Issue 8
November 30, 2023
(Revised March 10, 2024)

# NEWSLETTER

## Smart & Net-Zero Project

## Overview

Welcome to the FFTC Smart & Net-Zero Newsletter! Explore innovative technologies, sustainable practices, policy initiatives, and knowledge sharing platforms worldwide.

In this Edition, you will find short summaries of climate action plans and policies of several European countries, as well as of several policy review papers by academic researchers. In particular, OECD stresses that carbon pricing, or emission tax, is required to discourage high-emission activities, and to bring about transformative changes in food system. Also, an EU research team has pointed out the need for a credible carbon certification framework in support of carbon removal policy. Then in the New Section, one will also find reports of policy impact, such as how EU's new Green Policies and import ban on deforestation-linked commodities have spurred cattle ranchers in Brazil to adopt product origin tracking system.

**Content**

# RESEARCH

**01 THEME:** GHG emission reduction; MRV (measurement, reporting, verification)

## Greenhouse gas emissions and mitigation in rice agriculture

September 26, 2023 | Nature Reviews Earth & Environment | Source |

**Introduction:** Rice paddies supply stable food to half of the world's population but contribute about 48% of GHG emissions from croplands. Key Laboratory of Crop Physiology and Ecology in Southern China, Nanjing and University of Exeter, UK collaborated on reviewing greenhouse gas (GHG) emissions, mainly methane ($CH_4$) and nitrous oxide ($N_2O$), from rice fields and their impact on climate change.

**Key findings:** On average, each hectare emits approximately 7,870 kilograms of carbon dioxide equivalent per year, with $CH_4$ accounting for 94%. Emissions vary due to different management practices; for example, adding organic matter and continuous flooding increase $CH_4$, while nitrogen fertilizer application drives $N_2O$ emissions. Although current emission trends are uncertain, future projections suggest increased $CH_4$ emissions due to elevated $CO_2$ and warming.

**Conclusion:** The review study proposes integrated agronomic strategies, such as selecting new rice varieties, reducing continuous flooding, and removing straw, which could reduce emissions by 24%, 44%, and 46%, respectively. However, optimizing these approaches based on seasonal $CH_4$ emission patterns is crucial, highlighting the need for improved measurement and reduced uncertainty in global GHG estimates, especially in low latitudes.

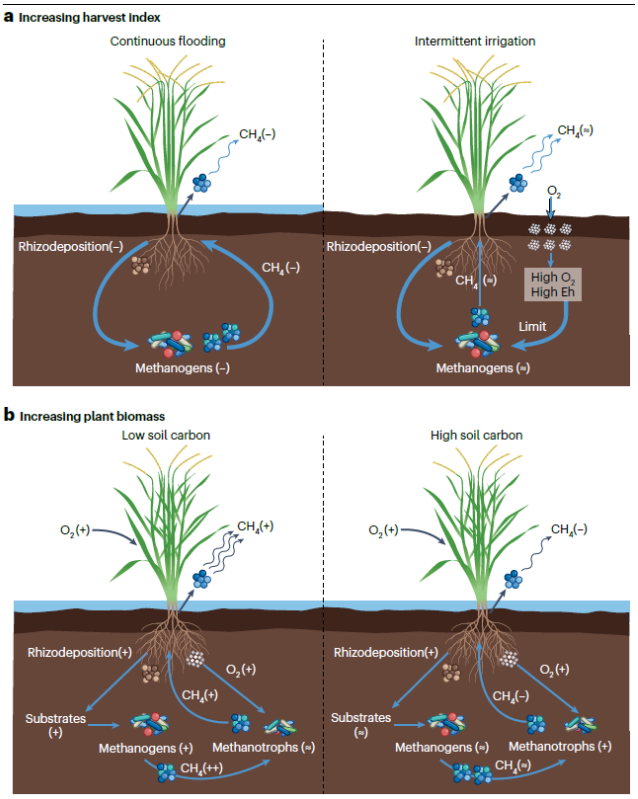


**Figure 1 | $CH_4$ emissions as affected by breeding strategies to increase rice yield.**

Rice cultivar

Select local high-yield cultivars with low GHG emissions

Water management

- **Rice season: apply non-continuous flooding practices**
  - Timing: if possible, drain at high $CH_4$ emissions stages
  - Numbers: multidrain if possible, or single drain
  - Severity: moderate drain (i.e. soil water potential, −10 to −20 kPa; water level below soil surface, 10–25 cm)
  - Days: unflooded days as long as possible
- **Fallow season: if possible, maintain unflooded**

Organic matter management

- Low SOC content: compost manure and straw addition (if possible, at fallow or upland crop season), plant low C/N green manure
- High SOC content: if possible, straw removal or return at fallow or upland crop season

Mineral N management

- N rate: optimal N rate at which maximum yield is achieved
- N placement: place fertilizer to ~10 cm of soil depth
- N type: if possible, apply enhanced efficiency N fertilizers or ammonium sulfate

Tillage and crop establishment

- **Tillage:**
  - Rice season: apply no tillage, if no tillage transplanting equipment and technology to sustain rice yield are available
  - Fallow season: if possible, apply conventional tillage
- **Crop establishment:**
  - Apply direct seeding, if direct-seeding equipment and technology to sustain rice yield are available
  - Plant ratoon rice when thermal energy exceeds requirements for single rice but falls short of requirements for double rice


Liming

Acidic soils (pH <5.5): lime addition

**Figure 2 | Potential mitigation strategies**

**02 THEME:** Policy Incentives, financing, pricing

# Incentive programs promote cover crop adoption in the northeastern United States

August 11, 2023 | Agricultural & Environmental Letters | Source |

**Introduction:** Under cover crop incentive programs, farmers across Maryland, Pennsylvania, New York, and Vermont are increasingly turning to cover crops as a means to enhance soil health and provide additional ecosystem benefits. A study by researchers from Cornell University in the USA surveyed 328 participating farmers to understand their characteristics and evaluate the impact of these programs on cover crop adoption.

**Key findings:** On average, results demonstrated that incentive programs led to a significant increase in the adoption of cover crops. The average cropland area planted with cover crops doubled from 50.7 hectares before program participation to 101.0 hectares during participation. Even among farmers who had concluded their program involvement, cover crop use remained, on average, 37.2% higher than before program enrollment.

**Conclusion:** These findings underscore the pivotal role of incentive programs in encouraging cover crop adoption and suggest insights for broadening participation among diverse farmers and enhancing the overall impact of such initiatives.

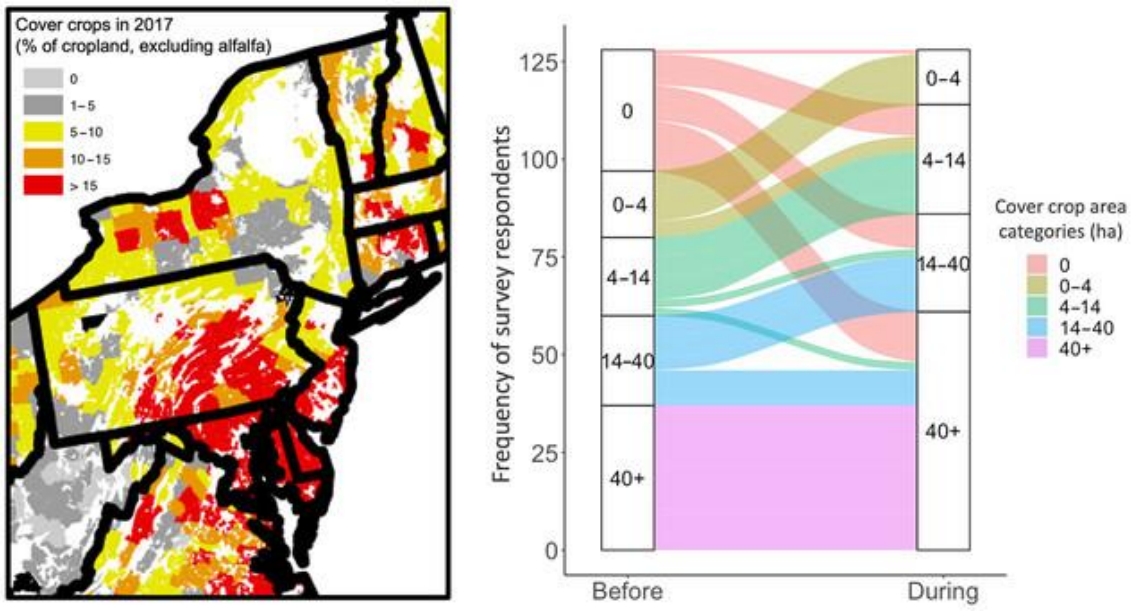


**Figure | Cover crop adoption as a share of harvested acreage, 2017.** Maryland, Pennsylvania, New York, and Vermont were among the states with the greatest adoption of cover crops expressed as a percentage of cropland (excluding alfalfa) in 2017.

**03 THEME:** Policy incentives, financing, pricing; GHG emission reduction; Carbon sequestration

# Sustainable pathways toward reimagining India's agricultural systems

July 18, 2023 | Communications Earth & Environment | Source |

**Introduction:** Researchers from University of Massachusetts Boston in the USA proposed policy framework and pathways towards achieving agricultural sustainability in India. The proposed pathways include: 1) Build soil fertility with less synthetic fertilizer, 2) Reuse crop residue as raw material, 3) Reduce greenhouse gas emissions from livestock, 4) Promote agroforestry for Carbon sequestration with co-benefits.

