Report on the overview of the National Climate Change (CC) MRV Platform under ICAT-Belize Phase 2

NCCO NATIONAL CLIMATE CHANGE OFFICE

eData™

ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency - ICAT

Deliverable #5

AUTHORS

Juan Carlos Namis
eData

Kamil Salazar
National Climate Change Office
Ministry of Sustainable Development and Climate Change

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Introduction

In 2019, the country began working with ICAT through a partnership with the National Climate Change Office (NCCO) focusing on enhancing capacities to assess impacts of policies, NDC tracking and institutional arrangements for transparency of climate change. In 2020 to 2022, Belize completed a phase 1 project under ICAT. The following outcomes were achieved in this initial ICAT project:

- Reporting requirements for climate change at international and national level were mapped and integrated into national MRV systems
- Institutional arrangements for data and information reporting and sharing within and between the institutions for climate change policies and actions were formalized
- MRV tools and procedures were designed to facilitate reporting
- GHG, Sustainable Development and Transformational Change impact assessment of selected NDC policy/action are performed including the design of a monitoring plan

Belize is currently implementing a second Phase called "Initiative for Climate Action Transparency (ICAT) Belize Phase 2" also through the NCCO under the Ministry of Sustainable Development and Climate Change (MSDCC). The project, also referred to as ICAT-Belize Phase 2 or Phase 2, follows the completion of the Phase 1 project mentioned above. Under this first phase, an online platform was developed to facilitate the tracking of Belize's Nationally Determined Contribution (NDC) to assist in the transition to the Enhanced Transparency Framework (ETF) under the Paris Agreement. The sole purpose of the platform at the time was to assist the NCCO in monitoring the NDC, however, there are several other reporting requirements that Belize must oblige to being a Party to the UNFCCC and Paris Agreement. Therefore, under Phase 2, one of the main outputs aimed to enhance national capacity to monitor and report climate change information more broadly. This is meant to better assist Belize in responding to the transparency requirements of the UNFCCC, while also improving the information and data based on climate action and policies and their impacts, ultimately contributing to improved climate governance.

This deliverable 4, Report on an Overview of the National Online Climate Change (CC) MRV Platform, falls under output 3: "Strengthening national and institutional capacities and tools to support the implementation of the national climate change MRV system developed under ICAT phase 1". Under this output, the technical feasibility of linking different modules from different sources to the main MRV online platform was assessed before proceeding with updating the system. Updates to the system include features such as:

- ❖ Storing greenhouse gas (GHG) data in alignment with the IPCC guidelines
- ❖ Data visualization features on the system
- ❖ Agricultural data analytics by monitoring farmlands
- ❖ An app for data providers to upload data

Each of the features listed above will be further described in the following sections of this report. These features directly support and enhances Belize's capabilities to report climate change information in future Biennial Transparency Reports (BTRs), National Inventory Reports (NIRs) and National Communications (NCs).

System Analysis & Design of a Climate Change MRV System

System analysis

Problem Definition

With the global drive to address climate change, there is a growing need for accurate and verifiable data on GHG emissions. Governments, industries, and international bodies require reliable systems to measure emissions, report progress, and verify the data to meet their climate targets. MRV systems are also essential for tracking progress toward climate goals outlined in agreements like the Paris Agreement.

Requirements Analysis

The system should provide the following:

- Measurement capabilities: Collect data on GHG emissions from various sources such as industries, transportation, agriculture, and deforestation.
- Reporting: Generate standardized reports for different stakeholders, following international standards (e.g., IPCC guidelines).
- Verification: Allow third-party verification to ensure the accuracy and integrity of the data.
- Transparency and Accessibility: Provide public access to certain datasets and dashboards for greater transparency.
- Interoperability: Ability to integrate with other national and international reporting systems.
- Scalability: Should handle growing volumes of data as climate policies evolve and more sectors become accountable for emissions.

System Architecture

The architecture of a system can vary based on type of data collected, available resources and priorities. There are three layers to a system architecture: (i) data collection, (ii) processing and analysis, and (iii) presentation. These are broken down below.

Tier 1: Data Collection Layer

- Typically, sensors and data collection devices can assist to measure GHG emissions from various sources (industries, forests, transportation, etc.). Input data from external databases (satellite data, climate models) can also be another source for this type of data
- Excel data collected from stakeholders or access to the Information systems and data can be captured by a form interface. This is the case for Belize which relies on excel sheets or other databases from different sectors to collect data.

Tier 2: Processing and Analysis Layer

- A data warehouse is required for central storage of raw and processed GHG data. It often requires some form of data processing and analytics engine which would include algorithms to process raw data and calculate emissions, trends, and anomalies.
- Verification tools is also another important factor that uses algorithms or modules to compare reported data with independent measurements and benchmarks.

