Issue 3
June 30, 2023
(Revised March 10, 2024)

NEWSLETTER

Smart & Net-Zero Project

Overview

Welcome to the FFTC Smart & Net-Zero Newsletter! Explore innovative technologies, sustainable practices, policy initiatives, and knowledge sharing platforms worldwide. In the Research section, you'll find a collection of articles on remote sensing for crop planning and natural resources conservation, as well as various low carbon farming practices. The News section contains updates on the use of digital technology in precision agriculture, and in achieving sustainability and transparency of the agrifood supply chain. The highlight of Open Data and Policy sections this month is how United States and Canada are transforming the agrifood system towards sustainability, as included in their Climate Action plan, agricultural policy and programs are practical measures such as promoting climate agriculture, and the building partnership among stakeholders along supply chain to promote sustainable agricultural products.

Content

RESEARCH

01 THEME: Carbon sequestration

Microbial necromass under global change and implications for soil organic matter

March 19, 2023 | Global Change Biology | Source |

Microbes play a crucial role in soil health and the cycling of carbon and nutrients. One important aspect of these microbes is their "necromass," the remains of dead microorganisms that contribute to soil organic matter. However, the impacts of global changes on microbial necromass are not well understood. Researchers from Sichuan Agricultural University and Vrije Universiteit Amsterdam conducted a study to investigate this relationship.

Their findings revealed that factors like nitrogen, phosphorus, and potassium inputs from human activities, climate warming, elevated carbon dioxide levels, and periodic drought significantly affect soil microorganisms and the formation of microbial necromass. They discovered that adding nitrogen along with phosphorus and potassium increased the content of fungal and bacterial necromass, leading to increased soil organic matter. Interestingly, warming temperatures favored bacterial growth over fungi, as bacteria thrive in higher temperatures. However, other global change factors had minimal effects on microbial necromass.

This study highlights the critical role of microbial necromass in soil health and its response to global changes. Further research is needed to understand the specific responses of bacteria and fungi to nitrogen addition and warming, as well as the contribution of microbial necromass to soil organic matter under different fertilization practices. By unraveling these relationships, we can better protect our soils and mitigate the effects of climate change.

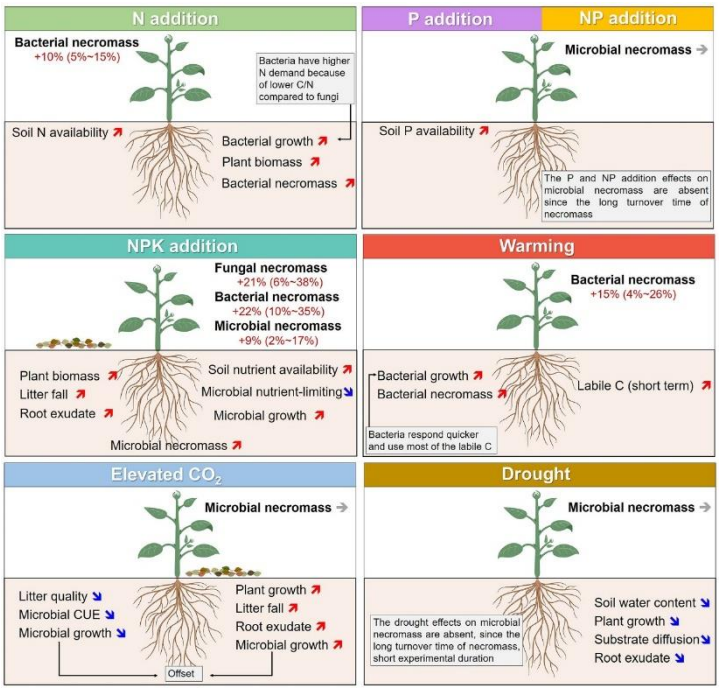


Figure | Graphical summary of the main processes of global change effects on the bacterial, fungal, and total microbial (bacteria plus fungi) necromass. Red arrows indicate positive effects (increase), blue arrows represent the negative effects (decrease), and grey horizontal arrows show absence of changes (no effects). CUE, carbon use efficiency.

02 THEME: Carbon sequestration

Management-induced changes in soil organic carbon and related crop yield dynamics in China's cropland

April 6, 2023 | Global Change Biology | Source |

Researchers from China Agricultural University conducted a study to understand how specific farming practices affect soil health and crop productivity in the face of climate change. By analyzing different management approaches, they found that implementing site-specific best practices significantly increased soil organic carbon (SOC) levels and maintained or improved crop yield. The most successful strategy involved combining mineral fertilizer with organic inputs, resulting in a remarkable 30.6% increase in SOC and a 79.8% increase in crop yield. They also identified key conditions for optimal results, such as arid regions, higher soil pH, lower initial SOC levels, longer implementation duration, and appropriate nitrogen input levels. Additionally, the study revealed a relationship between SOC and crop yield changes, suggesting the positive role of nutrient-mediated effects. The findings highlight the importance of improving SOC to enhance crop performance, but limitations remain in areas with low initial SOC, excessive nitrogen inputs, inadequate organic input, or inappropriate tillage. By optimizing farming practices based on specific conditions, we can contribute to sustainable agriculture and combat the challenges of climate change.

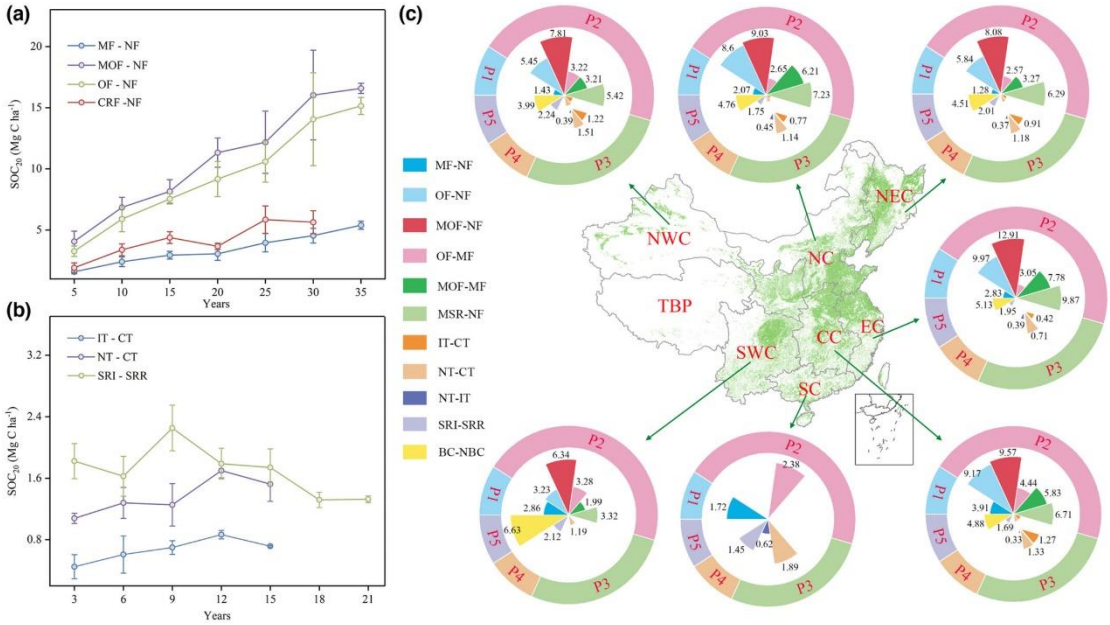


Figure | The characteristics of management-induced spatial–temporal variability SOC. The map in (a) and (b) showed management-induced SOC temporal changes. (c) showed area-weighted mean SOC stocks change in seven agronomic regions under different BMPs of China. The seven agronomic regions are NWC, Northwest China; NC, North China; NEC, Northeast China; EC, East China; CC, Central China; SC, South China; and SWC, Southwest China. "Map lines delineate study areas and do not necessarily depict accepted national boundaries".

03 THEME: Others

Negative effects of soil warming, and adaptive cultivation strategies of maize: A review

March 1, 2023 | Science of The Total Environment | Source |

Temperature plays a pivotal role in ecological processes, with climate change driving the need to understand its effects. While the impact of rising air temperature on maize shoot growth and yield has been extensively studied, little is known about how soil temperature affects root systems. Researchers from Northwest A&F University conducted a review to address this knowledge gap, focusing on the consequences of elevated soil temperature on maize root growth and communication with the aboveground parts of the plant.

As soil temperatures increase, maize faces additional challenges. The review outlines the effects of excessive soil temperature on the soil microenvironment, including soil respiration, microbial communities, carbon mineralization, and enzyme activity. It also highlights the negative impact on root water and nutrient absorption, as well as overall root-to-shoot growth.

To enhance maize yield and mitigate these challenges, the researchers propose various cultivation strategies. These include optimizing tillage methods, utilizing biochar amendments, applying organic fertilizers, optimizing irrigation practices, and implementing farmland mulching.

Understanding the intricate relationship between soil temperature, maize roots, and crop performance is vital for sustainable agriculture. By adopting effective cultivation approaches, we can navigate the challenges of changing soil temperatures and ensure food security.

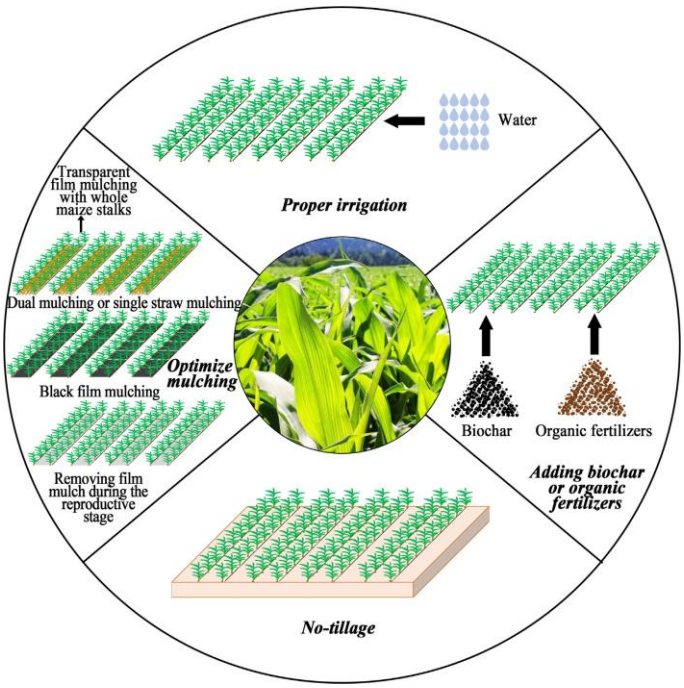


Figure | Cultivation strategies to avoid and tolerate higher soil temperatures. These ideas include improving tillage methods, adding biochar, applying organic fertilizers, optimizing irrigation and mulching measures.

04 THEME: Others

Urbanization can accelerate climate change by increasing soil N_2O emission while reducing CH_4 uptake

March 2023 | Global Chang Biology | Source |

A study conducted by the Chinese Academy of Sciences and City University of New York investigated the impact of urbanization-induced land-use change on carbon (C) and nitrogen (N) cycles, as well as greenhouse gas (GHG) emissions. Through a comprehensive meta-analysis, the researchers assessed the effects of urbanization on soil nitrous oxide (N_2O) and methane (CH_4) fluxes, quantified N_2O emission factors in fertilized urban soils, and identified key drivers of flux changes associated with urbanization.

The findings revealed that urbanization increases soil N_2O emissions by 153%, reaching 3.0 kg N per hectare per year, while soil CH_4 uptake rates decrease by 50%, to 2.0 kg C per hectare per year. Globally, the conversion of land to urban greenspaces has led to a significant increase in soil N_2O emissions (0.46 Tg N_2O-N per year) and a reduction in soil CH_4 uptake (0.58 Tg CH_4-C per year). The study also identified factors such as changes in soil properties, increased temperature, and management practices (particularly fertilizer use) as key drivers of these effects.

To mitigate these impacts, the researchers suggest avoiding soil compaction, reducing lawn fertilization, and restoring native ecosystems in urban landscapes. By implementing these strategies, the study indicates that the negative effects of urbanization on soil N_2O emissions and CH_4 uptake can be mitigated, contributing to more sustainable urban environments.

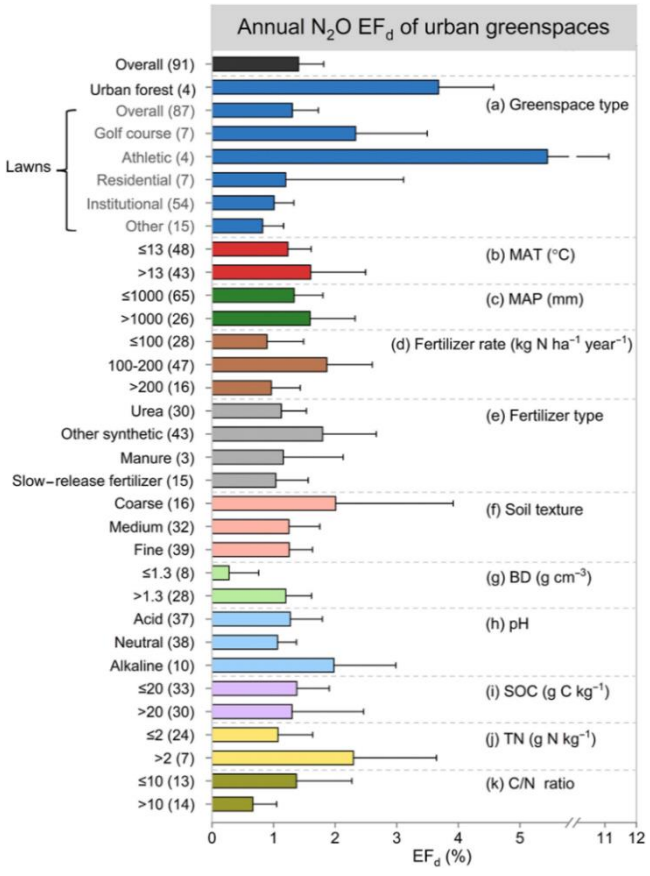


Figure | Effects of type of green space (a), MAT (b), MAP (c), N fertilization rate (d), N fertilizer type (e),soil texture (f), BD (g), soil pH (h), SOC(i), total N (TN) (j), and C/N ratio (k) on annual direct emission factors (EFd) of nitrous oxide (N_2O) in urban soils. The values in brackets indicate the number of observations in each sub-group. Error bars represent 95% confidence intervals. "Other lawns" refer to public park and ornamental landscapes. "Other synthetic" refers to synthetic N fertilizer other than urea and slow-release fertilizer, for example, calcium nitrate and ammonium nitrate. Acid, neutral, and alkaline mean pH ≤ 6.5, 6.6 ≤ pH < 7.3, and pH > 7.3, respectively. BD, bulk density; MAP, mean annual precipitation; MAT, mean annual temperature; SOC, soil organic C; TN, total N.

