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Status of Emissions in the Philippines: A Literature Review on the Inventory of Greenhouse Gases

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Abstract

In the Philippines, the predominant Greenhouse Gases (GHGs) contributing to climate change are Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Carbon Dioxide is primarily released through the burning of fossil fuels for energy and transportation, making it a significant factor in the nation's carbon footprint. Methane, on the other hand, is emitted from agricultural practices, particularly livestock farming, as well as from landfills and natural gas production. Nitrous Oxide emissions largely arise from agricultural soil management and the use of synthetic fertilizers. Together, these gases not only impact the environment but also pose serious risks to public health and biodiversity, highlighting the urgent need for effective strategies to mitigate their effects and promote sustainable practices throughout the country.

Keywords: Emissions, Greenhouse Gases, Inventory, Literature Review, Philippines

Introduction

The issue of greenhouse gas emissions is a critical concern for nations around the globe, particularly for developing countries like the Philippines. The country is situated in a region highly vulnerable to climate change impacts, including extreme weather events and rising sea levels. There is a need to monitor the current status of emissions in the Philippines, focusing on the inventory of Greenhouse Gases (GHGs) and the implications of these emissions for the environment and public health. Greenhouse Gases (GHGs) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases, which trap heat in the atmosphere and contribute to global warming. The Philippines, with its unique geography and economic activities, has a diverse emissions profile influenced by agriculture, forestry, energy production, and waste management (Climate Transparency Report, 2020) [5].

According to recent studies, the primary source of GHG emissions in the Philippines is the energy sector, which accounts for approximately 54% of total emissions. The reliance on fossil fuels for power generation, particularly coal and natural gas, has significantly contributed to the rising levels of CO_2. The transportation sector follows, responsible for about 29% of emissions, primarily due to the increasing number of vehicles and inefficient fuel use. Agriculture, while critical for the nation's economy, also plays a significant role in GHG emissions. Livestock production and rice cultivation are notable sources of methane emissions, contributing to about 15% of the country's total emissions. Deforestation and land-use changes further exacerbate the situation, as they reduce the carbon sequestration potential of forests, leading to additional CO_2 emissions (Global Green Growth, 2025) [6].

Research indicates that the Philippines has seen an increase in GHG emissions over the past few decades. The rapid urbanization and industrialization, along with population growth, have driven higher energy demands. However, recent government initiatives aimed at promoting renewable energy sources and improving energy efficiency have shown promise in mitigating these emissions. The renewable energy sector has grown, with investments in solar, wind, and hydroelectric power projects, which could lead to a reduction in reliance on fossil fuels (Chen *et al*., 2022) [2].

The Philippine government has recognized the urgency of addressing climate change impacts and has implemented various policies to tackle emissions. The National Climate Change Action Plan (NCCAP) outlines strategies to enhance resilience and promote sustainable development.

Additionally, the Philippines is a signatory to the Paris Agreement, committing to reduce its GHG emissions by 75% by 2030, conditional on financial and technological support from developed countries (Climate Change Commission, 2016) [4].

Despite these efforts, several challenges hinder effective emission reductions. Political stability, funding limitations, and the need for technological advancements pose significant obstacles. Moreover, the importance of community involvement and local governance in implementing environmental policies cannot be overstated. Engaging local stakeholders in decision-making processes ensures that initiatives are contextually relevant and widely supported (Global Green Growth, 2025) [6].

Methodology

This study utilized secondary data from a variety of literature sources, providing a comprehensive overview of the country's Greenhouse Gas Emissions such as the records from Climate Change Commission (2020) [3]. By analyzing existing research, the study highlights the major contributors to emissions, including industrial processes, transportation, and agriculture. It also examines the impact of government policies and initiatives aimed at reducing emissions, showcasing both progress and ongoing struggles. This examination of secondary data not only enriches the understanding of the Philippines' environmental landscape but also emphasizes the importance of informed decision-making in addressing climate change effectively.

