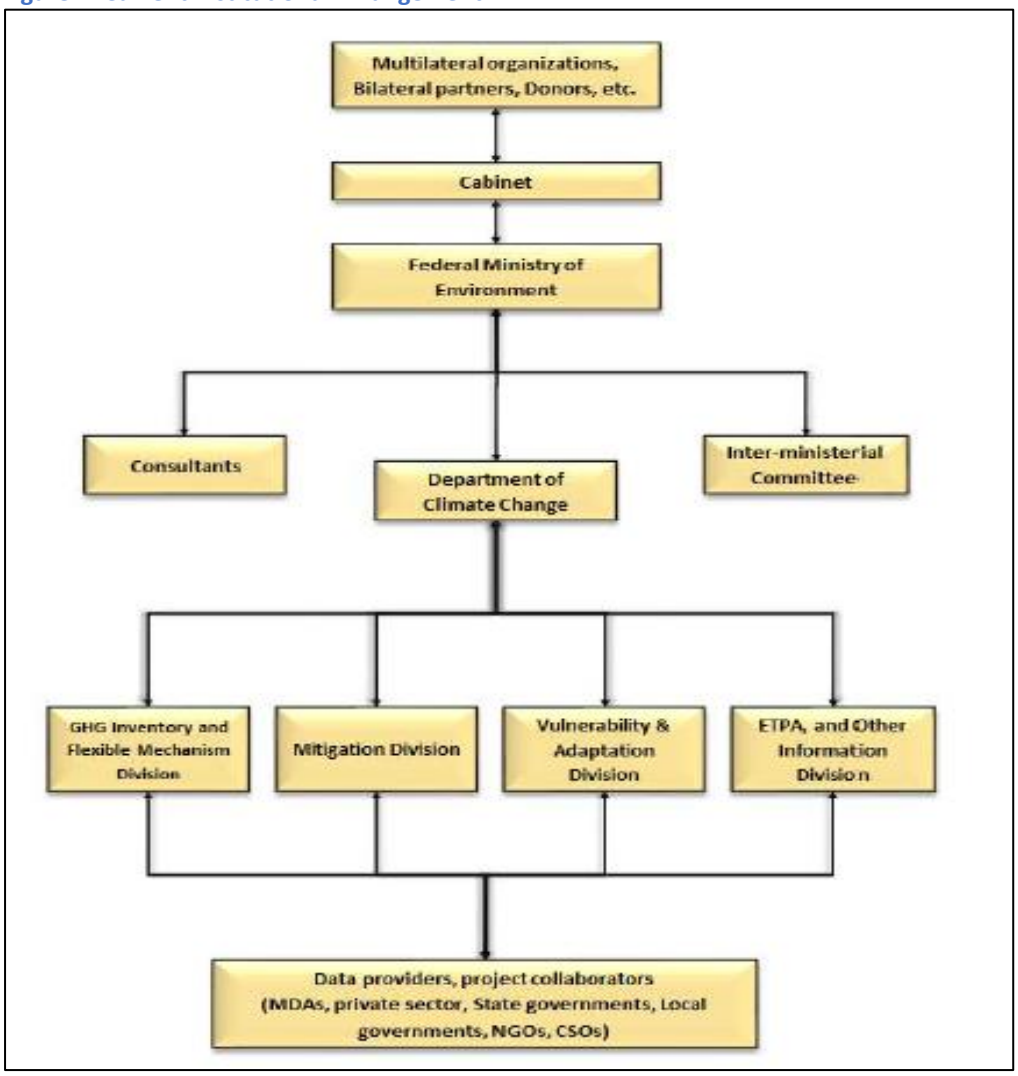
Transparency: There is sufficient and clear documentation so that individuals or groups other than the inventory compilers can understand how the inventory was compiled and can confirm the quality of the data;
Completeness: Estimates are reported for all relevant activities and gases. Where data are missing, their absence should be clearly documented;
Consistency: Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and activities reflect real differences in emissions. The inventory of annual trends, as far as possible, should be calculated using the same method and data sources for all years and should aim to reflect the real annual fluctuations in emissions and not be subject to changes resulting from methodological differences;
Comparability: The GHG inventory is reported in a way that allows it to be compared with GHG inventories from other countries; and
Accuracy: The GHG inventory contains neither over nor underestimates, so far as can be judged, and uncertainties have been reduced as much as is practical. This requires undertaking all efforts to remove bias from the inventory estimates.

4.1 GHG Inventory

Present Information flow

The Figure 7 below shows the institutional arrangements currently used in Nigeria for the development of the National GHGI

Figure 7: Current Institutional Arrangement



Source: Third National Communication

In the framework of the above approach to the GHG inventory at the national level, the specific flow of information for the GHG inventory is represented in Figure 7 above in a standard format used in quality assurance systems. There are features in this data flow of information that can be improved to make it more efficient in terms of ensuring the consistency and coherence of data from the crop and livestock sector. Further recommendations will be given in the chart below.

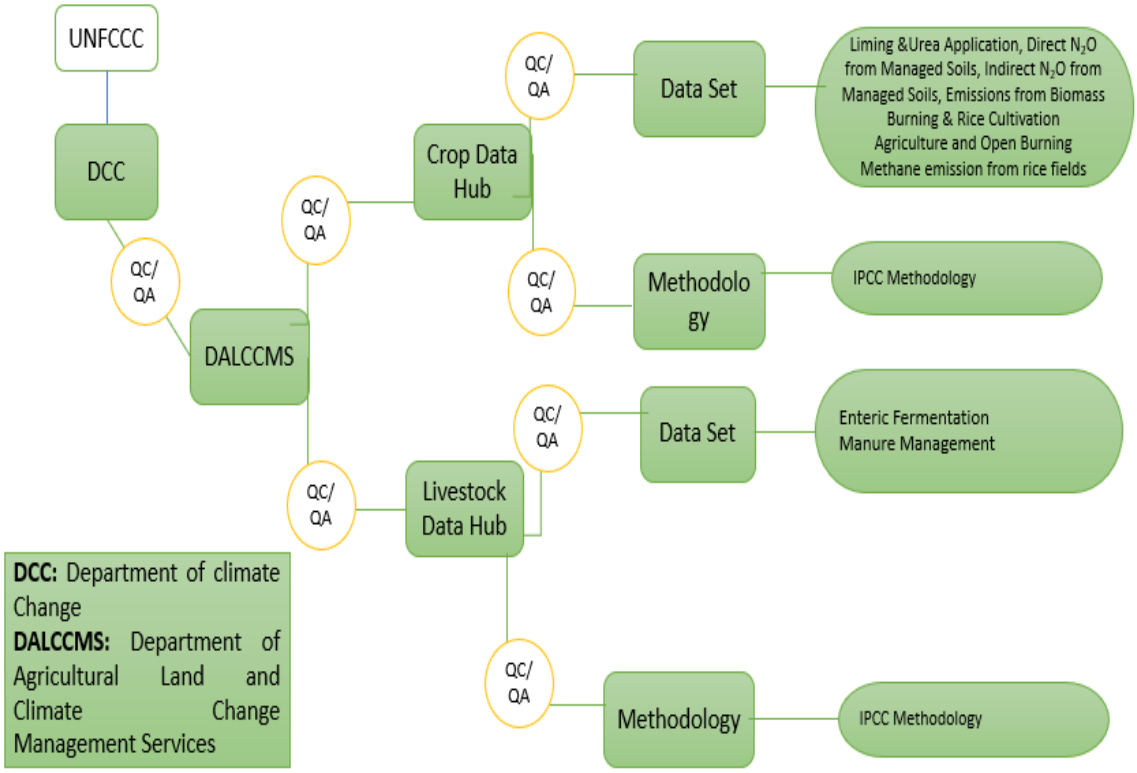
The entities that will be involved in the sectoral inventory development are listed starting with the DCC and followed by key ministries in the Administration (FMARD) and other reporting entities like NBS, and other MDAs. Those entities that receive the completed inventory i.e., the UNFCCC, other Bilateral organizations, and donors, will appear at the end of the list.

The data reporting entities need to have a clear mandate and procedures for data collection, processing, archiving, and disseminated at their level and this represents an important

recommendation of this sectoral framework to be completed possibly in connection with the implementation of IPCC 2006 GPG on inventory preparation and methodology.

The data collection and verification cycles provision and the dissemination of standard procedures will be designed to ensure that data is coherent and consistent at the reporting source and that it is delivered efficiently without creating an accumulation of processing needs that may cause a delay in analysis or reporting.

Figure 8: Proposed Crop and Livestock Sector Data Flow Chart



As shown in Figure 8, the sequence of events starts with verification by the DALCCMS that the reporting entities are still operational and are continuing to fulfill the request for data from the department and other entities. In addition, there is verification that the involved entities are preparing and delivering the data according to the disseminated procedures mentioned above. There are two data quality verification cycles, one done in the DCC and the other undertaken in cooperation with the DALCCMS to ensure that the final report of the GHG inventory is consistent and comprehensive according to the requirements of the applicable guidelines. Finally, the last stage is about sending the GHG inventory to the receiving entities.

