INITIATIVE FOR CLIMATE ACTION TRANSPARENCY (ICAT)

PHASE II

FIJI

GUIDANCE DOCUMENT ON SOLID WASTE DISPOSAL EMISSIONS CALCULATION

DISCLAIMER

PREPARED UNDER

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Contents

LIST OF TABLES

LIST OF TABLES IN ANNEX

LIST OF FIGURES

1.0 INTRODUCTION

Purpose and Scope

This document provides comprehensive guidance for calculating greenhouse gas (GHG) emissions from solid waste management activities in Fiji. The guidance document is based on the methodology presented in the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines and the IPCC 2019 refinement. Utilising the IPCC 2019 refinement allows Fiji to create a more precise GHG inventory for its municipal waste sector, supporting the development of more effective climate change mitigation strategies. The 2019 refinement has improved accuracy for tropical conditions through updated decay rate, enhanced methodologies specifically considering Small Island Developing States (SIDS) waste management challenges, and has integrated tourism impact.

It is designed to:

- Support Fiji's national GHG inventory reporting obligations under the United Nations Convention on Climate Change (UNFCCC).
- Support the implementation of Fiji's Low Emission Development Strategy 2018-2050.
- Facilitate tracking progress towards Fiji's Nationally Determined Contribution (NDC) targets.

The guidance covers emissions from managed and unmanaged solid waste disposal sites. The guidance consists of a second part, which has been utilised to calculate the solid waste emissions occurring in managed and unmanaged sites in Fiji.

1.2 Methodological References

The methodological framework of this guidance document is based on internationally recognised standards and methodologies, primarily drawing from the IPCC guidelines and their subsequent refinements. The foundation of the methodology relies extensively on the 2006 IPCC Guidelines for National GHG Inventories, specifically Volume 5, which focuses on waste sector emissions.[1]

The table below summarises the main categories of the waste sector, the chapters of the 2006 IPCC Guidelines that outline the methodologies for estimating GHG emissions, and the Common Reporting Tables (CRT) for reporting emissions for each category.

[1] IPCC 2006, Volume 5

Table 1: The categories of the waste sector

No	Category	GHG	2006 IPCC Guidelines Reference	Common reporting table
5B	Biological treatment of solid waste	CH_4, nitrous oxide (N_2O)	Vol. 5, chaps. 2 and 4	CRT 5.B
5C	Incineration and open burning of waste	Carbondioxide (CO_2), CH_4, N_2O	Vol. 5, chaps. 2 and 5	CRT 5.C
5D	Wastewater treatment and discharge	CH_4, N_2O	Vol. 5, chaps. 2 and 6	CRT 5.D

The 2019 IPCC Refinement to the 2006 Guidelines (IPCC, 2019) introduces several crucial updates that enhance the accuracy and comprehensiveness of waste sector emission calculations. These refinements include updated default parameters for waste composition that better reflect current waste streams and regional variations. Significant methodological improvements have been incorporated for key calculation parameters, including:

- refined approaches for determining CH_4 generation potential (L_o), more accurate decay rates (k)
- updated methane correction factors (MCF)
- revised oxidation factors that reflect recent research findings

Additionally, the 2019 Refinement expands the scope of waste sector calculations by introducing new guidance for emerging areas of concern, including the treatment of legacy waste in old disposal sites, emissions from mechanical biological treatment facilities, and considerations for advanced thermal treatment technologies. These updates ensure that Fiji's emission calculations remain up-to-date and aligned with the latest scientific understanding and technological developments in the waste sector.

1.3 Document Structure and How to Use This Guide

1.3.1 Organisation of the Document

The National Guidance document for calculating GHG emissions from solid waste disposal in Fiji follows a structured and systematic approach designed to accommodate users with varying levels of technical expertise. The document begins with fundamental concepts and progressively advances to more complex calculations and methodologies, ensuring a comprehensive understanding of emission calculation processes.

Each major section follows a tiered learning approach, starting with basic principles and definitions before moving to detailed technical content. For instance, the waste characterisation section begins with simple waste categorisation methods before progressing to detailed composition analysis and associated emission factors. This

sequential structure allows users to build their knowledge systematically while ensuring accuracy in emissions calculations.
The guidance provides specialised calculation methodologies for different waste management facilities that are common in Fiji.

The document incorporates decision trees at key decision points to assist users in selecting the most appropriate calculation methodologies. These trees guide users through questions about their facility type, data availability, and operational characteristics, leading them to the most suitable calculation approach. This systematic decision-making process helps ensure consistency in methodology selection across different facilities while accounting for varying levels of data availability.

The guidance document is enriched with practical examples drawn from real facilities across Fiji, including:

- Case study of emissions calculations from the Naboro Landfill
- Examples from rural waste disposal sites in Vanua Levu.

This guidance document has been used to undertake methane emissions calculations from Solid Waste Disposal. The report is titled “Solid Waste Sector Emissions Calculations”.

1.3.2 Application

The National Guidance document builds upon the Institutional Arrangements to Compile the National GHG Inventory as per Fiji’s Climate Change Act 2021, developed during the Capacity Building Initiative for Transparency (CBIT) Project. It is designed to serve multiple stakeholders involved in Fiji's waste management sector, with specific considerations for each user group's needs and responsibilities, including the inventory compilers. The guidance for local government authorities, particularly municipal councils and provincial administrators, provides essential frameworks for developing and implementing GHG monitoring programs at their waste facilities.

Waste facility operators represent a critical user group for whom the guidance provides detailed operational procedures and calculation methodologies. The document offers step-by-step instructions for data collection, record-keeping requirements, and emission calculation procedures specific to different facility types.

Environmental consultants will find comprehensive technical information for conducting emission assessments, preparing environmental impact statements, and developing mitigation strategies. The guidance includes specific verification and quality assurance (QA) protocols that consultants can use to ensure their assessments meet national and international standards.

Policymakers at various government levels will find the guidance valuable for understanding the technical basis of emission calculations, which is essential for

developing evidence-based policies and regulations. The document includes sections that explain how different management practices affect emission levels and provides frameworks for evaluating policy options.

For academic researchers, the guidance serves as a standardised reference for waste sector emissions in Fiji. It provides methodological frameworks for research studies and compares different waste management approaches. The document includes detailed technical appendices and references to support academic investigation and further research in this field.

1.3.3 Supporting Tools

A comprehensive suite of practical tools complements the National Guidance document to facilitate accurate and consistent GHG emission calculations across Fiji's solid waste sector. These include calculation spreadsheets, data collection templates, QA/quality control (QC) checklists, and uncertainty assessment tools, which are included as Annexes to this document.

These supporting materials are at the core of Excel-based calculation templates, developed in alignment with IPCC methodologies and adapted for Fiji's specific context. These templates incorporate Tier 1 and Tier 2 calculation methodologies, featuring built-in emission factors, automated calculation functions, and data validation checks. The templates are designed with user-friendly interfaces that guide users through data input processes while maintaining calculation accuracy and consistency with national reporting requirements. Specific templates have been developed for different facility types, including managed landfills, dump sites, and waste transfer stations, each incorporating relevant emission factors and calculation parameters specific to Pacific Island conditions.

A standardised set of data collection forms has been developed to ensure consistent and comprehensive data gathering across all waste facilities. These forms, available in digital and printable formats (as part of the Annex), are structured to capture essential parameters such as waste quantities, composition data, and operational characteristics. The forms are accompanied by detailed guidance notes that explain proper data collection procedures and recording frequencies. Quality control checklists have been integrated into the guidance framework to help users maintain data integrity and ensure calculation accuracy. These checklists, developed based on international best practices and adapted to Fiji's context, cover key aspects such as data validation procedures and documentation requirements. The QC system includes specific checks for different stages of the calculation process, from initial data collection to final emission estimates.

The guidance includes specialised uncertainty assessment tools to address the inherent uncertainties in GHG emission calculations. Some of the tools recommended by the IPCC

include the IPCC table for the application of the Error Propagation Method (Tier 1), Monte Carlo Simulation (Tier 2) and Expert Judgment (template attached in annexe as

Table A32). These tools help users identify, quantify, and report uncertainties in their emission calculations, following the approaches outlined in the IPCC Good Practice Guidance. The uncertainty assessment framework includes methods for evaluating both activity data and emission factor uncertainties, specifically considering challenges common in Pacific Island contexts, such as limited data availability and seasonal variations in waste composition. All these supporting tools are regularly updated to reflect improvements in calculation methodologies and changes in national circumstances.

1.4 Updates and Revisions

The Ministry of Environment and Climate Change (MECC) has developed the necessary institutional arrangements (IA) to prepare National Communications (NC)/Biennial Transparency Reports (BTR) in the future. This IA further outlines the IA for the development of the National GHG Inventory, and this guidance document provides the necessary sectoral guidance to determine emissions from Fiji's solid waste disposal. The guidance is a living document and may be updated by MECC when required.

Updates can be triggered with the release of new IPCC guidelines or refinements. The guidance can also be updated when new and updated default emission factors of national emission factors or country-specific parameters are made available. Country-specific data includes validation studies at major waste facilities, statistical analysis of collected data, and expert consultation to ensure the updated factors accurately reflect Fiji's circumstances. Stakeholder engagement is crucial to the guidance document's evolution through a formal feedback mechanism. Stakeholder involvement enables the identification and solution of practical challenges and technical issues as they arise.

2.0 GHG INVENTORY MANAGEMENT SYSTEM

A GHG Inventory Management System (IMS) is a systematic approach to collecting, documenting, and verifying GHG emissions data. The system consists of inventory planning, institutional arrangements, methods and data documentation, QA/QC procedures, key category analysis, an archiving system, and a national inventory improvement plan, as depicted in

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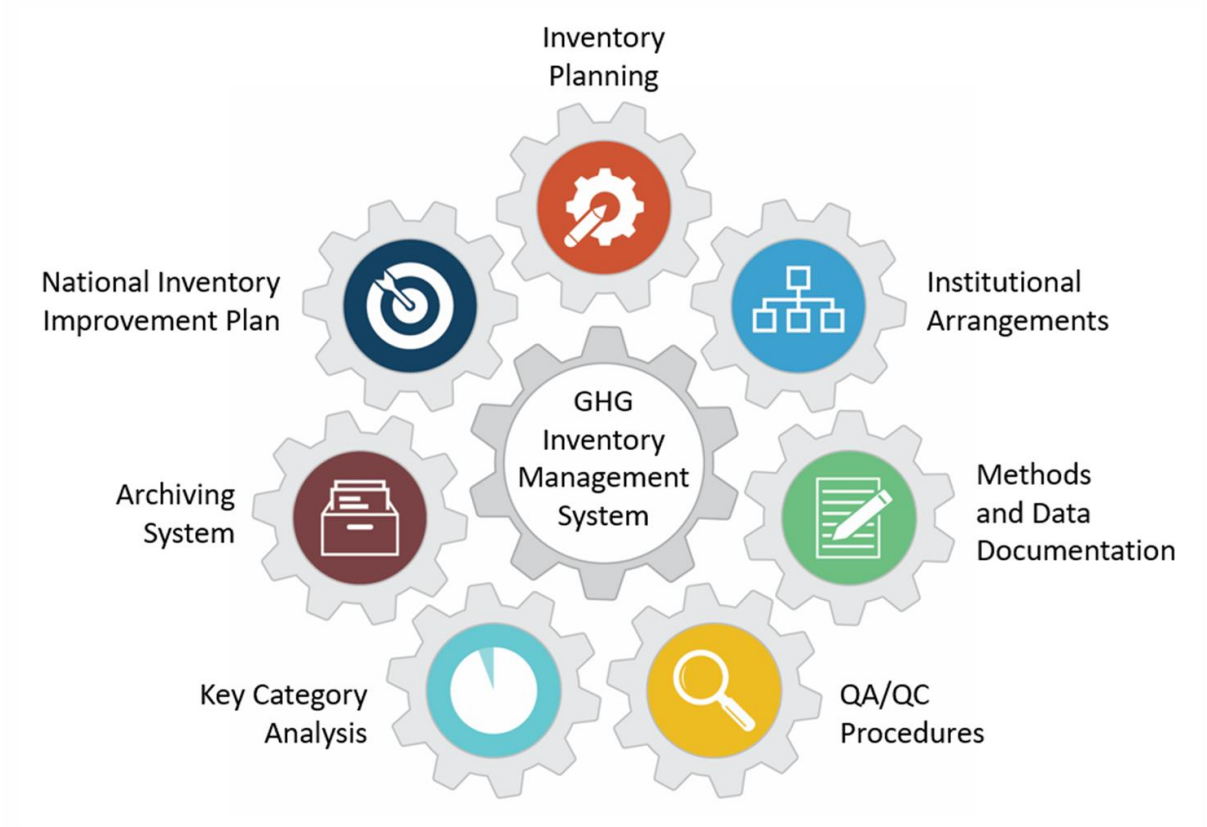

Figure 1: National GHG inventory system[2]

[2] Source: US EPA Toolkit

3.0 INVENTORY PLANNING

The inventory planning process consists of 7 stages, as depicted in

Figure *3* below. According to Part 7 of the Fiji Climate Change Act 2021, Section 30, in particular, legally mandates the Permanent Secretaries to biennially estimate, compile, and submit sectoral emissions and emissions reduction data to the National Climate Change Coordination Committee (NCCCC) while also implementing processes to manage and maintain this data within their ministries.

These seven stages are Plan, Collect, Estimate, Write, Review, Finalise and Submit, and Archive arranged in a circular flow, with "Improve" at the centre and "QA/QC and Archiving" as supporting elements. The length of the inventory cycle depends on the national circumstances and reporting requirements[2].

However, administrative processes must be completed before the inventory work commences. Therefore, including these administrative processes, the time frame required to complete Fiji's GHG inventory (including all sectors) is estimated to be 38 months. The timeframe is divided into three phases:

(i) *Phase 1*: Administrative process
This phase includes the pre-planning (3-4 months) and recruitment and tendering (4 months),

(ii) *Phase 2*: project implementation (24 months)

(iii) *Phase 3*: preparing the national reports and finalising and publishing (6 months).

This guidance will focus on Phases 2 and 3. Therefore, the total time commitment for getting the waste sector report will be around 30 months, noting that all the other sector inventory will be developed simultaneously.

The stages for planning Fiji's solid waste sector inventory are outlined as follows:

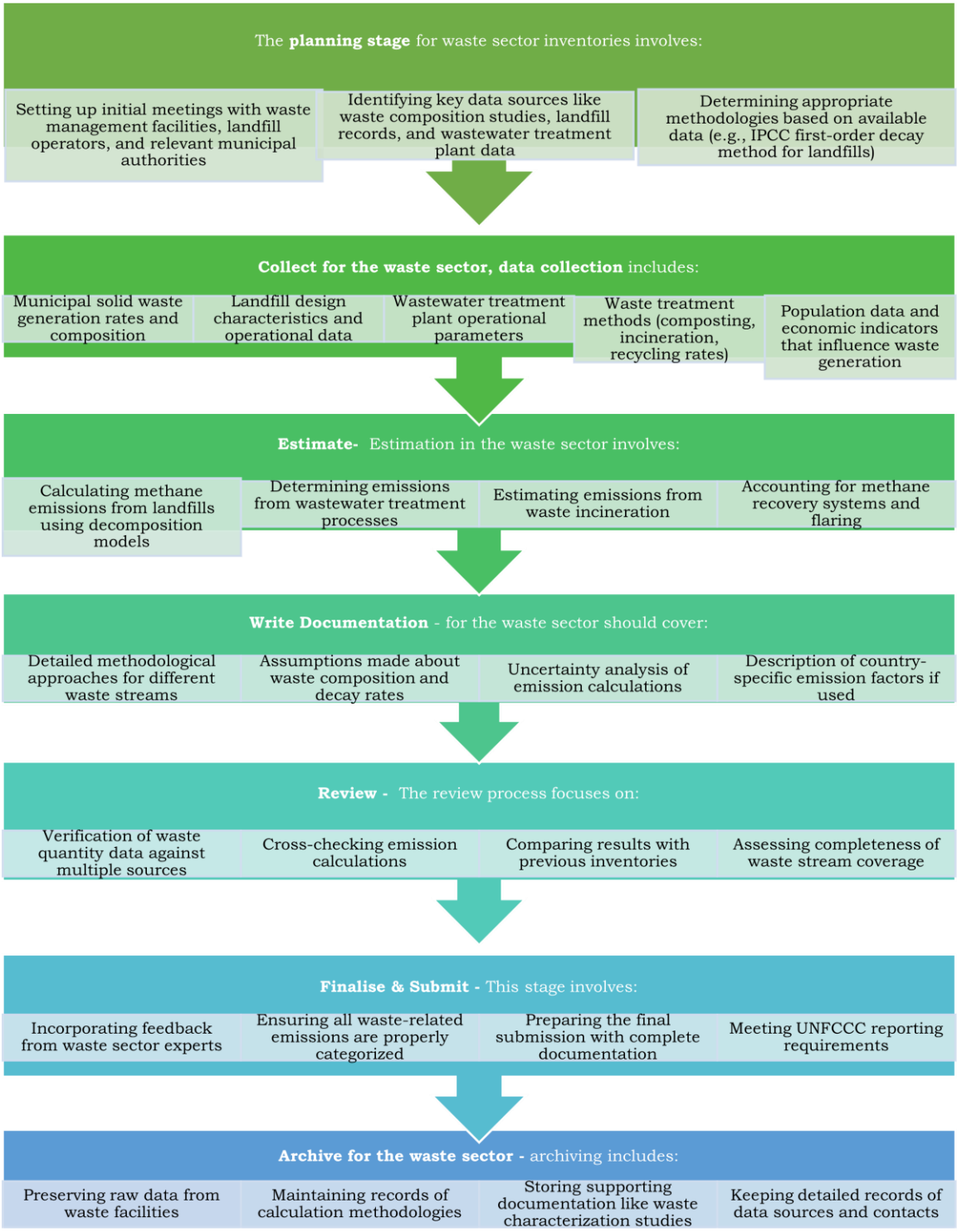

Figure 2: stages for planning Fiji's solid waste sector inventory

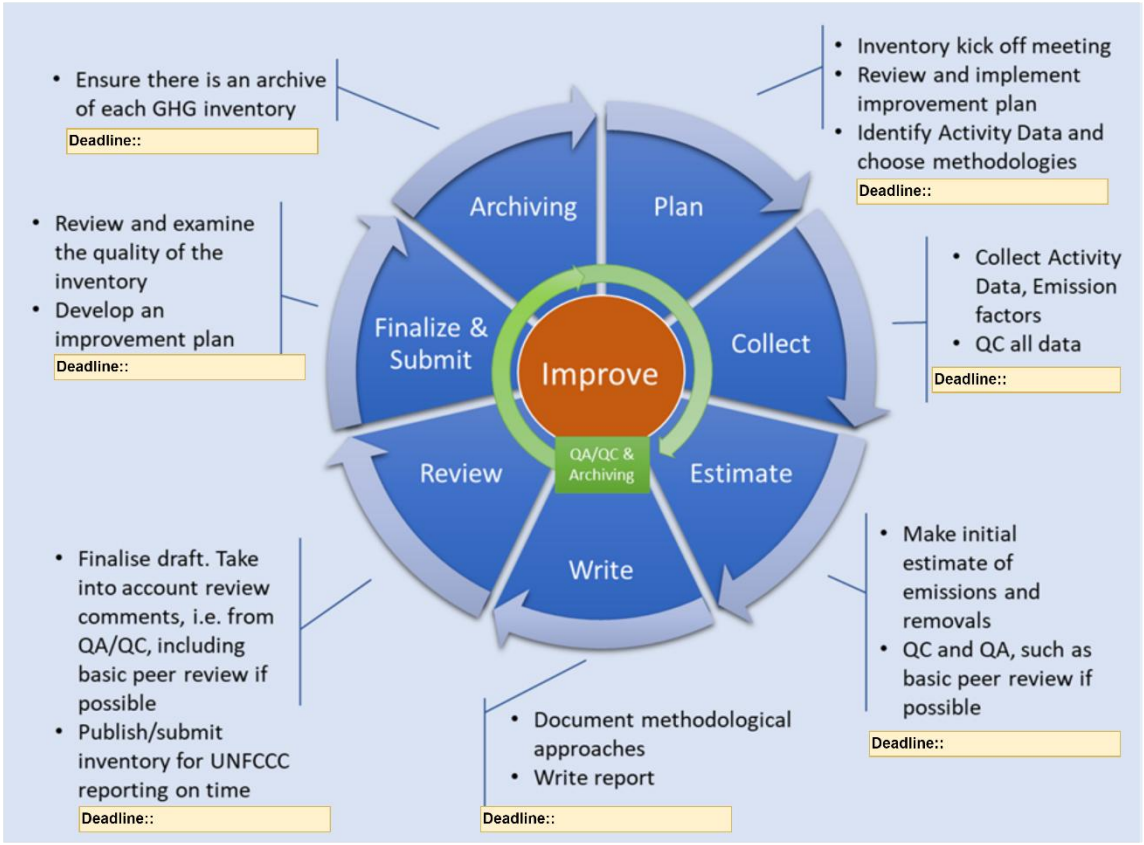

Figure 3: National GHG inventory cycle[3]

3.1 National Inventory Schedule

The initial step of inventory planning is developing a National GHG Inventory schedule. The key action items for the schedule development are displayed in the

Figure *4* below. The template for schedule preparation can be found in Annex I (Table A1). Once the schedule has been prepared, the

Figure 3 can be updated by including the timelines. It is also essential to keep a template to track the overall progress of the solid waste inventory development. The overall progress template can be found in the Annex (Table A2).