## Key findings

- There is an urgent need for new policy frameworks to revamp and enhance institutional networks and capacities to adopt landscape-systems approaches in agricultural research and resource management that promote sustainability, climate resilience, biodiversity, and ecosystem services. The scope extends beyond agroecosystems to include nearby ecosystems like forests, wetlands, abandoned fields, and urbanizing areas.
- Landscape-system research and source management needs to be based on field research across multiple agroecosystems, and interdisciplinary collaboration to create the knowledge commons can be facilitated by use of digital platforms.
- Field trials requiring a shift in research paradigm, should involve various stakeholders beyond agricultural scientists, such as farmers, local non-governmental organizations, and agencies, to collect large-scale farm-level data. 4) Disseminate knowledge to stakeholders such as small farmers via digital platforms of existing civil societies.

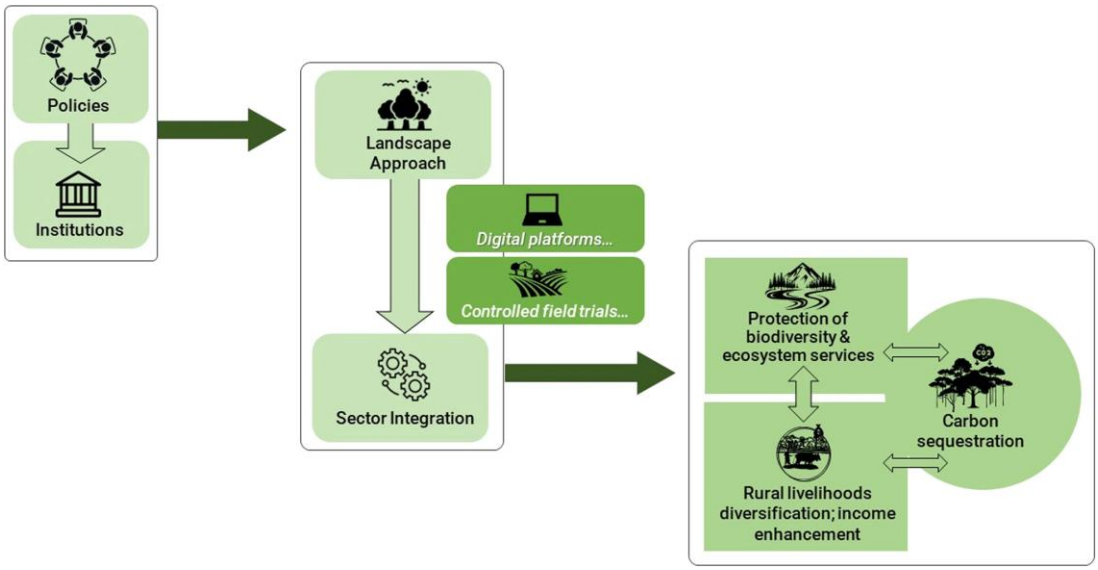


**Figure | A simplified, schematic transformation pathway for Indian agricultural systems.** The diagram outlines the flows of information and influence needed to generate large-scale outcomes incorporating biodiversity protection, livelihoods support and climate mitigation.

**04 THEME:** ICT in agrifood sustainability

# Precise irrigation water and nitrogen management improve water and nitrogen use efficiencies under conservation agriculture in the maize-wheat systems

July 26, 2023 | Scientific Reports | Source |

**Introduction:** Over a three-year field experiment aimed at addressing underground water depletion and ensuring agrifood system sustainability, researchers from International Maize and Wheat Improvement Centre in Bangladesh implemented a Subsurface Drip Irrigation (SDI) system combined with nitrogen management in a conservation agriculture-based (CA) maize-wheat system (MWS).

**Key findings:** When compared to conventional furrow/flood irrigation (CT-FI), SDI demonstrated significant increase of 5.2% to 15.8% in crop yields, approximatey 55% in water saving, and 25% reduction in fertilizer N use. Despite a higher production cost, the net returns from MWS were significantly elevated (USD 265) under SDI.

**Conclusion:** The study emphasizes the potential of combining conservation agriculture with SDI and N management for maximizing productivity, nitrogen use efficiency (NUE), and irrigation water productivity in the Trans-Indus-Gangetic Plain of South Asia.


**Figure | Maize-wheat systems**. (a) Single row of maize and (b) two rows of wheat crop on each permanent bed with subsurface drip irrigation system.

**05 THEME:** Carbon sequestration; Policy incentives, financing, pricing

# Farmer perspectives on carbon markets incentivizing agricultural soil carbon sequestration

September 25, 2023 | npj Climate Action | Source |

**Introduction:** Efforts to mitigate climate change and achieve net-zero emissions involve not only reducing current greenhouse gas emissions, but also deploying Carbon sequestration strategies, such as voluntary carbon offset markets to incentivise organic farmers to adopt related agricultural practices. Researchers from Hamilton College in USA conducted semi-structured interviews of both conventional and organic farmers to collect perspectives on soil carbon offset programs that have been implemented in the USA since 2017.

**Key findings:** Farmers expressed concerns about the complicated, burdensome, and unpredictable outcome of receiving offset credits. They implemented practices for their own business interests and sustainability concerns, rather than being primarily motivated by financial incentives from carbon credits. The study suggests that carbon offset credit payments for soil Carbon sequestration often go to farmers already implementing these practices, and the payments are viewed as an additional benefit rather than the main motivation.

**Conclusion:** This raises concerns about the effectiveness of these offset markets in ensuring true additionality, which is essential for effective climate mitigation.

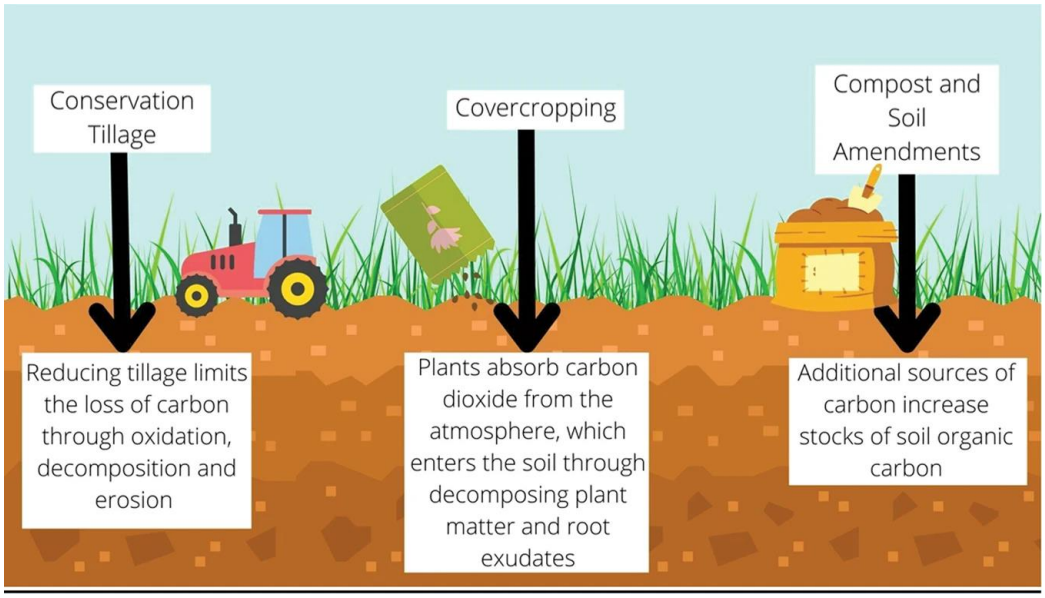


**Figure | Activities that enhance Carbon sequestration in agricultural soils.** This figure shows on-farm activities that can enhance soil Carbon sequestration. In some circumstances, types of activities can be implemented to generate carbon credits under voluntary market carbon offset protocols.

**06 THEME:** Policy incentives, financing, pricing

# The European Green Deal improves the sustainability of food systems but has uneven economic impacts on consumers and farmers

October 7, 2023 | Communications Earth & Environment | Source |

**Introduction:** EU established the policy program called The European Green Deal in 2019, aiming to create a fair, healthy, and environmentally friendly food system. To assess the impacts of this initiative, a partial equilibrium economic model was developed by France's National Research Institute for Agriculture, Food and Environment (INRAE). The model focuses on three main strategies: reducing chemical inputs in agriculture, minimizing post-harvest losses, and promoting healthier diets with fewer animal-based products.

**Key findings:** The study emphasizes that achieving significant improvements in climate, biodiversity, and nutrition necessitates the simultaneous implementation of all three measures. This integrated approach could result in a 20% reduction in greenhouse gas emissions from food consumption and a 40–50% decrease in biodiversity damage. Consumers benefit economically through lower food expenses, but livestock producers experience declines in quantity and price. Positive impacts on revenues for food/feed field crop producers depend on the balance between increased food consumption and reduced feed consumption.

