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The 2nd International Electronic Conference on Land

4–5 September 2025 | Online

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Table of Contents

Welcome from the Chair

Dear Colleagues,

It is a great pleasure to announce the upcoming virtual conference **"Land Entropy and Challenges for Restoration and Future Development"**, which will take place from 4 to 5 September 2025.

The conference will address the philosophy and key interdisciplinary and transdisciplinary methodological approaches of land system sciences. Considering the UN Sustainable Development Goals (SDGs), we aim to discuss the state of the art in the nexus of land systems and global change, the intersection of food, land, water, energy, socioeconomic and political land issues, land–climate interactions, land use planning and architecture, ecosystem services, women's land rights, and the challenges posed by land entropy in the global South. Agreements such as the European Landscape Convention and their relevance in protecting and restoring cultural landscapes, the natural heritage, and the diversity of land systems are expected to be discussed. Other relevant governance instruments and governance mixes that translate land system science outputs into policies and conventions will be debated against their efficiency and success in order to assess how to further develop them.

This conference aims to bring together the LAND community in its widest sense to discuss these latest advances. Sessions on land system science advances and their societal relevance will be chaired by leading researchers. Additionally, we aim to select a significant number of oral presentations from early stage researchers based on their submitted abstracts.

We look forward to seeing you online!

Prof. Dr. Hossein Azadi
Conference Chair
Department of Economics and Rural Development, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium

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Land (ISSN 2073-445X) is an international, interdisciplinary and cross-disciplinary open access journal of:

- Land system science and social–ecological system research;
- Land/land-use/land-cover change;
- Land management including agriculture, forestry, the built environment and others;
- Landscapes, landscape design and landscape planning;
- Land–climate interactions, including climate–biosphere–biodiversity interactions;
- Land/Soil/Water Systems: the interconnecting networks of biological, chemical, and physical systems;
- Urban contexts, urban–rural interactions and urban planning and development;
- Assessment and evaluation frameworks, indicators, indices, methods, tools and approaches (ecosystem services, multifunctionality and sustainability);
- The water, energy, land and food (WELF) nexus;
- Land, biodiversity and health nexus;
- Emerging technologies of data processing (deep learning/machine-based learning).

It publishes reviews, regular research papers, perspective and discussion papers, short communications and research notes, and there is no restriction on the maximum length of the papers.

Our aim is to encourage scientists to publish their empirical, experimental and theoretical research in as much detail as possible.

Full experimental and/or methodical details and data documentation must be provided for research articles. Computed data or files regarding the full details of the experimental procedure, if unable to be published in a normal way, can be deposited as supplementary material.

Research papers should ideally go beyond describing narrow case studies. They should either relate case studies to their regional/social–ecological/global context and address issues of transferability considering the usefulness for and interest of an international auditorium or should at least be based on comparative study designs. Contrariwise, communications or short notes can introduce (interim) case study results and experiences.

The unique features of this journal for which contributions are particularly invited and welcome are:

- Manuscripts regarding research perspectives, proposals and research ideas;
- Manuscripts concerning summaries and surveys on research cooperation and projects (that are founded by national governments, the EU or others) providing information for a broad range of users;
- Manuscripts that document how to transfer research findings to practice and implement findings in planning, decision making or policy processes;
- Manuscripts that introduce innovative modeling and/or impact assessment tools including prototypes and conceptual approaches;
- Manuscripts that report on failures (methods, approaches, hypotheses, assumptions, analytics and interpretation) and discuss how these could be avoided;
- Lead papers that introduce a Special Issue but go beyond a summary of the contributions (synthesis + review and conclusions).

Journal Webpage: https://www.mdpi.com/journal/land

Session Chairs

Prof. Dr. Chuanrong Zhang

Department of Geography & Center for Environmental Sciences and Engineering, University of Connecticut, Storrs, CT, USA

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Department of Geography & Center for Environmental Sciences and Engineering, University of Connecticut, Storrs, CT, USA

Invited Speaker

Dr. Susan E. Crow

Department of Natural Resources and Environmental Management Department, University of Hawaii Mānoa, Honolulu, HI, SA

Program Overview

Day 1 (Morning) 4 September (9:00–12:00 CEST)	Day 2 (Morning) 5 September (9:00–12:30 CEST)
Session 2: Landscape Architecture and Land Restoration	**Session 4: Big Earth Data for Land Monitoring** **Session 5: Land Use Dynamics and Socio-Ecological Systems**
Break	
(Afternoon) **(14:00–18:00 CEST)**	**(Afternoon)** **(14:00–18:00 CEST)**
Session 3: Soil Carbon Sequestration and Climate Change Mitigation **Session 1: Urbanization and Land Use: Navigating the Future of Cities**	**Session 6: Climate Action on Land Use** **Session 7: Resilient Agricultural Landscape Systems**

IECL 2025 Program

4 September 2025 (Thursday)

Session 2: Landscape Architecture and Land Restoration

Time: 9:00 (CEST, Basel) | 3.00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	Speaker	Title
9:00–9:10	**Prof. Dr. Hossein Azadi** Event Chair	Opening Speech by the Event Chair
9:10–9:20	**Prof. Dr. Thomas Panagopoulos** Session Chair	Welcome from the Session Chair
9:20–9:35	**D. Ben Ghida** Selected Speaker	Sustainable and Inclusive Cities? Strategic Urban Regeneration of Decommissioned Industrial Sites in France
9:35–9:50	**Clara Stella Vicari Aversa** Selected Speaker	The Strait Bridge as an opportunity for careful strategic architectural and urban regeneration
9:50–10:05	**Jing Zhang** Selected Speaker	Dialogue Between Palace and Land—Rain Garden and Hydrological Restoration Strategies for Sustainable Landscape Renewal at the Alhambra
10:05–10:20	**Kenjiro Kito** Selected Speaker	Characteristics of Decision-Making Regarding Stormwater Management and Blue–Green Infrastructure in Large Development Plans in Norway
10:20–10:35	**Celestina Fazia** Selected Speaker	Reuse of brownfield sites along water edges
10:35–10:50	**Vânia Morgado** Selected Speaker	Strategic planning of linear green spaces that connect green areas in Lagos, improving ecological connectivity, and providing various benefits for both the environment and the city's inhabitants
10:50–11:05	**Indishe Senanayake** Selected Speaker	Assessing the Performance of Landform Evolution Models in a Natural Catchment Analogous to a Post-Mining Landform
11:05–11:20	**Udisha Sarkar** Selected Speaker	Reviving Mehrauli: Integrating Landscape Design for Ecological Restoration and Heritage Renewal
11:20–11:35	**Alexander Omondi Imbo** Selected Speaker	Conservancies: A Demonstrable Local-Level Action for the Sustainable Development Goals in an African Indigenous Frontier
11:35–14:00	**Break**	

Session 3: Soil Carbon Sequestration and Climate Change Mitigation
Session 1: Urbanization and Land Use: Navigating the Future of Cities

Time: 14:00 (CEST, Basel) | 8.00 (EDT, New York) | 20:00 (CST Asia, Beijing)

CEST Time	Speaker	Title
14:00–14:10	**Prof. Dr. Nick B. Comerford** Session Chair	Welcome from Session Chair
14:10–14:30	**Dr. Susan Crow** Invited Speaker	From soil carbon to climate action: Metrics that matter
14:30–14:45	**Yanbin Chen** Selected Speaker	Reframing Grassland–Livestock Systems for Sustainable Land Transitions: A Digital Modeling Approach Aligned with Climate- and Nature-Based Goals
14:45–15:00	**Rajan G. Rejith** Selected Speaker	Generation of Synthetic Hyperspectral Image Cube for Mapping Soil Organic Carbon using Proximal Remote Sensing
15:00–15:15	**Vaishali Sharma** Selected Speaker	Spatio-Temporal Assessment of Carbon Sequestration Potential and Land Use-Based Carbon Stock Distribution in Sirmaur District Using InVEST Model (1993–2023)

15:15–15:30	**Juan Carlos Valverde** Selected Speaker	Total belowground carbon flux response of Eucalyptus genotypes to water deficit in Mediterranean Chile
15:30–15:35	**Prof. Dr. Chuanrong Zhang** Session Chair	Welcome from Session Chair
15:35–15:50	**Prof. Dr. Chuanrong Zhang** Session Chair	How Does the Small Area Fair Market Rent (SAFMR) Policy Affect Housing Prices?
15:50–16:05	**Chengpeng Li** Selected Speaker	Mapping the High-density Urban Land from a 3D Perspective: The Future Land War Between Surface Space and Low-altitude Space
16:05–16:20	**Fatiha Hakimi** Selected Speaker	Urban and Peri-Urban Agriculture and Its Role in Land System Dynamics: Insights from Meknès, Morocco
16:20–16:35	**Muhammad Salem** Seleced Speaker	Urbanization and Land Use Dynamics in Greater Cairo: Planning for Sustainable Urban Futures
16:35–16:50	**Sergio Cappucci** Selected Speaker	New perspectives on geothermal energy usage over the past 30 years in Italy: its impact on society, the economy, and land management
16:50–17:05	**Sheyla Cevallos-Misco** Selected Speaker	Accelerated Fragmentation of Papagayo Forest: Urgency for Protection Amid Urban Pressure in Guayaquil
17:05–17:20	**Angelica Stan** Selected Speaker	Assessing the Formal Quality of Parceling Grids, Relevant for Urban Resilience

5 September 2025 (Friday)

Session 4: Big Earth Data for Land System Monitoring and Modeling
Session 5: Land Use Dynamics and Socio-Ecological Systems: Modeling Across Scales

Time: 9:00 (CEST, Basel) | 3:00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	Speaker	Title
9:00–9:10	**Prof. Dr. Hanoch Lavee** Session Chair	Welcome message from Session Chair
9:10–9:30	**Dr. Gamal El Afandi** Invited Speaker	To be announced
9:30–9:45	**Tarun Teja Kondraju** Selected Speaker	A Google Earth Engine-based Application for Monitoring Soil Moisture using Sentinel 1 Synthetic Aperture Radar Data
9:45–10:00	**Mahdi Hasanlou** Selected Speaker	Urban 3D Multiple Deep Base Change Detection by Very High-Resolution Satellite Images and Digital Surface Model
10:00–10:15	**Angelos Alamanos** Selected Speaker	Assessing the Sustainability of Land Use Changes and SDG15 in Greece
10:15–10:25	**Prof. Dr. Christine Fürst** Session Chair	Welcome message from Session Chair
10:25–10:40	**Beatrice Petti** Selected Speaker	Diachronic analysis of agro-forestry landscape in Latium region
10:40–10:55	**Leonid Petrov** Selected Speaker	Institutional Dynamics of Land Use in the Makazhoy Hollow Between the 19th and 21st Centuries
10:55–11:10	**Eduardo Gomes** Selected Speaker	Modelling the impacts of land-use change on Cultural Ecosystem Services
11:10–11:25	**Isabel Adriana Chuizaca-Espinoza** Selected Speaker	Mining-Driven Land Use and Land Cover Changes in Quilombola Territories of the Brazilian Amazon
11:25–11:40	**Daniela Romero-Bermeo** Selected Speaker	Geospatial Tools and Mining Laws: Analysis of Regulatory Efficiency in the Ecuadorian Amazon
11:40–11:55	**Carlos Alberto Falquez-Chávez** Selected Speaker	Assessing the Impact of Illegal Gold Mining on the Fluvial Morphology of the Punino River in the Ecuadorian Amazon
11:55–12:10	**Divar Castro-Rodas** Selected Speaker	A Comparison of Supervised Classification Algorithms in Guayaquil Land Use and Land Cover Data: An Evaluation with Landsat and MapBiomas
12:10–12:25	**Abdullah İzzeddin Karabulut** Selected Speaker	Temporal Analysis of Groundwater Quality in the Harran Plain: Linking Land Use Change to Water Contamination (2005–2025)
12:25–14:00	**Break**	

Session 6: Climate Action on Land Use
Session 7: Resilient Agricultural Landscape Systems

Time: 14:00 (CEST, Basel) | 8:00 (EDT, New York) | 20:00 (CST Asia, Beijing)

CEST Time	Speaker	Title
14:00–14:10	**Dr. Nir Krakauer** Session Chair	Welcome from Session Chair
14:10–14:40	**Prof. Chuanrong Zhang** Keynote Speaker	Leveraging AI and Remote Sensing for Housing Market Risk Assessment under Climate-Driven Land Changes
14:40–14:55	**Niranjika Wijesooriya** Selected Speaker	Canopy Cover for Cooler Cities: A Meta-Analysis of Urban Greening and Temperature Reduction Strategies
14:55–15:10	**Ronald C. Estoque** Selected Speaker	Recent trends in global tropical forest loss: Implications for climate, biodiversity, and disaster risk reduction

15:10–15:25	**Sahil Chauhan** Selected Speaker	Biomass Storage and Natural Regeneration in Sacred Groves of the North–Western Himalayas: A Study on Ecological Preservation and Environmental Benefits
15:25–15:40	**Salvador Garcia-Ayllon** Selected Speaker	Effects of the phenomenon of diffuse territorial anthropization in the context of climate change on the Mediterranean coast during the last decade: from the environmental disaster of the Mar Menor of 2015 to the floods of 2024 in Valencia
15:40–15:55	**Catarina de Sousa Silva** Selected Speaker	How can we effectively plan urban green infrastructure to address environmental and social crises?
15:55–16:10	**Alexandru-Ionut Petrisor** Selected Speaker	Metropolitan Water Resilience: Resilient Urban Planning Strategies for Climate Challenges
16:10–16:15	**Prof. Dr. Veera Gnaneswar Gude** Session Chair	Welcome message from Session Chair
16:15–16:45	**Prof. Dr. Veera Gnaneswar Gude** Keynote Speaker	Understanding the Social Implications of Agrivoltaics in Farmlands
16:45–17:00	**Mian Muhammad Ahmed** Selected Speaker	Restoring Agricultural Landscapes: A Case Study on the Role of Microbial Diversity in Salt–Alkaline Stress Mitigation
17:00–17:15	**Djifa Fidele Kpalari** Selected Speaker	Regulated effect of fertilization and irrigation on greenhouse gas emissions in salt-affected soil: meta-analysis
17:15–17:30	**Julia Grochowska** Seleced Speaker	A Comparative Analysis of the Popularity of Regenerative Agriculture Practices in Poland, Germany, and Belarus
17:30–17:45	**Sabrine Soltane** Selected Speaker	Phyto-Acoustic Mulching: Paradigm for enhancing Allelopathic Weed Control
17:45–18:00	**Bernus Zinsou DJIGBE** Selected Speaker	The Impact of Integrated Farming on Soil Chemical and Microbiological Properties in Cashew Agroforestry Systems of Northern Benin
18:00–18:15	**Pierre Tovihoudji** Selected Speaker	The immediate and residual effect of cattle corralling and mineral fertilizer on maize cropping systems in the sub-humid zone of northern Benin: Yields, resource use efficiency, economic profitability, and post-harvest soil fertility
18:15–18:25	**Prof. Dr. Hossein Azadi** Event Chair	Closing Speech by the Event Chair

Session 1. Urbanization and Land Use: Navigating the Future of Cities

sciforum-132648: Assessing Industrial Land's Suitability for Sustainable Urban Planning in Dhaka Region Using Geospatial Techniques

Sk. Tanjim Jaman Supto [1,*], Dewan Reza Hamid Karzai [2] and Ettahad Islam Adib [2]

[1] Department of Environmental Research, Nano Research Centre; Sylhet; 3114; Bangladesh
[2] Department of Industrial and Production Engineering; Shahjalal University of Science and Technology; Sylhet; 3114; Bangladesh

The Dhaka Metropolitan Area is experiencing rapid industrial growth alongside uncontrolled urban expansion, leading to significant land-use conflicts and environmental pressures. This study investigates how to identify the optimal sites for industrial development that support sustainable urban growth by leveraging Geographic Information Systems (GISs), combined with a structured decision-making approach. The analysis incorporates key environmental and infrastructural factors to guide responsible planning aligned with global sustainability objectives. This study integrates spatial variables such as transport accessibility, land use, environmental sensitivity, and infrastructure presence. Up-to-date satellite imagery and land-use information from recent years ensure relevant and precise analysis. The findings indicate that roughly 10-15% of the metropolitan area is highly suitable for industrial activities, predominantly in the eastern and southern sectors. However, a considerable portion of existing industries is situated outside the officially designated zones, with nearly 9% infringing on protected environments, pointing to gaps in land management policies. Additionally, between 2014 and 2020, industrial expansion resulted in the conversion of over 1,100 hectares of natural land, underscoring urgent ecological concerns. Scenario modeling further demonstrates how strategic land allocation can balance industrial growth with environmental conservation. This research highlights the value of integrating a GIS with multi-criteria evaluation to provide a flexible, data-driven framework for sustainable industrial land-use planning.

sciforum-126338: Parametric Urban Morphologies: Architectural Strategies to Mitigate Land Entropy in Rapidly Growing Cities

Kachana Kasulu and Olga Volichenko *

Department of Architecture, Restoration and Design, Engineering Academy; Peoples' Friendship University of Russia (RUDN University); Moscow; 117198; Russia

Introduction: Urban sprawl and unregulated expansion continue to degrade land systems, leading to fragmented ecologies, inefficient infrastructures, and socio-spatial inequalities—an entropic state with critical implications for sustainability. This paper examines how parametric urban morphologies, rooted in computational design, can be strategically leveraged to reconfigure the spatial logic of rapidly growing cities. By integrating land-use optimization, density management, and adaptability, parametric methodologies offer novel pathways to counter urban entropy and support long-term resilience.

Methods: The study adopts a multi-scalar research framework, combining morphogenetic algorithms, GIS-based urban analytics, and rule-based parametric modelling. Selected case studies from fast-growing metropolitan regions (e.g., Sub-Saharan Africa, Southeast Asia, and Latin America) provide empirical grounding. Urban performance metrics—such as land-use mix, walkability indices, infrastructure efficiency, and environmental integration—are evaluated through parametric simulations. The design strategies are tested through iterative computational processes that explore form-density relationships and systemic adaptability to urban growth patterns.

Results: The findings indicate that parametric frameworks enable the generation of spatial configurations that are both density-efficient and responsive to environmental constraints. The models reveal increased land-use coherence, reduced infrastructural redundancy, and enhanced urban connectivity compared to conventional zoning approaches. Additionally, adaptable typologies generated through parametric logic demonstrate a higher potential for phased development and incremental urbanism, particularly in informal or semi-formal urban contexts.