[3] Source: US EPA Toolkit

Schedule Development	Quality Management	Timeline Management
• Project Coordinator (PC)/ National Inventory Coordinator (NIC) to consult with inventory agency management on suitable due dates • Allocate time for stakeholder consultations • PC/NIC to consult with stakeholders on schedule • Review and account for data providers' publication schedules • Plan for data collection periods	☐Implement continuous improvement measures compared to previous inventory ☐Conduct QA/QC activities throughout all compilation stages ☐Set final deadline for QA/QC checklist submission ☐Set final deadline for QC check findings submission ☐Submit all QA/QC materials to NIC or QA/QC Coordinator ☐Document responses to QA and QC findings ☐Archive QA/QC documentation with completed inventory	☐Define clear end dates for each compilation stage ☐Account for consultation periods in the schedule ☐Build in review periods ☐Set archival deadlines

Figure 4: Action items for schedule development

4.0 INSTITUTIONAL ARRANGEMENTS

The Climate Change Act 2021 is the cornerstone of Fiji's efforts to establish a transparent and robust GHG inventory compilation and reporting system. The Act formalises roles and responsibilities across sectors, ensuring a *whole-of-government approach* to emissions reporting and alignment with the international standard.

Governance and Institutional Provisions

- **National Climate Change Coordination Committee (NCCCC)**: Established to oversee cross-sectoral coordination and ensure alignment with the Climate Change Act.
- **Ministerial Focal Points**: Appointed by Permanent Secretaries to facilitate data collection and submission within their respective ministries.
- **Data Submission Mandates**: Permanent Secretaries are required to compile emissions data biennially and submit it to the NCCCC, ensuring consistent data flows.

Alignment with International Standards

- The Act mandates adherence to IPCC guidelines and the Enhanced Transparency Framework (ETF) reporting requirements, ensuring that Fiji's national inventory meets global standards for transparency and accuracy.

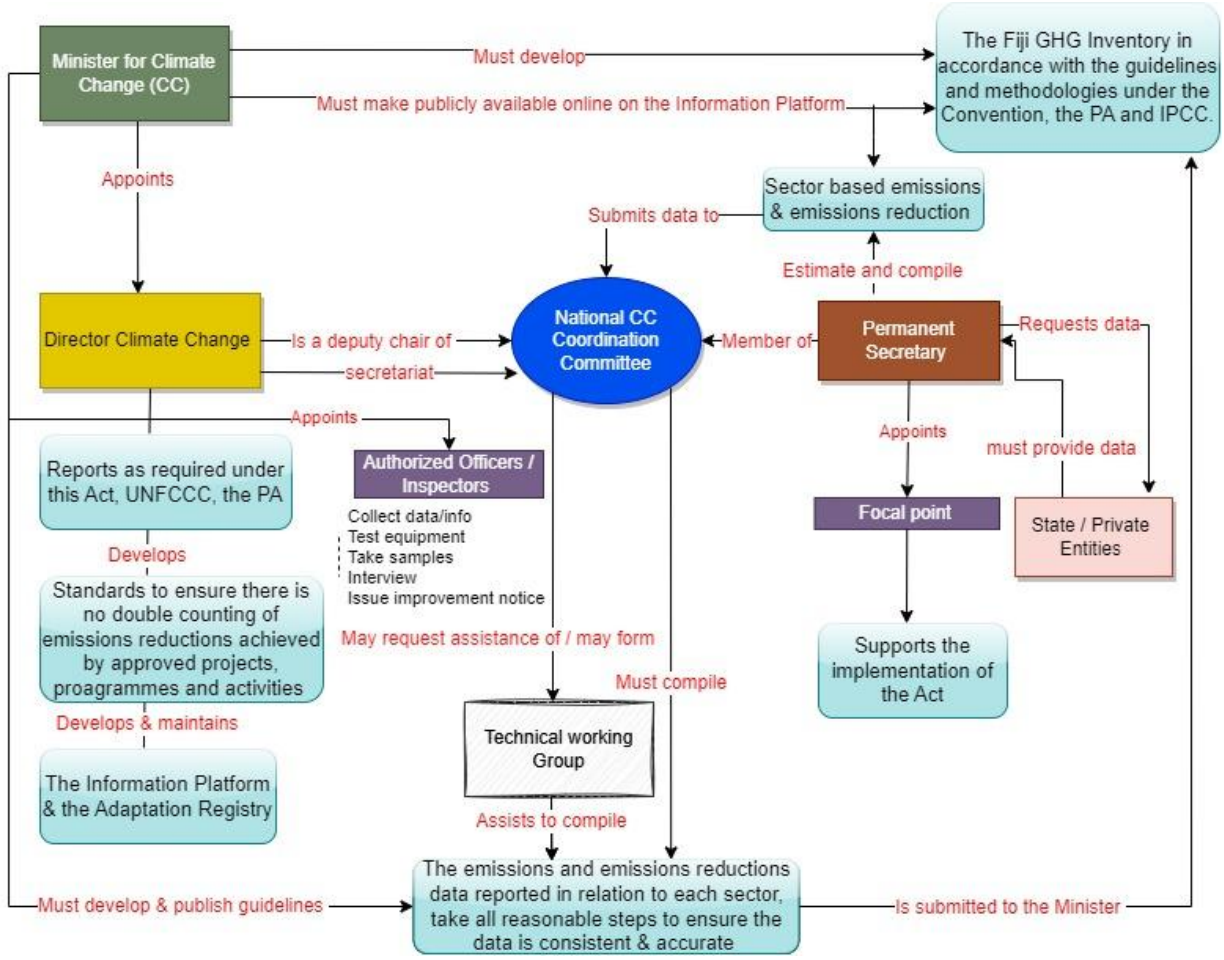

Figure 5: Institutional Arrangement and Governance structure as established in Fiji's Climate Change Act 2021

Figure 5 above outlines the organisational entities, processes, and procedures in place to coordinate and oversee the preparation and submission of National Communications (NCs) and Biennial Transparency Reports (BTRs), including the National Inventory Report to the UNFCCC. These arrangements ensure that the reporting process is timely, accurate, and consistent. Establishing robust institutional arrangements (IA), which includes relevant entities, qualified personnel, systems, and processes, is crucial for effective reporting.

Table 2: Key Steps to Develop Fiji's Institutional Arrangements for National Reporting

Identify a Lead Agency	The Climate Change Act (CCA) 2021 (Part 4, Section 11(2)(b)) mandates the Director of Climate Change to prepare reports required under the Act, the UNFCCC, and the Paris Agreement (PA). The BTR coordinator at the Climate Change Division will lead and coordinate the reporting process. Each stream of CCD will be responsible for respective sections of the BTR/NC.
Build a Working Group	Establish a working group comprising stakeholders from government agencies, civil society, and the private sector to support the preparation of NCs. The National Climate Change Coordinating Committee (NCCCC), as established under the

	CCA 2021 (Part 4, Section 12(10b)), has the authority to form technical working groups for reporting obligations under the UNFCCC, the Paris Agreement, and the Act.
Define Roles and Responsibilities	Clearly define the roles and responsibilities of all entities involved in the reporting process. Under the CCA (Part 7, Section 30), permanent secretaries are required to compile and submit data related to emissions and emission reductions within their respective portfolios to the NCCCC. The Director of Climate Change is responsible for compiling this data into Fiji's GHG Inventory.

Functional Responsibilities of Institutional Settings

In alignment with the Climate Change Act 2021, the institutional arrangements for national reporting, including the development of GHG Inventories, may include the following responsibilities:

- *Guidelines and Procedures*: Implement robust procedures for data collection, analysis, and reporting, including quality standards and reporting formats.
- *Monitoring and Evaluation*: Develop systems to monitor progress and identify areas for improvement in the reporting process, ensuring compliance with the Act and respective ministries' practices.
- *Stakeholder Engagement*: Engage stakeholders throughout the reporting process to ensure inclusivity and transparency, including opportunities for input and feedback.
- *Review and Update***:** Regularly review and revise institutional arrangements to remain responsive to evolving circumstances and priorities.
- *Transparency and Accountability*: Establish mechanisms to promote transparency and accountability, ensuring that reporting progress is communicated to the public and stakeholders.
- *Alignment with International Standards***:** Ensure compatibility with global reporting standards such as the IPCC, UNFCCC and the Paris Agreement by maintaining a national focal point.

Additionally, the IA should ensure:

- *Sustainability and Clarity*: Roles and responsibilities must be clearly defined while minimising the burden on data providers, who have existing duties.
- *Formalisation of Processes*: Establish formal agreements, such as memoranda of understanding, to solidify linkages and procedures for information and data flow.
- *Continuous Improvement*: Current processes should be reviewed and streamlined to identify opportunities for enhancement, bridging gaps between existing practices and new requirements.

Data flows, represented through data flow diagrams in Section 4.3, determine specific institutional arrangements for preparing Fiji's GHG inventory at the sectoral level, such as the waste sector (solid waste category). These diagrams illustrate the data collection, processing, and archiving responsibilities necessary for robust inventory development and reporting.

Step 1: Identify current inventory management team

- *The action item for step 1: list the lead agency (table 2) and identify inventory management team members. The information for Fiji waste sector inventory management team is represented in Table 3 .*

Step 2: Provide sectoral roles and arrangements

- *The action item for step 2: list more specific information about contacts/experts for inventory development for each sector. identify the role, organization, and contact information for those providing relevant data for estimating emissions. Insights on this flow of information and approval processes for the data are provided in the data flow diagrams. The template for step 2 can be located at Table 4 below*

Step 3: Provide improvements to institutional arrangements

- *The action items for step 3: list where institutional arrangements to support preparing the inventory are well established, where data is collected and managed adequately, and where strengthening is not needed. Identify what improvements are needed to enhance the institutional arrangements for each sector, and list these in the template for step 2 can be located at Table 5 below.*

Step 4: Review and complete inventory cycle timeline

- *From all the information gathered from Step 1- step 3, update the inventory cycle in Figure 2 above.*

Step 1: Identify the current inventory management team.

The proposed inventory management team coordinates the development of the National GHG Inventory (NIR) in conjunction with the country's designated inventory agency. The following tables give the proposed outline of the designated inventory agency and national inventory management team for Fiji's solid waste disposal.

Table 3: Designated Inventory Agency

Designated National GHG Inventory Preparation Agency/Organisation	UNFCCC Focal Point (Name) and UNFCCC Focal Point Agency	Describe the arrangements or relationship between Inventory Agency/ Organization and UNFCCC Focal Point Agency, if different.
Climate Change Division	Permanent Secretary Ministry of Environment and Climate Change (MECC)	N/A
	Manager of Climate Change Division (CCD)	
	Director - Climate Change Division (CCD)	

The roles outlined in Table 4 below do not necessarily imply that each role will be assigned to a separate individual. The Climate Change Division (CCD) retains the authority to allocate the specified roles to existing officers within the Division as deemed necessary.

Table 4: National Inventory Management Team

Role	Name	Organisation	Contact Information	Comments
Inventory Director/ Coordinator	Mitigation Specialist	Climate Change Division		Mitigation specialist
Waste Sector Lead	Director Environment	Department of Environment		The Principal Waste Officer based at the Department of Environment can assist.
Archive (Data and Document) Manager/ Coordinator	Project Coordinator	Climate Change Division		The CCD has engaged project coordinators for the National GHG reporting period. Thus, the coordinator can lead this component.
QA/QC coordinator	- Waste officer -Chosen waste sector expert	TBC	TBC	The expert engaged can, at the same time, build the capacity of the CCD staff.

Role	Name	Organisation	Contact Information	Comments
Uncertainty Analysis coordinator	Chosen waste sector expert	TBC	TBC	The expert engaged can, at the same time, build the capacity of the CCD staff.
Others: e.g., GHG Policy Specialist who tracks capacity building efforts and IPCC processes		Other National Experts National Expert & Consultant	TBC	A national expert in climate mitigation and knows the Climate Change Act, government policies and processes for inventory development.
		National Expert	TBC	Have compiled inventories for Second National Communication and Third National Communication. knows the Climate Change Act, government policies and processes for inventory development

Step 2: Provide sectoral roles and arrangements.

This step involves documenting current and planned procedures for managing Fiji's waste sector GHG inventory data. This includes how data is requested, compiled, and reviewed. The accompanying table outlines the key personnel and institutional arrangements responsible for developing Fiji's waste sector GHG inventory. It details the specific roles, organisational affiliations, and contact information for those who provide and compile the activity data used in GHG inventory calculations.

Table 5: The Waste sector institutional arrangements for solid waste disposal

Role	Organisation	Contacts [Name]	Contact Information [E-mail, Phone, etc.]	Participated in meetings on GHG inventory development? [Yes/No]	Comments
Technical coordinator (Could be source/ sector lead)	Climate Change Division	Mitigation Specialist	-		The role can be assigned to the PC/NIC.

Role	Organisation	Contacts [Name]	Contact Information [E-mail, Phone, etc.]	Participated in meetings on GHG inventory development? [Yes/No]	Comments
Consultant compiling estimates	Climate Change Division	Chosen waste sector expert	TBC		The individual will defer depending on who won the bid to compile the emission.
Expert reviewer	Climate Change Division	Chosen waste sector expert	TBC		
Data provider	Department of Environment	Waste officer	TBC		The Department will collect the data from all the organisations.
Other	All the sub-sectors providing data to the Department of Environment as identified in the Data Flow diagrams.				Raw data providers. Need training on template usage.

Step 3: Provide improvements to institutional arrangements

Fiji's solid waste disposal (SWD) sector benefits from robust IA that supports inventory development. The current system features well-established institutional structures with effective data compilation and management processes. While these foundations are strong, there is still room for enhancement. Table 6 presents a comprehensive analysis of the

existing IA's strengths alongside proposed improvements to strengthen the waste sector's GHG inventory development process.

Table 6: Potential Improvements in Management Structure of Fijis National Inventory System

Sector	Strengths in Management Structure of National Inventory System	Potential Improvements in the Management Structure of National Inventory System
Waste	▪ Climate Change Act 2021 is enacted ▪ The data collection system and templates exist. However, they need updating through the Capacity Buiding Initiative for Transparency (CBIT) project. ▪ The CBIT Project is providing funding through Global Environment Falicity (GEF) to develop a Database that will be used for collecting activity data and tracking policy, mitigation action, and Nationally Determined Contributions (NDCs). ▪ Emission calculation systems exist and are available for use, such as the IPCC Software. ▪ There is training available for experts registered on the UNFCCC roster. ▪ The instruction manuals for solid waste emission estimations using Tier 1 from 2006 IPCC GLs have been developed by Fiji Experts through the ICAT project. ▪ The institutional arrangements, QA/QC systems and data flows were discussed with the subsector data providers during the waste sector workshop (15-16 Oct 2024).	▪ create awareness and build capacity for the responsibilities established through IA for CCD and the Department of Environment. ▪ While data sharing has been eased with the Cabinet's decision to share between Ministries, a memorandum of understanding needs to be established with all the waste sector data providers and the lead Agency collecting activity data (Department of Environment). This will ensure a regular supply of data and also maintain confidentiality. ▪ Personal are assigned to the roles in Table 3 &Table 4. ▪ Ensure regular training and capacity-building programs for the data providers and the compilers. ▪ Nominate more experts for the UNFCCC roster of experts to build national capacity. ▪ Update the inventory cycle in ▪ Figure *3* with new information as it emerges.

Sector	Strengths in Management Structure of National Inventory System	Potential Improvements in the Management Structure of National Inventory System
	▪ There is a separate section to implement the Climate Change Act, the Climate Change Division under the Ministry of Environment and Climate Change.	

Step 4: Review and complete the inventory cycle timeline

The inventory cycle design must align with both national circumstances and country-specific reporting requirements. A biennial (two-year) inventory reporting cycle, as outlined in Fiji's Climate Change Act 2021, will also guide the waste sector inventory for Fiji. Inventories are prepared for annual emissions in the inventory cycle, year one will focus on collecting data from providers, implementing QA/QC checks on activity data, and providing refresher training to inventory compilers on GHG emission calculations. Year two will emphasise calculating GHG emissions, ensuring the inventory meets the five key principles: transparency, completeness, consistency, comparability, and accuracy. In short, these principles are known as TACCC principles and form the quality criteria for national GHG inventories under the UNFCCC reporting guidelines.

Solid Waste Disposal Data Flow

Establishing robust solid waste disposal data flows is crucial because waste management activities generate multiple types of GHG through various pathways. Data flows ensure the systematic collection, processing, and sharing of data, which institutional arrangements rely on to coordinate roles, responsibilities, and decision-making among stakeholders effectively. Well-documented data flows enable waste managers to understand their role in providing data about the composition and quantity of waste streams to inventory compilers, which directly affects emission calculations.

Fiji's waste sector data flow is significant for:

- Understanding the lifecycle of waste
- Understanding CH_4 generation in tropical conditions
- Tracking informal waste disposal practices in remote islands
- Assessing the impact of seasonal tourism on waste volumes
- Understanding data custodians and providers
- Identify areas where mitigation actions would have the most impact

Fiji's Low Emission Development Strategy (2018-2050) notes that improved sector-specific data flow supports Fiji's NDC implementation by enabling better monitoring of emission reduction initiatives in the waste sector. The sections below outline data flows

for relevant components of the waste sector in Fiji. These include town/city councils, biosecurity, Fiji Airports, Fiji Ports, and the Ministry of Health.

4.1.1 Institutional and Legal Framework for Data Flow

Under Fiji's Climate Change Act 2021, IA's are mandated to ensure that there is a structured data collection and reporting approach for the waste sector. The Climate Change Division, as the national inventory management entity, oversees the compilation of greenhouse gas (GHG) data, coordinating with various stakeholders, including municipal councils, private companies, and specialised waste handlers.

The NCCCC provides high-level governance, while technical working groups (TWGs) address specific data-related challenges. Sectoral focal points, designated within ministries, facilitate the flow of data from ground-level sources to national compilers, ensuring alignment with international reporting standards under the ETF.

4.1.2 Overall dataflow for the Solid Waste Disposal

The Figure 6 shows the flow of waste to the respective disposal sites in Fiji.
The diagram illustrates the waste management system in Fiji, showing various waste sources and their collection/disposal pathways. The council provides direct collection services (shown by solid black arrows) for several sources through a regular schedule, including household waste, offices, some industrial waste, and tourism industry waste. These regularly collected materials are sent to the respective disposal sites.

The medical sector generates clinical waste (indicated by pink dotted lines) and processes it through incinerators at major hospitals in Fiji. Sea vessel waste goes to the Fiji Ports incinerator, and aircraft waste is processed at the Fiji Airports Ltd incinerator. The resulting incinerator ash goes to the disposal site similarly.

Household white goods such as refrigerators and green/garden waste are collected through specialised services, while waste generated during natural disasters is managed through emergency disposal procedures. Both these streams eventually reach the disposal sites.

Private waste service providers (connected by blue dotted lines) handle certain waste streams from various sources, including some waste from the tourism industry, industrial waste, and the medical sector. Aircraft waste and some industrial waste (shown by green dotted lines) are directly disposed of at disposal sites without going through intermediate collection or processing steps.