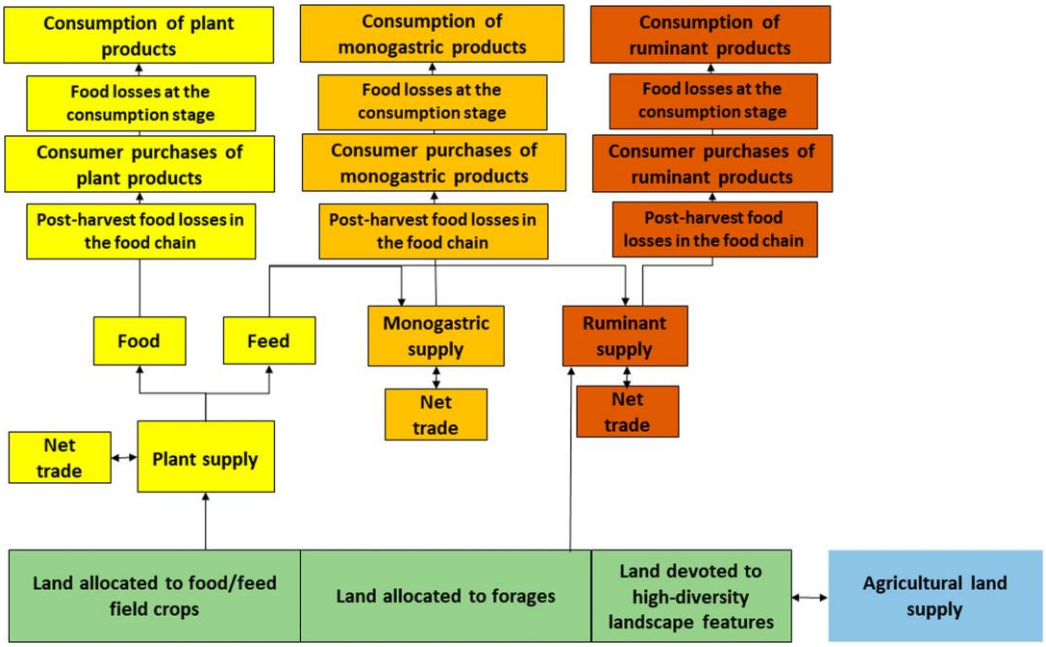


**Figure | Structure of the partial equilibrium economic model.**

**07 THEME:** Carbon sequestration

# Loss of natural capital due to expansion of cropland in China

September 25, 2023 | Nature Ecology & Evolution | Source |

**Introduction:** Globally, the increasing demand for food has led to widespread loss of biodiversity and ecosystem services. The research team from the Chinese Academy of Sciences utilized data spanning 2000 to 2015 from national ecosystem assessments in China, mapping the loss of four crucial ecosystem services (water retention, soil retention, sandstorm prevention, and Carbon sequestration), along with potential wildlife habitat due to cropland expansion.

**Key findings:** The study reveals that, China as the global main grain producer, at the national level from 2000 to 2015, land reclamation for cropland has undermined gains in wildlife habitat and the ecosystem services of water retention, sandstorm prevention, Carbon sequestration, and soil retention by 113.8%, 63.4%, 52.5%, 29.0%, and 10.2%, respectively.

**Conclusion:** This underscores the need to invest in restoration of natural capital to achieve global sustainability goals. Balancing the demands of agriculture with the preservation of ecosystems is essential to ensure a more sustainable future.

Read more: Natural capital investments in China undermined by reclamation for cropland

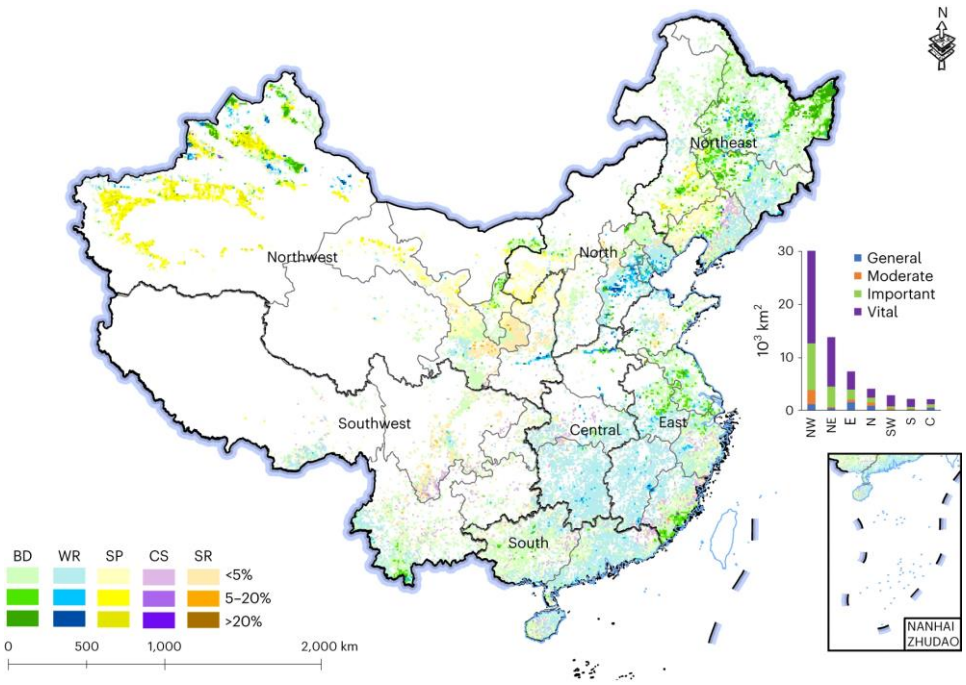


**Figure | Vital ecosystems converted to cropland across China, 2000–2015.**

**08 THEME:** Carbon sequestration

# Reusing abandoned cropland for food security and climate change mitigation

September 28, 2023 | Nature Communications | Source |

**Introduction:** Despite the growing challenge of land scarcity for agriculture, there is a significant global trend of cropland abandonment. Researchers from National University of Singapore has identified 101 million hectares of potential cropland that was abadoned between 1992 and 2020 from time series recently published by ESA Climate Change Initiatives (ESA-CCI), and explores the potential and trade-offs associated with reusing abandoned cropland for both food security and climate change mitigation spatially-explicit modeling and scenario analysis.

**Key findings:** The modeling results suggest that this abandoned cropland could simultaneously contribute to food production potential (ranging from 29 to 363 Peta-calories yr-1) and net climate change mitigation potential (ranging from 290 to 1,066 $MtCO_2$ yr-1), depending on land-use suitability and allocation strategies. The findings emphasize the importance of spatial prioritization to maximize the achievable potential of abandoned cropland. The study also presents various approaches to further enhance these potentials.

**Conclusion:** Ultimately, this research provides valuable insights into the possibilities of repurposing abandoned cropland for sustainable land management, offering a timely perspective to support both food security and climate goals.

Read more: The neglected role of abandoned cropland in supporting both food security and climate change mitigation

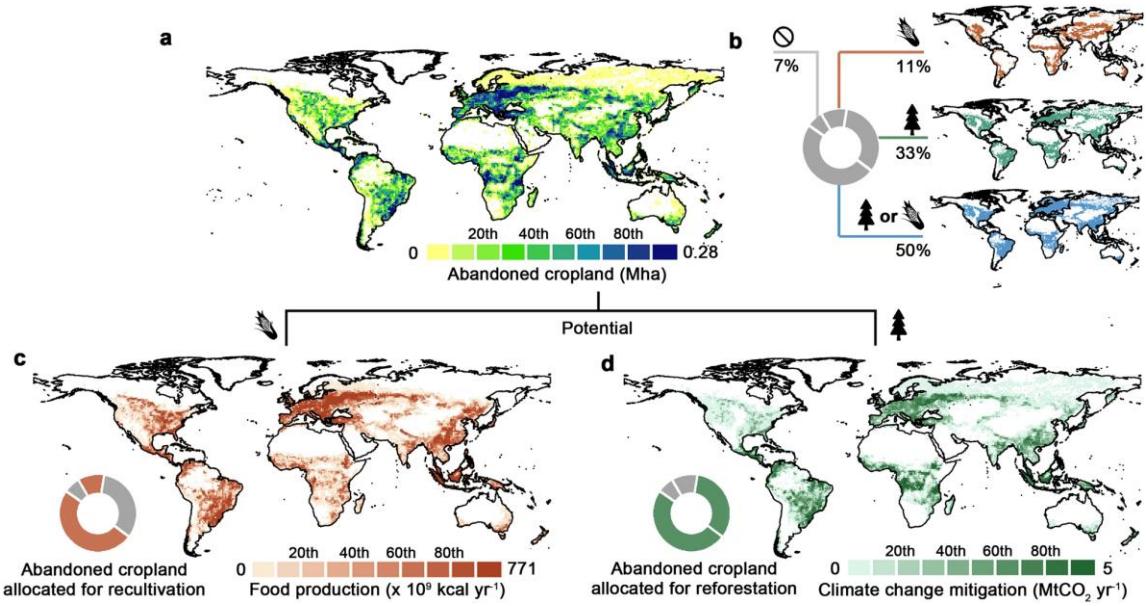


**Figure | Global abandoned cropland: extent, suitability, and potential.**

**09 THEME:** MRV; Policy incentives, financing, pricing

# Secure robust carbon dioxide removal policy through credible certification

October 3, 2023 | Communications Earth & Environment | Source |

**Introduction:** The Carbon Dioxide Removal (CDR) policy is crucial for achieving long-term climate goals, and the credibility of certification schemes is vital for its success. CDR involves activities that remove carbon dioxide from the atmosphere and store it durably in geological, terrestrial, or ocean reservoirs, or in products. Researcher from several German research institutes, such as Institute for International and Security Affairs, collaborted with International Institute for Applied Systems Analysis in Australia to comment on the current progress of The European Union (EU) in establishing a Carbon Removal Certification Framework (CRC-F).