The responsibility of the DCC through the FMEnv is to send it to UNFCCC and other bilateral organizations. Although, as indicated in the chart, there is feedback from UNFCCC on the GHG emissions inventory in the form of a review report, this is not represented in the diagram that describes the process as this diagram only addresses the proposed sectoral framework which ends with sending the inventory to the international bodies.

The data flow chart further reveals the proposed operational outline associated with the inventory preparation and other activities of the crop and livestock sector that will constitute the sectoral MRV system moving forward. This will be superimposed on the overarching MRV national system, the data

flow chart depicts the actual operational activities of the various tasks groups to be executed under future inventory preparation activities. Data preparation and evaluation will be primarily carried out at the task group level, a harmonized dataset in the appropriate format will then be inputted into the IPCC datasheets or any other standardized customized datasheets provided for the assignment in the crop and livestock sector and subsequently worked in the IPCC software and database for the generation of the estimates. Once the estimates are generated, the groups can begin the report writing process and subsequent deposition of the estimates and data through the data management system to be provided for the activity.

Sources of activity data

The inventory preparation will require data from a combination of sources such as national and international institutions. During data collection, priority will be given to data that have been generated in the country and the infrastructure to generate such data will need to be developed to ensure data quality, reliability, and consistency. In cases where the required data is not available in the country, the data from international organizations such as FAO, World Bank, etc. can be used. This move will enable Nigeria to move towards higher tiers and produced more accurate estimates. Table 2 provides an overview of the IPCC key data categories, current data sources, and other proposed data sources.

Table 2: Description of Activity Data Sources

Sub-Sector	Crop and Livestock Sector	Data type	Data Source
3.A1 and 3.A2	Enteric Fermentation & Manure Management	Animal population, Fractions of manure, management practices	Agriculture Facts and Figures FAOSTAT Expert Judgment FMARD
3.C3	Urea application and other carbon containing fertilizers	Annual Urea consumption figures	NBS, FMARD, FAOSTAT Agriculture Facts and Figures
3.C4	Direct N2O emissions from managed soils	Annual generic NPK consumption figures	NBS, FMARD, FAOSTAT Other publications
3.C5	Indirect N2O emissions from managed soils	Annual crop production in tonnes per annum	NBS, FMARD, FAOSTAT, Other publications
3.C6	Indirect N2O emissions from manure management	Animal population (cattle, goats, sheep, swine, donkey, poultry, horse)	NBS, FMARD, FAOSTAT, Other publications
		Fractions of manure management practices	FAOSTAT, FMARD, Other publications, Expert Judgment
3.C7	Rice cultivation	Annual rice production areas	NBS, FMARD, FAOSTAT
3.C8	Prescribed burning of savanna	Area maps	Global Fire Emission Database (GFED 4), Climatic Map, Global Ecological Zones (GEZ) NBS, FMARD, FAOSTAT
3.C9	Open burning of agricultural residues	Area maps	NBS, FMARD, FAOSTAT

4.2 Mitigation

Though the biggest challenge of agriculture is to feed the ever-increasing population while adapting to climate change, there is also a need to reduce GHG emissions from the crop and Livestock sector since it accounts for approximately one fourth of global GHG emissions when combined with forestry. Reduction of GHG emissions offers significant opportunities to address the food security and climate challenges in a more comprehensive fashion. Without reducing emissions in all sectors, the global average temperature will rise more than 2 degrees Celsius (3.6 degrees Fahrenheit), making it impossible to avoid extremely dangerous changes in climate.

Examples of agricultural mitigation activities includes reduction of deforestation, integrated-crop livestock system, alternate wetting and drying of paddy rice, animal waste treatment, improved livestock management, agroforestry and cropland and grassland management

Policies developed to help Nigeria achieve its NDC commitment will need to be tracked. The production of food, feed and fibers also contributes to deforestation and energy consumption, causing additional emissions. Tracking the NAMA is also useful for building financing mechanisms to support climate change mitigation as well as adaptation actions in the agricultural sector, taking into account Nigeria's unique national circumstance.

Developing structured data flow process with embedded QA/QC stages will help the sector to track and report accurately the mitigation and adaptation actions in the sector.

Chapter Five – Coordination, Systems, and Tools

5.0 Overview

Coordination, systems, and tools are needed for efficient performance of the sector transparency system. The process will require continuous management of data collection activities, analysis, QA/QC, summarizing and archiving of data.

The proposed institutional arrangement made provision for expected roles and responsibilities which will include preparation of inventory workplan, development of engagement tools and guides, creation of database and archiving system within the identified host entity, data analysis, process indicators and GHG reports.

The availability of these systems and tools will ensure that TWGs, national experts and host entity staff have access to the kind of activity data needed, able to manage the data flow, perform the required QA/QC and timely delivery of outputs. This gives opportunity for GHG inventory improvement plan to be implemented and monitored thereby leading to significant progress in quality of data delivered overtime.

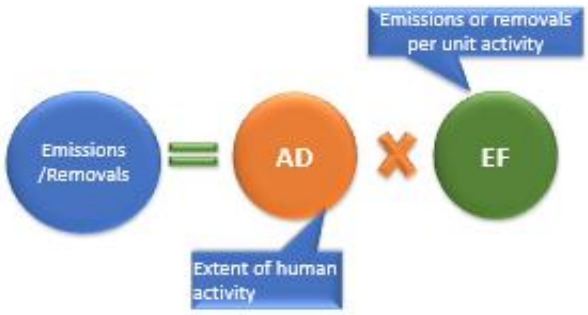
Primary data providers and coordinating entities will require a legal framework or data sharing agreement to effectively work together and achieve the needed objective within the set inventory workplan timelines.

5.1 GHG Inventory

Estimates of GHGE have been compiled using the IPCC 2006 Guidelines for National GHG Inventories (IPCC 2007) and the IPCC Good Practice Guidance and Uncertainty Management (IPCC 2000) for NC1,2,3, and the BUR1. The reports selected tier-one level for all analysis within the crop and livestock sector based on the availability of relevant activity data. The reports used default emission factors and over 95% of the data harvested from FAOSTAT. The IPCC 2006 software template was used for the inventory calculations.

General Principle of GHG Calculation

The fundamental formula for estimating the quantity of GHG emissions can always be expressed as the multiplication of the activity data (AD) by the emission factor (EF), as follows:



Where:

EF = Emission Factor
Emission factors are coefficients that quantify the emissions or removals of a gas per unit activity data. Emission factors are based on samples of measurements, averaged at various levels of detail depending upon the Tier methodology used, to develop a representative rate of emission for a given activity level under a given set of operating conditions.

AD = Activity Data
Activity data describe the magnitude of a human activity resulting in emissions or removals of greenhouse gases, taking place during a given period and over a specified area. Data on livestock type and numbers, the area extent of managed agriculture, pastures, and associated changes or the amount of synthetic or organic fertilizer applied, are all examples of AD relevant to the computation of emissions for the crop and livestock sector. In addition to the AD and the EF, this basic equation can also incorporate other estimation parameters to reflect actual emissions or removals.

The quantification of GHG emissions in an inventory is a multi-step process for each category and a detailed step-by-step approach is provided in the IPCC guideline.

Estimation Process
The IPCC 2006 Guidelines provide comprehensive documentation on how to proceed for estimating the emission and removals, and below are the initial steps of the process.

- **The identification of Key Categories**

A key category is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals. Whenever the term "key category" is used, it includes both source and sinks categories. Key categories should be the priority for the country when allocating inventory resources for data collection, compilation, quality assurance/ quality control, and reporting.

- **Selection of methods and measurement**

The IPCC-2006 Guidelines report three-tiered approaches related to methods used in the AFOLU Sector:

  - Tier 1 is the basic method.
  - Tier 2 is the intermediate method; and
  - Tier 3 is the most demanding, in terms of complexity and data requirements.

Generally, moving to higher tiers improves the inventory's accuracy and reduces uncertainty, but the complexity and resources required for conducting inventories also increase; Nigeria has adopted Tier 1 in most of the reports. Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate. If necessary, a combination of tiers can be used, e.g., Tier 2 can be used for biomass and Tier 1 for soil carbon. The methods will be generally applicable to Tier 2 inventories, but the default data presented for Tier 1 will be partly or wholly replaced with national data as part of the Tier 2 estimation.

- **The selection and collection of activity data**

Data collection is an integral part of developing and updating a GHG inventory. Formalized data collection activities should be established, adapted to the countries' national circumstances, and reviewed periodically as a part of implementing IPCC good practice guidelines.

Data sources:

- National and International Literature: The IPCC Guidelines recommend collecting data from bodies such as National Statistical Agencies, and national regulatory authorities responsible for permitting industrial and other processes subject to pollution emission legislation. Other sources of specialized literature that provide activity data, include UN statistics (including the FAOSTAT database: http://faostat3.fao.org/faostat-gateway/go/to/home/E), the US Geological Survey (USGS) and others.
- Surveys & Census information: Survey and census information provide the best agricultural, production statistics (e.g. 1992 Livestock census) that can be used for greenhouse gas inventories and are generally compiled by relevant MDAs.