The system demonstrates a multi-layered approach to waste management, with different handling methods based on the type and source of waste. It utilises both council-operated and private services, as well as specialised facilities like incinerators for specific waste types.

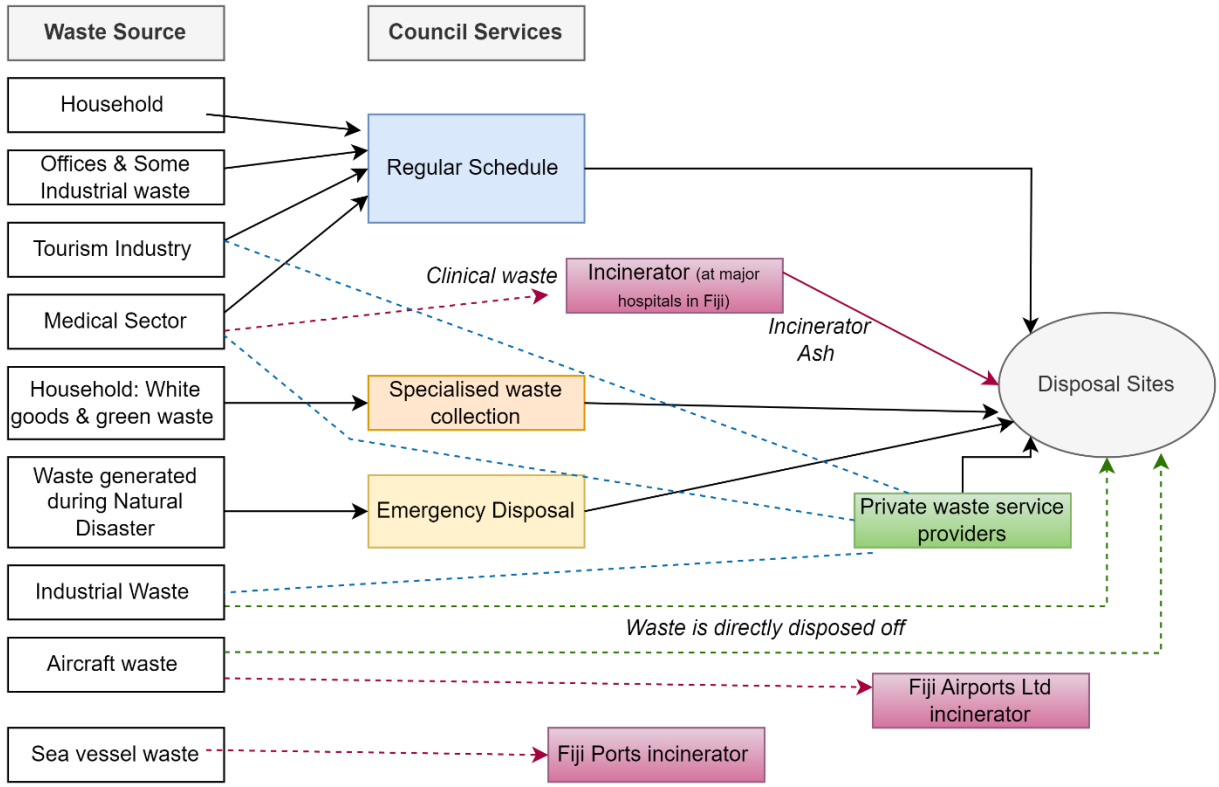

Figure 6: Waste flow to the respective disposal sites

The following sections systematically represent the waste sector's data collection workflow, highlighting the flow from field data capture to national-level usage for GHG emission estimations and waste management planning.

4.1.3 Town/ City Council Data Flow

Fiji's city councils primarily manage household and industrial waste generated within their jurisdictions. They follow regularly scheduled waste collections in urban and suburban areas and handle waste disposal in urban areas following natural disasters. Some town councils, such as Nadi Town Council, also collect waste from the tourism sector, which is disposed of at the Vunato dump. The main data held by the respective councils are the household and industrial waste collection data. The waste collected by the municipal councils is household waste, and currently, no waste segregation occurs. Hence, all the waste ends up at disposal sites. Therefore, when specific details regarding the percentage of waste disposed of, these values are usually estimated.

There are a number of ways each type of disposal site collects/estimates its waste data, as mentioned above. For example, the Naboro landfill and Vunato employ a weighbridge to capture the waste data in tonnes. Whereas other town councils depend on the truckloads of waste disposed of or estimate the amount of waste depending on the truck tray size.

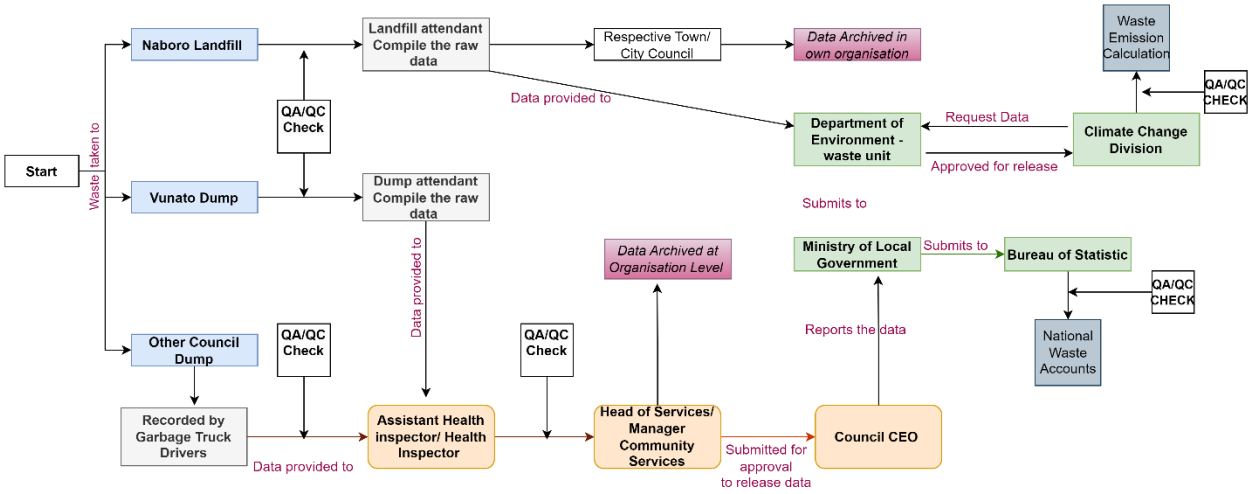

Figure 7: Data flow diagram for town/city councils in Fiji

Fiji's waste management infrastructure comprises one primary landfill at Naboro and seven additional dump sites. The dumpsite operates under different management structures, mainly municipal councils, compared to the Naboro landfill. The Naboro landfill operates under the supervision of an external contractor, setting it apart from the other disposal sites, which fall under the jurisdiction of their respective town and city councils. This distinction significantly influences how data is collected and managed at each location.

The Figure 7 above illustrates the waste data collection and reporting workflow for Fiji's municipal waste management system. The process begins at three waste collection points: Naboro landfill, Vunato dump, and other council dumps such as Sigatoka, Ba, and Labasa.

Data collection occurs differently at each location. At the Naboro landfill, the process follows a streamlined approach, systematically recording waste weights upon receipt. This data follows two primary channels: it is shared with the relevant town councils and simultaneously reported to the Department of Environment, which has the legal authority to collect such data under the Climate Change Act and the Environment Management Act.

At locations like the Vunato Dump, on-site dump attendants handle data recording. However, in cases where attendants are absent, as seen at the Ba town council dump site, the responsibility falls to garbage truck drivers. Each data collection point has a QA/QC check.

This collected data then moves through a hierarchical structure, beginning with the town or city council's health department. The health department serves as the initial data maintenance and verification point before the information is submitted to the Chief Executive Officer for review and approval. Following this internal process, the data is forwarded to the Ministry of Local Government (MLG), which then distributes it to the

Fiji Bureau of Statistics and the Department of Environment. Data is archived at each organisational level.

The final stage of this data management system allows the Climate Change Division to access waste data through the Department of Environment when needed to calculate waste sector emissions.

Currently, the data collection approach is on an ad hoc basis and is not structured well. However, the figure above ensures a more structured and sustainable approach for smooth data flow for future reporting that will be established under the CBIT project.

It is also worth noting that while different sites may have varying collection methods, this proposed structured approach ensures accurate waste data collection and reporting through multiple verification steps and organisational oversight. All data will eventually feed into a Fiji's DIigtal Transparency Tool which is being developed under the CBIT project as Fiji's monitoring, reporting and verification (MRV) tool.

4.1.4 Biosecurity Data Flow for Quarantine Waste

Another source of solid waste data can be obtained from Biosecurity of Fiji (BAF), which is the quarantine waste. Figure 8 illustrates biosecurity operations' proposed data flow process after the waste sector workshop consultation. The primary sources of waste are from aircraft and shipping vessels. The data collected includes various types of waste such as plastics, paper products, incinerator ash, operational waste like oil rags, and electronic waste. BAF approval is required before the waste is disposed of. The Biosecurity officer records the waste type and quantity. The data is compiled and submitted to the Biosecurity National Manager operation/Scientific team. From there, the information flows to the BAF Chief Executive Officer (CEO) for approval for the submission of the data to other organisations, such as the Department of Environment. The Department of Environment then forwards this information to the CCD specifically for waste emission calculations.

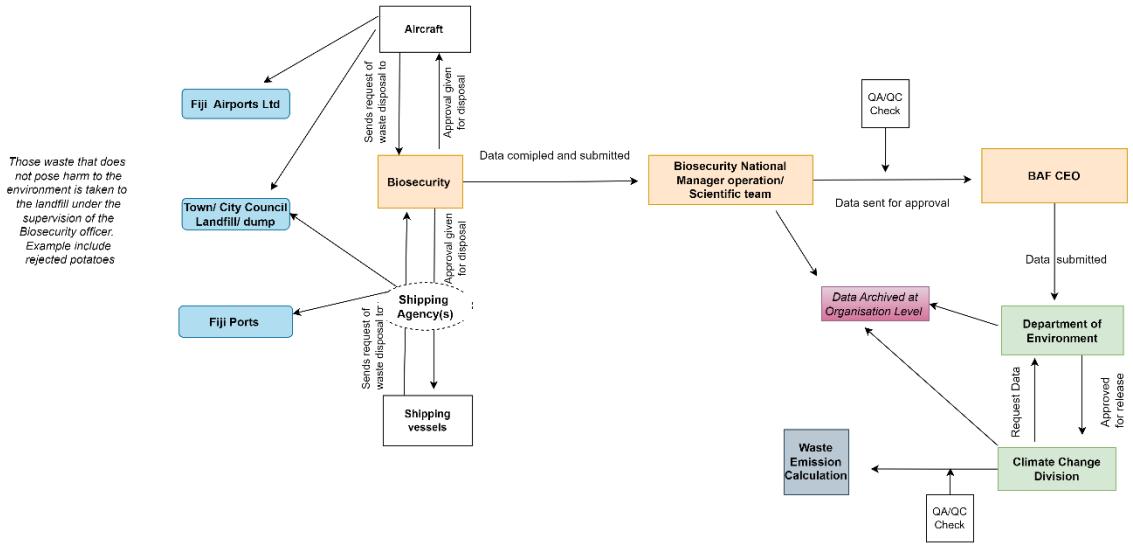

Figure 8: Waste data flow for the Biosecurity Authority of Fiji (BAF)

The individuals and agencies operating aircraft submit an application to Biosecurity officers that notes the quantity of waste for disposal. Biosecurity has not compiled this particular data. The waste quantity data remains in the application form as it is not required by their organisation, and there is no system used by them to record this data. Therefore, there is a need for a uniform data recording template and training for the respective officers in BAF on the use of the template.

Once BAF approves, aircraft waste is transported to the airport terminal incinerator for processing. As shown in

Figure 9, the electrical department oversees the incineration process and maintains data records. This data follows a structured path: It first goes to the sustainability officer, who submits it to the CEO for approval. Following CEO approval, the data is released to the Department of Environment. The Department of Environment can then channels this information to the CCD for waste emission calculations.

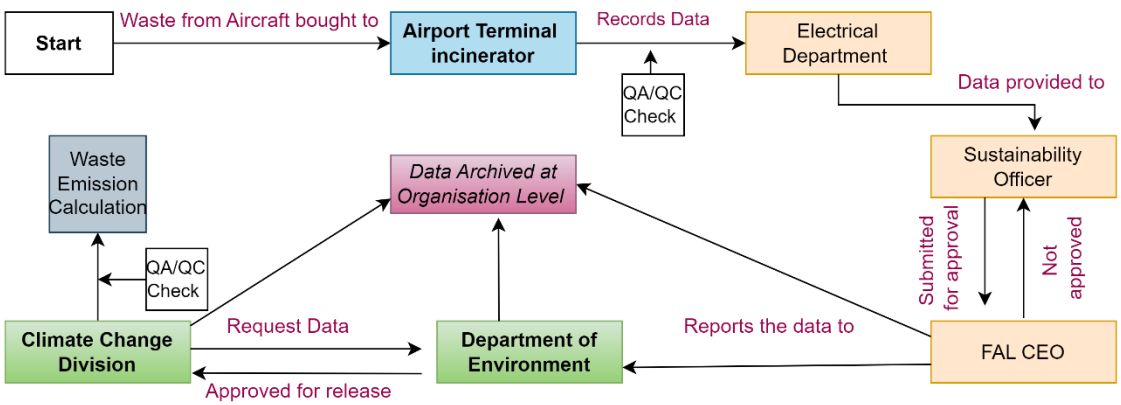

Figure 9: Waste data flow for Fiji Airports Ltd (FAL)

For shipping waste, BAF approval triggers its transfer to Fiji Ports. As shown in Figure 10, Fiji Ports collects waste using either 4.5-cubic-meter or 9-cubic-meter skip bins. The incineration data is measured in burning hours. The time of burning is proportional to the volume of waste burned. The Fiji Port operator estimates it. Approximately 5 hours of burning is required to burn 4.5 cubic meters of waste. While 10-14 hours is required to burn approximately 9 cubic meters of waste. This is how the total volume of waste burned is estimated for the inventory.

The Asset Department at Fiji Ports handles data recording and forwards it to the CEO for approval. Similar to the airport process, the approved data is then shared with the Department of Environment, which then can be provided to the CCD for emission calculations.

Notably, the data recorded at Fiji Ports is not in the format required for emission calculations. Therefore, a uniform data recording template and training for the respective officers in Fiji Ports on using the template are needed.

While BAF maintains primary records of waste quantities, the data from Fiji Airports Limited (FAL) and Fiji Ports serves as a valuable cross-reference for validation purposes. This dual-source data system helps ensure accuracy and reliability in waste management reporting.

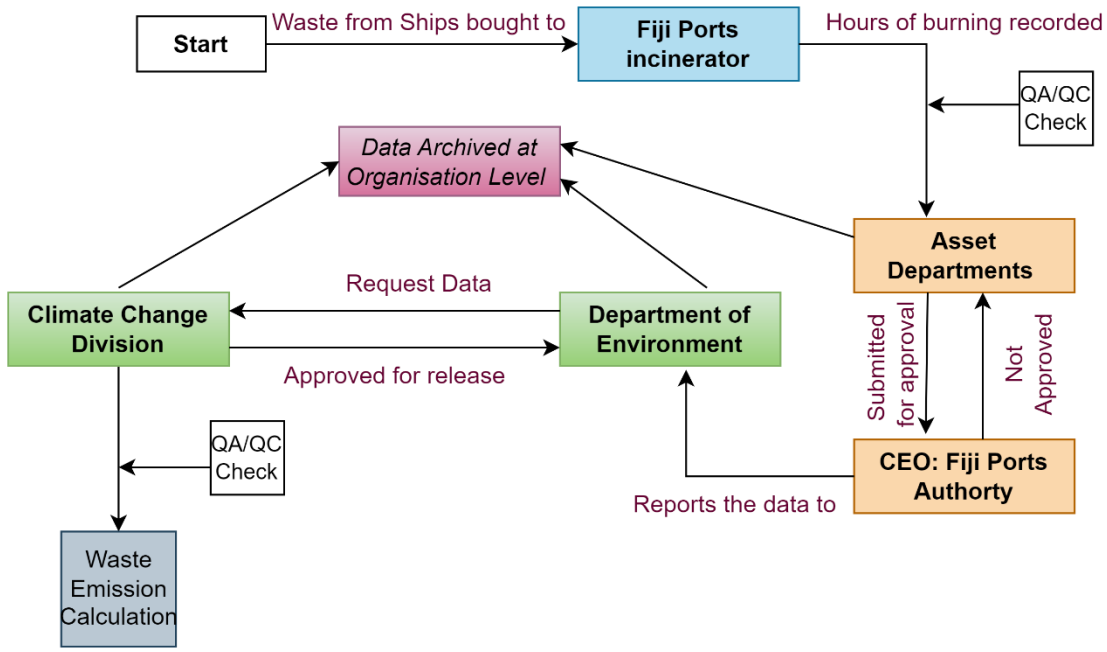

Figure 10: Waste data flow for Fiji Port

4.1.5 Health Sector Waste Data Flow

Fiji's healthcare system comprises government and private facilities, including hospitals and health centres. Clinical waste management follows a regional approach: private hospitals in the Central Division transport their clinical waste to the Colonial War Memorial (CWM) Hospital for incineration. Similarly, those in the Western Division utilise Aspen Medical's incineration facilities in Lautoka.

The *Figure 11* Illustrates the flow of waste data and reporting within a healthcare system. To maintain comprehensive waste data tracking for all healthcare facilities, it is recommended that Aspen Medical also report the waste data to the Central Board of Health and other major hospitals and health centres.

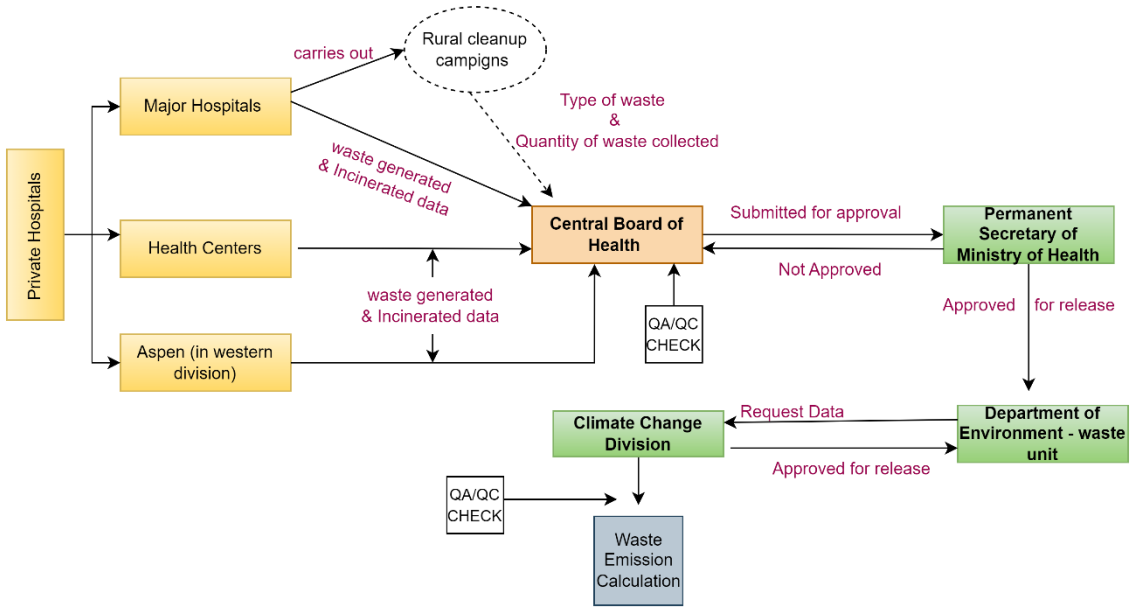

Figure 11: Waste data flow for the Health Sector

The MOH health inspectors also oversee the rural boundary and coordinate cleanup campaigns, particularly during disease outbreaks like dengue fever. The waste collected is disposed of at the respective municipal disposal sites. All the health sector data is to be collected by MOH and submitted to the Permanent Secretary of MOH for clearance before submission to the Department of Environment. The Department of Environment then forwards this information to the CCD specifically for waste emission calculations.