**Key findings:** Carbon removal actions or emission reduction activities vary in effective durations, CRC-F and associated carbon trading must distinguish between more permanent sequestration and temporary emission reductions to ensure efficacy in achieving policy goals. A strong certification framework within the EU is likely to serve as a best practice example to other national and multilateral processes in legislative making. The balance between streamlined regulation to foster innovation and a strong framework for private sectors to particate in climate actions is crucial for the success of EU CDR.

Read more: Secure robust carbon dioxide removal policy through credible certification

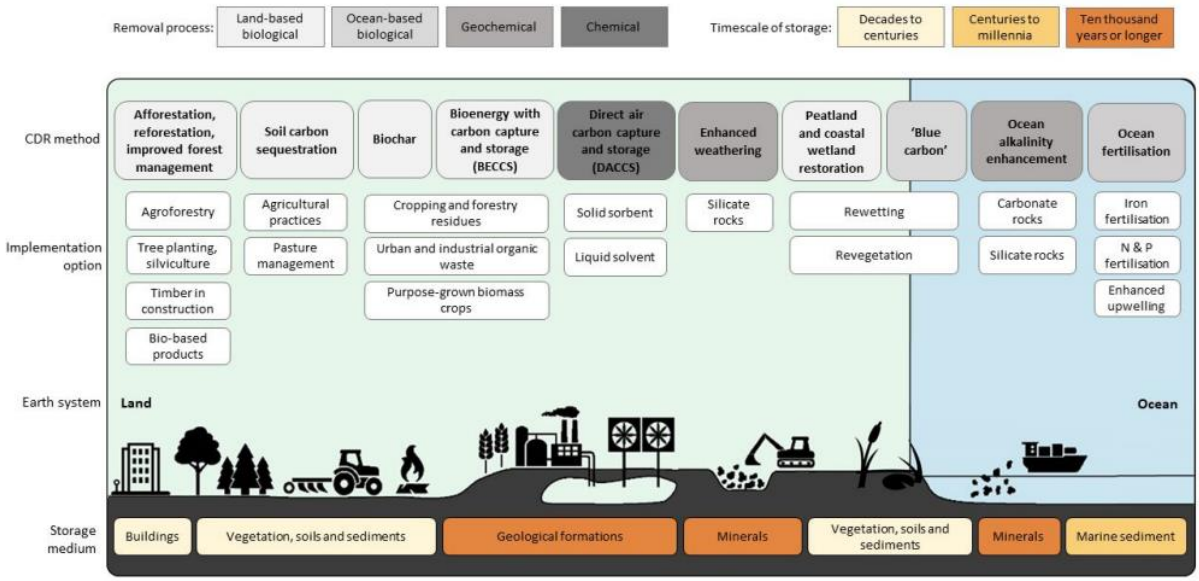


**Figure | Taxonomy for carbon removal / SOURCE: IPCC**

Picture source

**10 THEME:** ICT in agrifood sustainability

# Automated imaging sysem for insect pest monitoring

August 31, 2023 | Computers and Electronics in Agriculture | Source |

**Introduction:** Outdoor cultivation of mango faces challenges from insect pests and environmental factors. Integrated Pest Management (IPM) is proposed as a solution, using data-driven and eco-friendly methods to control pests. However, collecting insect population data manually is labor-intensive, prompting the need for automation. Research team from National Taiwan University introduces an image-based monitoring system designed to automatically capture insect pest populations and environmental conditions in mango orchards, employing solar-powered sensors to periodically acquire and analyze images from sticky paper traps.

**Key findings:** A modular deep learning algorithm accurately detects and classifies major pests, even in non-laboratory environments. Deployed in a remote mango orchard for over two years, the monitoring system demonstrated its efficacy in the identification of pest hotspots.

**Conclusion:** This innovative solution represents a breakthrough in smarter insect pest monitoring systems, promising improved IPM strategies for the sustainable cultivation of mangoes.

Read more: Edge-based wireless imaging system for continuous monitoring of insect pests in a remote outdoor mango orchard

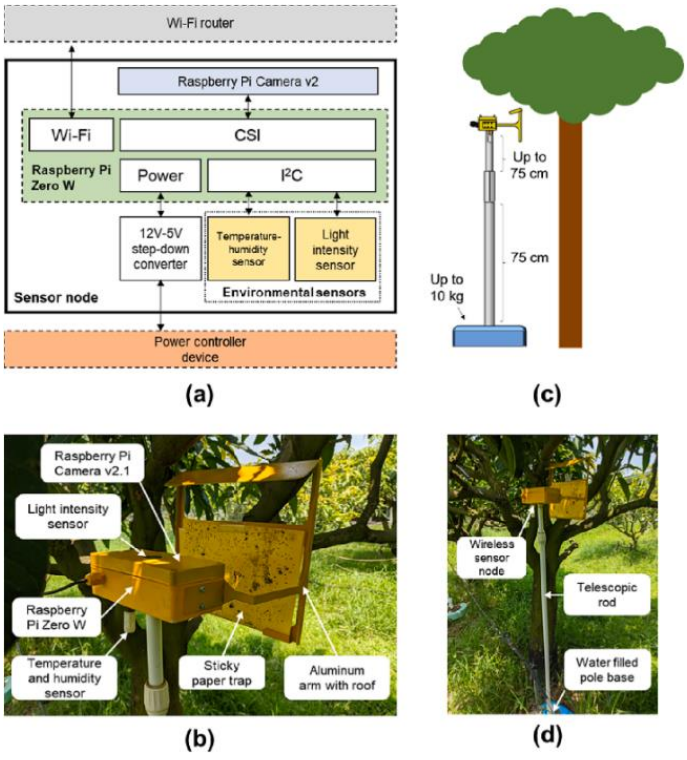


**Figure | Automated imaging sysem for insect pest monitoring.**

**11 THEME:** ICT in agrifood sustainability

# Enhancing energy efficiency of greenhouses using AI-based climate control

February 28, 2023 | Advances in Applied Energy | Source |

**Introduction:** Researchers from Cornell University in USA proposed the use of novel artificial intelligence (AI)-based control framework to enhance the energy efficiency of greenhouses while accurately regulating their indoor climate. The AI-based strategy learns from historical greenhouse climate data and adapts to current weather conditions and crop growth.

**Key findings:** In comparison to traditional control methods, the AI-based framework demonstrated remarkable performance. In a case study focused on controlling the greenhouse climate for tomato crops, the proposed strategy led to a substantial 57% reduction in energy consumption compared to conventional methods.

Read more: Energy-efficient AI-based Control of Semi-closed Greenhouses Leveraging Robust Optimization in Deep Reinforcement Learning

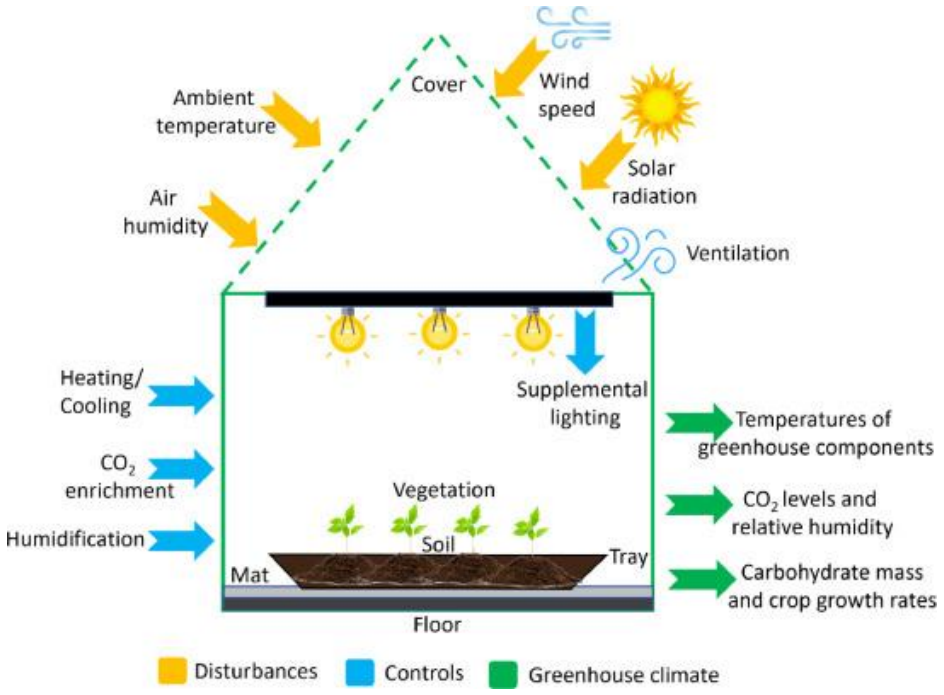


**Figure | Greenhouse simulation depicting the external disturbances, control actuators, and greenhouse states along with its components.**

# NEWS

**01 THEME:** Policy incentives, financing, pricing; GHG emission reduction

## Greenhouse Gas Emissions from Agriculture in Europe

October 24, 2023 | European Environmental Agency |

The European Climate Law outlines the EU's ambitious target to transition to a climate-neutral economy by 2050, with an interim goal of reducing greenhouse gas (GHG) emissions by at least 55% by 2030. Agricultural emissions fall under the EU Effort Sharing Regulation (ESR), which sets annual targets for member states until 2030. Methane ($CH_4$) emissions from enteric fermentation and nitrous oxide ($N_2O$) emissions from soils constitute a significant portion, comprising 48% and 31% of total agricultural GHG emissions, respectively.