05 THEME: Carbon sequestration

Cropland carbon stocks driven by soil characteristics, rainfall and elevation

March 1, 2023 | Science of The Total Environment | Source |

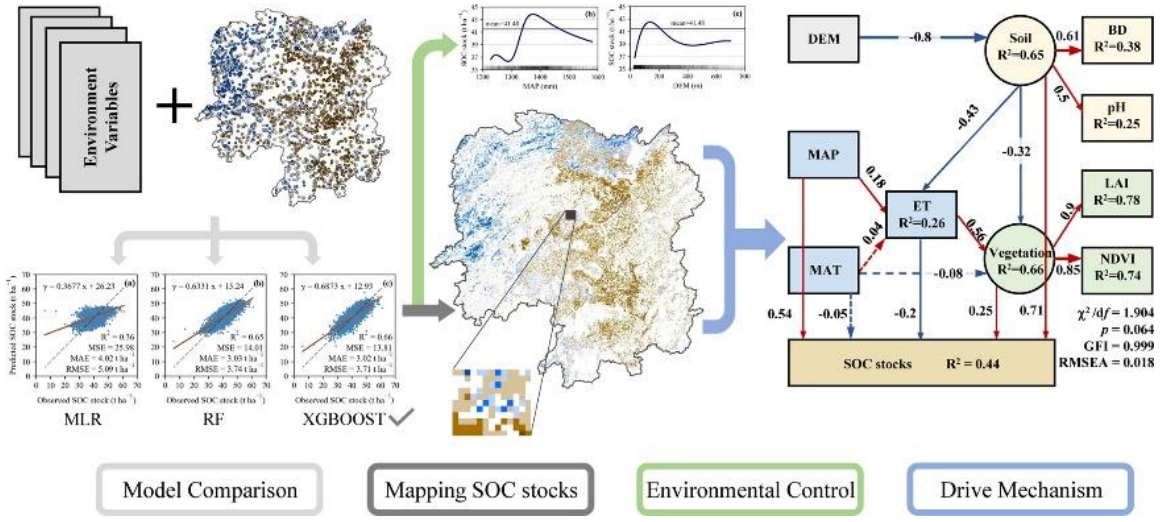
Soil organic carbon (SOC) is crucial for mitigating climate change by influencing CO_2 levels. Researchers from China Agricultural University and University of Tasmania in Australia conducted a study to understand the factors influencing SOC in croplands. Using machine learning and observed soil samples from Hunan Province, China, they examined 16 environmental variables and their impact on SOC.

The results showed that the extreme gradient boosting (XGBOOST) model performed best, accurately predicting 66% of SOC variations. High SOC levels were found in low-altitude areas with sufficient water. Precipitation had a positive relationship with SOC, but with diminishing returns.

The study also used a structural equation model to uncover direct and indirect effects of environmental variables on SOC. Soil properties influenced by elevation had the most significant impact, while precipitation and elevation directly and indirectly affected SOC levels.

This research provides valuable insights into SOC dynamics and offers guidance for sustainable land management practices to enhance carbon sequestration in croplands. The findings contribute to our understanding of SOC and inform efforts to mitigate carbon loss in agricultural soils under climate emergency conditions.

Graphical abstract



06 THEME: Carbon sequestration

Magnitude and efficiency of straw return in building up soil organic carbon: A global synthesis integrating the impacts of agricultural managements and environmental conditions

June 1, 2023 | Science of The Total Environment | Source |

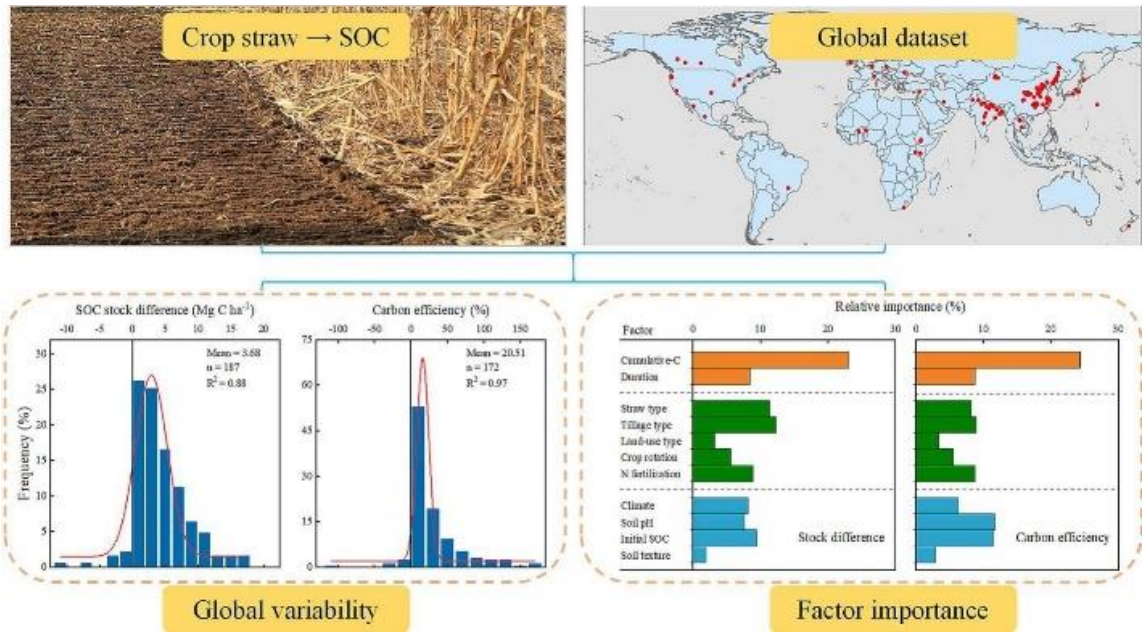
Straw return (SR) is a climate-smart agricultural practice recommended for enhancing soil organic carbon (SOC). To assess its effectiveness, researchers from China Agricultural University conducted a global analysis using 327 observations from 115 sites.

Their findings reveal that SR increased SOC by an average of 3.68 Mg C ha−1, with a carbon efficiency of 20.51%. Interestingly, less than 30% of the SOC increase was directly attributed to straw carbon input. The magnitude of SOC changes from SR increased with higher straw carbon input and longer experiment duration, while carbon efficiency decreased.

No-tillage and crop rotation practices were found to enhance the SOC increase through SR, especially in acidic and organic-rich soils. Machine learning analysis identified the amount of straw carbon input as the most critical factor, while local agricultural practices and environmental conditions determined regional variations.

These insights support tailored, region-specific SR policies for maximizing SOC increment while considering environmental impacts. By optimizing agricultural practices, farmers can accumulate more carbon and promote sustainable agriculture.

Graphical abstract



07 THEME: GHG emission reduction

Unraveling the effect of added microbial inoculants on ammonia emissions during co-composting of kitchen waste and sawdust: Core microorganisms and functional genes

May 20 2023 | Science of The Total Environment | Source |

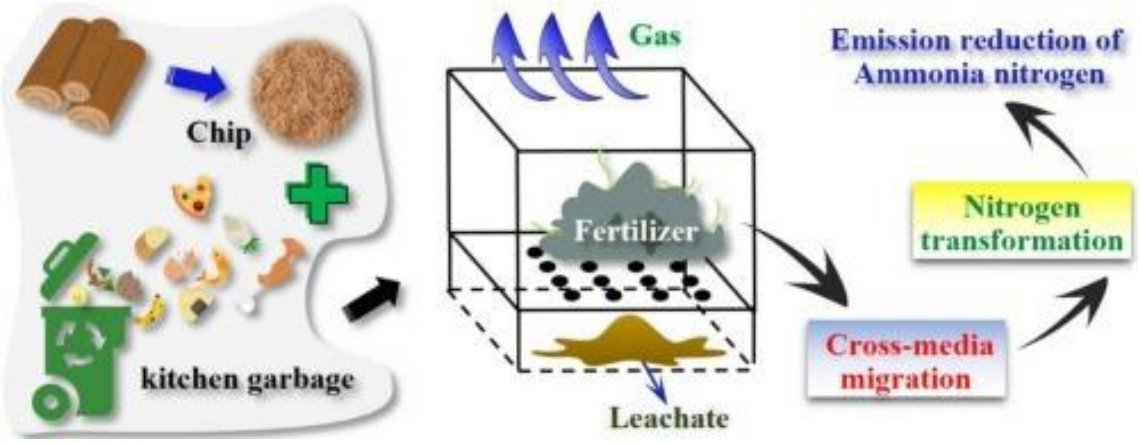
Microorganisms play a crucial role in the transformation of nitrogen during composting, yet their ability to mitigate ammonia (NH3) emissions remains poorly understood. To address this gap, a collaborative study by the University of Geneva, Switzerland, and the Ministry of Agriculture and Rural Affairs, China, investigated the impact of microbial inoculants (MIs) and different composting phases on NH3 emissions.

The researchers constructed a co-composting system using kitchen waste and sawdust, comparing systems with and without MI additions. The results revealed a significant increase in NH3 emissions upon adding MIs, with leachate contributing the most to ammonia volatilization. Furthermore, MIs influenced the proliferation of core microorganisms involved in NH3 emission, reshaping the microbial community dynamics.

The study also highlighted the ability of MIs to enhance the co-occurrence of microorganisms and functional genes related to nitrogen metabolism. Notably, genes associated with dissimilatory nitrate reduction showed increased abundances, contributing to elevated NH3 emissions.

This research provides valuable insights into the microbial mechanisms involved in nitrogen reduction during composting, furthering our understanding of effective nitrogen reduction treatments in agriculture. The findings contribute to sustainable waste management practices and environmental stewardship.

Graphical abstract



08 THEME: Carbon sequestration

Deep tillage enhanced soil organic carbon sequestration in China: A meta-analysis

May 1 2023 | Journal of Cleaner Production | Source |

To combat rising carbon dioxide (CO2) levels, soil organic carbon (SOC) sequestration is being explored as a solution. Deep tillage (DT) is a method that can influence SOC storage across the soil profile, but its effectiveness under different conditions in China remains unclear. Researchers from the Chinese Academy of Agricultural Sciences conducted a meta-analysis of 447 field observations to evaluate the impact of DT on SOC stocks.

The results showed that DT significantly increased SOC stocks by 7.36% compared to conventional tillage (CT). Subsoiling, a type of DT, had a greater effect (8.76%) than deep ploughing (5.85%). Subsoiling enhanced SOC in the 0-40 cm soil layer, with the greatest increase seen at the 0-10 cm depth. Deep ploughing affected SOC between the 10-40 cm depth, while both techniques had no impact below 40 cm.

Subgroup analysis revealed that factors such as high rainfall, fine soil texture, residue retention, double cropping, and increased nitrogen fertilization promoted SOC stock under DT. The study provides valuable insights for SOC management to mitigate climate change, emphasizing the need to consider environmental factors and management practices when implementing DT for enhancing SOC sequestration in different regions of China.

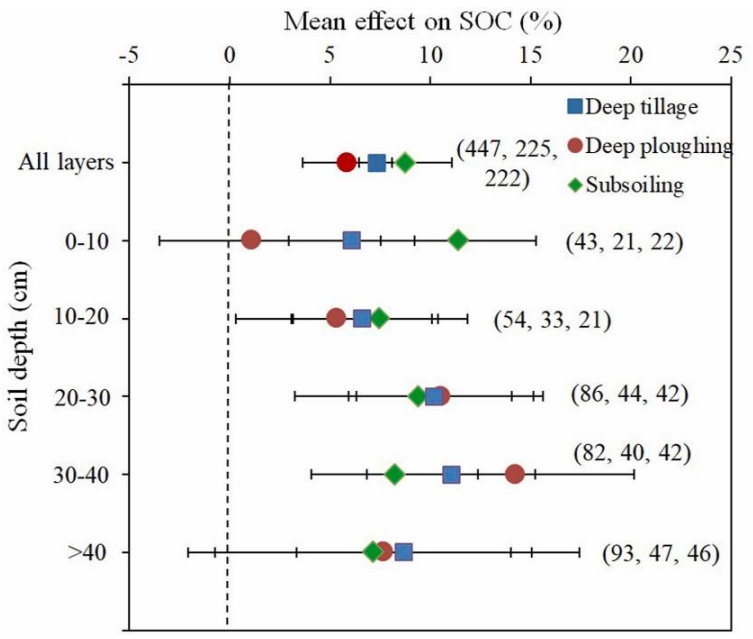


Figure | The effect of deep tillage (deep ploughing and subsoiling), subsoiling and deep ploughing on SOC storage compared with CT. Numbers in parentheses near the bars are the numbers of observations (Tillage, deep ploughing, and subsoiling in turn, respectively). Error bars symbolize 95% confidence intervals.

09 THEME: Carbon sequestration

Evaluating carbon sink potential of forest ecosystems under different climate change scenarios in Yunnan, Southwest China

March 4, 2023 | Remote Sensing | Source |

Forests are crucial in the carbon budget of terrestrial ecosystems, and Nature-based Solutions (NbS) play a key role in carbon neutrality efforts. Beijing Normal University conducted a study to understand the carbon dynamics of southwestern forests under different climate change scenarios. Using the Forest Ecosystem Carbon Budget Model for China (FORCCHN), they simulated the carbon sink potential of these ecosystems driven by downscaled global climate model data.

The findings reveal that gross primary productivity (GPP), ecosystem respiration (ER), and net primary productivity (NPP) are projected to increase from 2020 to 2060. Forests will act as carbon sinks, but net ecosystem productivity (NEP) will peak in the 2030s and decline thereafter. The SSP1-2.6 scenario demonstrates higher NEP and greater stability compared to other scenarios. Northwest and central Yunnan regions exhibit significant carbon sequestration potential, with a slight upward trend in NEP in the future.

Temperature has a strong positive correlation with GPP and ER, while precipitation has minimal influence. However, increasing temperatures may negatively impact forest carbon sinks. These findings guide forest management strategies and contribute to sustainable development goals, informing decisions on forest conservation and carbon sequestration.

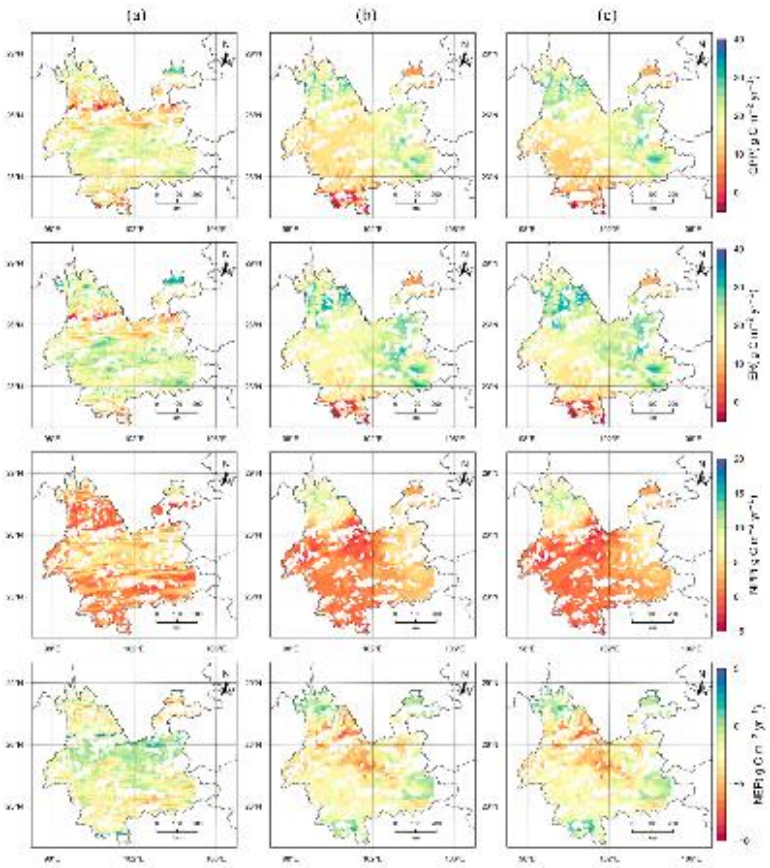


Figure | Spatial distribution of carbon flux trends in Yunnan Province from 2020 to 2060 under different emission scenarios: (a) SSP1-2.6; (b) SSP2-4.5; and (c) SSP5-8.5.

