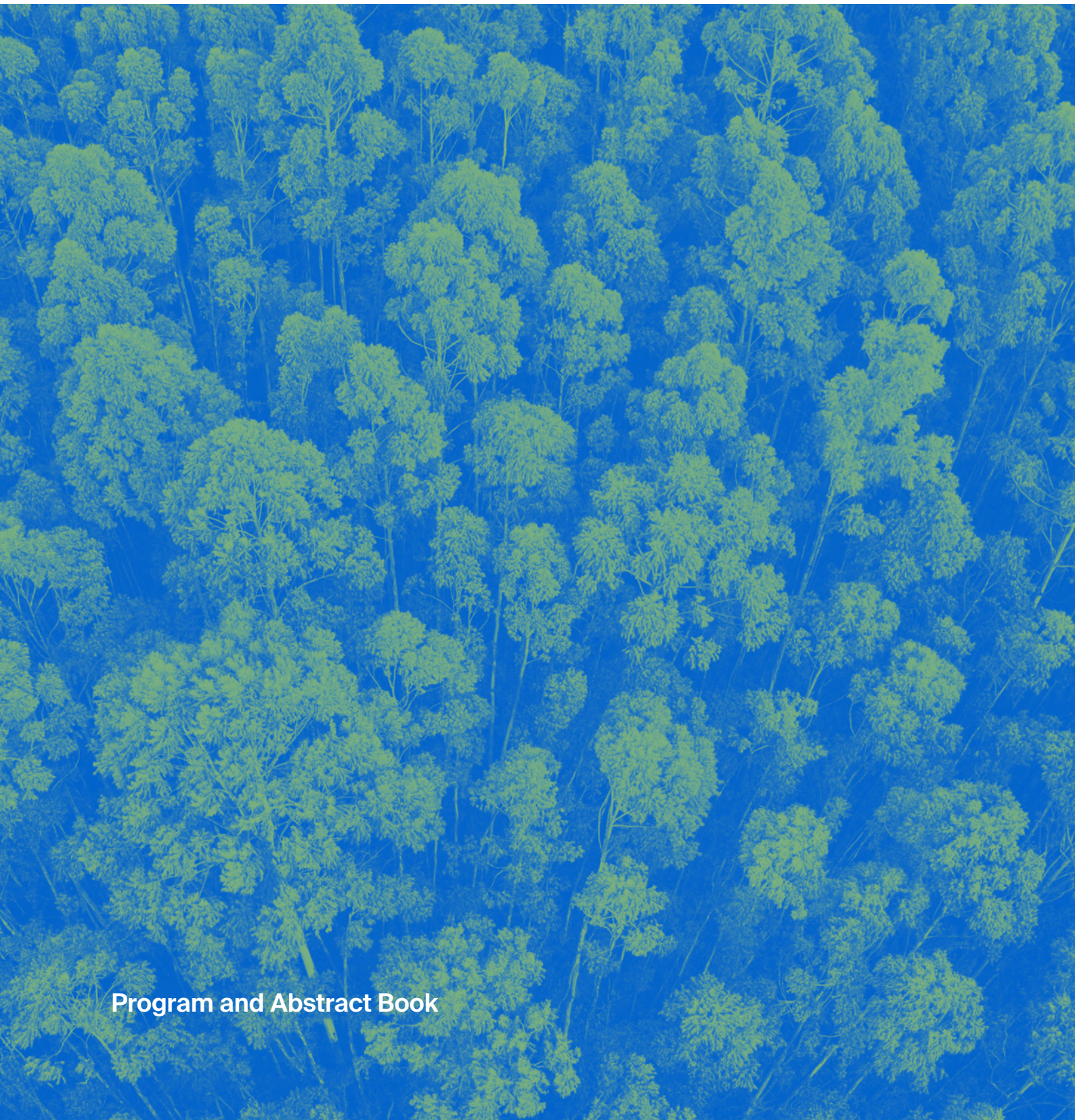
IECF 2024 Conference

The 4th International Electronic Conference on Forests

Science, Society and Innovation Nexus in Forestry: Pathways to Global Sustainability

23–25 September 2024 | Online



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The 4th International Electronic Conference on Forests

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Welcome from the Chair

Dear Colleagues and Esteemed Participants,

It is with immense pleasure and anticipation to announce The 4th International Conference on Forests - Science, Society and Innovation Nexus in Forestry: Pathways to global sustainability conference. This event is a testament to the collective spirit of the global forestry community, convening virtually to navigate the multifaceted challenges and possibilities of our time.

Forests are more than just timber reserves; they are the lifeblood of our planet. The echoes of their significance reverberate in numerous global discussions, from climate change conferences to health summits. Beyond their role in biodiversity conservation, carbon sequestration, and ecosystem service provision, forests embody the essence of cultural heritage, spiritual reverence, artistic inspiration, and much more. Their intertwining roots, much like our global community, remind us of the strength in unity and collaboration.

The recent disasters worldwide and future scenarios have heightened our realization of the imperative role forests play, not just in ecological balance, but in the very fabric of human health and well-being. In these trying times, it's pivotal that we champion the cause of sustainable forest management, viewing it not merely as a mandate but as a shared responsibility.

This conference stands as a beacon for pioneering innovations, fostering synergies, and promoting a holistic approach to forest research and management. It is a canvas where ideas meet action, where expertise bridges gaps, and where the future of forests becomes a collaborative vision.

You are sincerely invited to engage, share, and co-create during this journey. Your voice, research, and passion are integral to shaping the sustainable future forests we all envision.

Welcome to a dialogue of transformation and hope.

Dr. Giorgos Mallinis
Conference Chair
Laboratory of Photogrammetry and Remote Sensing, Department of Cadastre, Photogrammetry and Cartography, School of Rural and Surveying Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Forests (ISSN 1999-4907) is an international and cross-disciplinary scholarly journal of forestry and forest ecology. It publishes research papers, short communications and review papers. There is no restriction on the maximum length of the papers. Our aim is to encourage scientists to publish their experimental and theoretical research in as much detail as possible. Full experimental and/or methodical details must be provided for research articles.

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Keynote Speakers

Dr. Giovanna Battipaglia

Department of Environmental, Biological and Pharmaceutical Sciences and Technologies, University of Campania "L. Vanvitelli".

Dr. Giovanna Battipaglia is a plant ecologist, with research specialization in ecophysiology, and dendroecology. She is currently Professor in Forest Ecology at the University of Campania Luigi Vanvitelli. In 2005 she got her PhD in « Implementation and application of isotopic methodologies in environmental science research ». She has been working in several International institutes during her carrier, such as Center of Bio-Archeology and Ecology (CBAE- F), the Swiss Federal Research Institute (WSL - CH), The University of Amsterdam (UVA, NL), the Max Planck Institute for Biogeochemistry (MPI, G) and the Paul Scherrer Institute (PSI, CH). She has long expertise in ecosystem carbon dynamics and in using stable isotopes (with conventional and laser technologies) as a tracer for physical and biological processes. Her activity has been mainly devoted to understand the responses of terrestrial ecosystems i.e., forest, grassland and cropland, to climatic conditions and management regimes.

Invited Speakers

Dr. Camilla Wellstein

Free University of Bozen-Bolzano, Bolzano, Italy

Dr. Francesco Latterini

Polish Academy of Sciences, Kórnik, Poland

Dr. Pawel Horodecki

Polish Academy of Sciences, Kórnik, Poland

Prof. Dr. Brendan Mackey

Griffith University, Queensland, Australia

Dr. Gianluca Tondi

University of Padua, Padova, Italy

Dr. Mauro Bernabei

Institute of Bioeconomy, National Research Council, Trento, Italy

Dr. Verina Ingram

Wageningen University and Research Centre (WUR), Wageningen, The Netherlands

Dr. Konstantinos G. Papaspyropoulos

Aristotle University of Thessaloniki, Thessaloniki, Greece

Ms. Chenchen Wu

Chinese Academy of Science, Beijing, China

Program at a Glance

	Day 1	Day 2	Day 3
Morning	**Session 4.** Forest Wildfires	**Session 3.** Climate Smart Forestry and Forest Innovations **Session 5.** Wood Science, Production Chains, Fuelwood and Trade	**Session 1.** Forest Ecology and Management
Afternoon	**Session 2.** Forest Biodiversity, Ecosystem Services, and Earth Observations	**Session 6.** Bioeconomy and Forest Economics	

IECF 2024 Program

23rd September 2024 (Monday)

Session 4. Forest Wildfires

Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	CST Time	Speaker	Title
9:00–9:10	15:00–15:10	*Welcome from the Conference Chair* *Dr. Giorgos Mallinis*	
9:10–9:20	15:10–15:20	*Welcome from the Committee Member* *Dr. José Aranha*	
9:20–9:40	15:20–15:40	**Invited Speaker** Prof. Dr. Brendan Mackey	How climate change and forest management are influencing wildfire burn severity
9:40–9:55	15:40–15:55	**Selected Speaker** Michail-Christos Tsoutsos	Modelling the domino effect of wildfires
9:55–10:10	15:55–16:10	**Selected Speaker** Suresh Babu K. V.	Advancing wildfire detection through enhanced satellite technologies—review
10:10–10:25	16:10–16:25	**Selected Speaker** Angelos Alamanos	The impacts of a forest wildfire on flooding and economic damages
10:25–10:40	16:25–16:40	**Selected Speaker** Sebastião Agrela	Operational plan for combating rural fires on the island of Madeira

Session 2. Forest Biodiversity, Ecosystem Services, and Earth Observations

Time: 14:00 (CEST, Basel) | 08:00 (EDT, New York) | 20:00 (CST Asia, Beijing)

CEST Time	CST Time	Speaker	Title
14:00–14:10	20:00–20:10	*Welcome from the Session Chair* *Prof. Dr. Tianxiang Yue*	
14:10–14:30	20:10–20:30	**Invited Speakers** Prof. Dr. Tianxiang Yue & Ms. Chenchen Wu	The Relationship Between Tree Species Diversity and Forest Carbon Stocks
14:30–14:45	20:30–20:45	**Selected Speaker** Ronald C. Estoque	Spatiotemporal patterns of global tropical forest loss before and after 2015 and its implications for mitigation, biodiversity conservation and disaster risk reduction
14:45–15:00	20:45–21:00	**Selected Speaker** Diaz-Maroto I. J.	Effects of landscape homogenization on biodiversity conservation and ecosystem services
15:00–15:15	21:00–21:15	**Selected Speaker** Victoria Saavedra Alvarado	Integrating ecology and territorial management: Balancing biodiversity conservation with agricultural production in the Argentine Gran Chaco
15:15–15:30	21:15–21:30	**Selected Speaker** Federico Filipponi	Virtual constellation of Sentinel-2 and PlanetScope satellites to monitor forest ecosystems
15:30–15:45	21:30–21:45	**Selected Speaker** Uaktho Baishnab	Assessment of plant species and biodiversity in SUST Campus—A peri urban area
15:45–16:00	21:45–22:00	**Selected Speaker** Adriana Martinez Arias	Quantifying potential organic carbon in mangrove soils: A machine learning approach to improve conservation efforts in the Colombian Pacific Coast

24th September 2024 (Tuesday)

Session 3. Climate Smart Forestry and Forest Innovations
Session 5. Wood Science, Production Chains, Fuelwood and Trade

Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	CST Time	Speaker	Title
09:00–09:10	15:00–15:10	*Welcome from the Session Chairs* *Prof. Dr. Rodolfo Picchio & Dr. Rachele Venanzi*	
09:10–09:30	15:10–15:30	**Invited Speaker** Dr. Francesco Latterini	Climate-smart forest operations: How to adapt forest operations to a changing climate
09:30–09:50	15:30–15:50	**Invited Speaker** Dr. Paweł Horodecki	Invasive tree species effect on the leaf-litter decomposition process
9:50–10:05	15:50–16:05	**Selected Speaker** Eva Kiraly	Evaluating the potential for climate change mitigation through doubling the area of windbreak plantations in Hungary
10:05–10:20	16:05–16:20	**Selected Speaker** Lokesh Chandra Dube	Challenges and opportunities for India's carbon forestry in a dynamic 'Climate change supermarket'
10:20–10:35	16:20–16:35	**Selected Speaker** María Rosario García-Gil	Landscape Breeding
10:35–10:50	**16:35–16:50**	**Break**	
10:50–11:00	16:50–17:00	*Welcome from the Session Chair* *Prof. Angela Lo Monaco*	
11:00–11:20	17:00–17:20	**Invited Speaker** Dr. Mauro Bernabei	Timber trade in roman times as inferred by dendrochronology
11:20–11:40	17:20–17:40	**Invited Speaker** Dr. Gianluca Tondi	Tannin-based polymers
11:40–11:55	17:40–17:55	**Selected Speaker** Osman Emre Özkan	Effects of chemical modification with citric acid on wood
11:55–12:10	17:55–18:10	**Selected Speaker** María Carmona Cruz	*Pinus pinea* L. xylogenesis under extreme conditions in the Llobregat Delta litoral forests.
12:10–12:25	18:10–18:25	**Selected Speaker** Bu Kelkar	Evaluating the effects of thermal pretreatment of bamboo fibers on characteristics of bamboo–polypropylene thermoplastic composites
12:25–12:40	18:25–18:40	**Selected Speaker** Claudia Marcela Ibañez	Preliminary studies on the selection of Uruguayan woods for the production of transparent wood

Session 6. Bioeconomy and Forest Economics

Time: 14:00 (CEST, Basel) | 08:00 (EDT, New York) | 20:00 (CST Asia, Beijing)

CEST Time	CST Time	Speaker	Title
14:00–14:10	20:00–20:10	*Welcome from the Session Chair* *Prof. Dr. Emmanuel G. Koukios*	
14:10–14:20	20:10–20:20	**Session Chair** Prof. Dr. Emmanuel G. Koukios	Overview Speech
14:20–14:40	20:20–20:40	**Invited Speaker** Dr. Konstantinos G. Papaspyropoulos	Accountability of Forest Organizations in the Bioeconomy era
14:40–15:00	20:40–21:00	**Invited Speaker** Dr. Verina Ingram	Sustainably governing bioeconomies of global and local forest product value chains
15:00–15:15	21:00–21:15	**Selected Speaker** Nugraha Akbar Nurrochma	Climate Justice: balancing deforestation for developing and maintaining food security in Ghana to mitigate global warming with fairness
15:15–16:15	21:15–22:15	**Round Table Discussion** Prof. Dr. Emmanuel G. Koukios	The Effect of Bioeconomy Growth on the Feasibility and Sustainability of Forests

25th September 2024 (Wednesday)

Session 1. Forest Ecology and Management

Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	CST Time	Speaker	Title
9:00–9:10	15:00–15:10	*Welcome from the Session Chair* *Dr. Giovanna Battipaglia*	
9:10–9:40	15:10–15:40	**Keynote Speaker** Dr. Giovanna Battipaglia	Forest vulnerability to climate change
9:40–10:00	15:40–16:00	**Invited Speaker** Dr. Camilla Wellstein	The role of forest diversity and vegetation dynamics in face of extreme meteorological and biological events in the South Eastern Alps
10:00–10:15	16:00–16:15	**Selected Speaker** Hristina Hristova	Enhancing forest inventory with cost-effective videogrammetry: A case study using Insta360 Pro 2
10:15–10:30	16:15–16:30	**Selected Speaker** Longina Chojnacka-Ożga	The impact of extreme weather conditions on the forest dieback in the polish mountains
10:30–10:45	16:30–16:45	**Selected Speaker** Francesco Niccoli	A comprehensive analysis of castel volturno's *Pinus pinea* L. forest dieback using land-based and remote sensing techniques
10:45–11:00	16:45–17:00	**Selected Speaker** Afef Hajaji	Research on optimal biochar amount needed to mitigate salt stress-induced effects on germination and growth of Moringa Oleifera
11:00–11:15	17:00–17:15	**Selected Speaker** Dmitry Dergunov	Quantitative wood anatomy of Scots pine over 270 years in the foothills of the Western Sayan, Siberia
11:15–11:30	17:15–17:30	**Selected Speaker** Ayushman Malakar	Genetic variability assessment of *Azadirachta indica* A. juss in Eastern India: Implications for tree improvement

Session 1. Forest Ecology and Management

sciforum-095259: *Fagus sylvatica* L. Sap Flux Is Affected by Soil Moisture Variability Along a Steep Hillslope in Central Italy

Jerzy Piotr Kabala [1,*], Ilaria Zorzi [2,3,4], Ginevra Fabiani [2,5], Matteo Verdone [2], Alessio Giovannelli [6], Andrea Dani [2], Daniele Penna [2,7], Giovanna Battipaglia [1] and Claudia Cocozza [2]

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[2] Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Università degli Studi di Firenze, 50145 Firenze, Italy.
[3] Bluebiloba Startup Innovativa s.r.l., Via C. Salutati 78, 50126 Florence, Italy
[4] ForTech Laboratorio Congiunto, University of Florence, 50145 Florence, Italy
[5] Department of Environmental Research and Innovation, Luxembourg Institute of Science and Technology (LIST), 4362 Esch-Belval Esch-sur-Alzette, Luxembourg
[6] Istituto di Ricerca Sugli Ecosistemi Terrestri (IRET), Consiglio Nazionale delle Ricerche, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy
[7] Oregon State University, Forest Engineering Resources and Management Department, Corvallis, OR 97331, USA

Tree transpiration is an important component of the water cycle in forested ecosystems, accounting for more than 50% of the evaporative fluxes. Assessing the effects of meteorology and water availability on forest ecosystem functions like transpiration is becoming increasingly important in the context of climate change. We exploited the natural variability of soil moisture dynamics along a hillslope to analyse the effects of soil moisture and meteorological forcings on the sap flux dynamics of *Fagus sylvatica* L. trees. The study site is in the Re della Pietra catchment, Apennine Mountains, Central Italy, characterized by a Mediterranean climate. Sap flux and soil moisture at different depths were monitored at three different locations along the hillslope (TOP, MID and BOTTOM), as were the meteorological conditions outside the forest. The sensitivity of sap flux to hydrometeorological conditions changed along the slope: in the BOTTOM location, transpiration was most sensitive to incoming radiation and vapour pressure deficit, while in the TOP, there was a higher importance of soil moisture; the MID location showed intermediate conditions. A rise in the correlation between soil moisture and transpiration and a decrease in the correlation between transpiration and radiation were observed during the hot and dry month of August, for the TOP and MID locations, following a decrease in soil moisture. We show that in Mediterranean areas, during the growing season, transpiration can switch from “radiation-controlled” to “moisture-controlled”, when a threshold in soil water content is crossed. We provide evidence of spatial heterogeneity in transpiration, due to soil moisture variability, ultimately driven by topography. Furthermore, the severity of the drought effects on trees may be variable at a fine spatial scale due to topography. Accounting for these effects might allow for more effective management strategies, aiming at mitigating the climate change impact on forests and their ecosystem services.

sciforum-095961: Mixed Methods to Assess Sacred Forest Management Practices in Guinean Forest of West Africa Biodiversity Hotspot

Alessandra Manzini [1,*], Saliou Boni Biao [2], Safietou Soumaré [3] and Luc Descroix [4]

[1] EUTOPIA SIF Post Doctoral Research fellow, SPIRAL Project at PLACES LAB, CYU Cergy Paris, France and CASES group University Pompeu Fabra Barcelona Spain
[2] Laboratoire d'Analyse et de Recherche sur les Dynamiques Economiques et Sociales pour le Développement (Lardes), Faculté de Lettre, Arts et Sciences Humaines, Université de Parakou, Bénin, BP 123 Parakou, Bénin
[3] PhD Université Iba der Thiam de Thies, Université Côte d'Azur, Advanced Study in Geomatics Université du Québec à Chicoutim
[4] Senior Investigator, UMR PALOC IRD/MNHN, French National Museum of Natural History, Paris, Hydrologist at IRD (French Research Institute for Sustainable Development)

According to the FAO's *Global Forest Resources Assessment 2020*, the planet has lost 178 million hectares of forest since 1990. Africa had the highest annual rate of net forest loss, 3.9 million hectares in 2010–2020, due to human activities. Sacred Forests (SFs) are unique ecosystems, deeply intertwined with religious or traditional belief systems, key historical events, and specific burial practices. Sacred forests represent a holistic approach to the sustainable management of forests and are one response to the accelerating biodiversity loss. This research aims to describe how Sacred Forests in the Guinean forest of West Africa hotspot (Guinea, Senegal, and Benin) have been preserved, comparing their ecological dynamics with other forest management models. The case studies apply mixed methodologies to observe forest dynamics and survey Traditional Ecological Knowledge (TEK). Satellite remote sensing series help to diachronically monitor ecosystem dynamics. Interactive qualitative methodologies include socio-anthropological research, questionnaires, participant observations, and interviews with stakeholders of Sacred Forests' socio-ecological systems. The results show that the case studies are not subjected to the same anthropogenic pressures as other surrounding forests. Leveraging TEK and integrating scientific ecological knowledge (SEK) on SFs' socio-ecological systems, the paper advocates for a more holistic and inclusive approach to understanding and managing forests. Recognizing that local communities have long-standing relationships and deep-rooted knowledge systems can contribute significantly to sustainable forest management and conservation efforts.

sciforum-086649: Celebration of Landscapes in Indian Tribes Culture: Study of Baiga Tribe in Madhya Pradesh

Jyoti Yadav [1,*] and Janki Gonawala [2]

[1] Malaviya National Institute of Technology Jaipur (MNIT Jaipur), Jaipur 302017, Rajasthan, India
[2] School of Planning and Architecture (SPA), Bhopal 462030, Madhya Pradesh, India

The knowledge of using natural resources like flora, fauna, and minerals, materials for survival, and livelihood to cure human and animal diseases has been developed in several old tribal communities like the Baiga tribe of Madhya Pradesh. This great reliance on the surrounding landscape can be seen in the tribal communities' daily affairs. They live in the most interior part of the forest, and they are constantly dependent on the forest's agro-climatic conditions, resources, nature of soil fertility, availability of water, etc. Context and the surrounding landscape are the paramount sources of food and livelihood of tribal communities in India. Each tribe of India has its kind of landscape manipulating techniques in the form of agricultural, grazing, poultry farming practices etc. Their lives mostly rely on the harvest they get from the surrounding landscape throughout the year and thus become the primary source of their survival. Festivals are their way of expressing respect, gratitude and worship to these landscapes. My objective is to try to understand tribal community festivals and interdependency with their context and surrounding landscape. To understand this affinity between tribal community and their landscape I will try to provide brief study of ***BAIGA*** tribe of Madhya Pradesh of India.

sciforum-099997: Enhancing Forest Inventory with Cost-Effective Videogrammetry: A Case Study Using Insta360 Pro 2

Hristina Hristova *, Sunni Kushwaha, Clemens Blattert, Samuel Ringier and Janine Schweier

The Swiss Federal Institute of Forest, Snow, and Landscape (WSL), 8903 Birmensdorf, Switzerland

Assessing the forest's capacity to mitigate climate change and enable multi-functional management strategies for biodiversity and ecosystem service provision requires vast knowledge about the forest on a large scale. Traditional forest inventory methods can be labor-intensive and lack detailed enough measurements for large forest areas. To enable scalable forest inventories, a reliable and replicable approach for estimating key forest features with minimal manual effort and maximum impact is needed.

While terrestrial laser scanning (TLS) is considered the most precise method for generating point clouds in forestry, it can often be expensive and impractical for complex forest conditions, such as dense understory and steep slopes. In contrast, digital sensors like mass-produced cameras have become popular for data collection due to their availability and lightweight design. Additionally, videogrammetry, a method that creates 3D models from digital camera videos, has emerged as an efficient and low-cost approach for point cloud generation. However, its potential in the heterogeneous forest environment remains to be fully explored.

We propose a videogrammetry approach for reconstructing 3D point clouds in forest environments, leveraging a cost-effective and user-friendly Insta360 Pro 2 acquisition setup. This setup, incorporating six fish-eye cameras within a single camera body, allows the simultaneous capturing of six fish-eye videos and the complete coverage of a 360-degree field of view. Compared to more cumbersome alternatives, this setup simplifies and enhances data collection in various forest conditions.

