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March 30, 2026

NEWSLETTER

Smart & Net-Zero Project

The Smart Net-Zero (SNZ) project team under the Food and Fertilizer Technology Center (FFTC) for the Asian and Pacific Region regularly collects and shares information related to sustainable agri-food systems and climate-smart agriculture, including research, news, policy, data and event updates around the world on the project website.



Overview

Bridging Smart Environmental Control and Net-Zero Transitions in Agrifood Systems

Greenhouses are highly energy-intensive production systems, making smart environmental control increasingly important. The opening study points to a shift from fixed settings and technician-dependent operation toward real-time, data-connected control using IoT and reinforcement learning (RL). Another shows that RL and model predictive control are being combined to improve performance under uncertainty. A third links the field not only to indoor climate regulation, but also to energy autonomy and on-farm renewable integration. A fourth extends beyond greenhouses to livestock facilities, where net-zero design also depends on energy-efficient environmental management. The review places these developments in a broader methodological context and highlights the gaps they address, especially the need for real-world validation and lower-energy applications. Overall, studies show smart environmental control as an increasingly important pathway for improving efficiency, resilience, and decarbonization in agrifood systems.

News highlights how climate adaptation, emissions reduction, MRV tools, and carbon-market efforts are moving from commitments to implementation, from Japan’s smart agriculture to Australia’s emissions accounting and Taiwan’s soil carbon initiatives. In **Policy**, the featured reports reinforce this shift through stronger agrifood integration in NDCs, improved governance, and greater investment in innovation ecosystems.

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RESEARCH

01 THEME: ICT in Agrifood Sustainability

Enhancing greenhouse efficiency: Integrating IoT and reinforcement learning for optimized climate control

December 19, 2024 | [Sensors](#) |

Introduction: Automated greenhouse systems typically depend on fixed set-point controls that require skilled technicians for configuration and maintenance, limiting scalability and adaptability. Researchers from the University of Alicante and Miguel Hernandez University (Spain), together with the University of Costa Rica, proposed integrating Internet of Things (IoT) data acquisition with reinforcement learning (RL) optimization to automate and improve greenhouse climate control. The model was tested in a real industrial production greenhouse cultivating industrial hemp, guided by an agronomic technician whose expertise informed the RL transfer to the operational facility.

Key findings: The RL-based control system achieved energy savings of up to 45% during cooling and 25.93% during heating compared to traditional fixed set-point control, while maintaining temperatures within desired ranges. Energy savings increased at higher set-point temperatures, ranging from approximately 36% at 18°C to nearly 50% at 22°C. Among machine learning methods tested for indoor temperature prediction, gradient boosting and linear regression showed the lowest RMSE values. The integration of IoT enabled real-time data acquisition and seamless communication between greenhouse subsystems, allowing the RL model to adapt dynamically to changing environmental conditions. The approach reduces the need for constant human intervention, simplifying technician workloads and increasing scalability for larger agricultural enterprises. The authors noted that the model can be implemented using non-proprietary hardware and communication protocols in both existing and newly designed facilities, though further validation across diverse crops and climates is needed.