Results and Discussion

Table 1: Emissions of Greenhouse Gases by Energy Consumption 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
I. Energy			
1. Energy Industries	74,183.342	40.285	288.636
2. Manufacturing Industries and Construction	10,275.411	354.528	452.766
3. Other Sectors	11,398.112	2,045.675	245.472
4. Fugitive Emissions - Solid Fuels	-	560.204	-
5. Fugitive Emissions - Oil and Natural Gas	9.769	0.162	0.023
Total Emissions	95,866.634	3,000.853	986.896
Total CO_2 Equivalent	99,854.384		

Table 1 presents emissions data categorized by various sectors involved in energy production and usage, detailing the total emissions of Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O) measured in metric tons. This data is crucial as it highlights the significant contributions of different industries to Greenhouse Gas emissions, thereby illuminating the varying impacts of energy production methods and consumption patterns on climate change. By analyzing this information, stakeholders can better comprehend the urgent need for targeted strategies to mitigate emissions, emphasizing the role of policy, innovation, and individual responsibility in combating climate change. Understanding these dynamics is essential for fostering informed advocates for environmental sustainability and effective climate action (Gonocruz *et al.*, 2024) [7].

Table 2: Emissions of Greenhouse Gases by Transport 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
II. Transport			
1. Domestic Aviation	654.594	0.128	4.854
2. Road Transport	25,725.730	38.931	449.947
3. Railways	4.591	0.007	0.470
4. Water-borne Navigation	2,337.051	6.205	16.780
5. Other Transportation	173.863	0.273	17.783
Total Emissions	28,895.828	45.544	489.832
Total CO_2 Equivalent	29,431.204		

The data concerning greenhouse gas emissions from various transportation sectors reveals critical insights into the environmental impact of road transport. Measured in metric tons of emitted gases, this data illustrates that road transportation is a major contributor to overall greenhouse gas emissions (see Table 2). Such analysis is essential for informing environmental policy and improving transportation efficiency. By examining these emissions, policymakers and stakeholders can develop strategies aimed at reducing carbon footprints, promoting sustainable transportation alternatives, and ultimately mitigating climate change effects. Understanding these dynamics is crucial for fostering a more sustainable future (Osobajo *et al.*, 2020) [8].

Table 3: Emissions of Greenhouse Gases by Agriculture 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
III. Agriculture			
1. Rice Cultivation	-	26,984.898	-
2. Enteric Fermentation	-	8,327.213	-
3. Manure Management	-	2,751.749	4,406.452
4. Direct N2O Emissions from Managed Soils	-	-	6,875.216
5. Indirect N2O Emissions from Managed Soils	-	-	2,277.200
6. Direct N2O Emissions from Manure Management	-	-	1,220.157
7. Biomass Burning in Croplands and Grasslands	-	370.367	101.662
8. Liming	127.820	-	-
9. Urea Application	637.263	-	-
Total Emissions	765.083	38,434.227	14,880.687
Total CO_2 Equivalent	54,079.997		

Understanding Greenhouse Gas Emissions from Agriculture Agricultural practices (see Table 3) significantly contribute to greenhouse gas emissions, primarily through the release of Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Carbon dioxide emissions often arise from soil management, fossil fuel use, and land-use changes, while CH_4 is predominantly released from enteric fermentation in livestock and rice paddies, and N_2O primarily results from the use of nitrogen-based fertilizers. Understanding the levels and sources of these emissions is crucial for evaluating the agricultural sector's impact on climate change. By analyzing data on these gases, researchers and policymakers can develop targeted strategies to mitigate agriculture's environmental footprint, promoting sustainable practices that minimize emissions and foster resilience against climate change (Chen *et al*., 2022) [2].