- Modelling tools is also important and necessary to assess future climate and emissions projections based on different scenarios.
- The system for Belize acts as a data warehouse to store GHG emissions data and can facilitate the verification process that has been established in the country's institutional arrangements. The system does not have any modelling tools at this stage but is something that should be considered for future enhancements.

Tier 3: Presentation Layer

- Reporting tools such as dashboards, visualization, and report generation (standardized formats like CSV, PDFs) is a vital feature needed to present data after reporting and analysis has been completed. The online platform has this feature to allow visualization of the GHG data.
- Public portals can be another form to facilitate this. Public access to certain reports and data is important and therefore should also be considered in future enhancements.

Data Flow

Data flow within the system includes:

- Data Input: The system gathers data from various sources such as excel sheets used by the NCCO or developed within the IPCC software.
- Data Processing: The system processes the raw data to support data visualization through the generation of graphs. The calculation is done outside of this system and inputted after for data management.
- Verification: manual verification processes are conducted to ensure the accuracy of the reported emissions data. This is done through established processes in the NCCO's institutional arrangements.
- Data Output: Results are made available through customizable reports and dashboards for internal stakeholders.

Security and Privacy

The online platform facilitates different levels of security and privacy. There is an administrator that is housed in the National Climate Change Office and accounts are provided for their sector leads that can have different levels of access based on what is assigned by the administrator. The system has the following features that is conducted in the backend.

- Data encryption for transmission and storage.
- Access control to limit data exposure, with different access levels for various stakeholders.
- Audit trails to track any changes or updates to emissions reports.

Scalability

The system should be designed to handle future needs, including:

- More detailed sectoral reporting (e.g., specific industries, transportation types).
- Increased data collection points as more sources are identified or as other data monitoring needs are identified
- Modelling and projection tools
- Growth in the number of reports as additional regions or industries adopt MRV systems.

User Interface Design

The system's interface is user-friendly, allowing for:

- Simple report generation for non-technical users.
- Detailed analysis options for experts.
- Dashboards for policymakers with key indicators such as total emissions by sector, trends over time, and progress toward goals.

Implementation Stage

The system is built using web-based technology such as PHP, MYSQl, Javascript, JQuery, etc. The system captures GHG Inventory from the following sectors: Energy, IPPU, AFOLU, and Waste.

The Online Platform

Belize's National MRV System was developed under the phase 1 project which designed institutional arrangements for data and information reporting and sharing within and between the institutions for climate change actions. It also designed reporting templates for NDC tracking and created an online MRV system to utilize as a repository and point of access for climate change information. The online system allowed the tracking of NDC indicators and allowed relevant institutions to upload information and data needed to facilitate this tracking.

Under Phase 2, the online platform has been updated to store GHG data, to provide data visualization features, to view agriculture farms, and with an app for data providers to upload data. These are further broken down below.

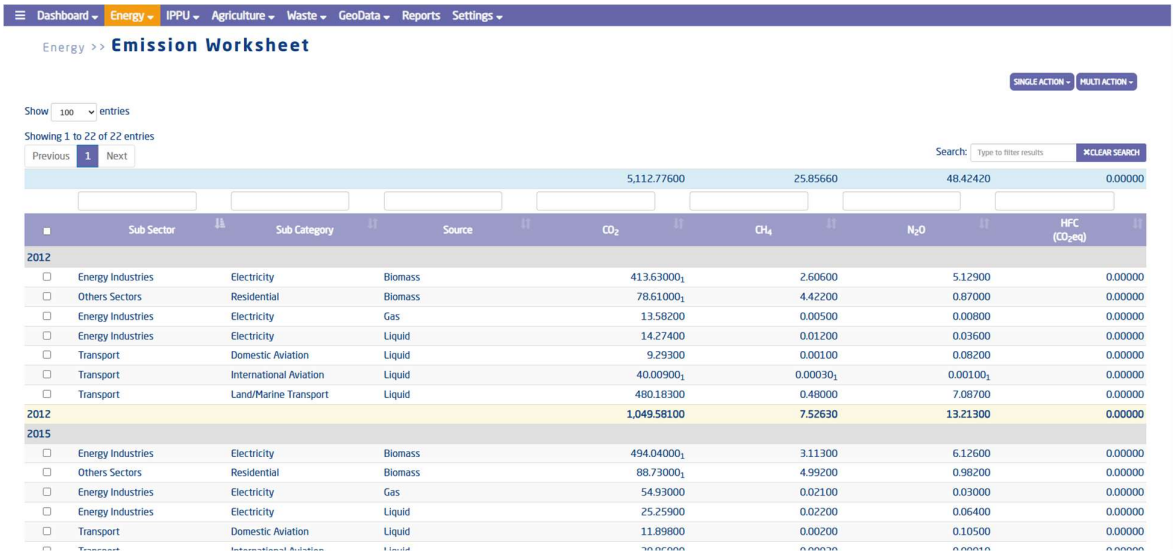
Storing Greenhouse Gas Data

Originally, the update of the online platform would have used the source code from SINAMECC, which is Costa Rica's National Climate Change Metrics System. However, this became unavailable, and the update was revised to simply serve as a repository for emissions data which was still a need identified by the NCCO.