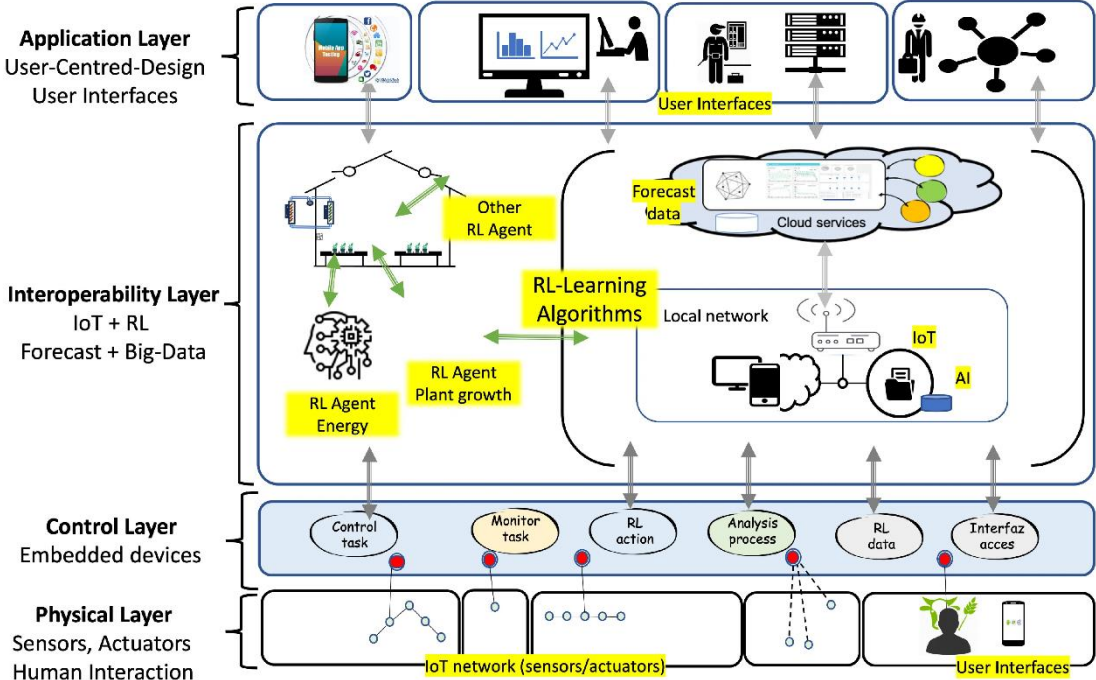


Figure | Layered technological architecture. Relationship between IoT, RL, digital platform and different interfaces.

02 THEME: ICT in Agrifood Sustainability

Reinforcement learning-based model predictive control for greenhouse climate control

March, 2025 | [Smart Agricultural Technology](#) |

Introduction: Model predictive control (MPC) is a promising approach for greenhouse climate management, but its reliance on accurate prediction models makes it vulnerable to uncertainties from modelling errors and inaccurate weather forecasts. Existing robust or stochastic MPC methods address this uncertainty but often reduce crop yield due to conservatism and increase computational loads. Researchers from Delft University of Technology and Wageningen University in the Netherlands proposed a combined MPC and reinforcement learning (RL) framework in which a parametrized MPC scheme learns directly from data to optimize constraint satisfaction and climate control performance under prediction uncertainty.

Key findings: Simulations using a lettuce greenhouse model showed that the proposed MPC-RL controller significantly reduced constraint violations compared to nominal MPC, robust MPC, and deep RL (DDPG) controllers. After 100 growth cycles of training, indoor CO₂ levels no longer violated bounds, and humidity violations were reduced to brief, infrequent exceedances. The approach maintained crop yield comparable to an ideal MPC controller without the conservatism-induced yield losses seen in robust MPC methods with higher sample counts. Economic profit indicators also favored the MPC-RL approach over DDPG, which maximized yield inefficiently relative to control inputs. Computation times were similar to standard MPC approaches and substantially lower than robust MPC with multiple samples. The authors noted that unlike black-box deep neural network controllers, the MPC-based RL approach allows interpretation of learned parameters, providing transparency for growers. Future work includes application to alternative greenhouse models and experimental validation in real-world settings.

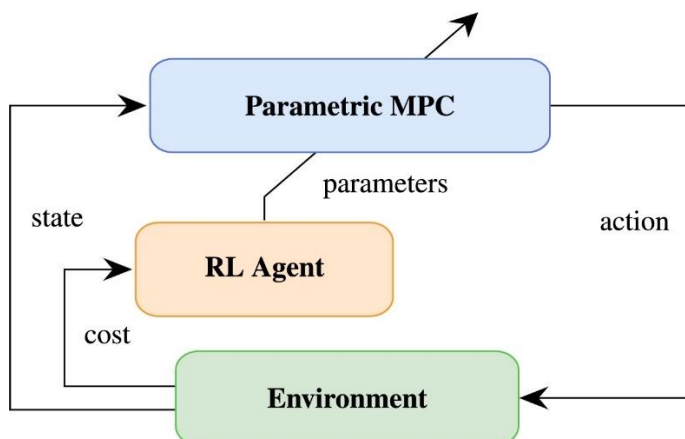


Figure | Diagram of the MPC-based RL architecture.

