



## Issue 10

January 30, 2024  
(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 to achieve net zero emission.

While COP28 recently concluded in December 2023, many participating international organizations have released statements on the need to promote sustainable diet in the past month. In particular, IPES-Food, an independent panel of experts on transition to sustainable food systems, call for local governments to play a leading role. The Open Data section this month features many decision support toolkits presented at COP28. In term of research, soil health, as well as the production of edible proteins and carbohydrates molecules through chemical and biological processes are gaining momentum. This month's news also contain many updates of carbon markets around the world. On the same topic, this month's Policy section features USDA's recent assessment of agricultural sector's participatin in the US carbon market.

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Newsletter Issue 10

January, 2024

RESEARCH

Smart & Net-Zero Project

RESEARCH

01 THEME: GHG emission reduction

## Ending extreme poverty has a negligible impact on global greenhouse gas emissions

November 29, 2023 | Nature | [Source](#) |

**Introduction:** While eradicating poverty has historically led to modest increases in global emissions, World Bank researchers re-examine the historical relationships between consumption, economic growth, and energy/carbon intensity to determine if poverty alleviation and climate change mitigation are compatible goals. The research estimates the economic growth needed to reduce extreme poverty to 3% globally, considering different poverty lines.

**Key findings:** To achieve economic growth needed to reduce extreme poverty to 3% globally, the estimated increase in carbon emissions would vary based on the poverty line. Alleviating extreme poverty, even at middle-income standards, can be prioritized without significantly affecting climate objectives. While there may be some trade-offs in specific policies, there are more synergies than conflicts between poverty alleviation and climate objectives, especially with advancements in renewable energy and efficiency measures. The World Bank research highlights the need for policies that reduce energy intensities, carbon intensities to address the challenges of poverty and climate change simultaneously.

Figure a shows three stacked area charts representing the relative increase in global CO<sub>2</sub>e emissions (%) from 2030 to 2050 for three poverty lines: \$2.15, \$3.65, and \$6.85. The regions included are East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa. Figure b is a bar chart showing tCO<sub>2</sub>e per capita in 2050 for various countries, ordered by their 2019 tCO<sub>2</sub>e per capita. The bars are color-coded by the target poverty line: 2019 (black), \$2.15 (yellow), \$3.65 (blue), and \$6.85 (green).

**Figure | Emissions of poverty alleviation.** a, Annual CO<sub>2</sub>e increase of poverty reduction at three poverty lines (percentage of 2019 global emissions) by region, b, Emissions of poverty alleviation in 2050 by country. The bar width of each country is scaled to their population in 2019. The yellow areas show the CO<sub>2</sub>e needed to end extreme poverty in 2050, expressed relative to the emissions of the country in 2019. The sum of the blue and yellow areas shows the CO<sub>2</sub>e needed to reach the target poverty rate of 3% at \$3.65, and equivalently for \$6.85. tCO<sub>2</sub>e, tonne carbon dioxide equivalent. BGD, Bangladesh; ETH, Ethiopia; NGA, Nigeria; PAK, Pakistan; PHL, Philippines; IND, India; EGY, Egypt; VNM, Vietnam; MEX, Mexico; TUR, Turkey; BRA, Brazil; IDN, Indonesia; COD, Democratic Republic of the Congo; CHN, China; DEU, Germany; JPN, Japan; IRN, Iran; RUS, Russia; USA, United States of America.

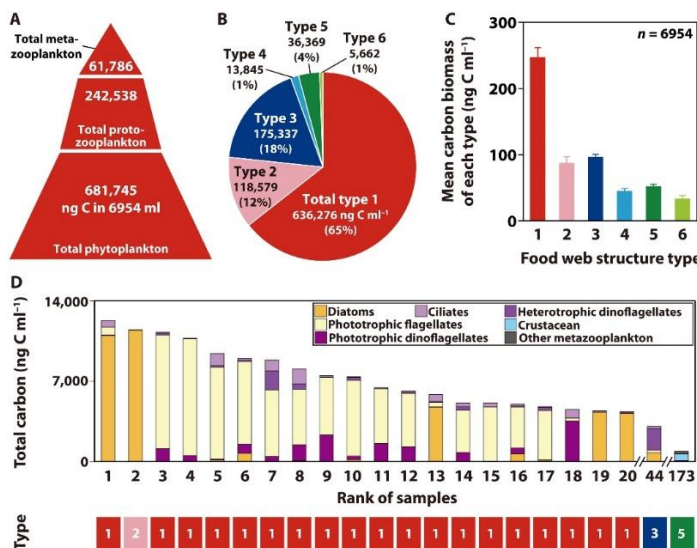
02 THEME: Carbon sequestration

# Food web structure for high carbon retention in marine plankton communities

December 15, 2023 | ScienceAdvances | [Source](#) |

**Introduction:** Before the industrial revolution, Earth's atmosphere had 280 parts per million of carbon dioxide (CO<sub>2</sub>), but human activities have added 300 billion tonnes of carbon, influencing the ocean's absorption of CO<sub>2</sub> and impacting global warming. Marine organisms play a crucial role in this process, with phytoplankton, unicellular protozooplankton, and multicellular metazooplankton contributing to the carbon biomass. Researchers from Seoul National University, Gyeongsang National University, and Kunsan National University in South Korea investigate the dynamics of carbon biomass in the global ocean's plankton communities from 1990 to 2021.

**Key findings:** The research reveals that phytoplankton-dominated bottom-heavy pyramids in food web structures retain higher carbon biomass in plankton communities compared to protozooplankton-dominated middle-heavy diamonds or metazooplankton-dominated top-heavy inverted pyramids. While bottom-heavy pyramids are predominant, predation by protozooplankton or the vertical migration of metazooplankton temporarily alters the structure, shifting to middle-heavy diamonds or top-heavy inverted pyramids before returning to bottom-heavy pyramids. This finding has significant implications for understanding carbon retention in the global ocean's plankton communities, highlighting the intricate interactions shaping these ecosystems and their response to external factors.



**Figure | Total carbon biomass of each plankton group and the dominant groups in the 20 highest total carbon biomass samples.** (A to C) Carbon biomasses (in ng C in 6,954 ml) of total phytoplankton, protozooplankton, and metazooplankton (A), total carbon biomass (in ng C ml<sup>-1</sup>) of each type (B), and mean carbon biomass (in ng C ml<sup>-1</sup>) of each type (C) in all the individual samples or locations in the phytoplankton-based food webs. Symbols in (C) represent treatment means ± 1 SE. (D) Dominant groups and types of samples or locations retaining the top 20 highest carbon biomasses of a total of three plankton groups. In addition, the samples retaining the highest carbon biomasses among types 3 (blue) and 5 (green) ranked in the 44<sup>th</sup> and 173<sup>rd</sup> places, respectively.

03 THEME: GHG emission reduction

## Bacterial denitrification drives elevated N<sub>2</sub>O emissions in arid southern California drylands

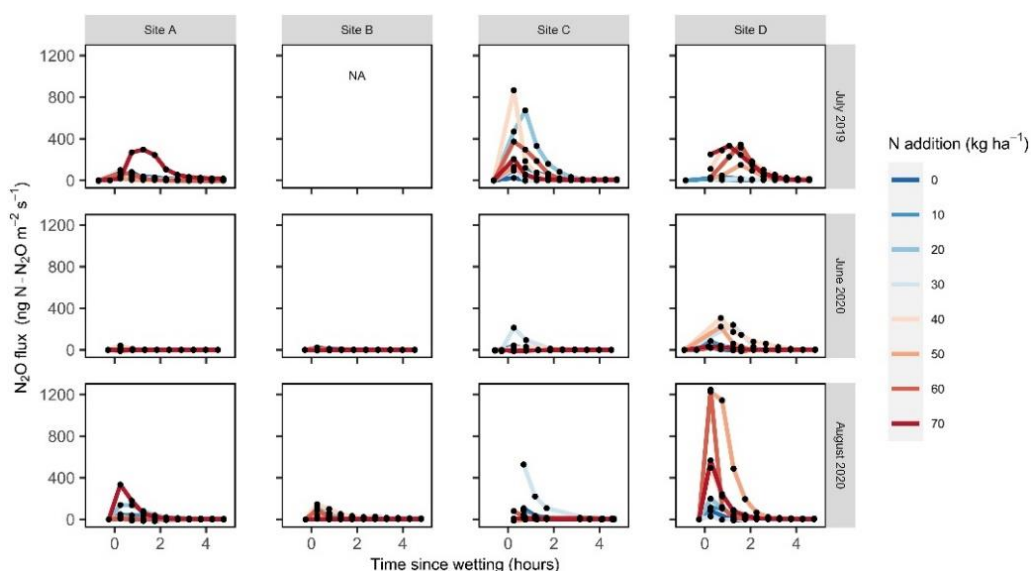
December 06, 2023 | ScienceAdvances | [Source](#) |

**Introduction:** Research team from University of California, Riverside in USA investigates the unexpected release of nitrous oxide (N<sub>2</sub>O), a potent greenhouse gas, from dry desert soils after being wetted. N<sub>2</sub>O contributes significantly to ozone depletion and global warming.

**Key findings:** Contrary to the belief that dry soils do not contribute to N<sub>2</sub>O emissions, the research reveals that the highest N<sub>2</sub>O emission rates occurred within minutes of adding water to extremely dry desert soils experiencing intense heat.

The researchers explore the processes leading to N<sub>2</sub>O release, focusing on denitrification, a microbial activity that converts nitrate (NO<sub>3</sub><sup>-</sup>) to N<sub>2</sub>O. The study found evidence of active denitrification genes and transcripts in the dry soils before wetting. By using isotopic and molecular analyses, the researchers trace the sources of N<sub>2</sub>O and determined that bacterial denitrification rapidly reduced nitrate to N<sub>2</sub>O within minutes of wetting.

The research suggests that dryland ecosystems, often overlooked in N<sub>2</sub>O emission models, may contribute significantly to atmospheric N<sub>2</sub>O concentrations. The study emphasizes the need to incorporate these dynamics into climate models to enhance predictions of greenhouse gas emissions as drought becomes more prevalent in terrestrial ecosystems.