10 THEME: GHG emission reduction

Subsurface fertilization boosts crop yields and lowers greenhouse gas emissions: A global meta-analysis

June 10 2023 | Science of The Total Environment | Source |

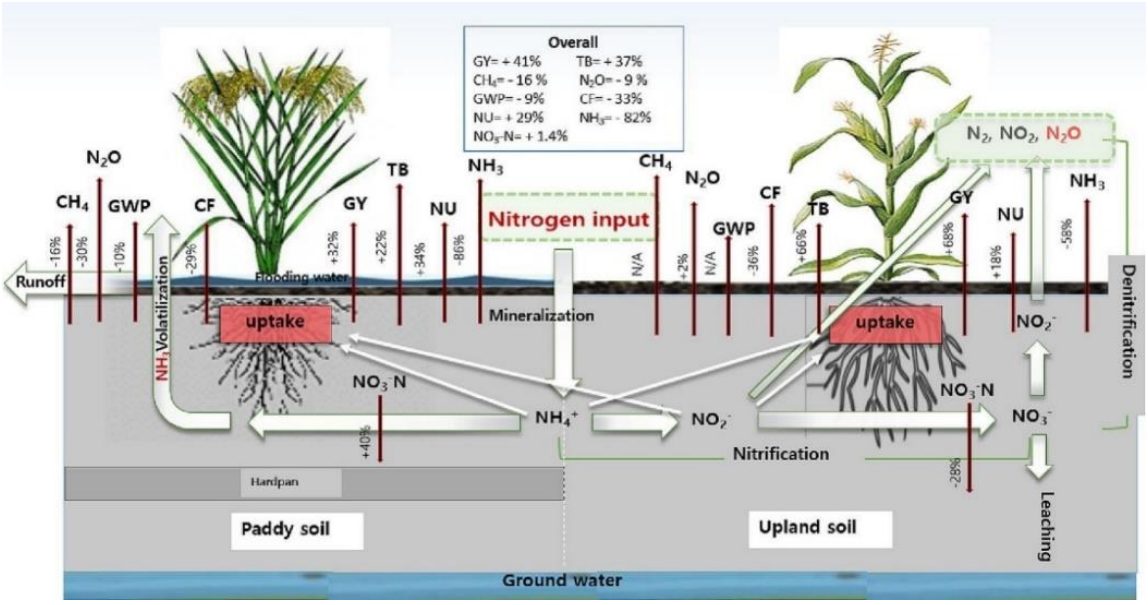
Subsurface application (SA) of nitrogenous fertilizers offers a promising solution to address climate change and ensure food security. Researchers from Gyeongsang National University, Korea, and Sher-e-Bangla Agricultural University, Bangladesh, conducted a comprehensive meta-analysis to assess the impact of SA technology on greenhouse gas (GHG) emissions, crop yield, nitrogen uptake (NU), and soil nitrogen levels.

Findings from 40 peer-reviewed studies reveal that SA technology significantly boosts rice yields by 32% and crop yield in upland systems by 62% compared to surface application of nitrogen (N). Notably, the greatest yield increases were observed at lower N input rates in rice paddies and medium N input rates in upland systems, indicating the influence of soil moisture on SA effectiveness.

SA treatments lead to substantial NU increases, with 34% in rice paddies and 18% in upland systems, while curbing ammonia (NH3) emissions and carbon footprint (CF) by 29% and 36% respectively. Additionally, SA demonstrates significant reductions in methane (CH4) and nitrous oxide (N2O) emissions, resulting in a 10% decrease in global warming potential (GWP) during paddy cultivation.

This meta-analysis highlights the dual benefits of SA technology: mitigating climate change by reducing GHG emissions and enhancing food security through improved crop yield and nutrient uptake. It underscores the potential of SA as a sustainable agricultural practice for a resilient future.

Graphical abstract



11 THEME: Carbon sequestration

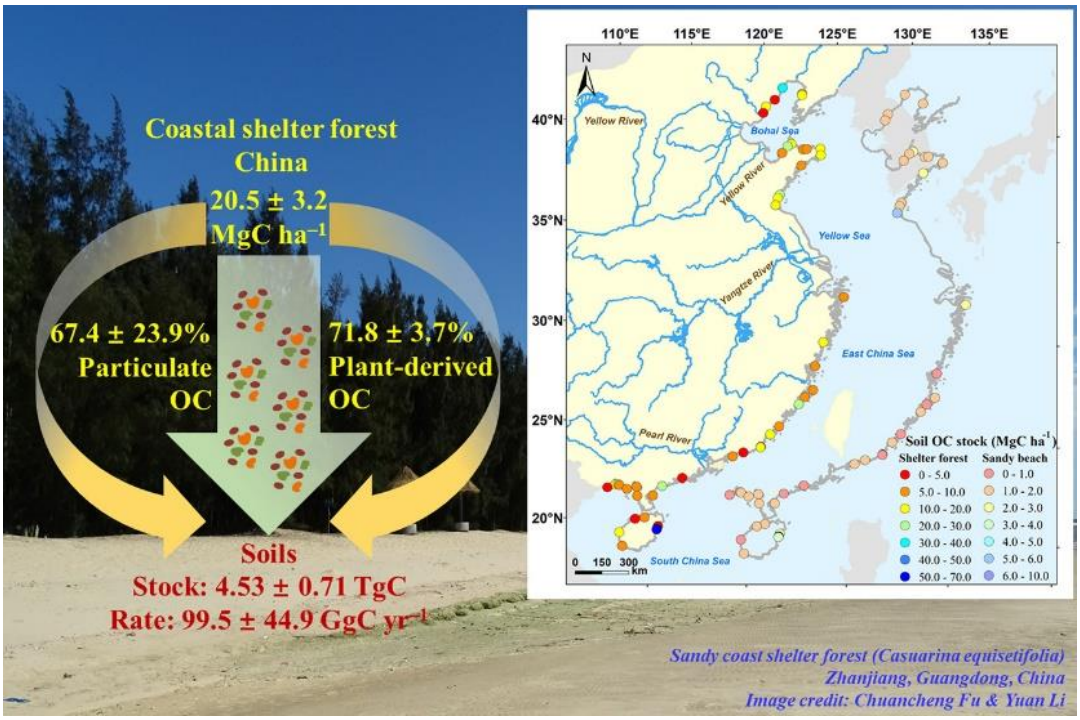
An overlooked soil carbon pool in vegetated coastal ecosystems: National-scale assessment of soil organic carbon stocks in coastal shelter forests of China

June 10, 2023 | Science of The Total Environment | Source |

Protecting and restoring vegetated coastal ecosystems present valuable opportunities for mitigating climate change. Coastal shelter forests, as one of these ecosystems, play a vital role in protecting sandy coasts. However, their potential for soil organic carbon (OC) sequestration has received less attention. A study conducted by the Chinese Academy of Sciences provides the first national-scale assessment of soil OC stocks, fractions, sources, and accumulation rates in shelter forests and sandy beaches along a 22° latitude span in China.

Comparing shelter forests to sandy beaches, the study reveals that shelter forest plantations achieve significant soil desalination rates of 92.0% and reduce soil pH by 1.3 units, enhancing soil quality. This improved soil quality facilitates OC sequestration, resulting in an average increase of 11.8 MgC ha−1 in soil OC stock in shelter forests. Particulate OC (POC) is the dominant fraction in both sandy beaches and shelter forests, with shelter forests having POC proportions exceeding 80%. The study suggests a substantial contribution of plant-derived OC, as indicated by low δ13C values, higher C:N ratios, and the dominance of POC. The analysis estimates soil OC stocks in Chinese shelter forests to be 20.5 MgC ha−1 in the top meter, with an accumulation rate of 45.0 gC m−2 year−1. According to afforestation plans, additional soil carbon sequestration of 1.72 TgC is expected in the future. These findings highlight the effectiveness of coastal shelter forests in sequestering soil carbon and emphasize their importance in coastal ecosystem management.

Graphical abstract



12 THEME: Carbon sequestration, GHG emission reduction

Carbon stocks and fluxes in Asia-Pacific mangroves: current knowledge and gaps

March 14, 2023 | Environmental Research Letters | Source |

A recent study conducted by a collaborative team from Indonesia, Japan, and Malaysia highlights the importance of mangrove forests in regulating climate change and carbon cycling. Mangrove forests are crucial in the Earth's carbon cycling and other biogeochemical processes in blue carbon ecosystems. However, there is a lack of concrete knowledge about carbon source and sink patterns, particularly in the Asia-Pacific (AP) region, which has a significant mangrove area of 68,493 km^2. The study summarizes a ten-year inventory of carbon stocks and fluxes across 25 AP countries to understand the current knowledge and gaps in mangrove blue carbon research. The findings reveal that while carbon stock assessments of individual components exist for all 25 countries, data on whole ecosystem carbon stocks and biogeochemical carbon fluxes are often lacking. There is also a scarcity of information on carbon export fluxes in Indonesian mangroves. To better understand the role of AP mangroves in global carbon stocks and climate, more detailed and comparable research on biogeochemical processes is necessary.

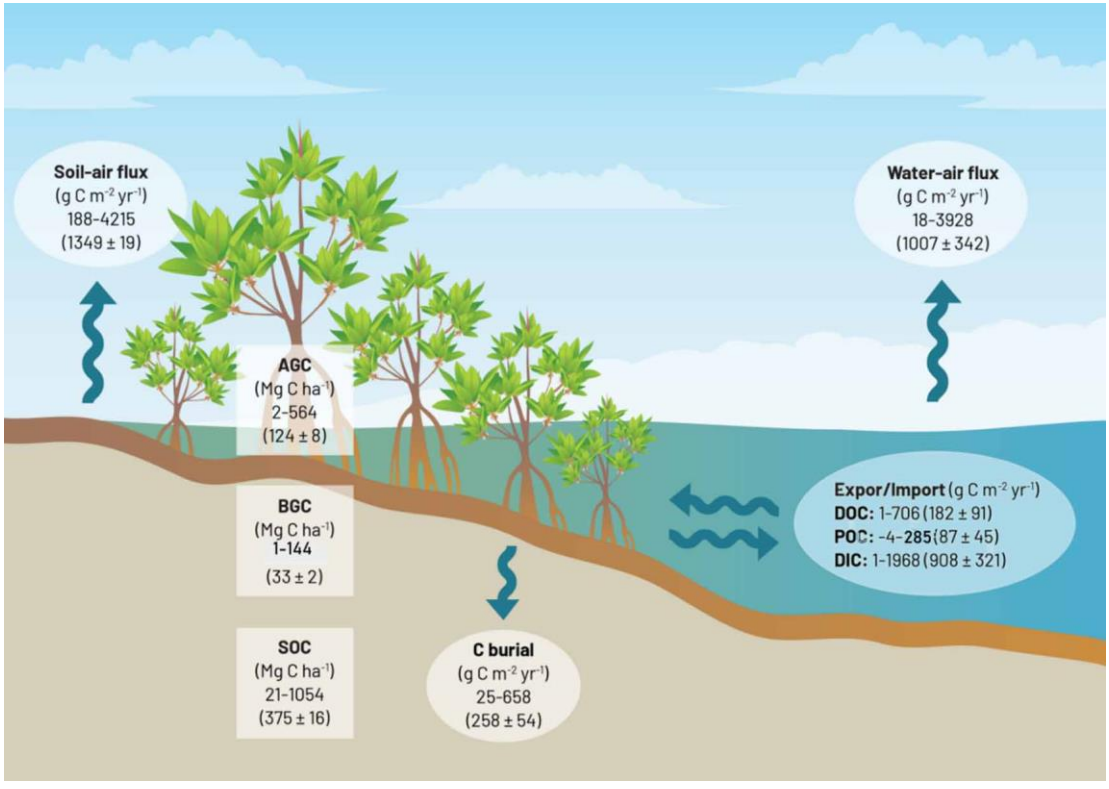


Figure | A schematic representation of an overall carbon budget for Asia-Pacific mangroves, applying a box model to summarize values across all studies (year of studies from 2011 to 2020).

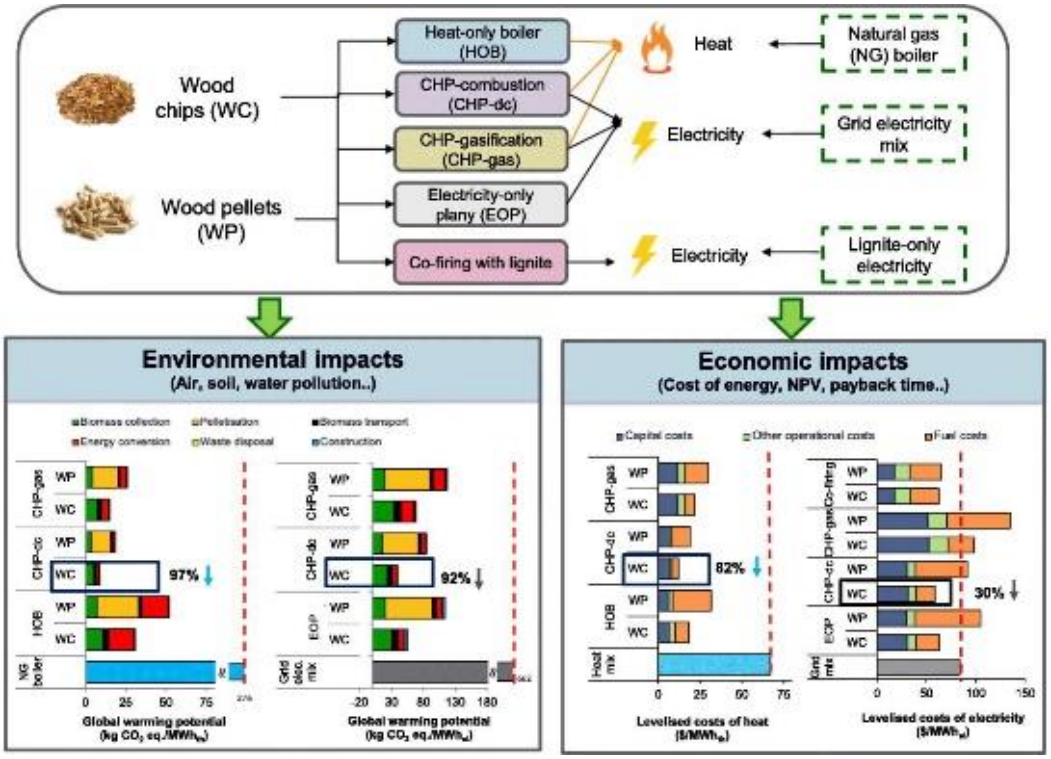
13 THEME: GHG emission reduction

Energy from forest residues in Turkey: An environmental and economic life cycle assessment of different technologies

May 20 2023 | Science of The Total Environment | Source |

A recent study conducted by The University of Manchester focuses on the potential of using forest residues as a sustainable and cost-effective alternative to fossil fuels for energy generation in Turkey. Forest residues, such as wood chips and wood pellets, are abundant and inexpensive feedstock that can help reduce greenhouse gas emissions and enhance energy security. The study evaluates the environmental and economic sustainability of different energy conversion options using forest residues, including direct combustion for heat and electricity, gasification for combined heat and power (CHP), and co-firing with lignite. The findings indicate that direct combustion of wood chips for cogeneration of heat and power has the lowest environmental impact and levelized costs for both heat and electricity generation. Energy derived from forest residues has the potential to significantly reduce climate change impact and reliance on fossil fuels, although it may increase some other impacts like terrestrial ecotoxicity. The study also highlights the economic feasibility of bioenergy plants, with some types generating net profits and offering cost savings compared to grid electricity and natural gas. By utilizing Turkey's available forest residues, the country could reduce greenhouse gas emissions and save on fossil fuel import costs.

