A Roadmap for Data Collection in the Agriculture Sector of the Kingdom of Eswatini

ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency – ICAT
A Roadmap for Data Collection in the Agriculture Sector of the Kingdom of Eswatini

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Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BTRs	Biennial transparency reports
CCU	Climate Change Unit
CSER	Centre for Sustainable Energy Research
CSO	Central Statistics Office
DAES	Department of Agricultural and Extension Services
ECGA	Eswatini Cane Growers Association
ECB	Eswatini Cotton Board
ESA	Eswatini Sugar Association
ESAFF	Eastern and Southern Africa small-scale Farmers Forum
EFU	Eswatini Farmers Union
ERA	Eswatini Revenue Authority
EWSC	Eswatini Water Services Corporation
GDP	Gross Domestic Product
GHGs	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
MoA	Ministry of Agriculture
MOUs	Memoranda of Understanding
MTEA	Ministry of Tourism and Environmental Affairs
NAMBoard	National Agricultural Marketing Board
NMC	National Maize Corporation
RESC	Royal Eswatini Sugar Corporation
SNL	Swazi Nation Land
SWAFCU	Swaziland Farmers' Cooperative Union
T2EF	Tier 2 Emissions Factor

Executive Summary

This is a report outlining the proposed roadmap for data collection and institutional arrangement for the agriculture sector in the Kingdom of Eswatini. It first profiles the status of agriculture data in the country, for both livestock and non-livestock sectors, which was done in close consultation with key stakeholders, including the parent ministry, the Ministry of Agriculture (MoA), data providers and inventory compilers. Using data requirements for Tier 2 calculations for both the sectors under agriculture, as well as identified appropriate data sources, data suppliers, and data gaps, as well as existing and required institutional arrangements, the proposed roadmap is outlined, including required protocols needed to acquire missing data.

1. Background

1.1 Introduction

The Agriculture, Forestry and Other Land Use (AFOLU) sector was the dominant sector in the greenhouse gas (GHG) emissions for Eswatini in 2018 (Figure 1), contributing 48%, while the next highest sector, Energy, contributing 40% (Dlamini et al., 2020). Agriculture is also a major contributor to the country's economy through the provision of food, jobs, and financial security. The country has been using Tier 1 level for its inventory for all sectors.

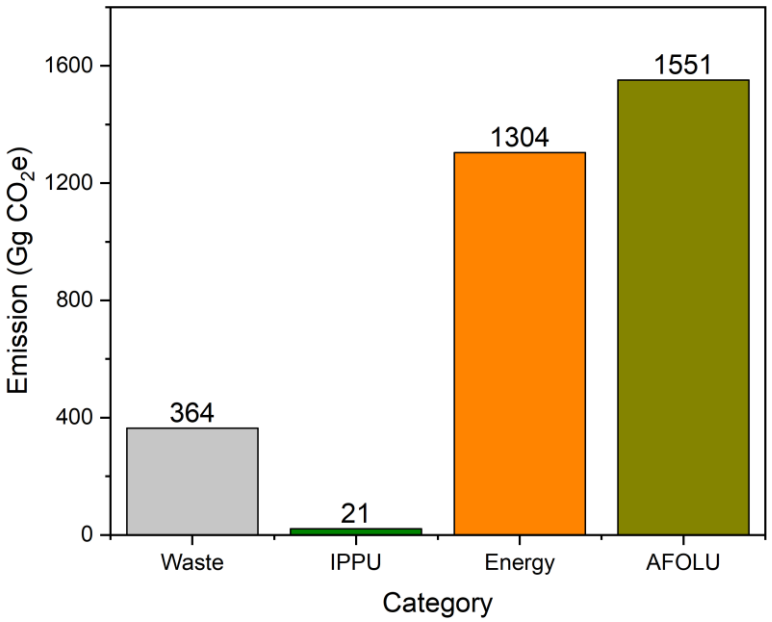

Figure 1: Eswatini's total GHG emissions by sector for the year 2018

2018 the AFOLU sector was a net emitter at 1551.14 Gg CO_2 equivalent (e) in Eswatini compared to 1990 where the country was a sink contributing -1090.61 Gg CO_2e. The emission increased relative to activities and management practices such as deforestation through forest conversions to cropland and grassland, biomass burning, emissions from livestock enteric and manure management and nitrogen additions to soil (Table 1). On gas-by-gas basis, N_20 had the greater share of the AFOLU reported at 41.7 % of the AFOLU sector emissions, followed by CO_2 (31.1 %) and CH_4 (27.2%). Within the AFOLU sector, the land category was the main emission source consisted 59% of the AFOLU emission. The rest were shared among aggregated sources and non-CO_2 emissions on land (13%) and livestock (24%) in 2018. Harvested wood products category was the only sink in the sector, with -4% contributions.

Table 1: AFOLU key categories for the Kingdom of Eswatini

Greenhouse gas source and sink categories	Gas	Emissions/removal (Gg CO_2e)		
		1990	***2015***	***2018***
Croplands	CO_2	175.20	1044.81	930.29
Grasslands	CO_2	248.35	588.21	575.50
Enteric fermentation	CH_4	504.45	442.82	383.41
Forest lands	CO_2	-2 185.91	-811.50	-290.68
Manure management	N_2O	189.39	173.91	151.18
Direct N_2O from managed soils	N_2O	339.20	333.42	306.41
Indirect N_2O from manure management	N_2O	132.46	113.67	96.56
Wetlands	CO_2	4.41	66.57	64.95

The AFOLU sector remains a key component of the Eswatini economy, collectively accounting for more than 13% of the country's Gross Domestic Product (GDP). Most of the high-value agricultural crops (sugarcane, forestry, and citrus fruits) are grown on Title Deed Land (TDL) and leased Swazi Nation Land (SNL) where there are high levels of investment and irrigation, and high productivity. However, about 75% of the local population reside in rural Swazi Nation Land (SNL) areas and is engaged in subsistence agriculture. Notably, both subsistence and commercial farmers practice livestock rearing and crop production (maize for subsistence and sugarcane for commercial, respectively). The socio-economic and land use dynamics have implications on the country's carbon profile, hence the need for continuous assessment and monitoring.

