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Greenhouse Gas Reporting in Kenya's Crop Subsector and Road Map for Improvement

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Executive Summary

This report examines the current state of greenhouse gas (GHG) inventory practices in Kenya's crop sub-sector and presents a roadmap for transitioning from Tier 1 to Tier 2 reporting methodologies.

The analysis reveals that while efforts have been made to report GHG emissions in the crop sub-sector in Kenya, significant challenges remain in terms of data collection. Existing GHG inventory practices primarily rely on Tier 1 methodologies, characterized by default emission factors and limited activity data. Challenges identified include data gaps, inadequate capacity and expertise, limited stakeholder engagement, and institutional coordination gaps. These challenges hinder the accuracy, transparency, and comprehensiveness of GHG-related inventory data in the crop sub-sector.

The transition from Tier 1 to Tier 2 GHG inventory methodologies in Kenya's crop sub-sector is a critical step towards achieving more accurate, transparent, and comprehensive emissions reporting. This effort requires improvement in each step of the GHG inventory cycle: planning, collecting data, estimating emissions. reviewing, reporting, and archiving. The road map for improved data collection and inventory at Tier 2 will include the following key steps: (1) Review and develop both existing and new tools and procedures for activity data collection; (2) Engage with current and potential activity data providers to design ways of collecting and aggregating the necessary activity data; (3) Develop country-specific emission factors for data categories required for Tier 2 reporting; (4) Establish a detailed and cohesive mechanism through which relevant institutions can contribute data and information to the GHG inventory process; (5) Raise awareness and build the capacity of inventory stakeholders; (6) Develop a data management system that unifies government functions, integrating the systems of the Climate-Change Directorate (CCD) of the Ministry of Environment and Natural Resources of Kenya.

Through such a roadmap, Kenya can strengthen its capacity for GHG inventorying in the crop sub-sector. Kenya can also improve the accuracy, transparency, and comprehensiveness of emissions data to support climate-smart agricultural practices. This transition to Tier 2 reporting methodologies is essential for informing evidence-based decision-making, promoting sustainable agricultural development, and contributing to global efforts to mitigate climate change.

Abbreviations

BAU	Business as usual
CBIT	Capacity Building Initiative for Transparency
CCD	Climate Change Directorate (Kenya)
CSA-MSP	Climate Smart Agriculture Multi-Stakeholder Platform
CIAT	International Centre for Tropical Agriculture
CIDPs	County Integrated Action Plans
FAOSTAT	Food and Agriculture Organization of the United Nations Statistics
JASCOM	Joint Agriculture Sector Coordination Mechanism
GDP	Gross Domestic Product
GHG	Greenhouse Gasses
GIS	Geographic Information Systems
ICAT	Initiative for Climate Action Transparency
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
KALRO	Kenya Agriculture and Livestock Research Organization
KIAMIS	Kenya Integrated Agricultural Management Information System
KNBS	Kenya National Bureau of Statistics
MECCF	Ministry of Environment, Climate Change and Forestry
MoALD	Ministry of Agriculture and Livestock Development
MOALD-CCU	Ministry of Agriculture and Livestock Development, Climate Change Unit
MRV	Monitoring, Reporting, and Verification
MTAR	Mitigation Analysis Report
MTPs	Medium-Term Plans
NCCAP	National Climate Change Action Plan
NDCs	Nationally Determined Contributions
NGOs	Non-Governmental Organizations
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change

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Introduction

1. Introduction

1.1 Greenhouse gas emissions in agriculture

The global challenge of climate change demands rigorous scrutiny of all sectors contributing to greenhouse gas (GHG) emissions. Agriculture is a key sector, both in terms of its contributions to emissions and its vulnerability to the impacts of a changing climate. GHG emissions from agriculture, forestry and other land use comprised about 22% of global emissions in 2019 (IPCC, 2023). Food systems emissions contributed to 18 billion tones of carbon dioxide equivalent in 2015, with 71% of the emissions stemming from agriculture and land use change activities (Crippa et., al 2021). Opportunities for GHG mitigation in the crops sub-sector include reducing emissions from land-use change, optimizing fertilizer use, improving crop and land management practices, and employing advanced technologies. Improved practices may include precision agriculture, integrated pest management, cover cropping, and crop rotation, all of which can significantly reduce emissions while enhancing soil health (Kwon et al., 2021). Long-term GHG mitigation strategies need to be incorporated into agricultural development policies and land-use planning to ensure effective implementation and sustainability.