**Figure | Field N<sub>2</sub>O emissions (in nanograms of N-N<sub>2</sub>O per square meter per second) over 5 hours after wetting summer-dry soils with 15N-nitrate solutions.** Each black dot represents flux measurements over a 2-min period for each of the eight automated chambers under N treatment (line colors correspond to levels of N enrichment; in kilograms per hectare). NA, data not available. The units and scale on all x and y axes are the same on each panel.

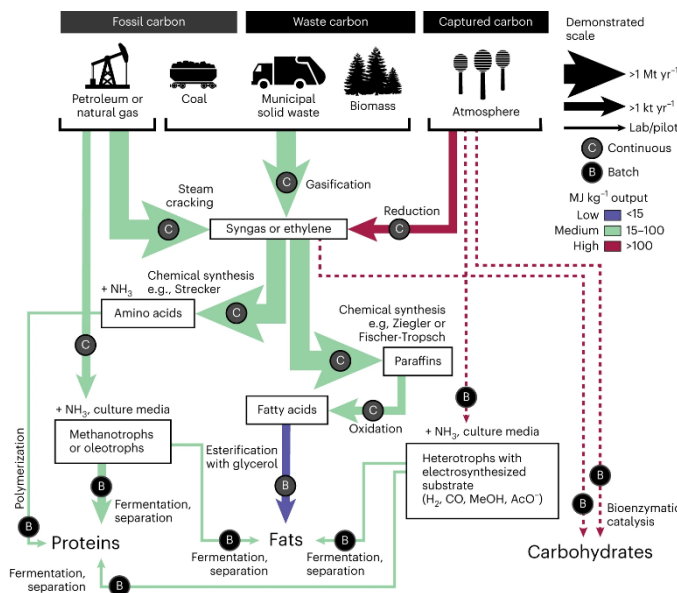
04 THEME: GHG emission reduction

# Food without agriculture

November 06, 2023 | Nature Sustainability | [Source](#) |

**Introduction:** The global production of food through traditional agriculture has significant environmental impacts, including extensive land use, water pollution, and greenhouse gas emissions. Researchers from University of California, Irvine and Orca Sciences and Carnegie Institute of Science in USA, University of Waterloo in Canada, and Tsinghua University in China explore synthesis of edible molecules through chemical and biological processes as alternatives to conventional agricultural production, focusing on dietary fats as one of the simplest nutrients to produce thermochemically and have a considerable environmental footprint in traditional agriculture. The study compares the environmental impact, particularly in terms of greenhouse gas emissions and land use, between conventionally produced agricultural fats and synthetically produced fats.

**Key findings:** The results suggest that synthetic fats, produced using various carbon feedstocks and low-emission energy sources, could potentially reduce emissions and land use significantly. While synthesizing food without agriculture could offer environmental benefits, the transition would require addressing challenges such as economic viability, societal acceptance, and potential social impacts on agricultural workers to ensure a just transition. Additionally, the study emphasizes the need for renewable energy sources and innovations to enhance the sustainability of synthetic food production.



**Figure | Schematic of potential pathways to synthesize food without agriculture.** Proteins, fats and carbohydrates can be synthesized from a range of carbon feedstocks via multiple chemical and biological pathways (arrows). The weight and colour of the arrows indicate the scale at which the different processes have been demonstrated and the energy required per mass unit output, respectively (see Supplementary Figure 1 and Supplementary Table 1 for references). Dashed lines indicate where energy requirements remain highly uncertain. Circular labels on each arrow further indicate whether the process is typically continuous (C) or batched (B). NH<sub>3</sub> is ammonia, H<sub>2</sub> is hydrogen gas, MeOH is methanol and AcO<sup>-</sup> is acetate. In the context of this study, we exclude agriculturally produced carbon feedstocks.



05 THEME: GHG emission reduction

## Nutritional-environmental trade-offs in potato storage and processing for a sustainable healthy diet

December 07, 2023 | npj Science of Food | [Source](#) |

**Introduction:** Over the past decade, micronutrient deficiencies in global health have persisted due to poor diets and limited access to nutritious foods. While developed countries have successfully addressed deficiencies through industrial-scale food fortification, a quarter of the world's population still faces micronutrient challenges, particularly in developing nations. Researchers from University of Arkansas in USA and McGill University in Canada track micronutrient losses for different household storage, processing, and consumption of potatoes, as well as to quantify and compare environmental impacts.

**Key findings:** Experimenting with various storage conditions, times, and processing, the research reveals that storing potatoes for longer durations and certain processing techniques result in substantial nutrient loss. Moreover, the study shows that longer storage and processing periods significantly reduces health benefits, ecosystem safety, and resource availability. The storing and processing of 1 kg of potatoes for 2 weeks using the boiled-fridge pathway leads to toxicity impacts equivalent to 0.53-0.64 kg 1,4-dichlorobenzene and a global warming impact of 27.1 kg CO<sub>2</sub>. Conversely, the boiled-unstored pathway shows the lowest environmental impact.

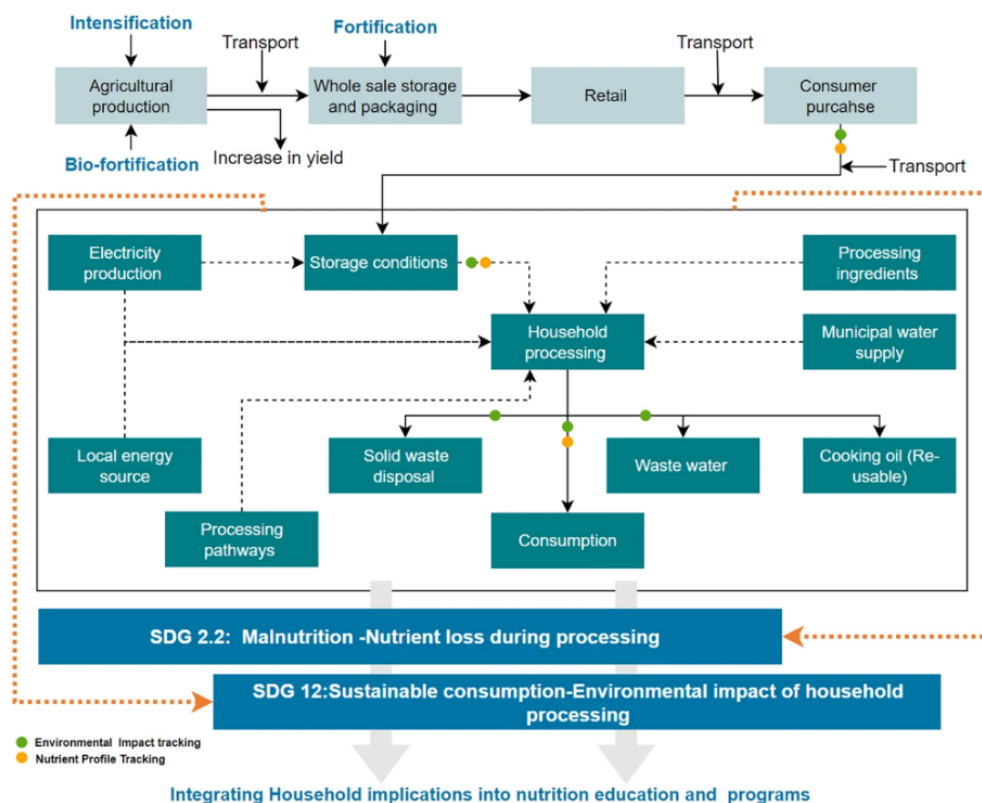


Figure | Theoretical framework to capture the nutrition, environmental and economic implications of household food processing.

06 THEME: ICT in agrifood sustainability

## Enhancing climate change resilience in agricultural crops

December 04, 2023 | Current Biology | [Source](#) |

**Introduction:** To ensure food security for a burgeoning global population, a 28% increase in global agricultural production is required over the next decade. However, climate-related constraints and the need for more arable land clash with diminishing water availability. Paradigm-shifting advances in crop breeding are essential, necessitating the safe application of genetic technologies while considering environmental, economic, and social factors. Scientists from University of Leeds in UK, University of Salamanka in Spain, Federal University in Brazil review innovative approaches to mitigate the impact of environmental stresses on agriculture, ranging from genomics to soil microbiome manipulation.

**Key findings:** To address challenges in understanding the molecular mechanisms of crop responses to climate change, identifying resilient crop phenotypes, and exploring the impact of management practices and the microbiome, the researchers proposed collaborative research networks to promote holistic solutions that rest on integration of high-throughput phenotyping and genotyping, crop management, modeling, as well as stakeholder engagement.

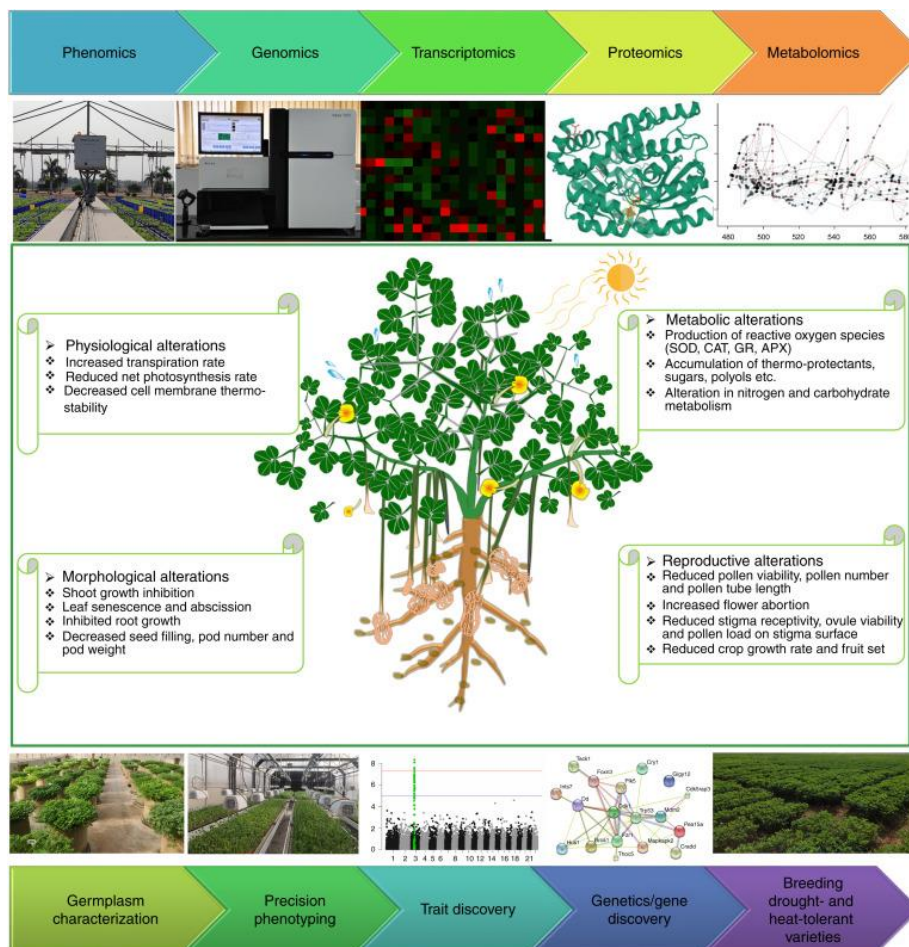


Figure | Understanding and harnessing gene bank diversity for developing stress-tolerant varieties.