Conclusions: Parametric urbanism offers a transformative architectural paradigm that responds dynamically to land entropy challenges. It allows for a more integrated, data-driven approach to urban design, one that aligns with ecological thresholds, socio-spatial equity, and infrastructural resilience. As cities face intensifying pressures of growth, climate stress, and spatial fragmentation, computational strategies for parametric morphogenesis provide a scalable toolset for shaping sustainable urban futures.

sciforum-133542: Research on the Motivation of Rural Homestead Exit Decision under the Framework of Sustainable Livelihoods: New Discoveries Based on Interpretable Machine Learning

Xiu Guo

College of Public Administration; Nanjing Agricultural University; Nanjing; 210095; China

The improvement of the rural homestead system is fundamental to increasing farmers' property income and achieving rural revitalization in China. Based on the sustainable livelihood framework, this study constructs an analytical framework and employs data from a 2022 field survey of 1,764 rural households across seven provinces. Using interpretable machine learning methods, we evaluate the predictive power of various types of capital characteristics on farmers' decisions to voluntarily exit their rural homesteads. The results indicate that (1) the Extreme Gradient Boosting (XGBoost) algorithm yields the highest prediction accuracy for homestead exit decisions and significantly outperforms traditional statistical models such as logistic regression; (2) the importance ranking of different capital categories is as follows: human capital > social capital > natural capital > physical capital > psychological capital > financial capital; (3) among the variables, frequency of participation in village collective activities, household non-agricultural income, contracted arable land area, and education level positively influence the likelihood of homestead exit, whereas homestead size and housing area exert a negative influence; (4) the key factors affecting homestead exit vary across pilot and non-pilot villages and between suburban and remote areas. Local governments should prioritize the enhancement of human capital, strengthen social capital networks, optimize the disposal of natural and physical capital, and provide psychological support and institutional guarantees. A differentiated policy approach should be adopted to improve farmers' willingness to voluntarily exit homesteads, thereby accelerating reform of the rural homestead system.

sciforum-126210: Urbanization and Land Use Dynamics in Greater Cairo: Planning for Sustainable Urban Futures

Muhammad Salem

Kyushu University; Fukuoka; 819-0395; Japan

Greater Cairo, one of the fastest-growing megacities in the Global South, presents a compelling case for studying the complex interplay between rapid urbanization, land use change, and planning governance. This proposed study aims to investigate the evolving land use patterns in Greater Cairo and assess the effectiveness of urban planning interventions in directing urban growth toward sustainability. The research will adopt a mixed-methods approach, combining spatial analysis of satellite imagery (2000–2023) with a review of urban policy frameworks and qualitative interviews with key stakeholders, including planning authorities, developers, and community representatives. GIS and remote sensing techniques will be used to quantify land use change and urban expansion, while interviews will explore the underlying drivers of informal development and governance challenges. Preliminary expectations suggest a continued shift toward peri-urban expansion and land consumption beyond officially planned areas, influenced by demographic pressures and weak regulatory enforcement. The study will also examine the impact of recent planning efforts, such as the establishment of new towns and strategic master plans, to identify gaps between policy intent and implementation. The proposed paper will argue for more integrated, inclusive, and adaptive urban planning frameworks that bridge the divide between formal and informal systems. It will highlight the importance of strengthening land governance institutions, decentralizing planning processes, and incorporating participatory mechanisms to support sustainable urban development. Insights from Greater Cairo will contribute to broader regional and global discussions on managing urbanization in rapidly transforming cities.

sciforum-126322: An Ecological Risk Assessment of the Heavy Metal concentration of crude oil-Polluted mangrove sediments in the Niger Delta, Nigeria

Opara Onyinyechi Grace

Peoples' Friendship University of Russia (RUDN University); Moscow; 117198; Russia

As the Niger Delta is a major crude oil exploration region with no stringent environmental laws in Nigeria, the ecological risk assessment of heavy metals in mangrove sediments is critical due to their persistence and toxicity. This study analyses the concentrations of five different heavy metals, which included cadmium, lead, copper, nickel, and zinc, in mangrove sediments of the Buguma community, Asari-Toru Local Government Area, in the Niger Delta, applying ecological risk indices to determine the contaminations and ecological threats of heavy metal pollution. Samples were collected from three different sites. Site 1: located near a sediment heap, a dump site with oil sheen, litter, and particulate contaminants, with an old local illegal crude oil refinery; site 2: an area with maritime discharges, sewage, and commercial wastes dumped nearby; and site 3: a densely populated settlement lining the tidal-swept mangrove swamp with household pollution. The research was carried out by employing ecological risk indices, which included the Contamination Factor, Degree of Contamination, Ecological Risk, Potential Ecological Risk, Pollution Load Index, and Enrichment Factor. The results showed that arsenic and lead exceeded human permissible limits, while cadmium, zinc, and nickel were within limits. The ecological risk assessment indices revealed that the sediments have varying levels of heavy metal concentration. The applied ecological risk indices were as follows: Ecological Risk: Cu (high ecological risk) and Pb (very high ecological risk); Enrichment Factor: Cd, Zn, and Pb; Degree of Contamination (very high degree); Contamination Factor: Pb (moderately degree) and Cu (high degree); and Potential Ecological Risk (obviously high). The results indicated increased levels of the heavy metals in all the sediments, indicating health and ecological risks to humans and aquatic biota, linked to anthropogenic activities. The results recommend efficient governance strategies and strict policy interventions for the immediate remediation of these sites. The results also suggest that further research should be conducted on the histopathological and biochemical effects on humans and benthic organisms.

sciforum-126222: Assessing the Formal Quality of Parceling Grids, Relevant for Urban Resilience

Angelica Stan

Ion Mincu University of Architecture and Urbanism; Bucharest; 011071; Romania

Urban resilience typically refers to the built environment and how cities can adapt to climate change and other natural factors. Studies on urban morphology reveal that the foundation of urban development lies in the parceling system, and that urban diversity is, to a large extent, a consequence of the diversity of parcels, which clearly expresses the transformation processes and shows the continuity between people and the territory they inhabit. However, the relationship between the formal qualities of the parceling system and urban resilience has not been extensively studied. This study focuses on investigating the main morphological parameters of the parceling formal quality, developing a method that aims to align them with the key attributes of the urban resilience concept, as defined by global frameworks. Recent approaches emphasize criteria like robustness, redundancy, integration, reflectiveness, inclusivity, and flexibility to address environmental, social, and economic challenges. This paper shifts the understanding of urban resilience beyond a focus on buildings (materials and technologies) to incorporate the parceling system as a crucial genetic structuring element of settlements. The advance of exclusively quantitative tools and methods in the measurement of urban form risks disregarding the cultural dimension of the parceling system, which defines its character not only symbolically but also practically. This paper advances the idea that urban resilience should not be viewed solely as a parametric and technical matter, but as a deeply human aspiration of the urban phenomenon as a whole. Therefore, this method provides a structured way to analyze the formal qualities of parceling grids as a first step in a more comprehensive urban resilience assessment, based on complementary approaches that incorporate socio-economic and cultural dynamics.

sciforum-134234: Assessment of Green Space (Urban Green Infrastructure) Considering Air Pollution in Urban Resilience: A Case Study of Isfahan City)

Forough Hossini [1], Ferial Farasat [1], Alireza Memaripour [1], Mahmoud Seifadini [1], Saeid Pourmanafi [2] and Sima Fakheran [2,*]

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[2] Associate Professor of Environmental Sciences, Department of Natural Resources, Isfahan University of Technology, Isfahan 84156-83111, Iran

Urban resilience in facing environmental hazards, especially air pollution, is one of the most significant challenges for metropolises. Isfahan city, given its dry and semi-dry climate, rapid population growth, and uncontrolled industrialization, is confronted with an air quality crisis and a reduction in per capita green space. This study aims to examine the relationship between the level of urban resilience, the severity of air pollution, and the role of urban green spaces in mitigating pollution effects in the metropolis of Isfahan. In this regard, through field studies, air quality monitoring station data, satellite information on green coverage, and a review of scientific literature, an attempt has been made to analyze the strategic role of green spaces in improving urban resilience. The investigations show that the average per capita green space in Isfahan is less than the global standard, and in some urban areas, this figure falls below 5 square meters. According to the results, green spaces play a key role in reducing pollution load by creating barriers to the transfer of suspended particles, absorbing pollutant gases, and moderating ambient temperature. Moreover, green spaces, as social gathering points and urban livability zones, increase psychological and social resilience against environmental crises. The research methodology is a combination of qualitative methods and GIS, remote sensing data, and correlation analysis. The results indicate that increasing green space density in areas with higher population density and pollution has a direct effect on reducing the average suspended particles. Finally, while proposing solutions such as revising Isfahan's detailed urban plan, prioritizing the expansion of green spaces in critical areas, utilizing smart air quality monitoring technologies, and implementing spatial justice-based policies, it emphasizes that achieving an air pollution-resilient city is not possible without precise planning for green space development.

sciforum-125718: Evaluating Spatial Equity in Access to Primary Health Care Using GIS: Insights from Tangier City, Morocco

Soukaina Bahmane * and Abdelilah Azyat

MASI Research Group, École Nationale des Sciences Appliquées (ENSA) of Tangier; Abdelmalek Essaâdi University; Tangier; 90000; Morocco

Primary Health Care (PHC) forms the cornerstone of healthcare systems, yet spatial disparities in access remain a persistent challenge, particularly in rapidly growing urban areas. This study leverages Geographic Information Systems (GIS) to assess the spatial accessibility of public PHC services in Tangier, Morocco, where urban expansion intensifies the need for equitable health service distribution.

The methodology integrates Service Area Analysis, Population Density mapping, and Health Facility Ratio (HFR) calculations. Walking time isochrones of 10, 20, and 30 minutes were generated around public PHC centers using the Valhalla Plugin in QGIS, offering a realistic measure of physical accessibility. Demographic data from the High Commission for Planning was combined with spatial layers of PHC locations to identify coverage gaps and assess service adequacy.

Results reveal significant inequalities across the five communes of Tangier. Central communes such as Charf-Souani exhibit high accessibility, with over 80% of residents within a 10-minute walk of a PHC. Conversely, peripheral areas such as Gueznaia show limited coverage, with less than 1% accessibility within the same walking radius. The HFR further highlights underserved areas, notably in high-density zones such asBnimakada, where the ratio remains critically low.

These findings underscore the pressing need for targeted health infrastructure planning to bridge accessibility gaps. The study demonstrates the power of GIS in guiding data-driven decisions to enhance health equity. Future work should expand the analysis to include private health providers and explore multimodal transportation impacts.

sciforum-124277: How Does the Small Area Fair Market Rent (SAFMR) Policy Affect Housing Prices?

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Access to affordable housing and equitable neighborhoods remains one of the most pressing challenges in modern urban life. Policymakers have long sought to enable low-income households to access neighborhoods offering better schools, safer environments, and stronger economic opportunities. However, such mobility-oriented initiatives can inadvertently disrupt local housing markets or even exacerbate existing inequalities. This study examines the effects of the Small Area Fair Market Rent (SAFMR) policy on the geographic distribution of Housing Choice Voucher (HCV) usage and on local housing prices across U.S. metropolitan areas. SAFMR represents a policy shift from metropolitan-wide rent subsidy standards to ZIP code-level adjustments, with the goal of expanding voucher-holder access to high-opportunity neighborhoods. Using a difference-in-differences framework and a rich panel of housing and voucher data, we document the policy's heterogeneous impacts across neighborhood opportunity levels, housing price tiers, Gini index levels, and voucher household concentrations. We find that SAFMR led to overall price declines in high-opportunity neighborhoods, though low-tier housing appreciated while high-tier segments declined. In low-opportunity neighborhoods, medium-tier housing saw the sharpest declines, while low-tier units gained modestly. Negative effects were most pronounced in high-opportunity neighborhoods with high income inequality, while large annual increases in voucher households led to price gains in high-opportunity areas but declines in low-opportunity ones. These findings underscore that the success of mobility-oriented housing policies needs the presence of complementary interventions to stabilize vulnerable submarkets and prevent spatial inequality.

sciforum-133933: Impacts of Land Use and Land Cover Changes on Urban Green Spaces of Bamako and Sikasso Cities in Mali

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Increasing land use and land cover change (LULC) and rapid urbanization have considerable impacts on urban green spaces and their ecosystem services (ESs). These impacts result in a loss of urban green space (UGS), especially market gardening, and particularly weaken the climate resilience of the cities. The results of LULC classification analyses and the Normalized Difference Vegetation Index (NDVI) were used to track the spatiotemporal dynamics of urban sprawl and its influence on the loss of green spaces in Bamako and Sikasso cities. The rates of cover, average annual change, and annual increase in the area of each land cover class were applied to analyze the evolution of vegetation formations from 1990 to 2020, while the NDVI was used to quantify the evolution of vegetation over the last 30 years (1990 to 2020). The results showed that built-up areas have increased in both cities, while farmland, high vegetation, medium vegetation (such as market gardening), low vegetation, and water bodies have regressed in the spaces occupied in both cities. The decrease in NDVI values observed in both cities indicates a decrease in green spaces, such as vegetation formation. This study recommends specific actions needed to promote the sustainable land use system, such as urban green spaces (specifically market gardening), which are crucial for the provision of ecosystem services in cities.

sciforum-128014: Land (Dis)mobilisation and conflicts in the urban/rural continuum in Greater Ouaga, Burkina Faso

Assonsi Soma

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Urban growth in Ouagadougou, the capital of Burkina Faso, is creating a growing need for land for housing and socio-economic activities. With the city running out of space, city dwellers are turning to the outskirts where land is still available. Numerous rural land changes are taking place in the Greater Ouaga continuum, which consists of the city of Ouagadougou and seven (07) surrounding rural municipalities. Land transactions are at the heart of the interplay of interests and powers, and of feelings of appropriation/expropriation. At the interface, conflicts are multiplying as a result of widespread land speculation. Urban projects initiated by the Government or private housing promoters dispossess stakeholders of their land, with or without compensation. As a result, the formal or informal reterritorialisation processes that (dis)mobilise them are based on a competitive fabric of spatial occupation. These practices harden social relations and call into question the dichotomous approach to rights in peri-urban areas, as opposed to the surrounding countryside. Disputes over land rights and the non-application of regulatory texts fuel land conflicts and give rise to various forms of social resistance. This situation raises questions about land management in the urban/rural continuum. The aim of this article is to analyse the forms of transformation of rural land tenure in Greater Ouaga, land conflicts, and the issues arising from them. The methodological approach will be based on a mixed socio-spatial approach combining qualitative and quantitative analyses based on documentary research, interviews, surveys, and field observations using appropriate tools such as guides, fact sheets, and satellite images. The data will be processed and analysed using geospatial tools, in particular, GIS and remote sensing. The results obtained will be discussed and suggestions made for better land management in the urban/rural continuum.

sciforum-126407: Land Entropy Quantification based on LULC Changes for Sustainable Urban and Agricultural Planning in Punjab, Pakistan

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Rapid urbanization and agricultural intensification in Punjab, Pakistan, have triggered significant Land Use/Land Cover (LULC) changes, threatening the ecological balance and food security. Quantifying land entropy through LULC change analysis is essential for sustainable urban and agricultural planning, particularly in rapidly developing regions such as Punjab, Pakistan. This study aims to assess the spatial disorder and fragmentation of land caused by urban expansion and agricultural land conversion in major cities using multi-temporal Landsat and Sentinel-2 satellite imagery from 1995 to 2025. Employing supervised classification techniques and Shannon's entropy index within a GIS framework, the research quantifies LULC transitions among agricultural land, built-up areas, barren land, and water bodies. Further incorporating machine learning (e.g., Random Forest, CNN) to predict future land entropy trends under different urbanization and policy scenarios would allow policymakers to simulate the effects of land use regulations, urban growth boundaries, or agricultural conservation policies.

Entropy Trends: Urban zones showed **high entropy** (SEI > 1.5), indicating chaotic growth, while agricultural areas exhibited **moderate entropy** (SEI 0.8–1.2) due to monoculture expansion.

LULC Shifts: A **15% net urban growth** (1995–2025) encroached on 20% of the fertile farmland, with vegetation declining by **22%** in central Punjab.

Hotspots: Lahore and Faisalabad districts had the highest entropy values (**SEI > 1.8**), correlating with GDP growth but also groundwater depletion.

The entropy index reveals increasing spatial disorder, particularly along urban–rural fringes, highlighting fragmented agricultural patches and unplanned urban growth.

This study concludes that quantifying land entropy via LULC changes provides critical insights into the dynamics of land transformation in Punjab, facilitating informed decision-making for sustainable urban expansion and agricultural conservation. Incorporating Earth observation data with entropy metrics offers a robust approach to monitoring land use patterns, enabling policymakers to balance development needs with environmental sustainability and food security objectives. Future work should integrate socio-economic drivers and predictive modelling to enhance planning frameworks in the region.

sciforum-126449: Mapping the High-density Urban Land from a 3D Perspective: The Future Land War Between Surface Space and Low-altitude Space

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With the burgeoning development of the low-altitude economy, China's spatial utilization model is experiencing a profound paradigm shift. As a result, both surface and low-altitude spaces are confronted with intense competition for spatial resources. This study employs a comprehensive mixed-methods approach, integrating cartographic theory analysis, three-dimensional spatial modeling, and in-depth comparative case studies in Shenzhen. The aim is to systematically unveil the crucial issues regarding the utilization of "surface-low altitude" spatial resources from a three-dimensional vantage point: (1) There exists an overlap in the three-dimensional spatial utilization between low-altitude flight spaces (such as those occupied by drones) and existing ground property rights (such as high-rise buildings). (2) The two-dimensional land management system encounters ambiguous boundary problems when addressing vertical space utilization. (3) Inconsistent terminology leads to substantial discrepancies in the interpretation of low-altitude rights among different jurisdictional departments (such as transportation, aviation, and land management departments). The research findings yield three fundamental insights: Firstly, the conceptual transition from planar "land" to three-dimensional "space resources" necessitates a redefinition of legal and technical frameworks. Secondly, through prototype testing, expanding the LADM (the ISO-19152, Land Administration Domain Model) to establish a three-dimensional land management system is anticipated to effectively handle integrated resource management of "surface-low altitude." Thirdly, the vertical-space-stratified governance strategy has the potential to unleash supplementary space resources within high-density urban regions. The findings of our research could offer a comprehensive perspective for the future governance of urban land and low-altitude areas. This stands in contrast to current practices that treat these two resource aspects in isolation.

sciforum-133835: Nature-Based Solutions for Biophilic Cities: A Critical SWOT Review

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Urbanization continues to place immense pressure on land use systems, resulting in habitat fragmentation, biodiversity loss, climate vulnerability, and a growing disconnect between people and nature. In response, nature-based solutions (NbSs) have gained prominence as an integrated approach to reintroduce natural systems into cities and support the emergence of biophilic urbanism. This paper explores the role of NbSs in shaping biophilic cities by conducting a systematic literature review and critically evaluating their strengths, weaknesses, opportunities, and threats (SWOT) in urban planning and design.

Using a systematic search of peer-reviewed journal articles, policy reports, and case studies published between 2000 and 2024, the review identifies key themes, implementation strategies, and outcomes associated with NbSs in urban contexts. The SWOT framework is applied to categorize the findings and analyze the strategic potential and limitations of NbSs within biophilic design practices. Strengths identified include ecosystem service enhancement, climate resilience, mental and physical health benefits, and aesthetic and cultural value. However, weaknesses such as fragmented governance, lack of measurable indicators, maintenance burdens, and potential for socio-spatial inequalities (e.g., green gentrification) are also evident.

Opportunities are highlighted in emerging policy mandates, climate adaptation funding, regenerative design movements, and community-led green infrastructure. At the same time, threats include land use conflicts, political inertia, uneven distribution of green benefits, and commodification of urban nature. The paper concludes by recommending pathways to better integrate NbSs into urban policy, land management, and planning systems, ensuring they support equitable, inclusive, and ecologically regenerative cities.

By situating NbSs within the biophilic city agenda, this critical review contributes to a deeper understanding of how land use futures can be shaped through design strategies that restore human–nature relationships and enhance urban sustainability.

sciforum-134003: New perspectives on geothermal energy usage over the past 30 years in Italy: its impact on society, the economy, and land management

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The Earth's heat comes from the residual heat associated with the formation of our planet, as well as from the decay of radioactive elements in the mantle. Urban development has not considered land properties and management to benefit from geothermal sources, which provide a clean, free, widespread, and programmable renewable energy source.

Scientific and technological progress have contributed to the use of geothermal to favour the transition towards low-carbon energy sources and sustainable development, which are key factors for the mitigation of and adaptation to climate change. Italy, for example, was the first country in the world to exploit geothermal energy, obtaining numerous social and economic benefits, but in the last 30 years, this exploitation has stood still, while other countries are investing and have recently exceeded their predicted electricity production from renewable geothermal resources.

In the present research, the major changes in low–medium–high-enthalpy geothermal systems that have occurred in Italy in the last 30 years are analysed and discussed, and the preliminary results of a larger investigation related to the perception of geothermal energy by the Italian population are presented. The present research is based on a survey, specifically designed to understand the perception of the Italian population with respect to the different geothermal energy systems (uploaded on the Qualtrix Platform®).

The integration of social and legislative issues is still in progress, but we can say that the use of geothermal energy is driven by a) fiscal benefit in terms of energy efficiency of people's own properties; b) the extraction of critical raw materials from medium- and high-enthalpy geothermal systems; and c) the search for natural hydrogen. From a technical point of view, a description of the progress can be provided, but the scientific community is not taking perspectives from a social and policy point of view, or the important role of urban, landscape, and natural resource management, fully into account.

sciforum-133520: Parametric Timber Urbanism: Algorithmic Wooden Megastructures for Low-Entropy, High-Density Land Use

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Introduction

Rapid urbanisation intensifies land entropy—manifested as spatial disorder, escalating resource dissipation, and ecological fragmentation—especially in cities that continue to sprawl horizontally. This paper advances *Parametric Timber Urbanism*, a design paradigm in which algorithmically generated cross-laminated-timber (CLT) and glulam megastructures stack mixed-use neighbourhoods vertically, shrinking urban footprints while lowering material and energy entropy and maintaining architectural flexibility.

Methods

A three-tier workflow was adopted:

Generative Modelling—Rhino-Grasshopper scripts evolved mass-timber superstructures from a 12 m × 12 m grid, incorporating variable core positions and modular facade panels.