03 Theme: ICT in Agrifood Sustainability

Enhancing energy autonomy of greenhouses with semi-transparent photovoltaic systems through a comparative study of battery storage systems

January 17, 2025 | [Scientific Reports](#) |

Introduction: Greenhouses require stable energy supplies for maintaining optimal environmental conditions, yet their heavy reliance on grid electricity increases operational costs and carbon footprints. Semi-transparent photovoltaic (STPV) systems can generate electricity while allowing sufficient light for plant growth, but their intermittent output creates reliability challenges. Researchers from Fırat International University (Turkey), Murdoch University (Australia), and Qatar University investigated whether integrating Battery Energy Storage Systems (BESS) with STPV panels could enhance greenhouse energy autonomy, using the Harmony Search optimization algorithm to determine optimal BESS sizing and placement across seasonal scenarios.

Key findings: Incorporating BESS significantly reduced grid dependency, with the energy autonomy factor improving from 43.43% to 24.17% in summer and from 81.36% to 69.45% in winter. Performance was highly sensitive to STPV panel transmittance rates and the minimum Daily Light Integral (DLI) required by crops - higher DLI requirements constrained the allowable STPV area, reducing energy generation capacity. Financial analysis showed BESS integration reduced total operational costs by 13.5% in summer and 6.1% in winter, with 20-year Net Present Value (NPV) improving from \$712,392 to \$946,730 in summer. Temperature effects on panel efficiency further influenced energy autonomy by 1.7-6.7% depending on season and DLI. The authors noted that achieving year-round energy autonomy requires dynamic seasonal adjustments to BESS and STPV configurations, and suggested that complementary solutions such as hydrogen storage could further reduce grid dependency during low-irradiance periods.

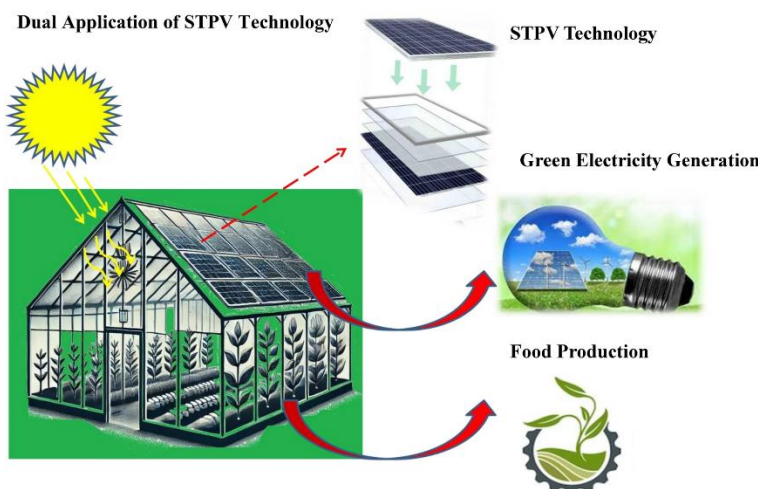


Figure | Dual application of STPV in a greenhouse.

04 Theme: GHG Emission Reduction

Design considerations for net zero energy buildings for intensive, confined poultry production: A review of current insights, knowledge gaps, and future directions

February, 2022 | [Renewable and Sustainable Energy Reviews](#) |

Introduction: Poultry housing may account for up to 50% of total non-renewable energy use and 20-35% of the life cycle impacts of poultry production, yet net zero energy (NZE) building design remains an under-explored mitigation strategy for the livestock sector. Researchers from the University of British Columbia Okanagan (Canada) conducted a PRISMA systematic review of 249 papers to identify insights from commercial and residential NZE building research applicable to poultry housing, quantify the magnitude and distribution of energy use in poultry facilities, and determine priority design considerations accounting for the physiological requirements of confined poultry production.

Key findings: The review found that heating, ventilation, and air conditioning (HVAC) systems dominate direct energy use in poultry housing, with heating as the primary consumer during cold seasons and ventilation during warm seasons. Three categories of strategies were identified as essential for achieving NZE status: 1) reducing energy use through passive design (especially improved insulation over maximizing glazed area, given poultry photoperiod requirements), 2) improving energy efficiency of active systems (LED lighting reducing energy by 80-85%, heat recovery ventilators, ground-source heat pumps), and 3) implementing context-appropriate renewable energy generation (solar PV, wind turbines, biomass from poultry litter, anaerobic digestion). The authors emphasized that poultry-specific constraints - including thermo-neutral temperature ranges, high ventilation rates for air quality, and humidity control - require design adaptations not found in commercial building NZEB research. Key gaps identified include the need for hybrid technology integration rather than isolated solutions, simulation models tailored to poultry housing, and smart control systems with sensor networks for real-time monitoring adapted to the dynamic physiological needs of birds across growth stages.