We compared two videogrammetric approaches for building a point cloud in a forest environment using Insta360 Pro 2. The multi-rig approach, using videos from the six fish-eye lenses,
outperformed the approach based on the stitched spherical video in reconstruction accuracy. While it required a longer computational time, the multi-rig system yielded a ground control point error of 2 mm, compared to 5 cm for the spherical point cloud, demonstrating its superiority.

sciforum-099524: Genetic Variability Assessment of *Azadirachta indica* A. Juss in Eastern India: Implications for Tree Improvement

Ayushman Malakar * and Animesh Sinha

Genetics and Tree Improvement Division, ICFRE-Institute of Forest Productivity, Ranchi 835303, Jharkhand, India

Azadirachta indica was designated the "Tree of the 21st century" by the United Nations, as it is believed to be the largest natural depository of bioactive phytochemicals. This study investigates genetic variability among 152 Candidate Plus Trees (CPTs) of *A. indica* selected from three agro-climatic zones (ACZs) in eastern India: the Lower Gangetic Plains (ACZ III), Middle Gangetic Plains (ACZ IV), and the Eastern Plateau and Hills region (ACZ VII). Phenotypic characters, fruit and seed morphology, kernel oil content (KOC), and azadirachtin concentration (AC) were assessed to characterize the genetic diversity. Significant variation was observed across all parameters among individual CPTs. Girth at breast height ranged from 0.9 to 2.8 m, tree height from 6 to 16 m, and crown volume from 146.95 to 2339.86 m^3. Fruit length varied from 13.55 to 21.55 mm and seed length from 9.21 to 17.37 mm. KOC ranged from 36.51 to 58.86%, with a mean of 47.22% (±0.4), while AC showed extreme variability (19.46–1823.45 µg/g seed). KOC exhibited strong positive correlations with crown diameter ($R = 0.57$, $p \leq 0.001$) and crown volume ($R = 0.45$, $p \leq 0.001$). Interestingly, AC did not correlate significantly with any studied parameter, suggesting a high genotype×environment (G×E) interaction for this trait. Analysis of variance revealed significant differences (p 0.05) between ACZs, but only for some traits. Cluster analysis using Ward's minimum variance criterion based on Euclidean square (D^2) distances performed in RStudio grouped the CPTs into five clusters as per pooled effects of all parameters. The highest inter-cluster distance was observed between clusters III and V (7.703), indicating a potential for heterosis in hybridization between these groups. Each cluster contained CPTs from all three ACZs, suggesting uniformly distributed variation across the study area rather than zone-specific patterns. This study provides valuable insights for improvement programs of the species and emphasizes the need for further research, including progeny trials, to comprehensively understand the genetic variability of *A. indica* in eastern India.

sciforum-099741: Monitoring the Biotic Stressors in a Mediterranean Holm Oak Forest: Outcomes of the Project SpecFor

Alberto Bernacchi [1,*], Roberto Danti [1], Gianni Della Rocca [1], Giovanni Emiliani [1], Lorenzo Arcidiaco [2], David Pellegrini [2], Elisa Pellegrini [3], Pippi Lorenzo [3], Samuele Risoli [3], Claudia Pisuttu [3], Cristina Nali [3], Lorenzo Cotrozzi [3] and Sara Barberini [1]

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[3] University of Pisa (UNIPI), Department of Agriculture, Food and Environment (DAFE). Via del Borghetto, 80, 56124, Pisa, Italy

Holm oak forests are currently a key element in the ecological and socio-economic sustainability of forest ecosystems in the Mediterranean area, but over the last few decades, extensive dieback and mortality episodes of *Quercus ilex* L. have been documented after severe drought events.

The project “SpecFor” focused on a typical Mediterranean forest ecosystem located along the southern coast of Tuscany (Parco Regionale della Maremma) where severe holm oak declines have recently been reported (Summer 2017). The goal is to develop an accurate and high-throughput framework for detecting forest damage and monitoring forest responses to biotic stresses based on the use of satellite imagery: hyperspectral and optical data.

A climatological analysis from 1950 to 2023 has been carried out, involving the analysis of temperature and precipitation variables extracted from the ERA5 Land dataset produced and distributed by ECMWF (Copernicus Climate Service). The climatological analysis allowed us to derive the anomaly time series of temperature and precipitation, both annual and monthly, and the most scientifically used drought index (SPEI—Standardised Precipitation--Evapotranspiration Index).

Three plots characterized by low, medium, or high degrees of three decline, were evaluated by phytopatological surveys (visual inspection and fungal identification by culturomic approach), and the ecological role of the fungal communities was investigated using Next-Generation Sequencing metabarcoding. Then, the assessment of forest health and tree growth was correlated with the vegetation index (NDVI) derived from satellite images. By combining advanced remote sensing techniques with traditional field methods and molecular analysis, the project aimed to develop a comprehensive approach to understanding the complex interactions between environmental factors, tree health, and fungal communities in Mediterranean Holm oak forests.

sciforum-095216: A Comprehensive Analysis of Castel Volturno's *Pinus pinea* L. Forest Dieback Using Land-Based and Remote Sensing Techniques

Francesco Niccoli [1,*], Jerzy Piotr Kabala [1], Simona Altieri [1], Salvatore Faugno [2] and Giovanna Battipaglia [1]

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[2] Department of Agricultural Sciences, University of Naples Federico II, via Università 100, 80055 Portici, Italy

Climate change is seriously threatening forest ecosystems, affecting their structure and functioning. Rising temperatures and reduced precipitation lead to prolonged droughts, which weaken the natural defences of trees and affect their photosynthetic and stomatal activities, making them vulnerable to other stresses, including pest attacks. Identifying the most vulnerable forest areas and understanding the mechanisms of tree decline are therefore crucial to developing effective management strategies.

This research combined dendrochronological and isotopic analyses with remote sensing to detect the early signs of dieback in a population of *Pinus pinea* L. in southern Italy affected by *Toumeyella parvicornis* parasite outbreak. Moreover, a comparative analysis of the methods was conducted to identify the most effective data processing techniques for detecting forest decline.

The study showed that the pest outbreak, which started in 2014, caused progressive tree defoliation from 2015, reaching a critical point in 2020, leading to a severe tree carbon deficit and triggering a significant decline in growth. Despite attempts to rebalance carbon metabolism through stomatal opening, as indicated by the intrinsic water use efficiency (WUEi) data, the pine forest did not recover. Indeed, these trees, particularly stressed by the climatic conditions of the area, died in 2023.

Although all satellite indices tested were able to detect defoliation dynamics, EVI and EVI2 proved to be particularly sensitive to changes in canopy cover, more than NDVI. The integration of additional indices, such as NDMI, improved the monitoring of canopy moisture and provided valuable insights into decline dynamics. Finally, dendrochronological analyses showed that detrended growth chronologies (BAI and TRW-I) were more sensitive in detecting dieback signals than raw tree-ring chronologies.

In conclusion, the data collected in this study not only provide information on the dynamics of forest dieback, but also highlight the importance of integrating different detection methods for the effective management of forest ecosystems.

sciforum-091057: A Machine Learning Approach for Predicting Selective Browsing Behavior

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Ungulates shape forest ecosystems through the selective browsing of different plant species, which serves a regulatory role in the interspecific competition between plants. Therefore, accurately predicting the extent of browsing on different plant species may promote forest management policies which advocate biodiversity alongside economic interests. This study applied a machine learning (ML) approach to create an accurate and robust system for predicting selective browsing behavior.

Using data from seven forested areas in Hungary, three ML models were constructed to predict the extent of browsing on different plant species based on the available plant supply within the habitat: a Random Forest, Gradient Boosting, and a Zero-Inflated Beta Regressor. The models were evaluated in terms of mean absolute prediction error and the ability to correctly predict larger browsing extents. The latter is a challenging task due to the sparse and mostly small-valued nature of the data. Additionally, in light of the effort required to collect browsing data, the models' robustness against smaller sample sizes was tested. The Gradient Boosting Regressor performed best in every aspect, achieving the highest accuracy even with lower sample sizes. A two-way ANOVA test confirmed that both the choice of ML model and the sample size has a significant effect on the prediction performance. The Gradient Boosting Regressor was integrated into a Jupyter Notebook pipeline designed for easy re-use on unseen forest data.

The results suggest that ML offers a viable approach to predict selective browsing in forest habitats, and such models can be integrated into simple applications for forest management and research applications. Future research could focus on testing the approach in a wider variety of habitats and on increasing the ease-of-use of the technique for users less familiar with ML.

sciforum-087505: Aerophotogrammetry and Artificial Intelligence to Quantify Trees and Palms in Amazon Native Rainforests

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The Amazon rainforest is composed of dense and large vegetation; this implies arduous data collection to study forest dynamics. To assist with these studies, remotely piloted aircrafts (RPAs) can be used to collect images of the forest to acquire characteristics such as the height of the forest, used for biomass and carbon calculations. This technology with machine learning can help in the processing of extensive data; however, it has not yet been applied to Amazon forests, and it offers an opportunity to improve the accuracy of carbon estimates. The aim of this study was to investigate the performance of the artificial intelligence (AI) YOLOv5 in a Google Colab environment to count palms and trees in aerophotogrammetric images captured with the DJI Phantom 4 Pro and a camera. The AI training, validation and testing phases were applied with 1229 images to generate six models to detect and quantify palms and trees in three sites in the state of Amazonas in Brazil. The models were evaluated using the AI metrics precision, recall and mean average
precision (mAP) and the remote sensing metrics omission errors, commission errors and accuracy. The models Palms400 and Trees600 obtained the best performances in mAP, with 76% for both; nevertheless, accuracy was highest in the Trees200 and Palms200 models, with 53% and 38%, respectively. In all models, the omission was higher than the commission, where the models did not detect all the objects, while commission errors did not exceed 20%. Thus, it is possible to say that the models performed well and it is recommended to use more different images of the objects in the AI phases, such as different shapes and colors, to improve AI for forestry applications, in order to satisfy remote sensing metrics as well as AI metrics.

sciforum-099928: Are Natura 2000 Sites Effective for the Control of Invasive Tree Species of European Union Concern? The Emblematic Case of the Largest Mediterranean Island

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The management and control of invasive alien species are two of the priorities for the targets of biodiversity conservation in Europe. Here, the Natura 2000 network includes the protected areas (Special Protection Areas and Special Areas of Conservation, or SAC) established under the Habitats Directive 92/43/EEC and specifically defined for the protection of biodiversity in the European Union. Since the Natura 2000 network aims to maintain or restore native habitats and species of community interest at a favourable conservation status; the uncontrolled spread of invasive alien species is in stark contrast with its key scope. This is especially the case for invasive alien trees (IATs), due to their high ability to deeply change the main characteristics of invaded ecosystems. This goal mainly concerns invasive species of the European Union concern, defined according to EU Regulation 1143/2014, and whose use, cultivation, and trade are prohibited in the territory of the European Union. In this research, the occurrence in forest habitats and the management of two IATs of European Union concern (*Acacia saligna* and *Ailanthus altissima*) were assessed by consulting the management plans of the SAC of Sicily (Italy). Through dedicated field surveys in some selected SAC, the effective implementation of the interventions provided for the control of the target species has also been assessed. Most of the consulted management plans recognized the threat represented by *Acacia* and *Ailanthus* and provided for their control and/or eradication within the protected site. However, the effective implementation of control activities has rarely been achieved. More worrying, in some cases, the threat posed by *Acacia* and *Ailanthus* was underestimated in the management plans. Finally, despite the increased awareness about the negative impacts of invasive trees on biodiversity and ecosystem services, effective control is far from being achieved, even within Natura 2000 sites.

sciforum-100077: Assessing Human Impact on Southern Mediterranean Forests: Novel Anthropogenic Pollen Indicators from Rif Mountains

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The study of modern pollen and vegetation relationships is vital for interpreting fossil pollen records and assessing human impacts on forests, both of which are essential for effective forest management strategies. Despite numerous studies on fossil pollen records in the Rif landscape, there is a notable lack of research specifically focusing on modern pollen and its implications for understanding human impacts on these forests. This paper introduces novel anthropogenic pollen indicators for the Rif Mountains and aims to evaluate the gradients of human impact on the forests of the southern Mediterranean. A combination of modern pollen studies, vegetation surveys, and ordination techniques using both quantitative and presence/absence data were employed, along with various environmental and land-use variables. Canonical correspondence analysis enabled us to assess the relationships between pollen types and environmental variables, allowing us to identify the most anthropogenic pollen indicators associated with land use and human practices, (e.g., Poaceae, *Cannabis*-t, *Olea*-t, and Asteraceae). Furthermore, an anthropogenic index score (AIS) was calculated for each sampled location to correlate pollen types with specific levels of human impact using correspondence analysis (CA). These levels were categorised as (a) low (e.g., *Cedrus atlantica and Quercus canariensis*), (b) moderate (e.g., *Erica*-t, *Arbutus unedo*, and *Alnus*-t), and (c) high (e.g., *Cannabis*-t, *Pistacia lentiscus*-t, and *Plantago*-t).

sciforum-093361: Assessing the Recovery of Forest Understory Vegetation after Clearcut Logging across a 445-Year Chronosequence

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The conversion of natural forested lands to managed forests has reduced the number of older, structurally diverse forests worldwide. In the conifer forests of the Pacific Northwest (USA), the long-term impacts of timber harvesting are not fully understood. We used a chronosequence of forests in southwestern Oregon that ranged from 25 to 445 years of age to compare changes in plant communities in logged stands with those in stands in late-succession conditions. The chronosequence consisted of 1350 m^2 permanent plots with similar elevation, aspect, slope, and forest type that were previously sampled in 2003. In 2021, we resurveyed the herbaceous understory in each plot to evaluate if the relationship between stand attributes and understory vegetation had changed over the 18-year period. Our results support the non-linear relationship between stand age and richness also observed in 2003, such that richness was highest in the youngest stands, reached a low point in mid-aged stands, and then reached high levels of richness in the oldest stands. However, changes in structural conditions and the response of understory vegetation varied among stands. We found that canopy cover increased (24%) over the 18-year period, with most of the increase occurring as young, recently clearcut sites entered a phase of canopy closure. These same stands lost an average of 11 understory species between 2003 and 2021, and the community composition of these younger stands became more similar to closed canopy stands. We observed a decline in evenness and diversity in the mid-age and older stands due to an increase in dominance of shade-tolerant plants. Overall, these results demonstrate a legacy effect of the historic phase of clearcut logging in the Pacific Northwest in which a large portion of forests on the landscape have now entered a period of high canopy cover and low richness and diversity.

sciforum-095421: Changes in Foliar Traits through Environmental Gradients in Two Mediterranean *Quercus* Species and Their Hybrids

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Introduction

We analyzed several leaf morphological traits of two *Quercus* species widely distributed in the Iberian Peninsula (*Q. faginea* and *Q. pyrenaica*) and their hybrids, under contrasting environmental conditions, to determine differences between groups, if they are consistent in the different climatic zones and whether they could confer an advantage to any of the groups in the new predicted climate scenario.

Methods

This study was carried out in three areas located in the central-west of Spain; in each area, three plots relatively close to each other were selected: one with apparent dominance of *Q. faginea*, another with dominance of *Q. pyrenaica* and intermediate zones with both species. In each plot, 10 specimens of the supposedly dominant category in each case were selected, after having been categorized using AFLPs. From each of the 90 specimens, leaf samples were taken and used for morphological analysis, including a total of 18 different traits.

Results

Only three traits revealed discriminant value between the three genetic groups (leaf weight per unit area, maximum width of the blade and depth of lobes), with the hybrids showing greater proximity to *Q. faginea* for the rest of the characteristics and consistent results in the different study areas. In all three groups, the leaves tend to be larger, with larger petioles and a greater number of and deeper lobes in the area where temperatures are higher.

Conclusion

Contrary to what was expected, it was not the hybrids that showed the greatest variability between areas, but rather the *Q. faginea* individuals that showed the greatest capacity to modify these traits in response to the different climatic conditions between study areas, which, together with their characteristic foliar traits (greater weight per unit area, smaller leaf size and shorter petioles), could determine a greater probability of persistence in the face of climate change.

sciforum-098489: Changes in Photosynthetic Pigment Concentrations Induced by Pinewood Nematode Infection on In Vitro Pine Shoots

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The pinewood nematode (PWN), *Bursaphelenchus xylophilus*, infects susceptible pine species and causes pine wilt disease. After reaching the pine's internal tissues, the PWN feeds on the resin canals and vascular tissue and quickly reproduces to large populations, causing a cessation of resin flow and embolism events in the tree's water column. At the pine leaves, the low water supply heavily damages the biochemical reactions of photosynthesis, reducing the net photosynthetic rate and stomatal conductance. Impaired photosynthesis leads to the first visible symptoms of pine wilt disease, namely, the yellowing and drooping of pine needles. In vitro cultures are useful tools to research changes in fine biochemical reactions because they allow for reproducibility and genetic homogeneity. In the present work, in vitro maritime pine (*Pinus pinaster*) shoot cultures were used to assess changes in the concentration of photopigments, i.e., chlorophyl a and b, carotenoids, and the stress-related anthocyanins, by resorting to spectrophotometry techniques. Infection with the pinewood nematode led to a 30% reduction in leaf concentrations of chlorophyl A and a 50% reduction in chlorophyl B. Carotenoid concentrations increased by 70%, while no changes were observed for anthocyanins. This preliminary study allows for gauging the impacts of pinewood nematode infection of pine at the initial stages of pine wilt disease as a contribution to developing an early detection method for this phytoparasite.

sciforum-098998: Climate Response of Ring Width in Some Shrub Species in the Forest-Steppe of Northern Mongolia

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The impacts of land use changes and climate change on shrub expansion have been extensively documented in the Northern Hemisphere. Studies conducted in the Tibetan Plateau indicate that shrub expansion is more reliant on soil moisture than in the Arctic, where results indicate that changes in temperature and precipitation have a significant correlation with shrub expansion. Studies on the spread of shrubs throughout Central Asia, including the northern part of our country, are, sadly, insufficient. We carried out studies on 6 shrub species present in the Shatan river area to determine the response of several shrub species to climate factors, growth patterns, and growth types of dependent habitat types. According to the results of our research, there is a correlation (R^2 = 24) between the morphological characteristics of the shrub. Also, depending on the type of habitat, the growth of annual rings is different (p 0.0001). In addition, each species has a different annual ring width (p 0.0001). In terms of climatic factors, wind had a negative effect (R^2 = 47) and precipitation had a positive effect (R^2 = 57) on the annual ring width of *Salix divaricate*, a shrub growing in river valley habitats, and it was weakly related to other species. This differential pattern indicator may function depending on the habitat. That being the case, dominant shrub species in southwestern Khentii taiga, Mongolia, have successfully been proven to have high dendrochronological potential and it is practicable to apply it for rangeland and ecological assessments.

sciforum-093476: Composite Effects of Forest Harvests and Seismic Lines Influence the Re-Establishment of Trees and Shrubs in Alberta's Mesic Upland Boreal Forest

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In the boreal biome, natural disturbances shape vegetation dynamics and forest recovery. However, increasing anthropogenic disturbances raise concerns about their combined effects on forest regeneration. This is especially relevant in Alberta's boreal forest, where oil exploration creates seismic lines that fragment forests and often coincide with forest harvesting. An important question for seismic line restoration is whether forest harvesting can naturally restore composition and structure, potentially eliminating the need for further restoration efforts. We measured the abundance and composition of trees and shrubs at 15 mesic upland forest sites that were recently harvested and contained within them a conventional seismic line. For each site, we compared two pairs of plots on and off seismic lines to inside and outside of forest harvests to test differences in woody stem regeneration and relative abundance in plant communities. We discovered that harvested seismic lines exhibited approximately 130% more woody stems compared to untreated lines adjacent to mature forests, indicating that forest harvesting contributed to the structural recovery of the forest within the line. However, the co-occurrence of both disturbances resulted in an increase in deciduous stem abundance while decreasing shrub species abundance. Furthermore, we observed a significant interactive effect of the two disturbances on the relative abundance of around 40% of the species assemblage. We demonstrate that the spatial overlap of seismic lines and forest harvesting can facilitate the restoration of forest structure, but also produces a distinct signature on species composition through composite effects. While forest harvesting appeared effective in "erasing" seismic lines without further active restoration efforts, emerging composite effects can significantly influence forest composition, with potential long-term implications for regeneration that require further investigation.

sciforum-099920: Early Detection of Invasive Species on Roadside Slopes in Andean Patagonian Forests of *Austrocedrus chilensis* (Argentina)

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The invasion of exotic plants threatens biodiversity, affecting ecosystem services and ecological processes in native ecosystems. Road construction creates new environments and contributes to the introduction and spread of exotic and invasive plants. This study aimed to analyze the contribution of different functional groups (annual herbs and grasses, perennial herbs and grasses, shrubs, trees) to the invasion of exotic species on roadside cut slopes in the *Austrocedrus chilensis* forest in northwest Andean Patagonia, Argentina. Roadside slopes (RSs) and nearby reference areas (RAs) were selected, and the cover of native, exotic, and invasive species from the functional groups was evaluated in 1 m^2 plots using the Braun-Blanquet method. It was found that invasive perennial herbs and grasses predominated on RS, with a cover (19.6 ± 3.0%) higher than that of RA (8.9 ± 1.5%). *Agrostis capillaris* and *Rumex acetosella* were the most abundant invasive species. Among native species, shrubs and perennial herbs and grasses were predominant on RS, with *Baccharis rhomboidalis* and *Acaena pinnatifida* being the most abundant. This study demonstrates that the roadside slopes of the *Austrocedrus chilensis* forest harbor invasive exotic species that can invade nearby natural areas. Early detection of these species is important for proper management and control, thus promoting the conservation of biodiversity in forest environments.

sciforum-096137: Effect of *Gastrodiae Rhizoma* Cultivation under Forest Stands on Runoff, Erosion, and Nutrient Loss

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Background

Understory planting of Chinese herbal medicine is a common soil and water conservation farming measure, and this approach makes full use of the natural conditions of the understory, but a large number of studies on soil erosion have focused on the simulation of natural conditions indoors, and there are very few investigations on soil erosion caused by understory planting in the field, and the present study aims to provide theoretical references and data support for the sustainable development of understory Chinese herbal medicine.

Methods

To reveal the nutrient loss characteristics of understory planting of *Gastrodiae Rhizoma*, runoff plots were set up in the field, and three surface slopes (5°, 15°, 20°) were designed to collect runoff sediments and compare the soil and water loss between the natural slopes and the slopes planted with *Gastrodiae Rhizoma*, to investigate the flow and sand production characteristics of understory planting on sloping cropland with different slopes and the loss of nitrogen and phosphorus nutrients carried by it, to provide a basis for the restoration of vegetation cover and the enhancement of soil fertility.

Results

The loss of soil and water and nitrogen and phosphorus in forested land planted with *Gastrodiae Rhizoma* increased significantly compared with that in natural forested land, and the greater the slope, the greater its loss.

Conclusion

Planting *Gastrodiae Rhizoma* should be avoided in areas with large slopes and serious soil erosion, and some soil and water conservation engineering measures can be taken, such as the construction of retaining walls, drainage ditches, etc.to minimize the scouring and erosion of the soil by rainwater.

sciforum-093474: Effects of Oil Sands Disturbances on Tree Structure and Composition along Alberta's Boreal Forest Edges

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The boreal forest, resilient to many natural and anthropogenic disturbances, faces significant changes due to forest fragmentation resulting from oil and gas operations. This fragmentation, particularly prominent in Alberta's northeast region, alters forest dynamics and affects wildlife habitat. In this study, we investigated changes in tree structure and composition associated with oil sands footprints on adjacent forest edges.

Specifically, we used a combination of field surveys and Light Detection and Ranging (LiDAR) data to test the influence of disturbance type (gap size), orientation, and distance from forest edges on forest structure and composition. Our study encompasses two disturbance types that vary in gap size: legacy seismic lines and abandoned well pads. For field sites, we examined tree species distribution within different size classes along 100 m-long belt transects perpendicular to forest edges. Paired with these field methods, we used LiDAR to analyze variations in structural patterns for different height strata of forests adjacent to these disturbances. Finally, we assessed whether the abundance of large trees, snags and downed woody debris changes with type and distance from edges. Snags and woody debris are crucial habitats for boreal fauna.

