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Understanding Carbon Footprints: Agricultural Emissions, Global Standards and Mitigation Strategies

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Introduction

Everybody leaves behind carbon. A person, organization, or activity's direct and indirect fossil fuel use results in the emission of carbon dioxide and other greenhouse gases into the atmosphere, which is measured as their "carbon footprint." Individuals, transportation, food, expenditures, and the amount of waste they discard, recycle, or reuse all have a significant impact on how big their carbon footprints are. Total greenhouse gas emissions (both direct and indirect) caused by an individual, event, organisation, or product, expressed as carbon dioxide equivalent. Are used as a direct measure of the quantum of gases emitted into the atmosphere causing climate change. Expressed in terms of the amount of carbon dioxide, or its equivalent of other GHGs, emitted. Often, the total carbon footprint cannot be exactly calculated because of inadequate knowledge of, and data about, the complex interactions between contributing processes, and their influence on natural processes of storing or releasing carbon dioxide.

Other footprints

- Water footprint
- Land footprint
- Ecological footprint
- Travel footprint

Agriculture's share in Greenhouse Gas Emissions:

The land use, land-use change, and forestry (LULUCF) sectors' emissions were not included in the worldwide anthropogenic emissions of greenhouse gases (GHG), which totalled 54 billion tons of CO_2 eq. and 52 billion tons of CO_2 eq. in 2019. The 17 billion tons of CO_2 equivalent that agri-food systems produced were caused by 7.2 billion tons of CO_2 equivalent from crop and livestock activities within the farm gate, 5.8 billion tons from pre- and post-

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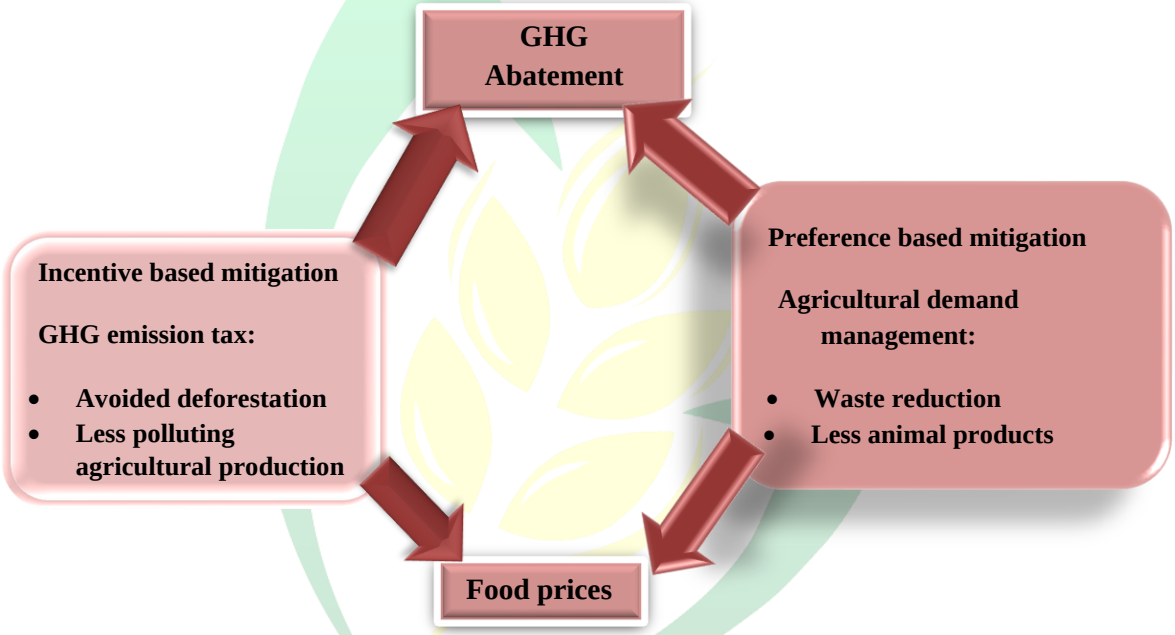
production processes like input manufacturing, transportation, and processing, and 3.5 billion tons from land use change processes primarily caused by deforestation, drainage, and burning of organic soils. Between 1990 and 2019, the GHG emissions from the world's agri-food systems rose by 16%. Methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) were the three chemical compound kinds whose emissions were most significant. These systems contributed 78%, 53%, and 21% of the world's emissions of individual gases, namely N_2O, CH_4, and CO_2.