The system has the capability to store sector emission worksheets that provides automatic visualization dashboards based on the provided data. The sectors are Energy, IPPU, Agriculture and Waste. It provides the NCCO with an online central data management system to keep track of, store and monitor the country's GHG emissions. It covers the timeseries of Belize's GHG inventory, which is from 1994 to 2022, aligned with the latest GHG inventory. The NCCO will have the ability to continue updating the system as new inventories are developed in the coming years.

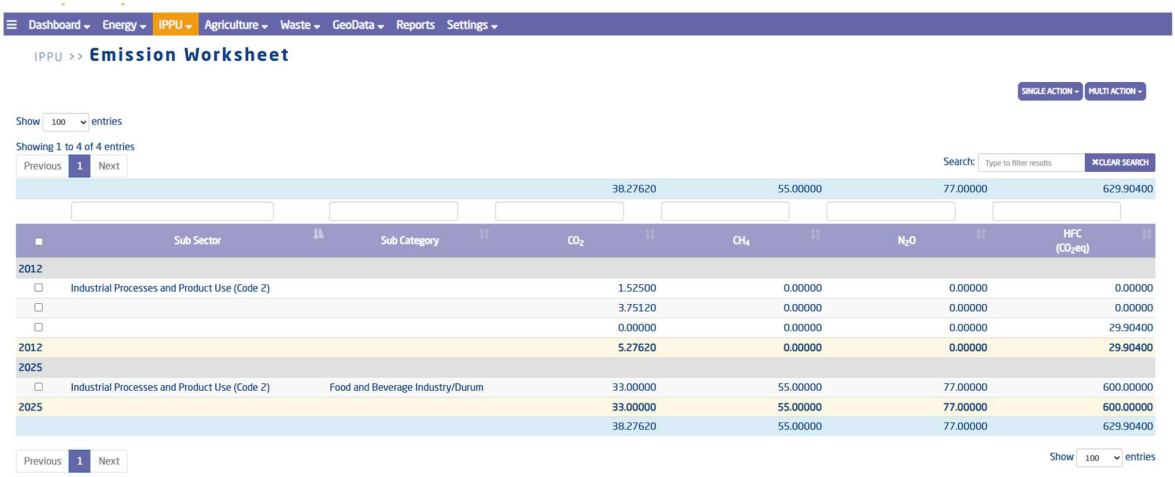
Below are examples of emission worksheets within the system:

Energy



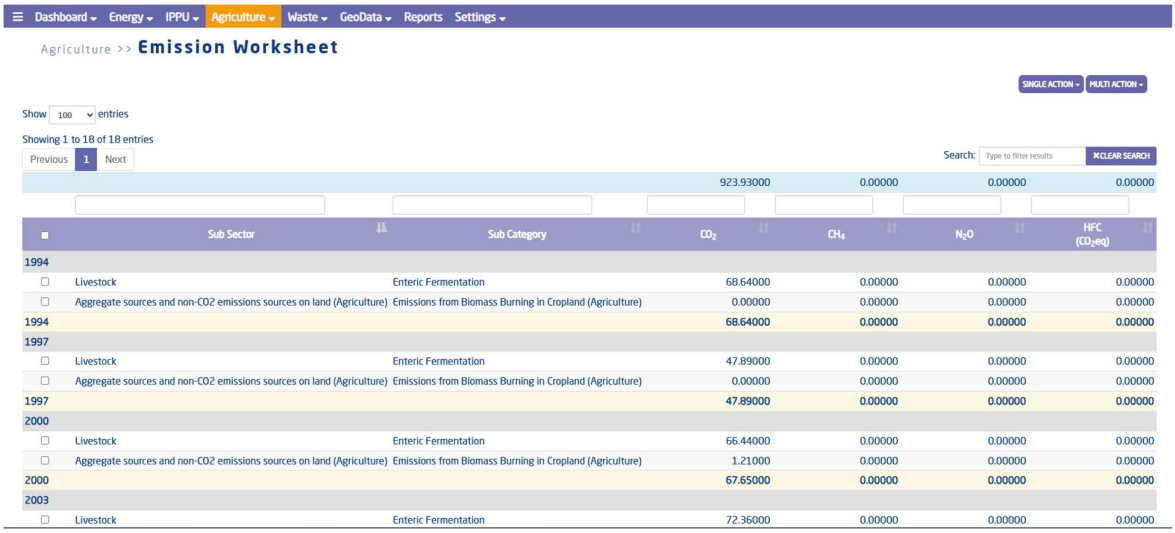
	Sub Sector	Sub Category	Source	CO_2	CH_4	N_2O	HFC (CO_2eq)
				5,112.77600	25.85660	48.42420	0.00000
2012							
	Energy Industries	Electricity	Biomass	413.63000$_1$	2.60600	5.12900	0.00000
	Others Sectors	Residential	Biomass	78.61000$_1$	4.42200	0.87000	0.00000
	Energy Industries	Electricity	Gas	13.58200	0.00500	0.00800	0.00000
	Energy Industries	Electricity	Liquid	14.27400	0.01200	0.03600	0.00000
	Transport	Domestic Aviation	Liquid	9.29300	0.00100	0.08200	0.00000
	Transport	International Aviation	Liquid	40.00900$_1$	0.00030$_1$	0.00100$_1$	0.00000
	Transport	Land/Marine Transport	Liquid	480.18300	0.48000	7.08700	0.00000
2012				1,049.58100	7.52630	13.21300	0.00000
2015							
	Energy Industries	Electricity	Biomass	494.04000$_1$	3.11300	6.12600	0.00000
	Others Sectors	Residential	Biomass	88.73000$_1$	4.99200	0.98200	0.00000
	Energy Industries	Electricity	Gas	54.93000	0.02100	0.03000	0.00000
	Energy Industries	Electricity	Liquid	25.25900	0.02200	0.06400	0.00000
	Transport	Domestic Aviation	Liquid	11.89800	0.00200	0.10500	0.00000