Multi-Objective Optimisation—A genetic algorithm balanced floor-area ratio, daylight autonomy, carbon sequestration, and structural efficiency, producing hundreds of candidate morphologies.

Entropy-Based Assessment—Integrated lifecycle inventory and exergy accounting quantified embodied energy, cumulative entropy generation, and circular-material loops. Benchmark scenarios compared timber towers to conventional steel–concrete high-rise typologies across three global climate zones.

Results

Optimised timber megastructures achieved a 65% reduction in embodied carbon and a 48% drop in cumulative exergy loss relative to steel–concrete towers of equivalent composition. Land-use efficiency rose from 3.5 to 9.2 in floor-area ratio, enabling a 72% decrease in ground coverage while preserving gross floor area. Passive-environmental performance improved: daylight and natural-ventilation indices increased by 28%, and thermal-mass modulation cut annual operational energy by 21%. Modular plug-in units allow 30-year lifecycle reconfigurations with 5 % additional material, demonstrating adaptive capacity without intensifying entropy.

Conclusions

Algorithmic mass-timber systems can deliver high-density, low-entropy urban morphologies that outperform conventional high-rise construction across environmental, structural, and socio-economic metrics. By pairing parametric optimisation with entropy-based evaluation, *Parametric Timber Urbanism* offers a scalable template for sustainable vertical expansion, aligning urban growth with carbon neutrality and circular resource flows.

sciforum-132677: Restorative Justice and Land Reform Policy in South Africa

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The ongoing inequalities in land access and ownership in South Africa pose a serious challenge that fundamentally threatens the human dignity, personal rights, and overall safety of numerous citizens. The historical effects of apartheid policies have led to a significantly unequal allocation of land, which has had a disproportionate impact on marginalised communities. Recognising these critical issues, the current debates and public forums related to land reform policy are vital steps toward attaining social justice and restorative justice and promoting economic progress across the country. Using qualitative data, this research will examine information gathered from various stakeholders engaged in the land reform discussion, including government bodies, civil society groups, advocates for land rights, and impacted communities. Participants will be chosen using purposive sampling, focusing on individuals with specific characteristics or experiences relevant to restorative justice and land reform policy. This recruitment approach will ensure that the data collected is both relevant and insightful to the topic under investigation. Data will be collected through semi-structured interviews. This approach enables a richer understanding of individual experiences and perspectives. The data from this study will be thoroughly analysed using thematic analysis, a qualitative research method that systematically identifies, analyses, and reports patterns within the collected data. It is essential to note that this research is ongoing, and the comprehensive findings on the empirical data will be available before the conference in September this year. However, based on secondary data gathered from the existing literature, despite the South African government's efforts to tackle persistent inequalities in land access and ownership, several challenges have emerged. Firstly, the redistribution of land frequently encounters resistance from current landowners, which complicates negotiations and makes them argumentative. Secondly, the execution of land reform policies has been hindered by bureaucratic inefficiencies and a lack of adequate funding and resources to support beneficiaries.

sciforum-126027: Smart Modular Construction as a Catalyst for Land Restoration and Resilient Development Futures

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With growing urbanization and climate change fueling land degradation and putting traditional development models under pressure, construction practices supporting ecological resilience and responsible land use have become urgently needed. Smart modular construction, which is adaptive, has minimal impact, and is highly digitized, may offer a fresh stimulus for land restoration and progressive development. This research looks at modular systems from the perspective of architectural flexibility for use as infrastructure.

This study is based on the conceptual design activity of a Smart Reconfigurable Modular Envelope (SRME) via a duly accessible 3D modelling software, with reference to real case studies of modular building systems. The design issues considered are ease of transport, minimum interruption at the site, and the opportunity provided by the land itself to adapt to variable land conditions. The technical decisions, however, were seconded by research work in sustainable materials and modular foundations that do not require deep excavation and in light integration with some basic smart technologies, such as environmental sensors at a bare minimum cost. Scenario analysis extended to potential land use in degraded, transitional, and rural environments.

Rapid deployment with little environmental impact is made possible by the suggested SRME concept, which shows great promise for application in delicate landscapes. Over time, smart sensors enable more adaptive use and improved site management by providing basic real-time monitoring of environmental data like temperature, humidity, and air quality. The system promotes the circular use of materials and components.

Given this modular construction ability, the construction could go beyond the current trend of efficient-type building and land stewardship. Modular systems, fabricated via merging digital fabrication and ecological design principles with that of circular construction, could be envisaged as tools for the restoration of degraded landscapes, the enabling of flexible development, and the support of resilient socio-ecological futures.

sciforum-124687: Spatiotemporal Analysis of Land Use Change and Gully Expansion in the Idemili Drainage Area, Southeastern Nigeria

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Gully erosion poses a significant environmental threat in southeastern Nigeria, with severe impacts observed in the Idemili Drainage Area, including ecological degradation, infrastructure damage, agricultural land loss, and community displacement. This study examines the spatiotemporal dynamics of land use and land cover (LULC) changes in relation to gully expansion, aiming to quantify their interconnections, identify erosion-prone locations, evaluate causative factors, and guide sustainable land management strategies. Landsat satellite imagery from 1992, 2002, 2013, and 2025 was processed using Google Earth Engine (GEE) with the Random Forest algorithm and analyzed spatially in ArcGIS 10.8. Image preprocessing included geometric, radiometric, and atmospheric corrections to ensure accuracy. The classification employed Anderson's (1976) system, categorizing the land into barren land, built-up areas, farmland, forest, shrubs, and water bodies. The analysis identified trends, magnitudes, and rates of land cover transformations. The results indicated a dramatic increase in built-up areas, rising nearly sixfold from 6.01% in 1992 to 41.75% in 2025, while farmland and forest cover significantly decreased by 49.23% and 35.30%, respectively. Between 2013 and 2025, built-up areas expanded rapidly by 114.76%, coinciding with consistent reductions in farmland, forests, and shrublands. Additionally, the increase in water bodies suggests altered drainage patterns contributing to gully formation. The substantial growth of built-up areas and reduction in protective vegetation cover are identified as primary landscape changes exacerbating runoff and soil instability, thereby intensifying the susceptibility to gully erosion. These findings demonstrate a critical relationship between LULC changes and environmental degradation, emphasizing the urgent need for effective land management and targeted erosion mitigation measures in the Idemili Drainage Area.

sciforum-131687: Spatiotemporal Analysis of Land Use Dynamics and Built-up transformation of Industrial Cities along Delhi–Mumbai Corridor: Case of Ahmedabad and Surat

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The 21st century is witnessing an unprecedented pace of urbanisation due to industrialisation, reshaping landscapes, and redefining the land utilisation process across the world. This transformation presents both opportunities and critical challenges, particularly in rapidly developing nations where urban expansion is often unplanned and ecologically disruptive. The interface between urban growth and land use dynamics has become a focal point for policymakers, planners, and researchers seeking to ensure a sustainable and resilient urban future. Urbanisation in India's industrial corridors has led to significant land use transformations, particularly in rapidly growing industrial cities such as Ahmedabad and Surat—two strategic urban centres along the Delhi–Mumbai Industrial Corridor (DMIC). This study presents a comparative spatiotemporal analysis of built-up expansion and land use/land cover (LULC) dynamics in both cities over the past two decades (2000–2020), aiming to evaluate the spatial implications of industrial growth on urban form and land conversion patterns. Using multi-temporal Landsat satellite imageries, the Normalised Difference Built-Up Index (NDBI) and supervised LULC classifications in a GIS, LULC transformations and built-up changes were spatially analysed within the city boundary. The findings reveal a contrasting yet converging pattern of urban expansion—while Ahmedabad exhibits a more radial and zonally structured growth due to its planned industrial development, Surat demonstrates a dispersed expansion with significant encroachment into agricultural and barren lands. The built-up area in Ahmedabad and Surat is increased by 13.24% and 26.60%, respectively, from 2000 to 2020. Industrial growth and corridor development are significantly contributing to the increase in urban footprints, especially in the areas influenced by economic zones. This study highlights industrialisation as a critical driver of land use transformation, exacerbating peri-urban sprawl and ecological fragmentation, and the need for more planned and sustainable urban growth—merging remote sensing and urban morphology—to provide spatially explicit evidence of the present situation and future sustainable planning.

sciforum-126057: The Lighting Plan for More Sustainable Cities

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Regenerating and making cities more sustainable does not only mean "reinhabiting" cities or parts of them by reusing degraded buildings and disused industrial areas. It means limiting the delocalization of services by encouraging a more efficient reorganization of urban functions. It is necessary to optimize the functioning of cities, improve accessibility to urban services, and ensure the connection between public spaces. A careful reuse of functions and relationships with urban environments promotes sustainable mobility; the concentration of primary activities within the existing city reduces consumption and CO_2 emissions associated with the use of private transport, as well as urban lighting and maintenance costs. In this sense, urban planning plays a fundamental role, but not only that. Implementation and sectoral tools must be able to interact. In some countries, this is a recurring approach: making sectoral tools interact is a principle shared at all levels. The paper will identify selected case studies chosen for their relevance and for the contribution they offer, within the framework of urban planning tools, to sustainability through the optimal location of services and their 24-hour, day and night functioning. This all aims to reduce consumption and emissions. In Italy, the Municipal Public Lighting Plan and, where applicable, the Municipal Energy Plan, if integrated, can reduce consumption and emissions and optimize functions without sacrificing efficiency and aesthetic needs. It is essential that new functions be aligned with the transformation demands of communities, and that they be supported by well-organized services and infrastructures. It would be appropriate to assign new functions to areas with greater energy availability. The above-mentioned sectoral tools, through effective dialogue, would allow for a reduction in air, noise, and light pollution; an improvement in the energy efficiency of systems; and an optimization of operating and maintenance costs.

sciforum-108480: Urban and Peri-Urban Agriculture and Its Role in Land System Dynamics: Insights from Meknès, Morocco

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As in many cities worldwide, urbanization in Meknès, Morocco, is rapidly expanding, leading to challenges in land systems, food security, and environmental sustainability. This study explores the role of urban and peri-urban agriculture (UPA) in addressing these challenges by analyzing agricultural systems on the city's outskirts. Field surveys were conducted to assess crop cultivation (vegetables, fruits, field crops, and forage) and livestock farming (cattle, sheep, and poultry). Most farms (72%) are large (>5 ha) and managed by experienced farmers (80% aged over 41), with farming motivated by poverty and unemployment. UPA contributes significantly to the local food supply and economic development by creating jobs and providing fresh produce through short and direct marketing channels. Additionally, UPA promotes environmental sustainability by utilizing animal by-products as organic compost and fertilizers. However, UPA in Meknès faces several challenges, such as urban encroachment on fertile land, high agricultural input costs, and price volatility. The findings underscore the importance of integrating UPA into urban development plans to safeguard agricultural land and support sustainable farming practices. Recommendations are provided to ensure the resilience of peri-urban agricultural systems in the context of rapid urbanization.

sciforum-126505: Urban Transformation Analysis of Metro Corridor Expansion, LULC Changes, and openly accessible DEM Accuracy Assessments using ICESat-2

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Metro expansion induces significant modifications to the terrain and land cover through construction activities such as flyovers, embankments, and excavation. Accurate elevation data is crucial to detect these horizontal and vertical changes, especially in rapidly urbanizing areas. This study utilized NASA's ICESat-2, launched in 2018 with the Advanced Topographic Laser Altimeter System (ATLAS), which operates at a wavelength of 532 nm and a pulse repetition frequency of 10 kHz, producing ~70 cm ground footprints. ICESat-2's high-resolution photon-counting laser altimetry provides more precise elevation data than conventional DEMs such as SRTM, ASTER, and CartoDEM. The Kolkata Metropolitan Area, situated along the Hooghly River in eastern India, was selected as the case study due to its ongoing metro expansion and urban sprawl. ICESat-2 elevation values were compared with six open-access DEMs—FABDEM, CartoDEM, TanDEM-X Edited DEM, SRTM, ASTER, and COP-DEM-GLO-30—at selected footprint locations. After filtering uncertainty and removing building footprints, 1636 ATL08 footprints were used for analysis of terrain height, and 38,101 ATL06 footprints were used for for the Digital Surface Model analysis. Outliers were eliminated using the 3-sigma method. Statistical metrics, including RMSE, MAE, mean, SD, and MAD, were used for analysis. The assessment of DEMs used ICESat-2 as a reference and a filtering threshold of 0.25m for elevation deviations, finding that the values of RMSE for FABDEM, CartoDEM, TanDEM-X EDEM, SRTM, COP-30, and ASTER are 1.41m, 4.36m, 3.42m, 4.78m, 3.07m, and 7.14m, respectively. The results indicated that FABDEM 1.41m (for ATL08) is the most reliable among the evaluated datasets. Additionally, LULC changes over the past 30 years were mapped using random forest classification and multi-temporal satellite imagery. The analysis showed significant increases in built-up areas from 1995 to 2025 among all the buffer classes of 250m, 500m, 750m, and 1000m used in this study. This integrated analysis offers critical insights for metro infrastructure development and urban planning in fast-growing metropolitan regions.

Session 2. Landscape Architecture and Land Restoration

sciforum-133970: Strategic planning of linear green spaces that connect green areas in Lagos, improving ecological connectivity, and providing various benefits for both the environment and the city's inhabitants

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Urban green infrastructure (GI) aims to increase resilience to climate change and provide ecosystem services, bringing benefits to the mental and physical health of residents and visitors. However, in most cities today, GI is fragmented and does not meet the needs of a growing population. The objective of this research is to evaluate the GI of Lagos in southern Portugal and, according to the results obtained, design solutions that help to increase the urban resilience projected for the population of 2051. The GI of Lagos is projected to increase from 27 m² of green area per inhabitant in 2021 to 44 m² in 2051, in line with the recorded population increase of 7%. Accessibility to GI was estimated based on the 3/30/300 rule, using a 30-meter strip for existing trees and a 300-meter strip for parks. The accessibility area, totaling 467 ha, corresponds to 58% of the residential area. Based on the GI analysis, an urban green corridor was designed to connect existing and planned green spaces, with the aim of counteracting the current landscape's fragmentation and increasing the city's resilience, providing multiple benefits for both the environment and the city's inhabitants. A comparative analysis with successful case studies such as that in the Emerald Necklace in Boston, the Vitoria-Gasteiz Green Belt in Spain, and the Monsanto Green Corridor in Lisbon, Portugal, was conducted to inform the projected GI.

sciforum-126343: Bioclimatic Landscape Structures: Designing Timber-Based Forms for Ecological Regeneration

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Introduction: As landscapes continue to suffer from degradation, fragmentation, and climate-induced stress, the urgency of integrative design solutions that address both ecological and spatial challenges has intensified. This paper investigates the role of bioclimatic landscape structures—specifically those utilizing timber technologies and parametric form-finding—as adaptive architectural responses for ecological regeneration. By bridging architecture, landscape design, and environmental systems, timber-based interventions are explored not only for their regenerative capacity but also for their ability to mediate between built form and natural process.

Methods: This research employs a transdisciplinary methodology that merges parametric design processes with environmental simulation tools (e.g., solar radiation analysis, hydrological modeling, and material life cycle assessments). Timber is selected as a central material due to its renewable properties, structural versatility, and carbon-sequestering potential. Case studies from degraded riverine, coastal, and post-industrial landscapes are analyzed to derive form-based strategies that align with the local bioclimatic conditions. Design iterations are developed using algorithmic techniques to optimize for ecological parameters such as water retention, biodiversity support, and microclimate modulation.

Results: The resulting design prototypes demonstrate how timber-based, parametrically generated structures can perform as ecological scaffolds—promoting native vegetation, managing stormwater, and creating habitats—while also contributing to human spatial experience and architectural identity. Simulations show enhanced thermal comfort, improved site permeability, and a reduction in land surface entropy. The application of lightweight timber assemblies enables flexibility, disassembly, and minimal land disturbance, further reinforcing sustainability goals.

Conclusions: Timber-driven bioclimatic design offers a robust strategy for reconciling ecological regeneration with architectural form-making. Through parametric methodologies, landscape structures can be tailored to complex environmental contexts, enabling scalable, adaptive, and low-impact interventions. This research underscores the importance of architecture not merely as shelter but as an active agent in the restoration and stewardship of the land.

sciforum-133882: Characteristics of Decision-Making Regarding Stormwater Management and Blue–Green Infrastructure in Large Development Plans in Norway

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Introduction

Blue–Green Infrastructure (BGI) is interconnected aquatic green spaces and designed green spaces to combat climate change. The collective effectiveness of BGI measures at catchment scale has been widely demonstrated. Connecting BGI at the catchment/district scale to obtain a large capacity. In stormwater management, where capacity is increased through such connections, detailed analysis of floodways, capacity, etc., is important. This presentation demonstrates the characteristics of decision-making regarding stormwater management that ensure the systematic integration of facilities in six large development plans in Stavanger.

Methods

‘’Opinions in the start’’, ‘’drainage plans’’, and ‘’final regulations regarding stormwater management’’ are summarized, and the interrelationships between the contents are categorized. Interrelationships are examined in which the contents of discussions and considerations "provide a direction for planning and analysis," "provide a basis for methods and requirements," or "become the contents of regulations as they are."

Results

There were common trends such as discussion of BGI in an early stage, analysis and consideration based on drainage plans, and a process of indicating the degree of BGI introduction at an early planning stage and requesting further analysis and consideration from the developer. There was a common trend that the municipality performed analysis and consideration to the extent that it could indicate main stormwater systems, requests related to specific developments, and specific problems, and the developer performed the remaining work.

Conclusions

The municipality clarifies the overall capacity and system through district-scale analysis. Within that, it integrates BGI for private properties, privately developed public facilities, private shared facilities, and BGI developed by the municipality. To achieve this, there is a systematic approach of discussing and clarifying the degree of BGI introduction and division of tasks based on analysis from an early planning stage, ensuring consistency from the district scale to the site scale.

sciforum-123156: Dialogue Between Palace and Land—Rain Garden and Hydrological Restoration Strategies for Sustainable Landscape Renewal at the Alhambra

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This study investigates sustainable landscape renewal at the Alhambra through the lens of rain gardens and hydrological restoration. Facing increasing environmental pressures such as seasonal droughts, flash flooding, and soil degradation, the Alhambra presents an opportunity to integrate site-responsive water-sensitive strategies within a historic context. Through topographic and hydrological analysis, the research identifies key zones where rain garden systems can be implemented to manage stormwater, improve infiltration, and enhance microclimates. In parallel, it explores the reactivation of historic water flows and passive irrigation channels, aligning ecological restoration with the site's heritage identity. Drawing from techniques such as vegetated swales, permeable surfaces, and native planting design, the project develops adaptable, small-scale interventions compatible with conservation guidelines. The approach emphasizes low-impact, reversible strategies that reinforce natural water cycles while improving soil stability and biodiversity. Engineering tools such as GIS mapping, water flow modeling, and soil performance evaluation are applied to assess feasibility and long-term benefits. By focusing on hydrological functions as a foundation for land restoration, this study contributes to ongoing conversations about sustainable practices in heritage landscapes. It offers a replicable model for integrating nature-based infrastructure into culturally sensitive sites and aligns closely with the themes of the "Landscape Architecture and Land Restoration" session.

sciforum-133482: Storage and use of rainwater in urban areas: Gambelas university courtyard

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Drinking water is a fundamental resource for the sustainability of life on Earth, so the preservation and efficient management of this resource are essential. However, due to the constant increase in population and urban expansion together with climate change, the consumption of drinking water has constantly increased; on the other hand, its availability is lower. It is in this context that the use of rainwater emerges, standing out due to being a sustainable, simple, and effective option, where it becomes possible to use water harvested from precipitation, using it for purposes that do not require the level of filtration and treatment of drinking water, such as the irrigation of green spaces, thus contributing to the reduction in the consumption of this resource. Therefore, the main objective of this work was to study and develop a pilot rainwater harvesting system, using as the study area Building 1 of the University of Algarve, on the Gambelas Campus. It was also decided to carry out a comparative analysis, thus comparing the results obtained in the analysis of this work with those of national and international example cases, in order to verify the efficiency of this system. It was thus verified through the analysis of the results that Gambelas has a typical Mediterranean climate, noting a scarcity of precipitation between June and September. It was also verified that with the amount of rainwater possibly stored, reaching 623 658 l or 623.658 m3, it would be sufficient to meet the estimated demand, reaching 441.36 m3. It is therefore concluded that the installation of the proposed rainwater harvesting system would effectively and sustainably meet the water demand for irrigation of the green spaces in the courtyard of Building 1 and its surroundings, thus making use of rainwater and reducing the consumption of drinking water.

sciforum-131771: Sustainable and Inclusive Cities? Strategic Urban Regeneration of Decommissioned Industrial Sites in France

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This study investigates the revitalization of abandoned industrial areas along riverbanks and coastal regions in France, assessing their capacity to drive sustainable urban change through cohesive planning and design approaches. Based on three case studies, La Seyne-sur-Mer (former shipyards), Les Rives du Gave in Pau (former logistics and industrial hub), and the PCUK site in Wattrelos/Leers (former chemical production facility), the research explores how sites marked by industrial decline are being reimagined to address contemporary challenges such as ecological recovery, social and spatial integration, and cultural heritage enhancement. The purpose is to examine how the strategic regeneration of decommissioned sites can contribute to sustainable and inclusive urban development. Using a cross-case analysis grounded in landscape and urban environmental research, the study compares planning strategies, tools, and outcomes. The findings reveal diverse but complementary approaches: 1) adaptive reuse of maritime infrastructure in La Seyne-sur-Mer, 2) ecological and recreational redevelopment in Pau, and 3) innovative phytoremediation and rewilding at the PCUK site. Despite their local specificities, these projects collectively illustrate how collaborative governance, nature-based solutions, and cultural initiatives can reintegrate neglected industrial zones into the urban fabric. The paper contributes to the wider discourse on European post-industrial regeneration by offering original insights into flexible, context-sensitive strategies that reconcile historical legacies with future sustainability goals.

sciforum-126347: Synthetic–Natural Interfaces: Architectural Frameworks for Nature-Based Landscape Rehabilitation

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Introduction

Accelerated land degradation—from industrial contamination to urban encroachment—poses critical challenges for ecosystem health and community well-being. This paper proposes Synthetic–Natural Interfaces, an architectural framework that fuses engineered structures with living systems to catalyze landscape rehabilitation. By designing transitional zones where built elements and ecological processes co-evolve, this approach leverages nature-based solutions to address soil erosion, water quality, and biodiversity loss while fostering meaningful human engagement.