Kenya's agricultural economy employs a significant portion of the population, contributing substantially to the national Gross Domestic Product (GDP) (Alessandro et al., 2015). The sector is key to the country's economy, contributing 33 per cent of the GDP directly, and another 27 per cent indirectly through linkages with other sectors. Agriculture employs more than 40 per cent of the total population and more than 70 per cent of Kenya's rural people (CBK 2024). The sector is also a major contributor to climate change through GHG emissions resulting from direct sources such as enteric fermentation and manure management, as well as soil management. The crop sector encompasses a diverse range of activities, from production of staple food to cash crops and horticulture, each with its unique emissions profile and associated vulnerabilities and impacts. Changing weather patterns, extreme events, and shifting pest and disease dynamics pose significant challenges to crop production and food security. At the same time, the urgency to reduce GHG emissions and transition towards low-carbon agricultural practices is becoming ever more urgent.

1.2 GHG Inventory requirements

Article 13.7 of the Paris Agreement requires that each party regularly provide a national inventory of greenhouse gas emissions and removals, as well as the information necessary to track the progress in implementing and achieving its Nationally Determined Contributions (NDC) (UNFCCC, 2018). Parties to the Agreement are required to submit biennial transparency reports (BTR) every two years, with the first submission due by 31 December 2024. The BTR includes information on national inventory reports (NIR). GHG inventory and reporting also aligns to the Sustainable Development Goals (SDGs) and hence promotes synergies between climate action and other development priorities, fostering inclusive and sustainable growth. The Kenya Climate Smart Agriculture Strategy has committed to reduce agriculture sector GHG emissions through adoption of low-cost climate smart technologies, enhanced soil carbon sequestration, and paddy rice management, among others (GOK, 2017). The strategy develops a Monitoring, Reporting and Verification (MRV) to account for climate actions.

Estimating and measuring emissions from agriculture relies on methods customized to the location, the value chain, and farm management practices. These methods also vary in precision, complexity, and accuracy, as well as data types required (IPCC, 2008). Tier 1, the most basic methodology, uses default values and provides a simple approach for estimating GHG emissions. The calculations use default emission factors from the IPCC and often less precise activity data, resulting in less accurate estimates. Tier 2 uses country-specific emission factors and more detailed activity data, leading to higher accuracy compared to Tier 1. Tier 3 involves the use of sophisticated models and detailed, facility-level data, resulting in the highest accuracy among the tiers. In agricultural systems, Tier 2 inventories are required to determine the impact of a wider range of mitigation actions across diverse agroecological zones.

The Initiative for Climate Action Transparency[1] has funded a project that aims at improving the GHG inventory for the crop sub-sector in Kenya. Through this project, we have reviewed the current GHG inventory preparation process for Kenya and accessed the current institutional arrangements to