07 THEME: GHG emission reduction

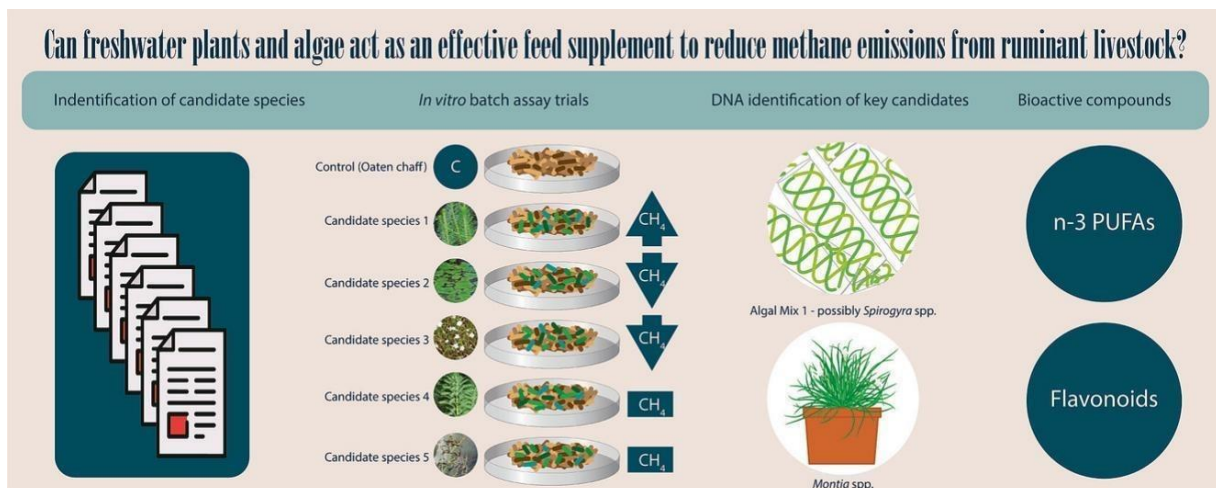
## Can freshwater plants and algae act as an effective feed supplement to reduce methane emissions from ruminant livestock?

March 01, 2024 | Science of The Total Environment | [Source](#) |

**Introduction:** Livestock contribute significantly to global greenhouse gas emissions, with methane production being a major concern. The marine red algae, *Asparagopsis taxiformis*, has shown promise in inhibiting methane production in livestock as feed additives, but challenges in scaling up production exist. In this study, researchers from Deakin University explore Australian freshwater plants and algae as potential feed supplement with methane-inhibiting properties.

**Key findings:** Three algal mixes and one plant species (*Montia australasica*) demonstrated the potential to reduce methane emission in *in vitro* batch assays. The algal mixes, particularly one dominated by *Spirogyra maxima*, and *M. australasica* showed promising results, suggesting an optimum dose for methane reduction. Fatty acids in Algal mix 1 and flavonoids like apigenin and kaempferol in *M. australasica* were identified as potential contributors to methane reduction. Importantly, the mineral composition of these samples indicated their safety for livestock consumption at a 20% inclusion rate.

### Graphical Abstract





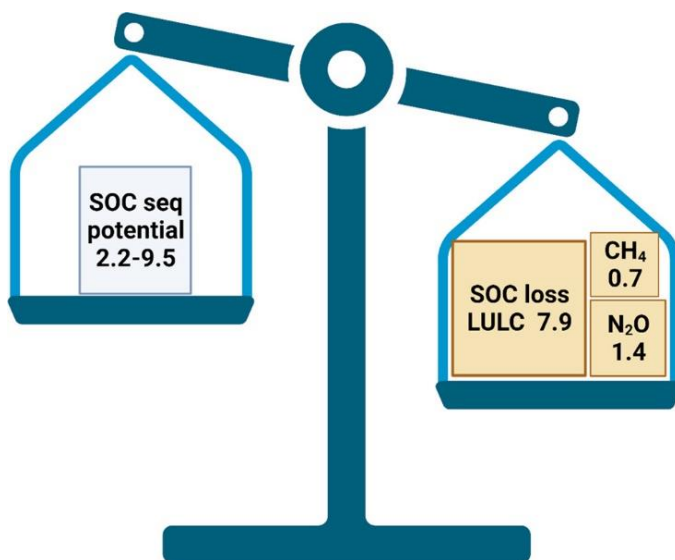
08 THEME: Carbon sequestration; GHG emission reduction

## Soil Carbon sequestration: Much more than a climate solution

November 20, 2023 | Environmental Science & Technology | [Source](#) |

**Introduction:** The focus on soil organic carbon (SOC) sequestration as a climate change mitigation strategy is facing scrutiny as time draws close to COP28. Scientists from University of Sydney, Australia and various international research institutions re-evaluate the effectiveness of initiatives like the 4per1000 in terms of increasing SOC to combat climate change.

**Key findings:** The historical loss of SOC due to intensive agriculture has led to its proposal as a carbon sink, but on-going agricultural development and practices contribute significantly to greenhouse gas emissions, equivalent to 25% of current fossil fuel emissions. Halting SOC loss is as important as investing in sequestration. In addition to climate change, in terms of food and water security, and biodiversity preservation, soil emerges as a crucial nexus, as various ecosystem functions are dependent on SOC. Increasing SOC not only aids climate mitigation but also improves drought resilience, soil fertility, and crop production. To advance our understanding and management of SOC, a comprehensive theoretical framework is needed, integrating soil health and climate change considerations. Novel technologies can enhance measurement and manipulation of soil functions, contributing to efficient food production and informed policy development.



**Figure | Annual soil greenhouse gas balance (in petagrams of CO<sub>2</sub>-e).** The soil organic Carbon sequestration potential on cropping lands remains lower than soil-based emissions of CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub>.

09 THEME: Carbon sequestration

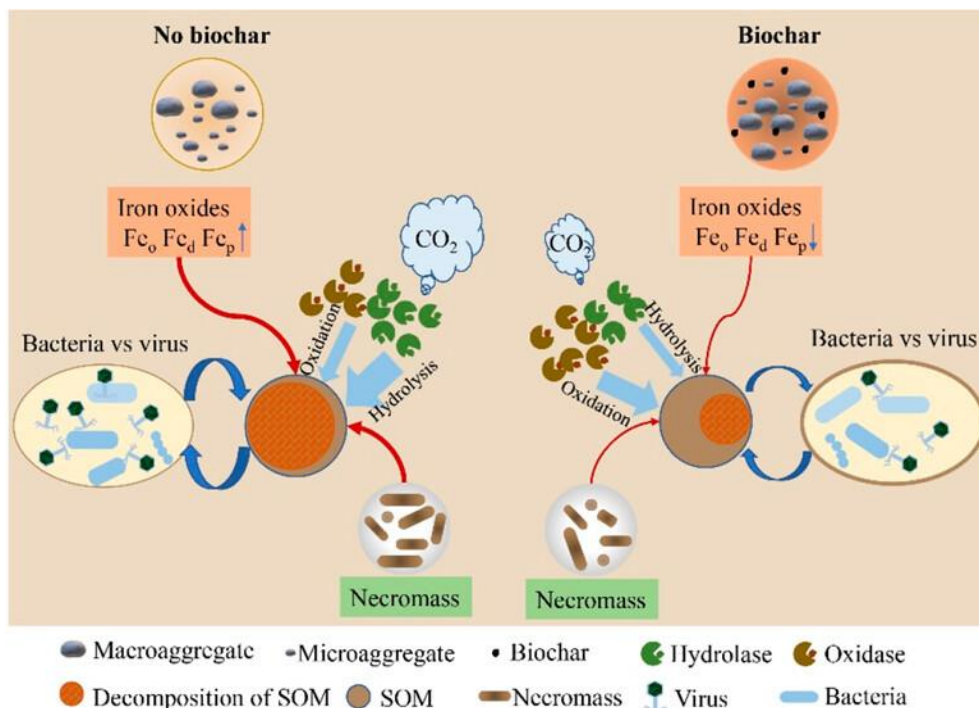
## Bacteria–virus interactions are more crucial in soil organic carbon storage than iron protection in biochar-amended paddy soils

November 20, 2023 | Environmental Science & Technology | [Source](#) |

**Introduction:** While iron oxides are thought to protect SOC in oxygen-deprived environments, the role of these oxides, biochar, and microbial interactions in SOC fate remained unclear. In a four-month experiment with rice seedlings under waterlogged conditions, researchers from Chinese Academy of Science investigated the complex interplay of iron oxides, biochar, and microbial communities in influencing soil organic carbon (SOC) dynamics.

**Key findings:** The study found that biochar significantly impacted soil enzyme activities, particularly in larger soil aggregates. Iron oxides and necromass were found to have negative associations with SOC levels. Notably, bacterial communities demonstrated strong connections with viral communities. Contrary to conventional beliefs, the increase in SOC was not primarily attributed to iron oxides; instead, it was strongly influenced by intricate interactions between bacteria and viruses, with specific keystone ecological clusters and taxa playing crucial roles.