IPPU



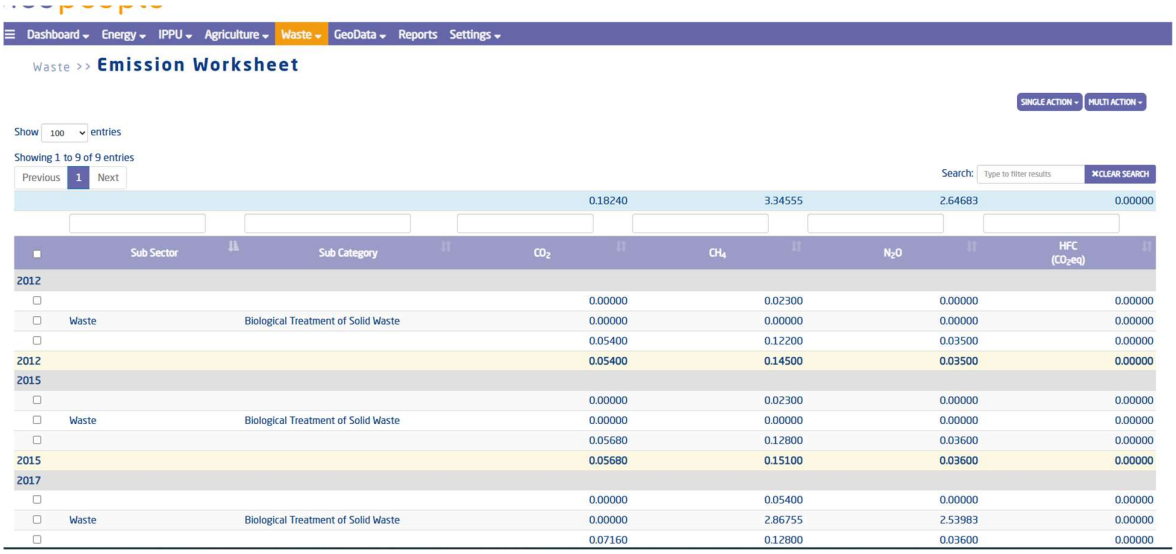
	Sub Sector	Sub Category	CO_2	CH_4	N_2O	HFC (CO_2eq)
			38.27620	55.00000	77.00000	629.90400
2012						
☐	Industrial Processes and Product Use (Code 2)		1.52500	0.00000	0.00000	0.00000
☐			3.75120	0.00000	0.00000	0.00000
☐			0.00000	0.00000	0.00000	29.90400
2012			**5.27620**	**0.00000**	**0.00000**	**29.90400**
2025						
☐	Industrial Processes and Product Use (Code 2)	Food and Beverage Industry/Durum	33.00000	55.00000	77.00000	600.00000
2025			**33.00000**	**55.00000**	**77.00000**	**600.00000**
			38.27620	55.00000	77.00000	629.90400