From 2005 to 2021, the EU witnessed a marginal 3% decrease in agricultural GHG emissions, with a further estimated 2% reduction in 2022. Projections suggest emissions will plateau until 2030, with a potential 8% decline if additional planned measures are implemented. This places the onus on member states to achieve more substantial reductions in non-agricultural sectors to meet national targets. While some countries, like Croatia and Greece, have successfully reduced emissions, others, including Bulgaria and Hungary, experienced increases.

Member states' projections indicate that without additional measures, trends will likely persist, but some anticipate a reversal. Notably, Austria, Croatia, Denmark, Finland, Germany, Spain, and Sweden plan additional measures, projecting a 10% or more reduction in agricultural emissions by 2030. Conversely, twelve member states have not reported such measures, potentially challenging overall EU emission reduction goals.

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**02 THEME:** GHG emission reduction

## Microalgae: A Sustainable Solution for Fish Feed

October 09, 2023 | Earth.org |

Fish farms, responsible for over half of the fish in the market, face challenges such as high feed costs, pollution, invasive species, and water resource use. To address these concerns, fish farmers are exploring sustainable alternatives, with microalgae emerging as a promising option. While current fish feeds rely on wild fish or terrestrial agriculture, microalgae offer a more ecologically friendly solution. These single-celled organisms can provide superior nutritional profiles and are easily cultivated. Challenges include the expensive extraction process, but the potential benefits, such as improved weight gain, antioxidant properties, and enhanced immune health in farmed fish, make microalgae-derived feeds appealing. Additionally, microalgae's flexible water requirements and the ability to cultivate them in wastewater or seawater contribute to their sustainability. Despite challenges in harvesting and processing, ongoing research and development efforts aim to establish a more cost-effective and efficient microalgae-based fish farming industry.

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**03 THEME:** GHG emission reduction

## Lab-Grown Seafood, Explained

October 11, 2023 | Earth.org |

The Food and Agriculture Organization (FAO) reports a consistent rise in global seafood consumption, driven by expanding fisheries and aquaculture. San Francisco-based company WildType addresses ecological concerns by introducing lab-grown salmon, claiming to produce the cleanest and most sustainable seafood. Cultivated from a small cell sample of wild-caught salmon, this method aims to counter the environmental impact of conventional aquaculture and overfishing. Lab-grown salmon avoids contaminants like drugs, heavy metals, and microplastics, achieving maturity in 4-6 weeks compared to 2-3 years in traditional practices.

However, skepticism surrounds the sustainability and nutritional efficacy of lab-grown seafood. Concerns include the environmental impact of sterilization processes and the carbon footprint associated with lab settings. While lab-grown products offer potential solutions to overfishing, ocean pollution, and climate change, questions remain about their ability to address these challenges effectively. The slow pace of lab-cultured seafood operations and the need for regulatory approval further complicate the industry's future.

Lab-grown seafood holds promise as an environmentally friendly protein source, but challenges such as production costs and regulatory hurdles persist. Continued research and technological advancements may contribute to a more sustainable and ethically sourced protein supply in the future.

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**04 THEME:** Policy incentives, financing, pricing

## Indonesia Launches Carbon Credit Market in A Leap Toward Net Zero

September 26, 2023 | Carbon credits |

Indonesia has launched a carbon credit trading market, selecting the Indonesia Stock Exchange (IDX) as the platform. As Southeast Asia's largest emitter, Indonesia aims to reduce carbon emissions, promote energy transition, and achieve net-zero by 2060. President Joko Widodo believes Indonesia has vast potential in nature-based carbon reduction efforts, envisioning the country as the world's carbon market axis. The carbon exchange is expected to reach a value exceeding $194 billion. Over 99 coal-fired power plants, representing 86% of Indonesia's active coal plants, are set to participate, signaling a significant step in the nation's efforts to decarbonize its power sector. The country is focusing on finding funds to address the highest-ever growth in coal emissions last year. Carbon credits from PT Pertamina Geothermal Energy's Lahendong power plant were the first to be traded, starting at $4.51/credit, with buyers including major banks, mining firms, and state energy company Pertamina. The government plans to implement international standards for carbon trading and apply a carbon tax, extending emission caps to various sectors, including forestry, agriculture, waste management, and industrial processes. The use of blockchain technology will record carbon credit transactions in this bold move towards Indonesia's net-zero goal.

**05 THEME:** Policy incentives, financing, pricing; Carbon sequestration; MRV (measurement, reporting, verification)

## Fiji's First Indigenous-owned Carbon Credit Project

September 12, 2023 | Mongabay |

The village of Drawa in Fiji has implemented a verified forest carbon project that involves selling carbon credits on the voluntary market through the Plan Vivo standard. The Drawa Block Forest Communities Cooperative (DBFCC) was formed eleven years ago by local chiefs to set aside parts of ancestral forest for conservation rather than timber harvesting. The project aims to provide an alternative to logging, preserving some of Vanua Levu's last primary rainforests and safeguarding habitats for endangered species. While controversy surrounds the integrity of carbon credits, the Drawa project offers a sustainable and economically viable option for the community. In addition to carbon credits, the cooperative has initiated a rainforest honey business as an alternative livelihood, providing income and promoting conservation.

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**06 THEME:** GHG emission reduction; Policy incentives, financing, pricing

## EU Bill and New Green Policies Spur Progress on Brazil's Cattle Tracking

September 23, 2023 | Mongabay |

The European bill to ban imports of deforestation-linked commodities and other movements against illegal deforestation even made the powerful Brazilian Agriculture and Livestock Confederation (CNA) recognize the problem and propose a traceability model to the federal government.

The National Bank for Economic and Social Development (BNDES), a major financier of Brazilian cattle ranching, has announced that it will adopt a self-regulation protocol developed by the Brazilian Federation of Banks (Febraban) to combat illegal deforestation. The protocol involves a traceability system for banks to track the origin of cattle and ensure compliance with environmental standards. The Febraban protocol aligns with the "Boi na Linha" program, a herd monitoring initiative that the Brazilian Association of Beef Exporters (ABIEC) has also adopted. The ABIEC program includes stricter socioenvironmental criteria for cattle purchases, aiming to prevent deforestation and ensure legal and sustainable practices. The Brazilian meat industry, including major players such as JBS, Minerva, and Marfrig, is working toward comprehensive traceability of the beef supply chain to address concerns related to illegal deforestation and environmental conservation. The integration of technology and collaboration across the industry are seen as crucial steps in promoting transparency and combating deforestation associated with cattle ranching in Brazil.

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**07 THEME:** Poicy incentives, financing, pricing; GHG emission reduction

## A New Ag Deal: a 9-Point Plan for Climate-Smart Agriculture

October 03, 2023 | Royal Bank of Canada |

The Royal Bank of Canada (RBC) collaborated with BCG's Centre for Canada's Future and the Arrell Food Institute at the University of Guelph to explore Canada's potential "moonshot": producing 26% more food by 2050 with fewer emissions, contributing to global population growth. The findings emphasize Canada's unique position to lead in climate-smart agriculture, given its unparalleled assets, but stress the need for increased investments, accurate measurement technology for emissions, cross-sector collaboration, enhanced private sector research and development (R&D), addressing skills gaps, and rewarding early adopters of sustainable practices. RBC then published a comprehensive plan for transforming Canada's agriculture sector into a leader in climate-smart and sustainable practices. The plan is organized into nine policy recommendations across five key areas: soil, methane, fertilizers, talent and technology, and consumers:

- **Build Standards To Support Carbon Markets:** Establish a solid system for measuring and reporting soil carbon and emissions to support a viable carbon market. Proposes methodologies for creating offsets and insets, with a focus on scientific measurement and reporting.
- **Create A Climate-Smart Database To Help Farmers:** Develop a national soil database to collect data critical for understanding soil health, nitrous oxide emissions, Carbon sequestration, and organic carbon stock patterns. Calls for real-time, downloadable economic intel to empower farmers, experts, and decision-makers.
- **Develop A Fair System That Ensures Market Equity:** Recognize and reward early adopters with measures like an expanded capital gains exemption and tax credits based on scientifically proven carbon stock. Encourage a fair system to motivate farmers without unintended consequences.
- **Promote Ways To Make Methane Cuts Profitable:** Coordinates with provinces for a nationwide blend mandate, supporting digesters through nationwide blend mandate, Strategic Innovation Fund (SIF), Clean Fuel Regulations (CFR) credits, Cleantech Investment Tax Credit, and agile regulatios for methane-reducing feed additives..
- **Strengthen Canada's Domestic Fertilizer Portfolio:** Streamline approval processes for biological products, improve transportation networks, and provide funding to biological companies.
- **Nurture An Innovation-Driven Ag Sector:** Create a network similar to CRIN for oil and gas projects to promote R&D in ag-tech. Hold competitions to spur innovation and allowing innovative companies to showcase solutions and finance their innovations.
- **Revive Canada's Knowledge-Sharing Network:** Proposes a collaborative approach involving public, private, and institutional actors to revive agriculture extensions and knowledge-sharing networks.
- **Boost Investment In Post-Secondary Education:** Create programs welcoming students from different educational backgrounds and micro-credential programs. Eiminate arriers to foreign credentials to bridge labour gaps in the agriculture sector.