Graphical abstract



14 THEME: Carbon sequestration; Policy incentives, financing, pricing

Assessing carbon abatement costs considering forest carbon sequestration and carbon offset mechanism: Evidence from Taiwan

March 22, 2023 | Forest Science | Source |

The researchers from National Yang Ming Chiao Tung University in Taiwan have conducted a comprehensive study to investigate the potential implications of carbon taxes and carbon offset markets on the economy and the environment. With Taiwan's commitment to achieving carbon neutrality by 2050 and the passage of the Greenhouse Gas Reduction and Management Act in 2015, the country is likely to adopt measures such as carbon taxes and the establishment of carbon offset markets, aligning with international trends. Employing a carbon emission reduction cost prediction model, the study assessed the costs associated with reducing carbon emissions under different scenarios. These scenarios considered the presence or absence of a carbon offset market, with or without the inclusion of forest carbon sequestration as offsets. The researchers selected Taipei and Kaohsiung, representing regions with varying levels of carbon emissions, to analyze the benefits of carbon emissions trading and forest carbon sequestration. The findings revealed that the lowest costs for carbon emission reduction were observed when a carbon offset market existed, and forest carbon sequestration could be utilized as offsets. Conversely, the absence of a carbon offset market resulted in the highest costs. The study underscores the significance of strategic policies, such as the establishment of carbon offset markets and the utilization of forest carbon sequestration, to effectively combat climate change. However, it also cautions that relying solely on forest carbon sequestration is insufficient to achieve Taiwan's carbon neutrality target by 2050.

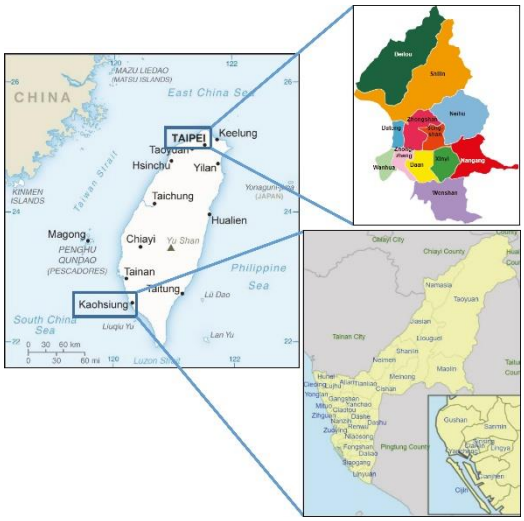


Table 9. Carbon trading volume of Taipei and Kaohsiung, 2020 to 2050.

Year	Carbon trading volume (in 10,000 metric tons of CO_2 equivalent)	
	Taipei	Kaohsiung
2020	976.36	5,261.79
2021	954.46	5,195.40
2022	932.52	5,129.98
2023	910.53	5,064.74
2024	888.50	4,999.47
2025	866.43	4,934.10
2026	844.33	4,868.64
2027	822.23	4,803.10
2028	800.11	4,737.52
2029	777.98	4,671.93
2030	755.85	4,606.34
2031	738.99	4,540.76

15 THEME: Policy incentives, financing, pricing

Looking up and going down: Does sustainable adaptation to climate change ensure dietary diversity and food security among rural communities or vice versa?

March 20, 2023 | Frontiers in Sustainable Food Systems | Source |

Pakistani research team led by University of Education works with researchers from Saudi Arabia and United States on a study that highlights the importance of sustainable food systems in ensuring food security and addressing climate change. The study explores the factors influencing sustainable adaptation to climate change and establishes a connection between sustainable adaptation and the food security of rural households. Data was collected from 384 farmers in Pakistan using face-to-face surveys and analyzed using statistical techniques. The results showed that factors such as education, farm size, credit access, extension services, internet use for agriculture information, women's participation in farm-related decision making, and recognizing climate change as a significant problem for agriculture positively influenced sustainable adaptation to climate change. Furthermore, farmers with higher levels of sustainable adaptation consumed more diverse diets and had better food security compared to those with lower levels of adaptation. The research suggests that farmers can improve food and nutrition outcomes by adopting sustainable practices to address climate change. The findings have significant policy implications for achieving sustainable development goals related to zero hunger and climate action in developing countries.

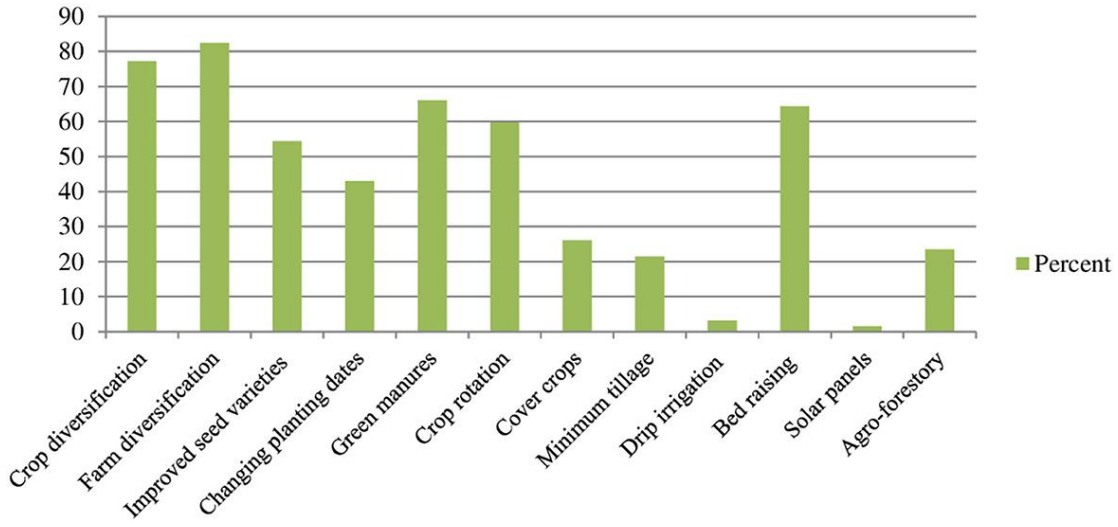


Figure | Climate change adoption status in the region

16 THEME: ICT in agrifood systainability

IoT-based *Bacillus* number prediction in smart turmeric farms using small data sets

Mar 15, 2023 | IEEE Internet of Things Journal | Source |

A recent study conducted by National Yang Ming Chiao Tung University in Taiwan focused on the *Bacillus bacteria*, which is widely used in the agricultural biotechnology industry to enhance crop growth. Traditionally, studies on *Bacillus* analysis were performed in laboratories due to the difficulty of conducting them in open field farming. The researchers aimed to predict the amount of *Bacillus* using innovative IoT (Internet of Things) and machine learning technologies, and they developed a method called AgriTalk.

The challenge was that only a small dataset was available for training the AI model, as soil analysis for *Bacillus* is time-consuming and limited. By using just five data items per farm, the researchers trained the AgriTalk system to predict the Bacillus levels for the following four months. The results were promising, with the mean absolute percentage errors (MAPEs) ranging from 6.73% to 19.76%.

The predictions obtained through AgriTalk provide valuable information for fertilization management in agriculture. Interestingly, the system showed higher accuracy in farms covered by peanut shells (average MAPE of 13.24%) compared to those covered by rice husks (average MAPE of 15.43%). These findings contribute to more efficient and effective agricultural practices.

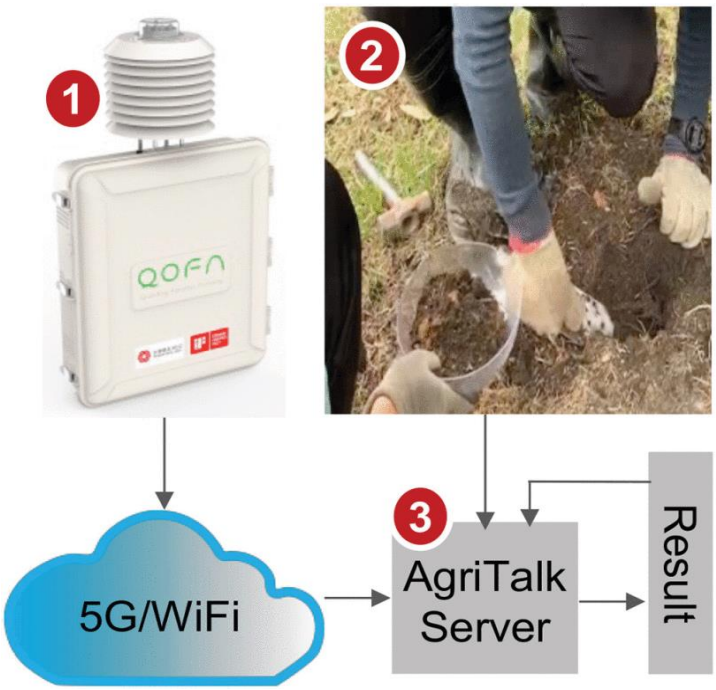


Figure |AgriTalk architecture.

17 THEME: ICT in agrifood systainability; GHG emission reduction

Digitalization, resource misallocation and low-carbon agricultural production: evidence from China

Apr 13, 2023 | Frontiers in Environmental Science | Source |

A recent study conducted by Northeast Agricultural University in China explored the impact of digitalization on low-carbon agricultural production in the country. With the rapid advancements in technologies like artificial intelligence, big data, and cloud computing, China's agriculture is entering a new digital era. The researchers analyzed provincial data from 2013 to 2020 and used advanced statistical models to investigate the relationship between digitalization and agricultural carbon emissions, considering resource misallocation.

The results showed that digitalization plays a significant role in curbing carbon emissions in agriculture, thus promoting low-carbon agricultural production. This effect remained consistent even after conducting robustness tests to ensure the reliability of the findings. Interestingly, the study found that the impact of digitalization on reducing carbon emissions was most pronounced in the eastern region of China compared to the central and western regions.

Furthermore, the researchers conducted a mechanism analysis, which revealed that digitalization helps rectify the widespread misallocation of capital and labor in agricultural factor markets. These findings hold significant policy implications for promoting low-carbon agricultural practices in China, highlighting the potential of digital technologies to contribute to a more sustainable agricultural sector.

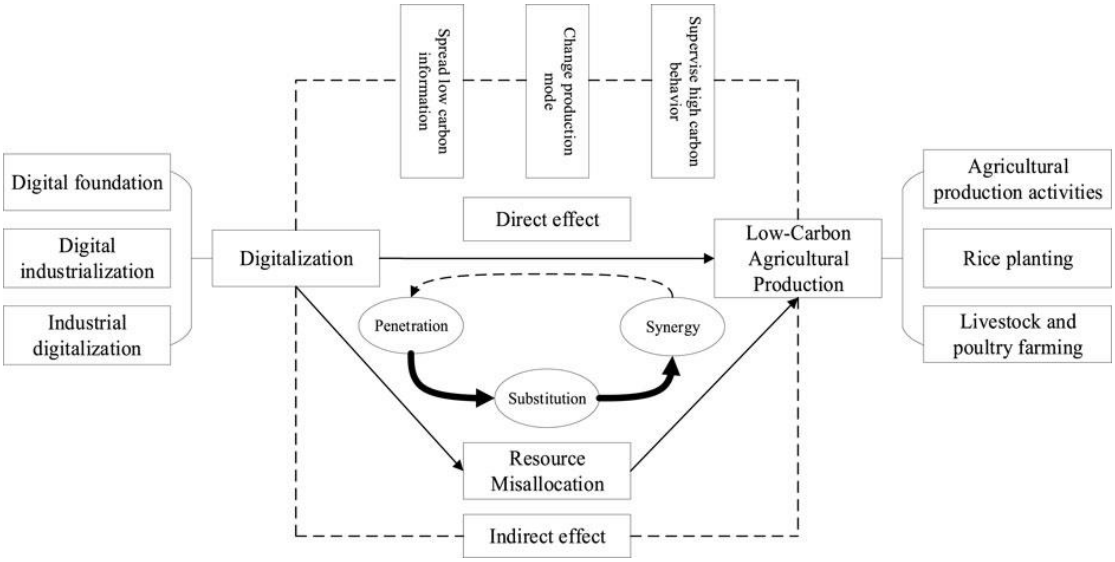


Figure | The impact mechanism of digitalization on low-carbon agricultural production.

18 THEME: ICT in agrifood systainability

Employing the agricultural classification and estimation service (ACES) for mapping smallholder rice farms in Bhutan

Apr 6, 2023 | Frontiers in Environmental Science | Source |

In Bhutan, creating accurate maps of annual crop types to support food security decision-making has been a significant challenge. The University of Alabama Huntsville, in collaboration with Bhutan, has undertaken a project to address this issue by advancing Science, Technology, Engineering, and Mathematics (STEM) in the country. Their joint effort has resulted in the development of a geospatial application called the Agricultural Classification and Estimation Service (ACES).

This study focuses on the co-development of a climate-smart crop type framework using Earth observation data and incorporates both modeling and training sample collection. The ACES web application and modeling software package allow stakeholders to utilize Earth observation data more effectively in their decision-making processes. The researchers also provide a transparent and replicable approach to overcome remote sensing limitations caused by topography and cloud cover, which is a common problem in Bhutan.

The study achieved promising results, with the Random Forest "LTE 555" model selected out of 3,600 possible models. It exhibited an overall test Accuracy of 85% and an F-1 Score of 0.88 for the year 2020. Independent validation of the model yielded an accuracy of 83% and an F-1 Score of 0.45 for the same year. The research provides valuable insights into model perturbation, hyperparameter tuning, and input features, which are crucial for future practitioners in this field.

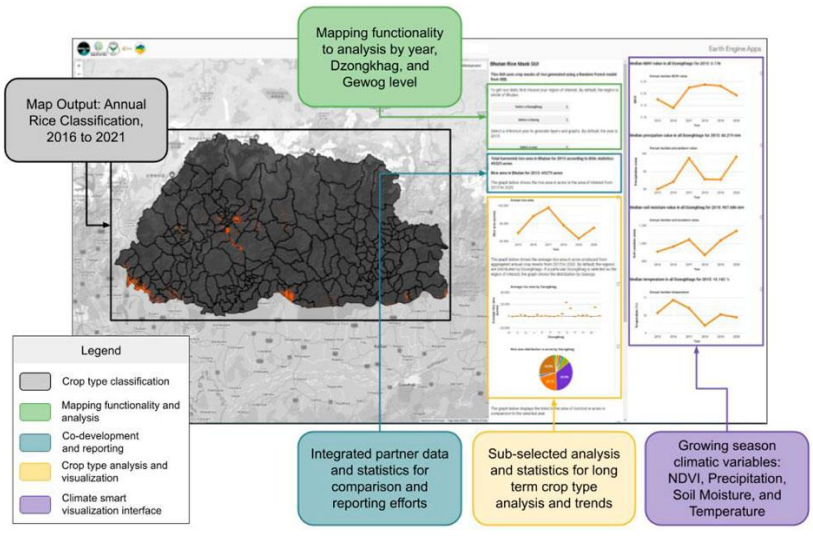


Figure | Agricultural Classification and Estimation Service (ACES) web application interface outlining crop type classifications, tool functionality, interactive statistics and analysis panel, and finally climate smart visualization interface

19 THEME: ICT in agrifood systainability

A real-time smart sensing system for automatic localization and recognition of vegetable plants for weed control

Mar 27, 2023 | Frontiers in Plant Science | Source |

Researchers at China Agricultural University have developed a smart weeder to combat weed threats in tomato production. Weeds pose a significant challenge, particularly during the early stages of tomato plant growth. To address this, the team created an integrated sensing system using cameras and color mark sensors. The system accurately locates tomato and pakchoi plants in real time, crucial for effective weed management.

Through experiments, the researchers determined that using the main stem of tomato plants as a reference yielded better results than pakchoi. Applying white markers on the lower main stem of tomato plants proved optimal. The system, equipped with six sensors, demonstrated high efficiency in detecting plant labels. A specially designed computer vision algorithm achieved an impressive overall accuracy of 95.19% in localizing tomato and pakchoi plants.

This sensor-based system offers a reliable and precise solution for automatic real-time localization of vegetable plants, enabling effective weed control in agriculture.