Agriculture



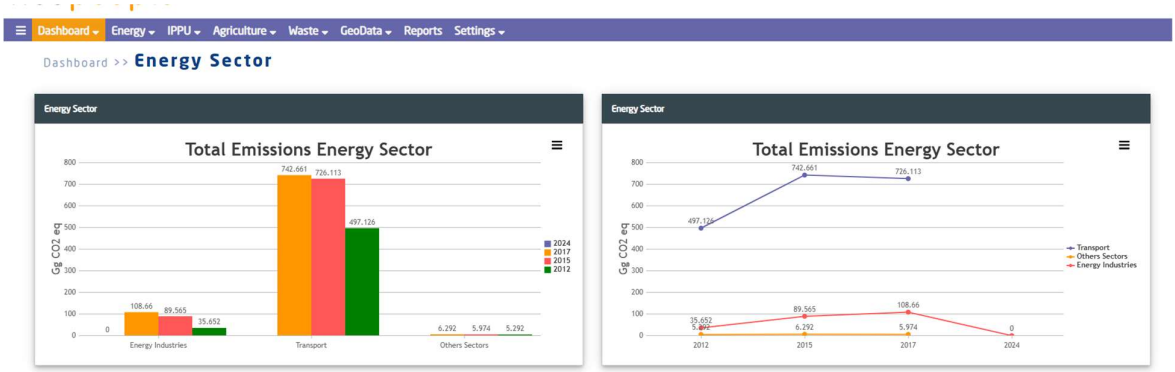
	Sub Sector	Sub Category	CO_2	CH_4	N_2O	HFC (CO_2eq)
			923.93000	0.00000	0.00000	0.00000
1994						
☐	Livestock	Enteric Fermentation	68.64000	0.00000	0.00000	0.00000
☐	Aggregate sources and non-CO2 emissions sources on land (Agriculture)	Emissions from Biomass Burning in Cropland (Agriculture)	0.00000	0.00000	0.00000	0.00000
1994			**68.64000**	**0.00000**	**0.00000**	**0.00000**
1997						
☐	Livestock	Enteric Fermentation	47.89000	0.00000	0.00000	0.00000
☐	Aggregate sources and non-CO2 emissions sources on land (Agriculture)	Emissions from Biomass Burning in Cropland (Agriculture)	0.00000	0.00000	0.00000	0.00000
1997			**47.89000**	**0.00000**	**0.00000**	**0.00000**
2000						
☐	Livestock	Enteric Fermentation	66.44000	0.00000	0.00000	0.00000
☐	Aggregate sources and non-CO2 emissions sources on land (Agriculture)	Emissions from Biomass Burning in Cropland (Agriculture)	1.21000	0.00000	0.00000	0.00000
2000			**67.65000**	**0.00000**	**0.00000**	**0.00000**
2003						
☐	Livestock	Enteric Fermentation	72.36000	0.00000	0.00000	0.00000