The increasing concerns over global climate change and pollution has seen a global drive to reduce the overall environmental impact of animal and crop production, these being the adaptation and mitigation (IPCC, 2021; Jackson et al., 2020). Such efforts and interventions are targeting improved/enhanced management-based mitigation and adaptation approaches for reduced GHG emissions across the sector.

The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories are the guiding greenhouse gas (GHG) documents for the Kingdom of Eswatini to prepare national inventories, national communications, and biennial transparency reports (BTRs). The guidelines provide several methodological options for estimating GHG emissions which are structured in the form of three tiers (Tier 1, 2, and 3) that describe and connect the various levels of detail at which GHG emission estimates can be made. Moving to higher tiers improves the accuracy of the inventory and reduces uncertainty, however, the complexity and resources required for conducting inventories also increases for higher tiers (Tier 2 and 3) (IPCC, 2006). The methods are distinguished between the tiers as follows:

- **Tier 1**: The methods are designed to be the simplest to use, for which equations and default parameters are provided in the 2006 IPCC guidelines. Country-specific activity data are needed, but for Tier 1, globally available sources of activity data may be used.
- **Tier 2**: These methods apply country-specific emission factors and use IPCC default equations and parameters. Higher temporal and spatial resolution and more disaggregated activity data are typically used in Tier 2 to correspond with country-defined coefficients for specific regions and specialized land-use or livestock categories. Tier 2 provides better accuracy than Tier 1 with moderate data and resource requirements.
- **Tier 3**: These methods are higher order methods, including equations and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at a sub-national level. They provide the highest accuracy while having less uncertainty. Due to their comprehensive nature, they demand the most in terms of data and resources.

This project, therefore, aims to develop robust sustainable data collection processes, including institutional arrangements, and improved Tier 2 data for future inventory compilation. It is meant to contribute towards ongoing efforts to improve the availability, collection and quality of data required for estimating emissions in the Agriculture, Forestry and Other Land Use (AFOLU) sector and to enable Eswatini to meet its enhanced international reporting standard requirements. This project, through improved data collection and enhanced MRV tools will play a major role in the enhanced GHG transparency in reporting climate action.

1.2 Objectives

The primary objective for the Agriculture Sector was to develop a robust sustainable data collection process, including institutional arrangements, and improved Tier 2 data for future inventory compilation. It is meant to contribute towards on-going efforts to improve the availability, collection and quality of data required for estimating emissions in the AFOLU sector and to enable the Kingdom of Eswatini to meet its enhanced transparency international reporting standard requirements.

1.3 Deliverables

The key deliverables expected from Activity 3 (Agriculture Sector) include the following outputs/documents:

a. Scoping and gap analysis report for the agriculture sector
b. Data collection templates for the agriculture sector (both livestock and non-livestock)

c. Stakeholder consultation workshop report
d. Roadmap validation workshop report
e. Roadmap for the agriculture sector highlighting institutional arrangements, data collection process and recommendations to fill gaps.

2. Methodology

2.1 Work plan and activities

To meet the aim of this assignment, specifically for Activity 3 (Agriculture Sector), 8 main activities were undertaken, and these are shown in Table 1 together with their timelines and anticipated duration.

Table 2. Main activities and timeline for Activity 3 (Agriculture Sector)

Activity	Output	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Activity 3.1	Meeting with Ministry of Agriculture (MoA) and inventory compilers to establish current status of agriculture data, identifying the data requirements for Tier 2 enteric fermentation calculations							
Activity 3.2	Identification of appropriate data sources, data suppliers and data gaps for improving the inventory for the agriculture inventory							
Activity 3.3	Consultative stakeholder workshop							
Activity 3.4	Development of draft templates inventory compilers							
Activity 3.5	Development of roadmap outlining the data collection process for the agriculture sector							
Activity 3.6	Validation of the draft Roadmap through a consultative stakeholder workshop							
Activity	Incorporation of stakeholder							

3.7	inputs and finalisation of roadmap							
Activity 3.8	Uploading and managing the files and templates through the existing inventory archiving system developed during the inventory compilation.							

2.2 Scoping and gap analysis

The activity was undertaken through, first profiling the status of agriculture data in the country, both livestock and non-livestock. This was done in consultation with the Ministry of Agriculture (MoA) and inventory compilers, and especially taking a leaf in the recently completed national study that was aimed at developing Tier 2 GHG inventory in the livestock sector and assessing the potential to reduce GHGs across the Agriculture sector in the country. The task also focused on identifying the data requirements for Tier 2 enteric fermentation calculations. The consultations then informed on appropriate data sources, data suppliers, as well as data gaps that need to be attended to for improved agriculture inventory.

2.3 Data collection templates

Guided by the scoping and gap analysis report, that highlighted data requirements for T2 inventory compilation, available data, and missing data, as well as data sources and data providers, consultations of relevant stakeholders were undertaken, and templates for collecting data for both livestock and non-livestock sectors were developed.

A national consultative stakeholder workshop was then held to inform on critical institutional arrangements, roles, and responsibilities for data collection, as well as contribute towards the development of draft templates that will be used by institutions to capture and report data, both livestock and non-livestock sources (e.g., fertilizers, urea, lime, and rice). The outputs of the workshop included recommendations on institutional MOUs that will need to be established with crucial institutions that are data sources/providers. Data collection templates developed by the consultants were validated through stakeholder consultations.

2.4 Development of a roadmap

The outputs (e.g., templates) and consultative meetings were used to develop this comprehensive roadmap document that fully outlines the data collection process for every sub-sector of the agriculture sector. The roadmap further highlights the identified existing data gaps and the recommended steps and developments critical for filling these gaps. The finalised templates and developed draft roadmap were validated through a consultative stakeholder workshop, where feedback received were incorporated into the final document.

2.5 Stakeholders' consultation process

Initial consultation of sector stakeholders was undertaken during the project inception stakeholders' meeting. During the meeting, stakeholders were introduced to the project, and what it aimed to achieve. This was then followed by individual consultation of stakeholders and institutions where further information was needed.