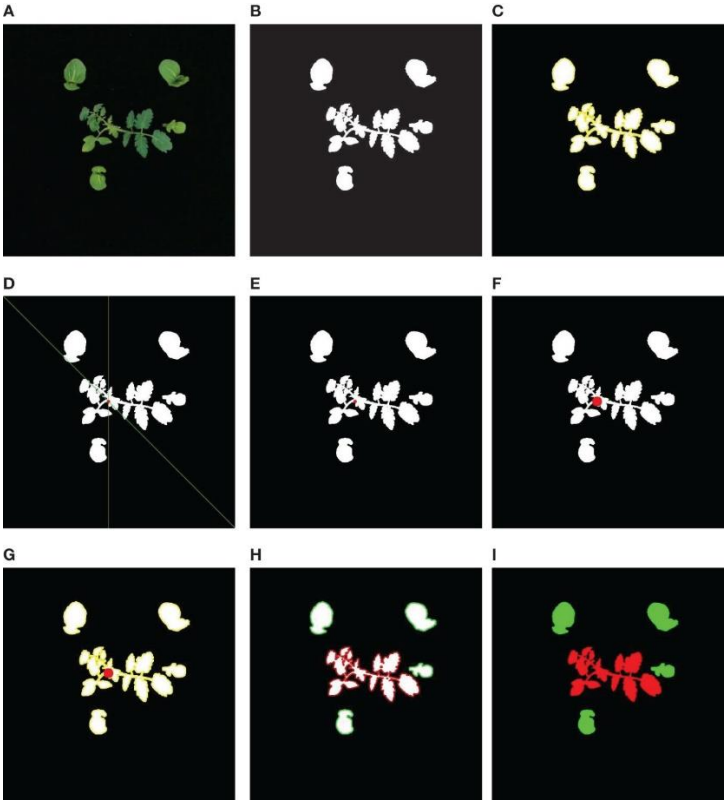


Figure | (A) Image of tomato plant and weeds captured by the system, (B) binary image after morphological operations, (C) binary image with plants contours (yellow), (D) position of the crop signal in the RGB image, (E) position of crop signal in the binary image, (F) crop signal tolerance bands in the binary image, (G) the contours of plants (yellow) and the crop signal tolerance bands (red) in the binary image, (H) the contours of tomato plant (red) and the contours of weeds (green), (I) pixel mapping of weeds (green) and crop plants (red).

20 THEME: ICT in agrifood systainability

Crop phenology modelling using proximal and satellite sensor data

Apr 15, 2023 | Remote Sensing | Source |

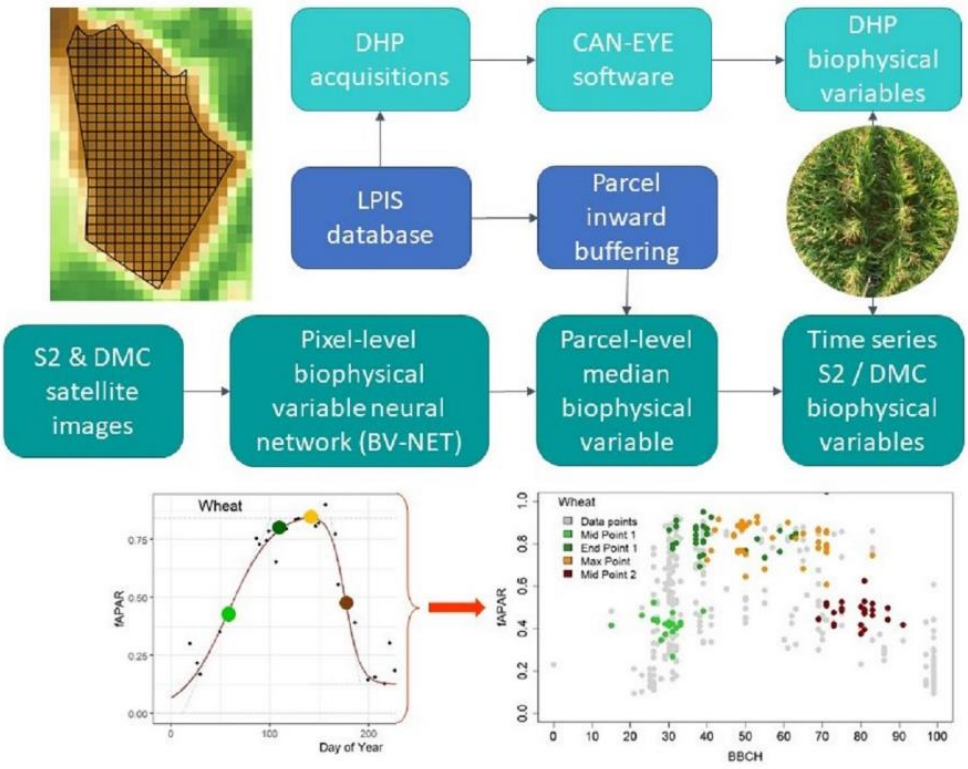
Crop phenology, the study of plant development stages, plays a vital role in predicting crop yields. A recent study conducted by researchers from Katholieke Universiteit Leuven and others in Belgium investigated the effectiveness of satellite sensor data in detecting these stages compared to field observations and proximal sensing.

The researchers analyzed data from winter wheat, silage maize, and late potato fields over a three-year period. They found that the spectral signals obtained from different sensors, including Digital Hemispherical Photographs (DHP), Disaster Monitoring Constellation (DMC), and Sentinel-2 (S2), were specific to each crop and independent of the sensor used.

Models based on the fraction of absorbed photosynthetically active radiation (fAPAR) derived from sensor data showed better accuracy in fitting the observed data compared to the fraction of vegetation cover (fCover). Maize had the best model fit, followed by wheat and potato. The S2-derived fAPAR exhibited reduced variability as the growing season progressed.

The researchers also developed a double sigmoid model that accurately identified key phenological stages such as stem elongation, senescence, canopy closure, flowering, and fruit development. Increasing the frequency of sensor revisits proved beneficial for detecting short-duration phenological stages.

These findings have implications for improving crop yield forecasting and agri-environmental modeling through data assimilation, ultimately aiding in better decision-making for sustainable agriculture practices.



21 THEME: ICT IN AGRIFOOD SYSTAINABILITY

Soil moisture inversion based on data augmentation method using multi-source remote sensing data

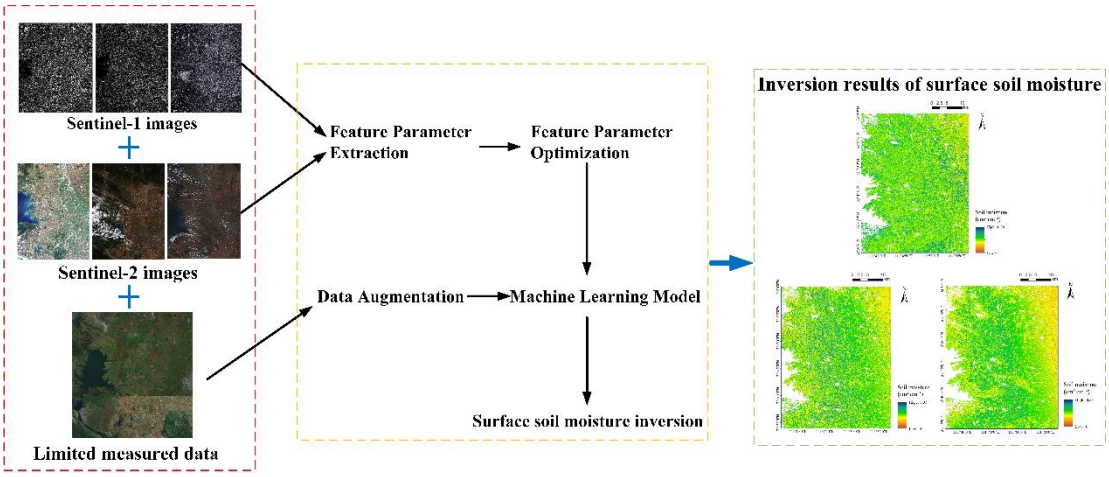
March 31, 2023 | Remote Sensing | Source |

Researchers from the Henan Engineering Research Center of Spatial Information Processing in China conducted a study focusing on soil moisture prediction, an essential factor connecting agriculture, ecology, and hydrology. Surface soil moisture (SSM) prediction plays a crucial role in irrigation planning, water quality monitoring, water resource management, and estimating agricultural production. To assess SSM in agricultural areas, the researchers utilized multi-source remote sensing.

However, limited field-measured SSM samples can severely impact the accuracy of SSM inversion using remote sensing data. To address this challenge, the researchers proposed an SSM inversion method suitable for small sample sizes. They employed the alpha approximation method to expand the measured SSM samples, providing more training data for SSM inversion models.

Feature parameters were extracted from Sentinel-1 microwave and Sentinel-2 optical remote sensing data, and three methods—Pearson correlation analysis, random forest (RF), and principal component analysis—were used for feature optimization. Three machine learning models suitable for small sample training—RF, support vector regression, and genetic algorithm-back propagation neural network—were built for SSM retrieval.

Experimental results demonstrated that after sample augmentation, SSM inversion accuracy improved. The combination of RF for feature screening and RF for SSM inversion yielded the highest accuracy, with a coefficient of determination of 0.7256, a root mean square error of 0.0539 cm^3/cm^3, and a mean absolute error of 0.0422 cm^3/cm^3. The proposed method was successfully applied to invert regional SSM, showcasing its effectiveness with small sample sizes.



22 THEME: ICT in agrifood systainability

Increasing accuracy of the soil-agricultural map by sentinel-2 images analysis-case study of maize cultivation under drought conditions

February 25, 2023 | Remote Sensing | Source |

Soil properties play a crucial role in determining the potential for food production in a region. However, soil characteristics can vary significantly within a single plot, making it challenging to accurately map soil diversity using traditional methods. In this study conducted by the Institute of Soil Science and Plant Cultivation in Poland, researchers explored the use of Sentinel-2 multispectral satellite images to improve the quality of soil-agriculture maps.

The researchers formulated a hypothesis that high-resolution satellite images, combined with spatial and temporal analysis, can enhance the accuracy of large-scale soil-agriculture maps. They focused on maize as a case study and utilized specific terms related to maize development stages and vegetation indices to differentiate soil conditions, particularly in relation to water retention during drought periods.

The findings confirmed the hypothesis, demonstrating that remote sensing techniques significantly improved the level of detail in soil-agriculture maps. The results represent an important initial step towards developing a comprehensive model for detailed soil-agriculture mapping in Poland, enhancing the accuracy of drought monitoring systems.

This research contributes to the advancement of remote sensing applications in agriculture, enabling more precise assessment and monitoring of soil conditions, and ultimately aiding in sustainable agricultural practices.

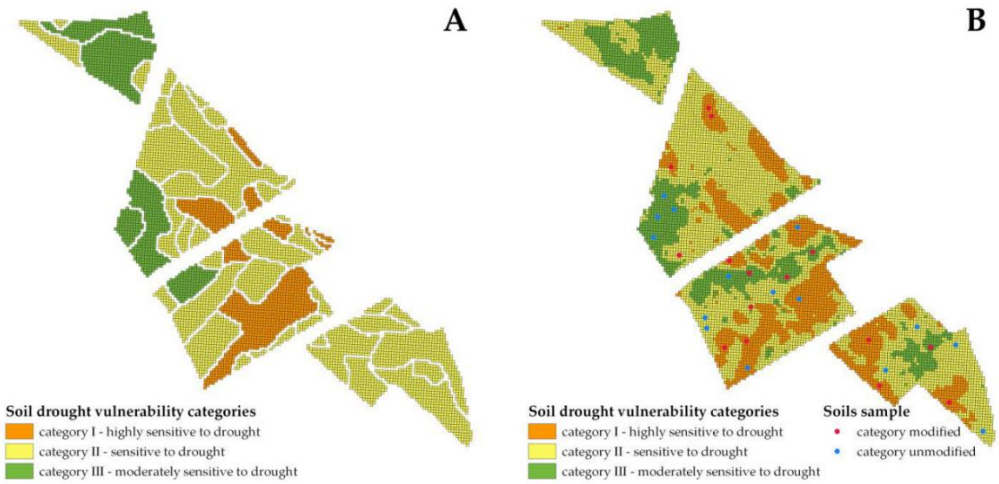


Figure | Drought vulnerability polygons of soils before reclassification (A), after reclassification with soil sampling locations (B).

23 THEME: ICT in agrifood systainability

Going back to grassland? Assessing the impact of groundwater decline on irrigated agriculture using remote sensing data

March 21, 2023 | Remote Sensing | Source |

Climate change has increased the risk of agricultural drought in arid and semi-arid regions worldwide. To adapt, farmers often shift to more drought-tolerant crops or permanently switch back to grassland. Understanding the impact of declining groundwater levels on this decision-making process is crucial. Researchers from New Mexico Tech conducted a study in Union County, New Mexico, to explore how groundwater level decline affects the propensity of cropland switching back to grassland.

The study integrated field-scale groundwater level projections and high-resolution remote sensing data on crop choices. Using a regression analysis framework, they found that as the groundwater level in the Ogallala Aquifer declined, cropland in the area gradually and permanently shifted back to grassland. For every one-standard-deviation decline in groundwater level, there was an average 1.85% increase in the likelihood of switching back to grassland.

The findings consider the fact that farmers explore other options before permanently switching back, such as growing more drought-tolerant crops or implementing land idling and rotation. The study concludes by discussing the policy implications for long-term land and water conservation.

This research provides valuable insights into the effects of declining groundwater levels on agricultural practices, helping inform sustainable land and water management policies in drought-prone regions.

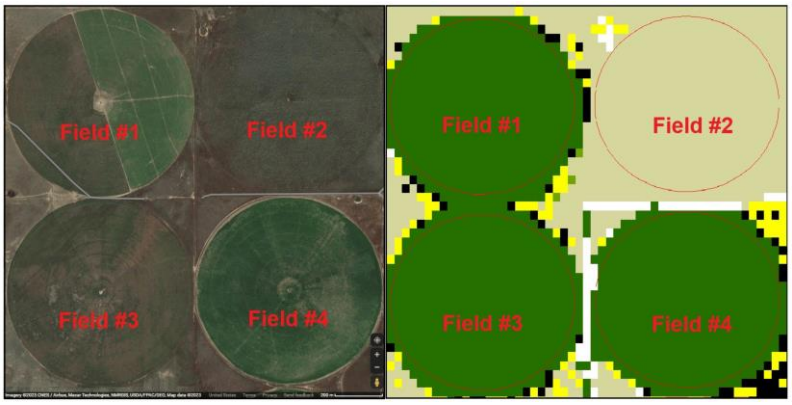


Figure | A standard 400 m radius irrigated field (field #2) in its transition into grassland (left panel) compared to the remotely sensed Crop Data Layer (right panel, 2019 data) of the same location. Data Source: NASS, USDA; Google Maps. Note: The remote sensing data in the right panel indicate that corn (in dark green) was grown in fields #1, #3, and #4 in 2019. Later, in 2021 (corresponding to the time of the left panel Google Maps imagery), field #3 was in idle status and fields #1 and #4 still had corn.

24 THEME: ICT in agrifood systainability

Red-green-blue to normalized difference vegetation index translation: a robust and inexpensive approach for vegetation monitoring using machine vision and generative adversarial networks

Mar 7, 2023 | Precision Agriculture | Source |

Researchers from the University of Prince Edward Island in Canada have developed an innovative and cost-effective protocol for monitoring plant health in agricultural fields using high-resolution multispectral imaging. By leveraging machine vision (MV) and generative adversarial networks (GAN), they were able to convert standard red-green-blue (RGB) imagery captured by unmanned aerial vehicles (UAVs) into valuable normalized difference vegetation index (NDVI) maps.

Traditionally, NDVI maps were generated from near-infrared (NIR) imagery, but this study directly translated RGB imagery into NDVI, making it more accessible and affordable. The researchers tested the protocol using a fixed-wing UAV equipped with a RedEdge-MX sensor to capture images from different potato fields throughout the 2021 growing season.

By training and evaluating GAN models, particularly Pix2Pix and Pix2PixHD, they found that Pix2PixHD outperformed Pix2Pix in terms of accuracy and performance. The protocol demonstrated breakthrough results, enabling cost-effective monitoring of vegetation and orchard health. The trained GANs can generate useful vegetation index maps for precision agriculture practices, including variable rate applications. Additionally, the protocol has the potential to analyze remote sensing imagery of large-scale agricultural fields and commercial orchards, extracting essential information about plant health indicators.