### Graphical Abstract



10 THEME: Carbon sequestration; Measurement, Reporting, Verification

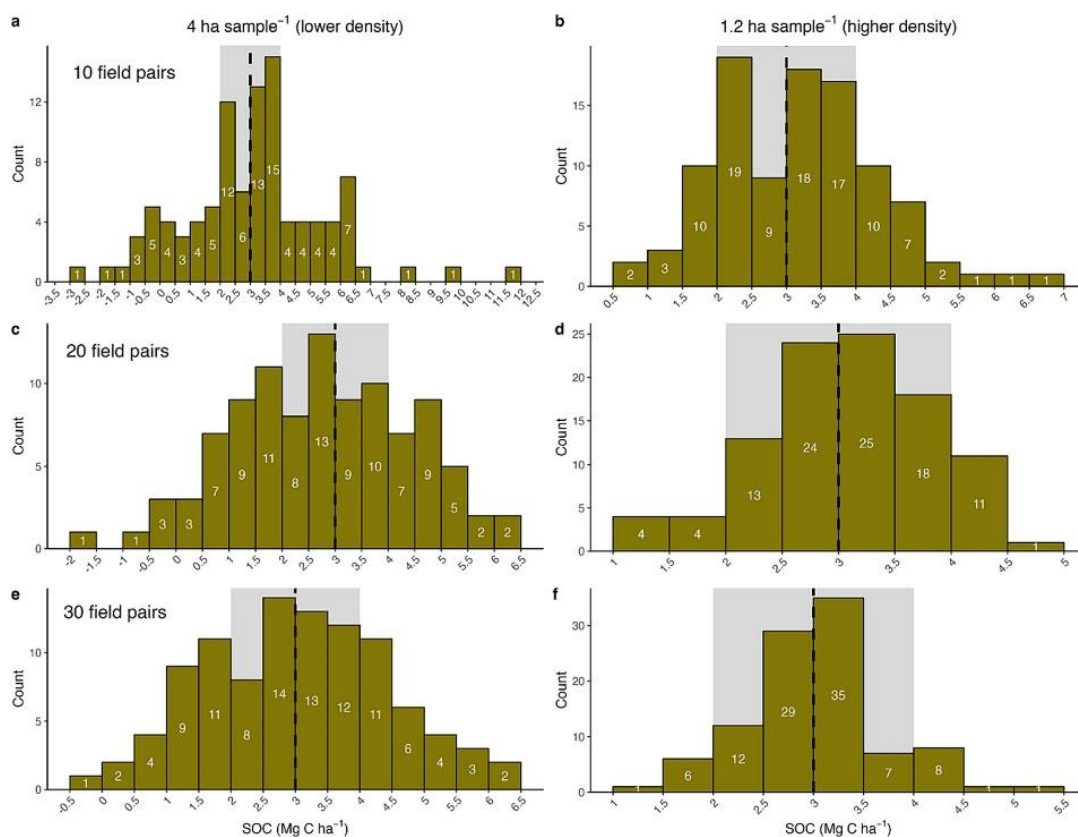
## Testing the feasibility of quantifying change in agricultural soil carbon stocks through empirical sampling

December 01, 2023 | Geoderma | [Source](#) |

**Introduction:** Debates about whether regenerative farming can effectively sequester carbon in soil to fight climate change have led Yale University research team and private sector participants to re-examine the measured soil organic carbon (SOC) changes in 45 cropland sites, as well as re-evaluate field measurement methodologies in terms of precision.

**Key findings:** Higher-density sampling is shown to minimize variation in estimates of initial SOC stocks, and paired control fields help to increase more accurate estimates of regenerative practice effects on SOC stock change. Larger subsamples of fields and higher sampling densities hold significant potential for accurate project-level estimates of SOC change. The study suggests to adopt best sampling practices and quasi-experimental approaches from various fields, such as medicine, economics, and ecology, in order to improve accuracy of SOC measurements and confidency in estimated SOC accrual effects of regenerative practices.

Additional collaborative efforts is called for to build an evidence base for the effects of regenerative practices on SOC accrual.



**Figure |** Monitoring estimates of mean project-level differences (x-axis) between Time2 (re-inventorying) and Time1 (initial inventory) were more accurate and/or robust using more fields and/or higher within-field sampling densities.

## NEWS

**01 THEME:** Measurement, Reporting, Verification; Policy Incentives, Financing & Pricing

### Can livestock and rice farming earn carbon credits and participate in carbon market?

December 09, 2023 | [our island, Taiwan](#) |

Hanbao Livestock Farm in Changhua County, Taiwan, has implemented sustainable practices to reduce methane emissions and greenhouse gases. With over 40,000 pigs, the farm uses a high-bed design in the pigsties, facilitating the collection of pig waste for anaerobic fermentation. The resulting methane is then used for power generation, contributing to an efficient and environmentally friendly energy cycle. The farm also maximizes methane production by adjusting pig feed, aiming for higher methane concentrations. Through a combination of solar panels and methane-derived power generation, the farm generates over ten million Taiwanese dollars annually.

Furthermore, Hanbao Livestock Farm participates in voluntary carbon trading, obtaining carbon credits through the Gold Standard international certification platform. By reducing emissions and efficiently utilizing waste, the farm contributes to environmental conservation and profits from selling carbon credits. Additionally, the farm is part of the Small Farmers Carbon initiative, focusing on agricultural practices that enhance soil organic matter, potentially leading to carbon credits for the participating farmers. This sustainable approach not only mitigates environmental impact but also demonstrates a profitable model for the agricultural sector.

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**02 THEME:** Measurement, Reporting, Verification; Policy Incentives, Financing & Pricing

### Voluntary Carbon Credit buyers willing to pay more for quality

December 04, 2023 | [Carbon credits](#) |

The latest "State of the Voluntary Carbon Markets 2023" report by Ecosystem Marketplace reveals a significant shift in the Voluntary Carbon Market (VCM). Despite a 51% decline in transaction volumes, there's an 82% surge in average carbon credit prices, reaching a 15-year high. Smaller yet dedicated purchasers are consolidating the market, showing a preference for high-integrity and high-quality voluntary carbon credits with co-benefits. Nature-based credits, constituting 46% of the market, saw prices more than double. Credits with environmental and social co-benefits commanded a 78% price premium, emphasizing buyer preference for projects aligned with UN Sustainable Development Goals. Newer credits and CORSIA-eligible credits also commanded higher prices. The report underscores a market shift towards integrity and quality, reflecting increased buyer sophistication.

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03 THEME: Carbon sequestration; GHG emission reduction

## World Soil Day, 5 December

December 05, 2023 | [FAO](#) |

World Soil Day, observed annually on December 5, highlights the critical importance of healthy soil and advocates for sustainable soil resource management. Instituted by the UN General Assembly in 2014, the day aligns with the birthday of the late King Bhumibol Adulyadej of Thailand, who sanctioned the event. The 2023 campaign underscores the interdependence of soil and water in sustaining life, emphasizing their role in food production, ecosystems, and human well-being. Climate change and human activities are causing soil degradation, impacting water resources. Sustainable soil management practices, including minimum tillage and organic matter addition, are vital for soil health, erosion reduction, and water retention. The campaign aims to raise global awareness about the crucial link between soil and water, promoting measures for their preservation for future generations.

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04 THEME: GHG emission reduction

## What you need to know about new animal-source food alternatives

December 08, 2023 | [UNEP](#) |

The United Nations Environment Programme (UNEP) released a report at COP28, focusing on sustainable protein alternatives to traditional animal agriculture. The report highlights that by 2050, alternatives such as lab-grown meat, plant-based products, and protein-rich foods derived from fermentation could constitute up to half of the global market for animal proteins. The alternatives aim to address the environmental impact of conventional meat and dairy production, which contributes significantly to climate change, deforestation, and biodiversity loss. The report indicates that plant-based protein products, compared to conventional meats, could require up to 97% less land, 30-50% less energy, and emit up to 90% fewer greenhouse gases. However, challenges such as cost, taste, and social acceptability need to be addressed for widespread adoption. Policymakers are urged to support research, ensure a fair transition, and consider socio-economic impacts in promoting these alternatives.

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05 THEME: Policy Incentives, Financing & Pricing

## COP28 presidency puts food systems transformation on global climate agenda as more than 130 world leaders endorse food and agriculture declaration

December 01, 2023 | [COP28 UAE](#) |

During the World Climate Action Summit at COP28, more than \$2.5 billion was mobilized for the food-climate agenda. The announcement was made by H.E. Mariam bint Mohammed Almhairi, UAE Minister of Climate Change and Environment and COP28 Food Systems Lead. Over 130 countries, representing over 5.7 billion people, have signed the 'COP28 UAE Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action.' The declaration aims to

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address global emissions while protecting farmers from climate change impacts. The UAE and the Bill & Melinda Gates Foundation also launched a \$200 million partnership for Food Systems, Agriculture Innovation, and Climate Action, focusing on research and innovations. The COP28 Food Systems Agenda emphasizes the need to integrate food systems and agriculture into climate ambitions to achieve the goals of the Paris Climate Agreement.

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06 THEME: GHG emission reduction

## COP28: FAO spotlights agrifood systems' potential to address climate impacts and achieve 1.5°C goal

December 13, 2023 | [FAO](#) |

During the UN Climate Conference (COP28) in Dubai, FAO and its partners emphasized the role of agrifood systems in climate solutions. FAO Director-General QU Dongyu led a delegation that launched significant reports, including a Global Roadmap to eradicate hunger while keeping the 1.5°C goal of the Paris Agreement. The Emirates Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action, endorsed by over 150 countries, was a key focus, emphasizing the transformative potential of agriculture in responding to climate change. FAO also joined the Technical Cooperation Collaborative to implement the Declaration. The Agrifood Sharm-El Sheikh Support Program, a three-year initiative, was announced to facilitate dialogue and knowledge sharing among global and regional policymakers. FAO highlighted the role of agrifood systems in climate change adaptation during the Global Stocktake at a high-level event. The organization launched the Food and Agriculture for Sustainable Transformation (FAST) partnership to address the decline in climate finance for agrifood systems, urging increased funding. Other key contributions included reports on reducing greenhouse gas emissions from global livestock systems, restoring mountain ecosystems, and a new phase of the EAF-Nansen Programme with Norway. FAO also signed crucial Memoranda of Understanding with Italy, the Asian Infrastructure Investment Bank, and the World Trade Organization during COP28. The organization participated in various events and launched partnerships, reinforcing its commitment to sustainable agrifood systems.