Then a two-day residential stakeholder's consultative workshop was also held between the 07th and 08th March 2022, in Hilton Gardens Hotel, Mbabane. Stakeholders, primarily, from the Ministry of Agriculture, and other relevant partners such as private organizations and NGOs were engaged through face-to-face consultation. In addition, stakeholders who could not make it to the meeting were engaged individually, either through a physical meeting and/ or remotely, through a virtual or telephonic call. This was done to assess the institutional arrangements and develop the data collection roadmap.

In summary, several activities aimed at strengthening the institutional arrangements and data collection process for the sector were undertaken, and these include:

- A scoping and gap analysis undertaken to understand the current situation in terms of institutional arrangements and data collection in place for estimating national GHG emissions, including an assessment of requirements for Tier 2 livestock methodologies.
- Consultative meetings were held with the parent ministry (MoA) and other relevant stakeholders to identify available data, gaps and needs, data sources and providers, existing institutional arrangements, and areas of improvement.

The list of data providers that were identified during the GHG compilation for the 4th National Communication were updated during the meetings, and data collection templates were developed to improve transparency and to assist with the accelerated international reporting requirements. These meetings informed the development of detailed institutional arrangements, along with roles, responsibilities, and QA.

- Stakeholders and data providers were further engaged through a consultation to inform the development of a roadmap that outlines the way forward and providing recommendations of actions to be taken to fill the data and institutional gaps and future MoU requirements.
- The developed draft roadmap was then shared virtually with stakeholders for validation, and their inputs and comments incorporated into the final roadmap report.

3. Data Collection Protocols in the Agriculture Sector in Eswatini

3.1 Key stakeholders and sources of data for the livestock sector

Livestock data is annually collected and reported by the Ministry of Agriculture (MoA), through its Department of Livestock and Veterinary Services (DLVS). The Livestock Services is mandated with providing livestock extension services, management of government ranches, animal nutrition and range management extension, as well as livestock marketing and markets information. The Veterinary Services is mandated with promoting animal health and welfare while creating conducive conditions for economic animal production. For the livestock sector, stakeholders finalised the main sources of data and institutions that will be key in the collection of data required as the Kingdom moves from Tier 1 to Tier 2, and these data sources and providers are summarised in Table 3 below.

Table 3: Main data providers for the livestock sector in Eswatini

Institution	Department/Unit	Officer(s)	Data
MoA	Department of Veterinary and Livestock Services National Data Office	Paseka Malima	National livestock population (cattle, goats, sheep, pigs, poultry, horses, and donkeys)
Central Statistics Office	Agriculture Data Unit	Melusi Simelane	National census years data on livestock population (cattle, goats, sheep, pigs, poultry, horses, and donkeys)
FAO			Productive data
King's Office	Livestock Section	Leslie Mapako	Livestock populations under Tibiyo TakaNgwane farms
Eswatini Dairy Board		Dr. Tony Dlamini	National dairy cattle population Milk yield
Eswatini Meat			Manure management

Industries			(abattoirs)
Eswatini Meat Wholesalers			Manure management (abattoirs)
Private Sector/Farms (Including IYSIS Farms)			Livestock populations Productive data Feed basket
Association of Livestock Farmers (Owned by communities at Maloma using Tibiyo Farm)			Livestock populations Productive data Feed basket
Smart Cattle Farmers			Livestock populations Productive data Feed basket

3.2 Key stakeholders and sources of data for the non-livestock sector

Non-livestock data are also annually collected and reported by the Ministry of Agriculture (MoA), through its Department of Agricultural and Extension Services (DAES). The main responsibility of the department is to promote crop production and improved human nutrition through the provision of agricultural extension services that advise farmers on improved farming systems and technologies. The overall aim is increased productivity and improved standard of living. There are other key sources of non-livestock data such as private companies. These main data sources and those that will be key sources as the Kingdom moves from Tier 1 to Tier 2 are summarised in Table 4 below.

Table 4: Main data providers for the non-livestock sector in Eswatini

Institution	**Department/Unit**	**Officer(s)**	**Data**
MoA	Crop section - Department of Agricultural and Extension Services (DAES)	Daniel Dladla	National crops data (hectarage and yield)

Central Statistics Office	Agriculture Data Unit	Melusi Simelane	National census years data on crops data (hectarage and yield)
FAO		Ncobile Simelane	National crops data (hectarage and yield)
King's Office	Crops Section	Leslie Mapako	Crops data from Tibiyo TakaNgwane farms (hectarage and yield)
Eswatini Revenue Authority	Imports and Exports	Muzi Dube	All imports for fertilizers, urea, and lime
Eswatini Sugar Association		Mphumelelo Ndlovu Patrick Mkhaliphi	Sugarcane hectarage and yield for commercial and small-scale farmers
Royal Eswatini Sugar Corporation, Illovo, and Tabankulu Farms		Jabu Myeni Hlelile Ginindza	Sugarcane crop hectarage and yield N fertiliser, lime and urea applied
Eswatini Cane Growers Association (ECGA)		Sipho Nkambule	Sugarcane crop hectarage and yield N fertiliser, lime and urea applied
Eswatini Cotton Board		Jeconiah Msibi	Cotton crop hectarage and yield N fertiliser, lime and urea applied
Eswatini National Maize Corporation			N fertiliser, lime and urea supplied to subsistence farmers
Rice farmers			Hectarage of rice cultivated, cultivation period and yield Pre, during and post season management practices
Eswatini Farmers Union (EFU), National Agricultural Marketing		Bheki Ginindza Maswati Dludlu	Crop and vegetables hectarage and yield N fertiliser, lime and

Board (NAMBOARD), Swaziland Farmers' Cooperative Union (SWAFCU) and ESAFF			urea applied
Farm Chemicals, Swaziland Agricultural Suppliers and Triomf (N fertiliser suppliers)			N fertiliser supplied to local commercial and subsistence farmers
Eswatini Water Services Corporation (EWSC)			Quantities of sludge used as manure
Forest Plantation Companies			Crop hectarage and yield Amounts of N fertiliser, lime and urea applied to soils
Orchards (banana, pineapple, citrus, etc.)			Crop hectarage and yield Amounts of N fertiliser, lime and urea applied to soils

3.3 Tier 2 data availability and gaps for the livestock sector

Data availability in the country is also largely influenced by land tenure. The title deed land (TDL), which constitutes 24% of the total land area is often characterised by high productivity, subsequently better management. On the contrary, a larger proportion of the livestock are found under Swazi Nation Land (SNL), approximately 75%, which suffers from low productivity and investment (Mabaso & Tfwala, 2021). With most of the data there are no official reports, and therefore expert judgement are currently the main source of data. Below is the list of available and missing data for the livestock sector in the Kingdom of Eswatini.