4.1.6 Other Subsector Data Flow

Certain large-scale industries in Fiji handle their waste management independently due to either the volume and nature of their waste or their geographic location limiting access to standard disposal facilities. These organisations include the Fiji Sugar Corporation, large

poultry farming operations, the Fiji Meats Industry Board (FMIB), and hotels situated on remote islands. Due to their unique waste management requirements, these entities can submit their waste generation data directly to the Department of Environment, following their internal approval processes. Specific industries, such as FMIB, may have a specific type of waste. However, others, such as tourism industries, will not be segregated. Therefore, it is recommended that these industries be studied to confirm the details of the type of waste generated, other than its main byproducts. This direct reporting pathway recognises the distinct operational contexts of these industries while ensuring their waste management practices remain documented and monitored by environmental authorities.

4.1.7 Conditional Statement for Data Unavailability

If approval is not granted to release the required data for calculating Fiji's solid waste emissions, the calculation process could be hindered due to incomplete or insufficient data. This would result in reliance on generic default values or assumptions provided by the IPCC guidelines, which may not accurately represent Fiji's specific context.

To address this challenge, a conditional statement can be included in the documentation or methodology, specifying alternative approaches in the absence of specific data.

In the event that approval is not granted for the release of the required data:

1. **Use of IPCC Default Values:**
   The IPCC default parameters for tropical conditions, waste composition, and landfill management will be applied to estimate emissions. For example:
   - **DOC (Degradable Organic Carbon):** 0.15 (average for developing countries)
   - **MCF (Methane Correction Factor):** 1.0 for managed landfills
   - **k (Decay rate constant):** 0.4 $year^{-1}$ for tropical wet conditions

2. **Assumptions for Waste Quantities and Composition:**
   Publicly available or regional average data for waste quantities and composition will be used. These estimates will be explicitly noted as provisional and subject to revision if actual data becomes available.

3. **Acknowledgment of Limitations:**
   The report will clearly state that results are based on assumptions due to data unavailability and may not accurately reflect Fiji's specific solid waste management practices.

4. **Request for Verification and Collaboration:**
   Stakeholders will be invited to review the assumptions and contribute anonymised or aggregated data to refine the calculations while maintaining confidentiality.

4.1.8 Summary

The waste sector currently has IA for data requests and sharing. However, the current system operates ad hoc without regular scheduling. Once the proposed national data management system under the CBIT project is implemented, these existing institutional relationships can be leveraged more effectively. The key improvement will be the transition to a structured reporting schedule, with data provided biennially as per Part 7 of the CCA 2021.

Additionally, there is an identified need to enhance data quality and consistency through training initiatives. These training programs should focus on two key areas: educating data providers about the specific data types required and establishing standardised data collection methodologies across all providers. This standardisation and training will ensure more consistent, reliable, and comparable data across the waste management sector, ultimately improving the quality of environmental monitoring and reporting.

5.0 METHODS AND DATA DOCUMENTATION

This section is important as it:

- Assists current inventory compilers in creating National Inventory Reports.
- Helps future compilers understand and maintain consistency with previous methods.
- Enables others to reproduce calculations, enhancing transparency for peer reviews.

The template under this section aligns with the 2006 IPCC Guidelines. It will help organisations meet reporting requirements (e.g. Biennial Transparency Reports (BTR)) and future requirements under the ETF for the UNFCCC.

The guidance document has been used to prepare the Waste Sector Emissions Report titles as "Part 2: Solid Waste Emissions Calculation" demonstrating its effectiveness and impact.

5.1 General information

The initial step is to record the general information on the GHG inventory. The template for recording the general information is provided in the Annex as

Table A3.

5.2 Methodology – Solid Waste – CRF 5.1

5.2.1 IPCC Guidelines and Its Application to Fiji

The methodological framework for calculating GHG emissions from Fiji's waste sector is based on the 2006 IPCC Guidelines and the 2019 Refinement, adapted to reflect Fiji's specific circumstances as a tropical island nation. The framework incorporates the First Order Decay (FOD) method for calculating CH_4 emissions from solid waste disposal sites, which has been modified to account for Fiji's high rainfall, elevated temperatures, and waste composition patterns (IPCC, 2019). National model adjustments include adjusted decay rates (k values) that reflect the rapid decomposition of organic waste in Fiji's tropical climate and modified MCF that account for the prevalent types of disposal sites across the country's diverse geographical settings. As Fiji falls under the **"Tropical Wet" climate** category (as defined in the 2006 IPCC Guidelines) based on its warm and humid conditions, the default value for tropical wet climate would be used such as:

- The decay rate is 0.17 yr^{-1}.
- All months have average temperatures > 18°C (64°F)
- Annual precipitation is large and exceeds annual evapotranspiration
- Usually found in lowland areas
- Year-round growing conditions (12 months)
- No winter dormancy period

5.2.2 Activity Data in Fiji

Activity data is the foundation of Fiji's solid waste GHG inventory. It is collected from multiple sources:

- **Municipal Councils**: Responsible for providing data on household and industrial waste through tools such as weighbridges or truckload estimations.
- **Hospitals and Clinics**: Report clinical waste, often incinerated, with data aggregated by the Ministry of Health.
- **Biosecurity Facilities**: Handle quarantine waste from airports and ports, tracked by the Biosecurity Authority of Fiji.
- **Private Industries**: Large-scale industrial operators like Fiji Sugar Corporation submit waste data directly to the Department of Environment.

5.2.3 Tier Selection and Data Requirements

Table 7: Comparison between IPCC Tiers

Aspect	Tier 1	Tier 2	Tier 3
Approach	Default method using global or regional data.	Country-specific parameters and data.	Advanced models or direct measurements.
Data Requirements	Minimal: global or regional default values.	Moderate: national or sector-specific data	High: facility-level data and dynamic models.
Activity Data	-Waste generation estimates. - Default waste composition.	- National waste generation statistics. - National waste composition studies.	- Detailed facility-specific data. - Direct monitoring.
Emission Factors	Default, DOC, and MCF from IPCC guidelines.	Country-specific, DOC, and MCF values derived from national studies.	Direct measurement or advanced modelling determines facility-specific, DOC, and MCF.
Uncertainty	High: relies on generalised assumptions.	Moderate: reflects national circumstances.	Low: site-specific and high-resolution data.
Application Feasibility	- Quick and easy. - Suitable for countries with limited data.	Requires national data collection systems.	- Requires sophisticated systems, resources, and technical expertise.
Emission Estimates	Generalized and less accurate.	Reflect national realities more closely.	Highly accurate, dynamic, and specific.
Methodology	- Default equations provided in IPCC	Adaptation of IPCC equations using	Use of detailed, dynamic modelling

Aspect	Tier 1	Tier 2	Tier 3
	guidelines. - Minimal country-specific input.	country-specific factors.	tools or direct facility-level GHG measurements.
Costs	Low: minimal data and computational resources.	Moderate: requires investment in data collection and research.	High: requires monitoring infrastructure and technical expertise.
Examples of Use	- Initial GHG inventories. - Small countries with limited capacity.	- Countries with moderate capacity and resources for national-level data.	- Developed countries or regions with advanced waste management systems.
Advantages	- Easy to implement. - Globally comparable.	- More accurate and country-specific. - Reflects local practices.	- Highly accurate and detailed. - Reflects site-specific practices.
Disadvantages	- High uncertainty. - Poor reflection of national circumstances.	- Requires more resources. - Limited by quality of national data.	- Expensive and resource-intensive. - Not feasible for all countries.

Reference [4]

A decision tree is shown in Figure 12 below can be used to determine which tier will apply for the solid waste inventory.

[4] IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 5, Waste.* Intergovernmental Panel on Climate Change. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html &
IPCC. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Intergovernmental Panel on Climate Change. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

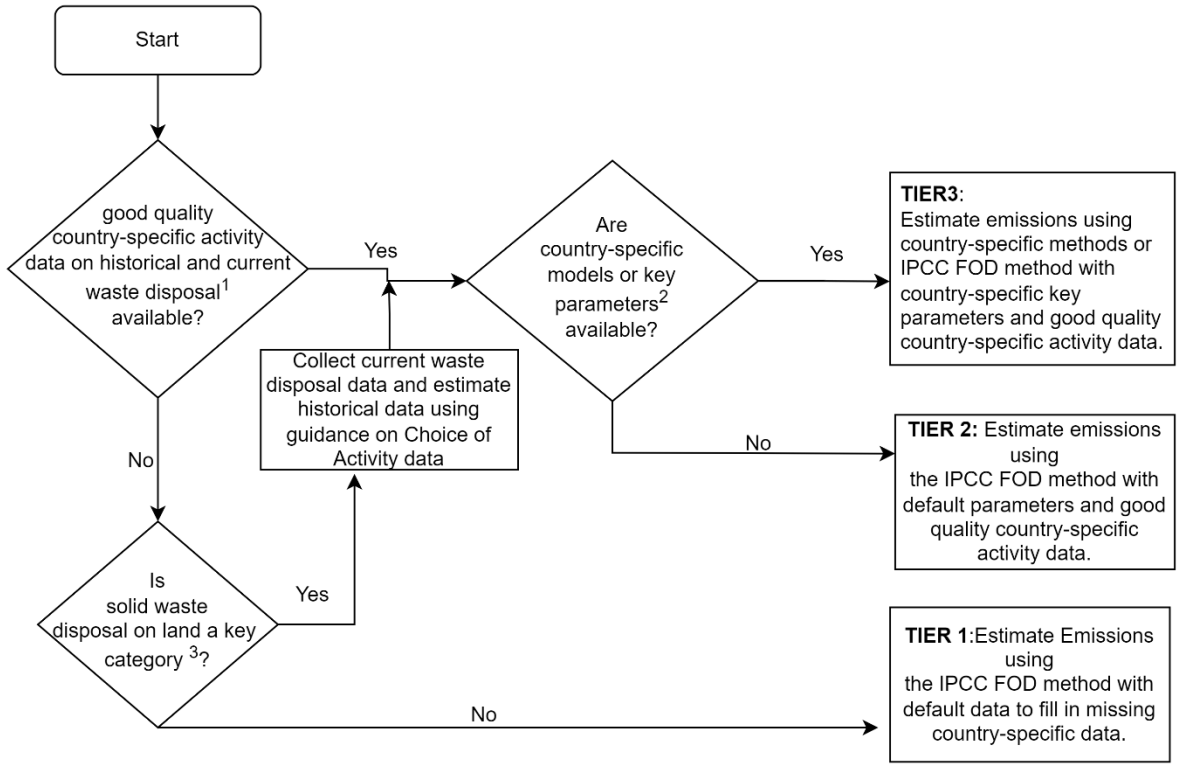

Figure 12: Decision tree for CH_4 emissions from solid waste disposal sites

Notes:

1. Good-quality country-specific activity data mean country-specific data on waste disposed of in SWDS for 10 years or more.
2. Key parameters mean DOC/Lo, DOCf and half-life time.
3. See Volume 1, Chapter 4, "Methodological Choice and Identification of Key Categories

In Fiji, the selection of tiers for GHG emissions calculations in the waste sector follows methodologies from the 2006 IPCC Guidelines. According to the latest GHG Inventory, the Tier 1 methodology was used to calculate emissions for Solid Waste Disposal (Category 4A) utilising country-specific data alongside default IPCC values.[5] The template for documenting the methodology is annexed as

Table A4.

[5] Government of Fiji (2023). National Inventory report

5.2.4 Calculation Methods and Procedures

In general, emissions are calculated using the equation:

Emissions = Activity Data x Emission factor

from the IPCC 2006 Guidelines. It is good practice to use specific activity data and emission factors. However, default values from the IPCC can be used without country-specific data.

Literature reviews on the availability of country-specific parameters for the solid waste sector were conducted under the ICAT phase II project[6]. According to the research, emissions calculations for waste in Fiji rely heavily on understanding the composition and characteristics of different waste types, as different materials decompose and release GHG at varying rates.

According to the JICA 2009 study cited in Fiji's national inventory, municipal solid waste is categorised into several key components: kitchen waste (33.6%), yard waste like grass and leaves (39.6%), paper (11.4%), plastics (films 5.1% and PET 1.7%), glass/ceramics (3.7%), metals (1.4%), textiles (1.1%), and other materials (2.4%).

The research also uncovered that organic waste, particularly kitchen and yard waste, forms the largest component of Fiji's waste stream. This is significant for emissions calculations since organic materials decompose anaerobically in landfills to produce CH_4, a potent GHG. Recent studies, including the 2021 PRIF Report for Ba Town and Labasa, have helped refine these composition estimates. The comprehensive analysis from recent waste audits suggests variation in waste composition across different regions, with kitchen waste ranging from 29-43% and grass/leaves from 21-38% of total waste.

Therefore, the waste composition percentage for Fiji using the current and previous publications is presented in the table below:

Table 8 Waste Composition Comparison

Categories studied	IPCC Oceania Default (%)	JICA, Fiji, March 2009 (%)	2024 Fiji Literature Review data average (%)[7]
Glass and ceramics	3.0	3.7	4.1
Metals	5.0	1.4	4.4
Organic matter			49.2
Kitchen waste	50.0	33.5	35.8

[6] The research was conducted by Jeantte Mani and Riteshma Devi. The results have not been published yet.

[7] Research conducted by Jeantte Mani and Riteshma Devi (2024).

Categories studied	IPCC Oceania Default (%)	JICA, Fiji, March 2009 (%)	2024 Fiji Literature Review data average (%)[7]
Grass, leaves	20	39.6	29.6
Paper and cardboard	10	11.4	13.9
Plastics	10	1.7	7.9
Films		5.1	6.9
Hygiene (Nappies/ diapers)			10.2 (5.3)
e-waste			0.5
Rubber and Leather			0.2
single-use items			3.1
Textiles		1.1	2.5
Wood			(5.0)
medical waste			3.7
Others	2.0	2.4	4.8

The review provides a comprehensive snapshot of Fiji's waste composition using the most recent studies, thus forming a benchmark for Fiji's waste composition factor. Therefore, the above waste composition values were used as Fiji values.

Furthermore, SPREP, in collaboration with the European Union, PacWastePlus Programme and Engineers Without Borders Australia, conducted an assessment of alternatives to single-use disposable diapers. The assessment stated that a baby uses 309kg/year of diapers in the Pacific. Out of which 47.6% (147 kg) goes to landfills/dumps, 45.6% (141 kg) ends up in the environment, and 8.4% (26 kg) is burnt. So nearly half of disposable diaper waste ends up in formal disposal sites (landfills/dumps), while a similar proportion is discarded directly into the environment. A small percentage is disposed of through burning, despite this not being recommended due to toxic fumes and health risks.

The report notes that disposable diapers can take approximately 500 years to break down, regardless of where they are disposed of. This creates long-term waste management challenges for Pacific communities, particularly given the significant volume generated—one baby uses an estimated 1,460 diapers per year in the Pacific region.[8]

In light of this assessment and taking into account (Table 8) the hygiene[9] waste product contributes 10.2% towards the total waste composition, it is assumed for the emission calculation purpose that 5.3% of the total hygiene waste is Nappies/ diapers.

Additionally, in the previous emission calculations (SNC, TNC & NIR), the wood used contributed 40% of the total waste composition. However, the research conducted under

[8] Secretariat of the Pacific Regional Environment Programme (SPREP). Assessment of Alternatives to Single-Use Disposable Diapers: Volume 5: Guidance for Communities and Private Sector. SPREP, 2022.
[9] Sanitary waste encompasses a broad range, including liquid or solid waste, such as diapers, feminine hygiene products, and incontinence products. It's also about items classified as 'offensive/hygiene waste' due to their appearance and odour resulting from human activities and bodily fluids.

the ICAT Phase II project did not register any wood in the waste composition. However, given that Fiji is prone to natural disasters such as floods and cyclones, the waste generated from these natural disasters, such as the damaged trees, is disposed of in the municipal waste disposal site. This was also confirmed by a representative of the Lautoka city council in the waste sector meeting on 15-16 October 2024 in Novotel Lami. Hence, for the purpose of emission calculation, it is assumed that the total waste composition consists of 5% wood.

Therefore, it is recommended that Fiji values be used; the review provides a comprehensive snapshot of Fiji's waste composition using the most recent studies, thus forming a benchmark for Fiji's waste composition factor.

Solid Waste Disposal Sites in Fiji

There are eight waste disposal sites in Fiji. One is a landfill, one is a managed semi-aerobic dump, and the remaining 5 are uncategorised open dumps. The details of the SWDS are presented in the Table 9 below.

Table 9: Solid waste disposal site in Fiji

Solid waste disposal sites	Years Active	Type of treatment
Naboro Landfill	2005-2024	Anaerobic well-managed
Sigatoka Dump	1950-2024	Uncategorised open dump
Lautoka (Vunato) Dump	2009-2024	Managed semi-aerobic
Ba Dump	1950-2024	Uncategorised open dump
Rakiraki Dump	1950-2024	Uncategorised open dump
Savusavu Dump	1950-2024	Uncategorised open dump
Levuka Dump	1950-2024	Uncategorised open dump

Landfill Emissions

I. First Order Decay (FOD) Model

IPCC provides tools that automatically calculate emissions over the decay time. These tools are the FOD model and equation, IPCC Waste Model (spreadsheet tool), and IPCC Inventory software. Thus, compilers do not need to calculate emissions "by hand" or develop a calculator for them. This section describes the FOD model.

a. Methane emissions

Methane emissions from solid waste disposal sites (SWDS) for a single waste type can be calculated using equation 3.1. Organic materials decompose without oxygen

(i.e., anaerobic conditions) and produce CH_4. However, not all this CH_4 reaches the atmosphere; some are broken down (i.e., oxidised) in the disposal site's cover layer, while some may be captured for energy use or burned off/combusted (flared). As a result, the actual CH_4 emissions released from these sites are lower than the total amount generated during decomposition.[10]

EQUATION 3.1

CH_4 EMISSION FROM SWDS

$$CH_4 \text{ Emissions} = [\sum_x CH_4 \text{ generated}_{x,T} - R_T] \bullet (1-OX_T)$$

Where:

CH4 Emissions = CH4 emitted in year *T*, Gg
T = inventory year
x = waste category or type/material
RT = recovered CH4 in year *T*, Gg
OXT = oxidation factor in year *T*, (fraction)
The CH4 recovered must be subtracted from the amount of CH4 generated. Only the fraction of CH4 that is not recovered will be subject to oxidation in the SWDS cover layer.

b. Methane Generation

The FOD model explains how CH_4 is generated from waste over time. When waste is placed in a disposal site, its CH_4-producing potential gradually decreases over decades, following an exponential decay pattern. The FOD model calculates how much waste material converts to CH_4 and carbon dioxide each year.

Decomposable Degradable Organic Carbon (DDOCm)[11] represents the amount of organic carbon in waste that will actually decompose under landfill conditions. DDOCm is crucial for:

- Estimating methane emissions from landfills, which the NIR, climate action planning, and waste management decision-making use.
- Modeling landfill gas generation over time to size gas collection systems appropriately, assess potential energy recovery projects, evaluate environmental impacts.
- Comparing waste management options by understanding the climate impact of different disposal methods, the effectiveness of waste diversion programs and the potential for methane capture and utilisation.

[10] Source: IPCC 2006, Volume 5. Chapter 3, page 3.8.
[11] IPCC 2006, Volume 5, Chapter 3

DDOCm is calculated by multiplying:

- *The waste amount* (This could be municipal solid waste, food waste, garden waste, etc).
- *The fraction of degradable organic carbon present* (accounts for how much carbon in the waste can potentially decompose. Different waste types have different DOC values - food waste has a higher fraction than wood waste, for example).
- *The portion that breaks down in anaerobic conditions* (recognises that not all potentially degradable carbon will actually break down in a landfill environment. Some organic matter remains stable even under ideal conditions).

- *A CH_4 correction factor for aerobic decomposition* (adjusts for aerobic decomposition that occurs, particularly near the surface of landfills where some oxygen is present. This reduces the amount of carbon available for anaerobic decomposition and methane generation.)

The equation is given below[12]:

EQUATION 3.2

DECOMPOSABLE DOC FROM WASTE DISPOSAL DATA

$$DDOCm = W \bullet DOC \bullet DOC_f \bullet MCF$$

Where:

DDOCm = mass of decomposable DOC deposited, Gg
W = mass of waste deposited, Gg
DOC = degradable organic carbon in the year of deposition, fraction, Gg C/Gg waste
DOCf = fraction of DOC that can decompose (fraction)
MCF = CH_4 correction factor for aerobic decomposition in the year of deposition (fraction)

Although CH_4 generation potential (Lo) is not used explicitly in these *Guidelines*, it equals the product of DDOCm, the CH_4 concentration in the gas (F) and the molecular weight ratio of CH_4 and C (16/12)[13].