- **Influence purchasing patterns through procurement:** Establish a green procurement program to purchase food produced through climate-smart agricultural practices, aligning with Net Zero commitments. Direct federal funds toward sustainable food purchases, supporting growers and reducing food waste.

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**08 THEME:** GHG emission reudction; Policy incentives, financing, pricing

## Livestock Farmers from Sweden to Greece Test Paths to Greener Agriculture

September 24, 2023 | Phys.Org |

Livestock farmers in Germany, Italy, Sweden, and the UK are shifting towards sustainable practices by feeding cows mainly or exclusively grass, aiming to reduce environmental and social costs associated with grain-based diets. The conventional use of imported grains contributes to deforestation, long transport routes, and higher emissions. Inspired by UK producers with 100% grass-fed cows, the EU project PATHWAYS is testing the feasibility of pasture-based farming. This approach offers environmental benefits such as nutrient return to the soil and $CO_2$ absorption. However, the success depends on consumers paying premium prices for healthier and environmentally friendly products. The project also addresses emissions, animal welfare, and waste issues in collaboration with partners across 12 countries. Additionally, the Code Re-farm project focuses on enhancing safety, improving practices, and providing consumers with information on food origin and production methods for dairy goats and poultry. Nine tools are being developed to monitor animal health, improve product quality, and inform consumers, promoting sustainable livestock farming in Europe, such as  a portable device that can determine the safety of eggs, an instrument to detect mastitis, etc.

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**09 THEME:** ICT in agrifood sustainability; Policy incentives, financing, pricing

## 2023 GAP Report: Only by Working Together will Agricultural Productivity Meet Demand

December 04, 2023 | Phys.Org |

The 2023 Global Agricultural Productivity Report, "Every Farmer, Every Tool," emphasizes the critical role of sustainable agricultural productivity growth in meeting global food security and environmental goals. Current efforts to expand production are deemed insufficient as global agricultural productivity growth has slowed. The report advocates for a higher target productivity growth rate of 1.91 percent annually to meet global agricultural needs sustainably.

GAP Report identifies the need to provide every farmer with access to productivity-enhancing technologies and efficient practices, such as improved genetics, precision agriculture, soil health and managemnet, integrated production systems, and pest and disease management, mechanization and automation, and knowledge platforms.

Sustainable productivity growth, recognized as a key solution, requires collaboration across public, private, and civil sectors. The report offers six data-driven policy and investment priorities to drive actionable steps, including investing in research, embracing science-based technologies, improving infrastructure, cultivating partnerships, expanding trade, and reducing post-harvest loss and food waste.

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**10 THEME:** GHG emission reduction; Policy incentives, finaicng, pricing

## Agricultural Machinery Sharing Program for Lowering Production Cost and Carbon Emissions (In Chinese)

September 15, 2023 | Agri-Harvest, Taiwan |

Taiwan's Agriculture Ministry launched an initiative under the "Agricultural Machinery Cultivation Service System" framwork to promote sharing of agricultural machinery to enhance farm efficiency and reduce carbon emissions. Implemented by Mingdao University's Smart and Refined Agriculture Department and the Taoyuan Youth Farmers Production Cooperative, the project focuses on leasing small electric farm equipment. This approach aims to make electric machinery more accessible and economical for farmers, contributing to the country's agricultural electrification.

The President of the Taoyuan Youth Farmers Association, Wu Cheng-fu, highlighted the cost-effectiveness of renting small electric farm machinery, especially for farmers who use such equipment infrequently. The project, in operation for nearly a year, has seen a rise in electric farm machinery usage, reducing carbon emissions by 15 tons. The initiative supports the growth of electric farming in Taiwan, offering an affordable and eco-friendly alternative for farmers with low equipment usage frequency.

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**11 THEME:** ICT in agrifood sustainability

## Yilan University Smart Agriculture Team Train Local Youth to Operate Drones (In Chinese)

September 07, 2023 | Economics Daily, Taiwan |

In response to aging labor in Taiwan's rural areas, the village of Erlong in Jiaoxi Township, Yilan County, announced the establishment of a drone fleet on September 7. The initiative, led by the "Flying Fish Team" comprised of students from the National Yilan University's Unmanned Aircraft Application and Smart Agriculture program, aims to revolutionize agriculture with technology. In collaboration with the Erlong Village Cultural Promotion Association and the National Yilan University Unmanned Aircraft Center, the project received enthusiastic support from villagers and local authorities. The program focuses on training local youth to operate drones, integrating technology for efficient crop management and addressing challenges in traditional farming methods. The initiative showcases the potential of smart agriculture to transform rural areas.

# POLICY

**01 THEME:** Sustainable consumption; Net zero strategy, Supply chain

## The role of carbon pricing in transforming pathways to reach Net Zero emissions

OECD| Source | Download |

**Introduction:** To achieve the ambitious goal of limiting global warming to 1.5°C as outlined in the Paris Agreement, transformative changes in greenhouse gas (GHG) emission pathways are imperative. Despite progress in national climate policies, existing measures are insufficient. Carbon pricing emerges as a potential tool, but its efficacy remains limited.

### Challenges and Opportunities

- **Insufficient Action:** Despite the proliferation of carbon pricing schemes globally, they cover only 23% of GHG emissions, with prices often below effective levels.
- **Demand-Side Shifts:** Comprehensive policies addressing both supply and demand sides are crucial. Carbon pricing can incentivize shifts in consumption patterns towards low-carbon alternatives.
- **Sectoral Impacts:** Carbon pricing alone hasn't driven sufficient emission reductions, but evidence shows positive impacts when combined with other policies, especially in the electricity sector.
- **Just Transition:** Transitioning to net zero emissions may have short-term social impacts. Proactive measures are necessary to support affected communities and workers.

### Policy Recommendations

- **Comprehensive Policy Packages:** Integrate carbon pricing with other measures to address both supply and demand sides, ensuring a just transition.
- **Sequenced Deployment:** Deploy supportive policies before carbon pricing to facilitate the adoption of low-carbon alternatives, then introduce carbon pricing to discourage high-emission activities.
- **International Collaboration:** Foster cooperation to enhance the effectiveness and efficiency of carbon pricing schemes globally.
- **Emissions Pricing in Food Systems:** Explore the potential of emissions pricing to reduce GHG emissions in food systems, considering methodological, technical, and political challenges.

**02 THEME:** Climate Smart Agriculture, Land and nature-based solutions, Sustainable consumption

# The Netherlands' Global Climate Strategy

Government of Netheralands| Source | Download |

Scientists issue a dire warning, stating that we are one minute to midnight in the race to fulfill the Paris Agreement and UN Sustainable Development Goals. Urgent action is needed to curb global warming, biodiversity loss, and environmental degradation, as each temperature increase has irreversible impacts. The Dutch government, recognizing the urgency, is accelerating climate action, aligning with the European Green Deal.

The Global Climate Strategy outlines the Netherlands' commitment to strengthen responses domestically and globally. Initiatives include enhanced climate diplomacy, increased climate finance, phasing out support for unabated fossil fuel activities abroad, and promoting greener trade missions and infrastructure projects. The government pressures G20 nations for climate mitigation, supports countries transitioning to clean energy, and doubles the budget to conserve tropical rainforests.

In adaptation efforts, the Netherlands utilizes expertise in agriculture, land use, and flood prevention. Financial support for climate transitions in developing countries will rise to €1.8 billion by 2025, doubling public adaptation finance. The government encourages private-sector investment, exemplified by the Dutch Fund for Climate and Development.

Emphasizing equal focus on mitigation, adaptation, and finance, the Netherlands aims for a low-carbon, climate-resilient world by 2050. The strategy underscores the urgency, aligning with international agreements and urging global collaboration for a sustainable future.