- **The selection of emission factors**

The IPCC Guidelines define the emission factor as the average emission rate of a given GHG for a given source, relative to units of activity. The 2006 IPCC Guidelines, adopting the Tier 1 methods for all categories, enable the use of readily available national or international statistics, in combination with provided default emission factors and additional parameters provided, thus making it feasible to prepare estimates. The recent communications submitted relied on the default emission factors for the GHGE inventory preparation. Developing country specific emission factors will help Nigeria submit GHGE estimates that are more accurate and reliable.

Table 3: Activity Data and Key Categories in the IPCC Guideline

Sub-Sector	Crop and Livestock Sector	Data type	Data Source
3.A1 and 3.A2	Enteric Fermentation & Manure Management	Animal population, Fractions of manure, management practices	Agriculture Facts and Figures FAOSTAT Expert Judgment FMARD
3.C3	Urea application and other carbon containing fertilizers	Annual Urea consumption figures	NBS, FMARD, FAOSTAT Agriculture Facts and Figures
3.C4	Direct N2O emissions from managed soils	Annual generic NPK consumption figures	NBS, FMARD, FAOSTAT Other publications
3.C5	Indirect N2O emissions from managed soils	Annual crop production in tonnes per annum	NBS, FMARD, FAOSTAT, Other publications
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		Fractions of manure management practices	FAOSTAT, FMARD, Other publications, Expert Judgment
3.C7	Rice cultivation	Annual rice production areas	NBS, FMARD, FAOSTAT
3.C8	Prescribed burning of savan**na**	Area maps	Global Fire Emission Database (GFED 4), Climatic Map, Global Ecological Zones (GEZ) NBS, FMARD, FAOSTAT
3.C9	Field burning of agricultural residues	Area maps	NBS, FMARD, FAOSTAT

Tools for GHGE Reporting in the Crop and Livestock Sector

A wide array of tools has been developed by various organizations to guide the preparation of GHGE inventories. Some of the identified tools will be summarized below.

Table 4: GHGE Reporting Tools in the Crop and Livestock Sector

Sector	Tools
Crop Sector	▪ IPCC Guideline: The IPCC guideline provides guidance on methods to estimate emissions from the crop sector from various land management practices like fertilizer application, crop residue management, bush burning, and other subcategories. ▪ IPCC Inventory Software: The IPCC Inventory Software implements the simplest Tier 1 method for all sectors and Tier 2 methods for agriculture categories under AFOLU Sector in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. ▪ MRV Toolbox: The MRV Toolbox provides links and resources for tools specifically for measuring, verifying, and reporting (MRV) GHGs with a focus on rice. Tools include guidance and calculators for GHG inventories, mitigation projects, product-specific assessments, and evaluation of GHG field experiments. ▪ Source-selective and Emission-adjusted greenhouse gas Calculator for cropland (SECTOR) tool: SECTOR is a Greenhouse Gas Calculator for cropland based on the IPCC Tier 2 approach for rice and other crops. SECTOR was developed in response to increasing interest in mitigation research on cropland, particularly rice production. The tool is currently available as an EXCEL file and requires inputs on crop area, yield, and management. ▪ Emissions Overview Tool (FAO): The Emissions Overview tool report gives emissions and trends in the AFOLU sector, subdivided by source categories, for one or more user-specified countries. It also contextualizes emissions within the regions, continents and globally. It is based on the FAOSTAT emissions database. It aims to support countries in the preparation of NAMAs and NDCs. ▪ Quality Assurance/ Quality Control (QA/QC) and Verification: The tool allows users to compare national GHG inventory data for the AFOLU sector reported to the UNFCCC with data from the FAOSTAT Emissions database. The tool helps countries improve their capacity to report the AFOLU sector in their National GHG Inventory. ▪ Mitigation Options Tool for agriculture (CCAFS-MOT): The CCAFS-MOT tool integrates published empirical models to emissions for different land use systems according to management types. Allows the user to rank mitigation potential of over 34 crop and livestock management practices, including geographic distinctions. ▪ Clean Development Mechanism (CDM) methodologies for agriculture: CDM provides methodologies for rice cultivation, manure management, fertilizer management, and mulching. These methodologies are intended for monitoring CDM projects. ▪ MRV Tool on how to set up national MRV systems: (GIZ) MRV Tool provides developers and implementers of NAMAs with brief step-by-step instructions on how to develop an MRV system. The tool navigates users to the relevant information, knowledge, instruments, and publications available. ▪ The GHG Mitigation in Rice Information Kiosk is a communication tool for information on greenhouse gas emissions and mitigation options in rice production systems and is part of the Climate and Clean Air Coalition's (CCAC) Agriculture Initiative. It covers best practices for minimizing emissions of climate pollutants from agriculture while increasing productivity and improving food security and livelihoods. ▪ UNFCCC Small-Scale Methodology: Methane emission reduction by adjusted water management practice in rice cultivation: This methodology comprises

Sector	Tools
	technology/measures that reduce anaerobic decomposition of organic matter in rice cropping soils, which reduce the generation of methane. The methodology includes projects such as farms that change the water regime during the cultivation period from continuously to intermittent flooded conditions and/or a shortened period of flooded conditions; alternate wetting and drying method along with aerobic rice cultivation methods (see IRRI Water Management); farms that change rice cultivation practice from transplanted to direct-seeded rice. ▪ UNFCCC Small-Scale Methodology: Reduction of N_2O emissions from the use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application: This methodology enables project proponents to calculate reductions in greenhouse gas (GHG) emissions from the use of the NUE seed. By reducing the amount of fertilizer required to sustain yields of regular seed, N_2O emissions are reduced.
Livestock Sector	▪ IPCC Guideline: The IPCC guideline provides guidance on methods to estimate emissions of methane from Enteric Fermentation in livestock, and methane and nitrous oxide emissions from Manure Management. ▪ IPCC Inventory Software: The IPCC Inventory Software implements the simplest Tier 1 method for all sectors and Tier 2 methods for agriculture categories under AFOLU Sector in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. ▪ The Global Livestock Environmental Assessment Model (GLEAM) is a spatially explicit life cycle assessment model for the livestock sector. Using input data on the herd, feed, and manure management, it calculates GHG emissions for livestock supply chains (6 species) using an IPCC Tier 2 methodology. ▪ Template spreadsheet for assessing the quality of Tier 2 livestock activity data: This spreadsheet complements the **Livestock Activity Data Guidance** (L-ADG) published by the GRA and CCAFS. L-ADG provides suggestions on how to identify, collect and assess the activity data used to compile Tier 2 livestock GHG inventories for cattle and sheep. ▪ Smallholder Dairy Methodology: Draft Methodology for Quantification of GHG Emission Reductions from Improved Management in Smallholder Dairy Production Systems using a Standardized Baseline: The methodology, presents requirements for a standardized baseline, guidance for quantification of GHG emission reductions in smallholder dairy production, quantification of project emission intensity, and quantification of net emission reductions. It also outlines monitoring methodology for data, monitored and not monitored parameters. Total emissions are calculated by multiplying the annual FPCM yield by the appropriate emission factors. ▪ Grazing Land and Livestock Management Methodology: American Carbon Registry (ACR), approved GHG offset methodology for Grazing Land and Livestock Management (GLLM). This methodology is applicable for global dairy and beef production, mainly focusing on five primary GHG sources, sinks, and reservoirs (SSRs): fossil fuel emissions, enteric methane, manure methane, nitrous oxide from the use of fertilizer, and biotic sequestration in biomass and soils. ▪ Clean Development Mechanism (CDM) methodology for manure management systems: This methodology applies to manure management on livestock farms where the existing anaerobic manure treatment system is replaced by a manure management system that results in fewer GHG emissions compared to the existing system. It is intended for monitoring CDM projects.

Data Management

The data reporting entities need to have a clear mandate and procedures for data collection, processing, archiving, and disseminated at their level and this represents an important recommendation of this sectoral framework to be completed in line with the IPCC 2006 GPG on inventory preparation and methodology. The DALCCMS as the focal sector coordinating entity will ensure consistent interagency collaboration and flow of data generated within the sector in the required format.

The data collection and verification cycles, provision and the dissemination of standard procedures will be designed to ensure that data is coherent and consistent at the reporting source and that it is delivered efficiently without creating an accumulation of processing needs that may cause a delay in analysis or reporting.

Data preparation and evaluation will be primarily carried out at the task group level, a harmonized dataset in the appropriate format will then be inputted into the IPCC datasheets or any other standardized customized datasheets provided for the assignment in the crop and livestock sector and subsequently worked in the IPCC software and database for the generation of the estimates. Once the estimates are generated, the groups can begin the report writing process and subsequent deposition of the estimates and data through the data management system to be provided for the activity.

5.2 Mitigation

Mitigation and adaptation actions are embedded in government policies and actions plans which need to be tracked and reported. To estimate the GHG impacts of a policy, it is important to understand how the policy the policy is intended to be implemented and how it will achieve the desired GHG Mitigation outcome[2].