Our findings aim to inform whether and how oil sands disturbances affect boreal forest ecosystems, particularly at forest edges. Determining these effects and the scale of their responses will help guide management practices, restoration, and conservation efforts in the increasingly fragmented oil sands region.

sciforum-099899: Emerald Ash Borer in the Park with a Long-Time History of Black Ash Sawfly Defoliation

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Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, 1888 (Coleoptera: Buprestidae) is native to temperate Northeast Asia. It invades *Fraxinus* sp. in large parts of the USA, Canada, and European Russia. In 2019, the pest was found in the Luhansk region of Ukraine, and by 2023 it had spread to forests and urban stands of the Luhansk, Kharkiv, and Kyiv regions. Particularly in 2023, EAB began to infest *Fraxinus excelsior* L. in the Molodezhny Park in Kharkiv (50°00′ N; 36°25′ E) (Ukraine), which had been regularly damaged by the ash black sawfly *Tomostethus nigritus* (Fabricius, 1804) (Hymenoptera: Tenthredinidae) for more than 20 years. The data on each tree's defoliation and health history were documented. Usually, EAB infestation is identified by the exit holes of beetles. However, in the case of infestation of the upper crown parts, the identification of the new spread of this pest can be late. Therefore, the purpose of our study was to determine tree characteristics that attract EAB. Long-term (since 2013) data about 90 ash trees' diameter, crown type, defoliation, health condition, epicormic shoot occurrence, etc., were compared to EAB presence in 2023 and 2024, identified by exit holes. In 2024, EAB infested 80% of the trees with traces of woodpeckers feeding, 91.1% with dieback, and 90.6% with epicormic shoots, asobserved in 2023. EAB infestation increased with tree defoliation by ash black sawflies. In 2024, EAB had infested all trees colonized by ash bark beetles (*Hylesinus* sp.) in 2023, and 88% of trees colonized by ash bark beetles in 2024. For 2023–2024, the proportion of trees with EAB exit holes increased from 8.9 to 79.2%, and those with dieback from 13.5 to 81.1%. Indirect symptoms (dieback and traces of birds feeding) suggest an additional infestation of more than 13% of trees.

sciforum-092862: Exploring Sustainable Forest Management in the Indian Himalayas: A Case Study of Traditional Knowledge and the Impact of Modern Development on Forest Ecology

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In a world where climate disasters have caused suffering for both the environment and humans, it is important to explore the existing relationship between forest ecology and the way it is managed by people. This article proposes to examine a case study of local forest management practices in the Indian Himalaya region. It will delve into their sustainable methods of managing the forest using traditional knowledge and examine the impact of modern development on their forest ecology. The area of study will be the mountain region of Lahaul in Himachal Pradesh, India. The research methodology for this study will primarily involve qualitative research methods such as interviews and focus group discussions with local community members. The importance of this study lies in its potential to contribute to the development of sustainable forest management practices that are both ecologically and socially beneficial. By examining the traditional knowledge and practices of the locals, this study will highlight the importance of incorporating local knowledge and practices in forest management policies. This study seeks to understand the dynamics between traditional and modern forest management practices and how they influence forest ecology. The findings of this research study will contribute to the development of a sustainable and holistic forest management policy that can serve as a model for other regions facing similar challenges. This study will also draw attention to the need for greater collaboration between policymakers and local communities in developing effective forest management strategies.

sciforum-093248: Exploring the Land Use Land Cover Change and Its Implications for Climate Regulation in the Ibadan Metropolis

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Land use/land cover is one of the major common global environmental challenges. Land use explains the interactions between humans and the environment, the results of anthropogenic activities, and the changes resulting from the activities. These changes contribute greatly to Earth–atmosphere interactions, biodiversity loss, and forest degradation. The detection of changes in land use/land cover gives important information about the trends in these changes. Their analysis will help to make informed and necessary decisions for climate regulation policy in Ibadan. This study analyzed the land use and land cover dynamics of the 11 local governments in the city of Ibadan using Landsat images taken from USGS Earth Explorer. The images were classified by Maximum Likelihood classification into four LULC classes: bare land, built-up areas, vegetation, and water bodies. The results showed that, in the city of Ibadan, there was a 29.93% decrease in land covered with vegetation between 2002 and 2022; 20.4% of vegetation areas was converted into built-up areas; and about 8.2% of vegetation areas was converted to bare land. The share of built-up areas increased from 10.32% of the total area to 36.12% in 2022. The NDVI result (0.59 in 2022, 0.56 in 2014, and 0.39 in 2022) showed a decrease in green areas due to the increase in built-up areas. This study revealed that urbanization processes are mainly responsible for land use/land cover change in Ibadan. In conclusion, this study advanced our knowledge of land use/land cover in Ibadan by providing information that is useful for policymakers and will help guide meaningful actions toward climate regulation.

sciforum-099859: Factors Affecting Bud Induction in *Fitzroya cupressoides* (Alerce) Embryos Cultured In Vitro

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'Alerce' is an endangered conifer native to Patagonia. Seed production is cyclic; seeds are frequently inviable in a high proportion, present dormancy, and there are no studies of their viability under long-term storage conditions. These difficulties impact their use in ex situ conservation programs. Thus, in vitro culture may provide valuable tools for the propagation of 'alerce'. We aimed to analyse the influence of stratification, scarification, and sterilization procedures; explant type; basal culture media composition; and 6-benzyladenine (BA) concentration on the success of bud induction. Firstly, we tested the effect of stratification, scarification, three sterilization methods, and four culture media (LP, SH, and the same media but with half macronutrients: HLP, HSH) supplemented with 4.4, 22, or 44 µM BA on bud induction, using whole seeds as explants. Stratification at 4 °C was evaluated in a period of 7–60 days; scarification was performed by immersing the seeds in H_2SO_4 for 2 min or in H_2O at 90 °C until reaching room temperature (before or after stratification). All seed lots that underwent stratification exhibited high contamination levels (>90%), whereas those subjected to scarification showed neither contamination nor bud induction. Secondly, an experiment without stratification nor scarification was conducted using the same media and BA concentrations mentioned above. Seeds were sterilized with 3% H_2O_2 + Tween 20 for 10 min, and whole zygotic embryos were used as explants. The contamination rate was 26.7%. Significantly higher bud induction was obtained with HSH (72.2 ± 25.4%) and with HLP (48.5 ± 8.7%), both supplemented with 4.4 µM BA. Bud formation was not observed with SH or LP supplemented with 22 or 44 µM BA. Seed viability (20.1 ± 5.7%) was similar to that reported for this species. These results will contribute to the development of a propagation protocol through organogenesis for alerce, a threatened species.

sciforum-090005: Form Factors and Diameter Height Modeling of Sal (*Shorea robusta*) in Nepal

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Timber volume estimation is fundamental for sustainable forest management. This study focused on estimating the form factor of *Shorea robusta* in various physiographic regions of Nepal, with a specific aim to develop a diameter-height model for the Terai region. Data collection involved the destructive sampling of 109 randomly selected *S. robusta* trees, with recorded information including diameter at breast height (DBH), tree height, and crown parameters. After destructive felling, overbark and underbark stem diameters, along with section lengths, were measured at intervals of 1 m up to the tree tip.

The analysis revealed average overbark form factors of 0.42, 0.41, and 0.4, and underbark form factors of 0.41, 0.4, and 0.38 in the Terai, Siwalik, and Middle Mountain regions, respectively. Form factor significantly varied with diameter class in Terai (p = 0.02 0.05) and (p = 0.04 0.05), Siwalik (p = 0.05 ≤ 0.05) and (p = 0.05 ≤ 0.05), and the Middle Mountain region (p = 0.006 0.05) and (p = 0.01 0.05) for overbark and underbark, respectively. Correlation analysis indicated a significant relationship, with DBH increasing with height (0.86, 0.80, and 0.83) while decreasing with both DBH (−0.47, −0.42, −0.64) and form factor (−0.41, −0.34, −0.40), respectively, in all regions. The Pearson correlation test further confirmed these relationships at the 5% level of significance.

For estimating tree height in the Terai region, a power form of the model H = 1.3 + 4.194 * DBH^0.464 demonstrated the best fit, with an adjusted R-squared of 0.79, RMSE of 3.47, AIC of 267.22, and a significant p-value (p 0.0001). This model contributes valuable insights for height estimation in *Shorea robusta* stands in the Terai region.

This research provides species-specific form factors that help improve the quantification of volume and other forest products, contributing to sustainable forest management in Nepal.

sciforum-099632: GIS Forestry Project of Seasonal Roads in the Siberian Federal District, Russia

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The seasonal use of roads includes construction and maintenance activities, depending on the season and weather conditions within a certain area. There are a number of scientific papers and web-GIS projects in Russia and worldwide discussing the seasonality of road use with variants of season duration, roads naming, technical methods of construction, etc. The regional forestry industry uses seasonal roads mainly for firefighting and logging, as additional elements to public road infrastructure. The present research had the aim to develop a forestry GIS project with spatial modelling of seasonal road use in the Siberian federal district of the Russian Federation. The chosen district has a large area, a constant need for the development of road infrastructure, and various regional forestry challenges. In order to reach our goal, we conducted a review of works on the spatial modelling of roads and their seasonality factor; created a model of permanent and seasonal roads use; and developed a database with the attributes of permanent and seasonal roads, finally presented as a web geoservice. GIS implementation is based on open source software and includes modelling of the road network in the QGIS application, using GeoDa and algorithms in Python. PostgreSQL/PostGIS was chosen as the software to create the geodatabase, a GIS server implemented with Linux and Geoserver. This GIS project ended with the
following conclusions. There is a lack of open data on the seasonal use of roads for the Siberian federal district and generally for Russia. According to the data we managed to collect, the Tomsk region, as part of the Siberian federal district, has the highest density of seasonal roads, and this could be explained by its actively developing natural resources. The regional services of the Emergency Situations Ministry and Rosavtodor, as well as regional administrations, are the most interested in such kinds of research in Russia.

sciforum-100044: Impacts of Soil Climate on Distributions of Forest-Forming Conifers in Current and Future Climates

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Introduction

Forests in Central Siberia represent a vast massif composed of six major conifers that shape the boreal forest: Siberian pine, Siberian fir, Siberian spruce, Scots pine, and two larches (Siberian larch on permafrost-free areas and Gmelin larch on permafrost). First, we built a bioclimatic model to predict major forest-forming conifer distributions based on atmospheric climate: warmth, water, and cold and soil permafrost. Our goal in this study is to supplement our model with soil climates: soil warmth and moisture and fertility resources.

Methods

For the mountain forests in southern Siberia (90–100 E and 52–56 N), a soil model was developed that related the forest composition to basic soil characteristics (warmth, moisture, texture composition, soil type, humus content, pH, C:N ratio etc.). Soil data (100 sites) were collected from the literature, which were accompanied by forest compositions from forest inventories and calculated climate data. The future climate was derived from the GCM INM-CM5-0 climate model for two scenarios, ssp126 and ssp585, at the mid-century.

Results and Conclusion

Soil properties were found to be important for conifer distributions over the mountains but less important than the atmospheric climates were. The genetic soil types and soil warmth and moisture appeared to be most important for the forest composition. The rest of the soil characteristics were much less important. Siberian larch and Siberian pine were found to be the most plastic conifers; Siberian fir was found to be the most demanding conifer. In the future climates, under additional warmth and plentiful rain across the mountains, as follows from the climate change scenarios, hydro-thermal conditions in soils would be favourable for the sustainability and productivity of coniferous forests.

sciforum-094573: Land Use Conflict between Farmers and Herdsmen—Implication for Agricultural and Rural Development in Nigeria

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In sub-Saharan Africa, the demand for livestock products, particularly milk and meat, is anticipated to increase between 3.2 and 3.9 percent year between 1997 and 2020 as a result of population expansion, income growth, and urbanization, according to Rose grant et al. (2001). They were evicted from Northern Nigeria due to the worsening environmental conditions, land degradation, and ongoing drought in the Sudan/Sahel savanna between 1960 and 1970. This explained why pastoralists left their home base and moved as far as the Guinean savanna and the edges of the forests in southern Nigeria 2007 (Fabusoro). The movement of nomadic pastoralists is said to be governed by variations in rainfall, grazing animals, pasture, and water, according to Adisa and Adekunle (2010) and Baba (personal communication). Gbaka (2014) reaffirms that while constantly moving toward pasture, water sources, salt licks, and livestock markets, the nature of the terrain that permits unhindered movement and protective mechanisms for their livestock against the whims of nature, they occasionally avoid the tsetse flies, severe weather, tribal enemies, livestock bandits, tax assessors, and hostile social environments. Additionally, such migration acts as a drought coping technique, Land disputes can cause conflict between farmers and herders. The effect of this is noticed on household wellbeing, loss of material resources, agricultural produce, and lower revenue. This is related to lack of grazing resources and climate change. Data was gathered via a structured interview schedule, focus group talks, visual representation, and personal observations. Descriptive statistics and factor analysis were then utilized to analyze the data. This presentation explores the various conflicts and makes recommendations for how to resolve them, including increasing awareness of land management, enforcing different regulations among farmers and herdsmen, providing grazing land, offering extension services to teach farmers and herdsmen about conflict coping.

sciforum-093957: Modelling Soil and Climate Effects on Radiata Pine Above and Belowground Carbon at Contrasting Sites in Chile

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Pinus radiata (D. Don) intensively managed plantations, that dominate Chilean forest landscape, have been challenged on their potential for carbon sequestration. Therefore, under this scenario, our study considered to account for potential under recognized carbon (C) sequestration pools and the following objectives: (i) above and belowground biomass (TBC), forest floor (FFC), mineral soil (SOC) and total C stocks (TCS) of adult stands at sandy and volcanic ash soils sites; (ii) model the effect of stand productivity and soil type on C stock; and (iii) model the C stock with respect to environmental, soil and site variables. Ten *Pinus radiata* stands were selected across a productivity gradient in sandy and volcanic ash soil sites. At each site, three 1000 m^2 plots were established. TBC was determined using allometric equations, while SOC was sampled to a depth of 1 m. Litter and woody debris were sampled to assess FFC. Results showed that recent ash soil sites presented a slightly higher TBC than sandy soil sites (178.5 Mg ha^{-1} vs. 172.4 Mg ha^{-1} respectively), and significantly higher SOC for recent ash soil sites (281.4 Mg ha^{-1}) than sandy soil sites (139.9 Mg ha^{-1}). In both soil types, FFC represented the lowest carbon stock of stands, with 2.9% for recent ash and 5.8% for sandy soil sites. There was a strong relationship between productivity with SOC and TCS (r^2 = 0.91, p 0.001) when considering soil type. The variables related to better nutritional and soil water conditions had a positive effect on the total C stock, and there was a negative effect on the variables related to water stress. Differences in C stocks according to soil type and climate showed the value of developing site-specific models to adequately estimate C stocks.

sciforum-094609: Modern Genetic and Dynamic Forest Typology: Priority Development Areas and Outstanding Problems

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The success of forest management depends to a large extent on the ecological classification on which it is based [1]. The purpose of this work is to review the current state, priority lines of development and unresolved problems of the original directions of ecological classification: genetic and dynamic forest typologies. Articles in journals on genetic and dynamic forest typologies from the past 10 years were selected and analyzed. Since its inception, genetic forest typology has focused on the study and classification of forests with complex structure and dynamics, and the use of new data analysis methods. The dynamic forest typology was originally developed to classify the disturbed vegetation of northern areas, which have relatively simple structures and dynamics. The current priority research areas of genetic and dynamic forest typology are the improvement of the conceptual and methodological bases of accounting in classification units for forest dynamics; the development of systems of regional classification of disturbed territories for their restoration; and the improvement of the methodology for identifying forest types based on the remote sensing of territories and modern data analysis methods. Currently, these typologies are being developed in parallel, using their scientific basis as well as the strengths of the European forest ecological classifications and the Braun–Blanquet approach. These typologies are of key importance for forest management in the Russian Federation and have great potential for further development under conditions of climate change and anthropogenic impacts.

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Reference

[1] Ivanova, N.; Fomin, V.; Kusbach, A. Experience of Forest Ecological Classification in Assessment of Vegetation Dynamics. *Sustainability* **2022**, *14*, 3384. https://doi.org/10.3390/su14063384.

sciforum-095193: New Methods in Digital Wood Anatomy: The Automatization of Pixel-Contrast Densitometry and Its Application across Angiosperms

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A new method of digital wood anatomy, pixel-contrast densitometry, was proposed recently for conifers. This technique can replace the X-ray densitometer with software that scans and analyzes the image. A photograph of the wood cross-section consists of pixels, i.e., dots of equal area belonging to either the cell wall or the lumen (empty space). By measuring the number of pixels of the cell walls and lumens, the ratio of the cell wall area to the total area of the scan can be determined. The result of multiplying this ratio by the cell wall matter density is the wood density, averaged for the scan area. We used this method to obtain another alternative parameter of wood structure, wood porosity, that is, the proportion of lumen area within scan. We applied this approach to eight angiosperm species of shrubs and trees in Southern Siberia, varying from ring-porous to diffuse-porous wood. The original software was created to implement the technique automatically.

Before analyzing images, their transformations were performed: (1) the Gaussian smoothing algorithm to clean the photo from noise and (2) the Otsu method to separate the cell walls and lumens. Then, a porosity profile over the entire cross-section of the growth ring can be constructed using the program's virtual sensor.

Good synchronicity between several measurements within ring proved that profiles of wood porosity describe the ring structure and capture inter-annual differences.

For samples of the three most long-living species, *Prunus padus* L., *Caragana arborescens* Lam., and *Alnus alnobetula* Ehrh., 14–32 year-long series of maximum, mean, and minimum porosity determinations and ring widths were analyzed, showing comparable inter-series correlations, common signals, and consistent inter-relations between these parameters of wood. This means that these easily measured characteristics register environmental variability during their formation. Directions for further research were also discussed.

sciforum-100068: Nutrient Dynamics in Major Forests of North-Western Himalaya, India

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Introduction

The North-Western Himalayan Region (NWHR) in India comprised of two states, Uttarakhand and Himachal Pradesh and two union territories of Ladakh and Jammu and Kashmir. The NWHR forest is rich in biodiversity, hosting a variety of plant species. The floristic account of forest type in N.W. Himalayas is divided it into four climatic zones *viz*., Tropical zone, Subtropical zone, Temperate zone and Alpine zone. Nutrient dynamics is broadly defined as the way nutrients are taken up, retained, transferred, and cycled over time and distance, in an ecosystem.

Methods

The data were gathered from various published studies on the NWHR through various databases. These studies were carefully reviewed in detail and presented.

Results

Various factors affect nutrient dynamics in forests including climate, soil, vegetation, topography, soil microbes and natural and anthropogenic disturbances. Nutrient dynamics in forest ecosystem can be understood through nutrient in forest soil, litter decomposition, throughfall, stemflow and nutrients in different plant parts. The studies of major soil nutrients (NPK) in North-Western Himalaya show variation with respect to different forest types, soil depth, altitude and season. Variation in litter production, decomposition and nutrient content is also observed among different forest types. Thorughfall, stemflow, nutrient uptake in different parts of trees and nutrient re-translocation also shows variation among different tree species.

Conclusion

Understanding the cycling of nutrients, such as nitrogen, phosphorus, and potassium helps maintain soil fertility, supports diverse plant species, and contributes to overall ecosystem resilience.

sciforum-096193: Quantitative Wood Anatomy of Scots Pine over 270 Years in the Foothills of the Western Sayan, Siberia

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With the advancement of methods for measuring the cell anatomical structure of conifer tree rings, dendroecology now possesses a robust methodological arsenal for analyzing previously inaccessible information about environmental dynamics during wood formation (xylogenesis). Key stages in this process are represented by quantitative parameters: the number of cells in the radial row (N) indicating production, tracheidograms (intraseasonal curves) of the radial cell diameter (D) reflecting growth by expansion, and cell wall thickness (CWT) representing secondary wall deposition. These parameters serve as promising proxies, offering detailed insights into the processes of seasonal wood growth and its internal and external regulation.

In this study, we utilized long-term (approximately 270 years) cell chronologies of average and maximum D and CWT for Scots pine (*Pinus sylvestris* L.) in the subtaiga zone characterized by moderate moisture deficiency. We identified their nonlinear dependencies on cell production in the cambial zone, expressed by N. By indexing those parameters, we excluded these dependencies, thereby minimizing the legacy effects, including inherited external signals. Subsequently, we analyzed the influence of intra-seasonal variations in temperature and precipitation, with daily time resolution, on the anatomical structure of tree rings using the indexed cellular chronologies. Our analysis revealed intraseasonal key intervals during which these climatic factors significantly influence the radial size and cell wall thickness of pine tracheids.

sciforum-099900: Red PINOS: A Participatory and Collaborative Governance Experience for Managing Exotic Conifer Invasions in Bariloche, Argentina

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The invasion of pines in the Argentine Patagonia, particularly in Bariloche, poses a significant challenge to biodiversity conservation and sustainable forest management. In response, Red PINOS, a participatory and collaborative governance structure, has emerged as a key alternative for articulating and coordinating efforts to address this issue in a comprehensive and holistic manner. This study aims to characterize the role of Red PINOS in mapping the social actors involved in pine invasion management in the natural--urban interface areas of Bariloche. Utilizing actor mapping techniques and social network analysis, the study identified and measured the levels of participation of diverse actors through various articulations. The initiative fostered various links and interactions, resulting in the establishment of a multi-actor, open, and dynamic round table that was previously non-existent.

The research identified twenty-eight actor groups linked to the issue, including ten from the public sector, five from the private sector, six from the academic--scientific sector, and seven from civil society. Currently, the governance table is comprised mainly of individuals from academic--scientific institutions, where the initiative originated, followed by the public sector, and civil society to a lesser extent. An initial link has been established with 70% of the actor groups, with the private sector presenting the greatest challenges for articulation.

The results demonstrate that Red PINOS has facilitated greater communication, consensus, cooperation, and synergy among government entities, non-governmental organizations, the scientific community, and civil society regarding action strategies for more efficient and effective pine invasion management. These positive outcomes are partially attributed to the mobilization of resources, knowledge sharing, and collaborative actions leading to increased awareness of the problem and mitigation of pine invasions. Examples: on-site removal efforts in a pilot area, growth of the social network, increased public interaction, and citizen participation in collaborative mapping of the invasions.

sciforum-092916: Redistribution of Qiongzhuea Tumidinoda in Southwest China under Climate Change: A Study from 1987 to 2012

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Qiongzhuea tumidinoda(a type of dwarf bamboo) stands out as an endemic bamboo species of significant conservation importance in southwest China, particularly in the upper reaches of the Yangtze River. It holds a pivotal role in poverty alleviation through the commercialization of its wood and bamboo shoots. However, the suitable area of this species is undergoing rapid changes due to climate change, resulting in species redistribution and potential losses for bamboo farmers. We utilized 209 presence records and 11 selected environmental variables to predict the potential suitable habitats for Qiongzhuea tumidinoda using Maxent and ArcGIS. Our findings revealed a southeastward shift and an elevation increase in the potential suitable habitats of Qiongzhuea tumidinoda. The area of potential suitable habitats in the study region exhibited fluctuating growth, expanding from 3063.42 km^2 to 7054.38 km^2. Mean monthly potential evapotranspiration (Pet) emerged as a critical determinant in shaping the distribution of potential suitable habitats for Qiongzhuea tumidinoda. Our study sheds light on the response of Qiongzhuea tumidinoda to climate change, offering valuable insights into the development and management of plantation industries associated with this species. In future, considering the high growth rate and possible larger suitable habitats, Qiongzhuea tumidinoda could be cultivated as a major crop to absorb carbon from the atmosphere, thus mitigating climate change.

sciforum-094702: Research on Optimal Biochar Amount Needed to Mitigate Salt Stress-Induced Effects on Germination and Growth of *Moringa oleifera*

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Nowadays, much attention is paid to the increase in abiotic stress caused by climate change. Salt stress is one of the major limiting factors threatening the majority of plant species, such as Moringa tree.

This study aims to assess the optimum use of biochar to alleviate the salinity stress-induced effects on the germination and growth of *Moringa oleifera*. To achieve our objective, biochar was applied at 5, 10 and 15% rates and saline substrate was applied at several concentrations (5 g, 10 g, 15 g/L NaCl). Our data showed that under the control condition (absence of salt), seed germination occurred earlier in soil amended with 5% of biochar compared to that in control soil (without biochar). It is crucial to note that the germination of Moringa seeds was reduced by 50% when the soils were amended with a rate of biochar of more than 10%. Moreover, in soil with increased salt stress levels, amendment with 10% of biochar enhanced germination. Furthermore, the leaflet number and seedling height were progressively reduced with the increase in the biochar amount in the soil. However, under th salt condition, 5% of biochar is efficient to alleviate the observed negative effect of salt on growth. In fact, the morphological aspects and growth of *M. oleifera* seedlings are diminished by biochar rates higher than 5%. It is demonstrated that salinity stimulated several adaptive responses such as antioxidant activity and a strong accumulation of secondary metabolites.

Concerning soil physical properties, regardless of culture condition, soil humidity is increased by the presence of biochar. Meanwhile, the soil's electric conductivity is reduced by the addition of a rate of 10% of biochar under control conditions.

We can suggest that biochar application at rate of 5% is recommended as an optimal level to enhance soil fertility, attenuate the negative effects of salt, stimulate germination and enhance the growth of *Moringa oleifera* under salt stress conditions.

sciforum-099635: Retrospective Analysis of OSM Road Data of Siberian Federal District, Russia for the Forest Transport Modeling

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The road network is a key element for the forestry in any region, and it has a significant impact on the overall development of the territory. The study aims to evaluate the applicability of road data for infrastructural GIS projects and forest transport modeling. We analyzed the parameters of archived road data on the Siberian federal district, Russia, for 2009, 2016, 2019, and 2023. The following tasks were set in accordance with the goal: to identify the dynamics of data changes from 2009 to 2023 for the regions and forestry management units of key areas, and to evaluate the geometry and attributive completeness of OSM road data. The most developed region in the dynamics of changes in the road network data was the Republic of Khakassia, where the number of roads increased more than threefold from 2016 to 2023. The least developed was the Altai Region, with an almost unchanged number of roads. There was a rather low density of road network in the Krasnoyarsk Territory, Irkutsk, and Tomsk regions. Forestry division for the Siberian federal district includes 286 units, and percentage of roadless units decreased from 27% in 2009 to 2% in 2023. The units of highest road density are located within the Novosibirsk, Omsk, and Kemerovo (Kuzbass) regions. Inconclusion, we state that present OSM road datasets as of 2023 are of help for projects that deal with infrastructure, and especially for forest transport modelling, but the content of OSM datasets has to be compared to road data from regional organizations and companies. A first experience of contacting them with a question of open data on the roads was gained, and we have some positive replies.

