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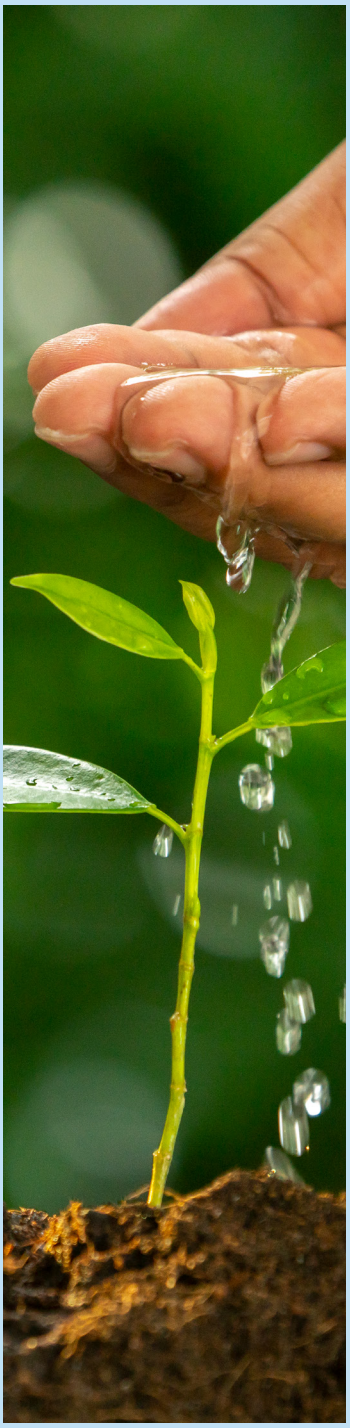

SMART TECHNOLOGY TO EMPOWER SMALLHOLDERS WITH CARBON FARMING

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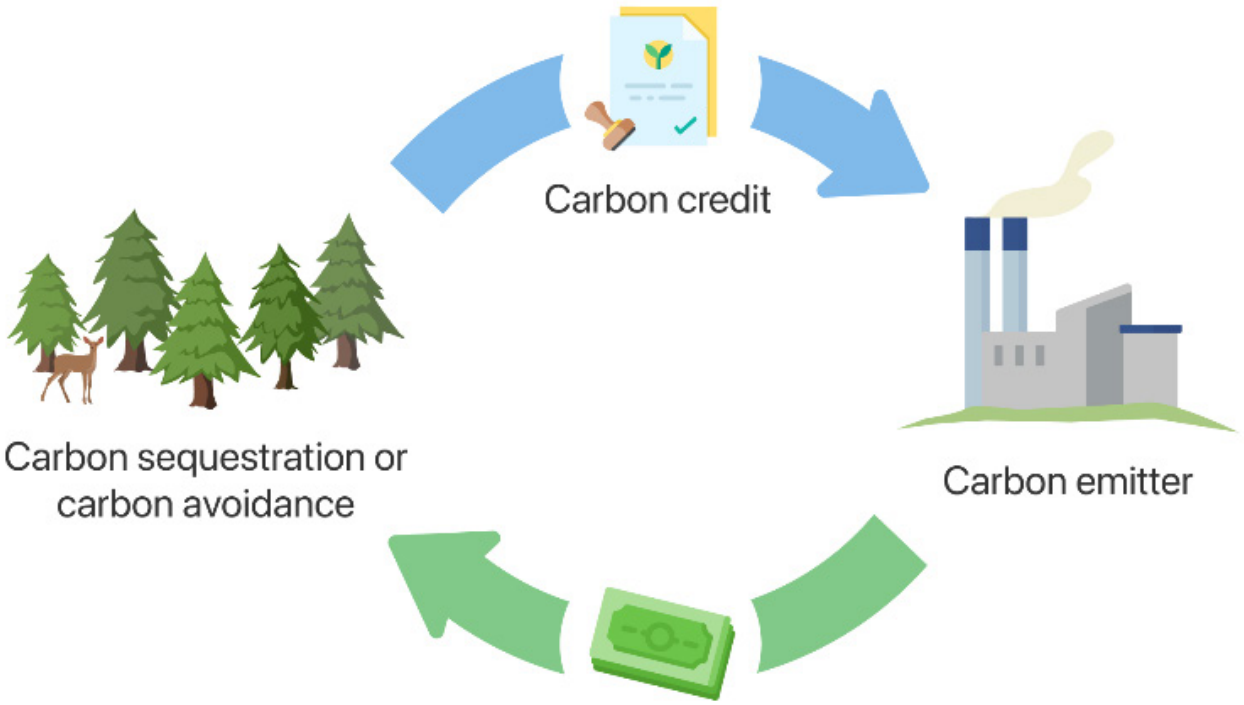
A carbon credit is an instrument which represents a one metric ton-equivalent of carbon dioxide removed through a carbon offset project. [1]

A carbon credit allows a holder to emit one metric ton equivalent of carbon dioxide gas into the atmosphere to meet the regulatory compliance under the cap-and-trade system ratified by global treaties and laws, such as the Kyoto Protocol, Paris Agreement, European Union Emissions Trading System, and the California Cap-and-Trade Program.