In order to identify the GHG impacts of the policy, it is useful to first identify the stakeholders affected by or with influence on the policy, and the inputs and activities associated with implementing the policy. Inputs are resources that go into implementing the policy, while activities are administrative activities involved in implementing the policy. These inputs and activities lead to intermediate effects, which are changes in behaviour, technology, processes or practices that result from the policy. These intermediate effects then lead to the policy's GHG impacts that enables tracking of NDC commitments

The DALCCMS as the focal sector coordinating entity will ensure consistent interagency collaboration and flow of data generated within the sector in the required format needed to track Nigeria's NDC commitment.

ICAT guidance tool for assessing the greenhouse gas impacts on agricultural policies can be adopted and capacity of implementing entities built on how to utilize the tools in the sector.

[2] ICAT *Guidance for assessing the greenhouse gas impacts of agriculture policies 2018*

Chapter Six – Stakeholder's Engagement

6.0 Overview

The sectoral framework for the GHG inventory system provides a live list of all stakeholders to be engaged in the GHG inventory compilation. It identifies the stakeholder roles, proposed details of their engagement with the GHG inventory activities, and provides an essential reference point for the coordination of future engagement activities. Connected to the list of stakeholders are the proposed work plan in section 8 and opportunities for interagency collaboration and integration, data supply and utilization, data sharing, and reporting

Effective and smooth stakeholder engagement is considered as one of the key success factors for the ICAT-Nigeria MRV project. Without active participation and contributions from relevant stakeholders in the crop and livestock sector, the project will not be able to have the access to accurate and reliable data and information, nor successfully develop a useful and comprehensive roadmap. Also, without stakeholders' buy-in, the roadmap will not be adopted and implemented. This will inevitably prevent the project from achieving the outcome of the Government's and non-government stakeholders adopting the roadmap. The active stakeholder engagement can ensure that the project provides suitable capacity-building activities, as strengthening stakeholders' capacity is one of the project objectives. In addition, close engagement with relevant stakeholders can ensure smooth implementation of the project as they are aware of the implementation status and tends to be supportive and responsive to the project's requests. Needless to say, successful stakeholder engagement is an essential part of the project.

Each organization defines the term 'stakeholders' differently depending on their interests and objectives. As the project aims to develop an effective and implementable GHG inventory framework for the Nigerian crop and livestock sector, it is proposed from the stakeholder consultative meetings that the project's definition of stakeholders will include persons, groups, organizations, private firms, academic institutions, civil society or government agencies that have played a key role in GHG emissions, mitigation, adaption, and technology transfer.

Stakeholders Identification

According to the definition of stakeholder presented above, the project team has identified stakeholders of which their mandates are related to the subject area in tracking and reporting GHG emissions, mitigation, and adaptation actions in the crop and livestock sector. The key sector stakeholders are briefly discussed below.

Department of Climate Change (DCC): The current IA has the Department of Climate Change (DCC) as the lead National Agency responsible for implementing and reporting climate action. The DCC comprises of four divisions comprising GHG and Flexible Mechanism Division, Vulnerability and Adaptation Division, Mitigation Division, as well as Education, Training, Public Awareness, and other information Division coordinating activities within various components. The DCC also convenes and chairs the Inter-Ministerial Committee on Climate Change (ICCC).

The Federal Ministry of Agriculture and Rural Development (FMARD): is the main ministry in charge of agricultural projects, policies, and implementation in the country. The Ministry is made up of about, 17 departments, 6 Regional Offices, 37 State offices, 11 Agencies, 15 research Institutes, 14 Colleges of Agriculture, and several Universities of Agriculture.

The ministry has the following mandate:

- Creating a conducive environment to stimulate greater sector participation in agriculture to enable the business side assume it's appropriate role as the engine of economic growth.
- Increasing agricultural production through the promotion of supportive and service-oriented sub-sectoral activities to enhance production, productivity, and marketing opportunities.

Department of Agricultural Land and Climate Change Management Services (DALCCMS) is the focal department responsible for climate change mitigation and adaptation activities within FMARD. They have received basic capacity building on GHG inventory preparation, nature of activity data needed and reporting requirement of the sector. Engaging the department to take the lead

National Bureau of Statistics (NBS) is the main National Agency responsible for the development and management of official statistics, the authoritative source and custodian of official statistics in Nigeria.

Other Stakeholders include State ministries of Agriculture, Departments of Agriculture at the Local Government Area's, Agricultural Development Programs (project offices at the states), Development partners (FAO, World Bank, UNDP etc), NGOs, CSOs and other non-state actors
Other national institutions active in other sectors, universities and research institutes, resource partners, civil society and the private sector also play a key role in the process.

Stakeholders Prioritization
From the list of stakeholders presented above, the project team carefully prioritized the stakeholders into two groups: a) Project Steering Committee (PSC); and b) Technical working group.

PSC will be the governing body for the MRV compilation as well as provide technical direction and advice. The coordinating entity will engage them and provide project updates regularly.

The Technical Working group can provide advice, assistance, and data for the project when needed, while not directly engaging in the decision-making process. The coordinating entity will keep engaging them and update the project progress periodically.

6.1 GHG Inventory

The stakeholder engagement process for the ICAT-Nigeria project, however, started with the commissioning of project consultants and project inception workshop, and consultations were made with the relevant agencies through interviews, focus group meetings, and virtual workshops. In situations where physical interaction was not possible, electronic media was used including zoom meetings, WhatsApp group discussion, telephone, and emails.

The ICAT-Nigeria MRV project will continue to develop and sustain dialogue with the relevant agencies of government, civil society organizations, the private sector, and development partners in the GHGI and MRV.

Stakeholder participation core focus area:

- **Establishing and strengthening the institutional arrangements for robust GHG emission inventory and MRV system**

Represents the starting and convergence point for all the project stakeholders through their participation in institutional governance, policy and institutional coordination, and the data management system governance. This, therefore, calls for a clear definition and elaboration of roles and responsibilities, and tailored engagement modes and approaches both for the project and subsequently for the GHG and MRV systems. The Ministry of Environment through the Department of Climate Change (DCC) is responsible for overall policy leadership for the project, enhance stakeholder ownership, and sustain their engagement for the project duration and the post-project period. Under this objective, a clear definition of roles and responsibilities for GHG and MRV stakeholders will be elaborated,
and this is intended to inform the institutional arrangements for GHG data collection and processing.

- **Building capacity of key stakeholders to collect, process, and feed activity data into the GHG emissions inventory system**

The core focus is to build technical capacities of the crop and livestock sector activity data hubs for GHG data collection, processing, and transmission. Stakeholder participation will take the form of training for knowledge and skills, and improved access to information and knowledge for learning purposes and to inform policy and decision-making processes.
So far, the consultants have held five (5) capacity-building workshops with the stakeholders since the inception of the project and still planning more stepdown training in the coming months.
Important to this process is the effective mobilization and engagement of stakeholders at the hub level to participate and maximize the benefits from the learning processes. The right combination of approaches and tools to deliver on the expected project outputs and sustainability of the outcomes have been adopted to ensure maximum impact.

- **Adoption and Operationalizing the Proposed Roadmap**

Beyond the engagements is the need to adopt and operationalize the inventory roadmap and workplan. This will ensure sustainability of the project objectives and provides the opportunity to demonstrate the knowledge and skills acquired by the consultants, share lesson learnt and recommendations through the proposed MRV workplans.
This will bring together all the participating stakeholders thereby calling for effective people management skills by the DCC, DALCCMS team and TWG working across the participating hubs. Public engagement is an additional dimension of the component, and this will involve strategies for their effective engagement in the GHG and MRV activities. Planned include information dissemination through publications and forums.

6.2 Mitigation

Stakeholders, at different levels and stages, are crucial to the success of tracking the impact of any mitigation and adaptation project. Through listening to the views of others, stakeholders can build a shared understanding of the issues. Priority areas for action emerge that take account of everyone's perceptions. This process requires time to build trust between the technical working groups and individuals involved, and can be empowering, as solutions are worked out collaboratively. If each participant is seen as having a valid view, a stakeholder process can encourage longer-term capacity development by developing pathways for coordinated action. Adaptive capacity is developed if people have time to strengthen networks, knowledge, resources, and the willingness to find solutions.

There are a great number of approaches to stakeholder engagement, and no single formula for success. Rather, there are combinations of tools and techniques that will be well-suited to a given situation. The choice of which to use depends on the complexity of the issues to be discussed and the purpose of the engagement, both of which will be determined in the initial steps of the MRV project where a careful evaluation of the time and resources available should be performed.
However, it is important that the stakeholders understand how they are being involved, how the information they provide will be used and whether they have any power to influence decisions. This will be critical if success will be achieved in implementing the MRV project for tracking mitigation actions.