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sciforum-100001: Site Management Models for Optimum Yield of *Tectona grandis* Linn.f Plantations in Southern Nigeria

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The depletion of tropical rainforests is on the increase and plantation forests have been identified as a quick-fix measure. Sustainable management of plantation forests for optimum productivity is, therefore, essential. Hence, this study was carried out to develop site management models (site index) for *Tectona grandis* plantations in Gambari, Oluwa, Omo, and Sankpoba Forest Reserves, Nigeria. The data for the study were collected from six (6) age series (6, 8, 10, 12, 14, and 16 years old) in each location. Five (5) sample plots (25 m × 25 m) were randomly selected per age series (making a total of 120 sample plots) and two-thirds of the data were used for calibration, while the remaining one-third was used for validation purpose. Based on the index age of 10 years, the selected site index models constructed using the regression model approach in Gambari, Oluwa, Omo, and Sankpoba were SI = exp [ln(Hd) – 8.65 (A^{-1} – 0.1)], SI = exp [ln(Hd) – 5.77 (A^{-1} – 0.1)], SI = exp [ln(Hd) – 9.31 (A^{-1} – 0.1)], and SI = exp [ln(Hd) – 4.35 (A^{-1} – 0.1)], respectively. Using the graphical approach and proportional curve method, the plantations were stratified into five site quality classes, I to V (I = the best site and V = poor site). A 10-year-old Teak stand from this study attained average dominant heights (m) of 16.2, 14.1, and 9.8 (Gambari); 19.5, 16.0, and 12.3 (Oluwa); 21.8, 16.2, and 10.5 (Omo), and 15.5, 11.4, and 8.9 (Sankpoba) on site classes I, III, and V, respectively. This implies that a stand with a height development pattern similar to curve I is growing on the best site and has a higher volume if production than a stand with a height development pattern similar to curve V. It is recommended that site classes I to III should be used for Teak plantations in this study areas

sciforum-099874: Soil-Based Site Conditions Affect Productivity of silver Birch Regeneration More Than The Plant Species Richness

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This study investigates whether plant richness or soil conditions affect the productivity of silver birch (Betula pendula Roth.) stands naturally regenerated in central Poland to a greater extent. We analysed 31 plots with birch regeneration aged from 2 to 19 years. At each plot, we determined the features of birch stands, vegetation cover, and soil. Relevés were elaborated according to the Braun--Blannquet procedure and ecological indicator values were calculated according to Zarzycki et al. To describe soil characteristics, we sampled its upper 50 cm layer. In the laboratory, texture, reaction, total carbon, total nitrogen (C and N, respectively), and base cation contents were determined. These features served to calculate the soil fertility index. Tree height measurements were applied to determine the site index (i.e., height at the base age of 25 years) for the analysed stands with a previously developed formula. The stands were also characterised with density and volume. We found that the site index depended significantly on the C:N ratio and soil fertility index ($r = 0.36$, $p = 0.045$ and $r = -0.49$, $p = 0.005$, respectively), while the stand density and volume were driven by both soil features, namely pH and loam content ($r = 0.44$, $p = 0.013$ and $r = 0.36$, $p = 0.044$, respectively) and plant richness, i.e., the number of trees and ingrowths ($r = -0.52$, $p = 0.003$ and $r = -0.37$, $p = 0.038$, respectively). At the early stage of silver birch regeneration, soil conditions play a more important role in stand development than the vegetation cover, which has the negative effect on birch productivity.

sciforum-094882: Spatial Pattern Analysis in the Neighbourhood of Small and Large Trees in Akure Strict Nature Reserve, Nigeria

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Introduction

Tree size and spatial distance regulate tree distribution pattern and future development of forest stand. The relationship between neighbouring tree distance and size expresses competition and coexistence processes. However, presence of different sizes and shapes makes no

single tree size variable consistently related to spatial tree distance. Hence, detection of tree competition and coexistence processes in tropical natural rainforest is difficult. Therefore, understanding the dominant process regulating tree distribution at different spatial distances is required for efficient management of forests. This study was designed to investigate spatial patterns of tree distribution in Akure Strict Nature Reserve.

Method

Eleven 11 (30 m × 30 m) plots was demarcated systematically on two parallel transects with interval of 50 m in this study. Tree stem with diameter-at-breast height (dbh ≥ 5 cm) enumerated, identified to species level and measured for diameter, total height and crown diameter. Two trees (Large and Small DBH) were selected as reference trees. A circular subplot of radius = 10 m; (314.2 m^2) was demarcated around each of reference tree and trees with DBH ≥5 cm within subplot were enumerated and their distances to reference trees were measured. Data collected were analysed using correlation and Nearest Neighbour analyses at α0.05.

Result

Twenty seven percent (27%) of the subplots expressed significant negative correlation between distance and canopy area up to distance of 7.37 m around Large reference trees while 18% of subplots expressed significant negative correlation between distance and canopy area at 6.65 m distance around Small reference trees. Hundred and 90.9% of subplots of Large and Small reference trees, respectively, expressed regular pattern at 10 m distance scale, Regular pattern increased and aggregate decreased with increasing distance scale.in subplots of Large and Small reference trees.

Conclusion

Spatial distribution of trees around large and small trees expressed canopy structure stratification and weak competitive interaction. in Akure Strict Nature Reserve.

sciforum-088859: Strategies for Enhancing Ecosystem Resilience to Climate Change

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This review aims to provide information about "Strategies for Enhancing Ecosystem Resilience to Climate Change". A community of living things interacting with their natural surroundings is called an ecosystem. The term "environment" refers to both the physical surroundings and living things. Despite being linked, these two are inseparable. Nutrient cycles and energy flows connect the physical and biological components. Significant variations in the world's temperature, precipitation, wind patterns, and other climatic indicators that last for several decades or more are referred to as climate change. The necessity of increasing climate change resilience, lowering risks, and minimizing greenhouse gas (GHG) emissions is highlighted by extreme and frequent manifestations of climatic variability. Households with low incomes and the impoverished are disproportionately affected by climate change. These households in developing nations are frequently the most dependent on industries (fisheries, forestry, and agriculture) that are sensitive to climate change and have little ability to adapt. According to research conducted in 2023, between 2000 and 2019, climate change-related losses and damages cost the world at least USD 2.8 trillion, or around USD 16 million per hour. Enhancing ecosystem resilience to climate change is crucial for the well-being of our planet. A few strategies involve putting policies in place to lower greenhouse gas emissions, encouraging sustainable land-use practices, and preserving and restoring natural habitats. To build a future that is more sustainable and resilient, cooperation is essential.

sciforum-096125: Sustainable Livelihood, Sustainable Forest: A Case Study in Java Forest, Indonesia

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The globalization era presents challenges for humans to achieve sustainable living. In achieving this, natural resources, especially forests, are the main focus of attention because of their
central role in supporting human life and environmental sustainability. Along with population growth and economic development, pressures on forests are increasing, impacting the balance within the ecosystem and the human welfare. In this background, it is crucial to understand that human sustainability cannot be separated from ecosystem sustainability. Forests provide wood and other forest products and play roles in maintaining water availability, reducing carbon emissions, and maintaining biodiversity. This research presents a comprehensive and integrated concept for achieving sustainable human life through a symbiotic relationship between sustainable livelihoods and forest preservation. Data collection was carried out for two years among forest communities in three villages in Central Java Province, Indonesia, based on the region's
geographical conditions and the community's socio-cultural conditions. Primary and secondary data sources were used, with research informants identified as heads of Forest Village Community Institutions (LMDH), forest farmers, accompanying facilitators, forest police, forestry officers, and community leaders. Data collection involved interviews, observations, focus group discussions, and searching for secondary data. All data was then analyzed using the spiral model. This research found a concept of balance between "Sustainable Livelihood" and "Sustainable Forest" as the foundation for achieving a sustainable life because human sustainability cannot be separated from ecosystem sustainability to achieve balance. To achieve a balance between "Sustainable Livelihood" and "Sustainable Forest," it is necessary to have policy efforts that support forest management. These institutions can bridge between communities and forests, as well as community culture. These results provide a new perspective on balancing forest use and ecosystem conservation and how this can contribute to achieving a holistically sustainable human life.

sciforum-100010: The Dark Coniferous Taiga of the Russian North Is Drying out against the Backdrop of Modern Climate Change

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This study investigates the decreasing resistance of dark coniferous forests to adverse environmental factors, which are becoming increasingly pronounced yearly because of modern global climate change. Boreal coniferous forest degradation and dieback are observed in a large area of Russian forest lands, including dark coniferous forests in the north of the European part of Russia. The research objects are dark coniferous forests of various condition categories in areas of intense drying out in the Arkhangelsk region and old trees growing in conditions with an expressed impact of a specific limiting factor. A study of dead and drying tree areas was carried out on the territory of the Sursky forest district (Arkhangelsk region), and a climate reconstruction was implemented for the Sursky forest district and the coast of the Unskaya Bay (Onega Pomorie National Park). Pine was chosen as an auxiliary species for dendroclimatic analysis since old pine trees grow on the Onega Pomorie territory and exhibit long-term climatic signals. The dendrochronological method was applied to determine the relationship between meteorological parameters and tree growth, and a forest pathological examination of trees was conducted. The determined fundamental causes of forest dieback were the trees weakening under the influence of
adverse climatic conditions, droughts in particular, and subsequent tree damage by stem pests.

sciforum-098994: The Dendrochronological Potential of *Salix lederbouriana* Trautv. on the Patch Ecosystem of the Desert-Steppe, Mongolia

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Recent increases in livestock numbers throughout Mongolia could alter plant communities, and the soils of habitats differ by landscape position. There is little research on the potential of dendrochronology to elucidate the effects of climate change, long-term drought, and grazing on perennial shrubs growing in the patch ecosystem of the desert steppes and low mountains in Mongolia. In particular, willows, which grow predominantly in patch ecosystems with oases and springs, play an important role in the functional activities of that ecosystem service. In recent years, natural factors such as low summer rainfall, long-term warming, increased frequency of thunderstorms, and the effects of grazing pressure from the increased number of livestock have led to the deterioration in the habitat around the spring, and the growth of perennial shrubs has decreased dramatically. Therefore, we aimed to determine the response to the dendrochronological potential of Willow (*Salix lederbouriana* Trautv.) species. Our findings indicate that the annual growth ring of Willow (*Salix lederbouriana* Trautv.) species is influenced differently by climatic factors. For instance, climate factors have a relatively weak correlation (r = −0.29) with annual ring growth, but growth between years is significantly different (F = 4.36, DF = 19, $p > 0.001$). Furthermore, it is indicated that there is a need to develop conservation and management strategies for Willow species that grow predominantly in the desert steppe ecosystem.

sciforum-099972: The Impact of Extreme Weather Conditions on the Forest Dieback in the Polish Mountains

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In the last decade (2011–2020), forests in the Sudetes Mts. (Poland) have shown a marked increase in the release of deadwood and an acceleration of the process of tree dieback. One of main tree species in the Sudetes is spruce, which quickly disappears from this area. The aim of the work was to determine the impact of climatic conditions on this process. The research used two measures characterizing the tree dieback process: the tree dieback intensity index and the tree species dieback intensity index. The following bioclimatic variables were used to estimate the impact of climatic conditions: air temperature, precipitation, hydrothermal Sielianinow index (HTC), forest aridity index (FAI), and the frequency of hurricane winds. Since 2015, there has been a very significant acceleration (10 times on average for the area) of tree dieback; the intensity coefficient of this process in 2015–2020 was several times higher than in 2011–2014. The greatest intensity of stand decay occurred 300–600 m above sea level, mainly coniferous species die, especially spruce, and to a lesser extent deciduous species. The intensification of the dieback process began after the extreme drought in August 2015. Another extreme spring–summer drought in 2018 and summer heat waves intensified this process. An additional factor weakening tree stands was the more frequent occurrence of strong winds (e.g., the hurricane 'Grzegorz' in 2018). The high volume of deadwood in 2017 and 2018 was augmented by quite a high volume of wind-broken and wind-fallen trees. These weather conditions constituted an important factor in the development of secondary pests. The weakened spruces were attacked by the bark beetles, the outbreak of which caused a massive dieback of spruce stands. In the last two years, mistletoe (*Viscum album ssp. album*) has become an increasing threat to forests in the Sudetes.

sciforum-089889: The Urgency of Implementing Field Research for Fir Forest Conservation and Management: Case Studies in Central Greece

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Findings from monitoring Greek fir forests in central Greece, regarding radial growth, insect infestations, plant communities, and climate response, have indicated the need for the immediate implementation of further field research within the fir forest ecosystem of the Giona and Parnassus mountains. This underscores the urgency of adopting measures to mitigate the impacts of both abiotic and biotic factors.

Our findings so far, encompassing biometric data, tree ring analysis, observations on plant communities, climatic response, and insect infestations—primarily *Choristoneura murinana*—across various stands on the mountains, have revealed significant local infestations of varying degrees. In many instances, these infestations were detected in adult trees, particularly in sunny areas or near country roads. Furthermore, our research has revealed the varied ability of the fir trees to adapt to both minor and significant climatic variations. The proposed research aims to monitor, preserve, and protect the fir trees, utilizing new knowledge for informed decision-making in their management. The project's scope includes studying the growth characteristics of the fir forest, mitigating threats from biological factors (primarily the moth *Choristoneura murinana*-Lepidoptera, Tortricidae) by involving pheromones and other biological methods, promoting natural regeneration, preserving biodiversity, and evaluating the water status of the fir trees in response to climate change. Investigating their interactions and understanding the ecosystem's status concerning the previously mentioned aspects is a significant priority for biological and genetic diversity, landscape aesthetics, recreation, and sustainable regional development (with economic impacts on local beekeepers and guesthouse owners).

The evaluation of the implementation of the National Biodiversity Strategy in Greece has shown partial or minimal progress in addressing new threats and challenges. The proposed project, with specific actions, aligns with the spirit of the National Biodiversity Strategy and contributes to the strategy goals, within the framework of conservation, restoration, and the strengthening of nationwide enhancement actions.

sciforum-099917: Wildland–Urban Interface Invasions by Exotic Conifers in NW Patagonia: Mapping Public Engagement

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The introduction of non-native conifers in Patagonia poses a significant environmental threat. These invasive trees disrupt essential ecosystem services, diminish biodiversity, and heighten wildfire risks. This study, driven by the multi-actor partnership "Red PINOS", investigates the potential of citizen science to assess public concern regarding the encroachment of these conifers in wildland–urban interfaces (WUIs) around Bariloche, a Patagonian city (Argentina).

To engage the public in mapping invasive conifer invasions and to gather information on locations of concern, a popular messaging platform was used to collect geospatial data and photographic evidence of these trees within Patagonian WUIs. Participants were invited to join a dedicated group within the platform. Once they joined, the participants received instructions on how to capture and submit relevant data. Citizen participation was heavily promoted across media (social media, radio, TV, newspapers).

We received records of 58 invasion foci, which reported the removal of 839 small-sized individuals up to 1.5 m tall. The most reported species were Pseudotsuga menziesii (57%) and Pinus contorta (24%), followed by Pinus ponderosa (8%). The records were widely distributed across WUIs in Bariloche, including areas dominated by diverse habitats: steppe, shrubland, and forest. Despite being the first public call for citizen participation, the initiative generated a significant number of contributions, suggesting potential for public engagement regarding invasive conifer threats.

These early results represent a significant achievement for Red PINOS, demonstrating the effectiveness of citizen science in fostering participatory governance and highlighting the importance of incorporating public perspectives into invasive species management strategies. As Red PINOS continues to expand its outreach and engagement efforts, citizen science is poised to play an increasingly crucial role in addressing the complex issue of the invasive spread of non-native conifers in Patagonia.

Session 2. Forest Biodiversity, Ecosystem Services, and Earth Observations

sciforum-095438: Evaluation of Land Cover and Use through Artificial Intelligence in the Premontane Humid Forest of the Munchique Natural Reserve, Quilichao River Basin, Cauca, Colombia

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Land cover and land use assessment is crucial for the sustainable management of natural resources and biodiversity conservation, especially in diverse and fragile ecosystems such as the Andean forests. This research aimed to identify changes in vegetation cover and their impact on land use in the Munchique Natural Reserve, in the Quilichao river basin, Cauca, Colombia, an area that harbors high biodiversity and numerous ecosystem services.

A land use and land cover classification (LULC) was performed using Sentinel 2 satellite imagery for the period 2018–2021, using ArcMap 10.8 and QGIS 2.18 software with the MOLUSCE plugin. A multi-layer artificial neural network (ANN) was used to predict changes up to the years 2030 and 2050, allowing to assess future land use dynamics. The land transition analysis showed a reduction of 102 ha of dense vegetation and 17 ha of pasture between 2019 and 2021, due to agricultural expansion.

The MOLUSCE plugin simulated land cover for 2030 and 2050. The validation of the simulation showed an accuracy of 98.70% and a kappa coefficient of 0.99487, indicating high accuracy in predicting land cover change. Future predictions suggest the loss of more than 300 ha of dense vegetation between 2021 and 2030, and 437.26 ha between 2021 and 2050, in addition to an increase of approximately 800 ha of crops in the same period. These impacts must be integrated into planning to ensure biodiversity and ecosystem services.

The results of this research provide key information to identify territorial conflicts and contribute to the sustainable management of natural resources in this region of Colombia.

sciforum-090971: A Brief Study on the True Freshwater Crab *Potamon ibericum* (Bieberstein, 1808) Absence Downstream of Kasilian River, Mazandaran, Iran

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Potamon ibericum is one of the true freshwater crab species in Iran, which has been endangered in recent years due to climate change and human activities. This freshwater crab is mostly found in the rivers located in the Hyrcanian forests of northern Iran, due to their high food diversity and suitable temperature. In this research, we focused on the absence of this species downstream of the Kesilian River, and we achieved important results. Sampling was conducted at eight different points along the river in April, June, July, September, November, and December to study the effects of temperature and environmental conditions on *P. ibericum* distribution. Our study revealed that the reasons for its absence are related to numerous human and non-human factors. The human factors include poultry farming; heavy machinery passing through the river to transport logs, sand, and rocks, which often result in oil and fuel leakage; and the expansion of agricultural and horticultural activities. The non-human factors include the presence of invasive species such as hooded crows and temperature changes, where the highest population of live crabs was observed during the warmer months, while the lowest population was recorded during colder temperatures. These findings emphasize the critical role of temperature conditions and human activities in the habitat distribution of *P. ibericum*, which has significant implications for further studies and conservation measures. Our goal is to help formulate strong strategies that ensure the sustainable presence and flourishing of *P. ibericum* in its native environment and encourage other researchers to investigate more deeply in this field.

sciforum-101766: AI-Based Approach to Foster Access and Scale to Real-Time Ground Forest Analytics

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Traditional forest measurement methods are labour-intensive, costly, and prone to errors, hindering scalability and accessibility. While remote sensing offers valuable insights, it falls short in capturing crucial details beneath forest canopies, leading to inaccuracies in carbon stock calculations. This study introduces a citizen-science-based approach that leverages smartphone technology and artificial intelligence (AI) to democratize and enhance real-time forest analytics.

The methodology employs a mobile application that guides users through Point Sampling, as described by Bitterlich (1948), eliminating the need for specialized tools and expertise. Users capture geotagged photos at designated points within the forest, which are then analysed by a computer vision model to reproduce forestry equipment like a prism, counting tree trunks, identifying their species, and determining ground characteristics, paired with remote sensing inputs. By integrating smartphone capabilities with AI-driven analysis, the platform enables rapid estimation of forest parameters, including basal area, biomass, vegetation structure, and biodiversity insights.

The qualitative results highlight the efficacy of this approach in overcoming the limitations of traditional field forest inventory methods. The user-friendly interface of the mobile app empowers local communities to actively participate in data collection alongside experts, fostering inclusivity and environmental stewardship. This innovative approach not only reduces costs and time associated with forest assessments but also promotes community engagement and contributes to more sustainable forest management practices.

sciforum-100085: Integrating Ecology and Territorial Management: Balancing Biodiversity Conservation with Agricultural Production in the Argentine Gran Chaco

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Bringing ecology closer to territorial management is fundamental to achieving a sustainable approach. It is a challenge to reconcile intensified agricultural production with the conservation of biodiversity and related ecological processes. As the magnitude of threats to biodiversity becomes increasingly recognized, the need for effective management inside and outside protected areas is evident. Management decisions have a direct impact on resources, so they must be based on rigorous evidence and scientific information. Some of the objectives considered are to recognize the most characteristic qualities in terms of management strategies for conservation areas; to distinguish the matrices in which they may be immersed; and to contemplating land-sparing and land-sharing models and their influence. To integrate diverse experiences of protected area management in Latin America with landscape analysis according to the land-sharing and land-sparing models, a comprehensive search for relevant articles was conducted. The Mendeley search engine was used and the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was implemented for article selection. Protected areas are essential conservation strategies. Effective management is crucial for achieving conservation goals, considering not only biodiversity but also cultural diversity, social development, and the sustainability of communities in direct and constant contact with them. In this context, we recognize two models, land-sharing and land-sparing, which contribute to landscape heterogeneity and diversity. Although this quality enhances diversity in the studied matrices, there is debate about which model is more recommendable for biodiversity conservation and productive activities, as they impact the balance of socio-ecosystems differently, both positively and negatively.

sciforum-099999: Abundance and Diversity of Butterfly Species across Different Land Use in University of Ibadan, Ibadan, Nigeria

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The University of Ibadan is renowned for its urban forest environment and biodiversity. This study therefore assessed butterfly species abundance and diversity across different land use in the University to enhance forest management practices and encourage biodiversity conservation. The University was stratified into five land use categories: Farming, Residential, Recreational, Aquatic and Utility areas. Three 500 m × 10 m line transects at least 100 m apart were established in each stratum and surveyed from 9:00 h to 12:00 h, twice a month for a period of 5 months (January–May). Visual encounter survey was employed to enumerate all butterflies encountered, while standard field guide was used to identify butterfly species. Point Centre Quadrant method was used to assess the tree species present. Data obtained were analyzed using percentages, means, ANOVA and Shannon-Wiener index. Tree species identified include; *Milicia excelsa*, *Terminalia superba*, *Terminalia Africana*, *Alstonia boonei*. A total of 2660 butterflies from 41 species belonging to 5 families: Nymphalidae (52.0%), Pieridae (23%), Papillionidae (9.0%), Lycaenidae (9.0%), and Hesperiidae (7.0%) were recorded. The highest (83.6%) and least (41.2%) butterfly populations were recorded in Aquatic and Residential areas, respectively. Shannon–Wiener Index was highest in Aquatic (2.80), followed by Residential (2.54) and least in Farm (2.35) areas. Species richness was highest (24.22 ± 5.03) and lowest (16 ± 2.98) in Aquatic and Recreational areas, respectively. *Junonia oenone* is the most (300) abundant, followed by *Eurema hecabe* (237) and the least are; *Nepheronia thalassina*, and *Hypolimnas misippus* (2 each). There was significant difference in species abundance across land use in the University ($\alpha_{0.05}$). Although land use has significant effect on the abundance and diversity of butterfly species, the University is a healthy environment considering the butterfly diversity.

sciforum-097735: Analysing the Climate Variability and Reforestation Activities in the Areas Adjacent to Internally Displaced Camps in Darfur

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Decades of conflict in the Darfur region of Sudan have inflicted widespread environmental degradation and displacement of local communities. This study employs advanced high-resolution satellite imagery analysis to investigate the intricate impact of prolonged conflict on land use management in Darfur, focusing on the assessment of afforestation activities and their implications for achieving Sustainable Development Goal (SDG) 15—Life on Land. This research utilized PlanetScope time-series imagery to examine the El-Salam internally displaced persons (IDPs) camp in Southern Darfur. Object-based image classification (OBIA) methods within QGIS 3.28.6 and Orfeo ToolBox 8.1.2 were applied for accurate image classification. Major land use and land cover (LULC) classes, including agricultural land, built-up, vegetation cover, bareland, water bodies, and dry wadi, were successfully identified through supervised classification with an overall accuracy ranging from 90.66% to 95.14%. The findings reveal a noteworthy increase in the percentage of vegetation cover, rising from 1.48% to 2.33% between 2010 and 2024, respectively, indicating a substantial change of 0.85% over the study period. Additionally, water bodies experienced a significant increase from no water bodies 0 to 0.03%, equivalent to (6.08) hectares. These improvements are linked to reforestation initiatives, where artificial water harvesting aquifers are built, and the considerable general increase in rainfall from 2014 to 2022. The statistics further show a rapid reduction in bareland areas from 58.43% to 42.40% between 2010 and 2024, respectively. This research significantly contributes to the existing knowledge on the positive environmental consequences of sustainable land use management, particularly in conflict-affected regions. The implications extend to the global sustainable development agenda, offering valuable insights into the restoration and preservation of terrestrial ecosystems within conflict zones, thereby addressing SDG 15: Life on Land. A future study is suggested to investigate in detail the drivers and consequences of the changes in conflict-affected communities.

sciforum-092985: Assessing the Impacts of Climate Change on Tropical Dry Deciduous Forests in Lesser Himalaya: A Phytosociological Perspective