3.3.1 Available data for livestock sector

According to the rigorous gap analysis that was undertaken and validated by national experts/stakeholders, there is historic livestock data that is already being collected and

available in the format needed for improvement from the use of Tier 1 to Tier 2 methods in the Kingdom. The data includes:

- Livestock population data that are grouped by the four administrative regions (Hhohho, Manzini, Shiselweni and Lubombo) and sub-regions are available nationally on annual basis from the year 2011 from the annual reports of the National Veterinary Services that are accessible from https://www.gov.sz/index.php/scholarship/80-agriculture/agriculture/1624-veterinary-and-livestock-services-reports.
- These national cattle population statistics are adequately disaggregated for Tier 2 (by type, i.e., dairy cows and beef cattle and by age (2-3 years, 1-2 years and < 1 year for both males and females)),
- There are other national statistics for goats, sheep, pigs, donkeys, horses, and poultry (indigenous, layers and broilers).

3.3.2 Missing data for livestock sector

The scoping and gap analysis process also found that, even though livestock population and herd structure is available, there were still a lot of data gaps, and the noted lack of data for the livestock sector are as follows:

- Livestock production systems:
    - No official documentation at a national level
    - Expert judgement is the current data source.
- Milk yields:
    - No data
    - Expert judgement currently used.
- Fat content of milk.
- Feed digestibility.
- Feeding conditions:
    - No data
    - Expert judgement currently used.
- Hours worked:
    - No data
    - Expert judgement currently used.
- Livestock unit (LSU) in Eswatini:
    - Current estimates do not take into consideration the breeds.
- Livestock weights and weight gains.

Table 5: A summary of activity data availability required for T2 and current data available

Parameter	Description	Cattle	Sheep/ Goats	Poultry
Population	Annual average population of each livestock sub-category.	✓	✓	✓
Livestock characterisation	Livestock sub-categories and characterisations per region	✓		✓
Body weight	Average live weight of each animal sub-category	✓*		
Mature weight	Shrunk body weight of mature animals	✓*		
Weigh gain	Average daily weight gain			
Body weight at weaning	Body weight at weaning	✓*		

Milk yield	Annual average daily milk yield per calendar year not per lactation	✓*	✓*
Fat content of milk	Average fat content of milk (Apply to females)		
Fraction of adult females pregnant	Fraction of adult females giving birth in a calendar year	P*	
Number of births	Number of births in a year (Does not apply to poultry)		
Feeding conditions	Categorization of animals as stall-fed, grazing confined pasture or grazing extensive rangeland		
Hours worked	Annual average number of hours of work per day (Applies to cattle)	✓*	
Wool production	Wool production (Dry matter before scouring) per head per year		
Feed digestibility	Digestible energy as a percent of gross energy		
Fraction of manure managed in different systems	Fraction of manure from each type of livestock managed in different manure management system in different climate regions	✓*	
Crude protein of diet	Average crude protein content of the diet		
Protein content of milk	Average protein content of milk		
Mean annual temperature	Mean annual temperature where livestock are located	✓	

NB: A tick (✓) indicates that data are available, while a tick with a star (✓*) refers to expert judgement. Where there is no tick, data are unavailable

3.4 Tier 2 Data availability and gaps for the non-livestock sector

3.4.1 Available data for the non-livestock sector

Similarly, for the non-livestock sector, the gap analysis that was undertaken and validated by national experts/stakeholders highlighted that there is historic data that is already being collected and available in the format needed for improvement from the use of Tier 1 to Tier 2 methods in the Kingdom. The specific details of the available historic data for each institution that is either a source or collector are fully outlined in the section below. Data available in the

non-livestock sector was found to be with Eswatini Revenue Authority, having been kept as records for imports into the country, and these include:

- Annual totals of imported N fertiliser
- Annual total of imported lime
- Annual totals of imported urea

3.4.2 Missing data for the non-livestock sector

The gap analysis report found that the available data was not available in a format suited for Tier 2, as it was not spatially distributed, or linked to crop type, but were in annual totals. It was especially noted that this approach also did not account for whether all N fertiliser, lime and urea that was imported in a year was all applied to soils, nor where exactly these were applied. The full list of missing data required for Tier 2 are:

- Field-based manure management practices
- Crop-specific data on N fertilizer application
- Crop-specific data on lime application
- Crop-specific data on urea application
- Cultivated rice hectarage
- Cultivated period of rice
- Amount of crop residue N applied to managed lands
- Organic N applied as fertiliser (e.g., animal manure, compost etc.)
- Urine and dung N deposited on pasture, range, and paddock by grazing animals
- Area of drained/managed organic soils
- Emission factors for rice (harvested area and flooded fields), N_2O and lime emissions

Table 6. A summary of activity data availability required for T2

Parameter	Description	Maize	Sugarcane	Rice	Other
N fertiliser	Synthetic and organic fertiliser applied to soils				
Urea	amount of urea fertilisation				
Lime	amount of calcic limestone or dolomite				
Rice harvested area, and cultivation period	Cultivated period and the area under cultivation				
Rice water regimes	Ecosystem (i.e., irrigated, rainfed etc) type and flooding patterns				
Rice straw incorporated	Straw in t per season				
Duration of straw incorporation (Rice)	Short (< 30 days) or long > (30 days)				
Weight of stubble left in the field (Rice)	How many cm of stubble is left in the field (e.g., 10, 20, 30 or more cm)				
Urine and dung N deposited	N deposited on pasture, range, and paddock soils by grazing animals				
Crop residue N	Crop residues (above-ground and below-ground),				
drainage/management of organic soils	area (ha) of drained/managed organic soils				

4. Suggested Roadmap and Data Collection Protocols for Tier 2 Data Needs in the Kingdom of Eswatini

The consultative process covered numerous aspects considered key for a successful data collection system, and successful upgrading from the use of Tier 1 to the use of Tier 2 for GHG emissions from the agriculture sector.