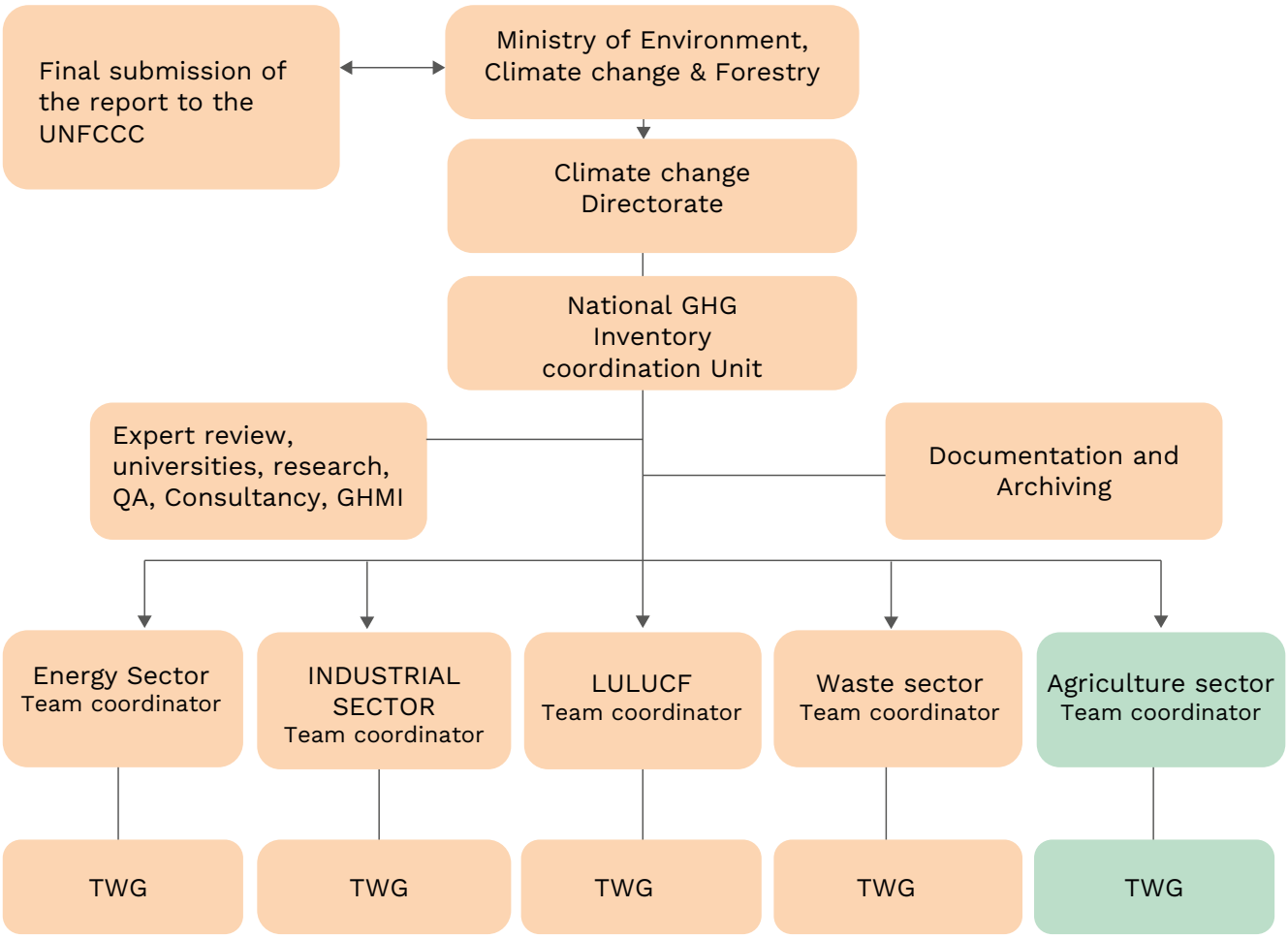
1 https://climateactiontransparency.org/governance/

support this process. In this report, we summarize the key findings from these assessments and develop a roadmap that can be used in supporting the Ministry of Agriculture in transitioning from Tier 1 to Tier 2 reporting of GHGs emission for the crop subsector. Information in this report was obtained from the desktop review as well as from presentations and discussions in workshops held with officials of national and county governments. The national-level officials participating and providing information for the workshop were from the Climate Change Directorate (CCD) of the Ministry of Environment, Climate Change and Forestry (MECCF) and from the Ministry of Agriculture and Livestock Development Climate Change Unit (MOALD-CCU). County technical officers came from the county government's Departments of Agriculture and Environment of pilot counties for this project, i.e. Taita Taveta, Makueni, Murang'a, Baringo, and Nyamira.