Waste



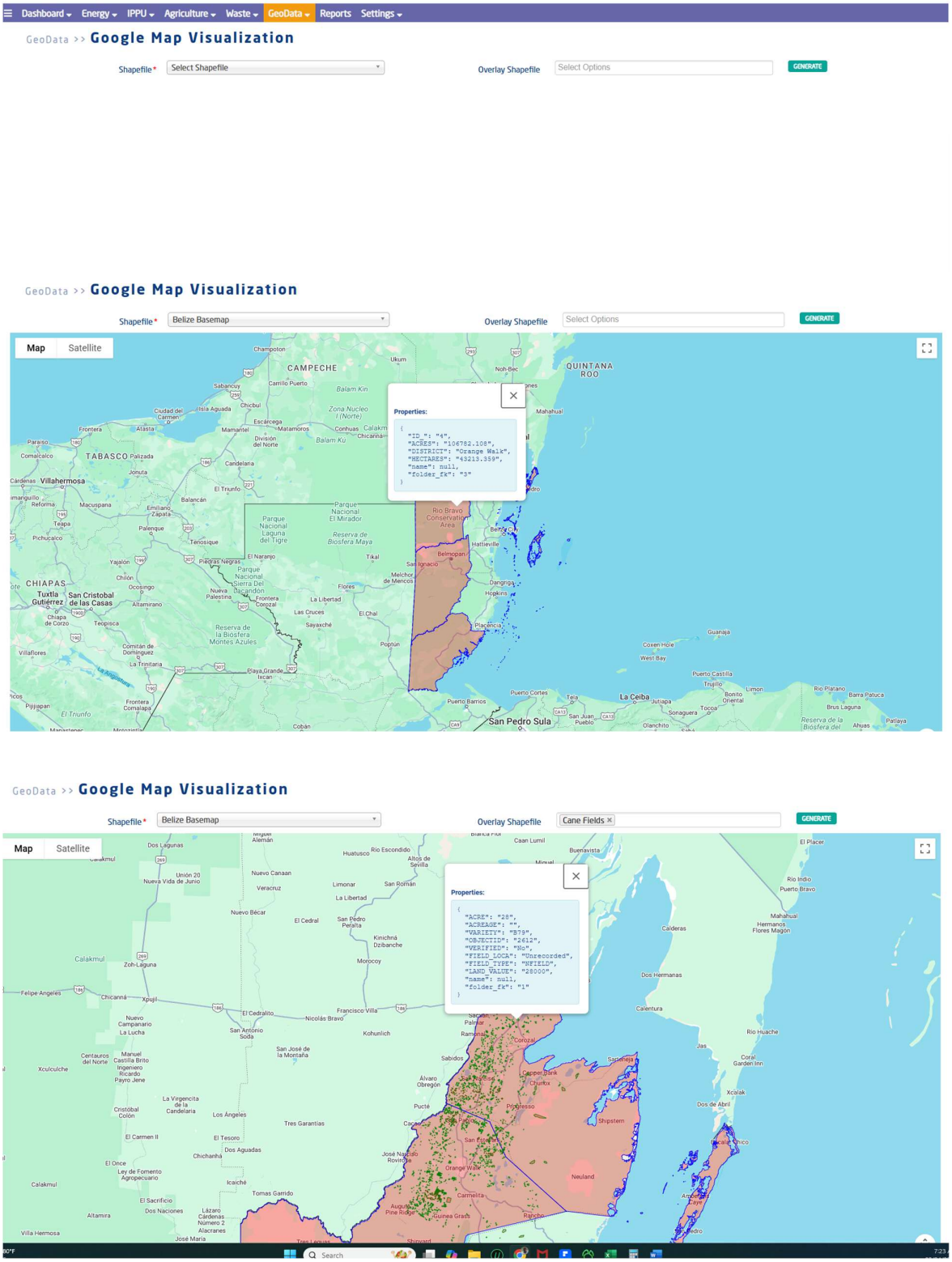
Data Visualization Features

The system has the capability to present the information inputted in the form of different graphs, providing the NCCO to visually view Belize's emissions by sector. The picture below is a screenshot that illustrates an example of this feature:



Agricultural Data

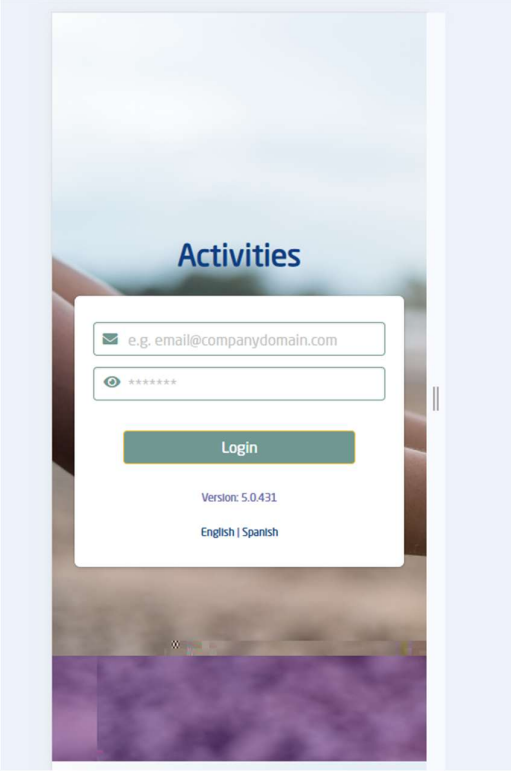
The monitoring of agricultural data primarily looks at storing shapefiles of livestock farms in Belize and viewing these on a map to be able to monitor land use change over time. Previously collected data and information on farms only provided point locations. The system has provided an additional feature, allowing the NCCO to view polygon shapes of the farms, rather than just points. The system stores the shapefiles within the database and processes those shapefiles in GeoJSON format in order to display them in Google Maps with the ability to overlay multiple shapefiles. The screenshots below provide an example of this feature:

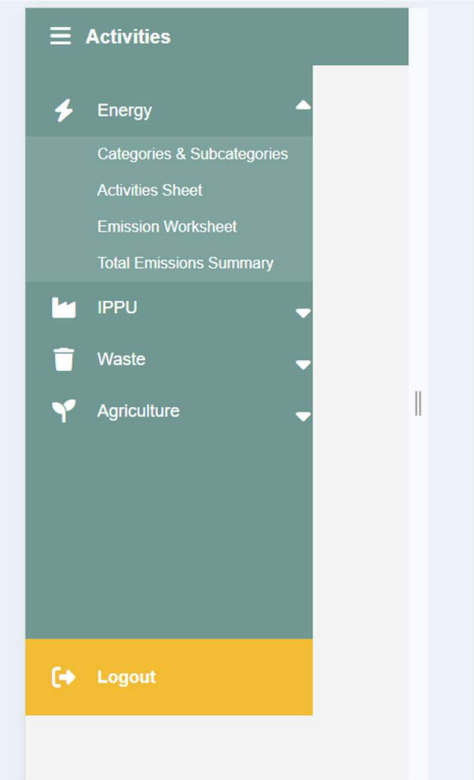


This feature enables NCCO to have a spatial and visual representation of livestock farms and related land use change over time, greatly enhancing the transparency and understanding of data and changes in this sub-sector.