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Tropical dry deciduous forests play a vital role in maintaining biodiversity and ecosystem services, yet they are increasingly threatened by climate change. This study aims to assess the significance of Pakistan's tropical dry deciduous forests in the context of ecological variables and climate change impacts. A comprehensive phytosociological survey was conducted to understand species composition, vegetation patterns, and environmental drivers influencing these
forests. The study area, located in the lesser Himalayan mountains of Pakistan, revealed the presence of 140 woody plant species belonging to 52 families. Through various multivariate analyses, nine distinct plant communities were identified, with the *Dodonaea viscosa-Acacia modesta-Dalbergia sissoo* community being the most dominant. Cluster analysis grouped these communities into five clusters, highlighting the spatial distribution patterns across the study area. Detrended Correspondence Analysis (DCA) and Canonical Correspondence Analysis (CCA) were employed to assess the relative significance of environmental variables in shaping species composition and distribution. Altitude, precipitation, and temperature emerged as primary factors influencing the distribution and composition of tropical dry deciduous forests along the Himalayan foothills. Higher altitude forests, characterised by maximum rainfall and lower temperatures, exhibited rich vegetation diversity, whereas lower altitude forests experienced higher temperatures and lower precipitation levels. Notable discrepancies were observed between protected and unprotected forest areas, emphasising the importance of immediate management interventions and in-situ conservation strategies. Based on the findings, recommendations include adopting mitigation and adaptation approaches to combat the increasing temperature and low precipitation in lower altitude areas. Mitigation strategies such as afforestation and renewable energy promotion, coupled with adaptation measures like forest restoration and community-based conservation, are essential for ensuring the resilience and sustainability of Pakistan's tropical dry deciduous forests in the face of climate change.

sciforum-098917: Assessment of Plant Species and Biodiversity in SUST Campus—A Peri Urban Area

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This study provides extensive taxonomic data on the floristic composition and assessment of the biodiversity that exists on the semi-natural Shahjalal University of Science & Technology campus. Using statistical information gathered through surveys carried out over a one-year period, this study presents a thorough analysis of the relationship between stakeholder perceptions of the biodiversity and composition of herbs, shrubs, and climbers on the campus. In total,
55 students, 15 teachers, and 10 staff from the campus took part in the survey. Most respondents are not entirely satisfied with the campus' biodiversity. They value green spaces and see them as critical to the campus' atmosphere as well as to the university's reputation. A total of 181 species under 160 genera and 84 families were identified with the help of Bangladesh National Herbarium. Moreover, the local names of some species were also found by the local people. This study demonstrated that out of 181 plant species, 66% of them were herbaceous, followed by 29% of shrubs and 5% of climbers. *Axonopus compressus* was the species that was most prevalent on the campus. Asteraceae, which had 18 species, was the most numerous family, followed by Poaceae (17 species) and Leguminosae, which had 13 species. As a result, when compared to other areas, the study area is floristically rich in climbers, shrubs, and herbs due to the sheer quantity of distinct plant species it contains. One globally vulnerable (VU) (*Araucaria heterophylla*) and one near-threatened (NT) (*Platycladus orientalis*) shrub were found in this campus area. All species have value in terms of the economy or the environment, but they are mostly used as grasses, weeds, ornamentals, medicinal plants, forage, fodder, and vegetables. By improving the current management and implementing the essential policies and methods, this region might become a superb campus-based center for the protection of biodiversity.

sciforum-099581: Assessment of Snow Water Supplies for Istra Station Territory Using Sentinel-2 Imagery Data

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This article investigates the relationship between snow and its water supply accumulation and qualitative and spectral-reflective forest characteristics. This study aims to develop methods for determining snow water supplies using Sentinel-2 imagery data. Our research is based on experimental fieldwork and previous analyss of the features of water accumulation in the snow in various natural landscapes. Considering the previously obtained snow accumulation dependences on the species composition, age, and forest density, modern approaches in forest inventory interpretation were used to identify how snow accumulation and its water content correlate with territory features. The designed method determines snow water supplies according to optical satellite imagery or forest inventory materials based on a small number of field measurements. The method's accuracy relies on the diversity of examined landscapes and ecosystems. The fieldwork was carried out on the territory belonging to the hydrological station of the Federal Budgetary Institution "All-Russian Research Institute of Silviculture and Forestry Mechanization" (FBU VNIILM), located in the Istra area, Moscow Region. Snow sampling and forest inventory were conducted along the routes that included various landscapes, from open spaces to high-density coniferous forests. This method estimates the water content in snow that we propose can be used to forecast moisture availability, surface runoff, and flooding and assesses the consequences of early spring droughts. The designed territory zoning of snow water accumulation is confirmed by plenty of previous studies conducted in similar conditions. The distinguishing feature of the method described in this article is the possibility of accurately assessing the snow water content while carrying out minimum experimental studies in vast areas, such as municipal districts or regions.

sciforum-099927: Biomonitoring Air Quality for Praseodymium in Leicestershire (UK)

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Aims

The aim was to biomonitor air quality for praseodymium (Pr) in Leicester city (England) after detecting slight contamination of this element in topsoils across the city and surrounding rural areas, when compared with other industrialised towns in Europe.

Methods

Thin layers of bark were collected from 96 trees from Leicester (n = 55) and surrounding rural/suburban areas (41), at a consistent height of 1.50–1.80 metres from the ground. Pr was monitored by ICP-MS in cleaned/ground/homogenised samples mineralised with HNO_3/H_2O_2 [LoD = 0.157 ng/g dry weight (dw)]. The data were compared with the levels of Pr described in 52 topsoil composite samples collected in the same year (2017–2018).

Results

The levels of Pr were slightly higher in the samples collected from trees that grw in urban areas (median and ranges, in ng/g dw): 2.611 (0.714–47.603) and 2.450 (0.757–14.839). These results might be explained by the presence of Pr monitored in topsoils, in which no statistical differences were found between both main areas, detecting a wide distribution of this element across the city and in surrounding rural areas. Levels were much higher than the range reported in *Pinus ponderosa* bark samples (US; 1.85–2.69 ng/g dw) collected in an area in eastern Washington away from roads, to reduce the effect from traffic, suggesting some anthropic atmospheric contamination of Pr in Leicester city and surrounding areas, derived from different sources such as agricultural practices, waste disposal, metal recycling, vehicular/industrial emissions, and urbanisation. However, the toxic risks derived from the ingestion of and dermal contact with Pr present in topsoils in Leicester city is likely to be minimal.

Conclusion

The presence of Pr in air in Leicester could be affected by different anthropic sources that should be investigated to reduce its presence; studies should include the monitoring of the content of Pr in particulate matter in Leicester city.

sciforum-100276: Comparative Analysis of Unmanned Aerial Vehicleand Mobile LiDAR Systems for Forest Inventory Parameters

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The advancement of Light Detection and Ranging (LiDAR) technology has revolutionized forest inventory practices by providing precise and detailed data on forest structure. This study aims to compare the accuracy, efficiency, and cost-effectiveness of two LiDAR platforms, Unmanned Aerial Vehicles (UAV) LiDAR and Handheld Mobile Laser Scanners (MLS), in capturing key forest inventory parameters such as stem mapping, diameter at breast height (DBH), and tree height. This study was conducted in a pine forest located in Chalkidiki, Greece. LiDAR data were collected using UAV LiDAR (DJI Matrice 350 RTK with Zenmuse L2) and a Handheld Mobile Laser Scanner (Leica BLK2GO) over the same forest plots. Additionally, manual measurements were conducted to serve as ground truth data. The raw LiDAR data were processed to extract forest inventory parameters, including point-cloud classification, segmentation, and parameter extraction. The platforms were compared based on data accuracy, time efficiency, ease of use, and cost, with statistical analyses performed to evaluate the differences in measurements obtained from each platform against ground truth data. Preliminary results indicate that both LiDAR platforms can effectively capture forest inventory parameters, but with varying degrees of accuracy and efficiency. UAV LiDAR demonstrated high efficiency and coverage, particularly in capturing canopy structure. The handheld mobile laser scanner offered flexibility and detailed ground-level measurements, providing more information below the canopy, but was strongly affected by complex terrain. These technologies offer significant potential for creating comprehensive 3D forest structure models, which are essential for future forest inventories in Greece and can aid in sustainable forest management.

sciforum-099951: Content of lutetium in Wild Soil Mushrooms from Leicester City and Surroundings Areas in England

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Background

Although the ingestion of and dermal contact with lutetium (Lu) has recently been measured in topsoils across Leicester (UK) and surrounding rural areas as low risk, this heavy rare earth element (HREE) was biomonitored in wild mushrooms.

Methods

A total of 106 mushrooms were collected from Leicester city and Bradgate Park. Species identification was confirmed by DNA barcoding. Lu was monitored by ICP-MS in cleaned/dried/homogenised mushrooms [LoD = 0.506 ng/g dry weight (dw)] and in topsoils collected in these areas; physicochemical properties and textures were also determined in topsoils using standard methods. The data were processed with NADA available in R software, owing to the censored values detected in mushrooms (60.8%).

Results

Contrary to the distribution determined in topsoils [0.123 (0.069–0.162) vs. 0.117 (0.084–0.182); median and ranges, mg/kg], the levels of Lu were higher in mushrooms collected in the main urban area (median and ranges, in ng/g dw): 0.347 (0.285–293.837) vs. 0.196 (0.780–8.116). The content of Lu in topsoils would only have a small effect on the levels of Lu detected in mushrooms, which is supported by the lack of correlation found between mushrooms and topsoils (p-value = 0.506) and by the different physicochemical properties and soil textures monitored. This pattern is different to other HREEs studied in the same areas, which might be explained by an unknown appetence for Lu by the different local species of wild soil mushrooms collected. Lu also varied between major mushroom species collected (median or 95-percentile and range, in ng/g): *Agaricus bitorquis* [edible; 88.6% of censored values, 1.518 (0.798–6.715), *Panaeolus foenisecii* [poisonous; 1.740 (0.812–49.692)], and *Mycena citrinomarginata* [unclassified; 0.855 (0.285–10.351)]. Lu also seemed to show little appetence for wild edible species when comparing with non-edible.

Conclusion

Although our results should be considered as preliminary, in general, collecting local wild edible mushroom species in Leicestershire would represent a small risk for humans due to their content of lutetium.

sciforum-100102: Deforestation and Its Causes in the Department of Tolima, Colombia, between 2015 and 2021

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Tropical forests perform environmental functions at different scales, from the local to the global. As an action for the protection of forests, the dynamics of the disturbances that affect it should be analysed; for this reason, it is necessary to determine the degree of deforestation in the department of Tolima and the associated causes. The methodology used considers the integration of social perception with spatially explicit data models, which allowed the analysis of changes and deforestation at numerical, spatial, and temporal levels. As a first measure, an analysis of global changes, forest changes, and systematic and random transitions was carried out. Subsequently, deforestation was evaluated, based on a numerical estimate, followed by the determination of the causes of deforestation with the application of a spatial logistic regression model. The results indicate that the forest present in 2015 was reduced; however, in 2021, the forest acquired new areas, which entails a net increase. Finally, both social perception and the mathematical model agree that the causes of deforestation are more influenced by the expansion of agriculture and settlements. These results may be integrated into the planning and management process of the natural forest in the department through, for example, the forest management plan.

sciforum-099978: Ecosystem Services and Biodiversity Conservation: local Demands and Political Guidelines

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Biodiversity, i.e., the variety of all living beings, is a fundamental component of sustainable natural capital. It sustains and enables all the ecosystem goods and/or services which humanity needs and should value. At the same time biodiversity has irreplaceable value for our society. There is no doubt that there are important discrepancies between local demands and political guidelines with respect to the need to conserve biodiversity given its role in the well-being of society as established by the Sustainable Development Goals (SDG) of the 2030 Agenda. For this reason, it is essential to apply a common strategy capable of maintaining, improving and increasing current biodiversity. Under those circumstances, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), independent intergovernmental body, carries out periodic assessments about biodiversity and ecosystem services as well as their interrelationships. The scope is to assess the status and trends with respect to biodiversity and ecosystem services, the impact on human well-being and the effectiveness of the actions and plans performed. The state of ecosystem services is worrying in many regions and many essential services are expected to deteriorate and even be lost during the current century. Some recent research has related the results, effectiveness of actions and plans, to political needs, although its real influence is still very limited. Perhaps a strategy at a territorial level could facilitate cooperation between those countries with similar needs and problems, through the exchange of information and the common development of capabilities. This would guarantee the adoption of sustainable policies aimed at increasing the population's well-being.

sciforum-100495: Edge Effects Up to 30–40 Meters Into Seasonal Forests Demonstrated through Vegetation Indices and Floristic Similarity

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Forest edges in forest fragments are formed by natural or anthropogenic disturbances, where these forest fragments in a rural matrix experience environmental pressures at different levels. However, few studies indicate the actual size of the edge and how far its effects are perceived in the forest. This study aimed to evaluate the edge effect in forest fragments using floristic studies and vegetation indices, determining the gradient (meters) in which the edge penetrates the forest fragment and identifying the vegetation indices that best apply to edge effect studies. The research was conducted in five seasonal forests where floristic differences were verified, generating two similarity dendrograms using the average vegetation density per plot at each distance from the edge (0–10, 10–20, 20–30, 30–40, 40–50, 50–60, 60–70, 70–80, 80–90, 90–100 m). To verify differences between the values of vegetation indices (NDVI, GNDVI, EVI, SAVI, Moisture, PV, Emissivity, and LST) concerning the distance from the forest edge towards its interior, the average values for each distance from the edge to the interior of each forest fragment were used. A dendrogram, a PCA, and linear and non-linear regressions were performed to determine the edge gradient in the fragments. The study found a perceptible difference between the edge and the forest interior when the edge reaches 30–40 m into the forest, both in floristic studies and vegetation indices. The work concludes that field research and remote sensing converge, with NDVI, EVI, and the indices PV and Moisture best reflecting the edge effect in forests, being complementary for vegetation quality analysis. The study proposes the adoption of vegetation indices during the implementation of the Environmental Regularization Program (PRA) to assess the real dimension of the functional Legal Reserve in rural properties and to formulate strategies for maintaining ecosystem services of these forest fragments.

sciforum-100123: Effects of Landscape Homogenization on Biodiversity Conservation and Ecosystem Services

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The interrelationship between population, anthropogenic component of landscapes, and environment, abiotic-biotic components of landscapes, plays a fundamental role both in the configuration and in the landscape dynamics. This aspect is of vital importance in those landscapes subject to human influence, where social, economic and ecological interactions, as well as feedback instruments manage biodiversity and ecosystem services. Although it may seem curious to us, now biodiversity in cultural landscapes is sometimes greater than in natural landscapes, always depending on the diversity due to nature together human actions. In this frame of reference, traditional land-use practices in the northwest Iberian mountains have created a well-structured system controlled by seasonal cycles and human activity patterns. However, in the last decades, socioeconomic globalization has prompted complex changes in the rural areas. The land abandonment has reduced the open spaces and has bringer about an increase of the forest land or/and forestry systems affects both ecosystem services and biodiversity. Therefore, landscape homogenization results in a decrease in open habitats, an additional problem for the conservation of agropastoral activities, and an increased risk of destructive forest fires due to less fragmentation of the forest area. The sustainability depends on traditional uses conservation: extensive grazing and suitable forest management. The environmental, cultural, and economic integration of agropastoral and forestry activities is vital to ensure the heterogeneity landscapes, together biodiversity and ecosystem services. Extensive grazing allowing a suitable livestock concentration in small areas avoids soil erosion and vegetation deterioration, increases mosaic diversity, and maintains open habitats. Selective felling is an economically viable and environmentally integrated silvicultural treatment that reduces forest fires by promoting landscape fragmentation.

sciforum-099974: Enabling Actions and Leverage Points for Governing Conifer Invasions in NW Patagonia

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Invasive conifers pose a significant threat to biodiversity, ecosystem services, and fire safety in Patagonian urban-natural interfaces. The Red PINOS partnership, a transdisciplinary initiative established in 2021, aims to develop a robust governance framework for managing conifer invasions in Bariloche department, Argentina. The initiative employs a two-pronged approach: identifying and implementing leverage points, to shift system dynamics toward a less invaded and invasible state, and taking short-term enabling actions to facilitate the implementation of these leverage points.

This study focuses on systematizing the experience gained by Red PINOS regarding enabling actions, while also providing a comprehensive overview of the ongoing discussions surrounding alternative leverage points for managing conifer invasions. Ultimately, this research seeks to improve governance for invasive species management in the region.

Using a participatory multi-criteria evaluation (MCE), stakeholders engaged at Red PINOS were asked to collaboratively assess ca. 30 intervention types based on criteria such as social acceptance, political and economic feasibility, flexibility, adaptability, data availability, research needs, short- and long-term impact, and systemic change potential, among others. The MCE identified promising interventions suitable for both enabling actions and types of leverage points, including public awareness campaigns, seedlings and adult tree removal in invaded areas, participatory mapping and monitoring programs, strengthening regulatory frameworks, and promoting sustainable biomass utilization for both private interests and poverty alleviation. After two years of transdisciplinary collaboration, stakeholders recognized that a combination of short- and long-term goals, coupled with progressive community engagement and institutional changes, is key to driving sustainable change.

In conclusion, this research highlights the value of considering both enabling actions and leverage points for effective invasive species management. The two-pronged and participatory approach employed, offers a model for other research-action initiatives addressing the identification of short and long-term intervention strategies to tackle complex environmental and social challenges.

sciforum-099911: Environmental Memetics: Exploring Public Perception of Invasive Conifers in NW Patagonia

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Invasive exotic conifer species pose a significant threat to biodiversity, ecosystem services, and fire risk in various regions worldwide, including areas in northwest Patagonia, Argentina. The Red PINOS partnership, established in 2021, brings together NGOs, scientific institutions, and government bodies to develop participatory governance strategies to mitigate the impacts of invasive conifer species like *Pinus contorta*, *P. radiata*, and *Pseudotsuga menziesii* in Bariloche and its surroundings.

Based on memetics and the spreading activation theories about how cultural traits evolve over time, we are exploring the public perception of these invasive pines in Bariloche by analyzing citizens' memes as words associated with pine forests. A total of 106 face-to-face surveys were conducted during the austral winter of 2023, targeting key public areas within the city. Respondents were presented with images of invasive pine encroachment and a Red PINOS poster promoting citizen participation and asked for the first five words elicited by them.

Results show that while "greenness" and "natural" were the most common memes associated with pines (31% and 27% of responses, respectively), "invasion" and "non-native" received negligible responses (5% and 1%). Notably, despite the significant scientific knowledge locally available and the strong impact of exotic conifer invasions in the region, 82% reported no prior knowledge about the environmental impacts of pines. Despite this lack of awareness, 55% of respondents expressed a high to very high level of adherence to the call for citizen participation in the second image showing the Red PINOS poster.

This study, while preliminary, highlights a critical gap in public knowledge about invasive conifers, suggesting a need for greater public awareness campaigns and participatory management strategies to effectively address this growing threat in northwest Patagonia. It also reveals a positive potential for a shift in perception through targeted outreach and engagement efforts.

sciforum-097409: Eucalyptol Serves a Signaling Function to Enhance *Cinnamomum camphora* Thermotolerance

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Terpenes serve important functions in enhancing plant thermotolerance, but the thermotolerance mechanism is still unknown. *Cinnamomum camphora* releases an abundance of monoterpenes to tolerate high temperature, and is subdivided into five chemotypes, such as camphor chemotype, eucalyptol chemotype, linalool chemotype, borneol chemotype, and isonerolidol chemotype. To uncover the thermotolerance mechanism of the uppermost monoterpenes in *C. camphora* and promote their development as anti-high temperature agents, the thermotolerance functions of eucalyptol in the corresponding chemotype of *C. camphora* were investigated. In contrast to normal temperature (28 °C), reactive oxygen species (ROS), thiobarbituric acid reactive substance (TBARS) levels, and antioxidant enzyme activities increased under 38 °C, and further increased in the treatment with fosmidomycin (Fos), inhibiting monoterpene synthesis at 38 °C (Fos + 38 °C) due to alterations in the expression of the genes related to non-enzymatic and enzymatic antioxidant formations. Compared with Fos + 38 °C treatment, Fos + 38 °C treatment with eucalyptol fumigation (Fos + 38 °C + eucalyptol) lowered ROS levels and antioxidant enzyme activities for increased non-enzymatic antioxidant gene expression and decreased enzymatic antioxidant gene expression. High temperature at 38 °C reduced the chlorophyll and carotenoid content as well as photosynthetic abilities by reducing the expression of the genes associated with photosynthetic pigment biosynthesis, light reaction, and carbon fixation. Fos + 38 °C treatment aggravated the reduction. In contrast to Fos + 38 °C treatment, Fos + 38 °C + eucalyptol treatment increased photosynthetic pigment content and improved photosynthetic abilities by up-regulating related gene expression. Therefore, the findings first uncover that the uppermost monoterpenes should serve important signaling functions in enhancing *C. camphora* thermotolerance, which provides a new thought for uncovering the thermotolerance mechanism of terpenes.

sciforum-095159: Exploration of Forest Resource by Both Man and Butterflies—A Case Study on Utilization of Medicinal Plants as a Larval Resource by Nymphalinae Butterflies

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India is renowned for its rich medico-cultural heritage. Despite modernisation coupled with scientific advancement, the rich traditional medicinal system cannot be overlooked. Interestingly, the chemical constituents of such medicinally significant plants also form the basis of host plant recognition by butterflies. Olfactory and gustatory cues and their associated chemosensory mechanisms of host plant identification at dual stages of their life cycle (i.e., larval feeding and oviposition) have been previously investigated.

Documentation of such therapeutically significant larval food plants of nymphalinae butterflies (Family: Nymphalidae) followed by recognition of their medicinal potential was undertaken across the Himalayan landscape of West Bengal, India. A specially designed questionnaire was prepared for these folklore therapists and traditional healers. The database was created for ascertaining the Informant Consensus Factor (ICF), Utilization Value (Uv) and Fidelity levels (F_L). Additionally, the Host Plant Specificity (H_{PS}) and Polyphagy Index (P_I) were determined to reflect the importance of such medicinal plant species as larval resource of butterflies. A total of 85 informants were interviewed, leading to the calculation of ICF, Uv and F_L for each plant species.

Thus, the therapeutic benefits of 28 plant species used against several categories of ailments were listed. The highest ICF value (1.000) was cited for diseases of the digestive system and disorders associated with the respiratory system. The maximum F_L of 100% was noted for *Urtica dioica, Artemisia vulgaris, Dioscorea deltoides, Mimosa pudica* and *Hygrophila auriculata. Urtica dioica* displayed the maximum Uv. Furthermore, *Junonia lemonias, J. orithiya, Hypolimnas bolina* and *H. misippus* possessed the highest H_{PS}. A maximum P_I value was determined for *Junonia lemonias* (5.477) followed by *Hypolimnas bolina* and *H. missipus* (5.000).

