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GREENHOUSE GAS EMISSION TRENDS IN AGRICULTURE: A FOCUS ON INDIA

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Climate change presents significant challenges for India, a country with a diverse climate and a large population that is highly vulnerable to its impacts. It was happened due to emission of greenhouse gas to the atmosphere. As a result of climate change, agricultural land, production, and productivity are gradually decreasing. This study was enlisted various sources of GHG emission from the agricultural sector.

Introduction

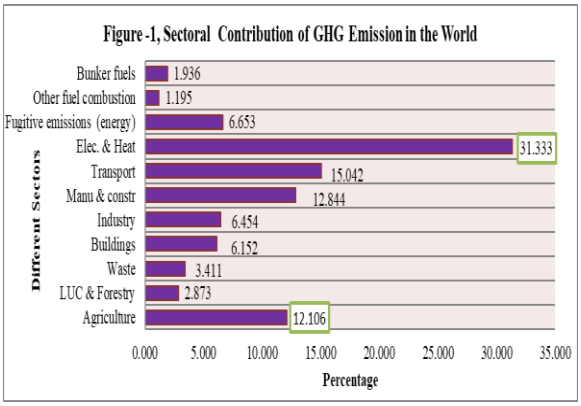
GHG emission is an emission of different gases to the atmosphere from different sectors at a particular time period. Human emissions of carbon dioxide and other greenhouse gases are the primary drivers of the global rise in temperatures (IPCC, 2021). Notable GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), per fluoro carbons (PFCs), hydro fluoro carbons (HFCs), sulfur hexa fluoride (SF_6), and nitrogen tri fluoride (NF_3) (Gavin, 2010, unfccc, 2022, Defra, 2023).

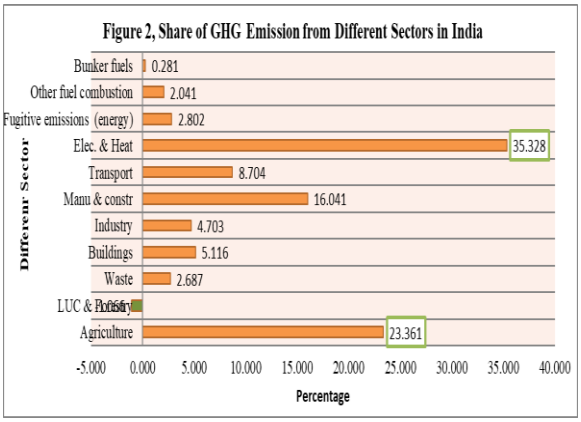
The total GHG emission is estimated to be 54.59 Billion tonnes of carbon equivalent in 2020. In 2022, China is in first position of global GHG emission with 30.68 percent share followed by United States (13.61) and India (7.62) out of the world GHG emission accounting (Climate watch, 2023 and Venkataraman, 2024). Among the various sources of 'C' emission (Figure 1, 2), electricity and heat generation are the major activity both in the World (31.33 percent) as well as in India (35.32 per cent) (Ritchie, et. al., 2020 and Climate watch, 2023).

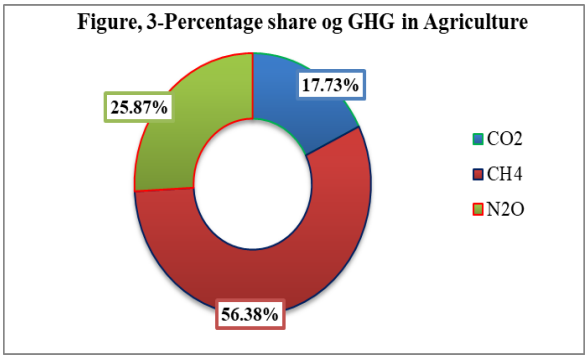
In total GHG emissions from agriculture, methane accounts for nearly half, with a 56.38 percent share (figure 3). This is followed by nitrous oxide at 25.87 percent and carbon dioxide at 17.73 percent in India. Climate change is leading to reductions in agricultural area, production, and productivity (Global Carbon Budget, 2023 and Venkataraman, 2024).

Sources of Green House Gases Emissions in Agriculture

According to Global carbon Budget (2023), Key sources of GHG emissions in agriculture include rice cultivation, enteric fermentation, crop residues, crop residues burning, manure management, manure applied to soil, drained organic soil, on- farm energy use, synthetic fertilizers, manure left on pasture.

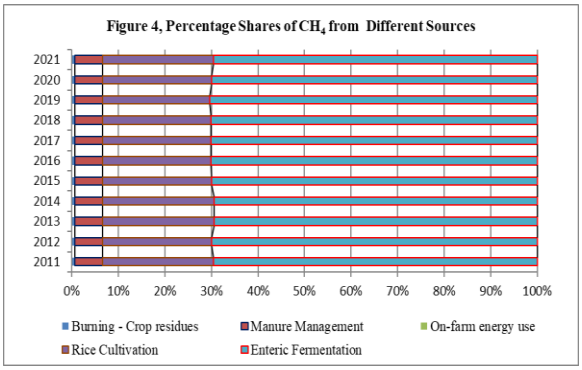






Sources of Methane emission in Agriculture

Among the three GHG gases, CH_4 ranked first and accounted for half of the total emissions. According to Figure 4, the main emitters were rice cultivation, enteric fermentation, crop residue burning, manure management, and on-farm energy use. The trend of CH_4 emissions from enteric fermentation was stable and high from 2011 to 2021, accounting for 69.54 per cent in 2021. This was followed by rice cultivation at 23.82 per cent, manure management at 5.93 per cent, crop residue burning at 0.67 per cent, and on-farm energy use at 0.01. From Table 1, the CAGR for all sources was positive, with a 2.6 per cent CAGR for CH_4 emissions from on-farm energy use.