2. Status of GHG Inventory Arrangements in Kenya

Kenya submitted its second national inventory to the UNFCCC secretariat in 2015 along with its Second National Communication (2NC) which contained a GHG Inventory for the period 1995-2010 (GOK, 2015). Kenyan officials conducted another GHG inventory preparation process in 2020, although it remains as a draft and was not submitted to the UNFCCC. In 2024 Kenya is set to submit its first Biennial Transparency Report (BTR), which will include a GHG inventory covering the period 1995 to 2024. The inventory is carried out in the six mitigation priority sectors: agriculture, energy, forestry, industry, transport and waste. In the national GHG inventory report preparation, the sectors are coordinated by the CCD of the Ministry of Environment, in an arrangement illustrated in Figure 1. The MOALD-CCU coordinates the agriculture sector technical working group (TWG) (shaded green) in compiling the report and submits it to the CCD.

Figure 1. **Institutional arrangements for the National Greenhouse Gases Inventory System for Kenya**



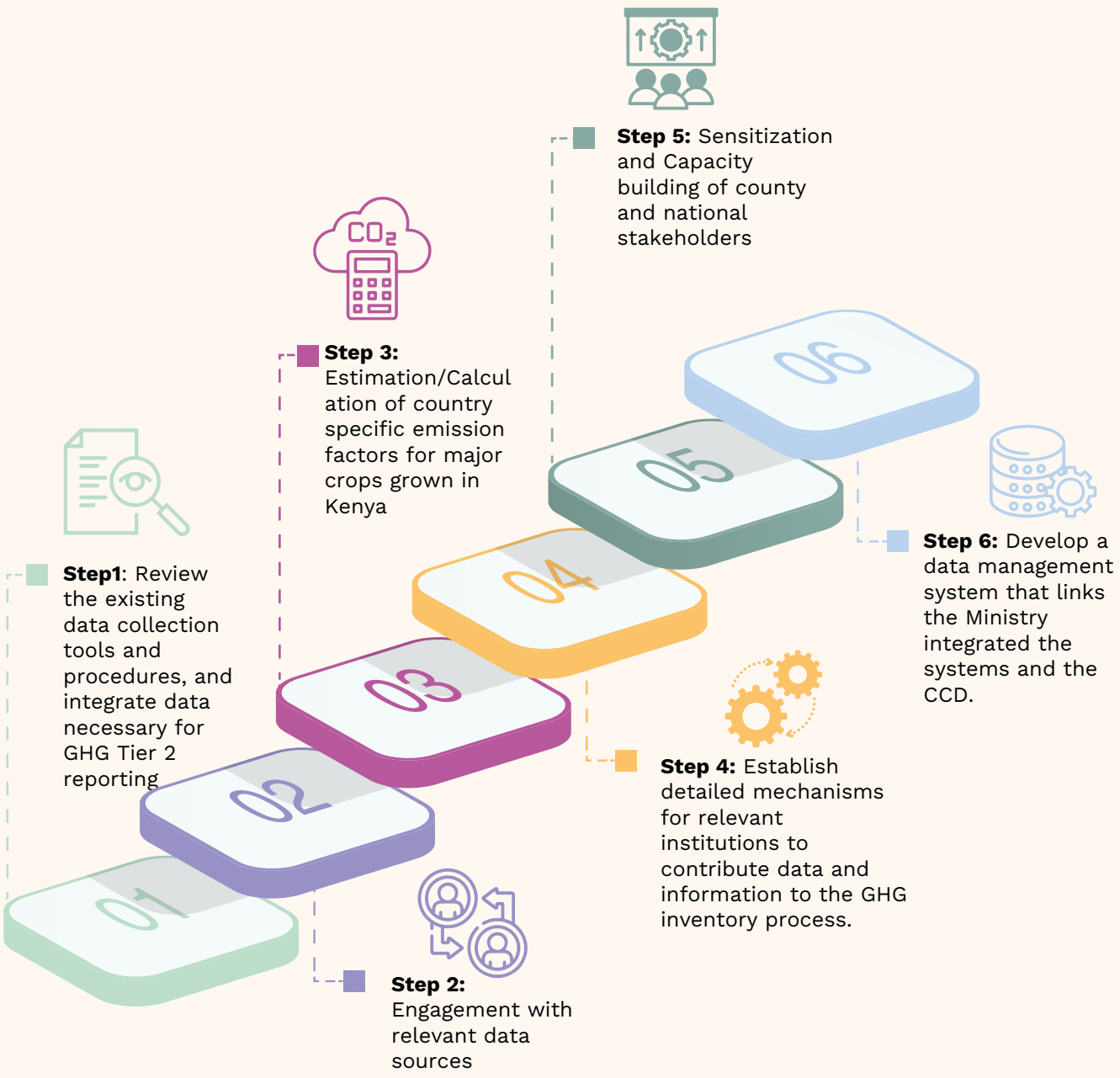
The agriculture sector TWGs (green) consists of data providers and experts from each of the two sub-sectors, livestock and crops with the experts working separately to produce an inventory for the agriculture sector. Although the livestock team has transitioned to reporting using Tier 2 methods, particularly for the dairy sub-sector, the crops-subsector reporting is still currently done using Tier 1 methods due to lack of detailed activity data and emission factors appropriate for tier 2 reporting. The GHG inventory to be included in 2024 mainly includes emissions from 11 key crops in Kenya, i.e., maize, beans, wheat, sorghum, millet, tea, coffee, rice, cotton, irish potatoes, and sugarcane. The management practices that have been accounted for in this inventory include fertilizer and manure application (Table 1). Data for the areas under each crop and the fertilizer use are aggregated by the statistics units from information gathered from the 47 counties in Kenya. The manure application rates that are currently used for the inventory are derived from FAOSTAT and are based on generalized values for each of the crops. With the crops sub-sector emissions based on Tier 1 reporting, IPCC default emission factors are used in calculating the emissions from fertilizer and manure application. The GHG inventory doesn't include information for other key cropland activities that are common at the farm level, for example tillage, cover cropping, and agroforestry. In addition, the values used for manure application rates are not based on real farm level data that considers variability depending on the crop and county. The crops sub-sector inventory needs to adopt a higher tier to provide more reliable information on emissions trends, hotspots, and mitigation opportunities. Reporting on Tier 2 will enhance transparency and accountability in international reporting as well as national and sub-national decision-making processes on climate action. This calls for the crops-sub-sector to establish a system for consistent activity data collection and development of country specific emission factors to enable transitioning to tier 2 reporting.