Thus, polyphagy is known to provide a stimulus among butterflies, enabling their sustenance through life history stages. Equally significant are such medicinal plants serving as botanical tools for traditional healers.

sciforum-094671: Exploring the Dynamics of Forest Biodiversity: Perspectives from a Four-Species Disease–Food Web Model

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This paper presents a comprehensive analysis of the dynamics of forest biodiversity through a model representing a disease–food web system, focusing on the interactions among four animal species within a forest ecosystem. The relationships between predators and prey, as well as the transmission of diseases within this system, provide valuable insights into the functioning of such ecosystems. If predator species are not present, it is proposed that the prey population will experience logistic growth. The hypothesis suggests that the infected prey consume healthy prey, utilizing a Holling type II functional response. This analysis focuses on maintaining non-negative solutions, ensuring that solutions remain within a specific range, and preserving non-negativity over time from initial conditions. These considerations are essential for comprehending the system's behavior and stability. Also, it involves assessing the stability of equilibrium points, which are states where the system remains unchanged over time, and evaluating how the system behaves under different conditions, such as varying environmental factors. Here, local stability is determined by examining the eigenvalue distribution. By investigating the effects of the factors on the model parameters, the study aims to understand how changes in the environment can impact the dynamics of the ecosystem. Thus, by exploring these aspects, the numerical findings of infection rate and predation rate contribute to a deeper understanding of ecological models. This model can be utilized to study and protect forest biodiversity, especially in the face of challenges posed by environmental changes.

sciforum-099988: Facts Speak Louder Than Words: An Environmentalist Message against the Invasion of Pine Trees through Citizen Participation in Manual Removal Campaigns

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The spread of invasive pines from productive plantations is one of the main environmental problems in Argentine northern Patagonia. This not only threatens biodiversity but also increases the risk of forest fires in natural–urban interface areas. However, the gradual nature of the invasion often leads to its being perceived as a natural process, and therefore, community education is necessary to understand the problem. In 2021, a group of scientific researchers, forest managers and environmentalists from Bariloche founded the Red PINOS partnership to self-organize the local community for participatory governance of this problem. The defined strategy centrally includes carrying out pine removal campaigns with publicly summoned volunteers. So far, we have conducted two campaigns (November 2022 and February 2023) at a pilot site of 7 hectares in a central area of Bariloche, located on the access road to the most important ski center in South America. This area, a multi-specific low forest, is invaded by *Pinus sylvestris*, *P. contorta*, *P. ponderosa* and *Pseudotsuga menziesii*. Over the two campaigns, 12,965 pine trees, up to 1.5 m tall, were manually removed with the participation of 34 volunteers within two hours each time (an average of 195.5 pine trees per person). These events were used to raise awareness about the issue of invasions through social media (e.g., WhatsApp, Instagram, Facebook) and local mass media (newspapers and radio), extending the environmental message to the entire community. Monitoring through transects carried out in March 2024 showed the persistence of pine trees below
30 cm, highlighting the importance of seed tree removal and ongoing monitoring to prevent new seedlings and escapees. Thus, seed tree removal will represent the second stage of the intervention, requiring the involvement of public and private institutions for the use of machinery and waste management, which can be a by-product of economic value.

sciforum-095746: Forest Bathing: A study in Três Picos State Park, Rio de Janeiro, Brazil

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The influence of the forest environment on human populations is reflected in a series of aspects of its use as raw material to promote well-being, added to the traditional knowledge accumulated over generations. Among the new practices and approaches to the use of plants, which add to the growing practice of Forest Therapy, is Forest Bathing, or Shirin Yoku. This study seeks to identify new forms of interaction with the natural environment, discussing the dynamics of the means and purposes of using the forest to promote health. The aim is to evaluate the aforementioned therapeutic approach applied to the Atlantic Forest. The work aims to analyze the health and well-being benefits perceived by visitors in their use of the Jequitibá Trails in the Três Picos State Park in profile analyzes of mood states (POMS) in students and users of its trails. The mountainous region of the state of Rio de Janeiro served as the location for the installation of numerous environmental therapy institutions, even though it is not directly related to Forest Bathing, this study seeks to carry out a historical survey of the therapeutic use in the region as a therapeutic site still used today by the Navy Brazilian. Finally, we seek to offer subsidies that enable Forest Therapy to join the list of Complementary Integrative Practices in Health, following the trend of global research and public policies that increasingly add therapeutic value to forest environments.

sciforum-095422: Forest Biodiversity at Risk, and Rural and Peri-Urban Land Consumption

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We often talk about urban land consumption in terms of an estimated loss of 19 hectares of natural soil per day, of which 15 square kilometers are permanent artificializations. We try to contain this with measures and regulatory rules. The areas most affected are metropolitan cities and coastal areas but also rural areas. Data pertaining to agricultural land consumption in some Italian regions, including Sicily, show that peri-urban land consumption increased by 2.7 percent in 2022 compared to the previous year (Ispra). The continuous transformation of soil causes serious damage to natural habitats by altering already delicate systems, increasing the risk of hydrogeological disruption and the loss of fertile and productive land. Consumption is causing the impairment of ecosystem services, damaging and minimizing them. Loss of biodiversity, changes in the carbon storage process by forests, and vulnerability related to environmental hazards and hydrogeological disruption are just some of the negative consequences of this phenomenon. The ability of communities and natural habitats to adapt and respond to change is being compromised, putting the long-term sustainability of peri-urban areas at risk. Addressing the problem of rural land consumption requires innovative and flexible strategies that take into account the complexity of social–ecological systems. The promotion of sustainable development practices, the protection of natural areas, and urban planning supported by precise regulations (think of Italian regional laws on the containment of land consumption, Veneto’s LR 14/2017, or those aimed at promoting urban regeneration interventions as a strategic alternative to new land consumption) are key to preserving the resilience of local communities and ensuring a sustainable future. These include implementing the “chain” of sustainability, helping to preserve the environment and natural resources with measures, new technologies and eco-innovations for agriculture. Encouraging forms of rural tourism with a strong identity can counter forms of overtourism.

sciforum-099465: Genome Downsize Insight into Plant Biodiversity Conservation: A Case Study of Polyploid *Morus* spp.

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Biotechnological involvement in gene pool conservation is limited, particularly among natural polyploid tree species such as mulberry (*Morus* spp.), due to the diversity in genome sizes and the additional complexity imposed by heterozygosity. Plant performance may be greatly influenced by variations in the number, size, and structure of chromosomes. The current work has devised a step-by-step, cost-effective procedure for the chromosomal analysis of *Morus* spp. shoot tips. We identified various cytotypes of *Morus* spp. available at Central Sericultural Germplasm Resources Centre (CSGRC), Hosur, Tamil Nadu, India, including diploid (2n = 2x = 28), aneuploid (2n = 2x = 30), triploids (2n = 3x = 42), tetraploids (2n = 4x = 56), hexaploidy (2n = 6x = 84), and decasoploidy (2n = 22x = 308). Flow cytometry (FCM) analysis was performed to confirm the genome size of highly polyploid species such as *M. tiliaefolia* Makino. (2n = 6x = 84; ~1188.83 Mbp), *M. serrata* Roxb. (2n = 6x = 84; ~1386.32 Mbp), and slow-growing phenotype *M. nigra* L. (2n = 22x = 308; ~4239.86 Mbp). This study identified considerable genome downsize in decosaploid *M. nigra* L. (1Cx, ~353.25 ± 07.23). Furthermore, morpho-anatomical, physiological, and biochemical traits were estimated for the selected 50 accessions, considering all cytotypes. Overall, current research suggests that over episodes of polyploidization and selection pressure, factors like the growth rate, genome size, and nutritional constraints enforced not only reduce the genome size but also restrict the growth (slow-growing) of polyploid mulberry. As a consequence, immediate attention is necessary to understand the structural and functional implications for polyploid conservation, particularly in tree species of wild origin.

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sciforum-099770: Human Impacts on the Genetic Diversity of Ishpingo Trees (*Ocotea quixos*, Lauraceae)

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Ocotea quixos, known as Ishpingo, is a tree endemic to the Amazonian rainforests of Colombia, Ecuador, and Peru. The dried flower buds and bark are often used as a spice, known for their cinnamon-like flavor. They are used in various traditional dishes and beverages in the Amazon region. The tree is also a source of essential oils that are used in aromatherapy and natural health products. In Ecuador, the Ishpingo tree faces significant threats due to overexploitation for its valuable spices and essential oils. Additionally, extensive deforestation and land use changes have dramatically reduced its natural habitat. Efforts are being made to conserve wild populations through sustainable harvesting practices and reforestation projects. Understanding and preserving the genetic diversity of Ishpingo is vital for ensuring the species' survival and continued contribution to the ecological and cultural richness of the Amazonian rainforest. Nevertheless, we currently lack comprehensive genetic diversity data. Within this scenario, we developed nuclear microsatellites to analyze the genetic diversity in the known Ecuadorian populations of Ishpingo. The results show low levels of genetic diversity, especially when compared with other *Ocotea* trees. Inbreeding was common in almost all populations, which can result in reduced reproductive success and fitness in natural populations. Despite these results, some populations still harbor moderate levels of genetic diversity, which is key for the preservation of this species. Implementing breeding programs to enhance genetic diversity, as well as preserving material in seed banks, will be essential in restoration actions.

sciforum-094857: Identyfing Suitable Thinning Areas in Pure Stands of Scots and Maritine Pine through Sentinel-2 Imagery and LiDAR

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Scots pine (*Pinus sylvestris Linneo*) and maritime pine (*Pinus pinaster Aiton*) forests are essential to the local economy in the province of Soria (Spain). Thus, regeneration care through thinning is key, not only from a silvicultural point of view, but also in terms of wildfire prevention. However, this operation incurs costs for forest owners. The availability of high-precision technologies such as LiDAR and high upgradability such as satellite imagery provide an excellent opportunity to automate the location of these areas suitable for thinning and therefore reducing costs. Free national LiDAR data are available for the year 2010, whereas Sentinel-2 obtains images every
3–5 days. Given this, the National Forest Inventory (2019) was used to identify plots that meet the conditions for applying thinning: pure stands of Scots or maritime pines where at least 80% of trees range between 0 and 5 meters' height or between 5 and 9 meters' height with a density above 1000 trees/hectare. In this way, the Sentinel 2 and LiDAR variables were used to create an automatic classification model using the random forest algorithm. The model was extrapolated on the area of the Spanish Forest Map established as monospecific stands of Scots pine and maritime pine. As a result, an updated map of the areas suitable for thinning in the province of Soria was obtained. The validation of the results showed a producer's and user's accuracy of 62% and 76%, respectively, for the Scots pine and of 66% and 75%, respectively, for the maritime pine. In conclusion, this map can be considered as a tool that facilitates the location of thinning areas.

sciforum-099985: Influence of Different Pre-Sowing Seed Treatments on the Germination and Growth Performance of *Sida cordifolia* Linn

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Sida cordifolia is an erect, branched, annual or rarely perennial woody, undershrub with stellately pubescent aerial parts, up to 1 m high belonging to the family Malvaceae. It is locally called as Bala. It grows as a weed on roadsides and waste places in tropical and sub-tropical regions throughout India. The annual demand of *S. cordifolia* is 1000–2000 MT. This study was carried out to determine the effects of different pre-sowing seed treatments on the germination and growth performance of *Sida cordifolia.* The seeds were collected from healthy and vigorous plants growing in natural populations of Anuppur Forest division, Madhya Pradesh India. The experiments were conducted in NWFP nursery of ICFRE – TFRI, Jabalpur. The following treatments were used: T_1 (control) T_2 (cold water) T_3 (hot water), T_4 (20% sulphuric acid), T_5 (conc. sulphuric acid), T_6 (mechanical scarification), T_7 (mechanical scarification + GA 100 ppm), T_8 (mechanical scarification + GA 500 ppm), T_9 (0.2% potassium nitrate), T_{10} (2% thiourea), T_{11} (30% hydrogen peroxide), T_{12} (cow milk), T_{13} (cow urine) and T_{14} (kinetin 500 ppm). Experiments were performed with 14 treatments and 3 replications in completely randomized design. Days to initiate germination, final germination, and germination % were determined as germination indices. Root and shoot length, vigour index, fresh and dry weight were evaluated as growth factors. The results revealed that various pre sowing seed treatments affected significantly the seed germination process. Initiation of germination was shown earlier in T_4 in 7 days where as late germination was found in T_1. The maximum germination percentage was recorded in T_4 (79.71%) which was significantly superior over other treatments whereas lowest (12%) was recorded in T_1. The highest root length, shoot length, fresh weight, dry weight, and vigour index was found in T_5. The results revealed that seeds pre-treated with T_4 showed the better germination and better-quality seedlings of *S. cordifolia*.

sciforum-099925: Is Forest Fragmentation Enhancing Natural Hybridization in Neotropical *Epidendrum* Orchids?

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Fragmented forests often experience altered environmental conditions that can change species' behaviours and ranges, potentially leading to new hybridization opportunities. In some cases, hybridization can be beneficial, providing a genetic rescue effect for small, isolated populations by introducing new genetic material, increasing genetic diversity, and enhancing the population's ability to adapt to changing conditions. Conversely, hybridization can lead to outbreeding depression or even genetic swamping of parental species. *Epidendrum* orchids, a diverse genus in the neotropics, frequently hybridize in nature. Hybridization in this genus can be facilitated by their generalist pollination strategies, where multiple pollinator species visit the flowers. Natural hybrids among *Epidendrum* species have been observed in regions where their ranges overlap, with divergent evolutionary outcomes. In this study, we address if natural hybridization between two species of Epidendrum (*E. calanthum* and *E. cochilidium*) is more frequent in fragmented sites than in well-conserved forest patches. Morphometrics, plastid and AFLP
markers, confirmed the presence of hybrids between the two species in seven out of eighteen samples. The hybrids exhibit a wide range of morphological traits including different colours, often blurring species discrimination. Undisturbed populations generally showed a lower number of hybrids, or only parental species. Establishing continuous monitoring of orchid populations and research on hybridization patterns would provide valuable insights into the dynamics of hybridization and inform conservation actions.

sciforum-095406: Methodological Bases for Predicting Siberian Moth Outbreaks in Dark-Coniferous Forests of Central Siberia

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Introduction

The Siberian moth *Dendrolimus sibiricus* Tschetverikov (Lepidoptera: Lasiocampidae) is a significant threat to the taiga forest ecosystem in Siberia. It has already caused extensive damage to forests dominated by Siberian fir *Abies sibirica*, Siberian spruce *Picea obovata*, and Siberian pine *Pinus sibirica* (also known as dark-coniferous taiga). Evergreen trees are unable to tolerate severe defoliation, which ultimately leads to their death.

The current insect pest monitoring system fails to provide the necessary tools for the timely implementation of measures aimed at eliminating the outbreak at its earliest stage.

The objective of the present study was to refine the forest pathology monitoring system by developing a spatial model to predict the primary areas of the Siberian moth outbreak in dark-coniferous stands of Central Siberia.

Methods

The methodological approach to the spatial modelling of Siberian moth outbreak areas is based on an understanding of the ecology of the pest, the characteristics of site conditions and landform, and remote sensing data. The algorithm was developed through a retrospective analysis of previous outbreaks.

Results

The model facilitates the identification of at-risk areas within the dark coniferous forests, which require close monitoring. The map provides an illustrative representation of the potential outbreak areas. The forecast model's overall accuracy is estimated at 75%. Nevertheless, the accuracy of this figure is contingent upon the specific set of predictors and the extent of the area in question.

Conclusion

The research yielded a model of spatial distribution that may be used for forecasting the primary outbreak areas of the Siberian moth.

Funding: The research was carried out within the framework of the project "Methodological bases for assessment of forest pathology risks in southern Central Siberia" (№ FEFE-2024-0016) under the state order of the Ministry of Science and Higher Education of the Russia for implementation by the Scientific Laboratory of Forest Health.

sciforum-099768: Natural Hybridization between *Chaetogastra longifolia* and *C. campii* (Melastomataceae)

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The neotropical region, encompassing the tropical and subtropical regions of the Americas and extending from southern Mexico through Central America and the Caribbean to South America, is known for its high biodiversity and complex ecosystems. Natural hybridization might have played an important role in shaping such biodiversity, but studies focused on understanding its influence are still scarce when compared with other regions of the World. Yet, understanding the mechanisms and consequences of hybridization is essential for effective conservation and management of these diverse ecosystems. In this study, we aimed to detect the presence of natural hybridization between *Chaetogastra longifolia* (Vahl) DC. and *Chaetogastra campii* (Wurdack) P.J.F.Guim. & Michelang. (formerly included in *Tibouchina*). Previous ecological studies have suggested the possibility of gene flow between them due to the existence of individuals with conflicting morphological traits in sympatric populations where the two species occurred. To achieve this, forty-eight samples of the two species of *Chaetogastra,* including putative hybrids, were analysed through plastid DNA sequencing results and taxon-specific amplified fragment length polymorphism (AFLP) fragment distribution analysis. The results confirmed the hybrid nature of all putative hybrids. The AFLP patterns of most hybrids demonstrated a closer relationship to *C. campii*, suggesting hybridization to be asymmetric with this species more often used as a maternal progenitor of hybrids. Some individuals collected as pure were also revealed to be of hybrid origin, indicating the possibility of backcrosses with parental species. Future studies should focus on understanding the ecological and evolutionary outcomes occurring after hybridization, as well as the existence of natural hybrids between other species of *Chaetogastra*.

sciforum-095440: Quantifying Potential Organic Carbon in Mangrove Soils: A Machine Learning Approach to Improve Conservation Efforts in the Colombian Pacific Coast

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Mangrove ecosystems, often referred to as “blue carbon”, play a significant role in storing vast amounts of carbon dioxide, thereby mitigating the effects of climate change. However, human-induced activities are endangering their carbon sequestration potential, particularly along the Pacific coast of Colombia. This study aims to quantify carbon stocks in mangrove soils along the Colombian Pacific coast. This quantification will serve as a foundation for monitoring potential future changes in these stocks due to regional transformations. Data from multispectral sensors, including Landsat 8 and Sentinel 2A, from 2014 to 2021 were integrated using a machine learning (ML) methodology. The efficacy of the model was assessed using the coefficient of determination (R^2) and root mean square error (RMSE). The extreme gradient-boosted regression model (XGBoost) applied to the Landsat 8 dataset yielded optimal values of R^2 = 0.825 and RMSE = 1.748 Mg C ha-1 for soil organic carbon (SOC). According to the model, the estimated SOC content varied from 0.524 Mg C ha-1 at a depth of 0–15 cm to 263.2 Mg C ha-1 at depths ranging from 50–100 cm within the mangrove forests. The results underscore the importance of machine learning and remote sensing as effective tools for establishing a rapid and reliable reference base. This will enable the prioritization of conservation efforts related to soil resources in mangrove ecosystems.

sciforum-100081: Spatiotemporal Patterns of Global Tropical Forest Loss before and after 2015 and Its Implications for Mitigation, Biodiversity Conservation and Disaster Risk Reduction

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Tropical forests provide a multitude of ecosystem services, such as maintaining global biodiversity by providing habitats for countless species. They also play a pivotal role in climate change mitigation by sequestering carbon and serving as carbon sinks, while also aiding adaptation efforts through nature-based solutions. Therefore, understanding the dynamics of tropical forest loss and its implications for both ecosystems and human communities is essential for guiding effective conservation and sustainable development strategies. The 2030 Agenda for Sustainable Development emphasizes the urgent need to halt deforestation and reduce the degradation of natural habitats. Similarly, the Paris Agreement highlights the importance of conserving and enhancing sinks and reservoirs of greenhouse gases, including forests. Approximately a decade has passed since the adoption of these significant global initiatives in 2015, prompting questions about whether there has been a change in the trend of global tropical forest loss. To address this issue, this study examines the spatiotemporal patterns of global tropical forest loss before and after 2015 using publicly available, spatially explicit data. It investigates whether tropical forest loss has slowed down or accelerated and whether it has been moving away from or toward areas with high potential for climate change mitigation, biodiversity conservation, and disaster (landslide) risk reduction.

sciforum-094435: Study on the Effects of Soil and Water and Nitrogen and Phosphorus Loss in Forest Land Planted with Gastrodiae Rhizoma under Natural Rainfall Conditions

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Background

Understory planting is a common soil and water conservation farming practice, that makes full use of the natural conditions of the understory, such as soil, climate, and ecosystems, to improve the efficiency of agricultural production.

Methods

To reveal the nutrient loss characteristics of understory planting of Gastrodiae Rhizoma, runoff plots were set up in the field, and three surface slopes (5°, 15°, 20°) were designed to collect runoff sediments and compare the soil and water loss between the natural slopes and the slopes planted with Gastrodiae Rhizoma, to investigate the flow and sand production characteristics of understory planting on sloping cropland with different slopes and the loss of nitrogen and phosphorus nutrients carried by it, to provide a basis for the restoration of vegetation cover and the enhancement of soil fertility.

Results

The loss of soil and water and nitrogen and phosphorus in forested land planted with Gastrodiae Rhizoma increased significantly compared with that in natural forested land, and the greater the slope, the greater its loss.

Conclusion

Planting Tianma should be avoided in areas with large slopes and serious soil erosion, and some soil and water conservation engineering measures can be taken, such as the construction of retaining walls, drainage ditches, etc. to minimize the scouring and erosion of the soil by rainwater.

sciforum-100143: Taxonomic Diversity of Diatoms in Parambikulam Tiger Reserve, Western Ghats, India

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Diatoms are unicellular organisms, they occur either as solitary cells or in colonies. Diatoms have two distinct shapes: a few centric diatoms and most pennate diatoms, they are surrounded by a cell wall made of silica. The present study tries to account for the diversity of Diatoms in Parambikulam Tiger Reserve, a protected area situated in the biodiversity hotspot of Western Ghats, India. The study was carried out over a period of one year, from October 2022 to September 2023 in three seasons (pre-monsoon, monsoon, and post-monsoon) from the freshwater resources within the sanctuary like rivers, reservoirs, and ponds. The surface water samples were collected in plastic containers with the help of a plankton net of mesh size 20 µm, samples were fixed in 4% formalin for permanent preservation and detailed identification. Diatom specimens were photographed and identified based on relevant published literature. Bacillariophycean members are difficult to identify, so a clearing process is applied using concentrated nitric acid and permanent slides were prepared using naphrax mounting medium. Scanning electron microscopy is also done for morphology analysis. The current study identified a total of sixty-one taxa, which are distributed under 26 genera. Obtained genera were *Achnanthidium* (1), *Amphora* (3), *Aulacoseira* (1), *Caloneis* (2), *Cocconeis* (2), *Cyclotella* (1), *Cymbella* (3), *Diploneis* (1), *Encyonema* (3), *Eunotia* (3), *Fragilaria* (1), *Gomphonema* (4), *Gyrosigma* (1), *Hantzchia* (1), *Luticola* (1), *Melosira* (1), *Navicula* (10), *Neidium* (2), *Nitzschia* (9), *Pinnularia* (4), *Planothidium* (1), *Pleurosigma* (1), *Rhopalodia* (1), *Surirella* (2), *Ulnaria* (1), *Stauroneis* (1). The species *Gyrosigma scalproides* (Rabenhorst) Cleve and *Nitschia irremissa* Cholnocky are found to be new reports to Kerala. This is the first study available with regard to the diversity of diatoms in the Parambikulam Tiger Reserve.

sciforum-099998: The Distribution and Population Structure of the Coffee Wild Relative *Coffea racemosa* in Southern and Central Mozambique

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Increasing and challenging environmental pressures are threatening coffee cultivation worldwide. One of the key strategies to mitigate the impact of such pressures is to incorporate crop wild relatives in the value chain. However, this is often restrained by the lack of knowledge concerning basic features, such as the number and type of wild populations, or current threats. To fill this gap in coffee cultivation, we studied the population structure and threats of *Coffea racemosa* Lour., a wild relative of the two principal traded species, *Coffea arabica* L. and *C. canephora* Pierre ex A. Froehner. *Coffea racemosa* is native from Mozambique, and is resilient to drought and most coffee pests. It also has a low caffeine level, with a high market potential as an alternative to coffee consumers who are caffeine-sensitive. Therefore, it is considered a good candidate to be used in future breeding programs. However, the current distribution of this species in Mozambique and the factors that might threaten its sustainable use are unknown. In this study, we searched for the occurrence of *C. racemosa* to understand how the species is distributed in Mozambique and how populations are demographically structured. Considering the scenario of high forest fragmentation in Mozambique, we specifically addressed if (1) populations vary between fragmented patches and conserved forests; (2) natural regeneration is occurring; and (3) habitat fragmentation is affecting the population's demographic structure. Our results show a demographic populational structure that is stratified into large, medium, and small trees and seedlings, with the latter mostly being found in conserved forests. In contrast, no seedlings or small or large trees were found in the small city patches, which were only composed of medium trees. Overall, there was no evidence of regeneration in small patches. These first insights are essential for the conservation and management of *C. racemosa* in Mozambique.

sciforum-099906: The First Checklist of Basidiomycetes Macrofungi Diversity in Constantine Forests, Algeria

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Macrofungi play diverse roles in ecosystems, serving as nutritional sources and finding applications in biotechnology, medicine, and ecology. Most of these macrofungi belong to the basidiomycete group, characterized by their production of large fruiting bodies that are visible to the naked eye. These fungi can be categorized based on their ecological relationships as saprophytes, parasites, and symbiotic species. The forests of Algeria are known for their rich diversity of macrofungi; however, the diversity of macrofungi in the Constantine region remains poorly understood. This study aims to identify macrofungal diversity in two forests in Constantine, Algeria.

Macrofungi typically begin to appear following the first fall rain. Surveys were conducted in the Djebel el Ouahch and Chettaba forests over two years (2017–2018). Fungal fruiting bodies were systematically collected and photographed for identification purposes, focusing on macroscopic characteristics such as shape, color, cap and stipe features, and spore morphology. A total of 90 species of macrofungi (Basidiomycota) were identified during the study period. The most represented families included Agaricaceae, Amanitaceae, Auriculariaceae, Boletaceae, Bolbitiaceae, Coprinaceae, Gasteromycetaceae, Gloeophyllaceae, Hydnangiaceae, Hymenochaetaceae, Phallaceae, Psathyrellaceae, Polyporaceae, Steccherinaceae, Stereaceae, Russulaceae, Tapinellaceae, Tricholomataceae, and Tubariaceae.

This study provides foundational data on the diversity of macrofungi in Constantine forests, offering a basis for further research and educational purposes.

sciforum-099964: The Impact of Climate Change as a Criterion for Degradation in a Forest-Dominated Tropical Watershed

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One of the main causes of the degradation of forest systems and the ecosystem services that they provide is climate change. It is anticipated that tropical forests will be especially susceptible to this. Understanding the impact of climate change on forest systems requires analysis over a considerable period of time and evaluation at specific intervals. In the southern western Ghats of India, a watershed with approximately 75% forest cover was the subject of a 50-year study (1970–2020), aimed at assessing the impacts of climate change using bio-climatic variables as indicators. A 30-year moving average window, encompassing the years 1970–2000, 1975–2005, 1980–2010, 1985–2015, and 1990–2020, was used to examine the influence of climate change. The study area was divided grid-wise (0.25 degrees), considering the resolution of the available input data for conducting the analysis. The changes in forest cover and forest carbon stock were analyzed as forest degradation indicators to verify the impacts of climate change on forest
degradation.