App for Data Providers

The app for data providers serves to assist in real time data storing of activity data that is used in the development of Belize's national GHG inventories. The norm has been the use of excel sheets to collect and store this data, however, there has been instances where the data has been lost, or files become corrupt and inaccessible. Therefore, these excel forms, which can be found in Annex 1, have been integrated unto the online platform to have them stored in one place and improve the data management for the NCCO. The excel forms have been translated and developed into a responsive web app allowing data to be collected using phones or a tablet in the field and immediately be saved in the database. Below are screenshots of this feature:





Conclusion

In conclusion, the ICAT-Belize Phase 2 project represents a significant advancement in the country's ability to monitor, report, and verify GHG emissions and other climate-related data in line with international standards. The enhancements made to the National MRV (Measurement, Reporting, and Verification) system, including the integration of GHG data storage, visualization features, and agricultural data analytics, are pivotal steps towards meeting Belize's climate action commitments under the Paris Agreement. The inclusion of an app for data providers improves data collection efficiency and ensures the integrity of the information used for future reporting.

These system upgrades will not only facilitate the continuous tracking of Belize's Nationally Determined Contributions (NDCs) but also provide a robust platform for transparency in climate reporting. As a result, Belize is now better equipped to prepare for future Biennial Transparency Reports (BTRs), National Inventory Reports (NIRs), and National Communications (NCs).

However, the true long-term success of this system will depend on its ongoing evolution, and in the end its users and their interaction with the system. Future updates to the MRV system will need to be aligned with decisions emerging from the annual COP meetings, which guide global climate policies and frameworks. This ensures that Belize's reporting remains relevant and consistent with international expectations. Additionally, there are key areas, such as monitoring loss and damage, that will require special attention in future updates. While tracking and reporting on loss and damage is a relatively new concept for many countries, it is of utmost importance, especially for developing nations and small island developing states (SIDS) like Belize. The need to monitor and track these impacts is crucial for ensuring that vulnerable nations are supported in their climate adaptation and mitigation efforts.

Another area of enhancement to consider in future updates is the facilitation of modelling and projections for climate change actions, policies, and emissions. This is crucial to ensure accurate predictions are used to help policymakers make informed decisions, ensuring that climate strategies are effective and aligned with long-term environmental goals. Additionally, it is helpful to track Nationally Determined Contributions (NDCs), which are central to the Paris Agreement's Enhanced Transparency Framework (ETF). By modelling these contributions, Belize can better assess its progress toward meeting its climate obligations, ensuring the country remains on track with its commitments. Integrating this functionality with other tools, such as GACMO, could enhance coherence, streamline analysis, and improve the overall accuracy of climate models by incorporating diverse datasets and simulations across various sectors.

Continued updates and recurrent refresher trainings on the use of the MRV system, data collection, measurement, reporting and verification, alongside integration with other national and international reporting frameworks, are essential to ensuring that the platform remains adaptable and fully capable of meeting emerging climate data needs. This commitment to continuous improvement, particularly in response to the evolving challenges of loss and damage, and projections, will be key to maintaining a dynamic, reliable, and comprehensive tool for climate action in Belize, one that can effectively support the country's goals in the global fight against climate change.

Annex 1

Sector	Waste										
Category											
Category code	4										
		Tons					Data provider (Name of institution)	Name of Person	Email Address	Location	Comments
		2018	2019	2020	2021	2022					
4.A	**Solid Waste Disposal**										
4.A.1	**Managed Waste Disposal Sites**										
4.A.2	Unamanaged Waste Disposal Sites										
4.B	**Biological Treatment of Solid Waste**										
4.C	**Incineration and Open Burning of Waste**										
4.C.1	Waste Incineration										
4.C.2	**Open Burning of Waste**										
4.D	**Wastewater Treatment and Discharge**										
4.D.1	Domestic Wastewater Treatement and Discharge										
4.D.2	Industrial Wastewater Treaement and Discharge										

Sector	Agriculture										
Categor	Enteric Fermentation and Manure Management										
Categor y code	3A1										
	Species/Livestock category	Number of animals (head)					Data provider (Name of institution)	Name of Person	Email Address	Location	Comments/Notes
		2018	2019	2020	2021	2022					
3.A.1	**Enteric Fermentation**										
3.A.1.a	**Cattle**										
3.A.1.a.i	Dairy Cows (Heads)										
3.A.1.a.ii	Other Cattle (Beef pop.)										
	Heads Slaughtered										
	Liveweight (lbs)										
	Dressweight (lbs)										
3.A.1.b	**Buffalo**										
	Dairy Buffalo (Heads)										
	Other Buffalo (Heads)										
3.A.1.c	**Sheep**										
	Sheep pop. (Heads)										
	Heads Slaughtered										
	Liveweight (lbs)										
	Dressweight (lbs)										
3.A.1.d	**Goats**										
	Goats pop. (Heads)										
3.A.1.f	**Horses**										
3.A.1.g	**Mules and Asses**										
3.A.1.h	**Swine**										
	Pig pop. (Heads)										
	Heads Slaughtered										
	Liveweight (lbs)										
	Dressweight (lbs)										
3.A.2.i	**Poultry**										
	Broiler pop.										
	No. of Birds (Slaughtered)										
	Liveweight (lbs)										
	Dressweight (lbs)										