Table 4: Emissions of Greenhouse Gases by Forestry and other Land Use (FOLU) 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
IV. Forestry and other Land Use (FOLU)			
1. Biomass Carbon Stock Silvopasture	(71,354.677)	-	-
2. Biomass Carbon Stock	11,247.006	-	-
3. Biomass Carbon Stock Deforestation	31,302.244	-	-
4. Biomass Carbon Stock Agroforestry/Perennial Crop	2,125.769	-	-
5. Biomass Burning - Forests	744.594	-	-
Total Emissions	(25,935.063)	-	-
Total CO_2 Equivalent	(25,935.063)		

The emissions of greenhouse gases, particularly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), from various forestry and land use activities play a critical role in climate change. The data presented in Table 4 illustrates how these activities contribute to the overall greenhouse gas emissions, with specific values indicating either emissions or changes in carbon stock. Notably, negative values signify carbon sequestration, a process where carbon is absorbed from the atmosphere and stored in biomass or soil. Understanding these dynamics is essential for developing effective strategies to mitigate climate change and enhance carbon storage practices within forestry and land management (Abeleda Jr & Espiritu, 2022) [1].

Table 5: Emissions of Greenhouse Gases by Industrial Processes and product use (IPPU) 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	HFCs
V. Industrial Processes and product use (IPPU)				
1. Mineral Industry	11,779.664	-	-	-
2. Chemical Industry	559.974012	20.914992	-	-
3. Metal Industry	1,280.711	6.790	-	-
4. Non-Energy Products from Fuels and Solvent Use	46.039	-	-	-
5. Product Uses as Substitutes for ODS	-	-	-	3,078.199197
Total Emissions	13,666.388	27.705	-	3,078.199
Total CO_2 Equivalent	16,772.292			

Greenhouse Gas emissions from industrial processes and product uses (IPPU) significantly contribute to climate change, and analyzing these emissions is critical for developing effective environmental policies. The emissions are primarily categorized by gas type: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), and Hydrofluorocarbons (HFCs). Each gas has different sources and impacts, with CO_2 being the most prevalent due to fossil fuel combustion in energy production and transportation (see Table 5). Methane, on the other hand, is largely released from agricultural practices and waste management, while Nitrous Oxide primarily comes from fertilizers in agriculture. Hydrofluorocarbons, though less common, are potent greenhouse gases used in refrigeration and air conditioning. Understanding the specific contributions of these gases is essential for evaluating the overall impact of industrial activities on global warming and crafting strategies to mitigate their effects (Raihan, 2023) [9].

Table 6: Emissions of Greenhouse Gases by Waste 2020 (In Gigagrams of CO_2 equivalent)

Sector and Source Categories	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
VI. Wastes			
1. Solid Waste Disposal	-	11,689.692	
2. Biological Treatment of Solid Waste	-	391.664	222.335
3. Incineration and Open Burning of Waste	0.322	1.288	0.265
4. Wastewater Treatment and Discharge	-	16,563.680	1,253.185
Total Emissions	0.322	28,646.324	1,475.785
Total CO_2 Equivalent	30,122.431		
Total National GHG Emissions (CO_2e)	204,325.244		

The data presented in Table 6 describe the Greenhouse Gas emissions from various waste management sources, specifically focusing on the contributions of Carbon dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). These emissions are significant as they directly influence climate change and environmental health. For instance, Methane, although present in smaller quantities, is far more potent than CO_2 in terms of its heat-trapping ability. Understanding these figures is essential for evaluating the environmental impact of different waste disposal and treatment methods. Local Government are encouraged to analyze this emissions data critically to assess the effectiveness of various waste management strategies, fostering a deeper awareness of how waste practices can be optimized to mitigate greenhouse gas emissions and protect our planet (Climate Change Commission, 2016) [4].

Conclusion

In the Philippines, the predominant Greenhouse Gases contributing to climate change are Carbon dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Carbon dioxide is primarily released through the burning of fossil fuels for energy and transportation, making it a significant factor in the nation's carbon footprint. Methane, on the other hand, is emitted from agricultural practices, particularly livestock farming, as well as from landfills and natural gas production. Nitrous Oxide emissions largely arise from agricultural soil management and the use of synthetic fertilizers. Together, these gases not only impact the environment but also pose serious risks to public health and biodiversity, highlighting the urgent need for effective strategies to mitigate their effects and promote sustainable practices throughout the country.

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