EQUATION 3.3

TRANSFORMATION FROM DDOCm TO L_o

$$L_o = DDOCm \bullet F \bullet 16/12$$

Where:

[12] Source: IPCC2006, Volume 5, Chapter 3, page 3.9.
[13] Source: IPCC2006, Volume 5, Chapter 3, page 3.9.

Lo = CH_4 generation potential, Gg CH_4
DDOCm = mass of decomposable DOC, Gg
F = fraction of CH_4 in generated landfill gas (volume fraction)
16/12 = molecular weight ratio CH_4/C (ratio)

The FOD model for calculating CH_4 emissions from solid waste disposal sites in Fiji follows the IPCC methodology with tropical climate adjustments. The basic equation for CH_4 generation is:

EQUATION 3.4
DDOCm ACCUMULATED IN THE SWDS AT TH END OF THE YEAR T

$$DDOCma_T = DDOCmd_T + (DDOCma_{T-1} \bullet e^{-k})$$

EQUATION 3.5
DDOCm DECOMPOSED AT THE END OF YEAR T

$$DDOCm\ decomp_T = DDOCma_{T-1} \bullet (e^{-k})$$

[14]

Where:

T = inventory year
$DDOCma_T$ = DDOCm accumulated in the SWDS at the end of year *T*, Gg
$DDOCma_{T-1}$ = DDOCm accumulated in the SWDS at the end of year (*T*-1), Gg
$DDOCmd_T$ = DDOCm deposited into the SWDS in year *T*, Gg
DDOCm $decomp_T$ = DDOCm decomposed in the SWDS in year *T*, Gg
k = reaction constant, $k = \ln(2)/t1/2$ (y-1)
t1/2 = half-life time (y)

For Fiji's conditions, specific parameter adjustments by type of solid waste disposal sites are summarised below:

Parameter	Managed Landfill (Naboro)	Unmanaged Deep (Lami dump)	Unmanaged Shallow (Labasa)	Manage Semi-Aerobic (Vunato dump)	Uncategorised Open Dump (Sigatoka dump)
k value (wet tropical)	0.17-0.35	0.15-0.30	0.15-0.25	0.05-0.10	0.04-0.05
DOCf	0.5	0.5	0.5	0.5	0.5
F	0.5	0.5	0.5	0.5	0.5

[14] Source: IPCC2006, Volume 5, Chapter 3, page 3.9.

CH_4 generated from decomposable DDOCm[15]

The amount of CH_4 formed from decomposable material is found by multiplying the CH_4 fraction in generated landfill gas and the CH_4/C molecular weight ratio.

EQUATION 3.6

CH_4 GENERATED FROM DECAYED DDOCm

$$CH_4\ generated_T = DDOCm\ decomp_T \bullet F \bullet 16/12$$

Where:

$CH4\ generated_T$ = amount of CH4 generated from decomposable material

$DDOCm\ decomp_T$ = DDOCm decomposed in year *T*, Gg

F = fraction of CH4, by volume, in generated landfill gas (fraction)

16/12 = molecular weight ratio CH4/C (ratio)

FOD Spreadsheet Model (IPCC Waste Model)

The FOD spreadsheet model, or IPCC Waste Model, calculates GHG emissions from waste disposal sites over time, focusing on CH_4 generation from decomposing waste. It accounts for the long-term nature of emissions, varying decay rates of different waste types, and local factors like climate and waste management practices. The model supports NIR, aligning with IPCC guidelines to ensure consistency and transparency. It allows for flexible data inputs and projections of future emissions and facilitates policy planning and mitigation strategies while meeting international reporting requirements.

The Third National Communication and the NIR (2023) used the IPCC waste model. The model applied the "waste composition option" and utilised Tier 1 methodologies with default parameters for the Oceania region, complemented by country-specific activity data such as population statistics, waste generation rates, and the distribution of waste among managed, unmanaged, and uncategorised disposal sites.

Documentation Requirements for Calculation

To ensure consistency and alignment with IPCC standards, the following formats and templates are recommended:

1. **Standardised Reporting Format:**
    - Use the IPCC's and the CRF tables for waste sector emissions, including:
        - Solid waste disposal on land (CRF Table 5A).
        - Biological treatment of waste (CRF Table 5B).
        - Waste incineration and open burning (CRF Table 5C).
        - Wastewater treatment and discharge (CRF Table 5D).

[15] Source: IPCC2006, Volume 5, Chapter 3, page 3.10

2. **National Inventory Reporting:**
    - Summarises the calculation methodology (i.e., Tier 1, Tier 2, or Tier 3), specifying assumptions, activity data sources, and parameters applied in emissions calculations across the time series. This should align with the guidelines outlined in the MPGs for the ETF under the Paris Agreement[16].
    - Provide a summary of any recalculations and changes compared with the previous inventory, ensuring consistency with the transparency requirements specified in the MPGs (Paragraphs 25–31).
    - Include Fiji-specific elements, such as local waste management strategies and unique environmental factors. This ensures compliance with MPGs, which encourage the inclusion of country-specific circumstances and improvements in methodological approaches over time (Paragraphs 23–24).

3. **Custom Templates:**
    - Develop Fiji-specific templates for municipal councils to standardise data submission. The proposed template is attached to the Annex as Table A5 and Table A6.

Calculation Worksheets

Transparent documentation of calculations is essential for reproducibility:

1. **Worksheet Design:**
    - Use IPCC software (w/ FOD model embedded) for the IPCC FOD Model (Excel)[17].
    - Clearly label parameters, such as degradable organic carbon (DOC) and CH_4 generation rates.
    -
2. **Version Control:**

- Track updates to calculation methodologies using versioning and maintain historical worksheets for audits.

5.2.5 Data Collection and Approval Processes for GHG Inventory Development

Data collection represents a critical foundation for developing and maintaining reliable national GHG inventories. The 2006 IPCC Guidelines emphasises that formalised data collection activities should follow the principles of transparency, consistency, comparability, completeness, and accuracy (TACCC principles).

[16] United Nations Framework Convention on Climate Change (UNFCCC). (2019). *Modalities, Procedures, and Guidelines for the Transparency Framework for Action and Support Pursuant to Article 13 of the Paris Agreement* (Decision 18/CMA.1, Annex). Bonn, Germany: UNFCCC Secretariat. Retrieved from https://unfccc.int

[17] IPCC 2006, Volume 5, Chapter 3, IPCC Waste Model (MS Excel)

The 2006 IPCC Guidelines for National GHG Inventories (Volume 1, Chapter 2: Approaches to Data Collection) specifically outline that countries should establish systematic data collection procedures that are:

- **Aligned with national institutional arrangements**
- **Consistent with the tiered methodological approach**
- **Subject to QA/QC procedures**
- **Regularly reviewed and updated**

The 2019 Refinement to the 2006 IPCC Guidelines further emphasises the importance of adapting data collection strategies to national circumstances while maintaining good practice principles. The data collection steps are presented in

.

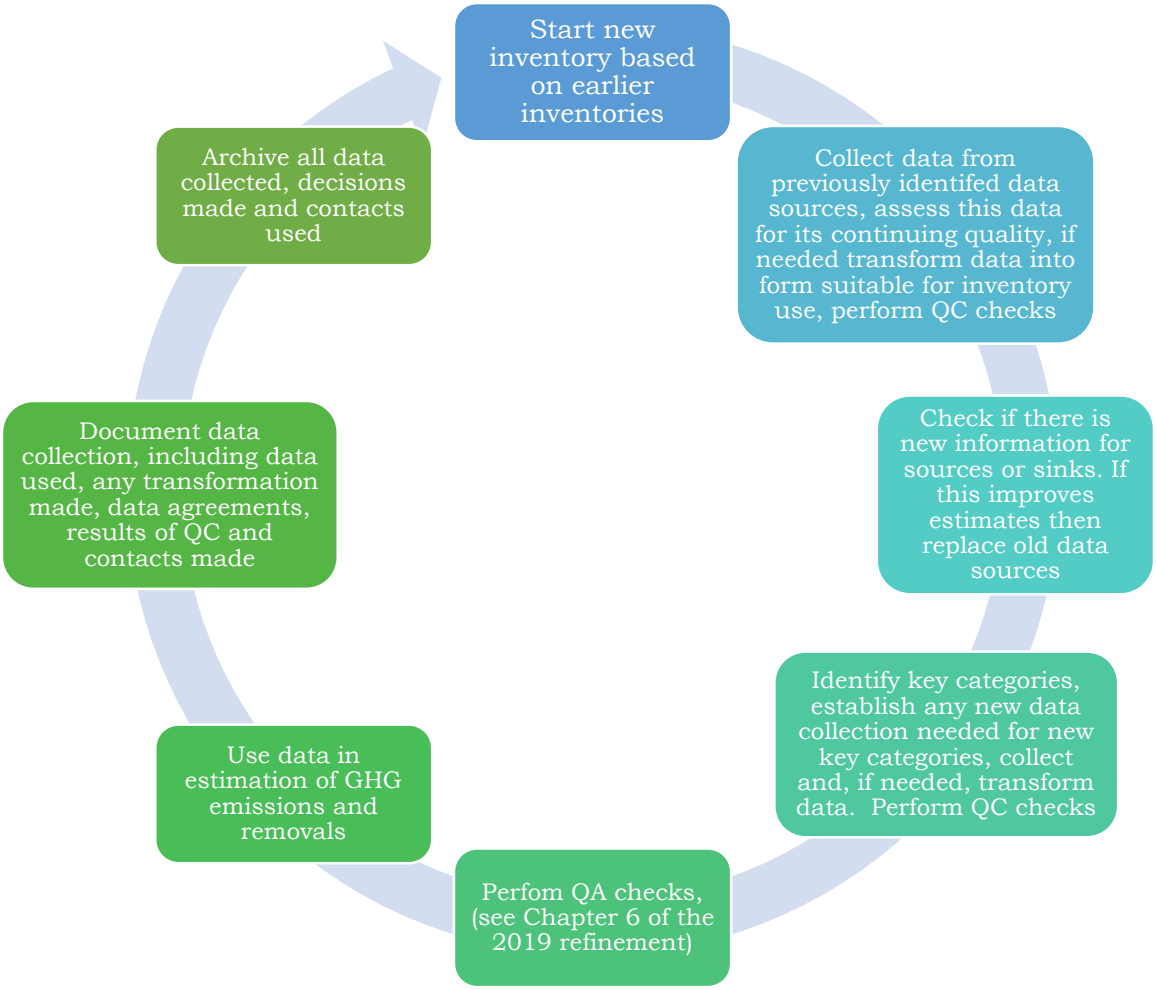

Figure 13: Steps in data collection according to 2019 Refinement

Note: This diagram outlines the steps in collecting and using data. In practice, some of the steps may be done in a different order or at different times for different sectors to suit national needs and circumstances. For example, documentation may be completed earlier than shown.[18]

The 2019 refinement recommends periodic reviews of data collection activities to ensure continuous improvement and suggests that countries should:

- Document data collection procedures
- Establish formal agreements with data providers
- Implement verification procedures
- Maintain consistent time series

[18] 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1.

5.2.6 Data Collection and Approval Processes for Solid Waste Disposal Category

Accurate, complete, and consistent activity data are essential for reliable GHG calculations and must be systematically collected to ensure consistency across time series. As solid waste disposal on land is a key category, it required a structured and methodological approach to data collection to produce robust emission estimates for this sub-sector. This section outlines the proposed system for gathering data directly from the source, implementing QA and QC procedures during data collection, and establishing protocols for data approval and archiving. These measures aim to provide inventory compilers with high-quality data for GHG estimations.

5.2.7 Activity Data Collection

Summary of Activity Data

Parameters	**Default 2006 IPCC Values**	**Fiji Country-Specific Value**
Solid Waste Generation rate		x
Solid Waste Generation Composition		x
Waste quantity		x
Waste Management Practices	x	x
DOC	X	
MCF	x	
k	x	

To date, activity data has been collected and recorded on ad hoc basis, often only when required and frequently not in a format suitable for effective and efficient emission estimation. During the national waste sector workshop at Novotel Lami on 15-16 October 2024, it was agreed that a standardised data collection template should be developed with built-in QA/QC features. A template for SWD has been created (refer to Table A5 in Annex) to align with Fiji's national circumstances. This template ensures accurate categorisation and sub-categorization of waste and captures the relevant and mandatory activity data necessary for robust GHG estimations. Training sessions should be conducted to familiarise stakeholders with these templates and ensure their consistent application.

Accurate GHG estimations for Fiji's waste management practices require the systematic collection of specific data points, including:

(i) **Solid Waste Generation and Composition:**
- Waste quantities by sector (municipal, industrial, agricultural, etc.).
- Composition percentages for organic (biodegradable) and non-organic waste streams.

- Historical waste disposal data (minimum 10 years[19]).

(ii) **Waste Management Practices:**

- Proportion of waste landfilled, composted, incinerated, or recycled.
- Landfill operational details, including CH_4 recovery.

(iii) **Site-Specific Data:**

Site-specific data	Fiji's context
Annual waste disposal rates	It is available. However, most of the open dump data is estimated by the respective town council.
Solid Waste Disposal (SWD) classification (managed/ unmanaged)	Available for each dumpsite.
Depth of sites	Estimates will be available on request to the town councils.
Operation practices	Available through request from town councils.
Waste collection frequency	The waste is collected according to the schedule. Therefore, frequent data can be made available through councils. However some city and town councils such as Lautoka[20] and Ba[21] has the schedule published on its website.
MCF based on site type	Fiji does not have country /site-specific MCF. Hence, the IPCC default value is used.
Fraction of degradable organic carbon (DOC).	Available through publications such as the IPCC guidelines.

(iv) **Climate and Environmental Conditions:**

- Mean annual temperature and precipitation (affects decomposition). This data can be obtained through Fiji Meteorological Services
- Soil types and leachate management data. The soil type data can be made available through the Ministry of Agriculture and Waterways, which keeps the soil type for the whole of Fiji. At the same time, the leachate management information can be obtained from the contract managing the landfill.

(v) **Demographic and Economic Data:**

- Population served by each waste management system. These data can be obtained directly from individual town councils.

[19] IPCC 2006, Volume 5, chapter 3.4
[20] Lautoka City Council waste collection schedule
[21] Ba town council waste collection schedule

- Trends in urbanisation and income levels affecting waste generation. These data can be obtained from FBOS.

(Source: IPCC, 2006; IPCC, 2019)

5.2.8 Data Collection Procedures

To ensure consistent data collection:

1. **Survey Design and Administration:**
   - Conduct waste audits in representative urban and rural areas. The town councils may not be able to perform the waste audit on its own due to capacity constraints. Therefore, conducting the audit will require partnerships with organisations such as JICA with technical capacity, CCD and donor agencies.
   - Use stratified sampling techniques to capture variability in waste composition. The town councils can conduct this.

2. **Data Sources and Partnerships:**
   - Collaborate with local municipalities, waste collectors, and NGOs. It is recommended that data-sharing agreements be prepared. There are no formal arrangements, such as an MOU between the leading agency collecting sectoral data and individual agencies, to share the data. During the waste sector workshop from 15-16 October 2024, the data providers have requested that MOUs be in place for data sharing.
   - Use existing datasets (e.g., Fiji Bureau of Statistics and local council records).

3. **Field Measurements:**
   - Conduct direct measurements for landfill emissions using Tier 3 approaches where feasible. A pre-feasibility study was done by the University of South Pacific and the National Institute of Water and Atmospheric Research to determine the methane recovery from the Naboro Landfill, which has the potential to be scaled up.[22] Two master's students have also conducted research on methane fluxes[23] and oxidation rats from the Naboro Landfill[24].
   - Verify data with periodic onsite inspections. The climate change focal point of the lead agency could do this. The roles and responsibilities of the Focal Point are discussed in the Documentation on IA's for preparing NC/BTR.

(IPCC, 2006; IPCC, 2019; Good Practice Guidelines, 2000)

[22] Mani, Francis & Gronert, Richard & Harvey, Mike. (2016). Pre-feasibility study for methane recovery at Naboro Landfill, Suva, Fiji Islands: Final Report on projects funded by PACE-Net Plus seed funding grants 2015.
[23] Quantifying methane fluxes from Naboro landfill
[24] Methane oxidation potential at the Naboro landfill in Suva, Fiji

5.2.9 Documentation Requirements for Activity Data

Comprehensive documentation ensures that inventory processes are transparent and repeatable. The documentation requirements are presented in the Table 10 below.

Table 10: Documentation requirement for Activity Data

Action	Explanation
Activity Data	▪ Maintain records of waste generation, composition, and disposal methods by stakeholders as identified in the data flow diagrams. ▪ Include data sources, collection methodologies, and frequency of updates.
Emission Factors	▪ Document the derivation or source of all emission factors (e.g., IPCC defaults, Fiji-specific studies).
Assumptions and Methodologies	▪ Clearly state all assumptions used in calculations, such as CH_4 oxidation factors and waste decay rates. ▪ Include references to supporting literature or studies.
Metadata Standards	▪ Ensure all datasets include metadata, such as the date of data collection, collector's name, and methodology.
Reference	*IPCC, 2006; IPCC, 2019*

5.2.10 Methane Correction Factors

5.2.10.1 MCF values have been adapted for Fiji's disposal site categories:

Disposal Site Type	MCF Value	Application
Managed Landfill (e.g., Naboro)	1.0	Sites with controlled placement and cover
Unmanaged Deep (≥5m)	0.8	Common in larger municipalities
Unmanaged Shallow (<5m)	0.4	Typical in rural areas
Semi-aerobic	0.5	Engineered sites with passive ventilation

The template for recording emission factor is annexed as Table A7.

5.2.10.2 Oxidation Factors (OX)

Oxidation factors reflect the amount of CH_4 oxidised in cover material:

Site Type	OX Value	Condition
Managed with soil cover	0.1	Well-maintained cover
Managed with non-soil cover	0	Poor or no maintenance
Unmanaged	0	Poor or no maintenance

For Fiji, as the open dumps are unmanaged, OX will be = 0

5.2.10.3 Default Values for Fiji Context

Waste Composition Values:

Waste Type	DOC Content[25]	k Value (year^{-1})[26]
Food waste	0.15	0.4
Garden waste	0.20	0.17
Paper	0.40	0.07
Wood	0.43	0.035
Textiles	0.24	0.07
Other	0.00	N/A

5.2.11 Sample Calculations

1. Naboro Landfill Case Study
    - Location: Suva corridor
    - Service area: Greater Suva area
    - Population served: ~300,000
    - Waste received: 93,820 tonnes/year (2023)

The following calculations demonstrate the application of IPCC methodologies to Fiji's context:

Step 1 : input Parameters

- ✓ Waste disposed : Waste disposed: 93,820 tonnes/year in 2023[27]
- ✓ DOC: 0.15 (weighted average based on waste composition)
- ✓ Food waste: 35.8%
- ✓ MCF: 1.0 (managed landfill)
- ✓ F: 0.5 (default IPCC value)
- ✓ k: 0.4 year^{-1} (tropical wet conditions)

Step 2: Weighted DOC calculation using Equation 3.2[28]

$DOC_{Food\ waste}$=Food waste fraction×DOC×Waste disposed

$DOC_{Food\ waste}$= 0.358 × 0.15 × 93,820

= 5,038.13 tonnes C

Step 3: Calculate DDOCm (Decomposable DOC) using Equation 3.2

DDOCm = Total DOC × DOCf

DDOCm = 5,038.13 × 0.5

=2,519.065 tonnes

[25] IPCC 2006 Guidelines, Volume 5, Chapter 3
[26] IPCC 2006 Guidelines, Volume 5, Chapter 3, Table 3.3
[27] Data provided by Department of Environment
[28] IPCC 2006 Guidelines, Volume 5, Chapter 3

Step 4: Calculate CH_4 Generation Potential using Equation 3.3[25]

L_0 = DDOCm × F × 16/12 (CH4/C molecular weight ratio)
L_0 = 2,519.065 × 0.5 × 16/12 = 1,679.38 tonnes CH_4

Step 5: Calculate CH_4 Emissions Using IPCC First-Order Decay (FOD) Model

The calculation below is for the first year of the CH_4 generation.