This study presents an exciting advancement in economically monitoring plant health and offers valuable insights for precision agriculture and remote sensing applications.

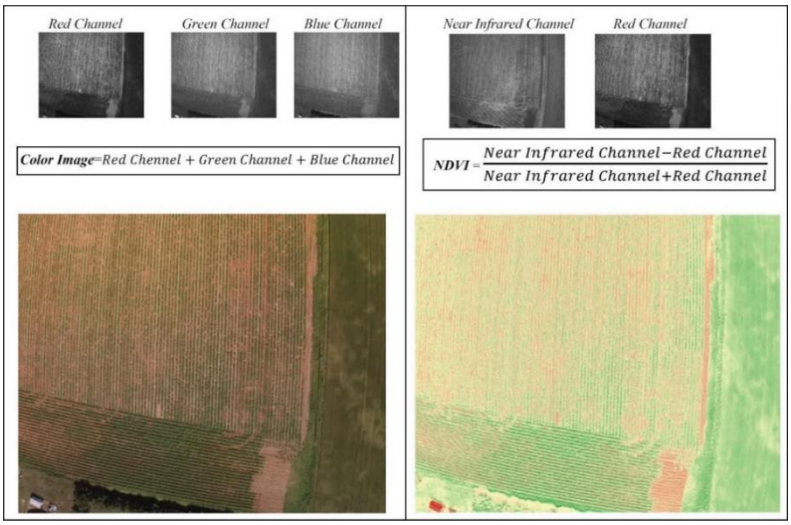


Figure | Generated dataset sample for the training of generative adversarial networks used in the design of the proposed protocol. The left image represents the input image which is the combination of the red, green, and blue channels, while the target image is the NDVI image which is the computation index of the red and near-infrared channels.

25 THEME: ICT in agrifood systainability

NH_2-MIL-125(Ti)/Reduced graphene oxide enhanced electrochemical detection of fenitrothion in agricultural products

April 4, 2023 | Foods | Source |

Researchers from Wuhan Polytechnic University in China, in collaboration with others, have developed a new method for detecting fenitrothion (FT), a harmful organophosphate pesticide, in environmental and food samples. Organophosphate pesticide abuse poses serious threats to human health, causing significant harm and even fatalities to millions of people annually.

The team designed a non-enzymatic electrochemical sensor using a combination of hydrothermally synthesized titanium-based metal-organic frameworks (MOFs) material (NH_2-MIL-125(Ti)) and reduced graphene oxide (RGO) nanocomposites. This sensor enables better enrichment of the target FT molecules and efficient electron transfer. Differential pulse voltammetry was used to analyze the sensor's response.

Under optimized conditions, the sensor demonstrated a linear detection range of 0.072–18 µM for FT, with a detection limit of 0.0338 µM. The sensor also exhibited excellent stability and reproducibility. Furthermore, it effectively detected FT in spiked agricultural products, making it a valuable tool for pesticide residue analysis.

This study introduces a convenient fabrication method using NH_2-MIL-125(Ti)/RGO nanocomposites, presenting a promising approach for the development of non-enzymatic detection methods for pesticides. The sensor's reliability and sensitivity contribute to efforts in monitoring and ensuring food safety and environmental protection.

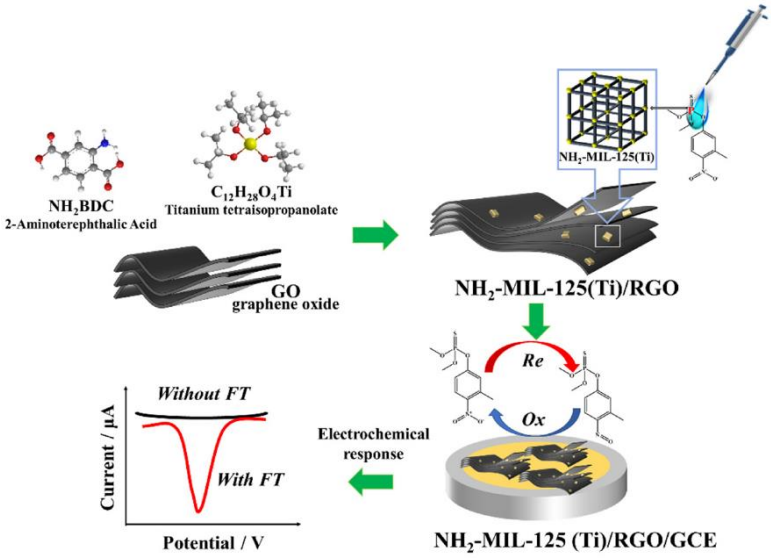


Figure | Schematic diagram of materials, NH2−MIL−125(Ti)/ RGO/GCE preparation process, and detection mechanism.

26 THEME: ICT in agrifood systainability

Development of a method for detecting the planting and ridge areas in paddy fields using AI, GIS, and precise DEM

April 25, 2023 | Precision Agriculture | Source |

Farmers in hilly and mountainous areas of Japan face challenges when it comes to mowing the ridges of rice farms. Additionally, there is a lack of geographical information about these ridges, including their slope angles, areas, and rates compared to the total paddy field area. This uncertainty makes it difficult for farmers and agricultural businesses to analyze management costs, particularly for mowing. To address this, researchers from Shinshu University and Advanced Technology Lab in Japan developed a method using artificial intelligence, geographical information systems (GIS), and precision digital elevation models.

By utilizing aerial laser survey data, the researchers created a machine learning model capable of accurately detecting planting and ridge areas in paddy fields from aerial images, achieving over 96% accuracy. This information can be used to generate polygons in GIS, providing precise measurements of ridge slope angles, ridge areas, and ridge rates in paddy fields. Importantly, these techniques can be applied to approximately 35,000 hectares of understudied paddy fields throughout Nagano Prefecture in just 2 to 3 weeks. These advancements aid in improving agricultural management and decision-making for rice farming in challenging landscapes.

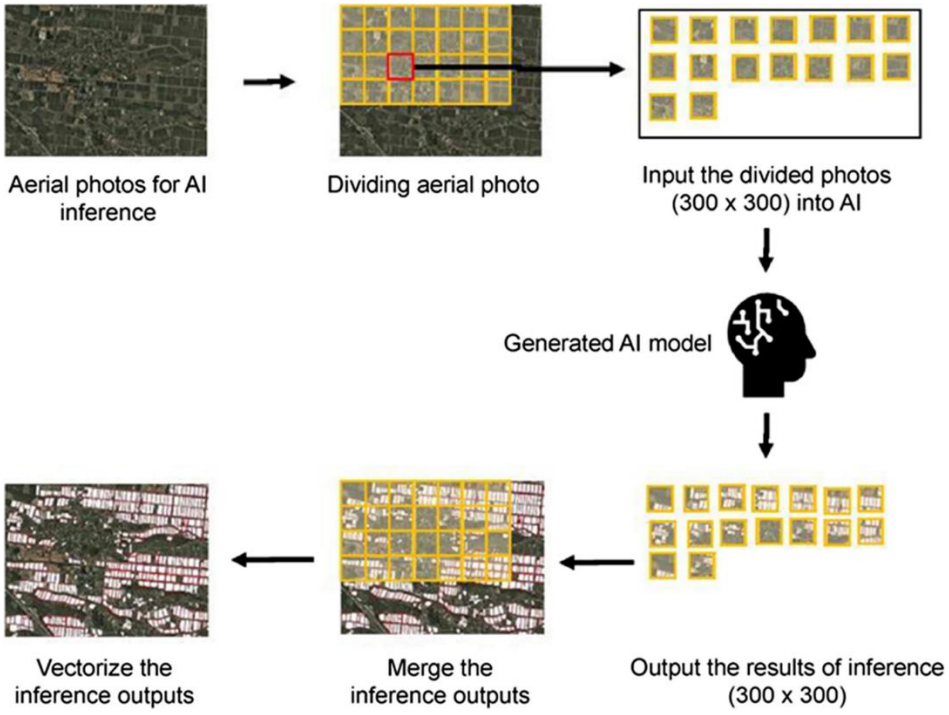


Figure | Inference flow of ridge and planting area recognition using the model and DEM

27 THEME: ICT in agrifood systainability

Potential assessment of PRISMA hyperspectral imagery for remote sensing applications

Mar2023 | Remote Sensing | Source |

Hyperspectral imagery, a powerful tool in precision agriculture, forestry, and environmental applications, has seen significant advancements in recent years. The PRISMA hyperspectral imagery (PHSI), introduced by the Italian Space Agency ASI, has brought about a new era in hyperspectral remote sensing with its exceptional spectral resolution. To explore the potential of PHSI for various remote sensing applications, researchers from Super GeoAI Technology Inc in Canada and SRM Institute of Science and Technology in India conducted a SWOT analysis.

The analysis revealed that PHSI, with its comprehensive coverage and higher reflectance spectra, holds great promise for extracting vegetation parameters. While it showed potential in applications such as snow, soil, water, natural gas, and mineral mapping, its limited acquisition, long revisiting times, noisy bands, atmospheric interferences, and computational requirements pose challenges for continuous monitoring and machine learning models.

Nevertheless, PHSI can contribute to large-scale mapping, technology transfer, and fusion with other remote sensing data. Overcoming these limitations requires strategies such as addressing satellite lifetime limitations and fostering interdisciplinary collaborations.

This study sheds light on the capabilities and challenges of PHSI, providing insights for remote sensing researchers and highlighting the potential applications and areas for further improvement in this exciting field.

Figure | PRISMA images available for Italy

28 THEME: ICT in agrifood systainability

Development of a radiometric calibration method for multispectral images of croplands obtained with a remote-controlled aerial system

March 2, 2023 | Remote Sensing | Source |

Researchers from Chonnam National University and Korea Aerospace Research Institute conducted a study focused on developing a practical and advanced calibration system for remote sensing (RS) using remote-controlled aerial vehicles (RAVs). RAVs are valuable tools for monitoring crops, environmental conditions, and agricultural productivity. However, the current calibration methods for RAV-acquired images are cumbersome and require calibration tarpaulins (tarps). The goal of this study was to create a standalone calibration system for RAV-based RS that eliminates the need for tarps.

To achieve this, the researchers used a quadcopter equipped with a multispectral camera and conducted calibration studies using pseudo-invariant tarps under varying light intensities. They formulated a standardization system for RAV RS based on the spectral images acquired by the quadcopter.

The calibrated images were validated using reflectance measurements in crop fields, and the outcomes of the calibration system were evaluated. The study concluded that the standalone RAV RS system, without relying on tarps, shows promise for effectively processing RAV RS-acquired images.

This research presents an important advancement in the calibration of RAV-based RS systems, enhancing their practicality and enabling more accurate and efficient monitoring of agricultural areas.

Figure | Photograph of (a) the 3DR Solo quadcopter drone and (b) spectral ranges of the three multispectral sensors in the agricultural digital camera used in the study.

29 THEME: ICT in agrifood systainability

Deep learning method based on spectral characteristic reinforcement for the extraction of winter wheat planting area in complex agricultural landscapes

Mar 2023 | Remote Sensing | Source |

Winter wheat is a vital food crop worldwide, and accurately monitoring its spatial distribution and planting area is crucial for effective agricultural management. Researchers from Anhui University and the Engineering Research Center for Geographical Information Intelligent Technology in China conducted a study to develop an intelligent method for extracting winter wheat information using remote sensing technology.

By analyzing the spectral and phenological characteristics of winter wheat, the researchers identified four red-edge vegetation indices (NDVI, NDRE, SRre, and Cired-edge) that enhance the ability to detect winter wheat. These indices were combined with a deep convolutional neural network (CNN) model to intelligently extract winter wheat planting areas in diverse agricultural landscapes.

The method was evaluated using data from GF-6 WFV and Sentinel-2A remote sensing satellites, achieving average overall accuracies of 94.01% and 93.03%, respectively. This approach provides a fast and accurate solution for monitoring winter wheat in complex agricultural environments, offering decision support for intelligent agricultural practices at national and local levels.

The study's findings hold significant application value and practical importance, contributing to the advancement of precision agriculture and supporting the efficient management of winter wheat crops.

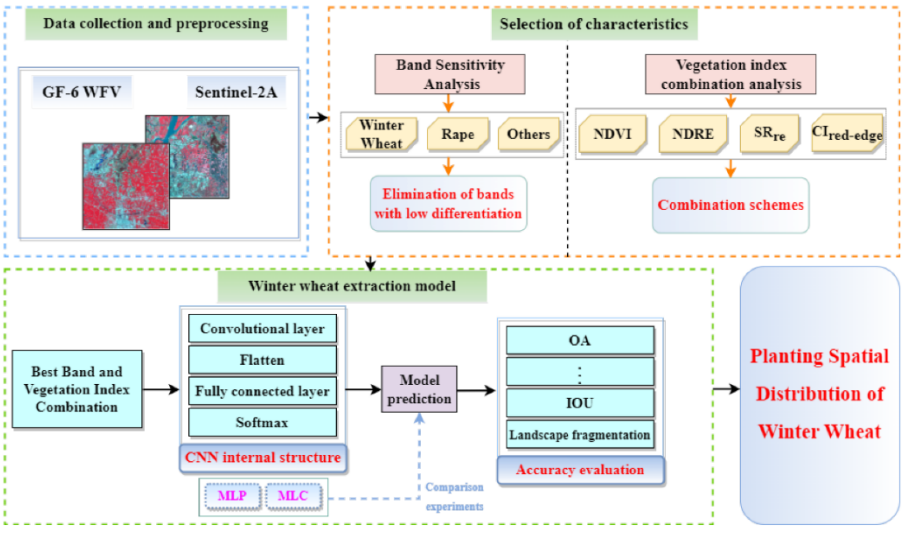


Figure | Flowchart overview of winter wheat extraction method.

30 THEME: ICT in agrifood systainability

Predicting site-specific economic optimal nitrogen rate using machine learning methods and on-farm precision experimentation

April 20, 2023 | Precision Agriculture | Source |

Researchers from the University of Nebraska conducted a study to improve nitrogen (N) fertilizer management in winter crops like wheat and barley. By applying the economic optimal nitrogen rate (EONR), farmers can enhance N fertilizer efficiency, increase profits, and reduce environmental impacts. The study utilized on-farm precision experimentation (OFPE) to collect extensive data for estimating the EONR.

Machine learning techniques, specifically generalized additive models (GAM) and random forest (RF), were employed to predict crop yields and EONR. The models analyzed various factors such as soil conditions, terrain characteristics, and remote-sensed variables.

The results showed that both GAM and RF models accurately predicted crop yields with an average error of 13.7%. However, the estimated EONR values differed significantly between the two models. Soil phosphorus availability and organic matter content emerged as influential factors, but their impact varied across fields.

The study highlights the importance of site-specific considerations when determining the EONR, as different fields may require tailored nitrogen recommendations. Further research is needed to refine machine learning methods and ensure reliable and automated N fertilizer recommendations as agriculture transitions into the digital era.