4.1 Existing livestock productive systems in Eswatini

A discussion was initiated on the need to define agricultural productive systems applicable in Eswatini. In the gap analysis that was completed at the onset of the assignment, production systems that had been proposed, based on work undertaken with FAO (Mabaso & Tfwala, 2021), were:

- Mixed production in the Highveld region (a combination of dairy and non-dairy)
- Mixed production in the Middleveld region (a combination of dairy and non-dairy)
- Mixed production in the Lowveld region (a combination of dairy and non-dairy)
- Mixed production in the Lubombo region (a combination of dairy and non-dairy)
- Dairy production (Mostly private farms
- Beef production (Private farms and feedlots, e.g., Sitilo Farm)

Experts in the sector noted that these descriptions were based more on the types of livestock (i.e., dairy or non-dairy/beef) as opposed to the dominant feed type and feed practice. However, they noted that the preferred definition of the systems, as per dominant practice among livestock farmers, be guided by the feed type and feed practice. This was important since it was noted that this was what was primarily the distinction than just livestock type. After the deliberations with stakeholders, below are the three systems that were agreed for the Kingdom of Eswatini, together with the livestock that falls under each.

1. Extensive productive system

This is the widely practiced system across SNL (subsistence farming) and livestock ranching farms (both commercial and government farms). The system is characterised by a low productivity per animal and per land area, and low inputs, capital, and labour compared to the farmed land area. This category would include:

- Ranching (Cattle, goats, and sheep)
- Subsistence livestock farming (Dominantly cattle, goats, and sheep)

2. Intensive productive system

This system is where livestock is mostly given high-quality feed supplement. This system is the opposite of the extensive system, mostly characterised by a relatively high productivity per animal and per land area, as well as high inputs, capital, and labour compared to the farmed land area. It is most mostly practiced under the following production types in Eswatini. This category would include:

- Feedlotting
- Poultry
- Abattoir
- Piggery

3. Mixed farming (semi-supplement)

This is a system whereby farmers neither practice any of the two mentioned system, but rather adopt a mix of both. Livestock do rely on feed naturally, but also supplemented with feed, especially in the dry winter season. This category would include the ranching of cattle, goats, and sheep, as well as the subsistence livestock farming, but with the supplementation of their feed.

4.2 Roadmap for data collection for the livestock sector

After the rigorous stakeholder consultations on data collection and requirements, a roadmap crucial for a fully operational data collection system for the livestock sector was explored, with different stakeholders making their input. This was mainly guided by the proposed data collection template spreadsheet for the livestock sector. The spreadsheet contains information on livestock population, production data, manure management, feed basket and quality assurance and quality control (Refer to attached livestock spreadsheet).

4.2.1 Establishment of MOUs with institutions

Stakeholders agreed unanimously that there was an urgent need for MTEA to setup a memorandum of understanding (MOU) with MoA which is the custodian ministry in livestock data collection in Eswatini. MoA houses the National Office responsible for the nationwide data collection, analysis and reporting, an MOU will serve to inform the office on the data requirements for T2 GHGs inventory compilation, and especially how and when data ought to be availed and/or transmitted to MTEA for the compilation purpose. In addition, MTEA will need to assist MoA to setup further MOUs with other agencies, namely, Eswatini Dairy Board, King's Office, abattoirs, and private farms who are also sources and providers of livestock data crucial for T2 GHGs inventory compilation.

4.2.2 Data collection protocols for productive data

Consultations highlighted that there were numerous data gaps and needs, meaning that there was still work to be done, both in terms of investing on equipment necessary for collecting the missing data, and in capacity building among data collectors, such as extension officers. It was noted that MoA has for years, been without equipment such as weighing scales that are needed for deriving stock weigh across the country. For the country to be able to generate this data, MTEA must assist MoA to source the data, and to develop a programme for sharing the equipment across the government dipping facilities and the private farms across the Kingdom. In addition, the data collectors will need to be sensitized and capacitated on the data needs for T2 GHGs inventory compilation, the data formats, and on the data collection procedures and methods. For quality and consistency in collected national data, all the data collectors

(extension officers and private farms) will need the capacitation. The established MoUs, coupled with the sensitization and capacitation exercise will ensure that all the concerned stakeholders (e.g., extension officers and leadership of the department of Livestock and Veterinary Services) fully appreciate the data needs and requirements of T2.

As part of the MOU that will need to be established between MTEA and MoA, it was stressed that it must be specific that the relevant data collection equipment and the data collection templates being introduced for collecting national livestock data must target the extension officers. The current operational and functional data collection protocol within MoA places extension officers at the grassroot level, collecting data directly from farmers through the national dipping system and annual livestock census. It was also highlighted that among critical machinery and equipment that will be needed is nutrition oriented and production-oriented equipment (Mueller-matrix polarimetric scatterometre for fat milk content, AgriCheck plus grain analyser for feed composition, etc) as the MoA currently does not have such equipment nationally. This should be housed at the Malkerns Research Centre. The NDC implementation plan funding is among noted potential technical and financial support.

Stakeholders noted that data sharing has always been challenging in the kingdom, with some institutions not willing to share data of national importance. It is therefore recommended that the country work towards establishing a legislation that mandates institutions and individual farmers to share data relating to climate change (to safeguard against institutions holding back critical data). The legislation shall authorise MTEA and institutions delegated by MTEA to establish MOUs that will govern the collection of such data from data sources and providers annually, using data templates that are part of the MOUs. For national livestock data, as outlined above, MoA is the custodian of all livestock data nationally. The legislation will authorise MoA to collect data from all data providers and sources annually and transmit it to MTEA for GHGs inventory compilation and archiving.

4.2.3 Data collection protocols for manure management

The national stakeholders of the livestock sector highlighted that there was currently no national data or a collection system for manure management. To date, GHGs inventories that

estimated emissions from manure management relied on expert judgement. It was indicated that the proposed MOU between MTEA and MoA, as well as the proposed MOUs between MoA and other institution/agency that deals with manure (abattoirs, King's Office, Eswatini Dairy Board and private farms) must have the manure management data collection template as part of it. MTEA and MoA should also engage the Faculty of Agriculture in the University of Eswatini (UNESWA) to strengthen existing research and establish a research programme specific to manure management.