Carbon markets

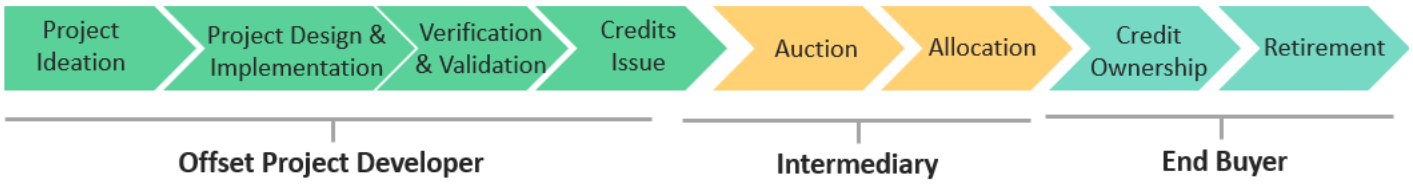
Organizations exceeding their emission limits can buy carbon credits from entities that have reduced their carbon emissions through carbon offset projects. These credits are an incentive for organizations to reduce carbon emissions and capture carbon to meet the Sustainable Development Goals adopted by the the UN General Assembly in 2015. These credits can be exchanged in the international market at market prices via various trading systems.

Organizations can also voluntarily compensate such carbon offset projects to attain carbon neutral status and support their environmental, social, and governance (ESG) programs.

Carbon markets are broadly classified into two categories:

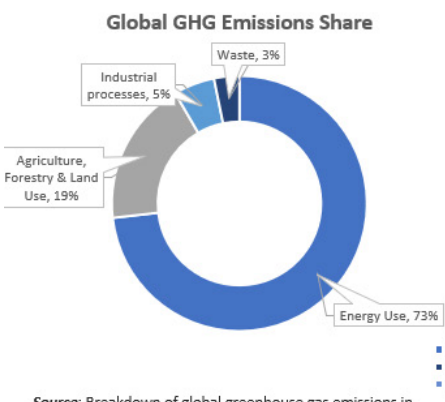
Cap-and-trade markets	Organizations need to cap their emissions under a mandatory limit, and purchase carbon credits, or pay a fine for exceeding the emissions limit. They can buy and sell carbon credits from cap-and-trade markets, for example, the European Union Emissions Trading System, California Cap-and-Trade Program, Australia emissions trading system, British Columbia emissions trading system, and the New Zealand Emissions Trading Scheme
Voluntary markets	It involves trading of carbon credits outside the regulated environment, enabling businesses, governments, NGOs, and individuals to voluntarily offset their emissions by purchasing carbon credits, for example, Offset Project Registries such as The Gold Standard, Verra, American Carbon Registry, Climate Action Reserve, CSA Group Registries

Carbon offset cycle from project development to retirement:

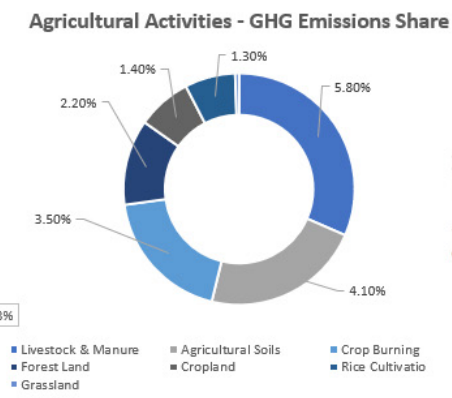


Greenhouse gas (GHG) emissions from agricultural activities

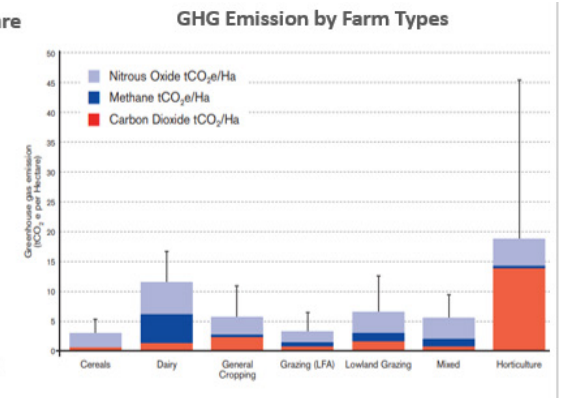
The second highest source of GHG emissions is land management. Agricultural activities contribute significantly to GHG emissions. At around 5.8% of the global GHG emissions share, methane released by cows and other livestock is one of the highest sources of emissions from agricultural activities.



Source: Breakdown of global greenhouse gas emissions in 2016, published by Climate Watch and the World Resources Institute.



Source: Breakdown of global greenhouse gas emissions in 2016, published by Climate Watch and the World Resources Institute.



