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Development of a Standardized Greenhouse Gas Quantification Template for the Philippine aviation industry

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Abstract. International aviation contributes 2.1% of global carbon emissions, with Philippine air transport emitting 0.712 million metric tonnes of CO_2e. In response, a greenhouse gas quantification template (GHGQT) was developed to enhance industry-wide emissions monitoring, using established methodologies from IPCC, WRI, and WBCSD, and other organizations. A readiness assessment identified regulatory gaps, inadequate data collection, and limited sustainability training. The GHGQT was applied to selected aviation companies to analyze Scope 1, 2, and 3 emissions. Results showed that PAL had the highest emissions due to large-scale operations, while Cebu Pacific led in Scope 3 emissions from wastewater discharge. The COVID-19 pandemic caused temporary reductions, reinforcing the importance of assessing GHG intensity rather than absolute emissions during disruptions. By providing a standardized approach, the GHGQT aims to improve emissions tracking, regulatory compliance, and sustainability efforts within the Philippine aviation industry.

Keywords: GHG emissions, emissions quantification, standard template, Philippine aviation industry

1. Introduction

Aviation emissions are projected to increase up to fourfold by 2050 from 2018 levels (Fleming et al, 2022). To address this, ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was introduced (International Air Transport Association, 2021). However, the Philippine aviation sector still lacks a standardized reporting system. This research aims to develop an aviation industry-specific GHG quantification template (GHGQT) for accurate emissions monitoring, facilitating informed decision-making.

2. Materials and Methods

2.1. Readiness assessment of existing data from aviation industry companies

A survey assessed industry awareness and regulatory frameworks using six criteria, shown in Fig. 1. Data were collected from the Climate Change Commission (CCC), Civil Aviation Authority of the Philippines (CAAP), and publicly listed aviation companies.

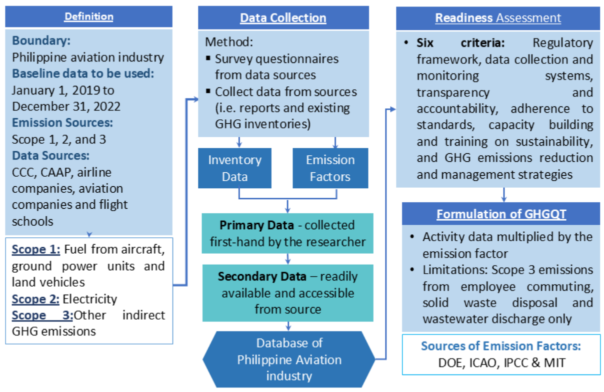

Figure 1. Stepwise methodology of the research

2.2. Development of GHGQT

The template followed IPCC, GHG Protocol Guidance, Sustainability Accounting Standards Board, European Environment Agency (EEA) and the CCC guidelines. Additionally, the emission factors were sourced from IPCC, ICAO, Department of Energy (DOE), Environmental Management Bureau, National Economic and Development Authority and EEA.

2.2.1. General equation for the estimation of GHG emissions

$$CE = \sum AD \times EF \times GWP_{100}$$

where *CE* is the total carbon emissions (tCO_2e), *AD* is the activity data, *EF* is the emission factor and GWP_{100} is the 100-year global warming potential (World Resources Institute, 2016).

The activity data came from fuel and electricity consumption for Scopes 1 and 2, respectively. In Scope 3, only the emissions from employee commuting, solid waste disposal and wastewater discharge were computed due to the restrictions on the data collected from the aviation companies. Methods included distance-based and average-data approaches. Moreover, emissions from solid waste were calculated using IPCC default methods.

2.2.2. Emission factors

Emission factors used in the template included the following:

- Fuel Consumption: Diesel (2.676 kg CO_2/L), Gasoline (2.272 kg CO_2/L), Jet Fuel (2.491 kg CO_2/L), Aviation Gasoline (2.201 kg CO_2/L), Sustainable Aviation Fuel (0.464-0.751 kg CO_2/L, based on feedstock).
- Electricity: Luzon/Visayas (0.7122 kg CO_2/kWh), Mindanao (0.7797 kg CO_2/kWh).
- Employee Commuting: Varied by vehicle type, e.g., buses (Diesel: 1.71 kg CO_2/km, Gasoline: 1.07 kg CO_2/km), passenger cars (0.239-0.281 kg CO_2/km).

3. Results and Discussion

3.1. Industry Readiness for GHG reporting

The aviation sector faced several challenges in emissions reporting, primarily due to the absence of mandated policies beyond ICAO guidelines. Among the Philippine airline companies, only AirAsia Philippines, Cebu Pacific Air (CPA), and Philippine Airlines (PAL) reported emissions, with Scope 3 emissions largely untracked. Furthermore, in 2022, only 25% of personnel received sustainability reporting training, highlighting a critical gap in industry preparedness. In response, CAAP initiated the development of a Civil Aviation Masterplan, aligning with ASEAN and EU best practices to enhance regulatory frameworks and promote sustainable aviation measures.

3.2. Emission profile of the Philippine aviation industry

Only three companies—Alpha Aviation Group (AAG), CPA, and PAL—provided activity data due to limited responses from the aviation industry. AAG submitted data through a data collection form, while CPA and PAL's data were sourced from their 2019 to 2022 sustainability reports. Scope 1 emissions were lowest for AAG due to its smaller operations, whereas PAL had the highest emissions because of its larger fleet and passenger volume. Scope 2 emissions showed a similar trend, but in 2022, CPA and PAL had nearly equal emissions due to PAL's transition to hydropower. CPA consistently had the highest Scope 3 emissions, mainly due to its wastewater discharge volume, while AAG's Scope 3 emissions remained minimal from 2019 to 2022 due to lack of emissions monitoring.

Table 1. Emission profile of Alpha Aviation Group, Cebu Pacific Air and Philippine Airlines (2019-2022)

Scope	Alpha Aviation Group				Cebu Pacific Air				Philippine Airlines			
	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
1	44,495.78	31,731.82	50,062.91	59,951.17	1,983,015.14	561,641.41	424,661.15	1,141,635.04	4,210,474.36	1,560,700.70	1,349,482.29	2,653,100.89
2	1,193.91	784.84	1,105.65	843.93	3,250.00	2,196.29	2,660.07	4,694.82	13,816.68	8,356.95	7,418.23	4,790.95
3	0.01	0.01	0.01	1,305.16	206.85	46.47	31.42	136.61	156.52	36.24	28.53	88.24

4. Conclusions

The readiness assessment highlights the Philippine aviation industry's challenges in comprehensive emissions reporting, including the absence of robust policies, limited data collection and monitoring systems, gaps in Scope 3 emissions data, and a lack of sustainability training among industry personnel. Analysis of activity data from AAG, CPA, and PAL indicates a significant decline in Scope 1, 2, and 3 emissions during 2020 and 2021 due to reduced travel demand and COVID-19 restrictions, emphasizing the need to assess GHG intensity rather than absolute emissions during abnormal periods. To enhance emissions reporting and sustainability efforts, the development of a standardized GHG quantification template is recommended, enabling more accurate measurement, improved tracking of progress, and stronger alignment with national and global climate commitments.

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