Table 1: **Gaps/Challenges in the Current GHG Inventory Arrangements**

Issue	Current arrangement	Gap/challenge
Activity data	Inventory uses data from crop statistics; fertilizer and rice units provide county specific data used in inventory. Only manure and fertilizer application are considered for the crops subsector	Data collected for other uses does not cover the GHG inventory needs comprehensively and is not sufficient for Tier 2 reporting. Data not available consistently across the years. Limited understanding of GHG inventory process and the data needs. Data sharing arrangements not formalized.
Emission factor	IPCC default factors are used.	Country specific emission factors required for Tier 2 reporting not available.
Inventory team	The sub-sector inventory team is constituted during the inventory time and only includes national-level representatives. Involves only units that are considered data providers at national ministerial level.	Data collectors like counties and non-state organizations/stakeholders not involved in the inventory process.
Quality Assurance (QA) and Quality Control (QC)	This is done by the sector team members with assistance from CCD. The inventory is also presented to the team from the Council of Governors for validation. No documentation to show how this is done.	This is only done by MOALD & F team and does not include other sector stakeholders thus excluding critical information on activity data and emission factor that may be available with various stakeholders

Issue	Current arrangement	Gap/challenge
Capacity and expertise	There is no prior training for the teams doing inventory. They learn on job as they undertake the inventory	Insufficient technical expertise, training, and resources to collect, analyze, and report GHG emissions data effectively. Limited access to appropriate technology and infrastructure, e.g. remote sensing tools and climate monitoring stations.

3. Roadmap for Improving GHG Inventory and Transitioning to Tier 2 in the Crop Sub-Sector



The transition from Tier 1 to Tier 2 GHG inventory methodologies in Kenya's crop sub-sector is a critical step towards achieving more accurate, transparent, and comprehensive emissions reporting. The MOALD – CCU that coordinates the inventory at the subsector level needs to take steps towards enhancing the GHG inventory improvements in GHG emission tracking and reporting. These steps should focus on addressing the gaps and challenges identified in Table 1 above.