Methods

A two-pronged methodology underpins this research:

Parametric Form-Finding: Algorithmic modeling generates a spectrum of interface geometries—ranging from porous berms to undulating boardwalks—that are optimized for hydrological flow, light penetration, and habitat connectivity.

Ecological Simulation: Coupled hydrodynamic and vegetation succession models assess performance criteria (e.g., sediment retention, moisture retention, native species establishment) across climatic scenarios.

Three pilot interventions—in a decommissioned quarry in Southern Europe, a peri-urban wetland in East Asia, and an abandoned rail corridor in North America—serve as testbeds. Performance indicators are measured over simulated five-year cycles to evaluate ecological uplift and social activation.

Results

The designs demonstrate substantial gains in ecosystem function and community benefit. Simulations project a 45–60 % reduction in peak stormwater discharge, a 30–50 % increase in native plant coverage, and a two-fold rise in faunal corridors compared with the untreated baselines. Qualitative feedback highlights enhanced public stewardship and place attachment, with users expressing increased willingness to participate in long-term stewardship. The modular nature of the synthetic elements enables phased installation, minimizing any initial disruption and allowing for adaptive refinement.

Conclusions

Synthetic–Natural Interfaces represent a scalable, context-responsive architectural paradigm for landscape rehabilitation. By weaving engineered forms and living systems into a unified design logic, these frameworks restore ecological integrity and cultivate socio-environmental resilience. Future work will investigate lifecycle material impacts and refine participatory governance models to ensure equitable, enduring stewardship.

sciforum-126171: A Framework for Landscape Restoration: Ecological Timeframes and Design Principles for Post-Tin Mining Land

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A methodological framework is outlined for landscape restoration on post-tin mining land, addressing the urgent global need for more effective strategies to restore degraded landscapes caused by extractive industries. Worldwide, open-pit mining has left extensive areas ecologically fragmented, while the conventional reclamation approaches often fail to match the scale or pace of damage. In this context, Bangka Belitung, Indonesia, is presented as a case study, where over one million hectares have been severely disrupted by illegal tin mining yet formal reclamation rates remain below 10%. This situation highlights the need for site-responsive interventions that work in harmony with natural processes rather than opposing them.

Two core components structure the proposed framework: *Ecological Timeframes* and the *Percept of Biological Design*. *Ecological Timeframes* provide a way to map the phases of ecological recovery, ensuring that the pace and sequence of natural regeneration are recognised and integrated. Positioning interventions within these phases clarifies when and where design efforts should be prioritised to effectively support ecosystem renewal.

The *Percept of Biological Design* functions as a practical design toolbox, comprising nine principles that translate the mapped timeframes into phased, site-specific actions. These principles inform decisions on focus, scale, and sequencing, allowing the interventions to adapt to changing site conditions over time.

By combining these two elements, landscape architecture is positioned as an adaptive and responsive medium aligned with ecological succession. Using Bangka Belitung as a case study, this framework demonstrates how locally grounded, time-sensitive strategies can contribute to more resilient and regenerative post-mining landscapes, supporting broader global restoration goals.

sciforum-126232: Assessing geodiversity in the coastal area of Naples (Southern Italy): insights for nature-based solutions

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Geodiversity can be described as the natural variety in geological, geomorphological, pedological, and hydrological elements in an area. The present study shows a geodiversity mapping of the urban coastal area of the province of Naples in order to assess its geodiversity potential and to support nature-based solutions (NBSs). This approach enabled a comprehensive understanding and assessment of biological and geological diversity, which constitute a priority for the landscape under investigation. This study focused on three types of ecosystem interventions: creation, restoration, and preservation. Each geodiversity unit was analyzed in terms of vegetation content to explore the following issues: correlation between the spatial distribution of physical and biological environments, assessment of biodiversity levels across the study area, and providing insights to improve NBSs for the local coastal environment. The results identified key spots for ecosystem interventions in the urban coastal area. Drawing upon this data, the study specifically examined municipalities southeast of Naples, at the foot of Mount Vesuvius, as they are highly urbanized areas experiencing significant momentum in urban regeneration projects. In conclusion, the study underscores the importance of the relationship between geodiversity and biodiversity and demonstrates the innovative use of geodiversity as a tool for effective land use planning and biodiversity conservation in dynamic coastal urban landscapes.

sciforum-128103: Assessing the Performance of Landform Evolution Models in a Natural Catchment Analogous to a Post-Mining Landform

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Ensuring the long-term erosional stability of post-mining landforms in Australia remains a first-order priority for the mining industry, particularly because these constructed landscapes must integrate seamlessly with the surrounding natural environment. This necessitates the evaluation of erosion rates not only on post-mining landforms—during both design and operational phases—but also on adjacent natural terrains. Landform evolution models (LEMs) offer a practical means for such assessments. However, accurately and reliably evaluating their performance across varying topographic, soil, and vegetation conditions remains a challenge. This study presents an evaluation of two landform evolution models—SIBERIA, widely applied within the Australian mining industry, and SSSPAM, a state-of-the-art coupled soilscape–landform model—using a natural catchment in the Upper Hunter region of Australia. This catchment, chosen for being analogous to a nearby mining site, was assessed under both dense and moderate grass cover conditions. High-resolution LiDAR-derived digital elevation data and site-specific parameters were used to perform the simulations. Field-based erosion estimates were obtained using sediment accumulation in a pond at the catchment outlet and the fallout radionuclide ^{137}Cs method. Sediment pond measurements indicated erosion rates ranging from 0.43 to 0.61 t/ha/yr, while the ^{137}Cs technique revealed maximum erosion and deposition rates of 1.5 t/ha/yr and 1.1 t/ha/yr, respectively. Model predictions varied with vegetation cover: SIBERIA estimated erosion at 1.07 t/ha/yr (dense grass) and 3.37 t/ha/yr (moderate grass), whereas SSSPAM predicted 0.35 t/ha/yr (dense grass) and 2.43 t/ha/yr (moderate grass). The results of both field-based methods and model evaluations are within comparable ranges, providing confidence in the models and their predictions. These findings highlight the utility of both field and modelling approaches in capturing erosion dynamics and offer valuable insights for model calibration and application in post-mining landscape design.

sciforum-133443: Biorestorer: Engineered Soils and Synthetic Succession for Restoration of Degraded Land

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Restoration of severely degraded land presents a major challenge across a broad range of environments, particularly where both soil structure and ecological memory are lacking. The traditional approaches often fail in such settings, necessitating new solutions for ecosystem recovery. Biorestorer is a modular platform for ecological restoration, designed to create functional soils and catalyze synthetic succession in highly degraded areas. The approach begins with “synthetic pedogenesis”: the substrate is assembled using a combination of dual-fraction biochar (600 °C for rapid microbial activation and 800 °C for long-term stability), carefully selected basaltic minerals for nutrient and pH buffering, and rock-solubilizing bacteria (RSB) to accelerate mineral weathering. A protective mineral cover layer is applied to reduce evaporation and erosion. The second phase, “synthetic succession”, involves sequential microbial colonization, targeted mycorrhizal inoculation, and the introduction of pioneer plant species, supporting the emergence of a self-organizing, resilient ecosystem even on initially sterile substrates. The validated components of Biorestorer are known to support rapid microbial establishment, enhance nutrient availability, and maintain the substrate's structure under simulated extreme conditions. Biorestorer is currently a theoretical platform without comprehensive field testing, but it is composed exclusively of scientifically proven and independently validated components. The system’s modularity allows procedures to be tailored to the local conditions and various levels of degradation while minimizing the ecological risk. Unlike the conventional methods, Biorestorer can be applied where no viable soil or biological legacy exists, opening up restoration opportunities for post-industrial sites, mine tailings, eroded agricultural land, and other critical areas. Biorestorer thus represents a new, flexible approach to restoring severely degraded land and expands the possibilities of ecological engineering.

sciforum-125377: Conservancies: A Demonstrable Local-Level Action for the Sustainable Development Goals in an African Indigenous Frontier

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Land-use governance is critical for contributions to the global Sustainable Development Goals (SDGs) as it shapes a wide range of environmental, social, and economic outcomes. Community conservancies have proliferated across rangelands in various African countries over the past three decades, exemplifying innovative arrangements of land- and resource-use governance. By 2023, Kenya had established 230 conservancies, covering 9.04 million hectares and accounting for 16% of the country's total land area, highlighting the growing importance of community-led land stewardship. The conservancies seek to enhance both livelihoods and biodiversity, while strengthening local cultures, values and institutions. They are expected to address multiple cross-cutting social–ecological challenges, as envisioned by the SDGs. This paper aims to assess the effectiveness and capacity of conservancies to address relevant SDG targets, using case studies from the Maasai Mara region in Kenya. This is relevant as local interventions such as conservancies have been addressing issues related to global goals in diverse and innovative ways for a long time, and interest is increasing in local-level implementation amid urgent need for accelerated action. Multiple data sources were used, entailing primary data from in-depth interviews, a focus group discussion and documents review, as well as secondary data collated from a review of primary and grey literature. Analysis considered how many SDG targets were addressed, and the strengths, weaknesses, opportunities and threats of leveraging conservancies to align their development objectives with the SDGs. The results show that conservancies are contributing to addressing crucial social–ecological challenges corresponding with specific SDG targets related to advancing human well-being, enhancing environmental and biodiversity conservation, and climate change mitigation and adaptation. However, conservancies are susceptible to structural and systemic barriers which encumber inclusive participation, raising social justice concerns. The findings offer valuable insights for policy and practical recommendations.

sciforum-125857: Reuse of brownfield sites along water edges

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Addressing the topic of brownfields that are located near waterways involves several disciplines. These are areas that, due to the complexity and specificity of the dimensions involved and their dynamics, require an integrated approach and innovative methods of analysis and planning/design. These areas usually present a high landscape value while being affected by forms of degradation and risks to the environment. The relocation of manufacturing activities, which began as early as the last century in Europe and has accelerated in recent decades in southern Italy, has led to the gradual decommissioning of substantial portions of industrial heritage in many rural and peripheral areas and urban centers. Important and strategic industrial areas by the sea, or along the edges of water, lakes, rivers, and estuaries, have also become threatened by the progressive loss of or decrease in economic activities, investments, infrastructure, and related services. *Methods:* This paper, after an examination of best practices in design and planning for the rehabilitation and reuse of brownfields, will analyze two or three case studies that are significant in terms of their context specificity and location in relation to the waterway. The goal is to understand the potential of such interventions to promote sustainable transformation and counter abandonment. Strategies will be devised to avoid this risk, enhancing the coasts as spaces for rebirth and innovation.

The paper will seek to bring out, based on the analysis of the case studies, the type of relationship with the environment, and the design responses with respect to intervention priorities, that have emerged by proposing a regeneration model.

Possible and diverse design strategies for the regeneration, preservation, and enhancement of the industrial heritage, involving resources and actors in the area by returning the industrial heritage of the sites to the site of collective cultural heritage, are proposed.

sciforum-134031: Reviving Mehrauli: Integrating Landscape Design for Ecological Restoration and Heritage Renewal

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Mehrauli, one of Delhi's oldest continuously inhabited settlements, lies at the ecological edge of the Aravalli ridge and has historically been sustained by traditional water systems and natural drainage patterns. However, over the past few decades, this balance has been critically disrupted. Rapid urbanization has led to a 76% increase in built-up area and a 51% decline in green cover between 1990 and 2020. The degradation of the Aravalli ridge, fragmentation of forest cover, and the conversion of permeable surfaces into impervious urban land have caused severe ecological and hydrological stress. Groundwater levels have plummeted from an average of 10–12 meters in 1996 to 22–25 meters in 2020. Delhi Police Department has identified 96 flood-prone points in South Delhi and recorded over 250 flooding incidents in the last five years. These incidences have become more frequent due to blocked natural drains and decreased infiltration. There is an urgent need to address the ecological degradation, water scarcity, and flooding risks that threaten Mehrauli's sustainability and heritage value. The goal is to develop an integrative approach that not only mitigates these urban issues but also revives Mehrauli's historical water systems and strengthens its cultural identity. The proposed strategy involves a series of landscape-based actions focused on ecological restoration, water management, removal of invasive flora, and the creation of green corridors and bioswales, which will restore ecological balance, reduce surface runoff, and mitigate UHI effects. It will also represent a form of cultural renewal, facilitating the rejuvenation of historic water bodies such as Hauz-i-Shamsi,built in 1230 AD, and key baolis like Rajon Ki Baoli and Gandhak Ki Baoli. Measures include desilting, repairing embankments, and reconnecting feeder channels to revive their groundwater recharge functions. Interventions should be aligned with the Delhi Master Plan 2041 and India's commitments under the UN Sustainable Development Goals.

sciforum-129415: The Cañadas Reales of the UNESCO Global Geopark Volcanes de Calatrava, Ciudad Real (Spain): a backbone of geomorphological heritage and Geotourism

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The Cañadas Reales ('Royal Cattle Paths') have been a transit route for transhumant cattle on their annual winter pilgrimage from northern Spain to central and southern Spain from their creation in the 13th century to the present day. Their origin dates to the Roman roads and tracks in *Hispania*. Transhumance was included in the list of UNESCO Intangible Cultural World Heritage in 2023. The Cañadas have been of great importance in the history of the territory of the UNESCO Global Geopark Volcanes de Calatrava, Ciudad Real (Spain). Within it, the areas of Campo de Calatrava and Alcudia Valley are the places where cattle from the northhibernate. Three cañadas—the Toledana, Segoviana and Soriana Oriental—converge and form the backbone of the geopark, together with other secondary cattle paths (cordeles, veredas and coladas).

The geopark shows a high level of geodiversity and geoheritage on an area of 4,383 km^2 belonging to 40 municipalities, linked to two Spanish Geological Contexts of International Relevance (Law 33/2015): the Mercury Mineralizations and the Neogene–Quaternary Volcanism of the Iberian Peninsula.

This work presents an inventory of the geomorphological heritage of volcanic and natural protected areas at the regional and European level (Natura 2000 network), as well as other resources of historical–cultural and ethnographic heritage, linked to the Cañadas Reales (sour water fountains, hot springs, baths, transhumance architecture, abandoned mines...). The objective is to promote geotourism through sites of geotouristic interest (natural and cultural) and through actions to be carried out by the Geopark's management body.

The proposed actions focus on refurbishing the official hiking routes within the Cañadas (georoutes or geoitineraries), providing them with informative content; creating interpretation centers for the Geopark ('Volcano House') and relative to transhumance, taking advantage of historic or disused buildings (such as the airport visitor center); resuming training courses for Geopark guide staff; and taking advantage of the synergies of the transport network (highways, high-speed trains, airport).

sciforum-126524: The Strait Bridge as an opportunity for careful strategic architectural and urban regeneration

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The Strait of Messina occupies a strategic position in the Mediterranean, representing an environmental and territorial peculiarity. The Strait Area is today at the center of the political debate for the stable crossing project, a strategic infrastructure work for Italy and Europe. With the Strait Bridge, territorial arrangements, sea fronts, infrastructure systems, and urban and architectural dimensions will change. It appears necessary to prepare the territories and take advantage of all the opportunities related to future scenarios. The Strait Area is not only marked by the crossing, but the whole territorial and urban system—the coastal strip and inland areas—becomes an active part of the processes of territorial regeneration and development.

Methods: The article, after an examination of the best practices and experiences of the world's Straits, analyzes useful case studies to understand what processes and phenomena “cross” them and what works, what urban, spatial, and architectural interactions and strategies they intercept or lap up. Marine “straits” are unique, and one realizes that the strength of their peculiarities lies not only in their function as a natural link between two shores but also in their role in channeling flows and energies.

The goal is to understand their extraordinary potential to promote a synergistic and sustainable transformation, devising strategies to prevent the opportunity of the construction of the Strait Bridge from becoming a missed opportunity for the enhancement of its shores as catalysts for rebirth and innovation. The paper addresses the relationship with the environment and design responses with respect to the intervention priorities that emerged from the case studies, proposing a regeneration model. Attempts are made to identify possible design strategies so that the bridge does not merely unite two shores but relates to socio-economic issues, regeneration, and architectural and urban enhancement, involving resources and actors in the Straits area.