Stakeholders, specifically officers from MoA, noted that there has been an increase on the use of chicken litter as feed for livestock in the Kingdom. As part of the institutional arrangement, it will be crucial to establish a section under the livestock and veterinary services department that will focus on the growing feedlot category in the country. The section will be responsible for developing a programme that will inform government and farmers on best practices and on the next steps crucial for establishing the category. In addition, specialists will need to capacitate extension officers on the data requirements and the data collection process.

Stakeholders also noted that all the abattoirs are key stakeholders as manure is generated by livestock in the facilities, and the abattoirs are spread across most municipalities in the country. Reporting of manure quantities and how these are managed will need to be reported by abattoirs to municipalities, who in turn will transmit the data to MTEA annually. Notably, this requires MTEA to establish MOUs with the municipalities and these abattoirs, as well as capacitation of these players on the data collection template, data capturing and sharing.

Eswatini Meat Industries were reported to have lagoons used to store manure generated by livestock in the facility for slaughter and during the slaughter process. MTEA will need to establish an agreement with Eswatini Meat Industries, Eswatini Meat Wholesalers and other players such as municipal abattoirs through an MOU, to start collecting data on the manure amounts and the management practices and reporting such data to MTEA through their municipalities. Municipalities will further need to compile records of manure generated in their cattle impounds (skips).

4.2.4 Data collection protocols for feed basket

Stakeholders highlighted the need for data collection templates for feed components to target the feed millers operating in Eswatini, and the key players include TWK, Arrow Feeds, Crane Feeds and Feedmaster. Discussions with the millers needs to be initiated to build awareness on the type of data that is required and to develop data collection templates and reporting protocols for feed components.

For the feed basket of dairy livestock, it was noted that the recommended MOU between MoA and UNESWA (Faculty of Agriculture) will facilitate research and data sharing on production variables and livestock populations. It was noted that as there is currently very limited data on production variables, it may be expedient to use data that research from UNESWA has generated thus far as a benchmark for all other variables. Furthermore, Eswatini Dairy Board will need to also be engaged by MTEA and MoA to continue supporting the inventory compilation through availing data on dairy. For the non-dairy category, the country will need to invest through a partnership of MTEA and MoA to engage specialists to capacitate and train extension officers so that data is sourced from the farmers, ideally during the annual census. To maximise on the existing census, MTEA will work with MoA to ensure that additional questions responding to the data needs of T2 are added to the census instrument. It is suggested that UNESWA play a key role in this regard to, first to train and capacitate extension officers, and importantly, to update and include such training in the curriculum to ensure graduates are already capacitated. The developed programme must include the development of a training manual.

4.3 Roadmap for data collection for the non-livestock sector

Similarly, the rigorous stakeholders' consultations on data collection and requirements, the development of a roadmap crucial for a fully operational data collection system for the non-livestock sector was undertaken. This was also guided by the proposed data collection template spreadsheet for the non-livestock sector. The spreadsheet contains information on crop production, rice cultivation, soils (Refer to attached non-livestock spreadsheet). Below are the conclusions and way forward for the category.

4.3.1 Establishment of MOUs

As highlighted in the livestock sector, the non-livestock sector will require that MTEA establish an MOU with MoA, and further assist it to establish MOUs with the institutions and agencies that are custodians of data required for Tier 2 GHG inventory compilations. These institutions include ERA, ECB, NAMBoard, NMC, ESA, and or individual large cane growers (RES, ILLOVO and Tabankulu), among others. The purpose of the MOUs is to facilitate the integration of the data collection templates into the data collection processes of the institutions, and for the adoption of the proposed data collection and sharing processes.

4.3.2 Data collection protocols for the sugar industry

This industry reported that data on the hectarage of cultivated fields/areas, residue, and bagasse management by individual companies and/or farmers was available. The industry has a database where the needed data on the hectarage cultivated is captured and stored through ESA (custodian of the data). A caution that was highlighted by stakeholders is that even though the data can be sourced anytime through submitting a request in writing through the CEO of ESA, the data belongs to the farmers, meaning that there is that level of protection to it. Data that is readily available, even at an operational level with ESA include:

- Soil inputs
- Crop cycle (age)
- Area under cultivation

The industry noted that for soil input data (fertilisers, lime, and urea), even though such data was not being collected, it is available as farmers have this data. Such data requirements will be catered for by the MOU, and the data collected once agreements have been established. The industry noted that it will lie with MTEA to be proactive by putting in place the MOU with MoA that also covers data requirements and reporting procedures, formats, submission process and dates, protocol of how the data will be collected, etc. But the proposed approach is to integrate the data collection template with the existing data collection structures.

The proposed protocol for collecting, storing, and reporting of the required data is one that seeks the assistance of ESA in collecting the soil inputs data from all small-scale sugarcane growers. There will be a need to establish a data collection system and a data collection template that will be used by the ESA extension officers who work with these farmers across the industry. Then for the large-scale sugarcane growers, can either use ESA to collect the data, or collect data from the institutions directly (RES, ILLOVO and Tabankulu).

As a way forward, stakeholders noted the need for engagement with higher level officers (such as heads of departments) to sensitise and capacitate them on the project, and the data requirements it comes with. The feeling was that the move would yield their buy-in and assumption of the responsibility. It was also advised that for the established data sharing agreement or MOU, the focal person is best coming from the Technical Services Section of ESA, the custodians tasked with the data collection, storage and sharing as instructed by the CEO. Stakeholders also noted that the NGO, PELUM is working on projects in communities aimed towards low GHG emissions, and therefore urged MTEA to work on integrating the NGO on the data collection process.

4.3.3 Data collection protocols for the cotton industry

It was established that the cotton industry also has been keeping records of data of the following over at least the past 10 years:

- Soil inputs
- Crop cycle (age)
- Area under cultivation
- Crop yields

Similarly, to sugarcane, data is requested through the CEO of Eswatini Cotton Board, and the request then trickles down the board structure to the technical manager who then provides the requested data. The board also reported that there is also data on the use of foliar cotton feeds for the plants which is sprayed. That data is already available as the board has been reporting on it in annual reports.