Source: Natural England Carbon Baseline Survey Project

Major sources of agricultural greenhouse gases

- LIVESTOCK REARING
- CHEMICAL BASED CROP FERTILIZATION
- MATERIALS FOR FARM MAINTENANCE AND BUILDINGS
- ENERGY CONSUMPTION FOR TRANSPORTATION & FARM BUILDING
- TRANSPORTATION OF FARM PRODUCE
- EMISSIONS FROM IMPROPER LAND USAGE
- WASTE GENERATED FROM FARM ACTIVITIES

Carbon farming

Carbon farming is a voluntary carbon offsets initiative which aims to provide economic benefits to farmers who adopt sustainable practices to reduce carbon emissions. It consists of farming practices which help reduce carbon from the atmosphere by converting it into soil organic matter and other plant material.

Carbon farming practice			
Application of compost	Forage and biomass planting	Alley cropping	Rotational grazing
Tillage and residue management	Establishment of shelterbelts	Restoration of wetland	Nutrient management
Manure management	Critical area planting	Biogas recovery system	Grassed waterways

Economics of carbon farming

Agriculture can potentially reduce GHG emissions by about 5,500 to 6,000 Mt CO2e (million metric tons of carbon dioxide equivalents) annually, by 2030. The economic potential can be at 1,500 to 1600, 2,500 to 2,700, 4,000 to 4,300 Mt CO2e at a carbon price up to US$ 20, US$ 50 and US$ 100 per Mt CO2e annually, respectively. [2]

Bayer is offering farmers monetary rewards for adopting climate-friendly agricultural practices, as part of the Bayer Carbon Initiative. [3]

Indigo Ag is providing US$ 10 for each equivalent ton of carbon dioxide removed by farmers. Farmers need to provide the geolocation and other details of the farm. Indigo will capture the agronomic data and the soil samples to assess the increase in organic carbon content. [4]

Technology for carbon farming

Agronomic practices tracking

Digitalization of the farming process can enhance the productivity of farmers. A farm management solution that tracks their agronomic practices offers real-time visibility into agricultural activities.

It helps them plan crop rotation, when to use fertilizers and pesticides, and also provides weather forecasts. When this information is integrated with farming data, it helps farmers work more efficiently and in a climate-smart manner.

GHG emissions management tools

Farm activities such as the use of fertilizers and pesticides, and livestock emissions produce greenhouse gases such as nitrous oxide, carbon dioxide, and methane. One of the ways that agricultural greenhouse gas emissions can be managed or reduced is by using high quality feed that reduces methane emissions by livestock. Crop rotation can support soil conservation and carbon sequestration. Energy conservation can also reduce greenhouse gas emissions by ensuring that all heating and cooling systems are functioning optimally.

Farm-level data capture

There are several digital tools for farmers to collect information such as farm yield data, soil data, GPS maps, satellite imagery. This data helps them make informed decisions on seeding, fertilizers, and other agronomic practices to increase carbon sequestration.

Farm-level sustainability metrics / scoring

The eight sustainability metrics - biodiversity, energy use, greenhouse gas emissions, irrigation water use, land use, soil carbon, soil conservation, and water quality - can be measured using various digital tools. Farmers can use the results to evaluate their sustainability practices.

Remote sensing-based mapping for vegetation cover

Tree cover on a farm is an important element in carbon capture and mitigating climate change. Vegetation cover mapping also helps farmers to manage resources sustainably. Farmers can use remote sensing technology to obtain a vegetation cover dataset.

Remote sensing technology uses cameras in aircraft or satellites to obtain images of the earth's surface. It detects the physical characteristics of an area, such as vegetation cover, by measuring its reflected and emitted radiation.

Blockchain-based smart contracting for carbon credits

Farmers can use blockchain technology, popularly associated with cryptocurrency, to confirm carbon offsets, using smart contracts secured by a distributed ledger. Smart contracts are traceable, transparent, irreversible self-executing contracts running on blockchains.

Automated reporting and payouts

Farmers can utilize digital platforms for carbon measurement and verification. Such technological solutions calculate how sustainable farming practices of farmers affect carbon emissions, and calculate their carbon credits. Agricultural carbon credit companies can use carbon sequestration data to provide farmers with automated payouts of credits.

Farm-level data for capturing GHG emissions	
Crop data	Crop, season, yield
Soil data	Soil organic matter, moisture, pH, soil drainage
Field treatment	Fertilizer, pesticide, crop residue management
Land usage	Tillage change, land use change, cover crop
Energy usage	Energy consumption for operations
Transportation	Transportation mode, weight and distance

Technology can make carbon markets transparent, hassle-free, and accessible to farmers, allowing them to avail of the economic benefits of carbon farming. Farmers can reap economic benefits of carbon farming and contribute to sustainable agricultural practices.

Infosys Smart Agriculture Solution

The solution has been built leveraging Internet of Things (IoT), AI/ML, Big Data & Analytics, Mobility and Cloud platforms combined with customizable algorithms, business logic, and strong agriculture domain expertise through collaboration with agriculture universities and research institutes. Infosys Smart Agriculture helps to calculate greenhouse gas emission based on agri-inputs used and crop management practices employed for a crop production. Refer the following for more details: Infosys Smart Agriculture PoV and Infosys Smart Agriculture Video

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