Session 3. Soil Carbon Sequestration and Climate Change Mitigation

sciforum-134079: From soil carbon to climate action: Metrics that matter

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Effectively confronting climate change requires quantitative, place-based metrics that provide measurable integrity for both global climate agreements and locally grounded actions. Soil carbon sequestration is a key mechanism for long-term carbon dioxide removal from the atmosphere, offering additional co-benefits that enhance climate resilience and readiness in both landscapes and communities. Over the past several decades, our understanding of the biological, physical, and chemical processes governing soil carbon storage, retention, and release in natural and agricultural systems has advanced significantly. Now, continued improvements in computational capacity and modeling tools allow us to link these soil processes to both direct (e.g., enhanced soil carbon stabilization through ecosystem restoration) and indirect (e.g., reduced reliance on imported fertilizers and diversion of organic waste through compost amendments) radiative forcing benefits. In Hawai‘i, where working lands and biodiversity conservation are often seen in conflict, examples of good rangeland stewardship demonstrate how well-managed grazing can align with conservation practices. These stories of resilience, supported by soil carbon and health data, offer quantitative, science-based evidence for the role of agricultural landscapes in climate solutions. Documenting and elevating these examples can dispel assumptions, providing metrics that track progress in ways meaningful to both local communities and broader climate frameworks. To translate this knowledge into meaningful climate action, adaptive, holistic, and quantitative assessment frameworks are needed—frameworks that resonate with communities and decision makers alike, mobilizing collective action in the face of rapidly accelerating environmental change.

sciforum-133051: Generation of Synthetic Hyperspectral Image Cube for Mapping Soil Organic Carbon using Proximal Remote Sensing

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The advent of hyperspectral remote sensing represented a breakthrough in the accurate, fast, and non-invasive estimation of important soil fertility parameters. The organic content in the soil acts as a strong indicator of soil fertility, which influences agricultural production and the global carbon cycle. The present study utilises non-imaging hyperspectral data in the spectral range of 350-2500nm collected proximally using an ASD FieldSpec spectroradiometer for estimating the soil organic carbon (SOC) content of a research farm in ICAR-Indian Agricultural Research Institute, New Delhi, India. The partial least squares regression (PLSR) scores were used as the independent variables for evaluating three multivariate regression models, such as support vector machine (SVM), random forest, and partial least squares regression, to estimate SOC. After pre-processing, the proximal spectral values were spatially interpolated using the ordinary kriging technique to construct a synthetic hyperspectral image of the experimental fields. The SVM outperformed other models, achieving an R^2 value of 0.83, which suggests an accurate prediction of SOC. On applying the regression model to this synthetic hyperspectral imagery, a high-resolution SOC map was generated. Our study indicated the potential of non-imaging proximal hyperspectral data for generating a high-resolution map showing the variability of organic content in the soil.

sciforum-131296: Reframing Grassland–Livestock Systems for Sustainable Land Transitions: A Digital Modeling Approach Aligned with Climate- and Nature-Based Goals

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Accelerating the transition to sustainable land systems requires integrated tools that can capture the complex interactions between soils, vegetation, livestock, and climate. In Ireland, grassland–livestock systems are a dominant land use and a major source of agricultural greenhouse gas (GHG) emissions. However, these systems also hold unique potential for delivering climate mitigation and ecosystem co-benefits. This study introduces a modular simulation framework designed to explore land use scenarios and carbon dynamics under changing climatic and management conditions. Built upon the HOLOS-IE platform, we develop and test interactive modules for grass growth and livestock productivity, calibrated for Irish agro-ecosystems. Unlike conventional approaches, our model links field-level management (e.g. grazing, fertilization) with soil carbon processes, allowing for a dynamic evaluation of nature-based solutions such as adaptive grazing, reduced-input strategies, and enhanced soil resilience. Spatially explicit weather, soil, and land use data are integrated to support scenario analysis and farm-level decision making. This approach contributes to global sustainability agendas by enabling climate-smart agriculture. It also aligns with principles of land governance through transparent digital tools that promote evidence-based policies and farmer engagement. The modeling system serves as a prototype for how agro-environmental models can be transformed into operational platforms for land monitoring, GHG reporting, and long-term planning under uncertainty. Our findings underscore the role of integrated modeling in delivering climate and biodiversity targets through sustainable land management.

sciforum-133188: Soil fertility and carbon and nitrogen stocks under Agroforestry Systems in Recôncavo Sul - Bahia - Brazil

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Agroforestry systems are forms of soil management used to diversify food production, increase biodiversity, and conserve soil carbon and nutrients. The performance of agroforestry systems (AFSs) can be related to the amount of nutrients released during the decomposition process of organic material added to the soil and the ability to retain carbon in the soil, minimizing its loss to the atmosphere. These systems offer numerous advantages for more sustainable agricultural production, with reduced problems related to soil management and conservation. The objective of this study was to evaluate the fertility and carbon (C) and nitrogen (N) stocks of agroforestry systems (AFSs) in Brazil. AFSs are composed of crops such as cocoa, cupuaçu, clove, guarana, piassava, allspice, rubber trees, and fruits. The region has clayey, sandy, and Latosol soils, as well as shallower soils such as Neossolos and Cambisols. Six AFSs and two areas of native vegetation were selected and used as references for the study. Sampling was carried out in 2024, and composite samples were taken from layers that were 0-5 and 0-20 cm deep to assess nutrient content, apparent density, and soil C and N stocks. The AFSs were implemented with management based on improving soil quality and maintaining fertility and C stocks at levels similar to native vegetation. Conservation practices such as no tillage, application of organic compost, and green manure favored soil organic carbon stocks contributed to improving soil fertility and increasing N content and stocks, with the highest values reaching 36.03 Mg $ha^{-1.}$ Carbon accumulation in native vegetation was greater than in the AFSs studied, at 38.9 and 54.9%. Management contributed to maintaining soil density at levels similar to native vegetation, and over time, promoted improvement in soil fertility in the surface layer.

sciforum-133841: Spatio-Temporal Assessment of Carbon Sequestration Potential and Land Use-Based Carbon Stock Distribution in Sirmaur District Using InVEST Model (1993–2023)

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Soil carbon sequestration is a vital strategy for mitigating climate change, particularly in ecologically sensitive regions like the Himalayas. This study evaluates the spatio-temporal dynamics of carbon stock potential in Sirmaur district of Himachal Pradesh over a period of 30 years (1993–2023). To achieve this, multi-temporal Landsat satellite imagery (30 m resolution) for the years 1993, 2003, 2013, and 2023 was used to generate Land Use Land Cover (LULC) maps through random forest classification in a GIS environment. The resulting LULC maps served as key inputs for the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) Carbon Storage and Sequestration model. This model quantifies total carbon stock by aggregating above-ground biomass, below-ground biomass, soil organic carbon, and dead organic matter across various land use categories. The results showed a steady increase in higher carbon density zones over the study period. Notably, the area under the “Very High” carbon density class (>15.6852 Mg/ha) expanded from 1,276.86 sq.km in 1993 to 1,379.66 sq.km in 2023. Conversely, the “Low” carbon density class (0–7.826 Mg/ha) reduced from 836.04 to 679.24 sq.km. Forests and agroforestry systems emerged as the dominant contributors to total carbon stock. This research highlights the importance of remote sensing and modeling frameworks in understanding carbon dynamics. It also provides scientific evidence to support climate-resilient land management and policy planning for carbon sequestration, particularly in fragile mountainous ecosystems.

sciforum-130157: Total belowground carbon flux response of *Eucalyptus* genotypes to water deficit in Mediterranean Chile

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Soil carbon sequestration is a crucial strategy for addressing climate change; however, the contribution of fast-growing tree plantations under drought conditions remains poorly understood. This study assessed the total belowground carbon flux (TBCF) of eight Eucalyptus genotypes over three years (ages 7–9) under two contrasting irrigation regimes in a plantation located in the Mediterranean region of Chile. The analysis included E. globulus, E. nitens × globulus (high- and low-yielding), E. nitens, E. badjensis, E. smithii, and E. camaldulensis × globulus, evaluated under irrigation (>75% field capacity) and drought (~25% above the permanent wilting point). The TBCF was estimated annually using a carbon mass balance approach, and productivity was assessed via the current annual increment (CAI). The results showed an average CAI of 27.4 $m^3 \cdot ha^{-1} \cdot yr^{-1}$ and a TBCF of 1204 $gC \cdot m^{-2} \cdot yr^{-1}$ under irrigation, while under drought, the CAI was reduced by 24% and the TBCF by 13% (to 17.5 $m^3 \cdot ha^{-1} \cdot yr^{-1}$ and 1036 $gC \cdot m^{-2} \cdot yr^{-1}$, respectively). E. smithii and E. nitens × globulus (high-yield) showed high stability, with CAI variations 10% and TBCF reductions 5%. In contrast, *E. globulus* and *E. nitens×globulus* (low-yield) exhibited >35% reductions in CAI and >20% in TBCF. A logarithmic relationship was observed between CAI and TBCF ($R^2 > 0.80$), with steeper slopes under drought, indicating increased belowground carbon allocation per unit of growth as the TBCF:CAI ratio increased from 44.0 under irrigation to 59.2 under drought, reflecting a shift in allocation strategy. These results suggest that under water-limited conditions, trees prioritize belowground functions (e.g., root activity and rhizosphere support), potentially at the expense of stem growth. These results highlight the functional trade-offs among genotypes and identify promising candidates for resilient carbon sequestration strategies under drought conditions.

Session 4. Big Earth Data for Land System Monitoring and Modeling

sciforum-126566: A Google Earth Engine-based Application for Monitoring Soil Moisture using Sentinel 1 Synthetic Aperture Radar Data

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This study took place in Perambalur district, Tamil Nadu, from September 2018 to January 2019, aiming to estimate and map soil moisture using Sentinel-1 C-band Synthetic Aperture Radar (SAR) data. Monthly dual-polarized (VV and VH) SAR images were collected along with simultaneous ground measurements using the gravimetric method during satellite passes. SAR data were processed using the SNAP toolbox to extract the backscattering coefficient (σ^0), which was correlated with local soil moisture and the incidence angle. VV polarization σ^0 values ranged from -14.28 dB to -2.47 dB and VH values from -21.84 dB to -9.04 dB. Multiple linear regression models were developed to establish empirical relationships between σ^0, the incidence angle, and soil moisture. The measured soil moisture levels displayed temporal fluctuations. October 2018 exhibited the highest variability (standard deviation ≈7.94) and an outlier value of 29.17%, likely due to uneven rainfall. January 2019 recorded the lowest average soil moisture (mean ≈5.04%) and the least variability, indicating stable, dry conditions. November 2018 had the largest sample size (30 observations) and showed moderate variability, while both September 2018 and January 2019 reflected relatively low moisture levels. A correlation analysis between observed soil moisture and SAR backscatter indicated that VV polarization consistently demonstrated a stronger association with ground measurements than VH. These empirical equations were integrated into a Google Earth Engine (GEE) tool for near real-time soil moisture visualization and monitoring. The GEE tool estimated soil moisture with a coefficient of determination (R^2) of 0.65 and delivered instantaneous spatial outputs. This study demonstrates that Sentinel-1 SAR data, particularly VV polarization, combined with cloud-based platforms like GEE, provides a reliable and scalable approach for real-time soil moisture assessment across agricultural landscapes.

sciforum-110544: Assessing the Sustainability of Land Use Changes and SDG15 in Greece

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Greece features a diverse landscape with significant land cover changes over recent decades, impacting sustainability components such as biodiversity, climate stability, and ecosystem services. Monitoring and mapping these changes are essential for informed land management. This research utilizes freely available satellite data (Remote Sensing) and open-source tools (QGIS and Excel sheets) to assess key metrics, including land cover change, productivity, and soil carbon storage. We also link these metrics to estimate the Sustainable Development Goal (SDG) 15, and the indicator SDG15.3.1, considering sustainable land use changes. The spatial synthesis of these metrics reveals areas of land improvement, stability, and degradation from 2010 to 2020, offering insights into Greece's historical land dynamics. Results highlight that most of the land remains in a stable state of “land sustainability,” but certain regions require targeted interventions to address degradation. Notably, urban expansion and intensive agriculture drive localized declines in ecosystem quality, while forest management and conservation policies contribute to stability and improvement. The methodology emphasizes transparency and replicability, with publicly available code and results tailored for Greece's unique environmental and socio-economic context. By aligning national efforts with SDG targets, this work supports policies for balancing economic growth with ecological resilience, ensuring the sustainable use of terrestrial ecosystems, and enhancing the quality of life for present and future generations in Greece.

sciforum-126260: Urban 3D Multiple Deep Base Change Detection by Very High-Resolution Satellite Images and Digital Surface Model

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Timely and accurate urban change detection is essential for supporting sustainable urban development, infrastructure management, and disaster response. Traditional 2D change detection approaches overlook vertical and structural alterations in dense urban settings. This study focuses on 3D multiple change detection in urban areas using high spatial resolution remote sensing imagery and digital surface models (DSMs) from two different time points, enabling the identification of both horizontal and vertical transformations. To address the complexity of urban changes, we developed a deep learning-based framework centered on Convolutional Neural Networks (CNNs) with various encoder architectures and customized loss functions. The input data consists of stacked multi-temporal optical images and corresponding DSMs, allowing the model to learn both spectral and elevation features. As part of a comparative analysis, we also implemented several traditional methods, including Principal Component Analysis (PCA), Change Vector Analysis with thresholding (CVA-thresholding), K-Means clustering, and a Random Forest classifier. An experimental evaluation was conducted on a high-resolution urban dataset, and performance was assessed using the F1-score, overall accuracy, and precision. The CNN-based models significantly outperformed the traditional methods, particularly in detecting complex and subtle structural changes that were otherwise missed. The best CNN model achieved an overall accuracy of 96.9%, an F1-score of 96.87%, and a recall of 95%. The integration of DSMs proved effective in capturing elevation-related changes, contributing to improved model sensitivity and classification performance. In conclusion, the proposed deep learning framework demonstrates strong potential for robust 3D urban change detection by effectively combining spectral and elevation data. While traditional methods offer useful baselines, the CNN-based approach provides superior accuracy and spatial detail, making it highly suitable for real-world urban monitoring applications.

Session 5. Land Use Dynamics and Socio-Ecological Systems: Modeling Across Scales

sciforum-134047: Community Approach to Sustainable Local Development

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The present study addresses the growing need for effective local sustainable development strategies by situating its inquiry within the interdisciplinary context of land system sciences, as well as the global framework of the United Nations Sustainable Development Goals. The research hypothesis is that the community approach, when integrated with institutional support, results in more legitimate, adaptive, and sustainable land system outcomes than those of the conventional top-down models. This research seeks to assess the transformative capacity of community-led approaches in influencing land use planning, resource management, and policy design. This study uses qualitative case studies, participatory action research, and a comparative policy analysis to systematically investigate how community-driven initiatives contribute to more resilient and adaptive socioeconomic systems. Data were collected from various localities actively engaged in participatory governance, ensuring robust representation of social, cultural, and ecological contexts. The findings indicate that community-led strategies not only foster social cohesion and economic diversification but also enhance the adaptive capacity for land–climate interactions. These strategies are more responsive and more inclusive than traditional governance models. A further analysis reveals that integrating local knowledge and participatory decision-making with institutional support produces more legitimate and sustainable outcomes. This study concludes that dynamic, context-sensitive frameworks that empower communities while leveraging institutional resources are necessary. This study provides practical guidance to policymakers and stakeholders seeking to advance sustainable and equitable land system transformations.

sciforum-133902: Classified forests under pressure: geospatial analysis of degradation dynamics in Northern Benin

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The forest complex Ouémé Supérieur–Wari Maro–Monts Kouffé in northern Benin constitutes an ecosystem of great ecological wealth but remains confronted with deforestation and accelerated degradation due to increasing anthropogenic pressures. This study aims to analyze the degradation hotspots in this complex through time and across space, highlighting human and infrastructural factors. To this end, an integrated methodological approach was mobilized, based on a diachronic analysis of multitemporal satellite images (from the years 1986 to 2024), coupled with remote sensing tools and geographic information systems (GISs). The results reveal a substantial increase in cultivated fields and fallows, from 454.12 ha (0.09% of the complex) in 1986 to 29,400.5 ha (6%) in 2024. Forest cover declined by 17.21% over the same period. Conversely, savannas expanded from 116,359.54 ha (23.73%) to 172,550.23 ha (35.19%). Land transformation processes, analyzed using Bogaert's decision tree, show continuous agricultural expansion, with the number of patches rising from 288 in 1986 to 2,742 in 2024. However, the 2024 pattern is marked by spatial aggregation rather than new patch creation, as indicated by the increase in the average patch size from 1.6 ha to 10.7 ha. Notably, a large share of these aggregated areas is located near roads, suggesting that accessibility plays a key role in land conversion. The linear regression between the proportion of fields/fallows and proximity to asphalt roads shows a determination coefficient R^2 of 0.72 with a p-value 0.01, indicating a strong and significant relationship. The fragmentation of the landscape is intensifying, particularly around asphalted roads, as well as unpaved ones. These findings highlight the need for a re-reading of protected forest management strategies, including better supervision of agricultural expansion, regulation of road developments, and increased involvement of local actors in environmental governance mechanisms.

sciforum-133953: Diachronic analysis of agro-forestry landscape in Latium region

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Despite rising demand for agricultural products, agricultural land abandonment is increasing, especially in developed countries, leading to recolonization by natural vegetation. This phenomenon impacts ecosystem services, biodiversity, and the economy, causing, for example, the loss of agrobiodiversity, soil erosion, and increased frequency and intensity of fires. Monitoring and understanding the drivers of agricultural abandonment are crucial for protecting historic landscapes. The aim of the study was to assess land use in the 1950s in areas of the Latium region that are currently classified as natural and semi-natural (about 736,000 hectares), and analyze the dynamics of renaturalized agroforestry landscapes. The diachronic land use analysis highlighted that approximately 76,700 hectares of today's wilderness areas were used for agriculture in the 1950s, with 70% consisting of arable land and 17% comprising complex cropping and farming systems. Grasslands covered more than 136,000 hectares, 57% of which are still preserved, while 40% have transitioned to forest or shrubland. Forest land use class increased from 25.59% in 1954 to 31.39% in 2006. The loss of agricultural land has significant implications for the economic sustainability of extensive livestock farming, the self-sufficiency of the food system, and also the proliferation of ungulates, a phenomenon that has become increasingly difficult to manage in Italy. At the same time, the loss of grasslands leads to the simplification of the landscape with a consequent loss of biodiversity. This phenomenon has also been observed in Natura 2000 sites, where around 30% of grasslands, including habitats of priority importance, have been lost. This decline highlights the critical challenges that must be addressed to achieve the goals of the “Nature Restoration Law”, which sets habitat restoration targets of 20% by 2030 and 100% by 2050, and the reduced capacity of these new simplified landscapes to provide ecosystem services.

sciforum-133834: Institutional Dynamics of Land Use in the Makazhoy Hollow Between the 19th and 21st Centuries

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The Makazhoy Hollow, a region of ecological and cultural significance in southeastern Chechnya within the Vedensky Zakaznik and Argun Museum-Reserve, exemplifies the interplay between traditional practices and evolving institutional contexts. This research investigates land use transformation stages in the Hollow, influenced by shifts in land ownership, economic strategies, and socio-cultural factors. Its contribution lies in informing sustainable master planning for mountainous areas, integrating heritage conservation with local economic growth.

Based on historical geography and landscape ecology methods, the study analyzed archival materials, cartographic sources, multi-temporal satellite imagery, and field data, including geobotanical descriptions and local interviews. Historical periodization identified key land use stages: traditional (19th–early 20th centuries), characterized by extensive animal husbandry and agriculture; Soviet (1920s–1980s), driven by ethnic resettlements and collectivization; post-Soviet (1990s–early 21st century), marked by regional conflict and land use decline; and modern (2000s onwards), associated with tourism and partial recovery. Institutional factors significantly shaped land use across these phases.