Data on soil inputs is not being collected in the industry, and thus no records are available. However, it was noted that once an agreement through an MOU has been established between MTEA and the Board, such data will be collected and availed by the Cotton Board as needed. It is, therefore, recommended that the MOU is immediately established by MTEA with the board, The MoU should detail the data requirements and the frequency of data reporting.

4.3.4 Data collection protocols for other crops (e.g., maize, sweat potatoes, sorghum, etc) under MoA

MoA reported that data on crop types and hectarage is available and is disaggregated by the administrative regions across both subsistence and commercial farming. However, it was noted that there may be an underestimation due to lack of mobility of the extension office teams, to enable them to cover all parts of the country. Such data is available to MTEA for the inventory compilation. To further strengthen such data, it is recommended that MTEA engage parastatals such as NMC and NAMBoard, institutions that interact directly with farmers for, and establish an agreement on how these institutions are to enhance the data collection process. Extension officers will be crucial for sourcing the data from individual farmers, especially subsistence farmers.

4.3.5 Data collection protocols for the forest plantation industry

The industry was not represented in the consultative workshop. However, it was noted that these are practiced commercially by a few institutions (Montigny Investments, Shiselweni Forestry, Peak Timbers Ltd., Shiselweni Forestry Company Ltd., and Swaziland Plantations). The hectarage of forests by species types is known to the respective companies, and likely, the amounts of soil inputs per year. MTEA is encouraged to engage the companies to sensitive them on the data requirements, and to introduce the develop template to be used for collecting the data.

4.3.6 Data collection protocols for the pineapple industry

The industry was not represented in the consultative workshop. However, it was noted that Rhodes Group is the primary pineapple grower in the country. According to Rhodes Group, as of 2017, it cultivated 1500 ha of land, where 40% was owned by the company, and the

remaining 60% was leased, resulting in about 23 000 tons of pineapple harvested annually. In order to double production, the company leased 1700 ha of land in Siphofaneni, and has started harvesting in the recent years. This shows that data on the hectarage of cultivated/planted fields is known, and should be made available to MTEA for the purposes of GHG inventory compilation once an agreement in the form of an MOU has been established with Rhodes Group. In addition, the quantities of soil inputs is known, and MTEA will need to motivate on the importance of such a data. MTEA is, therefore, encouraged to engage the company to sensitise them on the data requirements, and to introduce the develop template to be used for collecting the data.

4.3.7 Data collection protocols for banana industry

Even though banana coverage may not be very high, it is noted that there are substantial banana farms around Hluthi and Siphofaneni (under ESWADE LUSIP project). Nisela Farms in Nsoko also has a significant hectarage of banana. MTEA will need to engage these companies/farmers to reach an agreement on how the data on crop coverage and soil inputs applied each year can be recorded and reported to the ministry of the GHG inventory compilation purposes.

4.3.8 Data collection protocols for avocado and macadamia industry

This industry is very comparable to the banana industry in terms of hectarage, starting to have substantial avocado and macadamia farms in the country. This is especially in Nhlangano where there is at least an avocado farm that is around 1000 ha, and Nhletjeni area, which also in the Shiselweni Region (close to Nhlangano). As with the other industries that it is comparable to, MTEA will need to engage these farmers to reach an agreement on how the data on crop coverage and soil inputs applied each year is recorded, and reported to the ministry for GHG inventory compilation purposes.

4.3.9 Data collection protocols for citrus/orchards plantations industry

Even though the industry was not represented in the stakeholders that were consulted, it is very comparable to the banana industry, starting to have substantial avocado and macadamia

farms in the country. As with the other industries that it is comparable to, MTEA will need to engage these farmers to reach an agreement on how the data on crop coverage and soil inputs applied each year is recorded and reported to the ministry of the GHG inventory compilation purposes.

4.3.10 Data collection protocols for rice industry

It was noted that the rice category has remained very negligible, just about 10 ha nationally. However, it was agreed by stakeholders that for the purposes of records keeping and generation of time series data, the collection of the data on rice be initiated, at least on hectarage. The motivation is that the rice farmers need to be familiar with reporting and the use of the data collection templates. MTEA will be required to initiate the process through facilitating an MOU between MoA and the Taiwan Technical Mission in Eswatini. The mission shall be responsible for documenting the details (such as area and production parameters) for each individual farmer annually and transmitting the data to MoA. MoA will in turn transmit it to MTEA together with the other datasets falling under its portfolio.

4.3.11 Data collection protocols with Eswatini Revenue Authority

There is currently no manufacturing of fertilisers, lime, and urea in the Kingdom, with all these inputs and/or inputs imported from neighbouring South Africa and Mozambique, and records of such data collected and stored by Eswatini Revenue Authority (ERA). The data records of quantities of the inputs remain crucial for verifying data collected from farmers nationally. Therefore, an agreement will need to be established by MTEA with ERA.

4.4 Summary of actions to be taken under the roadmap

Table 7 below is the summary of actions to be taken overall, and specifically under the livestock and non-livestock sub-sectors of the agriculture sector of the Kingdom of Eswatini. It also summarises the lead institutions for each action, and the proposed timelines (i.e., short-, medium- and long-term).

Table 7: A summary of actions to be taken for the livestock and non-livestock sector

Livestock		
Actions	***Responsible***	***Timeline***
Setup MOU between MTEA and MoA that include the data collection templates for collecting data on livestock populations, productive data, manure management and feed basket	MTEA	Short-term
Establish MOU between MoA and other livestock data sources and collectors (Eswatini Dairy Board, King's Office, abattoirs, and private farms)	MTEA and MoA	Short-term
Add questions to annual livestock census data collection tool	MTEA and MoA	Short to Medium-term
Setup an MOU between MoA and UNESWA (Faculty of Agriculture) will facilitate research and data sharing on production variables		Short-term
Engage the Faculty of Agriculture at UNESWA to strengthen existing research and establish a research programme specific to manure management	MTEA and MoA	Medium-term
Develop and implement a sensitization and capacity building		Short-term

programme for national data collectors		
Develop a training manual for data collectors (extension officers)		Short-term
Non-Livestock		
Actions	***Responsible***	***Timeline***
Setup MOU between MTEA and MoA that include the data collection templates for collecting non-livestock data	MTEA	Short-term
Setup MOUs between MoA and other non-livestock data sources and collectors nationally (E.g., ECB, ESA, NMC, ERA, private farms for avocados, macadamia and banana, etc.), including data collection templates, details of the data requirements and the frequency of data reporting	MTEA and MoA	Short-term
Engage the commercial forestry industry (Montigny Investments, Shiselweni Forestry, Peak Timbers Ltd., Shiselweni Forestry Company Ltd., and Swaziland Plantations) to sensitive them on the data requirements, and to introduce the data collection template to be used in the sector	MTEA	Medium-term