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07 THEME: GHG emission reduction

## From green ammonia to lower-carbon foods

December 11, 2023 | [McKinsey & Company](#) |

Agriculture, contributing to 24% of global greenhouse gas emissions, faces a challenge in decarbonization due to limited emission reduction technologies. However, a breakthrough lever has emerged—replacing fossil-fuel-based ammonia with green ammonia in fertilizer production. Gray ammonia, responsible for 1.2% of global emissions, can be almost fully decarbonized through green ammonia, contributing significantly to greenhouse gas reduction.

A McKinsey analysis reveals that transitioning to green ammonia could cut emissions by an average of 5% in ten typical European consumer food products. Fertilizer producers are already

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exploring greener alternatives, with projects worldwide aiming for substantial emissions reductions. Green ammonia's impact extends beyond emissions reduction; it aligns with consumer demand for sustainable products, offering a competitive advantage.

Despite these benefits, challenges remain. Green ammonia projects require increased access to green financing and significant renewable power capacity expansion. Uncertainty in future green ammonia prices necessitates collaboration to absorb higher costs throughout the value chain. Consumer willingness to pay premiums for sustainability presents an opportunity to finance green ammonia projects, signaling a path toward a more sustainable agriculture sector.

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08 THEME: Policy Incentives, Financing & Pricing

## Government of Canada announces new economic incentive to reduce methane emissions from beef cattle

December 10, 2023 | [Government of Canada](#) |

In a significant move towards sustainable agriculture, Canada has introduced a draft protocol under its Greenhouse Gas Offset Credit System, focusing on reducing enteric methane emissions from beef cattle. Published by Environment and Climate Change Canada on Food and Agriculture Day at COP28, the protocol, known as the Reducing Enteric Methane Emissions from Beef Cattle (REME), aims to incentivize farmers to adopt practices that decrease methane emissions.

Methane, a potent greenhouse gas, is released during the digestive process of cattle, contributing significantly to Canada's total methane emissions. The REME protocol encourages beef cattle farmers to enhance animal diets, management, and other strategies, offering them an opportunity to generate offset credits for emission reductions. These credits, representing one tonne each, can be sold to facilities or businesses, providing financial benefits for farmers while contributing to a greener future.

The protocol aligns with Canada's commitment to reduce domestic greenhouse gas emissions and complements other initiatives, such as the \$12 million Agricultural Methane Reduction Challenge. Stakeholders are invited to provide feedback on the draft protocol, with the final version expected to be published in the summer of 2024. This marks a pivotal step in the nation's efforts to address climate change and foster sustainable practices within the agricultural sector.

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09 THEME: ICT in agrifood sustainability

## **Chunghwa Telecom and National Taiwan University join hands with industry, government and academia in smart agriculture (In Chinese)**

December 05, 2023 | [ET Today, Taiwan](#) |

Taiwanese telecommunications giant, Chunghwa Telecom, is spearheading agricultural innovation by investing in smart farming technologies. As global shifts toward industrialization and urbanization result in a dwindling agricultural workforce, scholars are turning to AI and digital analytics to address labor shortages and boost agricultural productivity.

Chunghwa Telecom's commitment to smart agriculture involves enhancing agricultural network environments and implementing IoT solutions. Through field sensors and NB-IoT mobile applications, an integrated solution allows farmers to monitor crop growth, soil conditions, CO2 levels, and climate changes in real-time via a cloud-based platform. Collaborating with Taipei University, the company aims to develop systems that alleviate the labor burden on farmers by transforming their experiences into decision-making systems.

Critical to these smart systems' operation is the Intelligent Biosensing Platform (IBP), synchronizing data related to crop growth and images, facilitating convenient monitoring, and recording of field conditions. Chunghwa Telecom's efforts also include contributing to the standardization of agricultural IoT data formats, promoting cross-platform data exchange for greater research outcomes. The collaboration between telecom experts and agricultural scholars aims to bridge industry gaps and unlock the full potential of smart agriculture, envisioning a sustainable and prosperous future for Taiwanese agriculture.

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10 THEME: Carbon sequestration; Measurement, Reporting, Verification

## **National Agricultural Science Award winning research include fresh milk source identification, AI pest monitoring, and natural carbon sink measurement (In Chinese)**

December 12, 2023 | [Agri-Harvest, Taiwan](#) |

In the biennial "National Agricultural Science Awards," the Taiwanese government honored outstanding contributions to agriculture and sustainability. Notable winners included the team led by Professor Lin Hsin-Chu from National Chung Hsing University, acknowledged for establishing a groundbreaking natural carbon sink measurement technique. Their research confirmed the highest carbon sink in "blue carbon," paving the way for achieving "net-zero."

The Livestock Research Institute's team received recognition for developing a milk inspection technology capable of distinguishing between domestic and imported dairy products. Additionally, Taiwan University's Professor Ta-Te Lin's team was celebrated for their AI-driven pest monitoring system, successfully commercialized and applied across various crops.



The awards ceremony, presented by Acting Minister Chen, Jun-Ji of the Ministry of Agriculture, aimed to encourage research teams making significant contributions to agriculture. Winners in different categories received cash prizes, emphasizing the practical applications and industry impact of their innovations. The event highlighted advancements in agricultural science, showcasing technologies addressing pest control, milk quality, and carbon sink measurements.

11 THEME: Policy incentives, Financing, Pricing

## Carbon Market Kickoff! New zero-carbon Economy Forum focuses on Taiwan's sustainable future (In Chinese)

December 26, 2023 | [Taiwan Carbon Solution Exchange](#) |

On December 22, Taiwan hosted the "Zero Carbon New Economy Forum" in collaboration with the Taiwan Stock Exchange and Taiwan Carbon Exchange, marking the launch of an international carbon trading platform. Government officials, including National Development Council Chairman Gong, Ming-Hsin and Financial Supervisory Commission Chairman Huang, Tien-mu, joined over 300 corporate executives and ESG leaders to witness the milestone. Notable Taiwanese companies, such as China Steel, TSMC, and Cathay Financial, were among the 27 enterprises awarded certificates for their pioneering role in carbon trading, collectively purchasing 88,520 tons of CO<sub>2eq</sub> credits.

Taiwan Carbon Exchange CEO Tien, Jien-Chung highlighted the platform's key features, emphasizing its potential to assist domestic enterprises in meeting supply chain carbon reduction requirements. The event featured World Climate Foundation Chairman Jens Nielsen, providing insights into global carbon trading trends and commending Taiwan's efforts towards a net-zero future.

Panel discussions focused on the evolution of green regulations and policies, as well as the future opportunities and challenges of carbon trading. Experts emphasized the importance of collaborative efforts across sectors to achieve global net-zero goals. The discussions aimed to deepen understanding and lead enterprises towards a zero-carbon future, reinforcing Taiwan's commitment to sustainable practices and addressing climate change challenges.

12 THEME: OTHERS

## Sustainable Food Systems Cannot be Postponed! – From the Marburg Gathering

November 20, 2023 | [Arc2020](#) |

As the European Commission's agenda shows little progress on the anticipated European Framework for Sustainable Food Systems ahead of the EU elections, activists and stakeholders gathered at the European Action Gathering in Marburg from November 6 to 8 to address the urgency of transitioning to future-proof sustainable food systems. Despite the absence of a

concrete legislative proposal from the Commission, the event, organized by groups including ARC2020.eu and Kollektiv von MORGEN e.V., drew over 100 participants from across Europe.

Discussions focused on the need for a comprehensive legislative plan, aligning with the promised European Green Deal. Frustrations mounted over perceived policy inconsistencies, such as deregulation of GMOs and reduced commitments to pesticide reduction, undermining the goals of a sustainable food system. The gathering aimed to bridge perspectives from grassroots initiatives to policy levels, emphasizing the importance of collaboration and coherence across multiple governance levels.

In response to the perceived lack of commitment from EU bodies, participants are actively co-creating the Marburg Action Plan, a set of practices and legislative proposals to urgently operationalize sustainable food systems at various levels. The plan addresses challenges such as agri-food governance, access to land, rural infrastructure, partnerships, sustainable markets, and collective knowledge building. Despite the setbacks, advocates remain determined to propel bottom-up solutions and regional voices into European policymaking for a more sustainable and equitable food system. The first draft of the Marburg Action Plan is expected to be released in the coming weeks, showcasing a grassroots commitment to change in the absence of immediate legislative action.

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# POLICY

01 THEME: GHG emission reduction; Carbon sequestration

## WRI: State of Climate Action 2023

World Resources Institute | [Source](#) | [Download](#) |

The "State of Climate Action 2023" report underscores the inadequacy of current global efforts to limit global warming to 1.5°C. The majority of indicators are off track, demanding immediate and intensified action. Out of the 42 assessed indicators, only electric vehicle adoption is on track for 2030 targets, the remainders are off track, and six indicators are regressing.

The food and agriculture sector, a significant contributor to greenhouse gas emissions, needs transformation through supply- and demand-side shifts. Efforts should focus on reducing food loss, cutting meat consumption, and implementing sustainable farming practices. Despite positive developments, such as commitments to agricultural innovation and climate-friendly diets, global progress remains slow. Urgent action is required to achieve sustainable food production, mitigate emissions, and meet climate goals amidst the ongoing challenges in the food and agriculture sector.

To limit global warming to 1.5°C, alongside substantial reductions in greenhouse gas emissions, carbon removal technologies are crucial. This includes both natural approaches like forests and technological. However, the current scale of technological carbon removal falls far short, with less than 1% of the expected annual requirement achieved. While there's increased financial support and momentum in this area, challenges persist. These encompass the need for more public funding, deployment support, increased demand from buyers, attention to measurement and reporting accuracy, and addressing governance gaps to ensure responsible and equitable scaling of these technologies.