The study concludes that land use change in the Makazhoy Hollow is a complex process shaped by interacting environmental, economic, social, and institutional factors. Sustainable development requires integrating historical knowledge, preserving traditional livelihoods, promoting tourism, and creating effective land governance to protect natural and cultural heritage. The results inform sustainable development strategies and land-use planning in similar mountainous areas.

sciforum-128575: Integrating remote sensing and modeling to assess land use changes and carbon dynamics in the Indian Himalayas

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The Himalayan region is experiencing evident climate change and increasing human interventions, leading to rapid alterations in land use and ecosystem balance, which highlights the necessity for sustainable planning using geospatial technology. Therefore, this study utilised satellite imagery (Landsat series) and Google earth engine to analyze decadal land use dynamics (2003, 2013, 2023) using the random forest algorithm and carbon storage data from Hamirpur district of the Indian Himalayas. The findings indicated significant shifts in land use over the two decades: the vegetation cover declined from 67% in 2003 to 61% in 2023, followed by a decrease in barren land from 2.6% to 1.8%, while waterbodies remained relatively constant at around 0.5%. In contrast, built-up areas increased notably from 4.3% to 7.1%, grasslands nearly tripled from 1% to 2.7%, and agricultural land showed a slight overall increase, stabilizing around 27%. Future land use projections using the CA–Markov model indicated a gradual decline in vegetation cover (0.83%) and a steady increase in built-up areas (6.25%), while other land cover classes are expected to remain relatively stable over time. The carbon storage estimation using the InVEST model indicated carbon variation from 0 to128 Mg ha^{-1}, and there was a decline in areas with very high carbon levels (6%) and an increase in medium and high carbon classes. Overall, the observed changes in land use dynamics and a decline in areas with very high carbon storage in the region highlight the need for integrated land management practices, including afforestation, controlled urban expansion, and the conservation of existing green cover to ensure sustainable development and enhanced carbon sequestration.

sciforum-126290: Modelling the impacts of land-use change on Cultural Ecosystem Services

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Cultural Ecosystem Services (CESs), including recreation, aesthetics, and cultural identity, are vital to socio-ecological resilience but remain difficult to assess due to their intangible and spatially heterogeneous nature. This study presents a spatially explicit framework to evaluate the impacts of land-use and land-cover change (LULCC) on CES in the Alqueva region of southern Portugal—a landscape that is undergoing rapid transformation driven by irrigation expansion and agricultural intensification. Using a combination of geospatial modeling, participatory GIS (PPGIS), stakeholder consultation, and scenario analysis, we assess CES under a 2040 Business-as-Usual trajectory. The preliminary results indicate a progressive decline in key CES, particularly those linked to cultural heritage, recreation, and aesthetic values, due to landscape homogenization and the erosion of traditional Montado systems. Despite this trend, multifunctional landscapes within the current matrix continue to support CES provision, emphasizing the role of sustainable land management in maintaining cultural and ecological functions. Stakeholder feedback reinforces concerns over cultural loss, sense of place, and the weakening of local identity, supporting the integration of CES into spatial planning and ecosystem restoration. This study contributes a replicable, multi-scale methodology that combines qualitative and quantitative approaches, offering policy-relevant insights for aligning land-use dynamics with socio-cultural values and enhancing the role of CES in long-term landscape sustainability strategies.

sciforum-133923: Temporal Analysis of Groundwater Quality in the Harran Plain: Linking Land Use Change to Water Contamination (2005–2025)

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This study presents a comprehensive assessment of groundwater quality changes in the Harran Plain, one of Turkey's largest agricultural regions and a core zone of the Southeastern Anatolia Project (GAP), encompassing approximately 1,500 km². The research primarily aims to evaluate the impacts of intensive agricultural activity, evolving land use, and irrigation practices on groundwater pollution. Electrical conductivity (EC) and nitrate (NO_3^-) concentrations were selected as key indicators of water quality. Spatial distribution maps based on seasonal averages were generated for the years 2005 and 2015 using data collected from 24 observation wells across the plain and evaluated against international standards (the WHO and the EPA) for drinking and irrigation water. In 2005, several wells exhibited critically high contamination levels, with EC values reaching up to 8,235 µS/cm and NO_3^- concentrations exceeding 720 mg/L. By 2015, these values had significantly declined in most areas—down to 2,510 µS/cm for EC and 327 mg/L for NO_3^-—except in W11 (Uğurlu) and W14 (Kızıldoruk), where elevated levels persisted. These improvements are attributed to the implementation of closed drainage systems, adoption of pressurized irrigation methods, improved fertilizer management, and the introduction of more balanced and sustainable cropping patterns. Concurrently, a major transformation in land use was observed, including a shift from traditional cotton and grain farming to high-value, low-water-demand crops. However, the expansion of residential and industrial zones in certain areas introduced new environmental pressures, with some wells recording increased NO_3^- levels. Uncontrolled land development and irregular irrigation practices were identified as contributing factors. Moreover, the conversion of pasture and fallow lands into cultivated areas appears to have altered the groundwater recharge regime, impacting overall water quality. These findings highlight the critical role of integrated water–land policy approaches for sustainable groundwater management in arid agroecosystems.

sciforum-112509: Variations in Water, Energy and Emissions Driven by Land Use Changes in Greece

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Land use changes, and especially urbanization, significantly impact water and energy systems and the associated GHG emissions. However, studying these dynamics and their effects on coupled water–energy–emissions systems remains underexplored in certain countries. Greece has been slow to integrate these systems into data-driven models assessing their feedback. To fill this gap, this research investigates these dynamics in Greece from 2022 to 2050, combining different modelling approaches for the first time. A Remote Sensing analysis utilizing publicly available data and open-source tools (QGIS) was applied to map and monitor land use changes, including urbanization. Greece is a particularly interesting case study, as simultaneous population decline and increasing urbanization are reshaping key sectors of the developing urban centers, i.e., the residential and services sectors. To capture the complex feedback between urban centers with changing population and their water–energy–emissions responses, we coupled the LEAP (Low Energy Analysis Platform) model with the WaterReqGCH model. Thus, the energy consumption and the associated GHG emissions of the residential and services sectors, along with their water consumption, were simulated. The results reveal critical trends: population decline drives a reduction in overall water and energy consumption, and yet, despite these reducing trends, urban areas claim increasing shares of these resources over time. Similarly, decreasing GHG emissions exhibit shifts in pollutant distribution, with certain emissions holding larger shares in urban contexts. This integrated land–water–energy–emissions analysis underscores the value of holistic assessments in managing these systems sustainably and highlights the need to develop plans considering them as a whole. The provision of detailed information on such evolution patterns and feedback is critical to shaping integrated policies aiming at multiple benefits. By linking urbanization patterns with resource dynamics and environmental impacts, we discuss how our findings can be translated into actionable insights for sustainable urban planning and resource management strategies.

Session 6. Climate Action on Land Use

sciforum-137076: Climate-Smart Land Remediation: Using *Salix babylonica* for Natural Water Purification

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Land ecosystems are critical frontlines in the battle against climate change and play a critical role in combating environmental degradation and ensuring the sustainable use of natural resources. Their hydrological cycling capacity, pollutant cleaning function, and ecological balance recuperation ability make them irreplaceable when it comes to developing nature-based solutions for treating water and landscape restoration. In this context, the present research examines the potential of Salix babylonica (weeping willow), a fast-growing and easily accessed tree species, as a sustainable source of environmentally friendly biosorbents for water treatment. The biomass was processed to obtain fine powders of leaves and roots and assessed for adsorption potential for the removal of calcium (Ca^{2+}), magnesium (Mg^{2+}), and the synthetic dye Crystal Violet (CV) from polluted water. Structural and surface analysis through FT-IR and laser granulometry determined material appropriateness for adsorption. Batch experiments at varied pH values, temperatures, and contact times assessed performance. Root powder desorbed 79.5% Mg^{2+} and 72.3% Ca^{2+}, and leaf powder desorbed 43.2% and 70.0%, respectively. Both powders desorbed more than 80% CV in the best conditions. The results point to the influence of physicochemical conditions and place S. babylonica as a terrestrial climate-resilient biosorbent with the potential to help achieve circular land use and ecological rehabilitation in marginal or degraded land.

sciforum-134008: Environmental Impact Analysis and Climate Action: A Study of Advanced Decision-Making Techniques for Land Use and Urban Development.

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Urban development zones and their climate exhibit cyclical changes throughout the year. Climate change is linked to deforestation, vehicular emissions, industrial activity, and dust storms. The consequences of urban land use and transport system development, influencing local environmental quality in general, and air quality in particular, are well-known and alarming. So, an increase in pollutants in the environment affects human and animal health, along with leading to a continuous increase in temperature. Particulate matter with a diameter of less than 2.5 µm (PM2.5) is a ubiquitous air pollutant released by biomass burning, vehicle and cooking exhausts, industrial processes, and non-exhaust sources. Due to its small size, PM2.5 can penetrate both the upper and lower respiratory systems. The application of advanced decision-making tools is necessary to predict upcoming climate action and the increase in environmental degradation. This research examines the application of machine learning techniques in assessing the impact of environmental change. Deploying different algorithms helped in the prediction of concentrations of high-risk pollutants. Models were analysed and compared based on different parameters to observe the performance of the models. To address the need for emissions reduction for sustainable urbanisation and to improve air quality, innovative decision-making tools that can be used in practice are necessary. The experiences and needs of stakeholders in charge of urban gross pollutant emissions reduction were analysed through a dedicated device. Environmental Impact Analysis will help achieve sustainability goals, such as Climate Action (SDG13) and Good Health and Well-being (SDG3). The use of machine learning techniques will enhance the efficiency of environmental performance and urban development.

sciforum-126256: Adapting to Climate Change: Land Use and Livelihood Changes in Coastal Fishery households on the Central Coast of Vietnam.

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Climate change is an escalating global challenge with far-reaching impacts on ecosystems, economies, and communities worldwide. Having been identified as one of the most affected nations, Vietnam is facing the effects of climate stress, particularly in the coastal region. Coastal households in Vietnam are at the frontline of environmental and socio-economic change, increasingly challenged by climate uncertainty, resource degradation, and a shifting policy landscape.

This study explores how fishery households on the Central Coast of Vietnam are adapting to growing uncertainty through changes in land use and livelihood strategies. Based on empirical data from a survey of 300 households conducted on the Central Coast of Vietnam, the study finds a gradual but significant transition from traditional capture fisheries toward diversified livelihoods, including aquaculture, wage labor, and small-scale commerce. These adaptations are closely linked to land access and use transformation, often driven by ecological pressures such as saltwater intrusion, coastal erosion, and institutional responses.

The findings highlight uneven adaptive capacities across households, shaped by land tenure security, gender roles, access to credit, and local governance. This study contributes to understanding coastal transformation under climate stress and underscores the need for inclusive, context-sensitive policies to support adaptive resilience in vulnerable fishing communities.

sciforum-134273: Assessment of Wildfire Damage over Eaton Canyon, California, using Radar and Multispectral datasets from Sentinel Satellite and Machine Learning Methods

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Eaton Canyon, in California, serves as the focal point for a comprehensive post-wildfire ecological impact assessment. This study employs an approach integrating satellite imagery from the European Space Agency's Sentinel constellation to study an area of 271.49 ??2. The data encompasses both radar and multispectral data, offering a multi-dimensional view of the affected landscape. The analysis leverages the power of the Random Forest Algorithm. Firstly, three widely-used indices—the Difference Normalized Burn Ratio (dNBR), Relative Burn Ratio (RBR), and Relative Difference Normalized Burn Ratio (RdNBR)—were calculated and compared based on their accuracy and Kappa Index. Secondly, we developed a fusion approach to create a precise fire severity map by classifying the affected area into distinct severity classes. Thirdly, a separate fusion approach was developed utilizing the Normalized Difference Vegetation Index (NDVI), Radar Vegetation Index (RVI), and Modified Normalized Difference Vegetation Index (MNDVI) to classify and analyze the distribution of trees types before and after the wildfire, such as Schinus Molle, Handroanthus Heptaphyllus, Koelreuteria Bipinnata, and Platanus Racemose. The results showed a perfect 100%accuracy and Kappa Index in all the predictions. A percentage of 56.79% did not burn due to the topography of the Canyon creating natural firebreaks. Areas classified as low-severity (13.49%) showed minimal damage with minimal tree mortality. Moderate-to-low-severity areas (5.79%) represented regions with partial crown burn and some tree mortality. Moderate-to-high severity areas (3.57%) showed significant tree mortality. Finally, high-severity areas (20.36%), characterized by complete tree mortality and a significant loss of vegetation cover, were largely concentrated in specific sections of the canyon, likely influenced by factors such as slope and fuel type. These findings, corroborated by ground-truth data, provide valuable information for post-fire ecological recovery efforts and future land management strategies in Eaton Canyon and similar fire-prone landscapes.

sciforum-131978: Biomass Storage and Natural Regeneration in Sacred Groves of the North–Western Himalayas: A Study on Ecological Preservation and Environmental Benefits

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Sacred Groves are ecologically significant forest patches preserved through traditional beliefs and community-based conservation practices. They contribute to environmental sustainability by sequestering carbon, conserving native biodiversity, preventing soil erosion, enriching soil fertility, regulating hydrological cycles, supporting natural regeneration, and maintaining ecological connectivity. Therefore, the current study investigates the variation in tree biomass components and regeneration attributes across twelve Sacred Groves in Himachal Pradesh, India, within the north–western Himalayan region. The primary objective was to assess their contribution to conserving biomass accumulation potential and regeneration status with adjacent forests impacted by anthropogenic pressures. Twelve sites (S1–S12) were selected across elevations ranging from 1400 m to 3000 m, categorized into Sacred Groves and Adjoining Forests. This study found consistently higher biomass in Sacred Groves, with total biomass ranging from 280.09 to 1530.21 t ha^{-1} (mean 885.84 t ha^{-1}), compared to 341.56 to 967.96 t ha^{-1} (mean 593.20 t ha^{-1}) in adjoining forests. Sacred Groves also exhibited superior natural regeneration, with recruit densities ranging from 750 to 7,500 ha^{-1}, establishment rates from 25.49% to 183.72%, and regeneration success between 60% and 275%. These results underscore the ecological maturity, stability, and resilience of Sacred Groves, emphasizing their critical role in maintaining biodiversity, enhancing carbon storage, and providing essential ecosystem services. As such, Sacred Groves are vital for supporting long-term ecological health and mitigating the impacts of increasing anthropogenic pressures and climate change. Their preservation is crucial for sustaining the ecological balance in the region.

sciforum-133844: Canopy Cover for Cooler Cities: A Meta-Analysis of Urban Greening and Temperature Reduction Strategies

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Urban heat is one of the most pressing challenges facing cities today, exacerbated by climate change, population growth, and expanding impervious surfaces. Urban tree canopy cover has emerged as a key nature-based solution to mitigate the urban heat island effect by providing shade, improving evapotranspiration, and influencing local microclimates. This paper presents a meta-analysis of existing empirical and modelling studies that examine the relationship between canopy cover and urban cooling outcomes across diverse climatic and geographic contexts.

Drawing on the peer-reviewed literature from 2000 to 2024, the study systematically reviews and synthesizes quantitative findings on canopy density, spatial distribution, species composition, and their effects on surface and ambient temperature reductions. The meta-analysis reveals that increased canopy cover consistently contributes to cooling benefits, with temperature reductions ranging from 1°C to 6°C depending on urban morphology, canopy structure, and land use type. The analysis also highlights diminishing returns beyond certain coverage thresholds, the importance of equitable canopy distribution, and interactions between vegetation, built form, and socio-economic variables based on the findings from the current studies.

Key themes emerging from the analysis include the role of canopy cover in climate adaptation strategies, its integration into urban planning tools, and barriers to implementation such as land use competition, maintenance costs, and policy fragmentation. The paper concludes by identifying strategic opportunities to maximise the cooling benefits of urban canopy cover—particularly in vulnerable, high-density neighbourhoods—and by recommending urban greening policies that align with climate resilience, public health, and sustainability goals.

This meta-analysis contributes to the growing body of evidence supporting urban forestry as a cost-effective, scalable, and multifunctional solution for creating cooler, more liveable cities in the face of accelerating urban heat challenges.

sciforum-133155: CNN-Based Insect Detection Using YOLO for Resilient Agricultural Systems

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Recently, convolutional neural networks (CNNs) have emerged as powerful tools across various domains, such as computer vision, audio processing, and text analysis, thanks to their outstanding performance in cutting-edge applications. In this study, we propose a CNN-based system for detecting harmful insects in agricultural fields, leveraging specialized datasets. Our approach utilizes the capabilities of three YOLO architectures, incorporating advanced techniques in deep learning and computer vision. In our work, we focus on four selected classes from the standard IP102 benchmark dataset for pest recognition, Black Cutworm, Red Spider, Aphids, and Flea Beetle, due to their significant impact on crop health and productivity. We propose a convolutional neural network (CNN)-based architecture using "You Only Look Once" (YOLO), specifically YOLOv5, YOLOv10, to process and evaluate our model. During training, the models achieved mAP scores of 83% for YOLOv5 and 86% for YOLOv10. Our experiments yielded high test accuracies, exceeding 92% for YOLOv5 and YOLOv10. The goal is to reduce pesticide usage, enable timely preventive actions, and mitigate economic losses by predicting infestations, supporting rapid interventions, and promoting sustainable agricultural practices through smart farming technologies. However, the application of CNNs to pest detection in agricultural contexts remains underexplored, particularly within the broader framework of climate action, sustainable land use, and resilient agricultural systems.

sciforum-131987: Comparison of Crop Water Consumption Estimations under Drought Conditions Using Different Methods: A Case Study from Central Anatolia, Türkiye

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This study evaluates crop water consumption and irrigation requirements in Eskişehir, located in the semi-arid Central Anatolia region of Türkiye, by comparing three widely used estimation methods. Seasonal crop evapotranspiration (ETc) and net irrigation water requirement (NIWR) values were calculated for the period 2016–2022 using (i) the Blaney–Criddle method (State Hydraulic Works, DSİ), (ii) the CROPWAT 8.0 model, and (iii) the locally developed SuET software, both based on the Penman–Monteith approach. A drought scenario was also constructed using the climatic averages of the region's driest recorded years (1994, 1995, 2007, and 2008).

The findings reveal considerable discrepancies among methods. For maize, the average NIWR was 377.5 mm according to DSİ, whereas CROPWAT and SuET yielded higher values, averaging 639.7 mm and 619.7 mm respectively. Similar differences were observed for alfalfa (NIWR: DSİ 503.5 mm, CROPWAT 789.2 mm, SuET 734.8 mm) and sunflower (DSİ 288.5 mm, CROPWAT 559.8 mm, SuET 636.4 mm). Under drought conditions, ETc values increased sharply. For example, CROPWAT estimated ETc for sunflower as 772.3 mm in 2016, rising to 927.3 mm in the drought scenario; SuET estimates rose from 708.9 mm to 752.1 mm.

The use of well-established models such as CROPWAT and SuET—both based on the validated FAO Penman–Monteith method—ensures methodological consistency and comparability. The inclusion of DSİ's Blaney–Criddle-based institutional records enables practical benchmarking and enhances the relevance of the findings.

These results emphasize the need for adaptive irrigation planning and provide crucial insights for improving water allocation strategies in drought-prone regions of Central Anatolia.

sciforum-123722: Effects of the phenomenon of diffuse territorial anthropization in the context of climate change on the Mediterranean coast during the last decade: from the environmental disaster of the Mar Menor of 2015 to the floods of 2024 in Valencia

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The negative effects associated with territorial transformation have become one of the key variables of planetary imbalance in the current context of climate change. Environmental disasters, floods, droughts, etc., are often the unexpected result of poor territorial management, causing environmental damage or even resulting in the loss of human life. This complex and sometimes difficult-to-detect phenomenon, known as diffuse territorial anthropization, has behavioral patterns whose cause–effect relationships are not always easy to assess. However, this problem exists in a diverse catalog of highly evident situations in developed European countries, especially on the Mediterranean coast. This paper reviews case studies that have occurred in this area over the last decade. By observing spatiotemporal GIS patterns and using geostatistical analysis, it is evident how unbalanced growth and transformation processes in land use have contributed to increasing territorial vulnerabilities, causing serious environmental problems or catastrophic flooding episodes. This study will explore the serious environmental problems that emerged in 2015 in the Mar Menor coastal lagoon, located in southeastern Spain, as a result of changes in land use in its watershed, which shifted from traditional dryland agriculture to intensive irrigated agriculture. It will also explore the recent flooding in southern Valencia, which caused more than 200 deaths by 2024. This problem is largely influenced by the transformation of the area's territory in recent decades.

sciforum-134055: Effects of Urban Growth and Industrial Expansion on Climate Change

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Urban expansion and industrial development are pivotal drivers of climate change, amplifying greenhouse gas emissions and altering both local and global climate systems. Rapid urbanization is linked to increased energy consumption, urban heat island effects, and changing precipitation patterns, as seen in metropolitan areas such as Bursa and Baghdad. While industrial growth promotes economic advancement, it significantly elevates carbon emissions, often surpassing mitigation efforts. Land-use policies that favor automobile-centric growth further intensify transportation emissions, undermining technical solutions. To examine these interconnected dynamics, this study adopts a conceptual and theoretical approach, developing an analytical framework to assess how energy systems, transportation networks, and land-use patterns influence emissions and climate vulnerability. Emphasizing systemic linkages rather than isolated elements, the analysis reveals that industrial expansion accelerates carbon emissions beyond current mitigation capacities, while urban sprawl heightens heat island effects. Although practical implementation is constrained by socio-economic and governance barriers, conceptual modeling suggests that integrated land-use strategies, low-carbon infrastructure, and adaptive urban planning could substantially reduce climate risks. These findings underscore the urgent need for comprehensive policies that address both immediate and long-term consequences. Transitioning toward decarbonized economies, sustainable urban planning, and diversified energy portfolios is critical to ensuring environmental resilience in an increasingly urbanized world.

sciforum-135975: Evaluating Pluvial Flood Risks in the Area of Delhi: The Case of Kamla Market Circle, Delhi, India

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The National Capital Territory of Delhi in India is a rapidly metropolitanized city, and like many others, it faces the risk of urban flooding. The city experiences pluvial flooding, a phenomenon where stormwater drainage systems are unable to handle the volume of water from heavy rainfall and is highly vulnerable to both riverine and urban flooding, posing significant threats to public health, infrastructure, and the local economy. Recent data from the Delhi Traffic Police indicates an increasing frequency of waterlogging incidents in this area between 2011 and 2021. This paper examines the flood risks and identifies parameters that exploit the vulnerability of an area to pluvial flooding, using the case of Kamla Market Circle in the central district of Delhi. It is a densely populated area in the district that has recently become prone to stormwater flooding. The research employs a literature study and field surveys to investigate these factors. The key parameters analysed, such as the degree of urbanisation, shifts in land-use, the capacity and performance of the stormwater drainage system, usage patterns by the local community, and the microtopography of the Kamla Market Circle, may have collectively contributed to the area's heightened vulnerability to pluvial flooding. The findings show that drainage inefficiencies and disruptions to the natural slope due to altered microtopography are the most critical contributors to recurring water accumulation. Moreover, informal modifications to streetscapes and inadequate waste management exacerbate localised flooding. A few context-specific interventions, such as improving surface permeability and regular drainage maintenance, are briefly discussed. This paper presents potential mitigation strategies to address the identified pluvial flood risks in the Kamla Market Circle of Delhi. By offering a comprehensive understanding of the area's flood vulnerabilities, the research aims to support the development of effective, location-specific flood management approaches for this high-risk urban zone.

sciforum-116816: How can we effectively plan urban green infrastructure to address environmental and social crises?