Chapter Seven – Institutional Arrangements

7.0 Organizational structure of Institutional arrangements

The Institutional arrangements for National Inventory Systems (IA) assists inventory teams in assessing and documenting the strengths and weaknesses of existing institutional arrangements and help plan arrangements for future inventory development to ensure continuity and integrity of the inventory, promote the institutionalization of the inventory process, and facilitate prioritization of future improvements

They help a Party meet its reporting requirements under the Convention and the Paris Agreement by ensuring that GHG inventories are prepared in accordance with the relevant COP/CMA decisions. Decision 18 / CMA.1 adopted common Modalities, Procedures and Guidelines (MPGs) for the transparency framework for action and support referred to in Article 13 of the Paris Agreement MPGs, para. 18

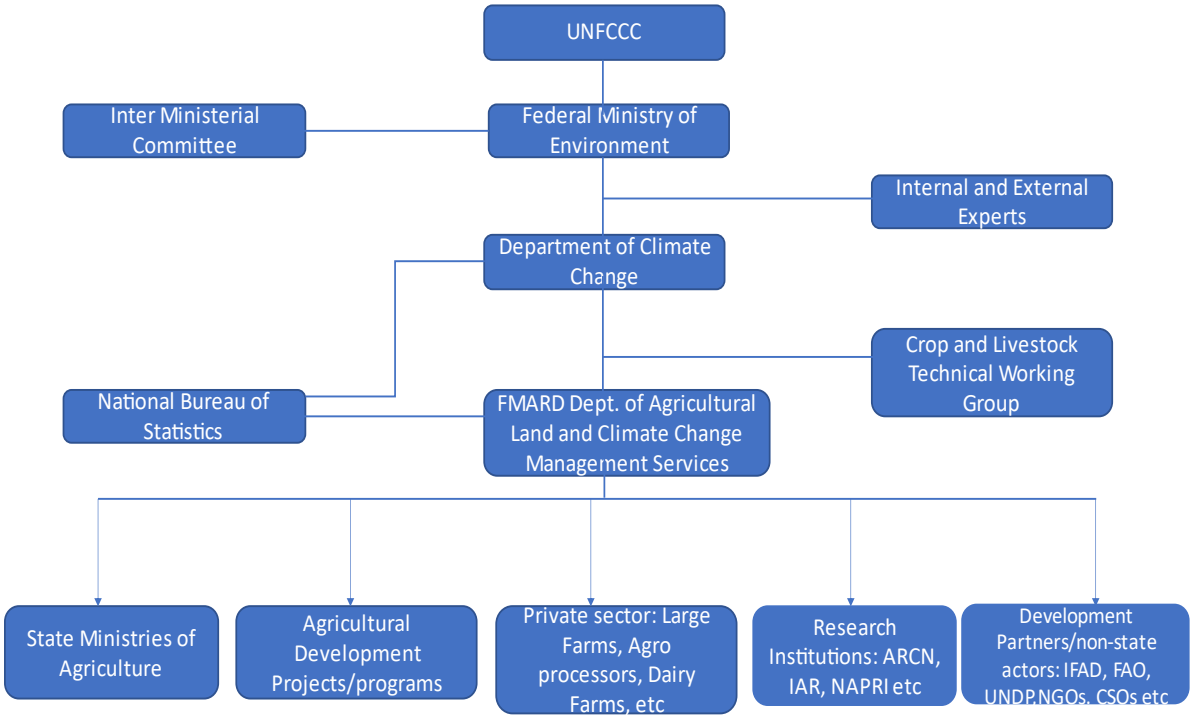
> *"Each Party should implement and maintain national inventory arrangements, including institutional, legal and procedural arrangements for the continued estimation, compilation and timely reporting of national inventory reports in accordance with these MPGs. National inventory arrangements can vary by Party depending on their national circumstances and preferences and change over time".*

The main purpose of clear institutional arrangements is to enable national and sectoral policy to be operationalized for the program to achieve policy and program objectives, e.g., quality, transparency, consistency, efficiency. It also enables program resources to be efficiently deployed, e.g., data processing, quality management and continuous improvement. Other issues bordering the inventory cycle like:

- MRV program institutionalization (internal)
- Administrator management responsibilities
- Program capacities, e.g. system and resources
- Government agencies, e.g. single vs. multi-agency
- Legislation and regulations, e.g., existing or new
- Tracking and enforcement

are clarified under the institutional arrangement. Institutional arrangements for mandatory GHG MRV program further provide legal basis for reporting, including enforcement, support efficient and effective program operation, e.g. resources and systems, ensure the quality of the inventory data including the collection, processing, communication, and detailed record-keeping of data and information supporting the program. The arrangements are also about the institutionalization of the regular process of inventory reporting, quality management, and continuous improvement.

Figure 9: Proposed Institutional Arrangement for the Crop and Livestock Sector



The proposed Institutional arrangements above include the interactions between organisations that will be involved with the GHG inventory inputs, compilation processes, and outputs. Clarifying the structure of institutional arrangements will help to formalize and communicate the functional roles of the identified organisations in the sectoral inventory compilation process.

There are many actors and stakeholders identified that will be involved with and/or interested in GHG inventory inputs, processes, and outputs. Key actors and stakeholder types are presented in figure 9. Understanding the interests, contributions and involvement of these actors and stakeholders helped in the design process and will further facilitate the establishment of a long-term and well-functioning national GHG inventory system.

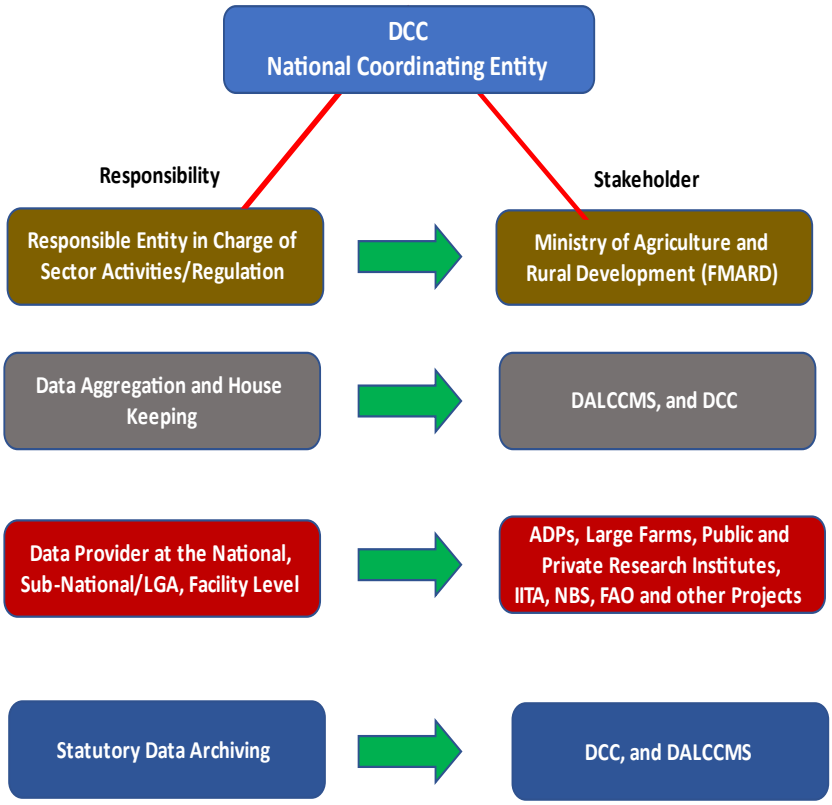
The structure of the proposed IA identifies DCC as the national focal point of the process and therefore play the coordinating role needed to facilitate and manage the inventory cycle.

The DALCCMS from the ministry of agriculture has the mandate to coordinate climate change related activities within the sector. This rightly position them to coordinate the GHGI process at the sectoral level. Other inter agency interaction with the NBS will be needed at various QA/QC stages of data collection and processing.

The data providers at the base will work together using the TWG platform created for the sector, to generate, collected, harmonize and report activity data during the GHGI preparation.

Developing a robust national inventory system requires a clear process with clear roles and responsibilities agreed and adopted across the network key stakeholders and principal data providers. The figure 10 below further gave clarity on the expected roles and responsibility of the relevant MDAs in the MRV process.

Figure 10: Roles of identified MDAs in the Inventory process of the Crop and Livestock Sector



Chapter Eight – Work Plan and Roadmap

8.1 Workplan

Developing a robust national inventory system requires a clear process with clear roles and responsibilities agreed and adopted across the network key stakeholders and principal data providers. The stages involved and accompanying tasks are discussed below.

8.1.1 Planning stage

The planning stage is the stage where the national focal point (DCC) responsible for the inventory initiates the commencement of the new inventory cycle. It covers several preparatory activities upon which the entire inventory exercise will be executed. The teams, their roles and responsibilities, and training will be determined at this stage. It is also at this stage that all the matters relating to logistics, the terms of the MOU, or any agreement among the inventory must be discussed and agreed on, new data sources can also be harmonized and introduced at this stage. Any gap identified in the previous reports submitted needs to be addressed at this stage. DCC can develop an MOU that will be objectively reviewed together with data providers and other key institutions and agree on realistic activities and timelines. Usually, such discussions will take place in the kick-off meeting. During the kick-off meeting, issues such as logistics, budgeting, timelines, and the frequency of review meetings will be discussed. The DCC as the responsible inventory institution will lead this stage. In addition, it will be important to invite the major data providers and facility owners who will be supplying project/plant-level data to the inventory compilers to participate in the meeting.