Step1: Review the existing data collection tools and procedures, and integrate data necessary for GHG Tier 2 reporting

Government officials currently collect data from initiatives unrelated to the GHG inventory. No efforts develop tools to specifically collect GHG inventory data or to integrate GHG data needs into the existing data collection tools. To make the inventory process credible and transparent, stakeholders will need to review current data collection tools and procedures in the context of data needs for reporting the GHG inventory using Tier 2 methods. The integration will be key to avoid data silos and duplication of efforts and resources. Procedures for collecting data using the tools will need to be defined in liaison with data collectors and providers. Stakeholders must ensure that the procedures are applicable and will generate useful data in a timely manner. The procedure will also need to define the data set formats and the methods of collection.

With Kenya being a devolved country field data needed for GHG inventory preparation and reporting would need to be collected at the farm level and aggregated to the ward, sub-county, county and finally at the national level. Ideally, the collected data could also allow for individual counties to do an assessment of the contribution of the crops sub-sector to GHGs emissions. Currently counties have been documenting the current areas under different croplands and submitting this information to the national statistics unit together with the crop production per season. Recently, the ministry in collaboration with FAO has launched the Kenya Integrated Agricultural Management Information System (KIAMIS), which is a detailed tool that collects cropland activities at the farm level, including information on crops distribution and crop management practices. In addition, the existing climate smart agriculture monitoring and evaluation (CSA-M&E) tool which was developed for adaptation reporting provides a platform through which data collected at the farm level can be reported from the ward to sub-county to county level. A detailed assessment of the data collected through KIAMIS needs to be done to identify the key missing data that is needed for the GHG inventory. This includes information on the crop-specific management practices that is crucial for Tier 2 reporting. Since the data for the GHG inventory is required every two years, mechanisms through which the data will be collected on a regular basis need to be well established.

Step 2. Engagement with relevant data sources

Currently, few data providers supply data for the GHG inventory, limiting the inventory to Tier 1 methods. During workshops organized through this project, we found that statistics, fertilizer and rice units are the main sources of data for the GHG inventory in the ministry of Agriculture. Although this data is submitted to these units from the counties, there are no clearly outlined procedures on how regularly the data is collected, which is crucial for transparent reporting. Consultative forums will need to be held to identify the potential sources for data not currently being collected. Once the appropriate data providers are identified, officials can organize meetings, workshops and other forums to discuss and agree on specifications of required data. Officials should define the routines and timelines for collection activities, any data updating requirements, and the frequency of data collection. They should produce agreements, terms of reference, and memoranda of understanding with organizations providing data. These instruments will clarify what is needed for the inventory, how it is derived and provided to the inventory compilers, and when it should be delivered. Stakeholders will review the existing data collection frameworks, at both the national and county levels, for the purpose of integrating data required for GHG inventory within existing frameworks.

Several potential sources may provide more refined data for use in Tier 2 reporting. These sources include the fertilizer voucher system, which has data on the exact number of farmers using fertilizer in different areas, and the KIAMIS which collects information on the area extent of different crops. Counties also collect data for their own use, which is not currently required by the national government. Some of the collected data could be useful for Tier 2 reporting of the GHG inventory. A detailed tool that can be used for collecting all the missing cropland activity that would be needed to transition to Tier 2 reporting is needed. Such a tool can be integrated into the already existing tools for data collection at the national level, e.g., KIAMIS. The CSA-M&E tool developed with support from the ICAT adaptation project provides a platform through which the data can be aggregated at the ward level and submitted for different sub counties and counties. However, the tool would need

to be reviewed to include a module through which data that is specific for the GHG inventory process can easily be submitted by the counties.

