



## Greenhouse Gas Emissions from Agriculture and Its Mitigation Strategies

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### Abstract

Climate change is the most important environmental problem, especially in developing countries. Greenhouse gas emission is the major factor in climate change. Carbon emission, nitrous oxide emission, and methane emission are the major components of greenhouse gas. The agricultural sector shares a major proportion of total GHG emissions. The agricultural industry's carbon footprint is determined by calculating the aggregate greenhouse gas emissions produced by all activities within the sector. The main cause of climate change is an increase in the concentration of GHGs in the atmosphere, which traps heat and interfere with outgoing infrared radiation, increasing the temperature of the atmosphere. Agricultural development in India is being affected by climate change due to its frequent drought periods, warmer temperatures, and unpredictable rainfall. These impacts may lead to lower crop yields, a higher risk of crop failures and food shortages.

**Keywords:** Agriculture, Greenhouse gas, Methane, Mitigation strategies

### Introduction

The agricultural industry is a significant contributor to greenhouse gas emissions and is also among the economic sectors most affected by both direct and indirect impacts of climate change. As the food demand is increasing with the rising population, the proportion of GHG emissions from the agricultural sector is also increasing (Samiappan *et al.*, 2018). Carbon footprint in agriculture refers to the amount of greenhouse gases emitted during the production, processing, transportation, and distribution of agricultural products. With reference to carbon emissions, agriculture practices are grouped into primary, secondary and territory sources (Palanisami *et al.*, 2010). The main sources of carbon emissions stem from both mobile operations such as tillage, sowing, harvesting, and transportation, as well as stationary operations like water pumping and grain drying. Fertilizer and pesticide production, packaging, and storage are secondary sources of carbon emissions. The purchase of raw materials and the creation of machinery and agricultural structures are tertiary sources of carbon emissions.

### Sources of Major Greenhouse Gases

#### 1. Carbon dioxide

There are many sources of carbon dioxide emissions in agriculture are as follows.

- **Uses of fossil fuels:** Agricultural operations like tractors, irrigation pumps, and other equipment that run on fossil fuels release carbon dioxide into the atmosphere.
- **Land-use modifications:** The release of carbon that has been stored in the soil and vegetation can result in carbon dioxide emissions when natural ecosystems like forests or grasslands are turned into agricultural land.
- **Soil management techniques:** Agricultural techniques, including tillage, burning agricultural leftovers, and excessive fertilizer use can increase the amount of carbon dioxide that is released from the soil.

#### 2. Methane

- **Enteric fermentation:** Ruminant species, including cattle, sheep, and goats, produce methane as a by-product of their digestive processes.

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- **Manure management:** As a residue of decomposition, methane is released into the atmosphere during the storage, handling, and treatment of livestock manure.

- **Rice farming:** The anaerobic decomposition of organic matter in flooded rice fields leads to the generation of methane.

### 3. Nitrous oxide

- **Fertilizer use:** A major source of N<sub>2</sub>O emissions is the use of nitrogen-based fertilizers in agriculture. The microbial breakdown of nitrogen fertilizers in the soil results in the production of N<sub>2</sub>O.

- **Manure management:** During the decomposition process, manure from livestock also emits N<sub>2</sub>O into the atmosphere.

- **Soil management practices:** Tillage, burning of crop leftovers and excessive fertilizer use are examples of agricultural practices that might enhance N<sub>2</sub>O emissions from the soil.

## Mitigation Opportunities to Reduce Greenhouse Gas Emissions

### 1. Conservation Agriculture

The purpose of conservation agriculture is to produce profitable and sustainable agriculture while maintaining and benefiting the environment (Sarwary et al., 2020). There are following ways to mitigate GHG emissions from conservation agriculture.

- **Reduced Tillage:** Conservation agriculture uses less tillage, which preserves soil organic matter and reduces carbon dioxide evaporation from soils.

- **Crop Residual Management:** By covering the soil's surface with crop residues like leaves and stalks, it can prevent soil erosion and improve soil carbon sequestration.

- **Crop Rotation:** To increase soil fertility and reduce soil erosion, crop rotation is a method used in conservation agriculture. Moreover, while improving soil organic matter, this approach can reduce the release of carbon dioxide from soils (Ozlu et al., 2022).

- **Cover crops:** Planting cover crops in between rows of main crops to cover the soil's surface, add organic matter to the soil, and maintain the soil's structure. By increasing the availability of nitrogen in the soil, cover crops can also help in lowering nitrous oxide emissions.

### 2. Agroforestry

- **Carbon Sequestration:** Trees store carbon dioxide from the atmosphere in their biomass and in the soil after absorbing it during photosynthesis. By planting trees in agricultural areas, agroforestry can help to boost carbon sequestration.

- **Reduced Soil Erosion:** Trees and shrubs help to anchor the soil, reducing soil erosion and the loss of soil organic matter. This can help to reduce carbon dioxide emissions from soils.

- **Increased Soil Fertility:** By fixing nitrogen, contributing organic matter, and improving soil structure, trees and shrubs can increase soil fertility. This may result in greater

agricultural output and lower fertilizer-related emissions.

### 3. Efficient Use of Fertilizer

- **Use of Organic Fertilizers:** Crops can be supplied with organic fertilizers like compost and manure. In contrast to synthetic fertilizers, organic fertilizers release nutrients more gradually, lowering the possibility of nitrogen leaching and nitrous oxide emissions.

- **Use of Nitrogen-Fixing Crops:** The soil can be enriched with nitrogen by using nitrogen-fixing plants like legumes. This may reduce the demand for synthetic nitrogen fertilizers and reduce nitrous oxide emissions.

### 4. Renewable Energy

- **Solar energy:** Farm buildings and irrigation systems can be powered by solar energy can lower emissions from the usage of diesel-powered generators and other equipment by substituting solar energy for fossil fuels.

- **Biogas energy:** Livestock manure and other organic waste products can be used to produce biogas. Biogas can be used in place of fossil fuels to produce heat for cooking which lowers greenhouse gas emissions.

## Conclusion

Agriculture is one of the primary sectors responsible for greenhouse gas emissions, which contributes to climate change. Reducing carbon footprint in the agricultural sector is important for limiting the effects of climate change and developing sustainable food production systems. However, there are many opportunities for reducing these emissions through various practices such as conservation agriculture, agroforestry, efficient use of fertilizers and renewable energy (Sarwary et al., 2022). In addition to reducing emissions, these practices can also improve soil health, water quality, and biodiversity, making agriculture more sustainable and resilient to climate change.

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