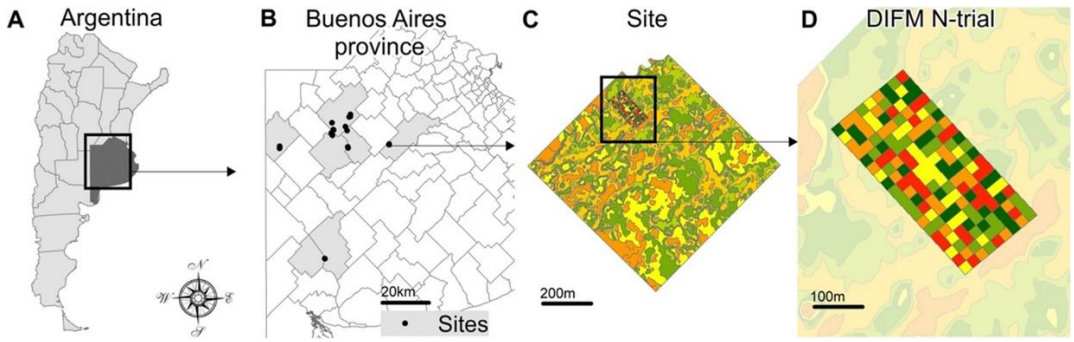


Figure | Location of experimental sites (A, B) and an example of the Data-Intensive Farm Management nitrogen trial (DIFM N-trial) (C, D) for Field_ID 1

NEWS

01 THEME: ICT in agrifood sustainability

AIM for climate summit opens with global food systems innovation and climate-smart agriculture initiatives

May 8, 2023 | USDA Press |

U.S. Secretary of Agriculture Tom Vilsack announced at the Agriculture Innovation Mission for Climate (AIM for Climate) Summit the increased investment and support from AIM for Climate partners worldwide in climate-smart agriculture and food systems innovation. The Summit, co-hosted by the United Arab Emirates (UAE) and the United States, aims to address the challenges of climate change and build sustainable and resilient food systems.

Secretary Vilsack emphasized the importance of global collaboration to tackle climate change and food security through innovative technology and approaches. Her Excellency Mariam bint Mohammed Almheiri, the UAE Minister of Climate Change and Environment, highlighted the UAE's commitment to international cooperation and sustainable solutions to address climate change and food security.

Key announcements at the Summit include increased investment exceeding $13 billion, 21 new innovation sprints worth $1.8 billion, and the addition of new partner countries. Secretary Vilsack also unveiled the USDA Science and Research Strategy, guiding scientific priorities for the next three years, and the launch of the International Climate Hub website to provide climate-informed agricultural decision-making tools.

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02 THEME: Policy incentives, financing, pricing

Biden-Harris administration announces new steps for climate resilience and forest conservation

April 20, 2023 | USDA Press |

In preparation for Earth Day, the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI) announced initiatives aimed at promoting forest conservation, enhancing forest resilience to climate change, and informing policymaking for healthy forests on federally managed lands. These actions, directed by President Biden's Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies, include inventorying mature and old-growth forests, setting reforestation targets, and analyzing reforestation opportunities.

The joint reports released by USDA and DOI provide critical information on mature and old-growth forests, their distribution, and the threats they face from climate change. The agencies will continue to engage with the public and refine their results based on feedback and scientific data. Additionally, the reports include recommendations for increasing reforestation capacity, strengthening partnerships, and developing a reforestation workforce.

The Forest Service has issued an Advanced Notice of Proposed Rulemaking for National Forest and Grassland Climate Resilience, seeking public input on adapting policies to protect and manage

national forests and grasslands in the face of climate change. They are also launching the Forest Service Climate Risk Viewer, a tool that assesses climate risks and vulnerabilities and supports localized analysis for conservation and adaptation efforts.

These efforts align with President Biden's vision for a resilient forest ecosystem and demonstrate progress in implementing his Executive Order. The USDA and DOI remain committed to collaboration and innovation to address the challenges of climate change and ensure the health and sustainability of forests.

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03 THEME: GHG emission reduction

"The world needs to embrace a suite of solutions": Divert on tackling food waste and climate change

May 16, 2023 | Power Technology |

Divert, a company founded by CEO Ryan Begin in 2007, has developed a solution to address the interconnected problems of food waste and the urgent need for clean energy. Divert takes a comprehensive approach to the food waste crisis by preventing waste through technology that extends the freshness of food and partnering with retailers to rescue unsold edible food for donation to food banks. Any remaining waste is converted into clean power through anaerobic digestion.

With 119 billion pounds of food wasted annually in the US, 34 million Americans facing hunger, and the pressing deadline to combat climate change, Divert's efforts to minimize food waste and mitigate its environmental impact are more important than ever. The company has experienced significant growth since its inception, expanding its partnerships with food retailers and developing new technologies and solutions to prevent wasted food upstream. Additionally, Divert has made strides in renewable energy, securing a long-term agreement with BP for the purchase of renewable natural gas generated from its facilities.

Divert's approach aligns with President Biden's executive order and demonstrates the company's commitment to addressing the wasted food crisis and promoting sustainability. By maximizing the freshness of food, recovering edible food for those in need, and converting waste into renewable energy, Divert is making a tangible impact on both social and environmental fronts.

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

USDA kicks-off effort to expand market opportunities for climate-smart commodities and learn from pilot projects

April 27, 2023 | USDA Press |

The U.S. Department of Agriculture (USDA) has officially launched the implementation phase of projects funded through the $3.1 billion Partnerships for Climate-Smart Commodities effort. As agreements are finalized, project partners will begin formal implementation of climate-smart production practices, marketing, and quantification, monitoring, reporting, and verification of greenhouse gas benefits. To facilitate collaboration and generate valuable lessons learned, USDA has also established the Partnerships for Climate-Smart Commodities Learning Network,

comprising all project partners. The network will share insights and data periodically as projects progress.

The initiative aims to support farmers, ranchers, and forest landowners in delivering climate solutions through climate-smart production that reduces greenhouse gas emissions and sequesters carbon. The investment will fund 141 projects over up to five years, providing technical and financial assistance to producers, piloting innovative methods for quantifying climate benefits, and developing markets for climate-smart commodities. Small and underserved producers are a priority for participation in these projects.

This effort aligns with the Biden-Harris Administration's focus on enhancing the competitiveness of U.S. agriculture, fostering rural community development, and supporting a diverse range of producers. Producers interested in participating can explore the active projects dashboard on the Partnerships for Climate-Smart Commodities website.

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05 THEME: Policy incentives, financing, pricing; GHG emission reduction

UK failing to honor net zero farming pledges, report finds

April 28, 2023 | The Guardian |

The UK government's plans to reduce greenhouse gas emissions from farming and land use are falling short of its promises, according to an analysis by WWF. The projected emissions reductions in agriculture and land use until 2037 are 58% lower than the figures supporting the original net zero strategy, equivalent to the emissions of the entire UK building sector. The government had pledged to replace the EU's common agricultural policy with environmental land management schemes that pay farmers for nature restoration. However, the new plan expects 38% lower emission reductions in farming compared to the original net zero strategy, with no actions to support sustainable diets. The projected emission benefits from tree planting and peatland restoration are also significantly lower than previously claimed. Campaigners warn that this lack of ambition will impede efforts to reach net zero and harm wildlife and biodiversity. Farmers feel left behind, with delays and narrow scope in the new payment schemes, and experts argue that prioritizing farming and nature is crucial for achieving climate goals and ensuring food security.

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06 THEME: ICT in agrifood sustainability

How Climate smart agriculture can help us tackle global food insecurity

May 8, 2023 | Earth.org |

Climate change is exacerbating global food insecurity, but Climate-Smart Agriculture (CSA) offers a promising solution. With changing weather patterns and extreme events affecting crop yields, agriculture is vulnerable to climate impacts. However, CSA practices can help address this challenge by increasing productivity, enhancing resilience, and reducing emissions. By implementing CSA, farmers worldwide can better prepare for the future and contribute to food security.
CSA takes a holistic approach to managing landscapes, integrating crops, livestock, forests, and fisheries. It aims to achieve multiple goals simultaneously, such as improving agricultural

productivity, adapting to weather events, sequestering carbon, and reducing emissions. Through technology, digitization, and data, CSA provides environmentally friendly farming practices.

Empowering farmers with knowledge and tools is crucial for successful CSA implementation. Smallholder farmers, who constitute the majority of global farms, need access to information and training to make informed decisions about their farming practices.

Scaling up CSA globally is essential to combatting food insecurity. Governments, international organizations, and private enterprises must collaborate to promote CSA, as it has the potential to transform agricultural systems, increase yields, and ensure a sustainable future for all.

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07 THEME: Policy incentives, financing, and pricing

U.S. to support Viet Nam's billion-dollar rice project

April 20, 2023 | VGP News |

The U.S. Secretary of Agriculture, Thomas Vilsack, has pledged support for Viet Nam's billion-dollar rice project during a press conference in Ha Noi. Vilsack emphasized the shared vision of both countries in adapting agriculture to climate change and ensuring global food security. The U.S. will provide information and best farming practices to assist Viet Nam in climate adaptation. Additionally, a program to use appropriate fertilizers will be promoted to increase productivity and promote green growth. Viet Nam's project aims to develop 1 million hectares of high-quality rice and reduce emissions by 2030, requiring an estimated investment of VND40,000 billion (US$1.7 billion). The U.S. will provide financial support through a fertilizer program and facilitate the exchange of farming experiences between American and Vietnamese experts. Vilsack also highlighted Viet Nam's vital role in ensuring food security as a leading rice producer, emphasizing the need to produce more food with fewer resources in the face of climate change.

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08 THEME: MRV (Measurement, reporting, verification)

How good is the data for tracking countries' agricultural greenhouse gas emissions?

May 19, 2023 | Phys.org |

A review conducted by the Alliance of Biodiversity International and the International Center for Tropical Agriculture highlights the limitations in accuracy and transparency of national greenhouse gas (GHG) emission inventories, particularly in the agriculture and land use sector. Inconsistent and inadequate reporting by low- and middle-income countries (LMICs), uncertainties in reported data, and a lack of robust activity data and locally specific emission factors hinder effective policy action. The study examines UNFCCC country-reported agricultural GHG data and three independent global databases to identify reporting issues affecting national inventories. The findings emphasize the need for more uniform reporting methodologies in LMICs to manage food security, climate change adaptation, and mitigation. The authors recommend using independent emissions databases alongside UNFCCC data to improve data quality and tracking progress. Developed nations are urged to provide increased technical and financial support to LMICs to strengthen institutional capacity for accurate and transparent GHG inventories.

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09 THEME: GHG emission reduction; Policy incentives, financing, and processing

Federal budget funds Haines' climate–smart farmers plan

May 15, 2023 | Wangaratta Chronicle |

The federal budget in Australia has allocated $302.1 million over five years to support climate-smart agriculture practices. The funding includes $76.4 million to establish a network of Sustainable Agricultural Facilitators who will provide extension services to farmers, helping them adopt climate-smart agricultural practices. An additional $158.6 million will be invested in projects to enhance agricultural productivity and sustainability, accelerate emissions reduction, and preserve natural capital on farms. Furthermore, $30.6 million will be allocated to support farmers in improving soil health and natural resources. Independent Federal MP Helen Haines, who has long advocated for neutral and trusted agricultural extension officers, welcomed the funding as a win for the agricultural sector. The initiative aims to help farmers take action on climate change, reduce emissions, and have a positive economic impact. Dr. Haines emphasized the importance of extension officers in guiding farmers during times of change and ensuring their participation in carbon and biodiversity credit markets. The government's consultation with the agricultural sector and organizations like Landcare will be crucial in effectively delivering the benefits of the funding.

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10 THEME: Policy incentives, financing, and processing

Fertilizer security for food security in Southeast Asia: Going local and circular

April 20, 2023 | Eco-business |

Southeast Asia's food security is at risk due to its heavy reliance on external sources of synthetic fertilizers. The Russia-Ukraine war has further exacerbated the issue, as trade sanctions have caused fertilizer prices to surge. To address this vulnerability, Southeast Asian nations should focus on developing local and circular fertilizer production methods. Recovering nitrogen, phosphorus, and potassium domestically through innovative circular solutions, such as biofertilizers derived from insect and seaweed farming, can provide sustainable alternatives. Large-scale nutrient recovery from sewage is another promising solution, utilizing human waste to extract necessary nutrients. Countries should invest in research and development for localized solutions, provide subsidies and incentives to local fertilizer producers, and create a market for nutrient recovery solutions. By strengthening fertilizer security through these measures, Southeast Asian nations can enhance their food security and contribute to the circular economy.

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11 THEME: ICT for agrifood sustainability

How to implement digital agriculture, step-by-step

April 28, 2023 | AgFunder Network |

In this article, digital agriculture expert Marco Brini shares insights from his self-published book titled "Implementing Digital Agriculture Step-by-Step." The book offers a comprehensive guide for farmers, agronomists, researchers, and students interested in the practical aspects of digital agriculture. It provides step-by-step guidance, real-world examples, and practical applications to help readers understand and implement digital agriculture technologies. By selecting the right tools and developing tailored implementation paths, farmers can optimize their operations,

increase productivity, and improve sustainability. Agronomists can advise clients on adopting and implementing digital agriculture technologies, while researchers and students can gain valuable insights into the field. Overall, the book serves as a roadmap for transforming farming practices and harnessing the potential of digital agriculture for increased productivity and sustainability.

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12 THEME: ICT for agrifood sustainability

How Climate smart agriculture can help us tackle global food insecurity

May 8, 2023 | Earth.org |

Climate change poses significant challenges to global food security, impacting crop yields and livestock production. Climate smart agriculture (CSA) offers solutions to address these challenges by increasing productivity, enhancing resilience, and reducing emissions. CSA utilizes technology, digitization, and data to provide an integrated and environment-friendly approach to farming. Examples of CSA in action include precision agriculture technologies, regenerative practices, and smart farming solutions that optimize resource use and improve crop yield. Initiatives such as the Alliance for a Green Revolution in Africa (AGRA) and the World Bank's project in India demonstrate the transformative potential of CSA in improving agricultural practices and increasing farmers' resilience to climate change. A mass movement led by governments, international organizations, and private enterprises is necessary to ensure widespread adoption of CSA and safeguard global food security.

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13 THEME: ICT for agrifood sustainability

A great opportunity to usher a digital revolution in agriculture during Amrit Kaal

April 26, 2023 | The Times of India |

The Amrit Kaal phase in Indian agriculture is expected to bring about a digital revolution in farming, aligning with Prime Minister Narendra Modi's vision to empower farmers. The government's plan to build a digital public infrastructure for the agriculture sector is set to be a game changer, enabling an inclusive farmer-centric ecosystem with access to information services for crop planning, farm input, credit, and insurance. The integration of technologies such as sensors, transmitters, AI, and IoT in agriculture can optimize crop growth conditions, improve efficiency, and reduce risk and waste. The adoption of smart agricultural practices is crucial to meet the increasing demand for food due to population growth. India's swift adoption of smart farming practices, including the electronic National Agriculture Market (e-NAM) and tech-driven tools like drones, has improved the lives of smallholders and transformed farming dynamics. The responsible application of frontier technologies in agriculture will not only empower rural households but also create employment opportunities and enhance the efficiency of the agriculture sector as a whole.

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14 THEME: ICT for agrifood sustainability

When to water? Researchers develop new tool for optimizing irrigation

April 27, 2023 | Stanford News |

Researchers at Stanford University have developed a new tool for optimizing irrigation in smart agriculture. The tool estimates water loss from soils due to evapotranspiration, which involves the evaporation of water into the atmosphere and water uptake by plants. Compared to existing methods, the tool is 100 times faster while maintaining high accuracy. It can be used to devise efficient irrigation schedules and adjust irrigation in real time based on weather conditions. Conventional models for evapotranspiration have relied on the vertical-flow assumption, ignoring horizontal water flow. However, for smart agriculture practices like drip irrigation, which administers water slowly and precisely to plants' root zones, the vertical-flow assumption is inadequate. The new tool provides guidance for positioning moisture sensors and drippers based on real-time conditions. The researchers plan to test the tool in real-world settings on a working farm.