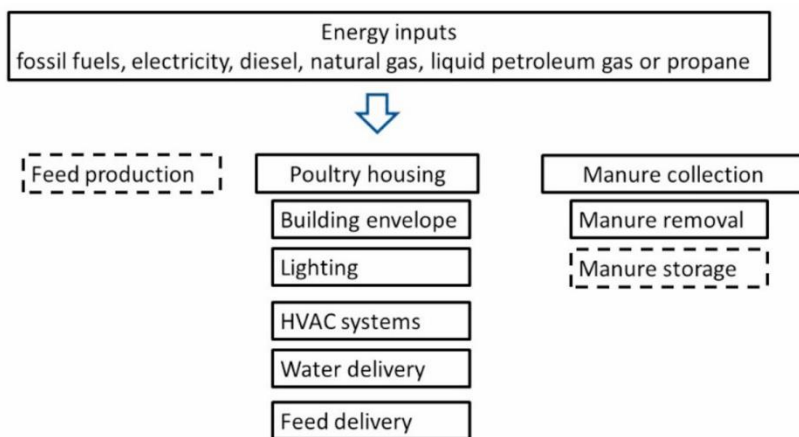


Figure | Analyzed boundary of poultry housing (activities in the dotted boxes were excluded).

05 THEME: ICT in Agrifood Sustainability; GHG Emission Reduction

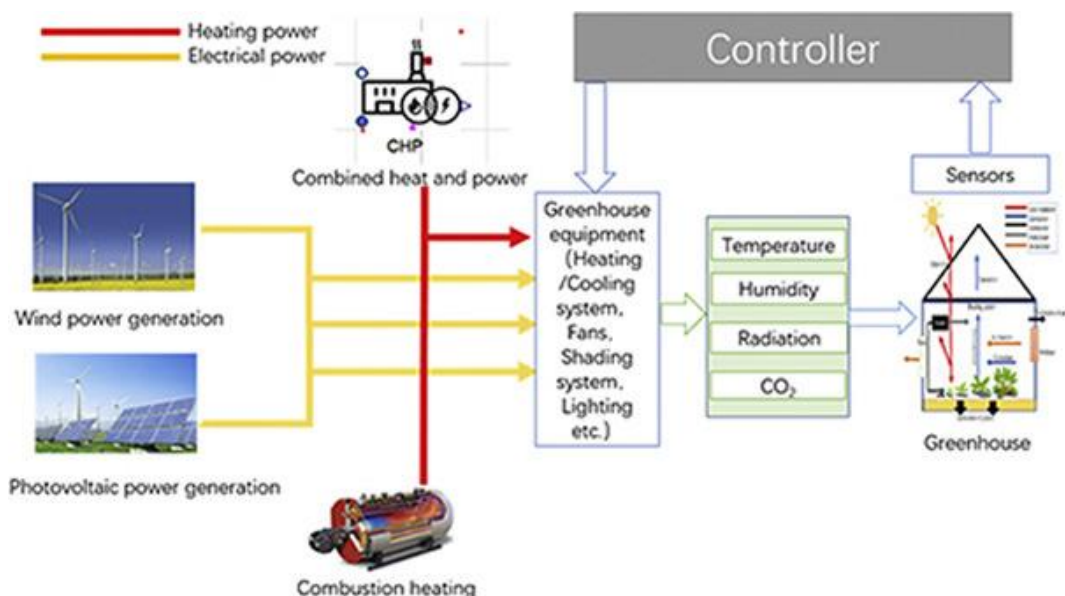
Methodologies of control strategies for improving energy efficiency in agricultural greenhouses