It is projected that the planning phase of the inventory will take an average of 15% of the total inventory timeframe. It is therefore important that the overall allocation of time to the various stages feed into the planning of time management. The issue of time management must also be discussed in the kick-off meeting. From the feedback gotten from stakeholder consultation and reviewing other countries' national systems, it will be useful for the inventory compilers in the sector to develop strategies to help them comply with the timeline they set for themselves. This is one of the ways to make the inventory efficient. At least the DCC should have an additional responsibility of ensuring that the inventory teams respect the timeline at all times. The expectation is that at the planning stage the following deliverables will be produced: comprehensive inventory work plan; overall and “sector” working protocols; identification of and formation of working groups and MOU for data supply.

Activities in the planning stage

Five (5) major activities need to be executed at the planning stage before the commencement of the actual preparation. The detailed descriptions of the activities have been provided below:

- **Prepare GHG Inventory Protocols**

The protocols for the preparation of the overall inventory and sector are the standard preparation procedures which will be put together in a simple spreadsheet by the DCC. The procedures will contain specific detailed instructions that all inventory partners have to discuss and agree to follow throughout the inventory. The content of the instructions will be tailor-made to UNFCCC reporting requirements, the IPCC methodological needs, and feedback from technical reviews of previous NCs/BUR’s submitted and prioritized planned improvements.

As much as possible, the identified and commissioned inventory team must make sure that specific tasks in the instructions must be followed at each stage of the inventory. This is one of the important ways to ensure that inventory becomes more efficient. For example, the sector lead institution (FMARD) could be assigned the responsibility of ensuring that sections of the instruction that is applicable to a particular subsector or subnational governments are fully implemented, documented and reported back in the crop and livestock sector report. The reporting should focus on the extent to which the sector experts used the instructions, the challenges they faced, and the specific measures needed to improve on them. The instructions will give concrete guidance that needs to be adhered to:

- complete various sections of the inventory on time;
- ensure consistency across source categories and in a format that allows swift compilation of the sector inventory into a single aggregate;
- perform adequate quality control checks, documentation, reviewing, and archiving.

The GHG protocol will be written in a simple and unambiguous language to cover the following

- A detailed timeline with all products and deadlines.
- Matrix detailing institutional responsibility
- Information on how the inventory will be prepared including file management, QA/QC procedures, uncertainty assessment, reporting instructions (content and format), documentation, and archiving procedures

Concerning sector-specific protocols, the instructions will address specific source-level issues such as internal deadlines, data sharing among teams, editorial directions, and additional information on responsibilities.

- **Identify and Form Working Groups**

The DCC in coordination with FMARD can set up the sectoral working group drawing experts from key MDA's and private sector players. Each stakeholder institution in the group will be represented by a competent officer. The inventory team working in the crop and livestock sector will be responsible for planning, preparation, management, and compilation of the sector inventories. Changes can be made to the working group if there are internal transfers or promotions within the participating institution to ensure efficient performance and timely delivery.

The membership of the working team must be assessed to know whether or not new members are to be brought on board. Especially for those experts who are no longer capable of joining the team because they have either been promoted, taken up new duties, moved on to another institution, or transferred to another department/region, it is important to find a replacement. There are situations where existing institutions may nominate new people to join the team. When new people join the team, it is important to take them through the rudiments of the inventory, what is expected of them and above all, ensure they understand the workings of the standard instructions that have been adopted for that inventory cycle. The new team member must also be taken through the QA/QC procedures to become abreast of the need to safeguard its quality.

- **Establish collaborative mechanisms**

During the review of the sectoral framework, the need to have a unified MOU was highlighted by the stakeholders as the collaborative mechanism to govern the working relationship between DCC and the key institutions. The DCC should be responsible for drafting the MoU and ensuring that the provisions of the MoU are implemented. During the kick-off meeting, all the inventory stakeholders must discuss and agree on realistic items that should go into the MoU.

- **Develop/revise inventory work plan**

The inventory work plan describes anticipated tasks, who will do them and by what date, deliverables, and the budget. The work plan also defines the objectives, the scope of the work, the tasks needed to accomplish the objectives, the staff that is responsible for each task, and the timeline for completing all tasks. The work plan has an audience larger than the inventory team and thus its timelines must be consistent with the biennial reporting time horizon as well as those national communications.

The DCC in collaboration with FMARD can work towards adopting a 2-year inventory workplan to feed into the BUR/BTR and NC. The framework introduces a possible work plan that can be improved upon.

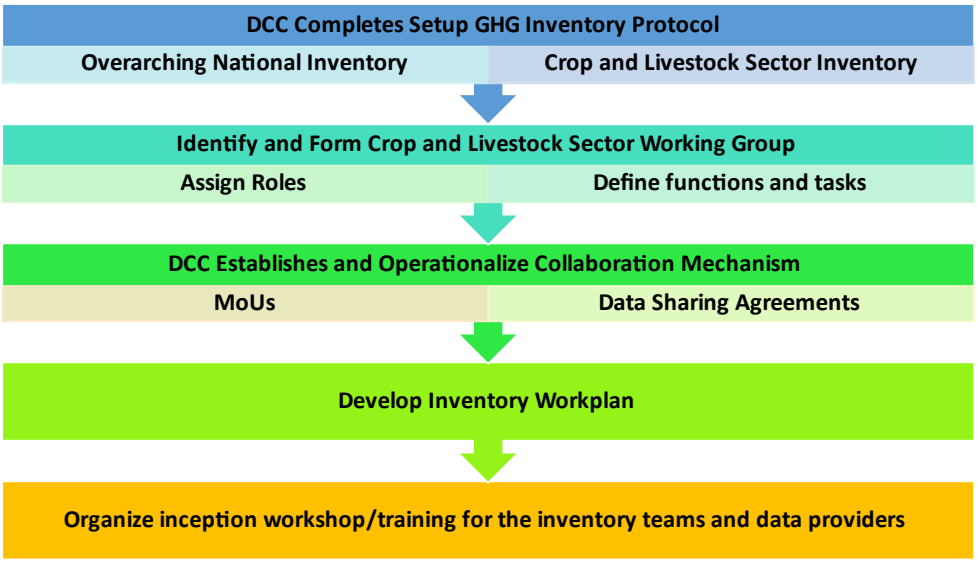
The cycle starts with a review of previous emission estimation methods and estimates, identification and formation of the teams, allocation of tasks, and the data collection and evaluation for the compilation of the inventory. The cycle is completed by an external independent review.

In addition, the result of the key category analysis (KCA) will be used to inform the identification of priorities or areas in the inventory that need more resources and attention in the current inventory cycle.

- **Organize kick-off meetings and training for inventory teams**

Before commencement of the inventory exercise, DCC in collaboration with FMARD should organize targeted training for the inventory teams. The kick-off training will focus on building the capacity of new members of the working groups on the various IPCC guidelines GPGs and most importantly the IPCC software for estimating GHG emissions in the various sectors. Particular attention will be given to the various crosscutting issues in the inventory and how they would be implemented at the sector level. This will ensure the readiness of the various teams. Additionally, during the kick-off meeting, pertinent organizations and logistical matters must be discussed. Some of the issues the kick-off meeting could consider in the agenda might include revision of the MoU, training needs, data request, and any changes in international decisions that are likely to affect the way the inventory is conducted etc. the figure below shows the summary of activities in the planning phase.

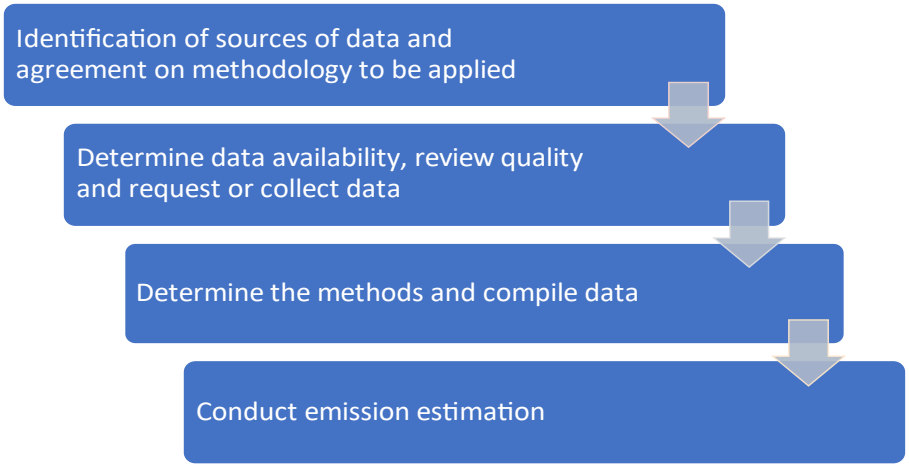
Figure 11: Summary of Tasks in the Planning Phase



8.1.2 Preparation Stage

The preparation phase of the inventory will take an average of 60% of the total inventory timeframe of two years. The main outputs of this phase will be the national GHG inventory and other documents. This is also the phase that has the most human involvement and tests the operational feasibility of the institutional arrangements that have been put in place. Given that it is the dominant stage, in terms of time spent, this phase presents the most challenges, which should be looked at to generate the required information.