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The benefits of nature exposure on human health, mental well-being, and overall quality of life are widely recognized. In urban environments, public green spaces play a crucial role in mitigating climate change, improving air quality, restoring biodiversity, and addressing social challenges such as poverty, inequality, and minority segregation while fostering a reconnection with nature. This study investigates the social and environmental services provided by five distinct public green spaces in Faro, Portugal, varying in typology and vegetation density. To explore these dynamics, we employed two complementary methodologies. First, a survey was conducted among a random sample of 300 Faro residents to assess personal characteristics, health and well-being, perceptions of key green spaces, visitation frequency, and the perceived impact of these visits on individual well-being. Simultaneously, field assessments combined with satellite imagery allowed for a detailed inventory of tree species within the selected green spaces, including measurements of trunk circumference and conservation status. The collected data was analyzed using the My-tree tool to quantify key ecosystem services, such as carbon sequestration, stormwater regulation, and air pollutant removal. Results indicate that green spaces with higher tree density and significant blue infrastructure positively influence residents' well-being. Among them, Mata do Liceu was identified as the most effective in mitigating climate change. Moreover, findings suggest a negative correlation between self-rated stress levels and the frequency of visits to green spaces, reinforcing the crucial role of urban nature in promoting mental health.

sciforum-124525: Impact of Climatic Parameters on the Dynamics of Changes in the Algerian Steppe of Naâma: A Machine Learning and GIS-Based Approach.

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The Algerian steppe has undergone significant land cover changes over the past decades, under the combined influence of human, animal, and climatic factors. This study aims to monitor and manage these dynamics using advanced tools such as Geographic Information Systems (GISs), remote sensing techniques, and machine learning approaches. Two steppe regions in southwestern Algeria—Naâma and Mécheria—were selected as study areas.

The adopted methodology includes characterizing the study area's climate through an aridity index, based on two key climatic variables: temperature and precipitation. A diachronic analysis of land use/land cover changes was conducted using Landsat satellite imagery from 1987 and 2019.

The results reveal a marked increase in sandy areas, which accounted for 46% of the total surface in 2019 compared to 32% in 1987. Conversely, rangelands experienced a significant decrease from 41% to 24% over the same period. This pattern suggests a degradation of grazing lands that has contributed to the encroachment of sandy zones. Agricultural and urban areas remain marginal (less than 1%), as do chotts and reforestation zones, which represent 1.81% and 2% of the total area, respectively, in 2019.

These findings highlight the influence of climatic conditions, particularly temperature and precipitation, on land cover dynamics. This dynamic is interpreted as the result of erosion and sand encroachment processes, particularly affecting the Naâma region

sciforum-126643: Implementing Nature-Based Solutions for Flood Risk Management in Urban Coastal Areas: A Synthesis of Evidence and Approaches

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Urban coastal areas face increasing flood risks due to climate change, sea level rise, and rapid urbanization. Traditional engineering solutions may not always be cost-effective, sufficient, or sustainable in addressing these complex and evolving challenges. As a result, Nature-based Solutions (NbSs) are gaining recognition as multi-functional approaches that work with natural systems to enhance coastal resilience and reduce vulnerability. This paper synthesizes current evidence and emerging approaches to implementing NbSs for flood risk management in urban coastal areas of the Nile Delta Region, drawing on interdisciplinary case studies, the scientific literature, and policy analyses. The study examines how NbSs contribute to flood mitigation while delivering a range of co-benefits, including improved environmental quality, enhanced urban planning, and strengthened community resilience. Additionally, NbSs offer long-term, adaptable, and cost- effective strategies that can complement traditional infrastructure. Key factors for successful implementation include inclusive stakeholder engagement, adaptive governance structures, and integrated planning across urban and ecological systems. However, barriers such as funding constraints, land use conflicts, limited technical capacity, and institutional fragmentation continue to hinder widespread adoption. This study presents a comprehensive framework to guide policymakers, urban planners, and practitioners in integrating NbSs into flood risk strategies. The findings emphasize the importance of context-specific, evidence-based, and inclusive approaches that align ecological functions with urban development goals, promoting more sustainable and resilient coastal urban futures.

sciforum-122914: Metropolitan Water Resilience: Resilient Urban Planning Strategies for Climate Challenges

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Cities face increasing water shortages due to climate change, intensified by rapid urban growth and rising consumption. Addressing these challenges requires integrated urban planning strategies that combine land-use decisions with sustainable water resource management. This dual approach is essential for balancing water availability with growing urban demand, particularly under conditions of climatic uncertainty. Integrated frameworks promote resource efficiency, stakeholder participation, and equitable distribution—principles that are central to sustainable urban development. This research evaluates the impacts of climate change on water resources at the metropolitan scale, investigates how rapid urbanization interacts with escalating water demand and climate variability, and compares management strategies across three different socio-environmental contexts to identify best practices. We also examine the role of demographic dynamics, spatial distribution, and governance in shaping water availability and access. Our methodology integrates geospatial analysis, policy review, and stakeholder consultation. GIS tools are used to map urban expansion, water infrastructure, and vulnerability zones using multi-temporal satellite data and hydrological stress indicators. Planning regulations and legal frameworks are analyzed to evaluate institutional coherence and identify areas for policy alignment. Semi-structured interviews with planners, engineers, and community stakeholders in Marrakesh, Amman, and Bucharest provide insights into local adaptation strategies and governance practices. Building on this interdisciplinary approach, we propose a planning methodology to strengthen water resilience in metropolitan areas, applying findings from Marrakesh and Amman to inform future strategies for Bucharest. These cities face shared pressures from water scarcity, climate change, and complex socio-economic dynamics. This study aims to enhance the resilience of urban water systems; improve efficiency and sustainability in water use; provide equitable access across social groups; increase institutional capacity for adaptive governance; and provide urban growth models that integrate environmental, social, and economic priorities to proactively address future water challenges.

sciforum-132667: Quantifying the Impacts of Climate Stress on Vegetation and Land Use in Sylhet Through Geospatial Analysis

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Climate stress is increasingly affecting how vegetation grows and how land is used, especially in regions like Sylhet. This study explores these changes by combining climate data with satellite imagery to understand how shifts in temperature and rainfall over the past decades have influenced the area's natural and built environments. We used climate records from the Bangladesh Meteorological Department alongside satellite-based vegetation indices (NDVI) and land use classifications derived through advanced image processing and GIS techniques. Landsat imagery from 1988 to 2025 was analyzed to calculate NDVI and assess land cover changes. Results indicate that average temperature increased during this period, while rainfall maintained a steady trend. Dense vegetation declined significantly, with more than 38 km² converted to sparse vegetation and about 7.6 km² transformed into urban areas. Additionally, sparse vegetation loss to urban and barren land exceeded 140 km², reflecting rapid urban expansion and growing anthropogenic pressure on natural ecosystems. Our findings reveal that rising temperatures and changing rainfall patterns have led to a noticeable decline in vegetation health and forest cover. At the same time, urban areas in Sylhet, particularly Sylhet Sadar, have expanded, increasing impervious surfaces. The growth of urban areas shows a scattered pattern that becomes more compact over time, shaped by population growth and the region's topography. Statistical analysis confirms that higher temperatures negatively impact vegetation, while fluctuations in rainfall and expanding urbanization contribute to wetland loss and degradation of agricultural lands. This study highlights how climate and human activities are intertwined in shaping land use and vegetation in Sylhet. It emphasizes the need for ongoing monitoring using geospatial tools and adopting land management strategies that can help the region adapt and build resilience against these environmental stresses.

sciforum-129411: Rainfall–Runoff Simulation Using the HEC-HMS and a GIS for Climate-Resilient Watershed Management: A Case Study of the Mangla Watershed, Pakistan

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Due to climate change, runoff simulations and understanding the relationship between rainfall and runoff are of great importance. Various hydrological models have been developed and used to simulate runoff in multiple watersheds in different parts of the world. This study combined a Geographic Information System (GIS) and the Hydrologic Engineering Centre-Hydrologic Modeling System (HEC-HMS) to simulate rainfall-based runoff for the Mangla watershed. This study used a digital elevation model (DEM), freely available satellite-based soil and land use and land cover data, rainfall data for the catchment delineation, and hydrological modeling using the GIS and the HEC-HMS. In the HEC-HMS, different parameters were used for the simulations, like the Soil Conservation Service (SCS)'s Curve Number loss method, the SCS's Unit Hydrograph transform method, the recession baseflow method, and the Muskingum reach routing method. The climate data was obtained from the Pakistan Meteorological Department (PMD), and the hydrological data was obtained from the Water and Power Development Authority (WAPDA). The model was manually calibrated from 1991 to 2000 and validated from 2001 to 2010. This study revealed the direct rainfall-based runoff modeling for the watershed using the HEC-HMS model. The model's efficiency was tested based on its statistical parameters, like the root mean square error (RMSE), standard deviation, Percent Bias, and Nash–Sutcliffe efficiency. The Nash–Sutcliffe efficiency for calibration and validation was 0.919 and 0.945, respectively. The results of this study suggest that the hydrological modeling using the HEC-HMS for the Mangla watershed could be applicable to future work on rainfall-based runoff modeling, and to reduce the impact of floods, it is crucial to have strong flood protection measures and emergency response strategies.

sciforum-126340: Recent trends in global tropical forest loss: Implications for climate, biodiversity, and disaster risk reduction

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Tropical forests are vital for achieving global sustainability, biodiversity, and climate goals. However, despite their social-ecological importance, tropical forest loss (TFL) remains a critical issue. This study addresses three fundamental yet important questions. First, how do TFL rates at the global and regional levels compare between the periods before (2011–2015) and after (2016–2022) the adoption of the SDGs and the Paris Agreement? Second, how do TFL rates across these periods relate to indexes of key ecosystem functions and services—namely, climate change mitigation (MIT), biodiversity conservation (BIO), and disaster risk reduction (DRR, specifically landslides)—and their co-benefits (CBI)? Third, how do TFL rates and these indexes relate to existing protected areas (PAs)? Using remote sensing-derived data and spatial analysis techniques, the results reveal a 34% increase in the global average annual TFL between the two periods, with significant increases observed in South America and Africa. Areas with moderate CBI experienced higher TFL rates in both periods. Although tropical PAs have expanded and are generally located in areas with higher CBI, their effectiveness in curbing TFL has been limited. The average annual TFL within tropical PAs rose significantly by 71% between the two periods. Furthermore, the average annual share of forest loss within tropical PAs, relative to the total TFL in the tropics, also increased significantly by 27%. Nonetheless, signs of a global slowdown in annual TFL rates after 2015 offer hope for reversing these trends. Fully achieving this reversal, however, requires transforming the enabling environment that sustains global TFL by strengthening national policies and effectively implementing international initiatives for sustainable forest management.

sciforum-134436: Reforestation with Denden Trees (*Elaeis guineenses*): Mitigation and Adaptation to Climate Change in Bahia, Brazil

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Currently, significant global concerns about climate change and pressures against biodiversity reduction in tropical ecosystems have favored the expansion of perennial crops. Reforestation with oil palms (*Elaeis guineenses*, Jacq.) can contribute to climate change mitigation by increasing forest areas that can actively sequester carbon dioxide from the atmosphere. With a productivity of 4 to 6 tons of oil/ha/year, oil palm has the greatest economic potential among oilseeds. In 2020, Brazil reached the 580,000-ton mark, ranking second in Latin America. In this sense, oil palm stands out among agro-industrial crops as an excellent agricultural option because it incorporates previously deforested and abandoned areas into the production process, helping to reduce pressure on deforestation in tropical regions. Furthermore, the plant matter produced annually by oil palm contributes to carbon recycling and sequestration, as well as the release of oxygen. The objective was to quantify biomass stocks and fixed carbon by analyzing carbon content and dry biomass. The study was carried out on a 320 ha oil palm plantation, where 15 representative palm trees were selected and divided into compartments: trunk, edible part (heart of palm), roots, foliage, and inflorescence (clusters and fruits). The average fixed carbon content for clusters and fruits was 49.5%; roots, 45.5%; foliage, 42.8%; stem, 41.2%; and edible part, 39.6%; with a weighted average of 43.1%. A 15-year-old cocoa crop produces an average of 354.32 ± 335.52 kg of dry cocoa beans.ha^{-1}.year^{-1}, storing an average of 16.05 ± 23.56 MgC.ha^{-1}. In Mimosa caesalpiniifolia, the carbon stock is 6.5 MgC.ha^{-1}. yr^{-1}, and in acacia, 5.8 to 6.45 MgC.ha^{-1}.yr^{-1}. Despite the small variation in carbon content, there were statistical differences. The total carbon immobilized by the shoot was 17.12 t ha-1. From the information provided above, it can be seen that the oil palm crop effectively participates in CO^2 cycling and fixation.

sciforum-133433: Revealing the Underreported Carbon Emissions of Lifestyle Blocks in New Zealand

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Introduction

Nearly 53% of New Zealand (NZ)'s total greenhouse gas (GHG) emissions come from the agricultural sector, of which over 90% are from livestock. Lifestyle blocks (LBs), which have been growing in popularity in NZ over the last 20 years, are semi-rural properties (0.5–50 ha) that typically prioritise lifestyle aspirations over production and commercial gains. As a result, their owners demonstrate a strong behavioural preference for keeping livestock for recreational or personal purposes. These livestock are often underreported and frequently excluded from national GHG emission inventories. Existing research has roughly estimated that including them could increase NZ's total carbon emissions by 1–2%. However, detailed data on livestock and management practices on LBs remain limited, making it difficult to accurately assess their contribution to national carbon budgets and environmental impacts.

Methods

This article presents insights from a national survey of LB owners, which collected detailed information on livestock keeping, land use practices, resource consumption behaviours, and sustainability engagement. Data were analysed using a carbon footprint framework across four key environmental factors, water, carbon, land, and biodiversity, to reveal their potential challenges and contributions.

Results and Conclusions

Findings reveal that 93% of respondents keep at least one type of livestock, and 77% own high-emission animals such as sheep and cattle. These animals are primarily raised for long-term personal enjoyment rather than meat production, resulting in a carbon footprint pattern that differs from traditional, production-oriented livestock farming. Nonetheless, LB owners generally show strong environmental awareness, engaging in sustainable land management practices like composting, manure reuse, and rainwater harvesting, as well as biodiversity conservation efforts like native tree planting and weed control. These positive actions can significantly offset livestock-related carbon emissions. With appropriate financial incentives and technical knowledge support, LB owners could contribute more meaningfully to climate change and NZ's broader sustainability goals.

sciforum-126489: Wildfire Damage Assessment over Eaton Canyon, California, using Radar and Multispectral datasets from Sentinel Satellites and Machine Learning Methods

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Eaton Canyon in California serves as the focal point for a comprehensive post-wildfire ecological impact assessment. This study employs an approach integrating satellite imagery from the European Space Agency's Sentinel constellation to study an area of 271.49 〖km〗^2. The data encompasses both radar and multispectral data, offering a multi-dimensional view of the affected landscape. The analysis leverages the power of the Random Forest Algorithm. Firstly, three widely used indices—the Difference Normalized Burn Ratio (dNBR), Relative Burn Ratio (RBR), and Relative Difference Normalized Burn Ratio (RdNBR)—were calculated and compared based on their accuracy and Kappa Index. Secondly, we developed a fusion approach to create a precise fire severity map by classifying the affected area into distinct severity classes. Thirdly, a separate fusion approach was developed utilizing the Normalized Difference Vegetation Index (NDVI), Radar Vegetation Index (RVI), and Modified Normalized Difference Vegetation Index (MNDVI) to analyze the distribution of vegetation before and after the wildfire. The results showed a perfect 100% accuracy and Kappa Index in all the predictions. A percentage of 56.79% did not burn, due to the topography of the canyon creating natural firebreaks. Areas classified as low severity (13.49%) showed minimal damage with minimal tree mortality. Moderate- to low-severity areas (5.79%) represented regions with partial crown burn and some tree mortality. Moderate- to high-severity areas (3.57%) showed significant tree mortality. Finally, high-severity areas (20.36%), characterized by complete tree mortality and significant loss of vegetation cover, were largely concentrated in specific sections of the canyon, likely influenced by factors such as slope and fuel type. These findings provide valuable information for post-fire ecological recovery efforts and future land management strategies in Eaton Canyon and similar fire-prone landscapes.

Session 7. Resilient Agricultural Landscape Systems

sciforum-126521: Reintegrating agriculture into the urban fabric: resilience and land sustainability through urban and peri-urban farming in Morocco

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Introduction

Urban and peri-urban agriculture (UPA) in Morocco is increasingly recognized as a strategic response to rapid urbanization, climate change, land degradation, and growing food insecurity. In metropolitan areas such as Rabat, Casablanca, and Meknès, UPA contributes to ecosystem services, food sovereignty, cultural heritage preservation, and inclusive livelihoods, particularly benefiting women and youth.

Methods

This study employed a spatial analysis of urban growth patterns and land use data, complemented by qualitative fieldwork, including stakeholder interviews and case studies, conducted in selected Moroccan cities. A socio-economic and agroecological assessment was also carried out to evaluate the multifunctional roles of UPA and its contribution to sustainable land systems.

Results

The findings show that UPA significantly reinforces the urban–rural continuum by buffering against land fragmentation and promoting sustainable land practices. Traditional agricultural knowledge, when combined with agroecological principles, enhances system resilience and resource efficiency. However, urban expansion, insecure land tenure, and water scarcity remain critical constraints. Governance gaps and limited policy integration hinder the scaling of UPA further.

Conclusions

UPA represents a valuable land use strategy to support local food systems, restore degraded landscapes, and improve urban resilience to climate change. Institutional recognition and integrated urban planning are essential to unlock its full potential. This work contributes to global dialogues on sustainable land systems and aligns with the UN SDGs 2, 11, and 15, responding to the global call for interdisciplinary approaches to land system sustainability in the Global South.

sciforum-132907: A Comparative Analysis of the Popularity of Regenerative Agriculture Practices in Poland, Germany, and Belarus

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Facing growing challenges from climate change and soil degradation, regenerative agriculture is emerging as a promising land management approach. It focuses on increasing soil organic carbon, improving soil health, and enhancing biodiversity—key factors for reducing greenhouse gas emissions and adapting to climate change. Although no single definition exists, regenerative agriculture commonly includes practices such as reduced tillage, cover cropping, diverse crop rotations, minimizing agrochemical use, applying organic fertilizers, and integrating crop–livestock systems. While the carbon sequestration benefits of these practices are well documented, there is limited knowledge about their actual adoption across different regions. This study aimed to evaluate the prevalence of regenerative agriculture practices and compare their implementation on farms in Poland, Germany, and Belarus. A survey was conducted among active farmers, covering the characteristics of the respondents and the farms they are associated with, as well as the frequency of specific soil-enhancing activities. Data analysis revealed varied adoption levels across the three countries, reflecting differing local conditions and approaches. Preliminary results suggest that although the awareness of regenerative agriculture exists everywhere, its practical use varies among countries. These insights improve the understanding of the current state of regenerative agriculture in the region and highlight disparities likely influenced by agricultural policies, support availability, educational backgrounds, and socio-economic factors. Recognizing these differences is essential for developing effective strategies to promote regenerative agriculture throughout Central and Eastern Europe.

sciforum-134144: Agroforestry Systems: Biodiverse, Resilient, and Productive

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There are diverse opinions on the best way to achieve a sustainable, productive, and resource-efficient agriculture, generating ecosystem services and providing sufficient food for present and future generations, in times of climate change, which threatens the biodiversity of Brazilian biomes, with a particular emphasis on those predominantly forested and with greater species richness and endemism. Agroforestry systems capable of meeting the challenges of a rapidly changing world require at least six of the agroecological principles that constitute the defining elements of Green Agriculture. The objective of this study was to understand the resilience of biodiverse agroforestry systems. The work was conducted in five grassroots communities of the Agroecological Network in Bahia, Brazil, where resilience indicators were assessed based on three dimensions of analysis: farmers' perceptions of climate change; vulnerability measurement; and response and recovery capacity. Ecological indicators involving ecosystem stability, resilience, and reliability were used to assess the ecological functionality of an agroforestry system in Bahia. The methodology used was MESMIS, a Framework for Assessing the Sustainability of Natural Resource Management Systems Incorporating Sustainability Indicators. Reference values were obtained based on the literature on similar reference fragments. The SAF achieved 27 of the 36 ideal reference parameters and demonstrated an intermediate functionality of the area, with high results for the Stability and Resilience attribute and low values for the Reliability attribute. However, these results are consistent with the age of the area, which is a secondary forest. Future monitoring of lagged factors can help track the return of these processes over time.

sciforum-133499: An Integrated Geospatial Framework for Assessing Agricultural Suitability Using Multi-Source Environmental Criteria

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Achieving sustainable farming in dry and semi-dry areas depends on accurately identifying optimal land zones by evaluating environmental factors. This research presents a combined approach merging object-oriented image processing with pixel-level modeling to evaluate farming land suitability in Iran's Anjir Plain. By employing Landsat-9 satellite data, 525 spatial units were created via multi-scale segmentation, ensuring boundaries matched natural terrain characteristics. Eleven environmental criteria related to water, climate, and terrain were normalized and combined using the Ordered Weighted Averaging (OWA) method to generate a suitability score (0–1) for each unit.