Overall

Actions	*Responsible*	*Timeline*
Engage with higher level officers (such as heads of departments) and politicians to sensitise and capacitate them on the project, and the data requirements it comes with	MTEA	Short to Medium-term
Establish legislation on climate change that will govern data sharing and collection	MTEA	Long-term

4.5 General challenges for the agriculture sector

Numerous challenges in the agriculture sector that threaten the development of a robust national data collection system were identified and these are outlined below.

1. Stakeholders noted that the borders into Eswatini were very porous, threatening proper stocktake of imports, as some may go unaccounted for. Due to porous borders, communities closer to the borders buy their implements from the neighbouring countries, and a lot of these together with pesticides and insecticides make it into the country.
2. In addition, dagga production, even though illegal, has remained a key source of livelihoods for rural households in the Kingdom, ultimately consuming high quantities of inputs such as fertilizers and water, which go unaccounted for.
3. Through government initiatives, farmers were encouraged to migrate from organic to synthetic for improved crop yield, and thus improved food security in the Kingdom. In addition, a soil testing centre was established, for farmers to get their soils tested to determine quantities before application. Nowadays, with farmers sourcing synthetic fertilizers, lime and urea through the government subsidies from NMC, the soil tests were supposed to be the determinant of quantities allocated to farmers. Unfortunately,

this is not considered, and farmers are allocated according to quantities they paid for. In addition, there is a grey area of whether all those quantities received are applied in their fields, or there are some that go into 'other' uses (dagga production).

4. There is also the observation that there was a norm by some officers to personalise data than institutionalise it within some institutions. These sentiments were shared by the Central Statistics Office (CSO), which noted that from the deliberations and submissions made during the workshop, there is a lot of data in the country, but dissemination and sharing is the challenge that needed to be addressed.
5. Lack of data from armed security forces (HMCS and the army) – implements that go into their agricultural fields are not accounted for.
6. Stakeholders also lamented that even though they are consulted constantly, the rate of taking back report/feedback/outputs to them was very poor.

4.6 Proposed solutions/areas of improvement to generic sector challenges

To operationalise the proposed systems and to respond to the challenges presented above, below are some of the proposed steps of action.

1. There is an urgent need for an over-arching legislation on climate change (Climate Change Bill).
2. There is a need to start conversations around how border security and regulation of imports and exports may be strengthened. There is especially a need to start discussions with border control institutions and departments, and security forces.
3. Acknowledging the dynamics brought about by the illegal farming of dagga across most parts of the country, as a way forward, it is recommended that remote sensing (satellite imagery) be used to map and estimate the total hectarage of dagga fields to indirectly estimate inputs that may be applied there.
4. To source data from the productions by security forces, it is recommended that consultation meetings are held by MTEA and the forces. In addition, the forces must be invited to stakeholder consultation meetings and workshops, so they appreciate the project and its role, and the importance to account for the inputs that go into their fields.

5. As stressed by most stakeholders from respective crucial institutions in the provision and collection of data for the sector, awareness raising, sensitizing, and capacity building is key as the informed and empowered institutions will embrace the system better, as well as release and share the data much easier.
6. Stakeholders also expressed the desire to see the use of the latest technologies for the data collection process. For example, it was recommended that the project moves away from paper-based and desktop/computer-based, to server-based data capturing and sharing. The low hanging fruit is the CBIT project that is being implemented which aims at creating an online data collection system, with numerous focal persons, each responsible for incorporating their specific data.
7. The government will need to revive the soil testing centre, and ideally establish more of such across the Rural Development Areas (RDAs) for ease of access and ease of burden on the one existing centre. This will ensure that farmers apply fertiliser, lime and urea inputs according to the requirements of their fields, and ensuring that over-application is prevented.

4.7 Next steps towards operationalising the roadmap

Consultations pointed to political buy-in being the greatest factor to the success of the envisioned data collection templates and an updated livestock data management system across the different ministries, departments, and agencies. It is, therefore, recommended that the templates be presented to heads of departments in the concerned ministries, especially MoA. This is aimed at ensuring that the proposed system is embraced, and it cascade until it is taken up by the respective ministers whose political buy-in will be needed. Thereafter, the recommended MOUs with institutions initiated, and seen to establishment and full implementation. Thereafter, each institution will be able to roll out the developed template specific to them, and the data collection process with data specific to the requirements of Tier 2 will be rolled out.

It is hoped that by the time the Kingdom fully rolls out the data collection process, the online data collection system being developed under the CBIT project will be functional, and stakeholders will have an online platform for their focal persons to report/upload data from

their respective institutions according to the established timelines set out in the MOUs. Furthermore, MTEA will still need to work closely with the MoA to mobilise resources for the acquisition of equipment needed in order to fill some of the identified data gaps.

5. Conclusions

This assignment seeks to increase the overall transparency capacity and to set-up of sectoral MRV systems in the Kingdom of eSwatini. In the Agriculture sector, the aim is to develop robust sustainable data collection processes, including institutional arrangements, and improved Tier 2 data for future inventory compilation. It is meant to contribute towards on-going efforts to improve the availability, collection and quality of data required for estimating emissions in the AFOLU sector and to enable the Kingdom of Eswatini to meet its enhanced international reporting standard requirements.

Consultation of stakeholders highlighted available and missing data that is required for Tier 2 in the Kingdom. In addition, existing institutional arrangement on available data, and envisioned future data were explored, as well as ways to improve this arrangement in the whole agriculture sector. Institutions that will need an agreement to be established with MTEA were also identified. A roadmap of how best the data collection system is established and maintained for both the livestock and non-livestock sectors was developed.

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