Mitigation strategies for greenhouse gases emissions



Driving Factors of the GHG Emissions Intensity in Crop Production

Fertilization

Technologies used in fertilization have an effect on how efficiently N is used. Strip fertilization, applying fertilizer at the right time, distributing doses, adjusting fertilizer level to suit spatially differentiated soil conditions, and having an abundance of nutrients in the soil all play crucial roles in proper fertilization technology. With the right fertilization techniques, the efficiency of N utilization in the production of wheat and rape can rise by around 10%. The amount of N_2O released after fertilization can range from 0.77% to 1.25%, depending on whether synthetic or organic fertilizers are used. The Intergovernmental Panel on Climate Change (IPCC) states that organic amendments have a default emission factor of 1% with an uncertainty range of 0.1% to 1.8%. When natural fertilizers are applied to low-organic matter

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soils, the availability of carbon compounds stimulates the microbial activity of the soil, which lowers the oxygen content of the soil and creates anaerobic conditions that are favourable to denitrification. This can result in an increase in N_2O emissions.

Plant Resistance

The processes involved in producing plant protection products, the use of fuel, and the use of agricultural machinery during field treatments are the primary sources of greenhouse gas (GHG) emissions from plant protection. Fertilization is a more significant factor in the creation of carbon footprints (CFs) than plant protection. It is important to note that a lower CF per product unit, like as a kilogram of wheat grain, can be obtained by having a better yield due to the plants' efficient cover against pest activity.

Utilization of Energy and Machinery

The primary source of energy used on farms is the burning of fossil fuels. Fossil fuels are utilized in the manufacturing of transportation equipment, fertilizers, plant protection goods, and agricultural gear. Many factors influence how much energy agricultural systems use, but the three most crucial ones are crop rotation, soil cultivation, and production intensity. Both directly and indirectly, greenhouse gas (GHG) emissions are impacted by the mechanical cultivation procedures.

Carbon sequestration

It is common to ignore the possibility of sequestering organic carbon (C) over the whole farm area. It should be emphasized that one key component in lessening the greenhouse effect in an agricultural production system is the appropriate management of soil organic matter (SOM). GHG emissions rise as a result of SOM deterioration. To counteract the processes of SOM degradation and therefore the loss of C, in the form of carbon dioxide (CO_2) emissions into the atmosphere, a continuous inflow of organic matter, in the form of crop leftovers, root mass, and natural fertilizers, must be maintained into the soil.

Initiatives taken to keep check on GHGs Emission

- Carbon Pricing
- Carbon Tax
- Carbon Sequestration
- Paris Agreement COP 21
- Monteral Protocol

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- Bharat Stage (BS) VI norms
- National Wind Solar Hybrid Policy 2018
- National Solar Mission
- National Mission For enhanced energy efficiency (NMEEE)
- National Action Plan on Climate Change (NAPCC)

Requirements for carbon footprints Specification for Publicly Available Products (PAS 2050): Product Carbon Footprint

- 2008 saw the development of this consistent technique by the British Standards Institute for evaluating the life cycle greenhouse gas emissions of goods and services.
- The first globally applicable standard on product carbon footprinting that is founded on consensus, PAS 2050 has served as the model for the creation of future international standards.
- The development of the 2011 revision to PAS 2050 involved numerous conferences with international stakeholders, particularly active participation from the large PAS 2050 user community. A measurement tool/protocol that allows companies to make credible reduction commitments and achievements on life cycle GHG emission of product.

Greenhouse gas protocol

- The World Resources Institute and the World Business Council for Sustainable Development collaborated to create the Greenhouse Gas Protocol, which serves as the cornerstone for more effective, resilient, and financially successful businesses as well as sustainable climate change solutions.
- One of the accounting tools created by the GHG protocol to help users comprehend, measure, and control greenhouse gas emissions is the GHG Protocol Product Standard.
- The standard is developed through an inclusive, multi-stakeholder, consensus-based process that involves a balanced participation of businesses, governments, non-governmental organizations, and academic institutions from all over the globe.

PAS 2050 Reporting principles:

- **Relevance**-Select sources, data and methods to assess GHG emissions
- **Completeness-** Includes all GHE emissions
- **Consistency**- Enable meaningful comparisons in GHG related information
- **Accuracy-** Reduce bias and uncertainty as much as practical

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- **Transparency-**Disclose enough information allowing third parties to make decision

Trends and similar concepts

The International Sustainability Standards Board (ISSB) aims to bring global, rigorous oversight to carbon footprint reporting. It was formed out of the International Financial Reporting Standards. It will require companies to report on their Scope 3 emissions. The ISSB has taken on board criticisms of other initiatives in its aims for universality. It consolidates the Carbon Disclosure Standards Board, the Sustainability Accounting Standards Board and the Value Reporting Foundation. It complements the Global Reporting Initiative. It is influenced by the Task Force on Climate-Related Financial Disclosures. As of early 2023, Great Britain and Nigeria were preparing to adopt these standards.The concept of total equivalent warming impact (TEWI) is the most used index for carbon dioxide equivalent (CO_2) emissions calculation in air conditioning and refrigeration sectors by including both the direct and indirect contributions since it evaluates the emissions caused by the operating lifetime of systems. The Expanded Total Equivalent Warming Impact method has been used for an accurate evaluation of refrigerators emissions.