**03 THEME:** Climate Smart Agriculture, Land and nature-based solutions, Supply chain

## Denmark's National Energy and Climate Plan

The Danish Energy Agency| Source | Download |

In June 2019, a new Danish Government formed a one-party minority Government led by the Social Democrats, in collaboration with the Red-Green Alliance, the Social Liberal Party, and the Socialist People's Party. This coalition established a vision outlined in the document "A Fair Direction for Denmark." The government aims to lead the green transition, elevate climate ambitions, and align with the Paris Agreement. Emphasizing a socially balanced approach, the coalition reached an agreement on a Climate Act in December 2019, committing to a 70% reduction in greenhouse gases by 2030 (relative to 1990) and achieving net-zero emissions by 2050. The strategies outlined in Climate Act are as follows:

- **Decarbonization - GHG Emissions and Removals:** The Climate Act sets a legally binding target to reduce greenhouse gases by 70% by 2030 and reach net-zero emissions by 2050. Climate Action Plans will follow, detailing policies for emission reduction in various sectors.
- **Decarbonization - Renewable Energy:** Denmark aims for at least 55% renewable energy in gross final consumption by 2030. The government plans initiatives to accelerate the transition to renewables in energy and transport sectors.
- **Energy Efficiency:** Despite expected increases in energy consumption, Denmark prioritizes energy efficiency, planning initiatives and subsidies for the period 2021-2030 to fulfill energy-saving obligations.
- **Energy Security:** Denmark maintains a high level of energy security through decreased dependency on third-country imports, domestic production, and cooperation with neighboring countries. The focus is on increased flexibility in the energy system.
- **Internal Energy Market:** Denmark emphasizes interconnectivity, with projects coordinated with neighboring countries and a focus on cross-border markets for balancing products. The country aims to increase flexibility in the energy system.
- **Research, Innovation, and Competitiveness:** The government commits to spending on research, development, and demonstration of new technologies related to energy and climate. Funding is allocated for climate-related research and innovation, promoting Denmark as a nation of green entrepreneurialism.

**04 THEME:** Climate Smart Agriculture, Land and nature-based solutions

# Norway's Climate Action Plan for 2021–2030 (white paper)

Ministry of Climate and Environment, Norway| Source | Download |

Norway endorsed climate action plan on January 8, 2021 as part of its commitment towards fulfilling Paris Agreement climate targets and advancing sustainable growth.

In terms of cutting agricultural greenhouse gas (GHG) emissions, the Norwegian Government and agricultural organizations, has signed a joint letter of intent outlining a ten-year plan (2021–2030) to achieve a collective reduction of 5 million ton $CO_2$eq. The Government pledges to provide a supportive framework to enable environmentally responsible choices within the agricultural sector. Key actions outlined in the plan include incorporating climate assessments into annual Agricultural Agreements, and specifying the mitigation impact in budget proposals. Collaborative efforts with agricultural organizations will focus on designing policy instruments aligned with both agricultural and environmental goals. The government will also prioritize improving emission inventories for the agricultural sector. Additionally, the plan explores the potential introduction of a tax on mineral fertilizers to reduce nitrous oxide emissions and aims to enhance the utilization of Norwegian feed resources, including rough grazing.

In terms of sustainable management of forests and land use, forests, acting as carbon sinks, absorb CO2, but land-use changes can lead to substantial emissions. The plan aims to enhance carbon removals in slow-growing northern forests through short-term measures like tending young-growth stands and reducing harvesting. Long-term strategies will contribute to a low-emission society by 2050. To boost carbon removals, the government considers factors at all production stages, promoting existing mitigation measures for forests. Grants for planting, tree breeding, and fertilization are proposed, emphasizing biodiversity and environmental interests. The plan addresses emissions from converting green areas (forest, peatland, agricultural) for construction and infrastructure. Smart spatial management, reusing industrial sites, and avoiding carbon-rich areas are crucial. Spatial planning at the municipal level, taxes on emissions from land-use change, and guidelines for holiday home planning are proposed. The plan also tackles emissions from converting peatland to agricultural land and peat extraction from forests.

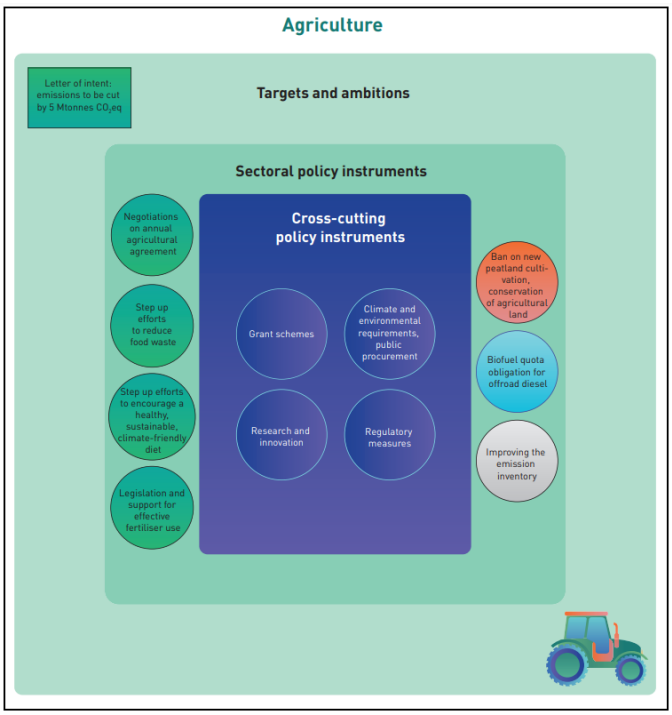


**Figure | Policy instruments to reduce emissions and enhance removals in agriculture.**

**05 THEME:** Climate Smart Agriculture, Land and nature-based solutions, Sustainable consumption

## Spain: National Climate Change Adaptation Plan 2021-2030

Ministry for the Ecological Transition and the Demographic Challenge, Spain| Source | Download |

The National Climate Change Adaptation Plan in Spain serves as a framework for coordinating public administrations in assessing impacts, vulnerability, and adaptation to climate change. Covering various ecological systems and socio-economic sectors, it addresses biodiversity, hydro resources, agriculture, coastal areas, and more. The plan aims to assist administrations and organizations at all levels in evaluating climate change impacts, providing information, tools, and assessment methods to define the best adaptation options.

For natural heritage and biodiversity, the plan focuses on studying climate change effects, supporting policies to reduce stress on species, integrating adaptation criteria in protected area planning, and enhancing green infrastructure. In forestry, desertification, hunting, and fisheries, it emphasizes understanding climate change impacts on forest resources, integrating adaptation into planning, preventing desertification, and addressing wildfire risks using nature-based solutions.

In agriculture, livestock, fisheries, aquaculture, and food, the plan aims to reduce climate change risks to food security. It calls for updating knowledge on climate change impacts, integrating this knowledge into sector plans, promoting adaptation interventions, and strengthening adaptation in fisheries and aquaculture. Additionally, it advocates for healthy diets, sustainable food systems, and adaptation strategies in rural areas for lower climate impact and greater resilience. The plan emphasizes collaborative efforts to define effective adaptation measures throughout Spain.

# OPEN DATA

**01 THEME:** Agrifood System, Land cover and Soil

## EuroCrops: The Largest Harmonized Open Crop Dataset Across the European Union

Technical University of Munich| Source | Data |

EuroCrops, currently hosted by Technical University of Munich, is a valuable resource comprising geo-referenced agricultural cropland data from 16 European Union (EU) countries, along with information about the specific crop species cultivated in these regions. These crop annotations are based on information provided by farmers who receive subsidies under the European Commission's common agricultural policy (CAP). Over the past 1.5 years, dedicated efforts have been made to collect individual national crop datasets and translate crop classes into English. These data have been integrated into a newly developed hierarchical crop and agriculture taxonomy (HCAT).


EuroCrops is accessible to the public and is continuously improved with the active engagement of its user community. This resource serves as a valuable tool for researchers, policymakers, and stakeholders in the agricultural sector, providing insights into crop distribution and farming practices across the EU.

**Figure | Cropped Region with References**

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**02 Theme:** Agrifood System

## Global crop-specific nitrogen fertilization dataset in 1961-2020

National Tibetan Plateau Data Center| Source | Data|

National Tibetan Plateau Data Center (TPDC) is one of the first 20 national data centers authorized by the Ministry of Science and Technology of China in 2019 . It is the only data center in China with the most complete scientific data for the Tibetan Plateau and surrounding regions. There are more than 1,700 datasets covering many disciplines such as geography, atmospheric science, cryospheric science, hydrology, ecology, geology, geophysics, natural resource science, social economy, and other fields.

Nitrogen (N) fertilizers play a vital role in supporting crop growth. However, their excessive use has resulted in a range of severe global environmental challenges. Recent research has produced several datasets related to agricultural N fertilization, each characterized by variations in temporal or spatial resolution. Nevertheless, the effective synchronization and utilization of these datasets

pose challenges due to disparities in temporal coverage, spatial resolutions, and the allocation of N fertilizers to specific crops.

To address this issue, a comprehensive dataset for crop-specific N fertilization has been reconstructed at a 5-arc-minute resolution, roughly equivalent to 10 km by 10 km, covering the period from 1961 to 2020. This dataset encompasses essential information, including N application rates, types of N fertilizers, and their placement methods. Furthermore, the N fertilization data has been categorized into 21 distinct crop groups, 13 fertilizer types, and two fertilization placement categories.

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**03 THEME:** Agrifood System, Land cover and Soil

## Spatial–temporal distribution of global production–living–ecological space during the period 2000–2020

Scientific Data| Source | Data |

Scientific Data is a peer-reviewed open-access journal for descriptions of datasets and research that advances the sharing and reuse of research data. Our primary content-type, the Data Descriptor, combines traditional narrative content with structured descriptions of data to provide a framework for data-sharing to accelerate the pace of scientific discovery. These principles are designed to align with and support the FAIR Principles for scientific data management and stewardship, which declare that research data should be Findable, Accessible, Interoperable and Reusable. This dataset addresses a gap in global databases, providing a valuable resource for evaluating sustainable development goal coordination, considering economic, social, and ecological elements in the production-living-ecology space. The dataset was generated by researchers from University of Chinese Academy of Sciences from integrating global land cover data from GlobeLand30 and population density data from NASA for 2000, 2010, and 2020 to create a comprehensive global production-living-ecological space map. Verification using random sampling in ArcGIS and Google Earth images yielded high accuracy of 83.94 to 87%.