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15 THEME: ICT for agrifood sustainability

Automated agricultural machinery requires new approaches to ensuring safety, says study

May 15, 2023 | Phys.org |

A recent study from the University of Illinois highlights the need for new safety approaches in the realm of automated agricultural machinery. While these technological advancements offer increased productivity, concerns about safety measures and regulations arise. The study reviewed over 60 academic papers and identified three main areas of focus: environmental perception, risk assessment and mitigation, and human factors and ergonomics. The majority of research emphasizes environmental perception, such as obstacle detection and response, while limited work has been done on risk assessment and ergonomics. The study also explores the types of obstacles machines encounter, including positive, negative, and moving obstacles, and the various sensor types utilized. The trend is towards using multiple types of sensors for the dynamic agricultural environment. Challenges include sensor sensitivity and handling quickly moving obstacles. The study concludes that while safety standards and regulations need to be revised to accommodate autonomous systems in agriculture, the development of robust safety systems is vital for the widespread adoption of automated agricultural machinery.

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16 THEME: ICT for agrifood sustainability

Top 10 companies using blockchain technology in agriculture in 2023

April 25, 2023 | Analytics Insight |

According to the Analytics Insight platform, here are the top 10 companies utilizing blockchain technology in the agriculture industry in 2023:

- AgriDigital: An Australian-based company providing blockchain solutions for agriculture supply chains, enabling real-time tracking and reducing fraud risk.

- IBM Food Trust: A blockchain-based platform for food supply chains, promoting transparency, traceability, and sustainability.
- AgriLedger: A UK social enterprise project supporting farmers in developing countries with tracing food origins and accessing financing.
- TE-FOOD: A blockchain-based platform enabling farmers to track products throughout the supply chain, optimizing production processes.
- Ripe.IO: A blockchain-based platform using IoT devices for real-time tracking and ensuring product quality.
- Demeter: A blockchain-based company offering transparency and traceability, promoting sustainable practices.
- AgriChain: Focusing on peer-to-peer agricultural transactions, enabling supply chain tracking and data accuracy.
- Ambrosus: Providing transparency and traceability in the food supply chain using blockchain and IoT devices.
- GrainChain: A blockchain-based platform for tracking products and optimizing production processes.
- Etherisc: A blockchain startup offering decentralized crop insurance applications for farmers, improving accessibility and efficiency.
- These companies leverage blockchain technology to enhance supply chain transparency, traceability, payment systems, and quality control in the agriculture industry.

POLICY

01 THEME: Carbon market; Climate smart agriculture; Nature-based solution; Net zero strategy; Supply chain

Canada's 2030 Emissions Reduction Plan

Government of Canada| Source | Download |

Introduction: Canada recognizes the urgent need to address climate change and transition towards a cleaner, more resilient economy. Our 2030 Emissions Reduction Plan outlines ambitious actions to mitigate carbon emissions while stimulating economic growth and job creation.

Key Initiatives:

- **Building Retrofit and Green Homes Strategy:** A $150 million investment will drive the retrofit of existing buildings to net-zero carbon standards, reducing emissions and creating jobs in construction and renewable energy sectors.
- **Low Carbon Economy Fund Renewal:** With $2.2 billion, the fund will empower provinces, territories, and communities to implement climate actions, with a dedicated $180 million Indigenous Leadership Fund supporting clean energy projects.
- **Electric Vehicle Infrastructure:** A $400 million allocation for zero-emission vehicle charging stations, coupled with incentives and mandates, aims to accelerate the adoption of electric vehicles, reducing emissions from transportation.
- **Oil and Gas Sector Transition:** Targeting a 31% reduction in emissions by 2030, the plan supports the industry in diversifying towards lower-carbon alternatives while investing in methane reduction and clean technologies.
- **Renewable Electricity Expansion: I**nvestments totaling $850 million will facilitate the transition to a net-zero emissions grid, creating jobs in renewable energy infrastructure and improving air quality.
- **Clean Technology Adoption:** Initiatives include a carbon capture strategy, investment tax credits, and funding for energy efficiency projects, positioning Canadian industries for sustainability and competitiveness.
- **Nature-Based Solutions:** With an additional $780 million, Canada aims to conserve and enhance natural carbon sinks, supporting biodiversity while capturing emissions through projects focused on wetlands, peatlands, and grasslands.
- **Support for Agriculture:** Investments of $900 million will assist farmers in adopting sustainable practices, transitioning towards a carbon-neutral agricultural sector while supporting research and innovation.
- **Price on Pollution:** The plan reaffirms Canada's commitment to carbon pricing as an effective tool for emissions reduction, exploring innovative approaches such as carbon market to ensure long-term sustainability.

02 THEME: Climate smart agriculture; Sustainable consumption

USDA Strategic Plan Fiscal Years 2022-2026

USDA| Download |

Introduction: The United States Department of Agriculture (USDA) plays a pivotal role in shaping agricultural policies that affect millions of Americans. In line with its mission to provide effective, science-based leadership in agriculture, USDA must prioritize initiatives that foster equitable development across rural communities.

Key Points

- **Promoting Diversity and Inclusion:** USDA must actively work to dismantle systemic barriers and promote diversity and inclusion within the agricultural sector. This includes supporting minority farmers, women in agriculture, and underserved communities through targeted funding, technical assistance, and access to resources.
- **Addressing Climate Change:** Climate change poses significant challenges to agricultural sustainability. USDA should invest in climate-smart agriculture practices, research, and infrastructure to enhance resilience and reduce greenhouse gas emissions. Prioritizing climate adaptation and mitigation efforts will safeguard agricultural productivity and protect vulnerable communities.
- **Ensuring Market Access:** Access to markets is essential for the economic viability of farmers and rural businesses. USDA should prioritize efforts to expand market opportunities for small-scale producers, including through support for local food systems, value-added agriculture, and export promotion initiatives.
- **Supporting Rural Development:** Rural communities face unique economic and social challenges. USDA should invest in rural infrastructure, healthcare, education, and broadband access to foster economic development and improve quality of life for residents.

Recommendations

- Develop targeted programs and policies to support minority farmers and underserved communities.
- Integrate climate resilience and adaptation strategies into agricultural practices and programs.
- Expand market access for small-scale producers through investment in local food systems and export promotion.
- Prioritize rural development initiatives to address infrastructure needs and promote economic growth in rural areas.

03 THEME: Climate smart agriculture; Nature-based solution; Sustainable consumption

USDA's Partnerships for Climate-Smart Commodities

USDA| Source |

Introduction: The United States Department of Agriculture (USDA) is committed to supporting farmers, ranchers, and private forest landowners in adopting climate-smart practices through innovative partnerships. This initiative aims to expand markets for climate-smart commodities, reduce greenhouse gas emissions, and provide tangible benefits to agricultural producers, particularly small and underserved stakeholders.

Investment Overview: USDA is investing over $3.1 billion in 141 projects under the Partnerships for Climate-Smart Commodities initiative. These projects prioritize the active involvement of small and underserved producers, ensuring equitable access to resources and opportunities.

Key Objectives

- **Technical and Financial Assistance:** Projects will offer support to producers for implementing voluntary climate-smart production practices, including cover cropping, no-till farming, and nutrient management.
- **Innovative Methods:** Pilot programs will explore cost-effective approaches for quantifying, monitoring, reporting, and verifying greenhouse gas benefits, fostering transparency and accountability.
- **Market Development:** Efforts will focus on developing markets for climate-smart commodities, creating new revenue streams for farmers and ranchers while promoting sustainable agricultural practices.

Impact and Benefits

- **Expanded Markets:** Hundreds of markets and revenue streams will be created for a diverse range of commodities, benefiting both traditional and specialty crop producers.
- **Land Engagement:** Over 25 million acres of working land will adopt climate-smart practices, contributing to enhanced soil health, biodiversity, and resilience.
- **Carbon Sequestration:** These projects are expected to sequester over 60 million metric tons of carbon dioxide equivalent, equivalent to removing millions of vehicles from the road annually.
- **Diverse Collaboration:** The initiative engages nearly 100 universities, including minority-serving institutions, and over 20 tribes and tribal groups, fostering innovation and inclusivity in climate solutions.

04 THEME: Climate smart agriculture

USDA Action Plan for Climate Adaptation and Resilience

USDA| Source | Download |

Introduction: In response to identified vulnerabilities, the United States Department of Agriculture (USDA) is implementing cross-cutting adaptation actions to bolster the resilience of American agriculture, forestry sectors, and rural and urban communities against the impacts of climate change. These actions aim to bridge the gap between scientific knowledge and on-the-ground practices, ensuring producers have access to relevant climate data and educational resources.

Key Challenges

- **Sustained Adaptation Planning:** Adaptation planning must be an ongoing, iterative process integrated into decision-making rather than a standalone activity.
- **Consideration of Current and Projected Climate Change:** USDA must consider both present and future climate change scenarios in its planning and decision-making processes.
- **Implementation and Monitoring:** Adaptation actions must go beyond planning stages and be effectively implemented, monitored, and re-evaluated over time.
- **Regional Variability:** Climate change impacts vary regionally, necessitating adaptation actions tailored to specific geographical contexts.

Proposed Adaptation Actions

- **Building Resilience Across Landscapes:** USDA will invest in soil and forest health to enhance resilience to climate change. This includes promoting conservation practices, improved water management, reforestation, and ecosystem restoration to protect ecosystem functions vital for long-term sustainability.
- **Increasing Outreach and Education:** USDA aims to promote the adoption of climate-smart adaptation strategies through expanded outreach and education efforts.
- **Enhancing Access to Climate Data:** USDA will improve access to climate data and decision support tools at regional and local scales, ensuring stakeholders have the information needed to make informed decisions.
- **Supporting Research and Development:** USDA will continue to support research efforts to develop climate-smart practices and technologies tailored to agricultural and forestry contexts. Research priorities include evaluating adaptive practices, enhancing crop resilience, and studying climate impacts on ecosystems.
- **Utilizing Climate Hubs:** USDA will leverage the Climate Hubs to deliver climate adaptation science and tools across USDA agencies, supporting farmers, ranchers, and landowners in making informed decisions.

05 THEME: Climate smart agriculture; Nature-based solution; Supply chain

Sustainable Canadian Agricultural Partnership

Government of Canada| Source | Download |

Introduction: The Sustainable Canadian Agricultural Partnership (Sustainable CAP) is a new five-year agreement between the federal, provincial, and territorial governments of Canada aimed at enhancing the competitiveness, innovation, and resilience of the agriculture, agri-food, and agri-based products sector. With a budget of $3.5 billion, the agreement includes $1 billion in federal programs and activities and $2.5 billion in cost-shared programs and activities funded by all levels of government.

Sustainable CAP focuses on five priority areas: building sector capacity, growth, and competitiveness; addressing climate change and the environment; promoting science, research, and innovation; developing markets and trade; and strengthening resiliency and public trust. The agreement includes increased funding, including $500 million in new funds, to support science, research, innovation, and the growth of the sector. It also introduces the Resilient Agricultural Landscape Program, a $250-million cost-shared initiative to support the conservation and enhancement of agricultural landscapes. Business risk management programs and disaster relief frameworks are also included to assist producers in managing risks and recovering from natural disasters.

OPEN DATA

01 Theme: GHG emission inventory

China's agricultural greenhouse gas emissions 1978-2016

Scientific Data| Source | Data |

China aims to achieve carbon neutrality by 2060, requiring significant reductions in greenhouse gas (GHG) emissions from all sectors, including agriculture. A recent study provides a detailed overview of agricultural GHG emissions in China from 1978 to 2016 at the province level. It examines emissions from various agricultural activities like crop farming, including crop residue burning, rice cultivation, and machinery and fertilizer use. By analyzing historical emissions drivers and trends, this data aids in understanding emissions' impact and developing effective mitigation strategies.

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02 Theme: GHG emission inventory

Global high-resolution gridded dataset of N2O emission and mitigation potential from maize and wheat fields

Data in Brief | August 2021 | Publication | Dataset |

This dataset provides detailed information on the emission of Nitrous Oxide (N_2O) and its potential for reduction in global maize and wheat fields. The dataset offers raw data at a high resolution, allowing for a closer examination of N_2O emissions. It includes baseline emission estimates at the pixel level, which were generated using four different empirical models and validated against experimental data from the literature. Additionally, the dataset incorporates spatially explicit data on soil, climate, and crop management from various sources. The researchers quantified the potential for N_2O mitigation under different scenarios of excess nitrogen reduction. This dataset is a valuable resource for assessing and implementing measures to reduce N_2O emissions in maize and wheat fields, enabling countries to set emissions reduction targets in the agricultural sector.

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03 Theme: Agrifood system; Land cover and soil; Environment & climate

The home of the U.S. government's open data

US Government | Source |

Data.gov is an online platform developed and managed by the U.S. General Services Administration, Technology Transformation Service. Launched in 2009, it serves as a repository for government data and is built using open source applications. The data on Data.gov is collected under the OPEN Government Data Act, which mandates that government data be made available in open, machine-readable formats while upholding privacy and security standards. Federal agencies are required to create a data inventory and publish a public data listing, following the DCAT-US Schema, which is then included in the central catalog for Data.gov. The platform hosts a vast collection of datasets, encompassing 153,657 datasets overall, with a specific focus on agriculture, which comprises 5,457 datasets.

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04 Theme: Climate smart and Net zero toolkit

COMET-Planner Global

USDA | Source |

The COMET-Planner Global Assessment Tool is an innovative platform that assesses Climate Smart Conservation Practices. It has been developed based on a decade of experience in the United States and is now available worldwide. The global version of COMET-Planner utilizes reliable methodologies from the Intergovernmental Panel on Climate Change (IPCC) and the Guidelines for Greenhouse Gas Inventories. This tool enables countries across the globe to benefit from the expertise of the USDA and Colorado State University in creating climate-smart conservation planning tools. By using the COMET-Planner Global Tool, individuals worldwide can access a map, mark their farm's location, choose their current land use and conservation practices, and determine the potential soil carbon sequestration benefits. This tool is playing a crucial role in promoting climate-smart practices for working lands worldwide and contributing to global climate solutions.

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05 Theme: Agrifood system; Environment & climate; Land cover & soil

Agriculture - Open Government (Canada)

Government of Canada | Source |

Explore a variety of helpful tools and information related to agriculture in Canada. These resources offer valuable tools and data to support agriculture-related decision-making and understanding of weather and climate impacts on Canadian agriculture.
Canadian Crop Metrics: Generate reports, graphs, and tables to compare current and historical conditions for 11 crop types in specific regions.

- **Agribusiness Site Explorer:** Compare geographical sites across Canada to make informed investment decisions in the agriculture and agri-food sector.
- **Predicted Bertha Armyworm Development Storymap:** Weekly predictions of bertha armyworm development, a major pest of canola in Western Canada.
- **Predicted Grasshoppers Development Storymap:** Weekly predictions of migratory grasshopper development, a destructive pest affecting grain growers.
- **Predicted Wheat Midge Development Storymap:** Weekly predictions of wheat midge development, a pest prevalent in wheat-growing regions.
- **Predicted Diamondback Moth Development Storymap:** Estimates the potential generations of diamondback moth, a pest that varies in severity each year across the Canadian prairies and the United States.
- **Vegetation Drought Response Index:** Weekly data representing land surface dryness based on vegetation conditions, helping model drought severity.
- **Agroclimate Interactive Maps:** Interactive maps presenting datasets on precipitation, temperature, growing degree days, and more, providing insights into weather and climate impacts on agriculture.
- **Crop Field Trial Regions and Safe Zones:** Harmonized regions for crop field trials in Canada, developed in consultation with stakeholders.
- **Cereal Aphid Manager Mobile App:** An easy-to-use app for farmers and crop advisors to control aphid populations in wheat, barley, oat, or rye.
- **Canada's Census of Agriculture:** Mapping application displaying comprehensive

agricultural data every five years at the national, provincial, and sub-provincial levels.

- **Weekly Best-Quality Maximum - NDVI Anomalies:** Dataset series comparing weekly vegetation conditions to normal levels using satellite imagery.
- **Canada Weather Stats:** A customizable weather dashboard consolidating current conditions, forecasts, and historical climate data for over 800 locations in Canada.
- **AAFC's Agroclimate Map Selector:** An online tool allowing users to view a vast collection of agroclimate maps based on region, product type, and timeframe, providing insights into historic and current agroclimate conditions.