Step 3: Estimation/Calculation of country specific emission factors for major crops grown in Kenya

Tier 2 reporting will require country-specific emission factors for the various cropland activities. Some research and academic institutions have already been engaging in monitoring of greenhouse gases emissions in different cropping systems within the country. Institutions such as the Alliance of Bioversity International and CIAT, International Institute for Tropical Agriculture, and the Kenya Agriculture and Livestock Research Organization (KALRO) have been running long-term experiments for different crops that can be used in deriving emission factors under different cropland management practices. The crops sub-sector working group will need to identify existing and upcoming initiatives for GHG monitoring within croplands. Through engagement with various research and academia institutions they should plan on ways of using the already collected data to estimate emission for major crops like maize and rice. In addition, the ministry can inform these institutions of the key agroecological zones to focus for selected crops in order to derive robust emission factors that can be used in the inventory. The CSA-MSP may form an avenue for this engagement, due to their promotion of different climate-smart agricultural practices and their collaborations institutions like KALRO, the Alliance of Bioversity and CIAT, the University of Nairobi, and Jomo Kenyatta University of Agriculture and Technology (JKUAT), among others.

Step 4: Establish detailed mechanisms for relevant institutions to contribute data and information to the GHG inventory process.

With the tools, procedures and the data sources in place, the stakeholders need a mechanism to collect and provide data for the inventory. This mechanism can ensure that the GHG inventory is institutionalized in the sub-sector, not an ad hoc activity. Different players with various mandates within the inventory process will generate innovative ways of improving the inventory process. They will enhance the efficiency and the frequency of the GHG inventory for decision making, policy review, and development processes. The GHG inventory needs to be included in the CSA-MSP reporting objective and thematic working group to ensure it gets priority in the action plan. The Joint Agricultural Sector Coordination Mechanism (JASCOM) forms another potential mechanism through which data sharing for GHG inventory can be established.

Step 5: Sensitization and capacity building of county and national stakeholders

Experts in the MOALD-CCU involved in the inventory preparation need to train different actors on the roles they need to play in data collection, compilation, and modelling. The training needs to take place for staff at both the national and county levels. Officials should train actors in how best to carry out the activities, ensuring improvement of the GHG inventory process. Capacity building of officers in these institutions will also be key in ensuring the roles are carried out effectively. This will include detailed training on field data collection to ensure that the data collected at the farm level is accurate. The sector working team must secure technical expertise and finances for building the capacity of the GHG inventory teams.

Step 6: Develop a data management system that links the Ministry integrated the systems and the CCD.

The data management system will ensure data is collected, stored and used securely. The National Inventory System will efficiently and cost-effectively facilitate the reproduction and update of GHG emission estimates. It will safeguard against data and information loss, facilitating development of subsequent GHG inventories by future inventory staff, consistent with prior inventories. The management system needs to include the inventory compilation plan, institutional arrangements, methods, and data documentation and files used for inventory calculations (e.g., spreadsheets, models, databases, IPCC Inventory Software). The system must also incorporate quality assessment and control procedures, key category analysis, the inventory report, and internal and external review comments and responses. This should be an ICT-based system that links stakeholders, with access rights and restrictions based on needs. The CCD has a climate resource centre that can be provide for this system.

Conclusion

The roadmap for improving GHG reporting in the Kenyan crop sector offers a pathway towards a more sustainable, resilient, and prosperous future. It provides a strategic framework for enhancing greenhouse gas (GHG) reporting in the Kenyan crop sector, underscoring the critical importance of transparency, collaboration, and innovation in addressing climate change and promoting sustainable agriculture.

By following this roadmap, the MOALD-CCU, stakeholders, and other partners in the crop-subsector will be able strengthen the GHG reporting capabilities, improve data accuracy and transparency, and advance climate-smart agricultural practices. The need for capacity building, technology adoption, and knowledge sharing will be necessary to empower stakeholders and enhance their ability to collect, analyze, and report GHG emissions data effectively. A robust foundation for climate action will be developed by investing in training, infrastructure, and partnerships for inclusive and equitable development across the crop sector.

As the sector continues its journey toward achieving its climate and development goals, stakeholders must monitor progress, evaluate impact, and adapt strategies based on emerging challenges and opportunities. Embracing a culture of continuous improvement and collaboration, the sub-sector can position Kenya to be a leader in climate-resilient agriculture, contributing to global efforts to mitigate climate change for the benefit of current and future generations.

The climate MOALD-CCU will therefore need to mobilize the required resources and relevant stakeholders to spearhead implementation of the roadmap. They can achieve this objective through the CSA-MSP and other relevant stakeholders responsible for implementation of climate related actions and data collection in the agriculture sector.

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