Using the IPCC's First Order Decay (FOD) model:
E_{CH4}= (MT * DOC * DOCf * MCF * F * (16/12) - R) * (1 - OX)[29]

- **Inputs**:
  - Total waste disposed (MTM_{T}MT): 100,000 tons/year.
  - Degradable organic carbon (DOCDOCDOC): 15%.
  - Fraction of DOC dissimilated (DOCfDOC_fDOCf): 0.5.
  - Methane conversion fraction (MCF): 0.5.
  - Oxidation factor (OX): 0.1.
  - Recovered CH_4 (R): 5,000 tons/year.

- **Output**: Methane emissions ECH_4=15,300 tons/year
  - ECH_4=15,300tons/year.

5.3 Uncertainty Assessment

The 2006 IPCC Guidelines recommend conducting and documenting uncertainty analysis for GHG inventories to improve transparency, reliability, and comparability of data. Tier 1 and Tier 2 approaches are typically used based on the methods' complexity and data availability.

The table below represents the comparison in a table form.

Aspects	Tier 1	Tier 2
Description	The simplest method uses IPCC default values for activity data and emission factors.	Detailed method using country-specific data and statistical techniques.
Suitability	Used when limited national data is available or for non-key categories.	Applied when sufficient national data is available and for key categories.

[29] IPCC, 2006, Volume 5, Chapter 3

Aspects	Tier 1	Tier 2
Data Requirements	Minimal relies on generic percentage uncertainty ranges from IPCC guidelines.	Requires detailed national datasets, measurements, or expert judgment.
Methodology	Simple propagation of uncertainty using IPCC-provided values.	May involve Monte Carlo simulations or advanced statistical techniques.
Purpose	To establish baseline uncertainties in early inventory stages or for smaller emission sources.	To refine uncertainty estimates and prioritise data quality improvements.
QA/QC Requirements	Basic validation and cross-checking of default data sources.	Comprehensive QA/QC measures for data accuracy and consistency.
Documentation Reporting Requirements	Sources of default values.	Description of country-specific sources and methodologies.
	Equations used in uncertainty propagation.	Explanation of statistical techniques (e.g., Monte Carlo).
	Simplified reporting in inventory	Detailed uncertainty estimates and implications for total GHG accuracy.
Reporting Requirements	Include uncertainty estimates for each category using default values	Provide category-level and overall uncertainty with detailed justifications.
When to Use	For baseline inventories and categories contributing minimally to overall GHG emissions.	For key categories or sectors critical to national GHG targets and policy decisions.
IPCC Guidelines Reference	2006 IPCC Guidelines, Volume 1, Chapter 3.	2006 IPCC Guidelines and 2019 Refinement, Volume 1, Chapter 3.

Tier 1 is suitable for early inventory stages or data-scarce situations, while Tier 2 is preferred for key categories with significant emissions or influence on national policies. Both approaches emphasise proper documentation and quality checks to ensure transparency and reliability in GHG inventories.

Uncertainty analysis should be conducted and documented at various stages of the GHG inventory process to ensure robust and credible results. Key stages include:

I. **During Inventory Planning and Design**

- When establishing the scope of the inventory, identifying emission sources, and selecting methodologies (Tier 1, Tier 2, or Tier 3), it is crucial to assess and

document uncertainties associated with data availability, quality, and applicability.
- Early identification helps prioritise efforts to reduce uncertainty in critical categories that contribute significantly to total emissions.

II. **Before Finalizing Methodology Choices**

- Uncertainty analysis should guide the decision to use specific methodologies or tiers.
- For instance, if high uncertainty is identified with Tier 1 default values, transitioning to Tier 2 or 3 methodologies with more specific data may be justified.

III. **During Data Collection and Parameter Estimation**

- While gathering activity data and parameters (e.g., waste generation rates, waste composition, decay rates), uncertainties should be quantified and documented to evaluate the reliability of inputs.
- For parameters derived from literature, uncertainty ranges must reflect variations in conditions, such as regional or temporal differences.

IV. **At the End of Inventory Calculations**

- After emissions are estimated, uncertainty analysis should be applied to both individual categories and the overall inventory to identify the most significant contributors to uncertainty.
- This helps in prioritizing future improvements and enhances the transparency of the results.

V. **When Reporting Results**

- Uncertainty results should be included in the inventory report to enhance transparency and provide confidence in the data.
- Clear documentation of assumptions, data limitations, and their impacts on the uncertainty of estimates aligns with the 2006 IPCC Guidelines and international reporting requirements.

VI. **When Recalculating and Updating Inventories**

- Whenever recalculations or methodological updates are conducted to improve inventory accuracy, uncertainty analysis must be revisited to assess how these changes impact the reliability of results.
- This ensures that continuous improvements are documented and uncertainties are reduced over time.

VII. **When Evaluating Mitigation Measures**

- Uncertainty analysis is crucial when using inventory data to assess the effectiveness of mitigation strategies. Understanding the uncertainty ensures that decisions are based on reliable estimates.

VIII. **In Response to Stakeholder Review or International Assessments**

- Uncertainty analysis is revisited when stakeholders (e.g., reviewers, policymakers) request clarification or when international frameworks, like the ETF, mandate detailed reviews.

First Order Decay Model Adjustments

Fiji adopts the IPCC-recommended FOD model for methane emissions, modified for its tropical wet climate:

- **Decay Rates**: Adjusted to reflect the rapid decomposition of organic waste.
- **Methane Correction Factors (MCFs)**: Identified for unmanaged disposal sites in rural regions.
- **Data Inputs**: Seasonal variations in waste generation, especially from tourism, are integrated for accuracy.

(i) Sources of Uncertainty

Category	Sub-Category	Uncertainty Range	Notes/ Sources
Waste Generation	Population Statistics	±5-10%	Based on census data reliability (IPCC, 2000)
	Per capita waste generation	±5-20%	Varies by urban/rural areas (IPCC, 2019)
	Historical waste disposal	±25-30%	Pre-2000 data, higher uncertainty for older records
Waste composition	Sampling methodology	±10-15%	Pre-2000 data, higher uncertainty for older records
	Seasonal variations	±20-25%	Higher during wet season in Fiji
	Geographic variations	±15-20%	Varies between urban and rural areas

(ii) Parameter Uncertainties Table Based on IPCC Guidelines

Parameter	Category	Default	Uncertainty range	source
Methane Generation Rate (k)	Wet Tropical Climate	0.17-0.35 yr^{-1}	-40% to +60%	IPCC 2019 Refinement
	Food waste	0.40 yr^{-1}	-30% to +40%	IPCC 2006, Vol 5, Ch 3
	Garden waste	0.17 yr^{-1}	-50% to +50%	IPCC 2006, Vol 5, Ch 3

Parameter	Category	Default	Uncertainty range	source
	Paper	0.07 yr^{-1}	-40% to +40%	IPCC 2006, Vol 5, Ch 3
Degradable Organic Carbon (DOC)	Food waste	0.15	±20%	IPCC 2019 Refinement
	Garden waste	0.20	±30%	IPCC 2019 Refinement
	Paper/ carboard	0.40	±15%	IPCC 2019 Refinement
	Wood	0.43	±30%	IPCC 2019 Refinement
	Textiles	0.24	±30%	IPCC 2019 Refinement
MCF	Managed Landfill	1.0	±10%	IPCC 2006
	Unmanaged (deep, >5m)	0.8	±20%	IPCC 2006
	Unmanaged (shallow, <5m)	0.4	±30%	IPCC 2006
Other Parameters	DOCf	0.5	±20%	IPCC 2006
	Oxidation Factor (OX)	0.1	±50%	IPCC 2006
	F (Methane Fraction)	0.5	±5%	IPCC 2006

5.4 Uncertainty Calculation

Uncertainty Calculation Methods

The calculation of uncertainties follows methodologies prescribed by IPCC Guidelines:

1. *Propagation of Error Method (Tier 1)*
   Combined Uncertainty = $\sqrt{(U_1^2 + U_2^2 + ... + U_n^2)}$ Where: U_1, U_2, ... U_n are individual uncertainty components

2. *Monte Carlo Analysis (Tier 2)*
   - Input parameter distributions
   - Multiple simulation runs (typically 10,000)
   - Confidence interval calculations
   - Sensitivity analysis

(Source: IPCC Good Practice Guidance, 2000; updated in 2019 Refinement)

5.4.1 Data Management Systems

Efficient data management is crucial for inventory accuracy:

1. **Digital Platforms:**
    - Develop a centralised database system using geographic information system (GIS) tools.
    - Enable automated data collection from monitoring devices at landfill sites.

2. **Metadata Standards:**
    - Ensure all datasets include metadata, such as collection date, location, and methodology.

3. **Interoperability:**
    - Link systems with Fiji's national statistical databases for broader analysis.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

The QA/QC procedures are crucial for developing national GHG inventories. They help build confidence in national GHG inventories and improve inventory management and reporting over time. The QA/QC section will support reporting requirements for UNFCCC and the ETF. It must be ensured that the QA/QC currently being developed under the CBIT Project is inclusive of these 7 steps under QA/QC[30] for sectoral data. These include:

STEP 1:	Convene a QA/QC Plan launch meeting and identify QA/QC personnel
STEP 2:	Develop a timeline for distributing the QA/QC plan amongst the inventory team and external experts, considering the overall inventory schedule created
STEP 3:	Establish category-specific QC procedures for source/sink category leads to follow
STEP4	Document recommendations received as a result of experts' QA activities
STEP 5:	Document recommendations received as a result of experts' QA activities
STEP 6:	Propose GHG inventory improvements as a result of QA/QC activities
STEP 7:	QA/QC Checklists

Table 11: QC and QA serve distinct roles in inventory management.

	Definition	**Difference**
Quality Control	Refers to routine technical activities carried out by inventory compilers to monitor and maintain quality during inventory preparation. It is integrated into day-to-day operations.	Is embedded in daily tasks.
Quality Assurance	Involves systematic reviews conducted by individuals external to the inventory development process, often independent third parties, after QC has been completed. QA typically includes expert peer reviews.	An external process that provides an additional layer of review.

[30] EPA

	Definition	Difference
Verification	Encompasses methods and procedures used during or after inventory compilation to establish reliability. This includes independent comparisons using external data and alternative estimation methods.	Can intersect with both QA and QC, depending on its timing and methods.

QC includes two main categories:

1. *General QC Procedures***:** Cover broad quality checks, such as accuracy of calculations, data processing, completeness, and documentation. These apply across all inventory categories.

2. *Category-Specific QC Procedures:* Address the unique data and parameters of individual source or sink categories. These complement general QC procedures and require specialised knowledge.

6.1 The Role of QA/QC in Inventory Management

Effective QA and QC enhance inventory quality and foster continuous improvement. A comprehensive QA/QC plan (template is annexed as

Table A10) is a foundational tool, detailing:

- Roles and responsibilities for QA/QC coordination. The template is annexed as Table A9;
- General and category-specific QC procedures;
- QA review processes;
- Documentation, reporting, and archiving practices; and
- A prioritised list of planned improvements, updated regularly.

6.2 Developing and Implementing a QA/QC Plan

A QA/QC Coordinator should be appointed to lead the development, maintenance, and execution of the QA/QC plan. This individual should:

- Collaborate with sector leads to incorporate specific needs into the plan.
- Regularly review and update the plan to reflect new processes, improvements, or inventory objectives.
- Maintain records of implemented improvements and their outcomes.

The QA/QC Coordinator should ensure the plan supports ongoing inventory improvement and aligns with the National Inventory Improvement Plan. This is especially critical at the start of each GHG inventory compilation cycle. Regardless of team size, a streamlined and effective QA/QC system is essential for achieving high-quality inventories.

The QA/QC should also include:

1. **Data Validation:**
    - Cross-check data with previous years to identify anomalies.
    - Validate composition data through laboratory analysis of samples.
2. **Verification Protocols:**
    - Adopt third-party audits for emission estimates.
    - Document changes in methodologies or assumptions.
3. **Regular Training:**
    - Train staff on QA/QC procedures, focusing on Fiji's specific challenges.

(IPCC, 2006; Good Practice Guidelines, 2000)

The template for category-specific QA/QC procedure and checklist are annexed as Table A9,

Table A10, Table A11 *and*

Table A12.

6.3 Verification Procedure

Verification ensures accuracy and credibility in GHG reporting:

1. **Internal Reviews:**
    - Conduct periodic internal audits of data collection and calculation processes.
    - Use staff trained in IPCC methodologies to identify and address inconsistencies.
2. **External Verification:**
    - Engage third-party experts or institutions for independent verification of emission estimates.
    - Follow ISO 14064-3 standards for GHG verifications where applicable.
3. **Error Margins and Uncertainty Analysis:**
    - Perform uncertainty analysis to quantify confidence levels in reported emissions.
    - Address significant errors by revising methodologies or assumptions.
4. **Review and Submission:**
    - Submit GHG inventories to the UNFCCC Secretariat as part of Fiji's National Communications and Transparency BURs.
    - Include responses to any previous review findings.

(Good Practice Guidelines, 2000; IPCC, 2006)

7.0 KEY CATEGORY ANALYSIS

The key categories concept:

- Identifies emission sources/sinks that significantly impact national GHG totals.
- Helps countries prioritise resources and reduce uncertainties.
- Considers both absolute emission levels and trends over time.
- Can incorporate uncertainty assessments to identify additional key categories.

Analysis Methodologies have two approaches:

Approach 1	Approach 2
Assesses categories by current emission levels and trends from base year.	Similar to Approach 1 but incorporates uncertainty assessments.
Key categories are those that sum to 95% of total emissions when ranked.	Uses 90% cumulative threshold.
Developing countries may use 85-95% threshold with proper documentation.	Developing countries with capacity constraints may use qualitative uncertainty discussion instead.
	Requires quantified uncertainty data.

The benefits of key category analysis are:

- Helps prioritise inventory improvements
- Guides resource allocation for better methodologies or data collection
- Enhances transparency in reporting
- Builds capacity for future ETF reporting requirements

The steps in KCA are represented in the figure below.

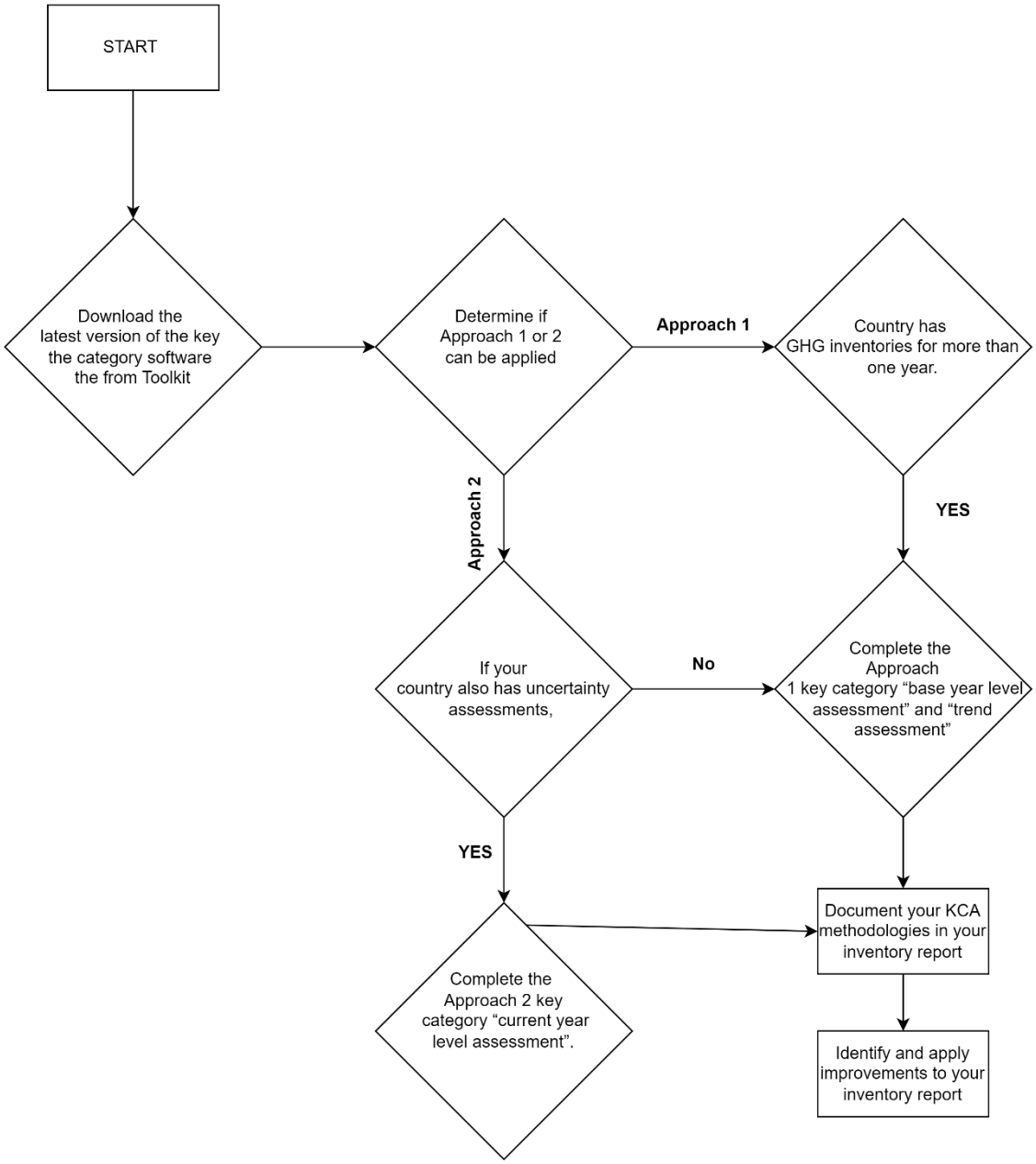

Figure 14: KCA steps

The template (annexed Table A18, Table A19, Table A20, Table A21,Table A22, Table A23 and

Table A24) provides step-by-step instructions for completing the analysis, with flexibility options for developing countries based on their capabilities. Countries should document any use of flexibility provisions and their plans for future improvements.

7.1 KCA in Fiji's Context

According to the NIR (2023), the key categories identified in the waste sector were SWD (category 4A) and Wastewater Treatment and Discharge (Category 4D). SWD was the major contributor to CH_4 emissions, accounting for 61.67% of total waste sector emissions and 65.39% of CH_4 emissions from this sector in 2019. In comparison, Wastewater Treatment and Discharge contributed to 31.80% of total sectoral emissions.

7.2 Methodology and Results (NIR 2023)

The KCA conducted in Fiji NIR 2023 used Approach 1 of the 2006 IPCC Guidelines, examining both level and trend assessments. This process summed the contributions of categories until they reached 95% of total national emissions or trends.

For the 2013-2019 period:

- Category 4A (SWD) showed a 26% increase in emissions due to population growth and activities at the Naboro Landfill.
- Category 4D (Wastewater Treatment) saw a 19% decrease in emissions, attributed to CH_4 recovery and flaring at the Kinoya Wastewater Treatment Plant.

7.3 Recommendations for Improvements

i. *Data Quality*: Enhance records for waste generation rates and composition, especially for municipal solid waste and industrial waste.
ii. *Standardization:* Align waste characterisation with IPCC guidelines across municipalities.
iii. *Monitoring Systems*: Install weighbridges and conduct regular waste composition studies.

8.0 ARCHIVING SYSTEM

A GHG inventory archive maintains all information about inventory compilation, reporting, and institutional arrangements. This archive serves three key purposes:

1. Enables inventory compilers to understand and maintain consistency with previous methodologies and processes.
2. Strengthens the long-term sustainability of the national GHG inventory management system.
3. Enhances transparency for UNFCCC reporting and peer review processes.

The Archiving Coordinator at the Climate Change Division should develop the Archiving System before beginning the inventory compilation cycle. This system should:

- Maintain consistent documentation across all sectors and categories.
- Preserve all materials from each compilation cycle without overwriting.
- Focus specifically on enabling inventory replication, going beyond simple file backup.

The Coordinator works with the PC/NIC and team members to develop and improve the system based on practical experience. The archive's primary goal is to facilitate the exact replication of previous GHG inventory compilation steps, serving as a comprehensive reference for future work. The data generated under the inventory can be achieved in the GHG database management system, which will be established under the CBIT Project.

There are 3 steps:

STEP 1:	Assess the existing archiving steps and procedures
STEP 2:	Develop the Archiving System
STEP 3:	Identify improvements to the Archiving System

8.1 Record-Keeping Requirements

1. **Minimum Retention Period:**
   - Maintain records for at least ten years, as per IPCC recommendations.
2. **Documentation Format:**
   - Store physical and digital copies of all data to safeguard against loss.
3. **Accessibility:**
   - Ensure records are accessible for reviews, audits, and future inventory compilations.