November 20, 2020 | [Journal of Cleaner Production](#) |

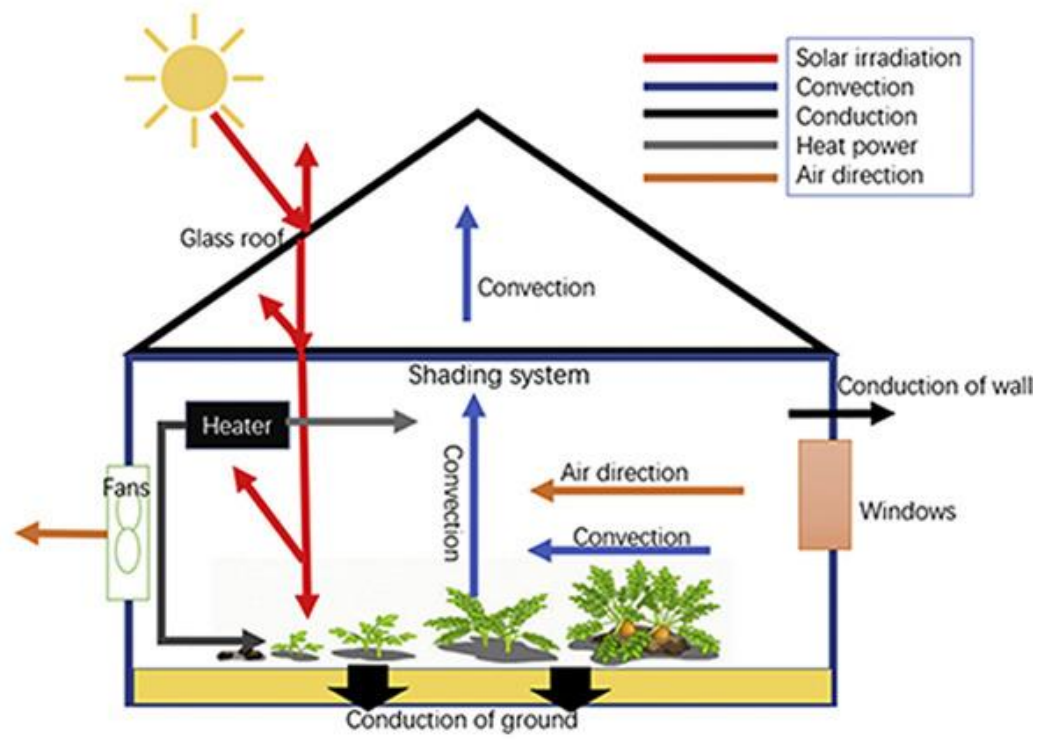
Introduction: Greenhouses account for the largest share of final energy consumption in agriculture, with heating alone consuming 65-85% of total energy. Despite the importance of control strategies for reducing energy use while maintaining suitable growing conditions, no systematic review had examined these methodologies comprehensively. Researchers from China Agricultural University, the University of Liverpool (UK), and the Fraunhofer Institute for Building Physics (Germany) conducted a systematic review of control strategy methodologies for improving energy efficiency in agricultural greenhouses, covering mathematical modelling, physical experiments, numerical simulations, and parametric sensitivity analysis across more than 30 performance-affecting parameters.

Key findings: The review identified that approximately 60% of the literature focuses on temperature and humidity as the primary controlled parameters, which directly affect both crop yield and energy consumption. Numerical simulation using MATLAB/Simulink is the most common methodology (around 30% of studies), while real physical experiments validating model accuracy remain very few. Since the 2010s, a clear trend has emerged: combining traditional control strategies such as PID and fuzzy logic with artificial neural networks and intelligent algorithms to simultaneously reduce energy consumption and maintain optimal microclimates. Specific energy savings reported include 36% water savings and 30% less electricity through improved cooling control, and 9% energy cost reduction via hybrid control during cold days. Over 30 control strategies were evaluated, with model predictive control, fuzzy control, and hybrid approaches consistently recommended for low-energy greenhouses. The authors identified that integrating big data, artificial intelligence, and machine learning with advanced control strategies will drive a revolution in greenhouse energy management, and that incorporating renewable energy and passive house technologies could bring agricultural greenhouses toward net-zero energy status.

Graphical abstract | Relationship among controller, greenhouse equipment supplied by thermal and electrical energy, controlled environmental factors (temperature, humidity etc.) and sensors in the greenhouse (a), detailed thermal environment inside the greenhouse (b).



(a)



(b)

NEWS

01 THEME: GHG Emission Reduction

From waste to wealth? The promise and challenges of the circular bioeconomy in Asian agri-food systems

January 30, 2026 | [Asia Pathways - Asian Development Bank Institute \(ADBI\)](#) |

This new analysis examines how the circular bioeconomy can transform agricultural waste into valuable products across Asian agri-food systems. The study identifies significant potential, noting that converting agro-food waste to animal feed and bio-based materials has reduced GHG emissions by 30% in India, while Thailand's climate-smart irrigation systems improved water-energy-food efficiency by 20%.