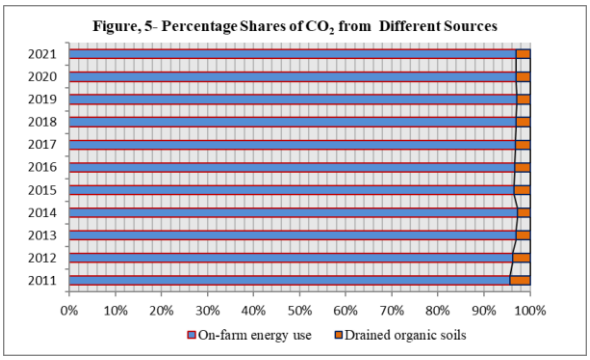
Sources of Carbon-di-oxide emission in Agriculture

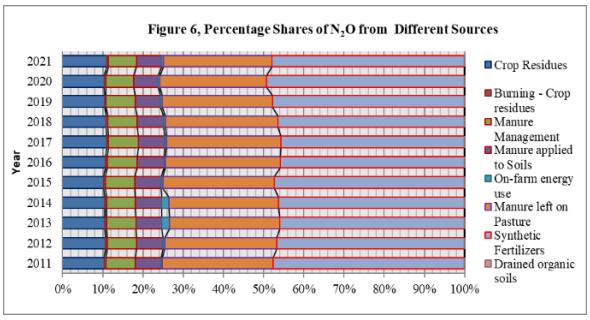
Among the three GHG gases, CO_2 ranked second. On-farm energy use and drained organic soil were the main emitters. From Figure 5, the trend of CO_2 emissions from on-farm energy increased slightly from 2011 to 2021. In 2021, on-farm energy accounted for 95 per cent of CO_2 emissions, while drained organic soil accounted for only 5 per cent. According to Table 1, of the two sources, only on-farm energy showed a positive CAGR, with a 2.6 per cent CAGR for CO_2 emissions. The other source remained neutral in nature.

Sources of Nitrous Oxide emission in Agriculture

Among the three GHG gases, N_2O was in the last position. From Figure 6, the main emitters were synthetic fertilizer, manures left on pastures, manure applied to the soil, crop residues, manure management, and drained organic soil. The trend of N_2O emissions from synthetic fertilizer was high from 2011 to 2021, accounting for 47.87 per cent in 2021 alone. This was followed by manures left on pastures

at 26.95 per cent, crop residues at 10.97 per cent, manure management at 7.06 per cent, manure applied to the soil at 6.23 per cent, burning crop residues at 0.42 per cent, and drained organic soil at 0.09 per cent. From Table 1, among all sources, the CAGR for six sources was positive, while it was negative for the remaining sources. Specifically, emissions from on-farm energy use and drained organic soils decreased by 3 per cent and 5 per cent, respectively, whereas emissions from synthetic fertilizer and manures left on pastures increased by 1 per cent each during 2011-2021.





Table, 1 Compound Annual Growth Rate from various Sources from Agriculture

S. No	Particulars	CAGR (%)	S. No	Particulars	CAGR (%)
I	**CH_4 Emission**				
1	Burning - Crop residues	0.401	3	On-farm energy use	1.005
2	Manure Management	0.501	4	Rice Cultivation	0.401
II	**CO_2 Emission**				
1	On-farm energy use	2.634	2	Drained organic soils	0
III	**N_2O Emission**				
1	Crop Residues	0.016	5	On-farm energy use	-3.921
2	Burning - Crop residues	0.175	6	Manure left on Pasture	1.005
3	Manure Management	0.009	7	Synthetic Fertilizers	1.511
4	Manure applied to Soils	0.008	8	Drained organic soils	-2.955

Conclusion

This accounting is considered a snapshot of various sources of GHG emissions in agriculture. These GHG emissions contribute to climate change. Several best management practices and alternative sources have been employed in agriculture to help reduce GHG emissions such as direct and indirect practices. By focusing on both direct actions, such as improving nutrient management and manure handling (Nandhini, *et. al.,* 2023), efficient irrigation and energy efficiency (Nandhini, *et. al.,* 2023, Nandhini, *et. al.,* 2024) and indirect measures, such as soil conservation and agro-forestry, farmers can significantly reduce their carbon footprint and enhance their farm's resilience to climate impacts.

Adopting these BMPs not only helps in climate change mitigation but also improves overall farm productivity and sustainability. This leads to carbon sequestration through agricultural practices. Additionally, it can improve the standard of living for farmers through the computation of carbon credits from sequestration.

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