8.2 Document/Information to be Archived

Some of the data and information that is to be archived include:

- Data and calculation spreadsheets and other electronic files for every Chapter of the NC/BTR.
- QA/QC plan with completed checklists.
- Key category analysis spreadsheets (for National GHG Inventory).
- Internal and external review comments and responses.
- Latest draft and final electronic versions for each of the Chapters (for use as a starting point to update the inventory in the future).

The template for the archiving system is annexed as Table A27,

Table A28 and Table A29.

9.0 NATIONAL INVENTORY IMPROVEMENT PLAN

The National Inventory Improvement Plan (NIIP) is a crucial tool for countries developing their GHG inventories. This planning document, outlined in Table A30 and Table A31, helps NICs systematically enhance their inventory processes.

A comprehensive NIIP should:

1. Identify specific improvements needed in methods, data collection, and inventory systems.
2. Prioritize proposed improvement projects.
3. Explain priority assignments, particularly for key categories.
4. Detail implementation requirements, including budget and resource needs.
5. Establish timeframes (near-term for next inventory or long-term for future inventories).

The plan should focus on improving five key aspects of national GHG inventories:

- Transparency
- Consistency
- Comparability
- Completeness
- Accuracy

Priority improvements typically target key categories as defined by IPCC good practice guidance, address capacity-building needs identified during technical analyses (such as BUR and in future the BTRs), and enhance other inventory aspects as resources allow.

The NIIP aligns with the ETF reporting requirements, which emphasize continuous improvement. Countries must regularly identify, update, and report areas needing enhancement. This includes addressing capacity constraints related to flexibility provisions and responding to recommendations from technical expert review teams.

9.1 Improving Accuracy Over Time

Strategies for reducing uncertainties are based on continuous improvement principles outlined in the NIR 2023, are as follows:[31]

1. Short-term Improvements (1-2 years)
    - Enhanced data collection procedures
    - Staff training programs
    - Quality control implementation
    - Regular equipment calibration

2. Medium-term Improvements (2-5 years)

[31]National Inventory Report (2023) Fiji

- Development of country-specific emission factors
- Improved waste characterisation studies
- Enhanced monitoring systems
- Better historical data reconstruction

3. Long-term Improvements (>5 years)
   - Advanced measurement technologies
   - Automated data collection systems
   - Refined modeling approaches
   - Regional data sharing networks

There are several opportunities to strengthen institutional and procedural arrangements for data collection and reporting in Fiji's waste sector. These recommendations address current challenges such as inconsistent data formats, ad hoc reporting schedules, and limited capacity for QA/QC. Below are actionable improvements to enhance Fiji's waste sector emissions inventory

	Issue	Impact	Recommendation
Lack of Standardized Data Collection Templates	Different organisations and entities (e.g., municipal councils, private industries, hospitals, and biosecurity agencies) use varied methods for recording data.	Inconsistent formats make it difficult to compile and validate data for national-level reporting.	Develop Standardised Templates**:** Introduce unified data collection formats and guidelines for all data providers.
Ad-Hoc Reporting Practices	Data reporting is often done on an ad-hoc basis rather than through regular, scheduled submissions.	• Leads to delays and missing information during the compilation of GHG inventories.	Regularise Reporting Schedules**:** Mandate periodic (quarterly or biennial) data submissions under formal agreements (e.g., MOUs).
Incomplete or Missing Data	Some sectors, such as informal waste collection or small-scale industrial operators, fail to	Creates gaps in the national GHG inventory, reducing the accuracy of emissions calculations.	Use appropriate gap-filling techniques given by IPCC.

	Issue	Impact	Recommendation
	report their waste data entirely.		
Insufficient Coordination Across Agencies	Collaboration between municipal councils, ministries, and private entities is inconsistent, with overlapping or unclear roles.	Leads to duplicated efforts, bottlenecks in data collection, and inefficiencies in reporting.	Enhance Inter-Agency Coordination**:** Strengthen the role of governance bodies like the NCCCC to streamline roles and responsibilities.
Inadequate Capacity and Training	Data providers, including waste facility operators and local councils, lack sufficient training on the methodologies and tools required for accurate data collection.	Results in errors in data recording and inconsistencies in emissions estimates	Provide Capacity Building**:** Conduct training for local councils, private operators, and ministry staff on emissions methodologies and tools.
Resource Constraints	Limited financial and technical resources restrict the ability to implement automated systems or hire dedicated personnel for data collection and quality control.	Reliance on manual processes increases the likelihood of human errors and reduces the efficiency of data flow.	Institutionalising roles and responsibilities to seek budget support from the Government.
Limited QA/QC Mechanisms	Quality assurance and quality control (QA/QC) systems are not robust or uniformly applied across sectors.	Errors in data entry, duplication, and loss of information compromise the credibility of the national inventory.	Allocate Resources**:** Seek funding for automated data management systems and employ dedicated staff for data QA/QC.
Data Integration Challenges	Different entities use incompatible	Integrating data from diverse	Use the development of the

	Issue	Impact	Recommendation
	systems or formats for data storage and management.	sources into a centralized system becomes labor-intensive and prone to errors.	Digital transparency tool under the CBIT Project as an opportunity to assess possibilities of integration.
Informal Sector Exclusion	Informal waste collectors, who handle significant waste volumes in some areas, are not integrated into formal data collection systems.	Their contributions to waste streams and emissions are not captured, leading to underestimating sectoral emissions.	Expand Coverage**:** Integrate informal sectors and remote regions into the data flow process through innovative data collection approaches.
Geographic and Infrastructure Limitations	Due to a lack of infrastructure and resources, remote islands and rural areas face challenges in collecting and reporting waste data.	National reporting may overlook emissions contributions from these areas.	Collaborate with the Ministry of Rural and Maritime Development to seek ways of improving data collection and waste management in these locations.

10.0 ANNEX

10.1 Annex I: Templates

Table A1: Inventory compilation schedule

	Stage	Due date (e.g., Month, day, and year)	Comments
Improve	Plan	[Enter Text]	
	Collect		
	Estimate		
	Write		
	Review		
	Finalise and submit		
	Archive		

Table A2: Overall progress capturing template.

Template	Summary of progress towards completing the template	Obstacles and possible solutions	Status
1. Inventory Planning	[Enter Text]		
2. Institutional Arrangements			
3. Methods and Data Documentation			
4. QA/QC Procedures			
5. Archiving System			
6. Key Category Analysis			
7. National Inventory Improvement Plan			

Table A3: General information on SWD

Key category in the previous GHG inventory: *(Yes or No)*	Yes		
Greenhouse gases and tiers, as reported in the previous inventory:			
Gases reported *Record the GHG emitted/removed. Example: CO_2, CH_4, or N_2O*	*Key category* *Record Yes if the GHG named at left was a key category. Otherwise, record No.*	*Activity data Tier* *Record the tier level used for activity data. Example: Tier 1, 2, or 3*	*Emission factor Tier* *Record the tier level relating to the emission factor. Example: Country-specific or default factor*
CO_2	No	Tier 1	The default emission factor was used.
CH_4	Yes	Tier 1	
N_2O	No	Tier 1	
Category description/definition: *Record the (sub)category description in line with the 2006 IPCC Guidelines and a clear reference to the section or table in the 2006 IPCC Guidelines.* *Example: Emissions resulting from the anaerobic decomposition of organic waste disposed of in solid waste disposal sites (SWDS). This includes methane (CH_4) emissions generated through the biological degradation of organic matter in the absence of oxygen. (Source: Volume 5, Waste, Chapter 3, Solid Waste Disposal, Table 3.1 https://www.ipcc-nggip.iges.or.jp/public/2006guidelines/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf)*			
Relevant national circumstances: *Record relevant national circumstances, e.g. relevance of source to the national economy and in day-to-day life, development of emissions of GHGs and/or removals of CO_2 over time. Information about national circumstances, particularly category's share in total emissions might not be available where a GHG inventory is compiled for the first time or information from previous compilation cycles have been lost or are known to be inaccurate. In this case, a simplified estimation or a qualitative assessment of the category's likely share in total emissions and its trends might be sufficient.* *Example: Emissions from this category have been increasing steadily over the last 5 years and had a share of 15% of total GHG emissions (without FOLU) in the 2014 inventory submission.*			

Table A4:Methodology

Greenhouse gas: *Record the specific gas or gases to which the below methodology relates. Example: CH_4*	
Equation and parameters: *Present the equation for the estimation of emissions/removals under this category and describe variables and describe its key parameters. Where several equations apply or equations are complex, a reference to the source complemented by any relevant assumptions about its application will suffice. Example: First order decay model as in Equation 3.1 of Chapter 3 of Volume 5 (Waste) of the 2006 IPCC Guidelines using default activity data and default parameters. Assumptions: No CH_4 capture takes place.*	
Reference: *List the source of the equation, including full title, chapter, and page number/equation number. Example: Equation 3.1 of Chapter 3 of Volume 5 (Waste) of the 2006 IPCC Guidelines.*[32]	
How and why this method was chosen: *Describe why this methodology is most appropriate for your country and how it was chosen. Appropriateness should be based on the IPCC decision trees, including considerations like data availability and cost-effectiveness. Describe the institutions/departments involved in the choice. Example: There is very little information on historical waste disposal amounts and waste composition available, therefore, a Tier 1 approach was chosen, allowing the use of default factors.*	
Known limitations**:** *Describe any known limitations to the methodology. Example: Using a Tier 1 approach will not allow accurate estimation of CH_4 generation from historical or current waste disposal.*	

Table A5: Waste collection data template

Waste Collection Data Template				
Household Collection				
Province/Town:				
1. What is the waste collection service coverage?				
Area of jurisdiction:		Population:_____	Waste Generation Rate:____	
Collected by	**% of Total Population**	**Frequency of Collection**	**Volume of waste (tons)**	**Percentage**
The Department				
Contractor				

[32] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf

No collection service				

2. Amount of waste collected?	
Type of Waste	**Estimated Recycling Rate (%)**
Municipal Solid Waste	
Hazardous waste	
Industrial	
Sludge	
Other waste	
Are the Rubbish segregated into?	
Waste characterisation	**Percentage**
1. paper & textile	
2.Garden	
3. food waste	
4. wood and straw waste	
5. Park and other organic putrescibles	
3. Disposal Method?	
Name of Disposal Site:	
Total Area:	
Year when disposal started:	
Estimated life span remaining (Year):	
Is there a functional weighbridge at the site?	Y or N
Amount of waste deposited daily (Tonne/day):	
Disposal method:	
Open dumping:	
Managed/unmanaged:	

Table A6: Town Council waste record template

Town Council Waste Record									
Year									
Solid waste disposal name									
Year	**Total Municipal solid waste (MSW) generated (ton)**	**Fraction of MSW disposed to solid waste disposal sites**	**Disposal Site (managed aerobic/anaerobic, semi-aerobic, unmanaged (deep/shallow)/uncategorised)**	**Waste characterisation**					**Amount of methane recovered?**
				% paper & textile	**% Garden**	**% food waste**	**% wood and straw waste**	**Park and other organic putrescible**	

Table A7:Emission factors/carbon stock change factors (EF/SCF) general information, values, and QA/QC

Type of EF/SCF: *Record a descriptive title for the EF/SCF.*								
Reporting unit: *This should be the unit in which the EF/SCF is reported for estimating emissions/removals.*								
Appropriateness to national circumstances: *State how this specific EF/SCF was chosen.*								
Time series covered: *Record the years for which the EF/SCF is available.*								
Reference (if applicable): *If the EF/SCF is from a publication, record the full reference.*								
Date of provision: *Record the date of receipt of the EF/SCF.*								
Source of EF/SCF: *Record the source of the EF/SCF, e.g., the institution and department that provided it.*								
Contact details: *Record the name, email address, and phone number of the contact person at the entity which provided the EF/SCF.*								
EF/SCF values: *Extend or modify the years as necessary to cover your time series.*								
1990	1991	1992	1993	1994	1995	1996	1997	1998
1999	2000	2001	2002	2003	2004	2005	2006	2007
2008	2009	2010	2011	2012	2013	2014	2015	2016
2017	2018	2019	[insert as needed]					
The EF/SCF values in the rows above are derived from the files listed here:				*List all files from which the EF/SCF values above come, and indicate where these files are located, and whom to contact in order to access these files.*				
Quality control measures *Indicate in the following rows what QC measures you have applied to the EF/SCF values indicated above. Add additional rows if you need to describe additional QC activities.*								

For suggestions about quality control activities, see chapter six of volume 1 of the 2006 IPCC Guidelines.[33] Before adding any additional QC measures, refer to Template 4. QA/QC. In case of data gaps or problems with time series consistency, refer to chapter five of volume 1 of the 2006 IPCC Guidelines.[34]	
Comparison to IPCC default factor: *If not using an IPCC default factor, compare the EF/SCF to the 2006 IPCC Guidelines default factor, and explain any differences.*	
Are all data entered correctly into models, spreadsheets, etc.? *Record Yes or No. If No, describe the corrective actions taken.*	

Table A8: Improvement options related to methodologies and data

Improvement No.	**Category sector**	**Category code and name**	**Key category in the previous GHG inventory: *Record Yes or No***	**Relevant GHG inventory principle**	**Potential Improvement**
1.	Waste	4A Solid Waste Disposal	Yes	Accuracy, Completeness	Conduct nationwide waste audits to improve data granularity, particularly in rural.
2.	Waste	4A Solid Waste Disposal	Yes	Comparability	Partner with academic institutions to perform real-time waste characterisation studies for better parameters.
3.	Waste	4A Solid Waste Disposal	Yes	Transparency, Consistency	Establish a centralised digital database integrating data from municipalities, private contractors, and field surveys.
4.	Waste	4A Solid Waste Disposal	Yes	Consistency, Accuracy	Develop and implement region-specific emission factors and adopt Tier 2/Tier 3 methodologies.

[33] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf
[34] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_5_Ch5_Timeseries.pdf

Improvement No.	Category sector	Category code and name	Key category in the previous GHG inventory: *Record Yes or No*	Relevant GHG inventory principle	Potential Improvement
5.	Waste	4A Solid Waste Disposal	Yes	Transparency, Completeness	Install smart sensors and IoT systems for real-time landfill gas and leachate monitoring.
6.	Waste	4A Solid Waste Disposal	Yes	Completeness, Comparability	Conduct training programs on IPCC methodologies for waste sector personnel to improve reporting quality.
7.	Waste	4A Solid Waste Disposal	Yes	Transparency, Accuracy	Establish a Fiji Digital Transparency Tool to track KPIs and ensure consistency in reporting practices.
8.	Waste	4A Solid Waste Disposal	Yes	Accuracy, Completeness	Install automated weighbridge systems at major landfill sites to standardise and improve data accuracy.

Table A9: QA/QC Personnel Responsible for QA/QC Activities

Role	QA/QC Responsibility	Name	Organisation	Contact Information
National Inventory Coordinator	All aspects of the inventory program, cross-cutting QA/QC	TBC	Climate Change Division	TBC
QA/QC Coordinator	Develop and implement the overall QA/QC plan	TBC	Climate Change Division	TBC
Sector or Category Lead(s)	Develop and implement general, sector-specific (as appropriate) and/or category-specific (as appropriate) QA/QC procedures. Focus on Key Categories	TBC	Department of Environment	TBC

Role	QA/QC Responsibility	Name	Organisation	Contact Information
Outside Expert(s)	Expert review of the inventory. Ensure the role of the expert is carefully defined and agreed upon. The expert can be within the country or an international expert.	TBC	National or International	TBC

Table A10: QA/QC plan distribution timeline

Task	Timeline (when the task will occur)	Outcome (description of the results of the task)	Potential Improvements (how the task may be modified to produce a better outcome)
Create (or update) the QA/QC plan	Within 1-2 months	A comprehensive QA/QC plan tailored to Fiji's national inventory requirements for solid waste disposal, ensuring adherence to IPCC guidelines and addressing data quality and consistency issues.	Engage sector experts (e.g., waste management specialists, local councils) early to gather feedback and ensure the plan is practical and context-specific. Use iterative stakeholder reviews.
Identify the best way to distribute the plan to each team member or external expert	2 weeks after the plan is finalised	A clearly defined distribution strategy that ensures all relevant stakeholders (e.g., Climate Change Division, municipal councils) have access to and understand the QA/QC plan.	Use digital and physical formats for accessibility, and conduct a briefing or workshop for stakeholders to clarify roles and resolve potential misunderstandings.
Distribute the QA/QC plan	1 week after the distribution strategy is defined	The QA/QC plan is shared with all team members, sector leads, and external experts involved in solid waste management reporting, ensuring alignment on QA/QC procedures.	Monitor receipt and acknowledgement of the plan. Incorporate a feedback mechanism (e.g., a survey) to identify areas of confusion or need for further clarification.

Table A11: General QC Activities

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
Data Gathering, Input, and Handling Checks					
Check that assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters are documented.	• Cross check descriptions of activity data and emission factors with information on categories and ensure that these are properly recorded and archived. • Record if there are multiple sources of the same activity data, and if possible document the reasons for any differences.				
Check for transcription errors in data input and references	• Confirm that bibliographical data references are properly cited in the internal documentation (see completed Template 3, Methods and Data Documentation, if applicable). • Cross check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors. Record the findings of these cross checks. Pay particular attention to systematic differences. Identify steps to reduce the error rate in the				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
	future. Add these improvement steps to the QA/QC development plan. • Utilize electronic data where possible to minimize transcription errors. • Check that spreadsheet features are used to minimize user/entry error:[35] o Do not "hardwire" factors into formulas. o Create automatic look-up tables for common values used throughout calculations. o Use cell protection so fixed data cannot accidentally be changed. o Build in automated checks, such as computational checks for calculations, or range checks for input data, mass balance checks, internal consistency checks				

[35] The guidance at https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc may prove useful

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
	within and between spreadsheets. ○ Ensure spreadsheets have clear instructions for updating and a description of how the spreadsheet works. ○ Ensure spreadsheets include a record of how they have been implemented and checked.				
Check that emissions/removals are calculated correctly	• Reproduce a representative sample of emissions/removals calculations. • If higher-tier methods or models are used, selectively reproduce complex model calculations with abbreviated calculations to judge relative accuracy. This could be done using IPCC Tier 1 methods. • In all cases, record the work done and the findings. Record any improvements identified (in the appropriate Templates, if applicable).				
Check that parameter	• Check that units are properly labeled in				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
and emission/removal units are correctly recorded and that appropriate conversion factors are used	calculation sheets and the completed Template 3, Methods and Data Documentation, if applicable. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment factors are used correctly.				
Check the integrity of database files	• Confirm that the appropriate data processing steps are correctly represented in the database. • Confirm that data relationships are correctly represented in the database. • Ensure that data fields are properly labeled and have the correct design specifications. • Ensure that adequate documentation of database and model structure and operation are archived.				
Check for consistency in data	• Identify parameters (e.g., activity data, constants) that are common to multiple categories and				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
between categories	confirm that there is consistency in the values used for these parameters in the emissions/removals calculations. • If using Excel, establish a "master set" of constants that all spreadsheets refer to rather than a set of constants in each spreadsheet.				
Check that the movement of inventory data among processing steps is correct	• Check that emissions/removals data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emissions/removals data are correctly transcribed between different intermediate products.				
Check that confidential data are appropriately protected	• Check that only the GHG inventory compilation team can handle/access confidential data. • Check that such data are reported in compliance with requirements agreed on with the data source (if applicable).				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
Check that uncertainties in emissions and removals are estimated and calculated correctly.	• If using expert judgement, check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate. • Check that qualifications, assumptions and expert judgements are recorded. • Check that calculated uncertainties are complete and calculated correctly. • If necessary, duplicate uncertainty calculations on a small sample of the probability distributions used by Monte Carlo analyses (for example, using uncertainty calculations according to Approach 1).				
Data Documentation					
Review internal documentation and archiving	• Check that there is detailed internal documentation to support the estimates and enable duplication of calculations, using completed Template 3, Methods and Data Documentation, if applicable. • Check that every primary data element has a				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
	reference for the source of the data (via cell comments or another system of notation). • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check that the archive is closed and retained securely following completion of the inventory. • Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.				
Calculation Checks					
Check methodological and data changes resulting in recalculations	• Check for temporal consistency in time series input data for each category. • Check for consistency in the algorithm/method used for calculations throughout the time series. • Reproduce a representative sample of emission/removal calculations to ensure mathematical correctness.				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
Check time series consistency	• Check for temporal consistency in time series input data for each category. • Check for consistency in the algorithm/method used for calculations throughout the time series. • Check methodological and data changes resulting in recalculations. • Check that the effects of mitigation activities have been appropriately reflected in time series calculations. Higher IPCC methodologies might be needed to accurately capture the effects of mitigation activities				
Check completeness	• Confirm that estimates are reported for all categories and for all years from the appropriate base year over the period of the current inventory. • For subcategories, confirm that the entire category is being covered. • Confirm that if an emissions or removal estimate is omitted for				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
	any given category, documentation to explain or clarify the omission is included, and notation keys are used for that category. (This may include categories that were also omitted from the previous inventory.) • Provide clear definitions of "Other" type categories. • Check that known data gaps that result in incomplete category emissions/removals estimates are documented, including qualitative evaluation of the importance of the estimate in relation to total net emissions (e.g., subcategories classified as "not estimated").				
Trend checks	• For each category, compare current inventory estimates to previous estimates, if available (e.g., archived Template 2). If there are significant changes or departures from expected trends, re-check estimates and explain any differences. Significant changes in emissions or removals				

QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
	from previous years may indicate possible input or calculation errors. • Check value of implied emission factors (aggregate emissions/removals divided by activity data) across time series to confirm that changes in emissions or removals are being reported. • Check if there are any unusual or unexplained trends in activity data or other parameters across the time series.				
Source: The checks identified are from the 2006 IPCC Guidelines for National GHG Inventories.					