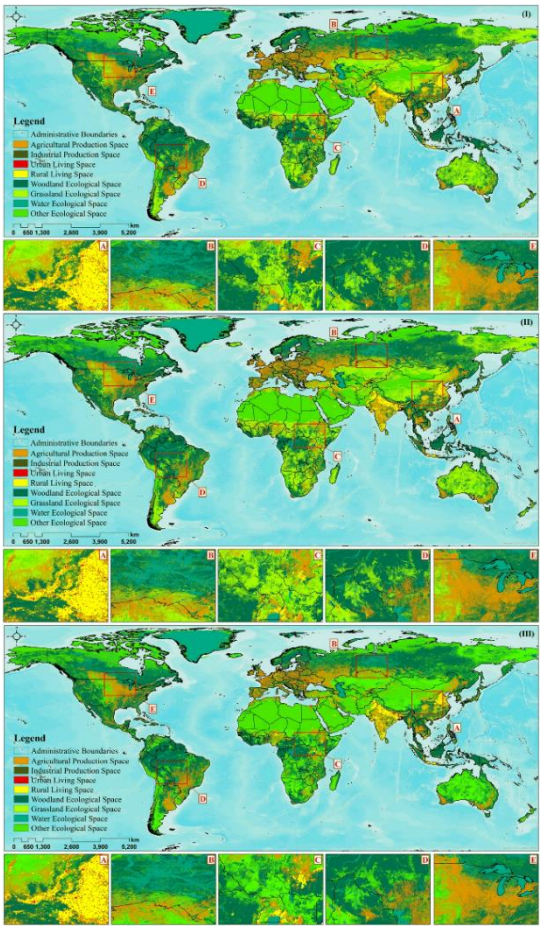


**Figure | Global production–life–ecological space classification in 2000 (I), 2010 (II), and 2020 (III).**

**04 THEME:** Environment and Climate, GHG Emission Inventory, Land cover and Soil

## Carbon-water flux datasets of Eurasian meteorological stations

Scientific Data| Source | Data |

Scientific Data is a peer-reviewed open-access journal for descriptions of datasets and research that advances the sharing and reuse of research data. Our primary content-type, the Data Descriptor, combines traditional narrative content with structured descriptions of data to provide a framework for data-sharing to accelerate the pace of scientific discovery. These principles are designed to align with and support the FAIR Principles for scientific data management and stewardship, which declare that research data should be Findable, Accessible, Interoperable and Reusable.

The exploration of carbon-water flux data from a more extensive network of meteorological stations presents a promising solution to the persistent challenge of limited observational data in this domain. The research team from Chinese Academy of Sciences has introduced an innovative framework designed to gauge the adaptability of Eurasian carbon-water flux simulation models, specifically the random forest model (RFM), to a diverse array of meteorological stations. To assess the concordance between these models and meteorological station data, a combination of statistical metrics, including the determination coefficient (R2) and Euclidean distance, was employed.

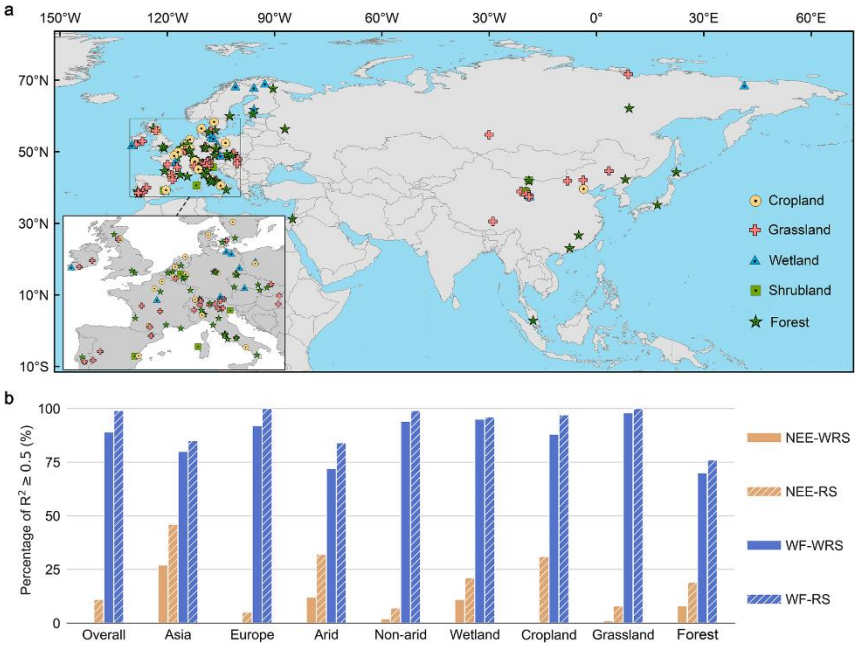


**Figure | Study area and the accuracy of carbon-water flux simulation models (random forest model, RFM).** (a) Distribution of the 156 Eurasian flux stations covering five main landscape types. (b) The accuracy assessments of the RFM based on the Eurasian flux stations in the framework of the 10-time 10-fold cross-validation. The figure shows the percentage of the RFMs with R2 ≥ 0.5 tested in the test sets for nine categories.

**05 THEME:** Climate Smart and Net zero toolkit

# FarmVibes.AI: Multi-Modal GeoSpatial ML Models for Agriculture and Sustainability

Microsoft | Source | Data | Guide |

FarmVibes.AI, developed by Microsoft, is a versatile platform designed for the development of multi-modal geospatial machine learning (ML) models tailored for agriculture and sustainability applications. The primary objective of this platform is to enable users to gain valuable insights by amalgamating and analyzing various geospatial and spatiotemporal datasets.

The platform offers a range of data ingestion and pre-processing workflows that assist users in preparing data for customized fusion models geared towards agricultural use cases. It provides convenient dataset downloaders, including resources like Sentinel 1 and 2 satellite imagery, US Cropland Data, USGS Elevation maps, NAIP imagery, NOAA weather data, and even private weather data from Ambient Weather. Users have the flexibility to incorporate their own rasterized datasets, such as drone imagery or additional satellite data, making them fusion-ready for utilization within FarmVibes.AI. Furthermore, the platform offers multiple data processing workflows that can be applied to the downloaded data, including index computation and data summarization.

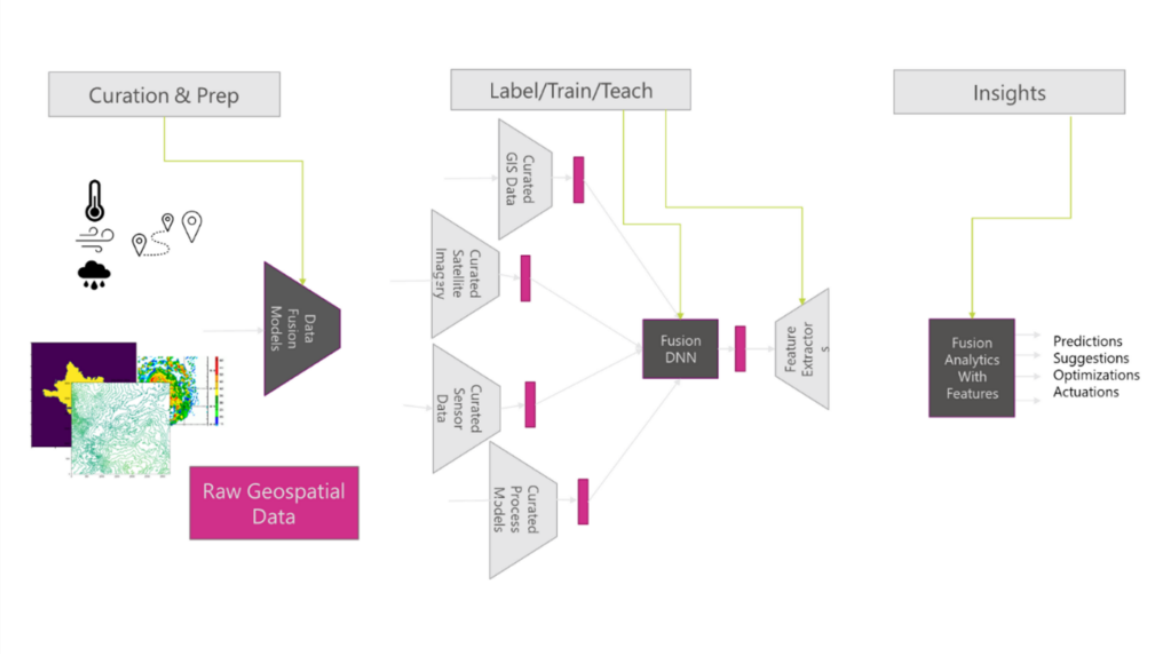


**Figure | Fusing datasets this way helps generate more robust insights.**