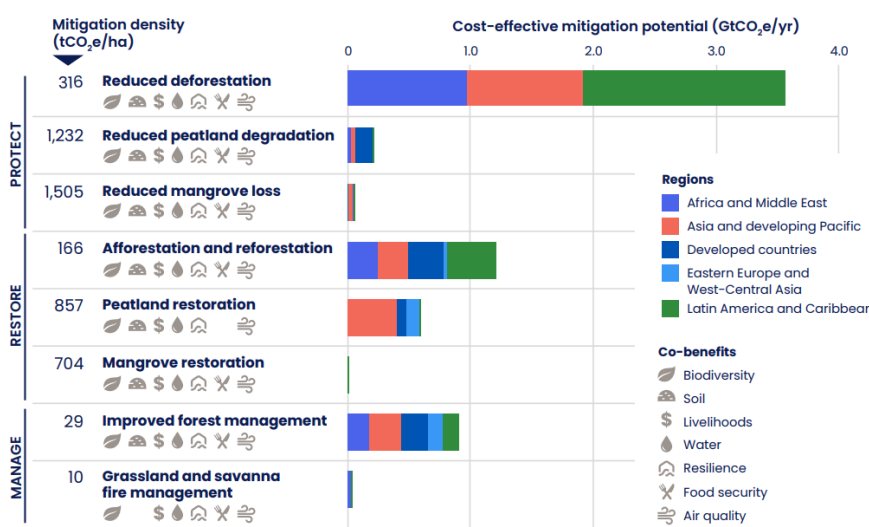


Figure | Global cost-effective mitigation potentials for land-based measures across forests, peatlands, mangroves, and grasslands from 2020 to 2050.

02 THEME: Carbon sequestration; Measurement, Reporting, and Verification; Incentives, Financing, Pricing

## A General Assessment of the Role of Agriculture and Forestry in the U.S. Carbon Markets

USDA | [Source](#) | [Download](#) |

USDA responds to the Consolidated Appropriations Act of 2023 by defining the role of agriculture and forestry in U.S. carbon markets. This analysis identifies key barriers and opportunities, proposing strategies to enhance market participation and ensure environmental integrity.

### Key Findings

- **Carbon Market Potential:** Agriculture and forestry offer significant potential for greenhouse gas (GHG) reductions through carbon markets. However, barriers, including high transaction costs, conservative accounting, and limited demand, impede widespread participation.
- **Credit Generation and Types:** Carbon credits are generated through protocols defining eligibility, emissions sources, and measurement procedures. While 40+ protocols exist, only 18 have successfully generated credits domestically. Compliance and voluntary markets differ in regulatory frameworks, influencing credit supply.
- **Supply and Demand Dynamics:** Over the past decade, forestry projects dominated credit supply, while agricultural credits, primarily from livestock projects, remained limited. Recent shifts show a decrease in compliance credits but a surge in voluntary carbon offsets due to corporate GHG emission reduction goals.
- **Quantification Challenges:** Accurate GHG quantification in agriculture and forestry projects is hindered by dynamic ecosystems. Protocol designs address challenges like additionality and permanence, but technical barriers persist, requiring advancements in monitoring technologies.
- **Barriers to Entry:** Low participation is attributed to high transaction costs, conservative accounting, and limited demand. Farmer and forest landowner awareness is high, but participation rates remain disproportionately low due to various barriers.

### Recommendations

- **USDA Program Implementation:** Establish the Greenhouse Gas Technical Assistance Provider and Third-Party Verifier Program to evaluate protocols, register entities, and provide technical assistance, fostering a supportive ecosystem for market participants.
- **Advisory Council Formation:** Create an Advisory Council to guide the USDA in program implementation, ensuring diverse perspectives and expertise.
- **Invest in Technological Solutions:** Direct investments toward a soil carbon monitoring network, GHG research, and innovative tools, addressing quantification challenges and building confidence among market participants.



## Smart & Net-Zero Project

- **Reduce Barriers through Existing Programs:** Leverage existing USDA programs, such as NRCS and Climate Hubs, to offer technical assistance and support, facilitating market entry for agricultural and forestry producers.
- **Promote Market Diversity:** Encourage participation in various environmental credit markets beyond carbon, maximizing opportunities for farmers and landowners.
- **Reduce Barriers through Existing Programs:** Leverage existing USDA programs, such as NRCS and Climate Hubs, to offer technical assistance and support, facilitating market entry for agricultural and forestry producers.
- **Promote Market Diversity:** Encourage participation in various environmental credit markets beyond carbon, maximizing opportunities for farmers and landowners.

03 THEME: GHG emission reduction; Incentives, Financing, Pricing

### Joint Crediting Mechanism (Japan)

Government of Japan | [Source](#) | [Download](#) |

Japan, committed to global greenhouse gas (GHG) reduction and sustainable development, implements the Joint Crediting Mechanism (JCM) under Article 6 of the Paris Agreement. The JCM serves as a flexible and swift avenue for technology diffusion and mitigation actions in partner countries.



#### Key Components

- **Technology Diffusion:** The JCM focuses on disseminating advanced decarbonizing technologies, products, systems, services, and infrastructure in partner countries. This facilitates the swift adoption of innovative measures to address climate challenges.
- **Quantitative Evaluation:** Japan commits to quantitatively assessing its contributions to GHG emission reductions and removals through the JCM. These evaluations serve as a basis for achieving Japan's Nationally Determined Contributions (NDC) targets, aligning with the ultimate objective of the UNFCCC.
- **Sustainable Development:** The JCM not only addresses GHG emission reduction but also emphasizes sustainable development in partner countries. By integrating environmental and developmental goals, the mechanism ensures a holistic approach to climate action.

#### Current Status

- **Partnerships:** Japan has established collaborations with 27 countries (as of August 31st, 2023) under the JCM. Continuous engagement and communication with developing nations further solidify the global impact of the mechanism.
- **Global Warming Countermeasures Plan (2021):** The JCM is strategically positioned in Japan's Plan for Global Warming Countermeasures, as outlined in the Cabinet Decision of October 2021. It plays a crucial role in achieving Japan's NDC and aims to secure

approximately 100 million t-CO<sub>2</sub> in accumulated emission reductions and removals by fiscal year 2030.

### Recommendations

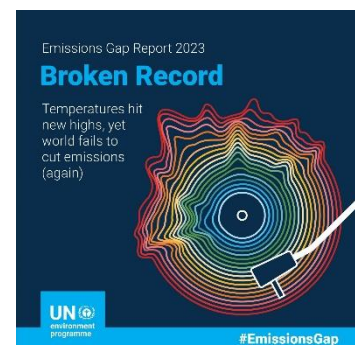
- **Enhanced Collaboration:** Strengthen public-private collaborations to maximize the impact of the JCM in achieving emission reduction targets and supporting sustainable development.
- **Continuous Communication:** Sustain engagement with developing countries, fostering partnerships and knowledge exchange to expand the reach and effectiveness of the JCM.
- **Monitoring and Reporting:** Implement robust monitoring and reporting mechanisms to ensure the accurate quantification of emission reductions, providing transparency and accountability.
- **Capacity Building:** Invest in capacity-building initiatives in partner countries to enhance their ability to adopt and benefit from decarbonizing technologies and measures.

04 THEME: GHG emission reduction; Measurement, Reporting, and Verification; Incentives, Financing, Pricing

## Emissions Gap Report 2023: Broken Record

United Nations Environmental Program | [Source](#) | [Download](#) |

This fourteenth Emissions Gap Report, released ahead of COP28, underscores the accelerating climate crisis. It evaluates the gap between pledged greenhouse gas (GHG) emissions reductions and the necessary reductions to align with the long-term temperature goals of the Paris Agreement. The report emphasizes the urgent need for global action to address the escalating climate emergency.



### Key Findings

- **Temperature Records and GHG Emissions:** Not only are temperature records consistently being broken, but global GHG emissions and atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) also set new records in 2022.
- **Global Emissions Inequality:** Emissions are highly unequally distributed among countries, reflecting global patterns of inequality.
- **Net-Zero Pledges:** While the number of net-zero pledges continues to rise, confidence in their implementation remains low.
- **Emissions Gap in 2030:** Current unconditional Nationally Determined Contributions (NDCs) imply a 14 GtCO<sub>2</sub>e gap for a 2°C goal and a 22 GtCO<sub>2</sub>e gap for the 1.5°C goal. Additional implementation of conditional NDCs reduces these estimates by 3 GtCO<sub>2</sub>e.
- **Action in the Next Decade:** Urgent action in this decade is crucial, determining the ambition required in the next round of NDCs for 2035 and the feasibility of achieving the long-term temperature goal of the Paris Agreement.

- **Global Warming Estimates:** If current policies persist, global warming is estimated to be limited to 3°C. Fulfilling all unconditional and conditional pledges by 2030 lowers this estimate to 2.5°C, with additional fulfillment of all net-zero pledges bringing it to 2°C.
- **Economic and Institutional Challenges:** Low- and middle-income countries face substantial economic and institutional challenges in low-carbon energy transitions but can also exploit opportunities.
- **Reliance on Carbon Dioxide Removal (CDR):** Delaying stringent global GHG emissions reductions will increase future reliance on CDR to meet the long-term temperature goal of the Paris Agreement.

### Policy Recommendations

- **Accelerated Mitigation Action:** Urgently strengthen mitigation actions to narrow the emissions gap, ensuring more ambitious targets for 2035 in the next round of NDCs.
- **Global Collaboration:** Encourage high-income countries to accelerate domestic emissions reductions, commit to reaching net-zero at an accelerated pace, and provide financial and technical support to low- and middle-income countries.
- **Inclusive Development:** Low- and middle-income countries must meet pressing development needs alongside transitioning away from fossil fuels.
- **Robust Monitoring:** Implement robust monitoring and reporting mechanisms to ensure accurate quantification of emission reductions, providing transparency and accountability.
- **Energy Transition Investments:** Explore opportunities and overcome challenges associated with energy transitions, promoting sustainable development.

05 THEME: GHG emission reduction; Incentives, Financing, Pricing

## Sharm El Sheikh Adaptation Agenda: Progress report

United Nations Climate Champions | [Source](#) | [Download](#) |

The Sharm El Sheikh Action Agenda (SAA) has emerged as a critical strategy to address the impacts of climate change across various sectors. One of its key components is its association with the agricultural domain, particularly regarding its implications for health and food systems. Initially introduced at COP27, SAA's priority lies in consolidating science-backed solutions across key systems, such as food, water, health, and infrastructure, making 4 billion vulnerable people resilient by 2030. The initiative emphasizes locally-led adaptation, equity, and inclusivity. Noteworthy achievements include the integration of health adaptation outcomes and strategic partnerships. However, despite progress, challenges persist. Insufficient adaptation finance hinders implementation, with public and private sources falling short by 10 to 18 times estimated needs. COP28 is a pivotal moment to catalyze action, aligning efforts with the Global Stocktake and Global Goal on Adaptation.