Findings revealed that altitude (r = 0.8), soil composition and bedrock (r = 0.7), and nearness to groundwater sources (r = 0.7) had the strongest positive correlation with farming suitability, whereas local climate conditions and temperature variables exhibited adverse effects. Merely 7 spatial units, spanning about 8,670 hectares, surpassed the high-suitability benchmark of 0.9, marking them as prime areas for agricultural expansion. Validation using 40 randomly sampled field data points yielded 90% accuracy and an 80% Kappa score. The combined method improved both classification precision and spatial consistency, ensuring better conformity with actual land divisions.

These outcomes highlight the efficacy of blending object-based analysis and OWA for pinpointing feasible agricultural lands, especially in water-limited settings. The framework serves as a practical planning aid for optimizing land use and managing farming resources in arid regions.

sciforum-138561: Assessment of agrobiodiversity status in the north of Iran

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Introduction

Loss of biodiversity in agroecosystems is considered a significant problem. Therefore, to protect this biodiversity, policies that are consonant with and strategically support ecosystems should be considered. Given the importance of biodiversity in sustainable agricultural systems and the observed agricultural variability in Guilan Province over the past two decades, this study was conducted to determine the biodiversity variability of crop and horticultural species in Guilan Province, northern Iran.

Methods

The data were classified into different groups: cereals, industrial crops, pulses, forage crops, orchards, and vegetables. All raw data were entered into Microsoft Excel (version 2013) based on region and year. Subsequently, several biodiversity indices—including Shannon–Wiener, Margalef, Menhinick, Simpson, richness, evenness, and Berger–Parker—were calculated.

Results

The results revealed significant variation in agrobiodiversity indices within Guilan Province during the study period. For instance, the Shannon–Wiener index for crop species increased from 0.62 to 0.66, while for horticultural products, it increased from 1.82 to 1.97. This increase was notably higher for horticultural products compared to crop species. The findings also indicated that Guilan Province does not exhibit an optimal situation concerning the Shannon–Wiener index, and from the perspective of cultivated species, there was relatively high similarity among townships. A significant factor contributing to the shift in dominance among horticultural species was the expansion of kiwi and citrus cultivation in the province.

Conclusions

Overall, these results suggest that species diversity in Guilan Province was low in most townships. The trend of changes in the indices demonstrated that biodiversity in many regions decreased from 1998 to 2014, in some cases reaching its lowest level. Therefore, methods such as cultivating diverse varieties of crops and horticultural species, implementing crop rotation, and employing intercropping strategies could be utilized to enhance the sustainability of agroecosystems in this province.

sciforum-127843: Eco-physiological Modeling of *Gmelina arborea* for Adaptive Plantation Design and Landscape Restoration

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The utilization of fast-growing exotic species within degraded tropical landscapes presents a significant opportunity to restore ecosystem services whilst sustaining productive land uses. *Gmelina arborea,* which has been extensively cultivated in Central America, emerges as a promising candidate for sustainable plantation forestry, contingent upon management practices that prioritize resource efficiency and climate resilience. In this research, we undertook the calibration of the 3-PG (Physiological Principles Predicting Growth) model utilizing multi-site field data from northern Costa Rica to simulate growth, canopy dynamics, and water use patterns under a variety of climatic and edaphic conditions. The model demonstrated a high degree of accuracy, with prediction errors remaining below 5% for diameter and above-ground biomass distribution, and under 10% for leaf area index (LAI) and total stem volume. These findings reveal a propensity towards slight underestimation, albeit within acceptable margins for operational application. Additionally, the model exhibits considerable potential for genotype-level calibration, facilitating its deployment in selecting drought-resilient planting material and designing silvicultural practices that mitigate mortality risks under water-scarce conditions while enhancing the efficiency of water and nutrient utilization. In summation, the 3-PG model constitutes a valuable instrument for assessing species adaptability under prospective climate scenarios and optimizing plantation management or genetic selection in regions susceptible to drought. Its integration into landscape planning enhances the efficient allocation of natural resources, contributes to carbon sequestration, and advocates for restoration strategies that eschew competition with natural ecosystems.

sciforum-126623: Evaluation of biostimulants from nature-based substances: promoting crop resilience and land sustainability models

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In the context of current climate change and ecosystem degradation, agricultural sustainability has been positioned as a core strategic objective to meet food demands while preserving natural resources. The latest Intergovernmental Panel on Climate Change (IPCC) report states that the agricultural sector is responsible for about 23% of net anthropogenic greenhouse gas emissions, driven mainly by the intensive use of synthetic inputs such as fertilizers, pesticides, and non-regenerative soil management practices. Bio-based formulations represent a range of solutions derived from natural components (e.g., active ingredients from algae and plants) that stimulate healthy crop growth and protect against pests. Biostimulants are substances or organisms that enhance plants' resilience to biotic and abiotic factors. These biostimulants are essential agents in organic agriculture, as they improve the physiological pathways of plants, allow for enhanced nutrient uptake, and strengthen their resistance to the effects of extrinsic factors. Furthermore, they promote land health by stimulating beneficial microbiota and incorporating organic matter, which enables agroecosystem sustainability and eases organic certification. European fertilizer legislation and the European Biostimulants Industry Council (EBIC)'s guidelines require the marketing of a product as a biostimulant to be supported by scientific evidence demonstrating its efficacy and precise mechanism of action. This review presents an updated view of plant biostimulants, evaluating their efficacy, mechanisms of action, and impact on plants' resistance within sustainable soil management frameworks. It includes a discussion of various crops' resilience and land sustainability models, focusing mainly on empirical and conceptual approaches, while also acknowledging mathematical and simulation models as complementary tools for future research.

sciforum-126384: Optimizing mineral fertilizer rates with biochar and compost: a slow-release fertilizer for nutrient use efficiency and cotton yield improvement in northern Benin

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In Benin, the sustainability of cotton (*Gossypium hirsutum* L.) production is threatened by the dependency on mineral fertilizers (MFs). Although MFs are effective in increasing cotton yields, they are often misused by farmers, leading to soil degradation and detrimental environmental impacts. This study optimizes nutrient use efficiency by activating biochar with two nutrient sources, MF (NPKSB+urea) and Compost (C), which was tested on cotton. The design was an RCBD with four replicates and eighteen (18) treatment combinations:three proportions of biochar (0%, 15%, and 25%, named B0, B15, and B25, respectively) and six fertilizer rates (combinations of MF and compost: 25% C+50% MF; 50% C+50% MF; 25% C+75% MF; 0% C+100% MF; 0% C+75% MF; and 0% C+50% MF, named C25N50; C50N50; C25N75; C0N100; C0N75; and C0N50, respectively). Variables measured included yield (YLD: 180 days after planting (DAP)), plant height (HT: 45, 60, 90, and 120 DAP), number of fruiting branches per plant (NFB: 120 DAP), and number of capsules per branch (NCF: 120 DAP). Analysis of variance (ANOVA) was performed using standard procedure in R version 4.4.2. The results show that yield was strongly influenced by the application of NPK fertilizer with or without compost compensation, while biochar does not show a significant effect ($p = 0.912$). But MF has a significant effect on all response variables, particularly on HT (p 0.001) and NFB ($p = 0.001$). Application of 25% biochar combined with 75% fertilizer exhibited higher performance, with an average of 141.2 cm. NFB increased with B15C50N50 (30.65 compared to 21,4 per plant on control plot). Regarding the cottonseed yield, an average highest yield of 3,41 t/ha was determined with B15C25N75 compared to 2.25 t/ha in B0C0N0. These results highlight the potential of biochar as a sustainable amendment to improve nutrient use efficiency. Combining MF application with biochar and compost maximizes cotton performance while reducing environmental impacts.

sciforum-134044: Phyto-Acoustic Mulching: Paradigm for enhancing Allelopathic Weed Control

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In the realm of sustainable agriculture, the quest for effective weed control methods has been a pressing challenge, with chemical herbicides posing risks to the environment and human health and contributing to herbicide-resistant weed populations. However, the efficacy of allelopathic mulches, such as pine bark or wheat straw, is often limited by inconsistent allelochemical release and environmental factors. This paper explores the potential of phyto-acoustic mulching as an innovative strategy for enhancing allelopathic weed control under field conditions. Allelopathy, the chemical inhibition of weed growth by plant-derived compounds, offers a sustainable alternative. Traditional mulching with allelopathic plant materials such as Pearl millet, Sorghum Parthenium hysterophorus, and Jute nonwoven fibers has demonstrated significant weed suppression, improved soil health, and increased crop yields. Recent research has demonstrated that sound waves can influence plant physiology, including growth, enzyme activity, and secondary metabolite production. For instance, sound waves at 1 kHz and 100 dB have been shown to promote cell division, increase protective enzyme activity, and enhance endogenous hormone levels in plants. Based on the existing literature, phyto-acoustic mulching could achieve significant weed suppression. Studies on allelopathic mulches report weed germination reductions of 20–60% [1]. Sound wave stimulation, which enhances secondary metabolite production by 20–30% in plants, could potentially increase allelochemical release by a similar margin, leading to weed suppression rates of 40–80% [2]. However, the integration of acoustic or vibrational stimuli to augment the release or efficacy of allelochemicals remains underexplored. This study proposes a novel framework for phyto-acoustic mulching, hypothesizing that controlled acoustic frequencies could enhance the decomposition of mulch materials or stimulate allelochemical activity, thereby amplifying weed control.

sciforum-125762: Regulated effect of fertilization and irrigation on greenhouse gas emissions in salt-affected soil: meta-analysis

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Understanding the impact of different agricultural practices on greenhouse gas (GHG) emissions in salt-affected soils is crucial for the adoption of best practices aimed not only at reducing the salt content of the soil and improving crop productivity but also at preserving the environment. A meta-analysis of 72 peer-reviewed published studies was conducted to obtain the central trend in CO_2 and N_2O emissions in response to different fertilization and irrigation practices on salt-affected soils. The results showed that high nitrogen (N) fertilizer rates (>200 kg N ha^{-1}) increased CO_2 and N_2O emissions by 44% and 83%, respectively, compared to low N rates (200 kg N ha^{-1}). The combination of organic fertilizer and N reduced CO_2 emissions by 63% and N_2O emissions by 62% compared to those under the single application of organic fertilizer. Irrigation levels below a 60% field capacity (FC) reduced CO_2 emissions by 44% and N_2O emissions by 85%, while irrigation above a 100% FC increased CO_2 emissions by 24% and N_2O emissions by 47% compared to those under 100% FC irrigation. Nitrogen application at a rate below 200 kg N ha^{-1} combined with an irrigation level below an 80% FC reduced CO_2 emissions by 2.5% and N_2O emissions by 75% compared to those under 100% FC irrigation. Positive relationships were obtained between soil salinity and GHG emissions, while CO_2 emissions decreased with increasing soil pH under fertilization practices. These results show that deficit irrigation, reduced use of nitrogen fertilizers, and the combined application of nitrogen and organic fertilizers are all practices potentially capable of reducing the greenhouse gas emissions from salt-affected soils.

sciforum-117352: Restoring Agricultural Landscapes: A Case Study on the Role of Microbial Diversity in Salt–Alkaline Stress Mitigation

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In the face of escalating soil degradation, particularly in regions prone to salt–alkaline stress, sustainable agricultural practices are becoming increasingly critical. Salt–alkaline conditions compromise plant health, reduce crop yields, and hinder agricultural productivity. One promising avenue for mitigating these stressors is through the use of soil microbes that can enhance plants' resilience to abiotic stress. This research investigates the role of microbial consortia in alleviating salt–alkaline stress in fruit crops, with a focus on the integration of plant-growth-promoting rhizobacteria (PGPR) and mycorrhizal fungi to improve nutrient uptake, enhance the soil structure, and promote plants' stress tolerance mechanisms. By leveraging molecular biology techniques, including metabolomics and transcriptomics, we explored the synergistic interactions between plant hosts and microbial communities under saline–alkaline conditions. Our findings highlight the critical role of microbial diversity in modulating plants' stress responses, enhancing their root architecture, and improving osmotic balance within plants. The application of microbial inoculants showed a significant reduction in stress-induced metabolic disruptions while simultaneously increasing the overall plant biomass, yield, and fruit quality in species like citrus and tomato. This research not only demonstrates the potential of microbial-based solutions to improve resilience to environmental stresses but also offers a promising strategy for restoring degraded agricultural lands. These results could contribute to the development of more resilient agricultural systems and support the transition towards sustainable practices that bridge the gap between ecological restoration and food production.

sciforum-129657: The immediate and residual effect of cattle corralling and mineral fertilizer on maize cropping systems in the sub-humid zone of northern Benin: Yields, resource use efficiency, economic profitability, and post-harvest soil fertility

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Organic and inorganic fertilization management in intensive cropping systems is essential to ensure long-term crop productivity and sustainability. This study evaluated the immediate and residual effects of cattle corralling combined with mineral fertilizer application on maize cropping systems in northern Benin. A four-year field trial (2012–2015) using a strip-plot design was conducted with four levels of corralling (NM: no manure, C0: immediate effect, C1–C3: one- to three-year residual effects) and three mineral fertilization rates (F0: none, F1: half, F2: full recommended dose). Over the four years, cattle corralling significantly increased the average maize yield from 2.0 t/ha (range: 1.0 – 2.9 t/ha) in NM to 4.0 t/ha (range: 3.4 – 5.1 t/ha) in C0, and the average net profitability from 384 USD/ha (range: 159 – 668 USD/ha) in NM to 1000 USD/ha (range: 792 – 1336 USD/ha) in C0. Water use efficiency (WUE) improved from 3.4 in NM to 6.8 in C0, and soil organic carbon (SOC) increased from 3.0 g/kg to 11.2 g/kg. The residual benefits of corralling declined over time without mineral input (C0 > C1 > C2 > C3 > NM) but were sustained and amplified when combined with mineral fertilizers (C3 > C2 > C1 > C0 > NM). Fertilizer effects were minor in C0 and C1, but became significant in C2 and C3, highlighting positive organic–inorganic synergies. Nutrient recovery efficiency (N, P, K) was initially lower in C0 and C1 but surpassed NM levels from C2 onwards (C3 > C2 > NM ≥ C1 > C0). These findings support an integrated soil fertility strategy combining corralling and optimized fertilizer use as a sustainable intensification pathway for maize production in sub-humid, low-fertility rainfed systems. Future research should examine long-term nutrient cycling, soil biology, and economic risk to refine sustainable management practices.

sciforum-128617: The Impact of Integrated Farming on Soil Chemical and Microbiological Properties in Cashew Agroforestry Systems of Northern Benin

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Soil fertility in sub-Saharan Africa is often degraded by poor farming. Microorganisms are essential to nutrient cycling and soil health, yet traditional methods often overlook their complexity. This study assessed the impact of land management on microbial diversity, enzyme activity, and nutrient availability in cashew-based agroforestry systems in Benin. Three integrated systems S1 (Sorghum bicolor–cattle), S2 (S. bicolor–cashew at low and high densities), and S3 (S. bicolor–cashew–cattle) were compared to a conventional monocrop (CFS). A randomized block design across four villages in Tchaourou yielded 72 soil samples, analyzed for microbial biomass carbon (MBC), enzyme activities (urease, dehydrogenase, phosphatase), and microbial populations. The results indicated that dehydrogenase activity increased from 16.59 to 56.46 μg TPF (triphenyl formazan) g^{-1} soil (S2-HD to S3-LD; +240%). Phosphatase activity rose from 388.25 to 771.29 μmol PNP (p-nitrophenol) g^{-1} soil (+99%). In contrast, CFS showed a decrease in dehydrogenase from 16.63 to 15.89 (-4.4%) and a slight increase in phosphatase from 299.21 to 312.58 (+4.5%). Urease activity peaked at 882.45 μmol NH_4^+/g·h in S3-LD, a 239% increase over CFS, which declined from 317.54 to 260.23 μmol NH_4^+/g·h (-18.1%) in the second year. MBC increased from 679.45 to 2,289.29 μg C/g soil (+237%) in integrated systems, while it decreased from 789.25 to 761.23 μg C/g soil (-3.5%) in CFS. SBR (soil basal respiration) improved from 4.02 to 6.71 mg C-CO_2/kg·h in integrated systems (+67%), while it rose modestly from 4.01 to 4.62 (+15.2%) in CFS. S3-LD consistently outperformed the other systems, highlighting the benefits of integrated farming for soil health. This system showed the highest levels of enzymatic activity, microbial biomass, and respiration, suggesting a more active and diverse microbial community that enhances nutrient cycling and fertility. Overall, integrated farming improved soil quality more than conventional farming, supporting productivity and ecosystem function.

sciforum-108943: Understanding the Social Implications of Agrivoltaics in Farmlands

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Agrivoltaics (the purposeful co-location of solar panels on agricultural lands) technology shows promise for potential gains in profits and land use productivity. While regarded highly for their technical and economic benefits and potentially positive environmental impacts, a critical knowledge gap about how these systems operate within a social context creates the critical need for investigating the social dimensions of agrivoltaics. In this research, we study the unforeseen and unintended consequences of agrivoltaics implementation in terms of social, cultural, ethical, and environmental impacts. First, we examine the inconsistencies that might pose barriers to the proper assessment of energy transition planning using agricultural lands. Second, we critically evaluate the existing literature for guidance on how to approach the social and socioeconomic challenges in food–energy–water nexus systems with potential land development conflicts. Finally, we summarize the insights derived from this intense research and propose future work for developing effective strategies to holistically address critical challenges in agrivoltaics implementation in farmlands.

sciforum-134073: Urban Market Gardening, Characteristics, Spatial Dynamics, and Creation of Employment in the cities of Bamako and Sikasso (Mali)

Mohamed Fomba

Regional Directorate of Agriculture; Sikasso; Sikasso Region; Sikasso; Mali

In Mali, the market gardening sector is considered a priority in the strategic framework for growth and poverty reduction, and in the national plan for agricultural investment and food and nutritional security. However, areas devoted to market gardening are in the process of being converted into building zones. These practices are increasingly controversial and are likely to affect vegetable production, which is an important component of daily diets and a major source of income in towns. This study made use of structured questionnaires for household surveys and remote sensing. Descriptive statistics were used in order to identify the means by which this activity could be characterized, assess the spatial dynamics, and create employment. The results of the spatial analysis showed that market gardening regressed in Bamako from 1990 to 2020 by -53.83%, while it progressed in Sikasso from 1990 to 2010 (by 20.9%), and regressed by -4.83% in 2020. The majority of the farms identified are characterised by low sustainability, with the agro-ecological dimension being the limiting factor, along with the reduction in surface area. Improving the “Soil Fertility”, “Spatial Organization” and “Good Agricultural Practices” components will improve the overall sustainability of urban market gardening in Mali. The socio-territorial sustainability of production is characterised by poor organisation of urban market gardeners and a lack of capacity building, low financial autonomy, and a lack of hygiene and safety in production activities (especially watering). To ensure the sustainability of market gardeners in Bamako and Sikasso cities, it is crucial to promote integrated soil fertility management with the use of improved seeds.

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