Sector	**Industrial Processes and Product Use**										
Category											
Category code	2										
		(Tons)					Data provider (Name of institution/company)	Name of Person	Email Address	Location	Comments
		###	###	###	###	###					
2.A	**Mineral Industry**										
2.A.1	Cement production										
2.A.2	**Lime Production (Tons)**	333.2	540.75								
	Dolomite Production (Tons)	2541									
2.D	**Non-Energy Products from Fuels and Solvent Use**										
2.D.1	**Lubricant Use/ importation in (TJ)**	94.71									
2.D.4	**Asphalt Importation/Use - Road paving with asphalt (Bitumen) (Gg)**	0.13									
2.E.5											
2.F	**Product Uses as Subsitutes for Ozone Depleting Substance**										
2.F.1	**Refrigeration and Air conditioning Equipment**										
	HCFC R -22 (Quota System) in Metric Tons	28.35		6.8	9.38	11.12					Annual ozone depleting substances (ODS) Consumption of HCFC in Tons
	HCFC R - 141b (Quota System) in Metric Tons	0.66		0.31	0.03	0					
	Total			7.11	9.41	11.12					
	HFC R-134A (Open License) in Metric Tons	48.38		27.95	691.9	33.86					
	HFC R-404A (Open License) in Metric Tons	10.99		4.65	4.66	3.918					
	HFC-410A (Open License) in Metric Tons	38.26		13.42	61.42	27.22					
	HC-290 (Open License) in Metric Tons	0.09									
	HC-600A (Open License) in Metric Tons	0.46									
2.H.2	**Food and Beverage Industry/Durum**										
	Durum Wheat importation into the country in Gg	17.76									
	Alcohol spirit/production (Imperial Gallons)	25,879									
	Beer Brewing/production (Hectoliter)	1.61									

Sector	**Energy**													
Category														
Category code														
			Fuel Type	Fuel Description	2018	2019	2020	2021	2022	Data provider (Name of institution)	Name of Person	Email Address	Location	Comments
1A. Fuel Combustion Activities														
1A1. Energy Industries														
	1A1a. Main Activity Electricity and Heat Production													
		1A1ai. Electricity Generation	Liquid	Other Petroleum Products (Residual Fuel Oils)										
				Diesel Oil										
				Lubricants										
				Crude Oil										
			Gaseous	LPG										
		1A1aii. Combined Heat and Power Generation (CHP)	Biomass	Solid Biomass (Bagase)										
		1A1aiii. Heat Plants												
1A2. Manufacturing Industries and Construction														
	1A2d. Pulp, Paper and Print													
	1A2e. Food Processing, Beverages and Tobacco	Combustion of crude oil												
	1A2i. Mining (excluding fuels) and Quarrying													
	1A2j. Wood and Wood products													
	1A2k. Construction													
1A3. Transport														
	1A3a. Civil Aviation	**1A3ai. International Aviation**	Liquid Fuel	**Aviation Fuel**	Aviation Gasoline/ Jet fuel Kerosene A1									
		1A3aii. National Aviation	Liquid Fuel	**Jet Kerosene**										
	1A3b. Road Transportation		**Liquid Fuel**	**Gasl Diesel**										
				Other Kerosene										
	1A3d. Water-borne Navigation													
	1A3di. International water-borne Navigation (International Bunkers)													
	1A3dii. Domestic water-borne Navigation	**Minimal data - were not active during covid**												
1A4. Othe Sectors														
	1A4a. Commercial/Institutional													
	1A4b. Residential	Estimation is made	Biomass	Wood										
	1A4c. Agriculture/Forestry/Fishing/Fish Farms													
1A5. Non-Specified														
	1A5a. Stationary													
	1A5b. Mobile													
		1A5bi. Mobile (aviation component)												
		1A5bii. Mobile (water-borne component)	**data from bdf activities**											
		1A5c. Multilateral Operations	No data											
1B. Fugitive emissions from fuels														
	1B2. Oil and Natural Gas													
	1B2aiii. All other													
		1B2aiii2. Production and Upgrading												
		1B2aiii3. Transport												
		1B2aiii5. Distribution of oil products	Get advise from ghg expert											
		1B2aiiii. Exploration (Oil)												
	1B2b. Natural Gas													
	1B2bii. Flaring													
	1B2biii. All other													
		1B2biii1. Exploration												