## COP27 Policy Recommendations

- Mobilize scaled-up adaptation finance from public and private sectors to meet the annual \$387 billion costs in developing countries.
- Strengthen international collaboration and partnerships to bridge the implementation gap, emphasizing locally-led initiatives.
- Prioritize multi-stakeholder engagement, ensuring inclusivity and equity in adaptation planning and resilience building. Implementation

## Implementation Report Highlights:

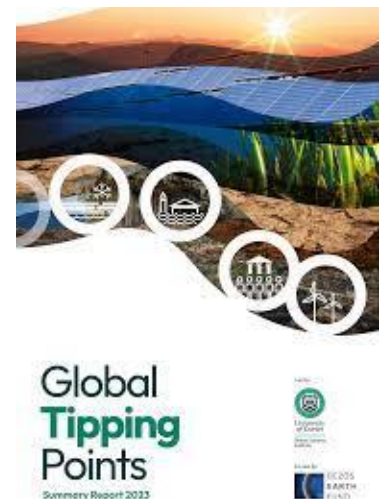
- **Task Forces and Steering Committee:** Seven Task Forces and a Steering Committee were established to drive partnership engagement, catalyze implementation, and track progress across various systems and outcomes.
- **Health Inclusion:** The SAA expanded to include health as a priority system, setting 2030 health adaptation targets in collaboration with the World Health Organization and the International Federation of Red Cross and Red Crescent Societies.

### 06 THEME: GHG emission reduction

## The Global Tipping Points report 2023

The Global Tipping Points Initiative | [Source](#) | [Download](#) |

The Global Tipping Points initiative, led by Professor Tim Lenton of the University of Exeter's Global Systems Institute and supported by a network of over 200 researchers from 90 organizations across 26 countries, unveiled its pivotal report at COP28 on December 6, 2023. Humanity faces unprecedented threats from harmful tipping points in the natural world, which could jeopardize our planet's life-support systems and societal stability. The imminent risk of crossing tipping points, exacerbated by global warming, demands immediate global action. This policy brief outlines the urgency of adopting a new governance framework to address negative tipping points and leverage positive tipping point opportunities.



## Key Challenges and Risks

- **Global Agricultural Impact:** The collapse of the Atlantic Ocean's overturning circulation, coupled with global warming, may result in a 50% loss of global wheat and maize cultivation areas.



- **Imminent Tipping Points:** Five major tipping points are on the brink due to current warming trends, with three more threatened by the 2030s if global warming surpasses 1.5°C.
- **Cascading Effects:** The full damage from negative tipping points will cascade through globalized social and economic systems, potentially exceeding countries' adaptive capacities.

### The Need for Global Governance

- **Inadequate Global Governance:** Existing governance structures are insufficient to address the scale of threats posed by negative tipping points.
- **Disastrous Trajectory:** The world is on a disastrous trajectory, with the potential for a domino effect of accelerating and unmanageable changes to life-support systems.
- **Transformational Change:** Linear incremental change is no longer viable; governance institutions must adapt to facilitate rapid, transformative change in societies and economic systems.

### Leveraging Positive Tipping Points

- **Urgent Transformation:** Society must rapidly reduce emissions and restore nature to prevent negative tipping points, embracing 'no regrets' actions that enhance sustainability, equity, and prosperity.
- **Harnessing Opportunities:** Positive tipping point opportunities, such as the exponential growth of renewable energy and environmental justice movements, must be harnessed through collective and concerted actions.
- **Resilience Building:** Societies must urgently become more resilient to minimize harms and sustain focus on triggering positive tipping points, even during negative tipping events.

07 THEME: GHG emission reduction

## What's cooking? An assessment of potential impacts of selected novel alternatives to conventional animal products

United Nations Environmental Program | [Source](#) | [Download](#) |

Animal source foods (ASF) contribute significantly to economies, employment, and nutritional needs globally. However, the surge in meat consumption raises environmental, health, and ethical concerns. This policy brief explores the potential of novel alternatives, including plant-based, fermentation-derived, and cultivated ASF products, as a sustainable solution.



### Key Points

- **Environmental Impact:** Conventional animal agriculture contributes 14.5–20% of global human-caused greenhouse gas emissions. Novel alternatives show promise in reducing environmental impacts, especially in comparison to high-emission sources like beef. However, energy efficiency and low-carbon energy adoption are crucial for maximizing benefits.
- **Public Health:** Comprehensive research is needed to evaluate the public health implications of novel ASF alternatives. While traditional plant-based diets have known health benefits, the health impacts of fermentation-derived or cultivated alternatives require further investigation.
- **Socioeconomic Considerations:** Adoption of novel ASF alternatives can disrupt existing food systems. Policymakers should prioritize food security, job protection, gender equity, and cultural preservation in the transition. Supporting research, open-source initiatives, and transparent regulatory frameworks can facilitate commercial viability.
- **Animal Welfare:** Novel alternatives offer the potential to drastically reduce harm to animals, especially plant- and fermentation-based options. Cultivated meat, though involving some use of animals, aims to minimize this impact, with ongoing efforts to eliminate the use of animal serum.
- **Policy and Regulation:** Governments play a vital role in shaping the future of novel ASF alternatives. Funding for research, transparent approval frameworks, and proactive policymaking are essential. Governments should reconsider subsidies supporting conventional animal agriculture to reflect health and environmental costs.
- **International Collaboration:** Collaboration on research, standards development, and international support is critical for the global uptake of novel alternatives. Shared knowledge and harmonized approaches can contribute to sustainable and healthier food systems.

08 THEME: GHG emission reduction

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## From Plate to Planet: How local governments are driving action on climate change through food

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iPES FOOD | [Source](#) | [Download](#) |

The urgency of addressing the climate crisis demands a transformative approach to food systems, a critical yet often overlooked aspect of climate action. While national governments face challenges in meeting climate goals, this report highlights the pioneering efforts of cities and regional governments in implementing effective, on-the-ground strategies to combat climate change through food system transformation.

### Key Findings

- **Local Governments as Climate Leaders:** Cities and regional governments are at the forefront of cutting greenhouse gas emissions through initiatives promoting sustainable diets, reducing food waste, supporting organic farming, and ensuring food access for vulnerable populations. These actions yield not only emissions reductions but also significant social, health, economic, and environmental benefits.
- **Blueprint for Holistic Action:** Local policies provide a comprehensive blueprint for addressing food and climate challenges, emphasizing social justice, participation, and accountability. These initiatives demonstrate the potential for integrating climate action into the broader framework of sustainable development.
- **Challenges Faced by Local Governments:** Despite limited resources, constrained political power, and challenges posed by crises such as COVID and rising costs of living, local governments persist in making strides toward sustainable food systems. However, their efforts often go unrecognized, emphasizing the need for increased support and acknowledgment.

### Recommendations

- **To achieve the Paris Agreement target and limit global warming, national governments should Embrace Local Exemplars:** Learn from the success of cities and regional governments by incorporating their innovative policies into national frameworks, inspiring comprehensive food and climate strategies.
- **Collaborate and Fund Local Initiatives:** Foster collaboration between national and local governments, providing financial support to scale up successful local initiatives on food and climate action across all cities and regions.
- **Integrate Food Systems into National Commitments:** Seize the opportunity of COP28's Paris Agreement stocktaking moment to revise national climate commitments, systematically integrating food systems and acknowledging the critical role of local action.

# OPEN DATA

01 THEME: Environment and climate; Climate action programs and projects

## The U.S. Climate Resilience Toolkit - Meet the challenges of a changing climate

U.S. Climate Resilience Toolkit | [Source](#) | [Data](#) |

The U.S. Climate Resilience Toolkit is a user-friendly website created to assist individuals in accessing tools, information, and expertise to enhance climate resilience. Consolidating resources from various U.S. federal government sources, the Toolkit aims to simplify the process of finding and utilizing valuable climate-related data. The overarching purpose is to empower people to comprehend and manage climate-related risks and opportunities, fostering resilience in communities and businesses against extreme events. This initiative operates within the United States Global Change Research Program, managed by NOAA's Climate Program Office, and hosted by NOAA's Web Operation Center. Developed using the Drupal content management system, the Toolkit, launched in 2014, has undergone updates, including a mobile-friendly design in version 1.5 introduced in July 2016.

**U.S. Climate Resilience Toolkit**

Steps to Resilience Case Studies Tools Expertise Regions Topics

Search

### Tools

Clear Filters Filter by topic: Filter by tool function: Filter by steps to resilience: Filter by region:

Tools are available to help you manage your climate-related risks and opportunities, and to help guide you in building resilience to extreme events. Browse the list below, or filter by topic and/or tool functionality in the boxes above. To expand your results, click the Clear Filters link.

**A Rural Capacity Map**

This tool helps to identify communities where investments in staffing and expertise are needed to support infrastructure and climate resilience projects.

[Read more >](#)

**ACIS Climate Maps**

Quickly generate maps of temperature and precipitation variables over various periods for states or regions of the United States.

[Read more >](#)

**Adaptation Resources for Agriculture - Responding to Climate Variability and Change in the Midwest and Northeast**

This technical bulletin contains information and resources designed to help agricultural producers, service providers, and educators in

**Adaptation Workbook**

Land managers, natural resource professionals, and motivated landowners can use this structured process to consider the effects of climate change on forests, urban forests, and agricultural properties.

[Read more >](#)

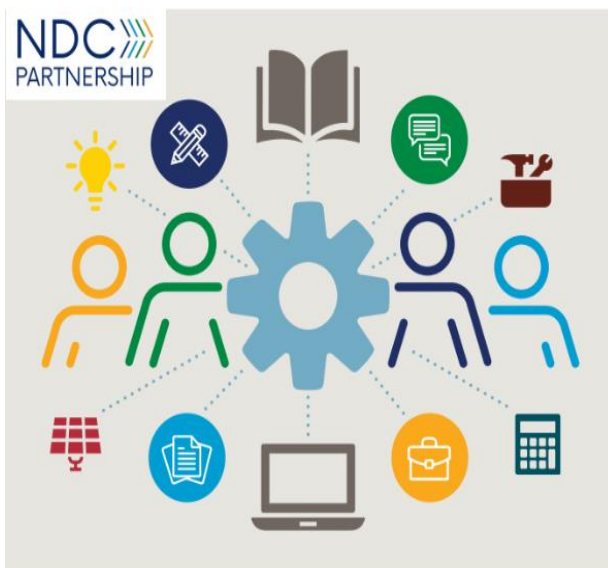
02 THEME: Climate action programs and projects

## Nationally Determined Contributions (NDC) Partnership - Climate toolbox and good practice database

NDC Partnership | [Source](#) | [Climate Toolbox](#) | [Good Practice Database](#) | [Guide](#) |

The NDC Partnership unites over 200 members, including 120+ countries and 80+ institutions, to address climate change and achieve the Paris Agreement and Sustainable Development Goals. Governments define their climate action priorities, and the partnership offers tailored support in expertise, technical assistance, and funding. This collaborative effort helps developing countries efficiently access resources for climate adaptation and mitigation, promoting equitable and sustainable development. The NDC Partnership emphasizes the need for coordinated global action to tackle climate change's extensive impacts, emphasizing that collective efforts surpass individual contributions.