However, adoption remains critically low, with less than 10% of biomass converted in both India and Indonesia. The authors highlight that weak technology access, fragmented policies across agriculture and energy sectors, and limited inter-firm collaboration in ASEAN countries constrain progress. They recommend strengthening incentive-driven models, investing in decentralized technologies, and establishing multi-stakeholder governance platforms to align policy objectives.



02 THEME: GHG Emission Reduction; Policy Incentives, Financing, Pricing

Strategy to cut European agricultural emissions by 40%

February 18, 2026 | [Open Access Government](#) |



A study by the Norwegian University of Science and Technology (NTNU), published in Nature Communications, proposes that Europe can reduce agricultural GHG emissions by 40% through strategic land reallocation. Researchers used satellite data to identify 24 million hectares of low-productivity land, representing 14% of European agricultural operations, and suggest rewilding these areas while optimizing farming on fertile plains.

In Norway, one-third of arable land produces only 20% of yields. The approach could increase crop yields by 10-20% on better land while reducing biodiversity pressure by 20%. Professor Francesco Cherubini emphasizes the environmental benefits of allowing trees, wetlands, and natural vegetation to reclaim degraded plots, creating carbon sinks and reducing erosion. The study offers a dual strategy of intensification and extensification without compromising food production.

03 THEME: ICT in Agrifood Sustainability

How Japan is using tech and partnerships to protect its agriculture

February 17, 2026 | [World Economic Forum](#) |

Japan is deploying smart agricultural technologies and public-private partnerships to adapt farming to accelerating climate impacts. According to the Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan recorded a +1.48°C temperature deviation in 2024, the highest on record, causing widespread chalky rice grains and poor fruit set across 60-70% of northern Japan. In response, heat-tolerant rice varieties now cover 206,000 hectares, a 2.5-fold expansion over the past decade, representing 16.4% of all staple rice production. Smart agriculture technologies in paddy cultivation have reduced labour hours by an average of 9%, with pesticide-spraying drones cutting working time by 61% and automated water management systems by 80%. The Act on the Promotion of Smart Agricultural Technology, enacted in October 2024, establishes certification schemes and provides financial incentives for technology adoption. Shizuoka Prefecture has also launched a regional initiative for avocado cultivation as crop suitability zones shift.



04 THEME: MRV (Measurement, Reporting, Verification)

CSIRO unveils new tool to help farmers measure environmental footprint

February 24, 2026 | [Commonwealth Scientific and Industrial Research Organisation \(CSIRO\)](#) |



Australia's national science agency, CSIRO, has launched [FarmPrint](#), a tool enabling farmers to evaluate, benchmark, and report their GHG emissions. FarmPrint adopts a cradle-to-farm-gate approach, measuring both on-farm emissions and those embedded in supply chains such as fertilizers, chemicals, and diesel. Developed as a prototype with early support from the Clean Energy Finance Corporation and refined over 12 months of trials on CSIRO research farms, the tool allows users to assess performance against regional benchmarks, monitor emissions changes over time, and identify reduction pathways. Its calculations align with evolving national and international reporting protocols, and an application programming interface (API) enables integration with other software systems. Dr Murray Hall, CSIRO senior research scientist, noted FarmPrint addresses increasing market, lender, and supply chain pressure for transparent emissions reporting, converting CSIRO's digital agriculture research into a practical farm management resource.

05 THEME: Policy Incentives, Financing, Pricing; Carbon Sequestration

Taiwan Carbon Solution Exchange and National Taiwan University discuss agricultural transformation under the ETS

February 10, 2026 | [Central News Agency](#) (Chinese) |

Taiwan's Carbon Solution Exchange (TCX) and the Taiwan Stock Exchange (TWSE) partnered with National Taiwan University (NTU) to host a seminar on natural carbon sinks, soil carbon sequestration, and the circular economy under the planned emissions trading system (TW ETS), set for simulated trial in late 2026. TCX CEO Ms. Seren Chen noted that combining mandatory ETS with voluntary carbon credit offsets represents the prevailing international hybrid carbon pricing model, and that the Ministry of Environment's newly published soil carbon sink methodology and circular economy roadmap draft will enable enterprises to convert farmland reductions into tradable carbon assets. Experts discussed accelerating soil carbon sequestration using agricultural residuals, establishing buffer reserve mechanisms for reversal risks, and introducing soil spectrum analysis to shorten measurement periods. The Ministry of Agriculture confirmed ongoing development of soil carbon storage maps and voluntary greenhouse gas reduction demonstration projects through public-private collaboration.