Figure 12: Summary of Activity in the preparation stage



- **Identification of data sources and methodology**

This activity is fundamental to the inventory. It helps the team to compile a thorough register of all sources of data and methodology intended for the inventory. All the sources in the register will be assessed in order of importance by grading them according to their accessibility, reliability, and acceptability. The identification of the data sources also includes routine data generators, such as the Ministry of Agricultures, National Bureau of Statistics reports, to others that are one time, and generated by projects, such as the data generated by the FADAMA Project, Value Chain Development Project, Commercial Agriculture Development Project. This component is one of the important activities that must be handled very carefully because the estimates largely depend on the activity

data that will be collected from the different sources. The use of routine datasets from the agencies and institutions presents minimal challenges, as compared to the onetime data that is generated by private individuals, private companies, and projects. Thus, particular attention should be paid to sourcing for data beyond the routine data providers.

- **Determine data availability; review its quality and request data**

This step entails assessing the availability and quality of activity data, conversion factors emission factors, and where necessary request for the data from the appropriate source (table 2). Completion of this step is necessary before an appropriate method can be chosen and all the data required by that method compiled. The collection of activity data will be one of the most time-consuming tasks in inventory preparation. There are several barriers to activity data collection, which might include:

- The lack of data for a certain year or complete lack of data for many years resulting natural disasters, drought, flood, or conflict
- An inconsistent time series of data due to changes over time in definitions, survey methods.
- Sometimes the data classification systems used in a country are completely different from either international standards or the IPCC inventory format.
- Access to activity data may be restricted (e.g., confidential cooperate data)

It is important to remember that assessment of the availability and quality of activity data, conversion factors, and emission factors is an iterative process. Because resources are limited, this activity will always be constrained by available resources. For example, some cooperate data may be considered confidential, hence major rice or livestock companies are mostly unwilling to share these datasets because they perceive that giving such data out could amount to exposing strategic information to competitors. On occasions where they give the data, they aggregate it in a way that the details are lost, thus making it only applicable in a general context.

Table 5: Data Source for the Crop and Livestock Inventory

Sub-Sector	Crop and Livestock Sector	Data type	Data Source
3.A1 and 3.A2	Enteric Fermentation & Manure Management	Animal population, Fractions of manure, management practices	Agriculture Facts and Figures FAOSTAT Expert Judgment FMARD
3.C3	Urea application and other carbon containing fertilizers	Annual Urea consumption figures	NBS, FMARD, FAOSTAT Agriculture Facts and Figures
3.C4	Direct N2O emissions from managed soils	Annual generic NPK consumption figures	NBS, FMARD, FAOSTAT Other publications
3.C5	Indirect N2O emissions from managed soils	Annual crop production in tonnes per annum	NBS, FMARD, FAOSTAT, Other publications
3.C6	Indirect N2O emissions from manure management	Animal population (cattle, goats, sheep, swine, donkey, poultry, horse)	NBS, FMARD, FAOSTAT, Other publications
		Fractions of manure management practices	FAOSTAT, FMARD, Other publications, Expert Judgment
3.C7	Rice cultivation	Annual rice production areas	NBS, FMARD, FAOSTAT
3.C8	Prescribed burning of savanna	Area maps	Global Fire Emission Database (GFED 4), Climatic Map, Global Ecological Zones (GEZ) NBS, FMARD, FAOSTAT
3.C9	Open burning of agricultural residues	Area maps	NBS, FMARD, FAOSTAT

- **Determine methods and compile data**

Once an initial assessment of data availability and quality is completed, the appropriate inventory methodology can be determined. In reality, this is sometimes an iterative process, i.e., after data availability and quality are assessed, an initial method is chosen, and more data collection ensues during which more or less data, or data of better or worse quality, are uncovered, and then the initial method or a different method (or different approach with the same method) is finally chosen. The IPCC GPG manuals contain decision trees to help Parties choose the methodology most suited to national circumstances. The IPCC guidance is organized into tiers that differ mainly in their level of accuracy and complexity.

The higher tiers typically require more disaggregated activity data and source-specific, technology-specific, region-specific, and/or country-specific emission factors. The most appropriate estimation method depends on whether a source is key, what data are available, and the level of financial and human resources that are available. If a source is key, the IPCC GPG encourages countries to use the good practice methods for key sources, which are usually Tier 2 or higher, although this is not always the case. Once the method is chosen, the requisite activity data, conversion factors and emission factor must be compiled. The estimation of emissions/removals in the categories is mostly based on the methods described in the 2006 IPCC Guidelines.

- **Conduct emission estimation**

Under this activity, the crop and livestock sector working groups will prepare the inventory calculation spreadsheets and the inventory text sections. If the inventory team is using the IPCC software, then data will only need to be inputted into the worksheets and tables. The major issues to consider and pay attention to, are QA/QC checks on every stage of data input to ensure that the right entries are being made, the appropriate inventory year has been chosen and everything is in order.

8.1.3 Management Phase

The management phase will include a set of activities, which will be implemented both at the sector level and the level of the inventory. 30% of the entire inventory time will be spent at the management phase. An initial activity that characterizes the management phase of the inventory is the QA/QC procedures and uncertainty analysis. The current QA/QC practices in the inventory as seen in the TNC are broadly derived from the recommendations in the IPCC guidelines. These procedures have been duly captured in the IPCC guideline QA/QC of inventory systems, which specifically focuses on the QA/QC activities. The next activity that follows is the activities relating to key category analysis. Guidance on the steps for the identification of key categories has been elaborated in the 2000 and 2003 IPCC Good Practice Guidance.

The guidance explains that a key category has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions or removals, the trend in emissions or removals, or both. Nigeria has identified the key categories for the inventory using the tier 1 level and trend assessments as recommended in the IPCC Good Practice Guidance and adopted by COP decision 13/CP 9. This approach identifies sources that contribute to 95% of the total emissions or 95% of the trend of the inventory in absolute terms.

The next component of the management phase is activities relating to reporting, documentation, and archiving. The report writing is done at the sector task group level, after which the general compilation is done.

Recommendation, documentation, and archiving can be moved a further step forward with the creation of the web-based storage system. At this level, the inventory team will engage with the web management personnel to upload all the datasheets and estimates, and reports.

A final activity that will complete the management phase of the inventory is mechanisms to undertake inventory improvements interventions. This ultimately sets the scene for the commencement of the next cycle.

Table 6: Proposed Schedule of Inventory workplan

Inventory States	Task and deliverables	Completed deadlines	Responsible Entity	Priority for next Inventory[3]
Planning stage	Review of preview estimates, procedures, feedback from ICA, comments from informal technical review, and list of planned improvement	Q1	DCC and FMARD	Very High
	Establish Inventory protocols. The protocol will contain instructions and procedures for preparing the inventory.		DCC and FMARD	High
	Validate and distribute protocols/instruction manuals to the teams and actors in the inventory.		DCC and FMARD	High
	Identify and form inventory-working groups for the inventory sectors and cross-cutting issues.		DCC and FMARD	Low
	Formulate and sign MOU among inventory institutions. The MOU defines specific functions of inventory institutions relating to estimation etc.		DCC and FMARD	Very High
	Organize a maiden meeting of the working group	Q2	DCC and FMARD	High
	Training for inventory teams to ensure readiness and distribute overall and sector inventory instructions, provide relevant training to teams.		DCC and FMARD	Medium
	Organize kick-off meeting.		DCC and FMARD	High
Preparation Stage	Identification and review of data sources including choices of data, methodologies, and software.	Q2	DCC and FMARD	Very High
	Data request, data review, evaluation, and documentation		DCC and FMARD	Very High
	Data request, data review, evaluation, and documentation		DCC and FMARD	Low
	Review performance of GHG online database and where necessary making changes to work efficiently.		DCC and FMARD	Medium
	Review performance of data storage server and where possible making necessary corrections		DCC and FMARD	Medium
	1st Quarter review meeting	Q2	DCC and FMARD	Low
	GHG estimation. Worksheets and text files for each source/removal due each entity	Q3 to Q5	DCC and FMARD	Very High
	All sector worksheets and documentations submitted national inventory compiler	Q6	DCC and FMARD	High
	Compile zero order draft of composite inventory and submit to inventory coordinator	Q6	DCC and FMARD	High
Management Stage	Distribute zero-order drafts for internal review and submit a comment to inventory compiler	Q6		Medium
	Distribute source files (worksheets) and internal review to lead institutions	Q6		Medium

[3] Priority attention in terms of allocation of time and financial resources as well as adhering to strict timelines will be given to activities rated as High and Very High in the inventory cycle. This is because, these activities will support efficient delivery of the inventory.