The results highlight a considerable increase in the impact of climate change on forest systems. In conclusion, the impact of climate change can be considered a forest degradation criterion, and bioclimatic variables are effective indicators of it. This analysis will help prepare forest management strategies and formulate mitigation plans in the context of climate change.

sciforum-100002: The Mycorrhizal Relationship between *Maritime pine* and *Aleppo pine* with Four Species of Higher Fungi of the Genera *Suillellus* and *Suillus* in the Ghazaouet Littoral, Northwestern Algeria

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Fungi are both allies and rivals of plants, and some are involved in plant symbiosis. Mycorrhizae are symbiotic associations contracted by plant roots with the mycelium of a number of mushrooms for mutual benefit. They are essential for 80% of rooted plants, helping them absorb mineral elements, improve nutrition, and resist water stress. Maritime pine (*Pinus pinaster*) and Aleppo pine (*Pinus halepensis*) belong to the Pinaceae family and are two-needled conifers. The former is characterized by its rapid growth to 30 m, and it is a light species known to be thermophilic and require heat and humidity. The latter also has a remarkable drought tolerance. This study focuses on contributing to the determination of fungal species that live symbiotically with maritime pine and Aleppo pine along the Ghazaouet coastline, using surveys conducted during 2021 and 2022, in which we collected under maritime pine and Aleppo pine in the proximity of 2 to 5 m and sampled natural mycorrhizal roots. Identification was based on morphological characteristics, with recognition of macroscopic keys (shape; cap; tubular hymenophores and their organization; internal coating and structure of the foot; color and texture of the flesh; veil and ring) and microscopic observation of spores and fungal structures in the fresh state, using reagents such as Lugol and Melzer. Sections of the mycorrhizae were mounted in cotton blue and observed under a photonic microscope. Four species of basidiomycetes were determined, belonging to four genera: *Suillellus luridus*, *Suillus granulatus*, *S. mediterraneensis,* and *S. bovinus*. Mycorrhization plays a vital role in the dynamics and survival of forest ecosystems.

sciforum-098311: Unveiling Brazil's Plant Diversity: A Review of Neutral Genetic Variation

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Understanding genetic diversity is crucial for plant adaptation in a changing world. High neutral genetic variation (NGD) can indicate potential for adaptation, informing conservation efforts. Brazil, a megadiverse nation with diverse forests encompassing a great variety of ecosystems, harbours a wealth of plant life, yet studies on NGD remain scarce. This work analyses published data (2001–2022) on NGD in native Brazilian plant populations. We identified 651 studies through a systematic search on the Scopus database, with most using microsatellite markers (SSR;
N = 340) and focusing on Fabaceae, Bromeliaceae, and Arecaceae families (N = 107, 72 and 66 respectively). Interestingly, the highly informative SNP markers were underutilized (N = 19), and many papers used dominant markers such as ISSR and RAPD (N = 97 and 62, respectively). This suggests a shift towards next-generation sequencing technologies for a more comprehensive picture of genetic variation. Species-wise, *Euterpe edulis* Mart. (heart of palm tree) and *Hancornia speciosa* Gomes (umbu tree) were most studied, highlighting the link between NGD research and economically important or threatened species. Notably, trees and herbs dominated the studies (N = 371 and 194, respectively), with a focus on the Atlantic Forest biome. However, Cerrado and Amazon biomes were also well represented, underscoring the importance of broader investigation across all Brazilian ecosystems. These findings reveal a critical gap in knowledge. With looming climate and landscape changes, a more comprehensive understanding of NGD across Brazil's diverse flora is vital. Future steps include incorporating recent data and performing a meta-analysis to gain deeper insights into national conservation strategies, ultimately aiding in the development of effective strategies to safeguard Brazil's irreplaceable plant biodiversity.

sciforum-100008: Using YOLOv8 for Interpreting Survey Data of High Spatial Resolution in the Visible Spectrum Range

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The development of artificial intelligence systems allows the application of a set of technical vision algorithms to solve issues of deciphering high-spatial-resolution optical survey data obtained from various types of drones. This study aims to develop a technology for recognizing objects in logging sites. The study objects were cutting areas of varying-intensity logging. The visible-range survey data from a DJI Mavic 3 were investigated. The You Only Look Once version 8 (YOLOv8) model was applied as a computer vision algorithm, an advanced solution in the field of technical vision due to the high speed and accuracy of recognizing various objects in images. The neural network was trained on objects: growing trees, species composition, areas for storing logs, assortments, logging residues, and soil damage. Data labelling was implemented using the Label Studio software product, and the network was trained in the Python environment. The models available in YOLOv8 have five levels of image processing, which determine the accuracy of object detection and processing time. The level of processing is determined experimentally by the accuracy of object recognition for a specific task. All five models were tested to find the best solution for identifying various objects in the forest. The study results showed acceptable accuracy in identifying growing trees, classifying tree species composition, and determining
storage locations for logging residues, stacks, and logs.

sciforum-096204: Variation of Plant Species Diversity along an Altitudinal Gradient in Subtropical Pine Forest, Swat, Pakistan

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This study investigates plant species diversity patterns in Chir pine (*Pinus roxburghii*) forest along an altitudinal gradient in the Karakar Valley, Swat, Pakistan, covering an area of 97,339 hectares around Karakar village at 1336 m above sea level.

Field studies were conducted across various high-altitude regions to assess plant species diversity, composition, and richness along slopes and altitudinal gradients within four forest management units (compartments). Data were collected systematically from 39 plots using a systematic sampling technique along transects: 30 × 30 m plots for tree species, 5 × 5 m plots for shrubs, and 1 × 1 m plots for herbs.

Results indicate a significant decline in tree species diversity with increasing altitude, especially in Compartment 36, compared to Compartment 37, which shows an increase in species diversity with altitude. Compartment 48 exhibits a less pronounced increase in diversity with elevation. Shrub species density per hectare consistently decreases across all compartments, indicating a decline in shrub diversity with elevation. In contrast, herbaceous plant species diversity increases with altitude in all compartments, except for a notable decrease at higher elevations in Compartment 48.

Tree species diversity, measured by the Simpson index, shows an overall decline, while the Shannon index indicates an increase. The Margalef index highlights general trends in tree species diversity. Shrub species diversity trends upward according to the Simpson index but downward according to the Shannon and Margalef indices. Herbaceous species diversity increases in all regions, corroborated by all three diversity indices.

This study underscores the importance of conserving Chir pine forests. The findings provide critical insights for sustainable land use planning and biodiversity conservation in the Karakar Valley and similar ecosystems. The study advocates for the protection of natural habitats to preserve native species diversity and emphasizes active community participation in conservation efforts.

sciforum-083515: Vegetation Composition, Structure, Distribution and Growth Performance of Natural Forest Patches across Agro-Ecologies in Northwestern Ethiopia

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There is an urgent need for conservation measures and a management plan because the natural forest resources in northwest Ethiopia are currently in danger. Although we have a limited understanding of these dynamics, these forests' vegetation is changing in terms of growth performance and distribution. The necessity of looking into the underlying causes of these changes and their implications for conservation and sustainable forest management programs is highlighted by this information gap. Furthermore, only a few site-specific studies on vegetation changes in relation to environmental variations have been done. Consequently, this study aimed to examine the existing state of these resources to apply sustainable forest management practices. To achieve this, transects with 200 square plots measuring 400 m^2 were set up at nine forest patches with 200 m spacing between plots and transects. Vegetation and environmental data were collected and analyzed using R version 4.1. Significant variations (p 0.008) were found in vegetation features along the slope, forest patches, and agro-ecology. When compared to other forest patches, highland and mid-altitude forest patches had the highest species diversity (2.48) and stocking (2578 trees ha^{-1}). The gentle slope has the most species diversity (2.83). The species similarity between highland and mid-altitude forest habitats was found to be significant (69%). The vegetation cover in the mid-altitude forest patches was also high (abundance: 5–12%). In all of the forest patches examined, tree life forms exceeded shrubs, climbers, and herbs. According to the study's findings, the state of forest resources varies considerably across different environmental variations. Despite the impression of entire forest patches from the outside, the interiors are open, with only huge and mature trees covering the canopy. This state has been triggered by deforestation, degradation, and inappropriate human and grazing operations.

sciforum-099885: Virtual Constellation of Sentinel-2 and PlanetScope Satellites to Monitor Forest Ecosystems

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Earth observation capacity, used to monitor forest ecosystems and characterize forest disturbances using satellite Earth observation data, has improved over the past few years, with the development of many algorithms that exploit dense time series at high spatial resolutions. In particular, a significant contribution to land monitoring is offered by Copernicus Sentinel-2 and cubesat satellite constellations, whose high revisit frequency, observation scenario, and guaranteed continuity have encouraged the development of operational monitoring services, also supporting sustainable ecosystem management. In particular, PlanetScope satellite constellation, consisting of more than 200 cubesat satellites, is able to image all Earth land nearly with daily frequency. Virtual constellations of satellites, integrating multiple sensors, allow for the generation of denser vegetation indices using a time series, helping to improve vegetation time trajectories, augment phenology estimation accuracy, and consequently enhance the monitoring capacity of forest ecosystems.

This research study compared and integrated a time series of various vegetation indices calculated from satellite Earth observation acquisitions over forest areas from Sentinel-2 MSI and PlanetScope DOVE and SuperDove satellite sensors. Time series were used to estimate phenological metrics and monitor the post-fire vegetation recovery of forest located at distinct phytoclimatic belts. Technical issues related to the use of virtual constellations of satellites, like radiometric normalization and spatial co-registration, were evaluated and discussed.

Results indicate that the exploitation of the medium-term time series of vegetation indices estimated from satellite data is a suitable tool that can be used to identify, describe, and monitor vegetation post-fire dynamics in ecosystems disturbed by wildfires. This research study demonstrates the ability of virtual satellite constellations to strengthen forest monitoring, highlighting the suitability of proposed approaches to develop operational services for supporting forests ecosystems surveillance, especially under climate change scenarios, supporting sustainable ecosystem management.

Session 3. Climate Smart Forestry and Forest Innovations

sciforum-100312: Artificial Intelligence and Remote Sensing for Climate-Resilient Precision Forestry Management

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The need for innovative technologies in sustainable forest management is evident in the face of the escalating challenges posed by climate change and deforestation. This study introduces an approach combining artificial intelligence (AI) and remote sensing techniques to transform precision forestry management for enhanced climate resilience. By harnessing AI algorithms to scrutinize data sets sourced from satellite imagery, drones, and IoT sensors, stakeholders can make well-informed real-time decisions to optimize forest health, biodiversity preservation, and carbon sequestration potential. The methodology involves using convolutional neural networks (CNNs) to analyze satellite imagery for identifying forest cover changes with an accuracy rate of 92%. Drone-based LIDAR data are employed to assess canopy structure and biomass, providing detailed 3D models that have a margin of error as low as 5%. IoT sensors deliver ground-level data on soil moisture, temperature, and other critical parameters at an update frequency of every 15 min, ensuring timely data collection. These diverse data streams are seamlessly integrated through a machine learning platform that offers predictive analytics and visualization tools. This platform enables forest managers to monitor ecosystem health proactively, with predictive models achieving up to 87% accuracy in forecasting potential disturbances. Results from pilot implementations in diverse forest ecosystems, including temperate, tropical, and boreal forests, demonstrate the efficacy of this approach. In a year-long pilot in a tropical forest, illegal logging activities were reduced by 40%, while response times for the early detection of wildfires improved by 30%. Biodiversity indices showed a 15% improvement due to targeted conservation efforts guided by AI-driven insights. By synergizing advanced technologies, this inventive solution not only
optimizes forest management practices but also lays the groundwork for a more sustainable and resilient future for our forests amidst environmental adversities. The integration of AI and remote sensing in precision forestry management represents a significant step towards achieving climate-resilient forests and safeguarding biodiversity for future generations.

sciforum-098863: Challenges and Opportunities for India's Carbon Forestry in a Dynamic 'Climate Change Supermarket'

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Market-based mechanisms assist in the abatement of excessive greenhouse gas emissions. We had postulated earlier that carbon markets are evolving into a complex 'climate change supermarket'. India is at the forefront of carbon forestry; however, the range of projects developed so far lacks versatility in terms of carbon pools, greenhouse gases, and intervention types. Based on the existing literature and field observations from two registered AR-CDM projects in Kashi and Mahoba forest divisions in Uttar Pradesh (India), questions were formulated for an expert survey. Through this survey of 43 experts, we assessed India's potential to lead in forest-based carbon markets and examined how well-prepared the institutional framework in India is to adopt new market-based mechanisms in carbon forestry and identify areas where improvements are needed. The individual ranking of experts was converted to a scoring matrix using reverse scores. As per the sum of the reverse scores obtained, forest-dependent people were revealed to be the most crucial strength, followed by forest governance. About 42% of the experts did not consider the measurement, reporting, and verification arrangements to berobust. Around 35% of the experts thought that there is a probability of more than 50% that India can meet its forest-related NDC goal. Of the 43 respondents, 56% believed that this goal can be met if international support is available. Out of 43, a total of 25 experts (58%) believed that India is somewhat ready for a domestic carbon market, while 17 experts (40%) believed that India is not prepared. Of the total, 72% of the experts foresee India as a leading country in the event of international carbon markets revival as an implementation of the Paris Agreement progress.

sciforum-093795: Dendrochronological Study of *Manilkara Huberi* (Ducke) A. Chev. (SAPOTACEAE) in a Upland Forest of Central Amazonia Using High-Frequency Densitometry

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This study evaluated the correlation of climatic variables with the chronology of a tree species, *Manilkara huberi* (Ducke) A. Chev. (Sapotaceae), from a upland forest in Central Amazonia. Samples were taken from a forest management area and analyzed using a dendrochronological technique, high-frequency densitometry. Instrumental climate data in the Amazon are insufficient to describe the natural variability of rainfall regimes and their association with major ocean–atmosphere interaction events. A dendroclimatic signal was found for *Manilkara huberi*, which forms annual growth rings as a consequence of the seasonality of rainfall. The annual growth rings of this species are indicated by an alternation of fiber and parenchyma with a band of distinct fibers marking its boundary and are macroscopically difficult to detect. In order to produce a reliable marker of the rings for *Manilkara huberi*, the technique of high-frequency densitometry was applied, an innovative method of measuring density variations in relation to the wood surface, in high resolution, using the dielectric properties of the wood. The indexed chronology showed a significant correlation with precipitation data from the study region, as well as with sea surface temperature anomalies from the Tropical North Atlantic and traditional El Niño regions. Close congruence was also found with Berlage's (1931) chronology in Java, Indonesia, for the period between 1725 and 1929, despite a distance of more than 18,000 km between the two study regions. This can be explained by teleconnections between the two precipitation regimes, regional and ENOS, and also indicates the potential of dendrochronology, specifically high-frequency densitometry, as a powerful tool for obtaining information about past climatic conditions in the tropics using the annual growth rings of tree species.

sciforum-099822: Dynamic Models Applied in Paricá Production Optimization

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Paricá (Schizolobium parahyba var. amazonicum) is an alternative to reforestation efforts, especially in tropical regions. Its exceptional qualities make it an undeniably advantageous choice for forestry projects. Paricá is characterized by high-quality wood, fast growth, and a notable adaptability to different types of soil and climatic conditions. Furthermore, it demonstrates a natural resistance to pests and diseases, reducing the need for harmful interventions. However, optimising forest management and ensuring the long-term sustainability of paricá plantations requires accurate tools for estimating production. Enter the ADA (Algebraic Difference Approach) and GADA (Generalized Algebraic Difference Approach) dynamic models. These powerful computational tools act as virtual laboratories, simulating individual tree growth and the overall dynamics of forest stands over time. By incorporating crucial information such as climate, soil composition, tree competition, and individual tree characteristics, the ADA and GADA models enable remarkably accurate yield predictions. These forecasts are particularly valuable because they consider multiple management scenarios, enabling forest managers to make informed decisions. With the knowledge obtained from the ADA and GADA models, forest managers can optimise harvest times, maximising productivity and minimising environmental impact. In addition to operational efficiency, these models play a vital role in assessing the economic viability of paricá reforestation projects. By providing reliable forecasts, they increase the sector's attractiveness to potential investors, attracting much-needed capital for sustainable forestry practices. Building on this foundation, we will delve deeper into the world of dynamic models. We will present specific models based on the ADA/GADA methodology, developed and applied to data meticulously collected in paricá plantations subject to sustainable management practices in the Northern region of Brazil. Through this exploration, we aim to contribute not only to the sustainable development of our region but also to the well-being of Brazil as a whole.

sciforum-090876: Enhancing Carbon Sequestration and Ecological Practices: Examining the Function of Climate-Smart Forestry and Augmented Reality in Climate Change Mitigation

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Climate-smart forestry (CSF) has recently emerged as a 'hot topic' in the U.S. forestry community. Forest development, the health benefits of forests, and other forest products and services are long-term goals. Finally, CSFs enable forests and communities to adapt and mitigate the
impacts of climate change. Forests are considered an important part of the carbon cycle and play a key role in controlling, mitigating, and adapting to climate change. Poor forest management accounts for 17% of global carbon emissions. However, forests are likely to contribute approximately 10% of estimated global emissions between 2024 and 2050. Additionally, forest products
continue to store carbon even after deforestation, and their shelf life varies depending on how long they have been used. CSF's mission is to reduce greenhouse gas emissions and improve forest management to achieve efficient and sustainable forest products and services. Afforestation and reforestation (AR) on marginal lands is a natural solution to climate change. There is a gap in understanding the potential of augmented reality for conservation and commercial use to influence forest management and the use of trees for climate change mitigation. Here, we summarize these differences to assess 100-year economic and conservation realities (known and new) across different cropping and thinning systems using quality of life and various survival measures. The new AR industry can reduce greenhouse gas emissions from wood products (CLT) and biochar (3.73 × 3.69 GtCO2e) over 100 years compared to the anti-AR industry (3.35 × 3.69 GtCO2-eq.) and augmented reality. This resulted in a reduction of 4.15 Gt of CO_2 emissions, especially in the study area. Forests, which store more carbon than produce CO_2 (3.17 to 3.51 GtCO2e), are cold and dry and have variable soil binding sites and CLT odors. In the short term (approximately 50 years), eliminating AR would lead to greater reductions in greenhouse gas emissions.

sciforum-091320: Evaluating the Potential for Climate Change Mitigation through Doubling the Area of Windbreak Plantations in Hungary

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The land use sector assumes a pivotal role in global efforts to combat climate change, particularly as outlined within the Paris Agreement, EU climate regulations, and overarching net zero targets. Agroforestry systems, by capitalizing on the interplay between trees and agricultural endeavors, offer numerous advantages, including carbon sequestration, soil preservation, and biodiversity enhancement. Windbreaks are integral components of Hungarian agricultural landscapes. An enhanced agroforestry subsidy system could positively influence windbreak expansion, highlighting the need to assess their carbon sequestration potential. As part of the ForestLab project at the University of Sopron, we study how agroforestry systems contribute to climate change mitigation and adaptation.

Building upon the work of Király et al. [1], we evaluate the implications of doubling the windbreak plantation area in Hungary by projecting its total carbon sequestration and annual climate change mitigation potential up to 2050. For modeling purposes, we use the recently developed Windbreak module of the Forest Industry Carbon Model.

Our projections indicate that newly established windbreak plantations, covering 14,256 hectares, could sequester 913 kilotons of carbon by 2050. The average annual climate change mitigation potential of these plantations is estimated at 144 kilotons of CO_2 equivalent, with the majority of carbon sequestration occurring in the biomass pool. This potential represents 2% of the total annual carbon sequestration in the land use sector as reported by the Hungarian Greenhouse Gas Inventory.

Our findings emphasize that agroforestry practices can cultivate resilient and productive agricultural landscapes while contributing to national climate change mitigation efforts and sustainable development goals.

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Reference

[1] Király, Keserű, Molnár, Szabó, Borovics (2024): https://doi.org/10.3390/f15010063.

sciforum-099986: Exploring the Potential Application of Machine Learning Techniques in Forest Management Planning

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Forest management practices in recent times have evolved from focusing solely on timber production towards a more holistic approach incorporating ecological and social aspects. In order to support this movement, the Québec government has mandated and adopted a form of spatial organization termed COS (Spatial organization compartments). COS are subdivisions of the management unit designed to spatially aggregate a harvest area. The spatial aggregation of harvest areas ensures that the extent of the cut areas in the landscape is minimized, and it also reduces the amount of logging roads, thus reducing the complexity of forest operations. The delineation of COS is one of the first steps in management planning, and forest managers carry out this task manually. These units then become constraints for the calculation of Annual Allowable Cut (AAC). However, the boundaries obtained through manual delineation are rarely optimal. We propose a machine learning methodology combining the use of Graph Neural Networks (GNNs) and Reinforcement Learning to partly automate the process. Initially, the stand level data of a forest is encoded into a network of edges and graphs, which is then fed through the GNN to obtain topology aware graphs. After obtaining the dynamic graph that was passed through the GNN, the problem of boundary delineation can be formulated as a Reinforcement Learning problem. The model features an interactive process where the planning agent observes the graph's state, selects edges for optimal plans, receives rewards or penalties based on the guidelines set by the ministry, and the environment transitions based on the agent's actions. This machine learning approach has significant implications in the adaptation towards climate change. It becomes particularly invaluable during the replanning stage when natural disturbances impact planned harvest blocks, necessitating the swift generation of alternative optimal solutions.

sciforum-100054: Influence of the Bioestimulant Larrea Divaricata on the Quality of Neltuma Alba Plants in Nursery

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In our region, there has been a strong push towards establishing forest plantations with Neltuma alba (Algarrobo blanco), a species of great ecological and productive importance. Therefore, ongoing research on this species is crucial.

It is worth noting that for successful plantation establishment, it is essential to work with individuals exhibiting physiological and morphological characteristics that enable them to survive and adapt to field conditions after transplanting. Based on previous studies, the use of plant bioestimulants is suggested as a potential tool to reduce stress in N. alba plants during acclimatization and field planting stages. The aim of this study was to explore the potential of a phytoextract derived from Larrea divaricata (Jarilla) at different concentrations as a plant bioestimulant to improve the quality and stress response of N. alba seedlings.

This research involved sowing identified N. alba seeds in nursery tubes filled with a substrate composed of composted pine bark and perlite (50:50). Fungicides and insecticides were applied, and the irrigation program was adjusted according to environmental conditions and growth phases.

During the final nursery stage (acclimatization stage), the Larrea-based bioestimulant was applied at concentrations of 3% and 4%, with two applications every 7 days, to evaluate its effectiveness on plant growth and quality. Height and stem diameter at collar height were recorded, and plant quality indices were determined. The results suggest that Larrea is a bioestimulant capable of enhancing stress resistance and improving quality parameters in algarrobo blanco.

sciforum-089149: Landscape Breeding

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Introduction

Traditional forest tree breeding involves a lengthy process of crossing, testing, and selection, known as the breeding cycle, which requires significant logistical efforts and faces limitations like experimental trial sizes and the precision of measurements. The advent of genomics introduced the possibility of developing molecular tools to accurately identify the genome shared among individuals, forming the basis of the Breeding without Breeding (BWB) approach. This method aims to bypass artificial mating but has been limited by the need for structured open-pollinated trials. Recent advances in remote sensing technology now offer a way to phenotype trees accurately and extensively, considering environmental factors and enabling the assessment of various tree attributes at a landscape scale.

Methods

In Sweden, a significant portion of commercial Norway spruce forests are regenerated from improved progenies, making it an ideal setting to combine molecular pedigree reconstruction with remote sensing. This integration forms the basis of Landscape Breeding, a novel strategy aimed at enhancing genetic diversity and improving seed orchards by selecting superior trees directly from commercial forests, thereby expediting forest enhancement for sustainable biomass production.

Results and Conclusion

We developed a method that merges genetic, genomic, and remote sensing data to scan Norway spruce stands, covering a clonal archive, a progeny trial, and commercial forests. Preliminary data processing is underway, with remote sensing data being used for genetic analysis. This method demonstrates the efficacy of remote sensing in evaluating tree genetics on a landscape level, marking a significant advancement in forest breeding strategies.

sciforum-095546: Potential of Plantation Forest for Carbon Sequestration and Climate Change Mitigation in Essera District, Dawro Zone, South West Ethiopian People Regional Government

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A nondestructive sampling method was utilized to evaluate the above-ground carbon stock of a tree plantation forest by laying 10 plots of size 25 m * 25 m. All trees within the sample plot were recorded and DBH and height were measured by a caliper and a clinometrer, respectively. To determine the above-ground biomass of trees, the formula IPCC = $0.0673(\rho HD^2)^{0.976}$ was applied. To obtain the below-ground biomass, the above-ground biomass was multiplied by 20 percent. To convert biomass into carbon quantity, biomass was multiplied by 47 percent. To see the relationship between variables, SPSS version 20 was used and one-way ANOVA and *t*-test were used. In the plantation forest in this study, an area of 110 tree/ha was found, which indicated that the trees were sparsely populated or its density was very low. The total above-ground biomass was 902.377 tons and the below-ground biomass was 180.46 tons. There was no significant relationship between quadrat and number of trees, as r^2 is 0.262 and the Durbin–Watson coefficient is 2.825. The results of ANOVA showed p values of 0.130^b, which is also not significant. Diameter at breast height (DBH) and height have very strong relationship because ANOVA indicated p = 0.000^b. These three factors had a very strong correlation, according to sample tree correlation. R-Squared (R^2) =0.994 indicated that the above-ground biomass, height and DBH had a strong positive and linear relationship. The total carbon density was 508.8972 tons. Cupressus lusitanica could accumulate a larger amount of biomass than others at a proportion of 36.78 percent; followed by Eucalyptus camaldulensis, which covered 32.72 percent; while Grevillea robusta had 30.5 percent of the total accumulation. There was a significant difference between the biomass accumulations of the three investigated plant species because the t value for above-ground biomass was 0.006 and that for below-ground biomass was 0.009.

sciforum-090308: The Governance of Amenity Trees in the Premises of Industrial Companies in Ibadan Metropolis, Nigeria

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Industries contribute to environmental pollution, and increasing tree cover is an often-proposed urban climate change adaptation strategy. This study examined the governance of amenity trees so as to encourage industries to create policy frameworks to ensure trees perform to their maximum capacity. Twenty industries were randomly selected in Ibadan Metropolis. Structured questionnaires were distributed to three departmental/unit heads in each industry. Data were analysed using descriptive and chi-square analysis.