06 THEME: Carbon Sequestration

Ministry of Agriculture's study on carbon sequestration finds green manure boosts rice productivity

January 26, 2026 | [The Liberty Times](#) (Chinese) |



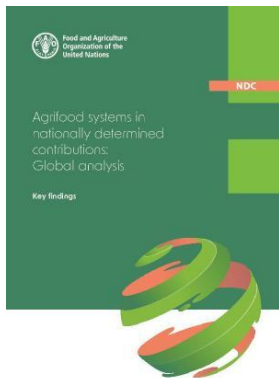
Taiwan's Ministry of Agriculture (MOA), through the Taiwan Seed Improvement and Propagation Station, has completed a 3-year study on farmland carbon sequestration in the Dajia (大甲) rice production area of Taichung City. The research, conducted from 2023 to 2025, integrated green manure cover crops, sun hemp and rapeseed, into rice rotation systems and established a systematic field monitoring database. Results showed that first-season rice yields in 2025 significantly exceeded those of 2024, with green manure-treated plots consistently outperforming untreated areas. In the 0-30 cm soil layer, organic carbon storage under green manure treatments exhibited a cumulative accumulation trend, with rapeseed and sun hemp zones showing greater carbon increases than rice-only plots. The station also monitored methane (CH₄) and nitrous oxide (N₂O) emissions linked to nitrogen cycling under different green manure regimes. The Ministry plans to develop standardized assessment parameters, guidance manuals, and promotion plans to scale sequestration-enhanced farming practices across Taiwan.

POLICY

01 THEME: Net Zero Strategy; Climate Smart Agriculture

Agrifood Systems in Nationally Determined Contributions: Global Analysis

Food and Agriculture Organization (FAO) | [Source](#) | [Report](#) |



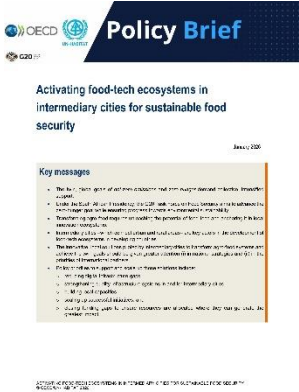
This FAO report provides a comprehensive global analysis of how agrifood systems are addressed in nationally determined contributions (NDCs) under the Paris Agreement. Drawing on a systematic review of 167 NDCs representing 194 Parties as of January 2024, the report assesses the current status of agrifood system climate commitments across adaptation, mitigation, and climate finance dimensions. The report finds that **food insecurity and loss of ecosystems and biodiversity** are the most frequently reported climate-related risks in NDCs, cited by 88% of countries with adaptation components. Between 2007 and 2022, the agriculture sector absorbed one-fourth of disaster impacts across all sectors, with over 65% of drought-related losses occurring in agriculture. By mid-century, 10% of currently suitable agricultural area is projected to become climatically unsuitable under high-emission scenarios, and an additional 80 million people will be at risk of hunger by 2050.

Despite growing ambition, significant gaps remain. **Current NDC mitigation targets are highly insufficient, with policies currently in place projected to result in 3.1°C of warming.** Countries would need to collectively reduce GHG emissions by 28 to 42% compared to 2019 levels to limit warming to below 2.0°C or 1.5°C, respectively. **Agrifood systems generate approximately 30% of global GHG emissions annually**, yet many NDCs lack quantified mitigation targets for key subsectors. The report highlights that least developed countries (LDCs) and low-income countries report climate-related risks at higher rates than the global average, particularly for food security (95% in LDCs), livelihoods and poverty (85%), and water security (89%). On climate finance, a substantial gap persists between the finance needs articulated in NDCs and actual flows directed to agrifood systems. The report calls for deep transformation across agrifood systems and an immediate redirection of global capital toward climate finance, emphasizing the need for 3rd-round NDCs in 2025 to significantly raise ambition, action, and support.