Inventory States	Task and deliverables	Completed deadlines	Responsible Entity	Priority for next Inventory[3]
	Incorporate internal comments, observations, and corrections	Q6		High
	Collect uncertainty values from sectors and quantify uncertainty for the overall inventory.	Q6		Very High
	Compile second order draft of inventory and revise worksheets	Q6		High
	Compile second order draft of composite inventory, source files and submission to inventory compiler and external reviewers (QA)	Q6		High
	External review of second order inventory (QA) submits	Q7		High
	Comments to Inventory Compiler			Medium
	2nd Quarter review meeting	Q6		High
	Incorporate external comments and revise worksheets for all sectors	Q7		Medium
Compilation stage	Draft improvement strategy for each sector due inventory compiler	Q7		Medium
	Collect all pertinent paper and electronic source materials for archiving place in archive due national archiving and documentation institution	Q8		High
	Compile final Inventory and preparation of key category analysis			High
	Compile inventory improvement strategy due to inventory coordinator			Medium
	Compilation of National Inventory Report (NIR)			Very High
	NIR submitted to National Inventory Entity for incorporation into National Communication and Biennial Update Report			Medium
	Dissemination of NIR – Submission to UNFCCC, inventory is available for public release			High
Technical Review through ICA	DCC Coordinate the technical review process			High
	Compile all comments, feedback, and planned improvement list			High

8.2 Roadmap

Improvement plans

This section focuses on mechanisms to improve the national and sectoral MRV system and the compilation of the GHG inventory report. It involves institutional mechanisms and procedural issues, as well as training activities to ensure a very consistent and robust reporting cycle of Nigeria's GHG inventory in the near, medium, and long terms.

The context for sectoral MRV improvement plans

Nigeria's GHG inventory has gone through a cycle in which estimation and compilation of the report were practically done by individuals to a system currently being proposed where the inventory process will be streamlined into relevant sector institutions and agencies. This trajectory in its self is a tremendous improvement that will add multiple benefits to the inventory process, and also ensure that the compilation and reporting of the inventory outcomes will be sustained and remain responsive to current and emerging demands as well as satisfying the robustness required in the submission of the three major documents to the UN, i.e. National Communication, Biannual Update Report, and the National Inventory Report. However, in as much as the current arrangements have chalked success, there are major bottlenecks that need attention. These issues are mostly around capacity improvement and strategies to strengthen the institutional arrangements in the near, medium, and long terms.

Near term strategies

Though the existing institutional arrangements for the inventory has successfully produced outputs that have been used to meet Nigeria's reporting obligations under the UNFCCC, it has not been without its challenges, which necessitated the need to overhaul it and make it more sustainable and responsive to emerging and current developments in presenting national communications as well as the GHGI. The new proposed institutional arrangement is being developed to utilize existing structures and institutions to ensure sustainability. It is also meant to adequately fill gaps that have been identified in the existing institutional arrangement. However, it is apparent that for the new system to take over and provide the expected outputs, there is the need to identify obvious challenges and difficulties which could stall the attainment of the aims behind the development of the new system. Specifically, the modalities under the near term are intended to offer immediate responses and framework within which the inventory process will continue to operate and meet its outputs, while further systems are put in place in the medium and long terms**.**

In the near term;

- Since the mainstreaming interventions are still in the early phases, it is important to maintain key experts who might be outside of the current institutional arrangements to provide technical backstopping and facilitation of the tasks in the sector-level task groups. This will ensure that there is adequate time for the new personnel involved under the new institutional arrangement to update themselves with the assigned tasks and responsibilities. It will also ensure the smooth transfer of roles and capacity to the structures under the new system and offer a good boost to a solid foundation for the implementation of the new arrangements. Ultimately, such an arrangement will ensure that there is a bridging mechanism linking the existing institutional arrangement to the new one. Thus, a possible disconnect and total halt of the inventory process could be avoided.
- Moving forward, it is important to engage a core group of experienced experts who have been involved in the GHG inventory in the various sectors over the years to train and mentor assigned personnel under the new institutional arrangement. This will improve the human

resource strength for the estimation and generation of information. It also constitutes a critical component of the smooth operation of the new arrangement.

- There is also the need to provide logistics and the necessary facilities to initiate and empower the institutions to adequately take over the roles and tasks involved in the assigned inventory process.
- The institutions involved in the new arrangement should commit staff and establish a clear mechanism for the implementation of the assigned roles in the inventory within their setup.
- It is also important for a thorough needs assessment to be done for the implementation of the inventory to be established, to ensure that resources are geared towards specific planned improvement mechanisms.

Medium-Long term strategies

Even though some specific tasks will be met in the short term, for the ultimate sustainability of the new institutional arrangement and the compilation of the GHG report, there is the need for more holistic and targeted activities, which will ensure that the established system has robust mechanisms for the implementation of the inventory. Given that the new arrangements and the associated responsibilities might be new to most of the institutions involved, it is necessary to have framed mechanisms in place that will guide its establishment and operation. To meet the objective of sustainability and continuity, most of the modalities that will constitute the framed activities to guide the smooth operation of the new arrangements could be phased in the medium and long terms. This will allow for adequate planning, planned capacity development, and leveraging sustainable funding mechanisms to strengthen the institutions beyond individuals. In the medium to long term, the following tasks are envisaged;

- There is the need to have a continual training mechanism in place that will ensure that the people involved in the inventory are on top of the methodologies and technical issues associated with the implementation of the inventory. This planned capacity-building component should be modeled around the planned improvements envisaged under each inventory regime. This will ensure that specific capacity gaps are being identified and provided to meet the requirements of the inventory. These targeted measures to address the planned improvements under each inventory cycle is a progressive approach to ultimately strengthen the processes for executing the inventory and also reduce the uncertainties around the inventory estimates.
- The existing funding arrangements for the inventory will be inadequate for the arrangements under the new institutional arrangements. Though leverages to utilize the existing structures and mandates of the institutions involved are core drivers for the new arrangement, the associated cost in mainstreaming a new inventory procedure into the operations of these institutions should be provided, to ensure that bureaucracies and bottlenecks are limited. Ultimately, budgetary provisions should be made under various budget lines in these institutions to complement the funding provisions for the inventory.
- To entrench the activities of the inventory in the institutions involved, there will be the need to dedicate staff and logistics for the inventory. These will ensure that the inventory gradually rolls out to be a specialized component of the mandates of the institution. But importantly, given the stringent timelines and technicalities involved in the inventory, individuals involved in the inventory are not burdened with other roles in their institutions, which will lead to delays and inefficiencies in the delivery of assigned outputs.

Table 7: Crop and Livestock Sector Proposed Road Map

S/N	Components	Actions to be Taken	Time Schedule
1	Adoption of Improved Institutional Arrangement	Institutional arrangement to be presented at the final project stakeholder workshop	Dec-2021
	Legislative framework	Formalize and update the mandate of key institutions to empower them for efficient operation	3-6 months
2	Development of Legal instruments MOUs and DSAs	DCC in collaboration with DALCCMS to develop MOUs and Data sharing agreements	3 – 6 months from start-up of the MRV process
3	Adoption of workplan as national working tool	Hold a stakeholder workshop and adopt MRV Inventory workplan, sharing roles and responsibilities	3 – 6 months from start-up of the MRV process
4	Setup of Crop and Livestock Sector TWG	Convene and inaugurate the Crop and Livestock Sector TWG	3 – 6 months from start-up of the MRV process
5	Setup key categories not captured under Crop and Livestock Sector	Setup the framework for data collection and processing under key IPCC categories in the Crop and Livestock Sector not captured in the TNC	6 – 24 months from start-up of the process
6	QA/QC protocol	Introduce process for quality assurance and control of all data collected in the sector	3-6 months
7	Methodology & Guidebook	Adopt or develop methodologies for estimating mitigation and adaptation actions as well as develop guidebook to easily step down the process	6 – 24 months from start-up of the process, to be improved periodically
8	Capacity Building	Continuous capacity development programs to be developed to fill the knowledge and skill gaps in the sector.	Continuous

8.3 Conclusion

The main objective of the crop and livestock sector sectoral framework is to create the pathway for enhanced transparency in implementing the MRV program. Institutional arrangements for mandatory GHG MRV program is needed to provide legal basis for binding commitments and reporting, enforcement, and efficient and effective program operation.

It is considered good practice that countries that desire to improve the quality of their reporting must also improve the quality (transparency, accuracy, completeness, comparability, and consistency (TACCC)) of national GHG inventories on a continuous basis. This can be achieved through the development of a robust national GHG inventory program. These reports are critical source of useful national data and if updated regularly will prove reliable for policy development and tracking progress made towards achieving NDC commitments. There should be improvement over time to provide increasingly useful information on national GHG trends (including influencing factors) and transparent reporting. Establishing sustainable national GHG inventory arrangements will help to continuously improve and regularly update national GHG inventories.

Developing a robust national inventory system requires a clear process with clear roles and responsibilities agreed and adopted across the network of key stakeholders and principal data providers. The main purpose of clear institutional arrangements is to enable national and sectoral policy to be operationalized for the program to achieve policy and program objectives.

The recommendations made in the above sections of the report if adopted will beam the light towards achieving the enhanced transparency framework.