The Climate Toolbox is a curated and searchable database of tools and resources designed to support the planning and implementation of Nationally Determined Contributions (NDCs) related to climate action. It encompasses guidance, frameworks, templates, analysis tools, and links to other knowledge platforms, drawing from over 200 organizations. Aimed at government officials, implementing partners, and relevant stakeholders, the toolbox allows users to filter and search for resources based on sectors, themes, regions, scales, expertise levels, and languages. It includes tools, platforms, and technical support, with strict inclusion criteria focused on relevance, peer-review, and applicability to NDC planning and implementation.



The Good Practice Database (GPD) serves as a comprehensive repository of case studies on effective climate action, emphasizing learning and leadership. This joint initiative by organizations like PATPA, UNDP NDC Support Program, GCAP, and NDC Partnership offers an easily searchable collection of examples where countries successfully design and implement climate measures or overcome obstacles. With over 300 case studies covering various sectors, themes, and implementation stages in mitigation and adaptation, the GPD provides valuable insights for users seeking relevant information based on specific criteria.



03 THEME: Land cover and soil; Environment and climate; Agrifood system; Climate smart agriculture and Net zero toolkit

## **SENSES toolkit & the role of land for food production and climate protection**

European Commission | [Source](#) | [Data](#) |

The SENSES Toolkit is a distinctive set of user-centric visualization tools designed for understanding climate change scenario knowledge. This collection encompasses tools that facilitate learning about the scenario approach and its crucial insights, tools for exploring climate change scenarios, and practical guidelines tailored for three key user groups: policy, finance, and regional decision makers. Rooted in co-production techniques, the toolkit aims to generate relevant and practical climate change scenario knowledge. Its primary goal is to enhance the assessment and application of such knowledge by providing interactive tools that connect users directly to the original scenario data. The toolkit strives to ensure that the tools developed are clear, accessible, trustworthy, and beneficial for stakeholders, minimizing the risk of misinterpretation and promoting transparency in information extraction.

The Role of Land for Food Production and Climate Protection module addresses the significant challenges posed by human activities on the Earth's ice-free land, mainly used for agriculture and forestry to meet the needs of over 7 billion people. Current practices in agriculture, forestry, and land use contribute to climate change, biodiversity loss, and land degradation. The module explores the causes and consequences of increasing pressure on land and looks into future scenarios based on the IPCC SRCCL. Greenhouse gas reduction efforts and land-based carbon removal are crucial in these scenarios, but there's a finite land resource leading to potential trade-offs between large-scale mitigation and food security. The discussion emphasizes the importance of early action, lifestyle changes, and regulatory policies for a more sustainable path toward the 1.5°C goal of the Paris Agreement, highlighting the need to address challenges while minimizing adverse impacts on food security and biodiversity.

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04 THEME: Agrifood system; Climate Actions Programs and Projects

## **COP28 agriculture, food and climate national action toolkit**

COP28 UAE | [Source](#) | [Data](#) |

The COP28 Food Systems and Agriculture Agenda, established in 2023 by the United Arab Emirates (UAE) Presidency, emphasizes the critical role of transforming food and agriculture systems to meet global climate change goals set by the Paris Agreement. The agenda, built on four pillars - national leadership, non-state actors, scaling up innovation, and finance, urges governments to integrate actions within national strategies, including Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs). Under this agenda, a taskforce, including partners like WWF, Global Alliance for the Future of Food, and the Food and Agriculture Organization of the United Nations, collaborated to create the "COP28 Agriculture, Food and Climate Action Toolkit."

The Toolkit serves as a guide for national policymakers and decision-makers, offering summaries of priority actions, examples of well-integrated NDCs and NAPs, and an overview of existing initiatives and tools related to agriculture and food systems. The toolkit aims to support countries in strengthening the integration and alignment of national climate action and food system transformation strategies. It focuses on enhancing the integration of food and agriculture system transformation in NDC and NAP processes, contributing directly to Pillar 1 of the COP28 Food Systems and Agriculture Agenda. The toolkit's goal is to facilitate state-level action and mobilize the global community to sustain efforts in aligning climate action and food systems transformation beyond COP28, in line with international agreements and declarations.

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05 THEME: Agrifood system

## FAO climate risk toolbox

Food and Agricultural Organization of the United Nations | [Source](#) | [Data](#) | [Guide](#) |

The Climate Risk Toolbox (CRTB) is a freely accessible resource hosted on the Hand-in-Hand geospatial platform, developed to integrate climate resilience into agricultural investments, policy plans, and decision-making worldwide. The tool enables users such as policymakers, climate funds, and international development organizations to conduct climate risk screenings, visualizing hotspots and assessing hazard probability, exposure, and vulnerability in targeted agricultural systems and communities.

Recognizing the increasing threat of climate variability and change to agriculture, the CRTB supports evidence-based decision-making by providing tailored recommendations during risk screenings. It addresses the urgent need for climate investments in agriculture, emphasizing the vulnerability of underrepresented social groups and fragile ecosystems. The tool aligns with the 26th United Nations Climate Change Conference's (COP26) call for transformative development in agriculture.

The CRTB is in line with the Food and Agriculture Organization's (FAO) Strategy on Climate Change, contributing to the 2022–2031 agenda that emphasizes tailored climate action, inclusive digitalization, and knowledge-sharing. This strategy aims to assist countries in designing and implementing climate-resilient national commitments for agriculture. The CRTB, developed using the latest climatic, geographical, and socioeconomic data, ensures transparency and accessibility of information for users and project formulators, supporting informed decision-making at the global level. It aligns with FAO's Framework for Environmental and Social Management, integrating climate hazards and impacts into every stage of the project cycle.

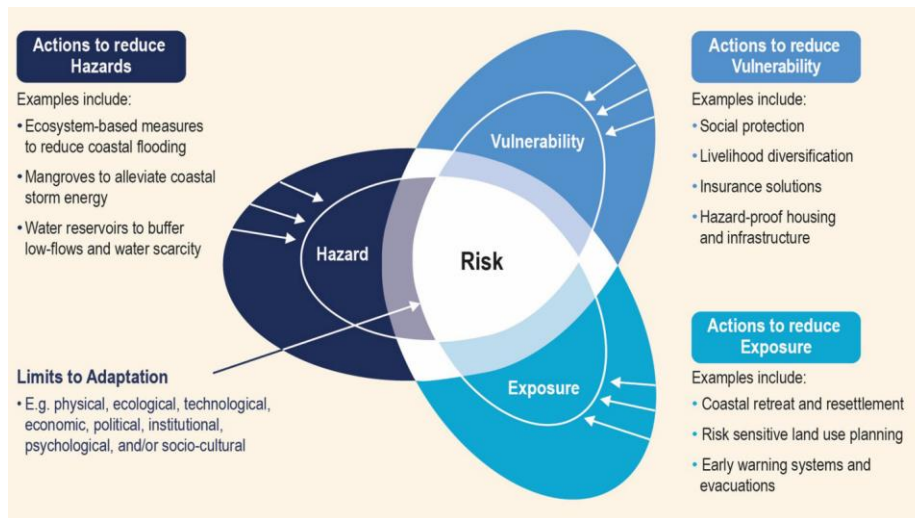
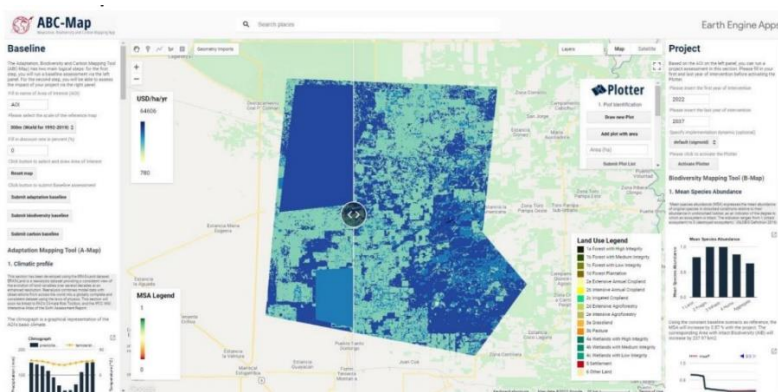


Figure | Climate risk conceptual framework

06 THEME: Agrifood system, Climate smart and Net zero toolkit, GHG emission inventory, Land cover and soil  
**Adaptation, biodiversity and carbon mapping tool (ABC-map)**

Food and Agricultural Organization of the United Nations | [Source](#) | [Data](#) | [Guide](#) |

The world faces interconnected crises—climate change, biodiversity loss, and land degradation—threatening sustainable development and food security. Recognizing the urgency to address these challenges holistically, the Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), French Development Agency (AFD), and German Federal Ministry of Food and Agriculture (BMEL) collaboratively developed the Adaptation, Biodiversity, and Carbon Mapping Tool (ABC-Map).



ABC-Map is a tool designed to comprehensively evaluate the environmental impacts of national policies, plans, and investments in the agriculture, forestry, and other land use (AFOLU) sector. Utilizing Google Earth-based satellite imagery, it facilitates a holistic assessment of climate, biodiversity, and land

restoration actions, aiming to uncover synergies and trade-offs. The Adaptation section focuses on understanding climate change risks and assessing changes over time in a specific area. The Biodiversity section incorporates indicators like species abundance and land use changes in protected areas, providing insights into biodiversity pressures. The Carbon section accounts for greenhouse gas emissions in the AFOLU sector, aligning with reduction goals. This technical manual outlines ABC-Map's structure, methodology, and the diverse data and factors used, including emission factors, carbon stock values, and datasets from sources like ESVD and GLOBIO.