Table A12: Category-specific QC Procedures

Category code and name: Note "KC" if it is a key category					
QC Activity	Procedures	Task Completed		Corrective Measure Taken (if applicable)	Supporting Documents
		Name/ Initials	Date		
Emission Factor QC					

Category code and name: Note “KC” if it is a key category					
QC Activity	**Procedures**	**Task Completed**		**Corrective Measure Taken (if applicable)**	**Supporting Documents**
		Name/ Initials	**Date**		
Assess the applicability of IPCC default emission factors	• Evaluate whether national conditions are similar to those used to develop the IPCC default factors. • Compare default factors to site or plant-level factors. • Consider options for obtaining country-specific factors. • Document results of this assessment.				

Review country-specific emission factors	• QC the background data used to develop the country-specific factor to assess adequacy of the emission factors and the QA/QC performed during their development
	  ○ E.g., if based on measurement studies, did measurement program included QC procedures
	  ○ E.g., understand characteristics of data (e.g. completeness, etc.)
	• Assess whether secondary studies used to develop country-specific factors used (at a minimum) general QC activities.
	• Compare country-specific factors to IPCC defaults; document any significant discrepancies.
	• Compare country-specific factors to site or plant-level factors.
	• Compare to factors from other countries (using UNFCCC review tools, reported factors in inventory submissions, and/or IPCC Emission Factor Database).
	• Conduct reference calculations that use stoichiometric ratios and conservation of mass and land.
	• Document results of this assessment.				

Category code and name: Note “KC” if it is a key category					
QC Activity	**Procedures**	**Task Completed**		**Corrective Measure Taken (if applicable)**	**Supporting Documents**
		Name/ Initials	**Date**		
Review measurements	• Determine if national or international (e.g., ISO) standards were used in measurements. • Ensure measurement equipment is calibrated and maintained properly. • Compare direct measurements with IPCC or other published default factors; document any significant discrepancies.				
Activity Data QC					
Review national-level activity data	• Determine the level of QC performed by the data collection agency. If inadequate, consider alternative data sources such as IPCC defaults and international activity data sets (e.g., IEA, FAO). Adjust the relevant uncertainty accordingly. • Compare activity data from multiple references (e.g., other independently compiled data) if possible (e.g., IEA, FAO, etc.), including data time series				

Category code and name: Note “KC” if it is a key category					
QC Activity	**Procedures**	**Task Completed**		**Corrective Measure Taken (if applicable)**	**Supporting Documents**
		Name/ Initials	**Date**		
Review site-specific activity data	• Determine if national or international (e.g., ISO) standards were used in collecting or generating data. • Compare aggregated site-specific data (e.g., production) to national statistics/data. • Compare data across similar sites. • Compare top-down and bottom-up estimates for similar orders of magnitude.				

Trend checks of activity data	• Compare data to previous year’s data and review any sharp increases or decreases.
	  ○ If national activity data for any year diverge greatly from the historical trend, they should be checked for errors.
	  ○ If a calculation error is not detected, the reason for the sharp change in activity should be confirmed and documented.				

Category code and name: Note “KC” if it is a key category					
QC Activity	**Procedures**	**Task Completed**		**Corrective Measure Taken (if applicable)**	**Supporting Documents**
		Name/ Initials	**Date**		
QC uncertainty estimates	• Apply QC techniques to uncertainty estimates. • Review uncertainty calculations. • Document uncertainty assumptions and qualifications of any experts consulted.				
GHG Estimate QC/Verification					
Verify GHG estimates	• Compare estimates to other independently compiled national estimates as available. • If using higher-tier methods or models, apply lower-tier methods (e.g., Energy sector comparison of reference and sectoral approach). • Compare intensity indicators between countries • Document, report, and archive verification findings and any further actions (e.g., additional QC, improvement plans).				

Table A13: External Reviewers

Name	Organisation	Area of Expertise	Contact Information	Date Comments Received	Comment Summary

Table A14: Potential Improvements to the GHG inventory

Topic	Category Code and Name	Issue	Relevant Inventory Quality Principle	Improvement Option
Data Collection Systems	4.A Solid Waste Disposal on Land	Limited data availability and inconsistencies, particularly from rural and informal settlements	Transparency, Completeness	Conduct nationwide waste audits; establish a centralised digital database; develop automated weighbridge systems; partner with academic institutions for region-specific parameters.
Policy Adherence	Cross-cutting	Weak enforcement mechanisms and lack of inter-agency coordination	Consistency, Comparability	Establish a National Waste Management Taskforce; implement performance-based incentives; update and strengthen relevant legislation.
Addressing Data Gaps	4.A Solid Waste Disposal on Land	Reliance on default IPCC values, causing high uncertainty in emissions calculations	Accuracy, Completeness	Develop country-specific emission factors; adopt Tier 2 and Tier 3 methodologies; collect region-specific waste activity data.
Capacity Building	Cross-cutting	Limited technical capacity affects data collection and	Transparency, Accuracy	Conduct training programs on IPCC methodologies; establish a Waste Management

Topic	Category Code and Name	Issue	Relevant Inventory Quality Principle	Improvement Option
		emissions reporting.		Training Center; collaborate with local universities for capacity building.
Advanced Technologies	4.A Solid Waste Disposal on Land	Inadequate waste management infrastructure for advanced monitoring and reporting systems	Accuracy, Completeness	Implement IoT solutions and remote sensing technologies; pilot waste-to-energy projects; invest in smart sensors for landfill monitoring.
Public Engagement	Cross-cutting	Low public awareness and participation in waste management	Transparency, Completeness	Launch education programs; establish community waste management committees; introduce financial incentives for source segregation and recycling participation.
Monitoring and Evaluation	4.A Solid Waste Disposal on Land	Lack of tools for continuous oversight of emissions and waste management	Transparency, Accuracy, Completeness	Develop a National GHG Emissions Monitoring Platform; establish KPIs for waste management; conduct annual third-party audits.

Table A15: QA/QC Coordinator Checklist

Activities	Task Completed	
	Name	Date
1. Clarify and communicate QA/QC responsibilities to inventory team members.		
2. Develop and QA/QC checklists appropriate to roles on the inventory team. (See Table 4-2 and Table 4-3 in the "QA/QC Procedures" Template for examples)		
3. Distribute QA/QC checklist to appropriate inventory team members and set deadline for completion.		
4. Ensure the timely and accurate completion of QA/QC checklists and related activities by checking in with team members.		

Activities	Task Completed	
	Name	Date
5. Collect completed QA/QC checklists and forms.		
6. Review completed QA/QC checklists and forms for completeness and accuracy.		
7. Deliver documentation of QA/QC activities to the inventory lead and archive coordinator.		
8. Coordinate external reviews of the inventory document and ensure that comments are incorporated into the inventory. Steps to coordinating external reviewers include: i. Identify external reviewers (e.g. through category leads). ii. Set review schedule. iii. Establish review format (e.g., digital markup in Word or Excel). iv. Contact external reviewers, informing them of the schedule and expectations. v. Work with NIC to distribute the Inventory draft for review. vi. Collect and compile review comments. vii. Deliver compiled comments to national inventory and sector leads to address. viii. Update inventory, as appropriate, based on comments. ix. Deliver compiled comments and responses to the archive coordinator to retain for reference.		

Table A16: National Inventory Coordinator (NIC) Checklist: Crosscutting Checks for Overall Inventory Quality

Activities	Task Completed	
	Name	Date
Emission Calculations Across GHG Emission and Removal Categories		
1. Identify parameters that are common across categories (e.g. conversion factors, carbon content coefficients, etc.) and check for consistency		
2. Check that calculations using the same data inputs (e.g. animal population data) report comparable values (i.e., analogous in magnitude)		
3. Check across categories to ensure that the same electronic data set is used for common data (e.g., linking		

Activities	Task Completed	
	Name	Date
animal population data to both enteric fermentation and manure management calculations)		
4. Check that the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across categories		
5. Check that total emissions are reported consistently (in terms of significant digits or decimal places) across categories		
6. Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels		
7. Other (specify):		
Documentation		
8. Check if internal documentation practices are consistent across categories		
9. Other (specify):		
Completeness		
10. Check for completeness across categories and years		
11. Check that data gaps are identified and reported as required		
12. Compare current national inventory estimates with previous years'		
13. Other (specify):		
Maintaining Master Inventory File: Spreadsheets and Inventory Document		
14. Follow file control procedures		
15. Other (specify):		

Table A17:National Inventory Coordinator (NIC) Checklist: Detailed Checklist for Inventory Document

Activities	Task Completed	
	Name	Date
Front Section		
1. Cover page has the correct date, title, and contact address		
2. Tables of contents, tables, and figures are accurate: titles match the document, page numbers match; numbers run consecutively and have correct punctuation		
3. The Executive Summary and Introduction are updated with appropriate years and a discussion of trends		
4. Other (specify):		
Tables and Figures		

Activities	Task Completed	
	Name	Date
5. All numbers in tables match numbers in spreadsheets		
6. Check that all tables have the correct number of significant digits		
7. Check alignment in columns and labels		
8. Check that table formatting is consistent		
9. Check that all figures are updated with new data and referenced in the text		
10. Check table and figure titles for accuracy and consistency with content		
11. Other (specify):		
Equations		
12. Check for consistency in equations		
13. Check that variables used in equations are defined following the equation		
14. Other (specify):		
References		
15. Check consistency of references, and that citations in text and references match		
16. Other (specify):		
General Format		
17. All acronyms are spelled out first time and not subsequent times throughout each chapter		
18. All fonts in text, headings, titles, and subheadings are consistent		
19. All highlighting, notes, and comments are removed from the document		
20. Size, style, and indenting of bullets are consistent		
21. Spell check is complete		
22. Other (specify):		
Other Issues		
23. Check that each section is updated with the current year (or the most recent year that the inventory report includes)		
24. Other (specify):		

Table A18: Key Categories Based on Contribution to Total National Emissions

IPCC Category Code	IPCC Category	Gas	Current Year Emissions (Gg CO_2 Eq.)	Contribution to National Emissions	Cumulative Per Cent of National Emissions

Table A19: Key Categories Based on Contribution to Total National Emissions in Base Year

IPCC Category Code	IPCC Category	Gas	Base Year Emissions (Gg CO_2 Eq.)	Contribution to National Emissions	Cumulative Per Cent of National Emissions

Table A20: Key Categories Based on Contribution to Overall Trend in National Net Emissions

IPCC Category Code	IPCC Category	Gas	Base Year Emissions (Gg CO_2 Eq.)	Current Year Emissions (Gg CO_2 Eq.)	Contribution to Trend	Cumulative Contribution to Trend

Table A21: Key Categories Based on Contribution to Total National Emissions with Uncertainty

IPCC Category Code	IPCC Category	Gas	Level Assessment	Relative Level Assessment	Cumulative Per Cent of National Emissions

Table A22: Key Categories Based on Contribution to Total National Emissions with Uncertainty in Base Year

IPCC Category Code	IPCC Category	Gas	Level Assessment	Relative Level Assessment	Cumulative Per Cent of National Emissions

Table A23: Key Categories Based on Contribution to Overall Trend in National Net Emissions with Uncertainty

IPCC Category Code	IPCC Category	Gas	Trend Assessment with Uncertainty	Relative Trend Assessment with Uncertainty	Cumulative Per Cent of National Emissions

Table A24: Key Categories Identified Using Qualitative Criteria

IPCC Category Code	IPCC Category	Gas	Criteria
			e.g. completeness

Table A25: Improvements to the GHG inventory

Improvement #	Sector	Source Category and IPCC Tier Used	Potential Improvement	Steps Needed to Implement This Improvement
1				
2				

Table A26: Assessment questions

Example Assessment Questions	**Assessment Findings and Comments**
Is there an archiving system from previous compilation cycles, or are archiving procedures documented in any other way?	[Enter Text]

Example Assessment Questions	**Assessment Findings and Comments**
Where is previous GHG inventory compilation material stored and in which format (e.g., electronically, on paper)?	
Who has access to archives from previous GHG inventories?	
Which documents were archived?	
Were both drafts and final versions archived? If so, at which points in the GHG inventory compilation cycle were drafts archived?	
For categories with recalculations due to methodological changes or refinements, where are the data sources and references for both the past and the new methodologies, and the documentation of time series consistency archived?	
If there is an archiving system, was its implementation tracked (e.g., using a checklist or spreadsheet)?	
If files were archived electronically, was a folder structure used to enable easy access to the documents? If so, describe the structure.	
Was a naming convention for files used (e.g., to indicate sectors, categories, status, type of document, version or date, or responsible staff)? If so, describe the convention used.	

Table A27: Materials to be archived

Materials to be archived	**Staff from whom the materials should be obtained**	**Point in time at which the materials should be archived**
1. Institutional Arrangements (Template 2) **Example: NIC; At the beginning of the inventory compilation cycle**	[Enter text]	
2. Inventory compilation plan (Template 1, Inception Memorandum supporting template) **Example: NIC; At the end of the inventory compilation cycle**		

Materials to be archived	Staff from whom the materials should be obtained	Point in time at which the materials should be archived
3. Methods and Data Documentation (Template 3) Example: Sector/Category Leads; At the beginning and at the end of the inventory compilation cycle		
4. Any files used for calculations and recalculations (e.g., spreadsheets, models) Example: Sector/Category Leads; At the end of the inventory compilation cycle		
5. Uncertainty assessment files (category-level and overall) Example: Sector/Category Leads, NIC; At the end of the inventory compilation cycle		
6. QA/QC Procedures (Template 4) Example: NIC; At the end of the inventory compilation cycle		
7. Results of QC processes (Template 4) Example: Sector/Category Leads; At the end of the inventory compilation cycle		
8. Key Category Analysis (Template 5) Example: NIC; At the end of the inventory compilation cycle		
9. Draft and final versions of the inventory report Example: NIC; After each version of the report is compiled		
10. Internal and external review comments and responses Example: NIC; At the end of the inventory compilation cycle		

Materials to be archived	Staff from whom the materials should be obtained	Point in time at which the materials should be archived
11. Archiving System (Template 6) **Example: Archiving Coordinator; At the end of the inventory compilation cycle**		
12. National Inventory Improvement Plan (Template 7) **Example: NIC; At the end of the inventory compilation cycle**		
13. Contacts and contact information for data sources **Example: Sector/Category Leads; At the end of the inventory compilation cycle**		
14. Communication with data sources and the data obtained **Example: Sector/Category Leads; At the end of the inventory compilation cycle**		
15. Decision-making documents related to the compilation process (e.g., minutes of meetings of the GHG inventory compilers, email communication, minutes of phone communication, any documentation of official consideration and approval processes that precede submission to the UNFCCC) **Example: NIC and Sector/Category Leads; Whenever communication has taken place**		

Table A28: Improvements to the Archiving System

Improvement Number	Issue	Improvement Option	Implementation Action
1	[Enter Text]		
2			
3			

Table A29: Checklist: Archive Activities, Responsibilities, and Schedule

Activity	Due Date	Activity Completed	
		Completed by (name)	Date
Archiving Coordinator			
Create official archive, backup, and access requirements	[Enter Date]	[Enter Text]	
Generate folder structure and naming convention.			
Update the archiving system and deadlines.			
Convey archive structure, naming convention, access, and archiving system to inventory compilers			
Collect and archive documents describing institutional arrangements (Template 2)			
Collect and archive documents describing methods and data collected (Template 3)			
Collect and archive the inventory compilation plan (Template 1, *National GHG Inventory Inception Memorandum* supporting template)			
Collect and archive any files used for calculation or recalculations (e.g., data from IPCC Inventory Software, spreadsheets, models)			
Collect and archive any files used for assessing uncertainty of the Inventory estimates overall and at the category level (e.g., spreadsheets, data from IPCC Inventory Software)			

Activity	Due Date	Activity Completed	
		Completed by (name)	Date
Collect and archive the QA/QC plan and results of QA/QC assessments (Template 4)			
Collect and archive results of QC processes (Template 4)			
Collect and archive the key category analysis (Template 5)			
Collect and archive drafts and final versions of the inventory report			
Collect and archive external review comments and responses.			
Archive documentation of the archiving system (Template 6)			
Collect and archive the national inventory improvement plan (Template 7)			
Collect and archive contacts and contact information for data sources.			
Collect and archive communication with data sources and the data obtained.			
Collect and archive documents indicating decision-making related to the compilation process (e.g., minutes of meetings of the GHG inventory compilers, email correspondence)			

Table A30: Improvement options

Number	Key Category (yes/no)	Category Code and Name	Issue	Improvement Option	Priority of Improvement	Timing of Improvement	Additional Information Needed for Improvement
1	[Enter Text]						
2							
3							
4							
5							

6							
7							
8							
9							

Table A31: Potential high-priority projects for improving the national GHG inventory

Number (from Table 7-1)	Estimated Staff Time (workdays)	Estimated Cost for Services (local currency)	Estimated Cost of Equipment (local currency)	Reference to Further Information	Responsible Staff
[Enter Text]					

Table A32: Expert Judgment Template

Documentation Of Expert Judgement[36]	
Reference number for judgment:	
Date :	
Name of expert(s) involved:	
Experts' professional background: ▪ Academic qualifications: ▪ Professional certifications: ▪ Relevant experience: ▪ Previous similar assessments	
Expert Professional References: ▪ Key publications: ▪ Professional affiliations: ▪ Relevant project experience:	
Experts' Roles and Responsibility: ▪ Specific role in this assessment: ▪ Areas of expertise applied:	

[36] Adopted from Volume 1, Chapter 2, IPCC 2006 Guideline and chaged to suit country needs

Documentation Of Expert Judgement[36]	
Independence Statement: Declaration of any potential conflicts of interest or confirmation of independence	
The quantity being judged.	
***The logical basis* for judgement, including any data taken into consideration. This should include the rationale for any uncertainty distribution's high-end, low-end, and central tendency.**	
***Information Sources*:** ▪ Literature reviewed: ▪ Data considered: ▪ Other expert consultations:	
***The result*: e.g., activity value, emission factor or for uncertainty, the probability distribution, or the range and most likely value and the probability distribution subsequently inferred**	
***Assumptions*: List key assumptions made in forming the judgement**	
Identification of *any external reviewers*	
Results of any external review	
Expert Signature: ***Date:***	
Additional notes: ***Any other relevant information or special considerations:***	

10.2 Contact Information for Support

Key organisations providing technical support:

- National Contacts:
  - Department of Environment
  - Climate Change Division
  - Waste Management Unit

- Regional Support:
  - SPREP - Pacific Regional Environment Programme
  - Pacific NDC Hub
  - J-PRISM II Technical Support Team

- International Support:
  - UNFCCC Secretariat
  - IPCC Technical Support Unit
  - World Bank Technical Assistance

- ADB Pacific Department