03 THEME: Supply Chain; Sustainable Production

Activating Food-Tech Ecosystems in Intermediary Cities for Sustainable Food Security

Organisation for Economic Co-operation and Development (OECD), UN-Habitat | [Source](#) | [Report](#) |



Published jointly by the OECD and UN-Habitat under the South African G20 Presidency, this policy brief examines the role of food-tech ecosystems in intermediary cities for advancing sustainable food security. It argues that achieving the twin global goals of net-zero emissions and zero hunger requires unleashing the potential of food-tech innovation and anchoring it in local innovation ecosystems, with particular attention to intermediary cities that connect urban and rural areas. The brief reports that the share of people facing moderate or severe food insecurity has risen from 21.5% in 2015 to 28% in 2024, and that agrifood systems accounted for about 1/3 of global anthropogenic GHG emissions in 2022, up roughly 14% since 1990.

Venture capital investment in food-tech surged nearly 12-fold in 15 years, from approximately USD 4 billion in 2010-2012 to an estimated USD 47 billion in 2022-2024. Approximately 31% of food-tech start-ups worldwide are located in intermediary cities, compared to 26% for other sectors. The brief presents case studies from intermediary cities in Argentina, Brazil, Egypt, Jordan, and Kenya, demonstrating how public-private partnerships, international development cooperation, and local innovation ecosystems are piloting food-tech solutions. Policy recommendations include promoting open science and technology transfer, enhancing peer learning on governance pilots, closing digital and physical infrastructure gaps, strengthening quality infrastructure systems such as the OECD Seed Schemes, and building local government capacity. The brief calls for a step change in international development policy guided by place-based, localized approaches, with greater national and international attention to the food-tech initiatives piloted by intermediary cities.

EVENT

01

2nd Edition of Agriculture, Forestry, and Horticulture World Conference (AFHWC 2026)

July 20-22, 2026 | Hybrid | Singapore |

Agriculture, Forestry and
Horticulture World Conference

AFHWC 2026

The AFHWC 2026, organized by Precision Global Conferences (PGC), will be held under the theme "*Thriving Earth: Agriculture, Forestry, and Horticulture for a Sustainable World*". The conference brings together agronomists, environmental scientists, policymakers, and industry leaders to exchange knowledge and advance sustainable practices across agriculture, forestry, and horticulture. The programme includes research presentations, CPD-accredited interactive workshops, and networking opportunities. Key focus areas include food insecurity, deforestation, soil erosion, and climate resilience, with an emphasis on identifying scalable solutions to global sustainability challenges. Featured speakers include researchers from institutions in China, India, the United Kingdom, Egypt, Malaysia, and Tunisia.

02

ICOS Science Conference 2026 - Science, Data, Services: Together for Climate Action

September 15-17, 2026 | Hybrid | Lund, Sweden |

Organized by the Integrated Carbon Observation System (ICOS) research community, the conference is relevant to MRV and climate action research, drawing on ICOS's 3 observational domains: atmosphere, ecosystem, and ocean. It brings together researchers and stakeholders from across the ICOS community to advance knowledge on GHG observation, climate data, and related services. Session themes are available for browsing on the conference website. Registration is expected to open in May 2026.



03

The 13th International Conference on Agriculture (AGRICO 2026)

September 17-18, 2026 | In-person | Bali, Indonesia |



Guided by the theme "*Powering the Future of Sustainability for More Prosperous Farming*," the AGRICO 2026 conference aims to unite researchers, practitioners, and policymakers to advance academic

dialogue and practical solutions for resilient and equitable agriculture. Plenary speakers represent institutions in Australia, Thailand, the Philippines, Cambodia, Kenya, and Jordan. The call for papers welcomes submissions spanning food security, crop production, sustainable farming, emerging agricultural technologies, and related fields. Accepted manuscripts may be submitted for publication in Scopus-indexed journals, as well as peer-reviewed conference proceedings with ISSN and DOI. The abstract submission deadline is April 23 and the early bird deadline is May 19.

04

3rd Global Summit on Food, Agriculture & Plant Sciences 2026

September 21-22, 2026 | Hybrid | Kuala Lumpur, Malaysia |

The Global Summit organized by Universal Pannel, will be held under the theme "Innovations for a Sustainable and Nourished Planet". The event addresses advancements and technology trends in food, agricultural, and plant sciences, and examines key challenges facing the food and agriculture sectors. Scientific sessions cover a broad range of topics across food science and technology, agronomy, soil science, plant genetics, precision farming, and related fields. The summit welcomes researchers, policymakers, industry professionals, and faculty from agricultural universities, and includes a Young Scientist programme offering oral presentations, mentorship, and networking opportunities for early-career researchers.