Nineteen amenity trees were identified. Polyalthia longifolia (30.8%) had the highest number, while Eucalyptus camaldulensis (0.6%) and Alstonia boonei (0.6%) had the smallest. Black Horse Plastic Limited had the most trees (33) on her property, followed by Premier Feedmill (30). Premier Feedmill company, on the other hand, had a higher species richness (six) than Black Horse Plastic Limited, which had only five species. Deepee Global had the fewest trees (eight) in and around their surroundings. Respondents (25.0%) stated that they had no idea when trees were planted, 38.3% revealed that there was no department(unit) responsible for tree management, and there was no precise tree maintenance schedule. However, the planting (38%), watering (55%), pruning (30%), cutting (30%), and cleaning of trees' surroundings (45%) were all conducted when needed. Respondents (98.0%) responded that no funds were set aside for tree management. The year of the planting, who conducted the planning, and the planting objective all have a significant relationship with silvicultural activities practiced in different industries. The study confirmed that industries have trees, but there is no consistent tree management schedule and funding. It is therefore recommended that every industry creates a policy framework to guide strategic decision making in tree management.

Session 4. Forest Wildfires

sciforum-088882: Differential Expression of Genes in *Quercus agrifolia* from Different Fire History Areas in the Angeles National Forest

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Our study established transcriptomic and soil metagenomic resources for *Quercus agrifolia* (leaf). *Q. agrifolia* is a hardwood that may live for centuries.

Samples were collected from three fire history areas in Gold Creek Preserve, Angeles National Forest. Low, medium, and high intensity burn areas are referred to as the Blue, Green, and Red Trails. In our previous work, we showed taxonomic differences in fungi and bacteria in the three different fire areas. The current study sought associations between plant gene expression and microbial functions.

During May 2022, snap frozen plant tissue samples for RNA sequencing and soil samples for metagenome sequencing were collected. The bioinformatics for plant RNAseq was QC in SOAPnuke and MultiQC, Trinity de novo assembly, BUSCO evaluation, salmon quantification, and annotation with Trinotate. Metabarcoding analysis used DNA Subway Purple Line. Soil metagenomic analysis was carried out in Nephele BioBakery, MicrobiomeDB, and STAMP.

For oaks, the transcriptome was 96.17% complete according to the BUSCO assessment. Three trees were sampled from each of 3 burn areas which allowed for contrasts in DEseq2 based on the tree location. There was evidence of differential gene expression related to the isoprenoid pathway, freezing resistance, drought response, and pathogen defense. However, there was some evidence of heterogeneity of gene expression within the clusters, for the top 25 differentially expressed genes.

In WGS results, there was not strong evidence of functional differences associating the soil microbiome of *Q. agrifolia* with plant secondary metabolite production. However, there were taxonomic & alpha diversity differences associated with different areas of the preserve, each having different fire histories. Further studies should focus on microbes associated with plant tissues and their potential association with plant secondary metabolite production. For example, further
experiments should use woody tissues.

sciforum-088824: A Review of the Causes, Effects, and Mitigation Strategies for Wildfires

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Wildfires are a common natural disaster that may seriously harm infrastructure, human lives, and ecosystems all over the world. Since 2016, there have been some of the most costly years for wildfire-related economic and insurance losses; from 2013 to 2022, wildfires cost USD 98.87 billion in worldwide economic losses and USD 69.92 billion in insured losses (adjusted to USD 2023). This review includes information on the causes, impacts, and mitigation strategies of wildfire. The main causes of wildfires might be human activities, such as arson or accidental igniting, or natural events, like lightning strikes. Many areas have shown that wildfire frequency and intensity are influenced by climate change, which is linked to rising temperatures and prolonged droughts. Wildfires have wide-ranging and complex effects. They may cause ecosystems to change, biodiversity to disappear, and habitats to be destroyed. Because they destroy property, infrastructure, and natural resources, wildfires cause significant financial losses. In addition, the inhalation of smoke can lead to respiratory issues and force communities to quit their homes, both of which are major health hazards associated with wildfires.

Homeowners in the wild land–urban interface need to be ready for wildfires that could endanger their properties. Certain protocols and strategies can be put in place to prepare for wildfires as more people relocate to these areas. Defensible areas, growing vegetation resistant to fire, fire-retardant building materials, and sprinklers to prevent the spread of the fire are some of these measures. In conclusion, wildfires are serious disasters that extensively affect economies, human lives, and ecosystems. Societies may try to lessen the frequency and severity of wildfires; save lives and livelihoods; and preserve our natural environment by being aware of the causes, effects, and suitable mitigation techniques.

sciforum-096158: Advancing Wildfire Detection through Enhanced Satellite Technologies—Review

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This review delves into the advancements in satellite-based wildfire detection systems, highlighting their pivotal role in monitoring remote areas. The evolution of fire detection technology can be traced from the early use of polar-orbiting meteorological satellites in the 1980s to the sophisticated sensors and algorithms employed today. A key breakthrough came with the introduction of the Moderate-Resolution Imaging Spectroradiometer (MODIS) sensor on NASA's Terra and Aqua satellites. MODIS and similar sensors like VIIRS can detect fires by measuring thermal radiation and spectral characteristics. The contextual algorithm used in MODIS fire detection plays a crucial role in improving accuracy by analyzing spatial and temporal factors.

However, these contextual algorithms face limitations, such as the potential to miss small fires and sensitivity to errors in background temperature estimation. To address these challenges, researchers are developing improved fire detection techniques. These include integrating multiple contextual tests, applying machine learning methods, and leveraging auxiliary data sources like topographical information and land cover maps. Efforts are also underway to create harmonized fire detection products across different satellite sensors and to adapt algorithms regionally for improved performance. Advancements in detecting smoldering fires, especially in peatlands, are crucial for better understanding greenhouse gas emissions. This review emphasizes the importance of these continuous improvements in satellite-based fire detection systems for enabling early wildfire identification, facilitating timely response, and ultimately reducing the devastating consequences of wildfires.

sciforum-095142: Effects of Wildfire Forest and the Impact of Heavy Machinery on Reforesting: Soil Compaction, Erosion, and Shock on the Biodiversity and Coopetition of the Forest Ecosystem

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Introduction

The research focused on the impact of burned forests on biodiversity and soil layers. The interaction between forests affected by wildfires and the ecological dynamics within forest ecosystems is complex. This complexity is increased by the use, on some occasions, of heavy machinery used in reforestation, which compacts delicate soil. Understanding the effects of wildfires on biodiversity, nutrient cycling, mycorrhizal networks, soil erosion, and forest resilience is key. The goal is to provide information for better conservation and restoration strategies for forests damaged by fire.

Methods

This study used a systematic review of the literature in an important series of databases. The key variables referenced included nutrient cycles, heavy machinery compaction alterations in different mycorrhizal networks, the survival and recovery of resilient trees, and the impact of fire on soil microbial communities. Case studies on natural fire regimes and their impact on biodiversity and forest dynamics were also included.

Results

The results indicate that forest fires significantly alter the cyclic and mycorrhizal networks, affecting the resilience of the forest ecosystem. Fire-induced deforestation can benefit some biodiversity by promoting fire-adapted species. On the contrary, the heavy machinery used in reforestation causes soil compaction, altering the ecological 'coopetition phenomenon'. The combined stressors of fire and soil compaction make better recovery difficult. However, in contrast, other studies show that controlled burning can mitigate some negative impacts, facilitating the recovery of the mycorrhizal network and improving the regenerative capacity of trees.

Conclusion

Understanding the cumulative effects of wildlife deforestation versus traditional deforestation is essential for developing effective forest conservation and restoration policies. The findings suggest that integrating prescribed burning and sustainable forest management practices into forest management can promote resilience and recovery. Future research should explore the feedback loops between fire regimes, biodiversity, and forest dynamics to refine these strategies further.

sciforum-100019: Evaluation Method for Selecting the Most Suitable Intensity of Silvicultural Intervention in Relation to the Estimated Reduction in Combustion Energy Load within a Forest Ecosystem

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This research develops a forest management method to select the optimal intensity of silvicultural intervention aimed to reducing combustion energy load within a forest ecosystem. Since the fuel load is the only modifiable factor in the linear intensity equation of a wildfire, thinnings are essential to prevent or mitigate wildfires. The methodology involves measuring the tree volume within a sample area, determining the volumetric difference per square meter before and after intervention, and calculating the volume of aboveground biomass removed using the specific wood density of the target species. The higher heating value of the species is calculated and multiplied by the removed biomass volume and its specific weight. By comparing pre- and post-intervention values within Byram's equation, the variation in flame front intensity can also be determined. This approach allows forest managers to decide thinning intensity based on fuel load and calorific energy. Results show that systematic thinning reduces potential combustion energy, decreasing wildfire danger and intensity. Additionally, the study calculates the kilograms per square meter of water saved post-intervention compared to what would be needed to extinguish a full-scale forest fire. This method provides a quantifiable approach for tailoring silvicultural interventions, enhancing forest resilience and safety. The data obtained from the spreadsheet is then used within the Q-GIS software to spatialize the calorific energy before and after the intervention using the geostatistical interpolation method known as kriging, which involves obtaining the different intervention scenarios for silvicultural operations. By applying this methodology, forest ecosystems can be managed in a more sustainable and suitable way, effectively balancing ecological health with wild fire prevention.

sciforum-099621: Fire Risk Assessment in the Cross-Border Area Using National Technical Specifications

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Forest fires in Mediterranean ecosystems are a common phenomenon. In Greece, only 5% of forest fires are related to natural causes, whereas human activities are responsible for 95%, heightening the severity and complexity of these fires. However, in cross-border regions, different fire management systems can result in a variety of factors that drive forest fires.

The objective of this work was to evaluate the fire risk in the Region of Central Macedonia, Greece, for the prevention and mitigation of fire disasters in the cross-border area, adhering to the technical specifications of the national fire protection plan. The datasets used for this study were obtained from national official sources and OpenStreetMap, while their completeness and reliability were checked using visual interpretation methods, with medium-high and very-high spatial resolution remote-sensing data available from Copernicus, National Cadastre and Mapping Agency, and Google Earth imagery.

Wildfire risk assessment considered two parameters, namelyfire hazard and fire vulnerability. Fire hazard combines vegetation flammability as a potential for the easy initiation and rapid progression of fire, with fire cause elements such as voltage network, road network, settlements, forest/rural fire-starting points, and explosion risk elements. The final fire hazard map was evaluated and refined using actual fire data from the past decade. Fire vulnerability considers the combustibility of vegetation types under weather and topographical conditions that favor fire spread, as well as threaten values regarding tangible and intangible elements-at-risk such as areas of high natural value, as well as socio-economic data. Both parameters received a score (1 to 10), and wildfire risk was assessed on a qualitative rating scale of five categories from low to very high.

Overall, the present work, as part of the eFIDAR project, is a step towards common forest fire management in the cross-border region, increasing forest fire preparedness and knowledge transfer between Greece and North Macedonia

sciforum-095274: Modelling the Domino Effect of Wildfires

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Wildfires comprise one of the most destructive and lethal natural hazards, where various physical factors, such as low soil moisture, and human factors, such as the absence of preventive measures during wildfire season, can contribute to the generation of megafires. Although human activities such as arson make up the most frequent factor for a fire event, there are several natural hazards, such as lightning, heatwaves as an outcome of extreme temperature, and drought, that can also trigger or increase the probability of wildfires. On the other hand, subsequent secondary hazards such as floods and landslides can be effectuated in the long term as a result of wildfires. It is worth mentioning that the frequency of events of the aforesaid natural hazards has been increased intensively since 1980, according to the United Nations Office for Disaster Risk Reduction (UNDRR). The prediction of natural hazards is of outstanding importance, with the aim of disaster mitigation; thus, the utilization of Artificial Intelligence and Data Science is necessary. Various Machine Learning (ML) algorithms have been used in the literature to forecast wildfires and the aforementioned disaster chain, each one providing divergent predictions, in combination with Earth Observation (EO) indices, geospatial, and socio-economic datasets. The objective of this research is to expound the methods used in the literature to model and predict wildfires and their interconnected hazards by performing a review process.

sciforum-100032: Operational Plan for Combating Rural Fires on the Island of Madeira

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Fire is a natural element in ecosystems around the world. It plays a crucial role in the evolution of landscapes and the maintenance of biodiversity; Madeira island has a vast forest patrimony, with 58,294 hectares subdivided between forests, herbaceous areas, and other wooded regions. One of the main risks on the island is rural fires. To combat this phenomenon, starting in 2015 (during the critical fire period), the Regional Government implementedan operational program to combat rural fires, focusing on patrolling, surveillance, and direct combat. All teams record the current status on a tablet and communicate via radio. These records are monitored daily and in real time. The layout of burned areas (greater than 1 ha) are carried out in collaboration with government entities. We intend to present the results of the last 9 years. Ignition sources are divided into several categories, namely forestry—305; bush—621; authorized controlled burns—373; unauthorized controlled burns—3145; and agricultural—263. One of the lessons is that the south coast of the island has more ignition points than the north coast; however, despite a smaller number of ignitions on the north coast, the recurrence since 2018 has been constant, and the consequences that may arise are very worrying. Urban or peri-urban fires occur in situations of introduced vegetation and ecosystems that have been greatly altered by humans. Madeira's ecosystem did not evolve with the presence of fire, so it was not part of the landscape's evolution process. Rural fires effectively entered areas of native vegetation and destroyed the original vegetation. Human intervention to control fires and suppress their spread alters the frequency and intensity of natural fires, disturbing the ecological balance. The protection and adequate management of natural areas adjacent to urban areas are essential to preserve fire ecology and fire-adapted biodiversity.

sciforum-100063: Problem of Rural Fires in Urban--Rural Interface Areas: Case Study of Samardã Wildfire 2022

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Over the years, the active movement of the population in Portugal has contributed to increased pressure on urban--rural interface areas. The frequent abandonment of rural areas and increase in the aging rate, boosted by the rural exodus of younger age groups, have contribute to the lack of planning, the abandonment of agro-pastoral activities, an increase in the fuel load, and the growth of fuel use near population centres. The combination of these factors contributes to increasing the fire risk susceptibility in urban--rural interface areas.

This paper presents a case study that took place in the municipality of Vila Real, Portugal in 2022, the Samardã Wildfire fire. It was based on the use of geographic information system tools, statistical procedures, and historical fire analysis.

It was possible to verify that the area affected by the 2022 fire has a high recurrence rate, evidenced by the fires that occurred in 2005 and 2017, which consumed a large percentage of the same area as the 2022 fire.

Analysing the data providing by the map of the use of soil in 2021 (COS 2021), it was found that 85.5% of the burnt area was occupied by scrubland, sparse herbaceous vegetation, and areas without vegetation; 12.4% was occupied by various settlements; and only 1.6% was occupied by agricultural areas. The rest was occupied by artificialized areas and water. In 1990, this area was 80% occupied by scrubland and rocky areas, 14.9% by diverse settlements, 5% by agricultural areas, and only 0.1% by artificialized areas.

The results show that when rural fires hit areas at the urban--rural interface, the means of protection and rescue are primarily allocated to protecting people and property, to the detriment of extinguishing the fire front. This prioritization of actions has contributed to an increase in the area burned, since the fire front burns more freely.

sciforum-095398: Satellite Assessment of Post-Fire Forest Cover Loss in Siberia and Its Relationship with Fire Characteristics

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The impact of fires on forests is determined by a number of factors, including fire type and intensity, forest stand species composition and age structure, soils and other conditions. This paper examines the relationship between fire intensity, assessed using fire radiative power (FRP), and the degree of forest disturbance, assessed through the proportion of tree cover loss. The objectives of this study included the following: (1) analysis of the dynamics of FRP and the proportion of stand-replacement fires in Siberia; (2) assessment of the relationships between FRP and predominant tree species as well as the seasonality and duration of fires and the proportion of stand-replacement fires. MODIS thematic products for 2002–2022 were used to obtain data on the locations and areas of wildfires as well as FRP estimates. These products included MODIS burned area product and MODIS thermal anomalies product containing FRP estimates. The global forest cover change product was used to detect areas where forest loss had occurred. Increasing trends in both the total burned area and the area of stand-replacement fires were observed in the region. A significant increase in stand-replacement fires occurred after the year 2012. The highest proportion of stand-replacement fires was observed in dark coniferous stands (61%) and in larch-dominant stands (52%). Significant increasing trends in FRP were observed in dark coniferous stands (r^2 = 0.6, p 0.01), larch stands (r^2 = 0.5, p 0.01) and pine stands (r^2 = 0.4, p 0.05). Stand-replacement fires were also characterized by ~14% higher mean FRP values compared to non-stand-replacement fires (~30 vs. ~26 MW/km^2). Stand-replacement fires were mainly observed during the second half of summer and were characterized by a longer duration compared to non-stand-replacement fires (3.8 vs. 4.9 days). The results showed that the proportion of stand-replacement fires in Siberia is largely determined by the fire radiative power, fire duration, seasonality, and prevailing forest stands.

sciforum-094999: Evaluation of the Effects of Wildfires in Siberian Forests Based on Satellite Data for 1996–2023

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Wildfires are the most significant factor that affects the boreal ecosystems of Siberia. The issue of monitoring fire consequences such as tree stand losses, long-term changes in the thermal regime of soils, and direct emissions of carbon is very important for the region. Remote sensing data are the most effective technique for controlling large-scale processes caused by wildfires in Siberia.

Our study used fire data from the satellite monitoring bank (Institute of Forest SB RAS, Krasnoyarsk, Russia) for 1996–2023. Fire intensity was ranged based on the Fire Radiative Power (FRP) technology of MOD14/MYD14 products. We controlled vegetation cover using the "Vega-Pro" GIS service of the Space Research Institute RAS (Moscow, Russia). To evaluate fire emissions, we modified the Seiler–Crutzen method (1980), by accounting for fire intensity in terms of FRP.

We obtained the following results: firstly, we calculated that during 1996–2023, Siberian forests were impacted by 15.48 ± 2.33 thousand fires per year, which is about 11.34 ± 2.88 million hectares of burnt areas annually. Considering fire intensity, we estimated the stand-replacement fires in Siberia at approximately 1.0 million hectares, and this value has the potential to surpass 3.0 million hectares by 2050, given the current trends in burning regimes and fire intensity.

Next, over the two decades of 2002–2022, a growth trend in high-intensity fires was typical for a significant part of Siberia (~30% of the total area), mainly in larch-dominated forests (>60° N) and in the tundra zone (>67° N).

Finally, direct fire emissions have been rising from 60.0 ± 25.8 Tg/year in the early 2000s up to 296.0 ± 102.0 Tg/year during the 2020–2023 seasons due to increases in both wildfire area and the proportion of high-intensity fires. Thus, in the near future, carbon sinks may be suppressed by annual fire emissions, resulting in a positive carbon balance in some ecosystems of Siberia.

sciforum-095736: The Impacts of a Forest Wildfire on Flooding and Economic Damages

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Wildfires are an escalating global threat, particularly during summer periods, jeopardizing ecosystems and human activities, with evident consequences across multiple regions worldwide. Forest wildfires, in particular, demand urgent attention due to their profound impact on environmental and socioeconomic systems. The study of forest wildfires is crucial for understanding and mitigating their adverse effects, but such combined fire-impacts phenomena are complex and challenging to study.

The consequences of forest wildfires include altered hydrological processes, which increase the risk of flash floods in downstream areas during extreme storm events. In this study, we address this often-overlooked issue by simulating a real flash-flood event that occurred after a forest wildfire in a Greek case study. We assess the flood inundation of an extreme storm that took place after the wildfire, and estimate the associated direct economic damages.

We employ a combination of multiple methods and tools, including: (a) the atmospheric model WRF-ARW to represent the real storm; (b) remote sensing techniques to assess the burn extent and severity, in order to mode the different catchment properties in pre-fire and post-fire conditions, as well as the flood extent; (c) the 2D HEC-RAS hydraulic-hydrodynamic model to simulate the flood extent and water depth; and (d) a coupled semi-automated AI-based approach alongside an economic routine to estimate the flood's damages in terms of affected properties and road closures.

The results indicate that the impact of forest wildfires can significantly influence flood response and risk in downstream areas. The direct economic damages are substantial, affecting multiple sectors and infrastructure systems.

It is crucial to better understand the influence of forest wildfires on flooding dynamics and develop portfolios of proactive measures to address these increasing risks.

Session 5. Wood Science, Production Chains, Fuelwood and Trade

sciforum-099877: Anatomical Characterization and Mechanical Properties of Two Endemic Thin-Walled Bamboos Used for Mat Weaving in Western Ghats

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Bamboo forms an important resource for indigenous communities, especially in Asia with its abundant bamboo resources. Thin-walled bamboo is widely used for mat weaving by the tribal communities in Western Ghats, which forms a major utilitarian item. Two endemic bamboos, *Teinostachyum wightii* Bedd. & *Ochlandra travancorica* (Bedd.) Benth, are used for mat weaving by the communities, with the former being the most preferred species. The physical and anatomical properties of these two bamboo species are studied in the bottom, middle and top portions. The internodal length of *T. wightii* was found to be more (120 cm) in the middle, reducing the need for joining the slivers, which is an important parameter of mat weaving. Density ranged between 0.48 g/cm^3 and 0.59 g/cm^3 for *T. wightii.* Vascular bundles were found to be predominantly of Type II. Fiber characteristics showed variations across height levels (bottom, middle and top) and radial positions of the species (outer, middle and inner). Mechanical properties were studied for the splits (IS 8242) that were used to produce slivers from the bottom, middle and top parts of both species. The study revealed that *T. wightii* splits had better MOE (6563 N/mm^2) compared to *O. travancorica* (8334 N/mm^2), which could explain the reason why it is the preferred choice of indigenous communities for weaving highly flexible bamboo mats with various designs.

sciforum-099863: Physical Traits, Treatment Responses, and Fiber Properties of *Dendrocalamus brandisii* and *Dendrocalamus asper*

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Dendrocalamus brandisii and *Dendrocalamus asper* are commercially significant bamboo species within the *Dendrocalamus* genus, widely utilized in building and construction. To optimize their use for various purposes, it is essential to thoroughly explore and understand their properties. The present study investigates the properties of two bamboo species, *Dendrocalamus brandisii* and *Dendrocalamus asper*. The research focuses on anatomy, physical properties, their behavior towards various treatment methods, and fiber characteristics across different sections (inner, middle, and outer section of the bottom, middle, and top part) of the bamboo. The results indicate significant variations in these properties. The moisture content of these species ranged from 60.02% to 101.28%, and density values varied between 0.588 g/cm^3 and 0.731 g/cm^3. Volumetric shrinkage percentages were distinct, with *D. brandisii* exhibiting less shrinkage compared to *D. asper*. Round culms of both species treated with boric acid and borax showed retention values between 3.58 kg/m^3 and 7.22 kg/m^3 against various treatment methods such as diffusion, butt end, and pressure treatment. The fiber characteristics analysis also showed variations across different sections and parts of the bamboo and between species. These findings enhance the understanding of various properties of two important bamboo species, informing their potential for various applications in construction, manufacturing, and other industries.

sciforum-099898: *Pinus pinea* L. Xylogenesis under Extreme Conditions in the Llobregat Delta Litoral Forests

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Understanding the process of wood formation, xylogenesis, is fundamental for the ecological management and conservation of forests due to the implications of tree responses to the impact of climate change, especially in harsh environments. Such is the case with the coastal forests of *Pinus pinea* L. in the Llobregat Delta (Barcelona, Spain), classified as habitats of special interest and conservation under European regulations.

In this study, we selected four stands of these coastal forests, which differ in tree density and phreatic water parameters, determining the xylem formation process in 20 adult *Pinus pinea* L. trees (5 from each stand of similar age and diameter). Concretely, we show results from two of these stands, both differing just in tree density.

Procedures. Every twenty days from November 2020 to December 2023, we extracted 1–1.5 cm long minicores, from which we obtained histological sections (6–8 µm). These sections were photographed (40x) to determine the number of cells and the ring width. Tracheids were classified in terms of blue cells (elongation and thickening cells) and early- and late-wood cells. The trees selected were dominant, healthy individuals, representative of each stand, located at a mean of 15 m from each other. The parameters of brackish groundwater are located at a depth of 1.3 m.

Results. The results indicate that *Pinus pinea* L. exhibits greater phenotypic plasticity than anticipated, suggesting that competition among trees exerts a significant influence on phenology. We found that the growing period for the less dense stand is quite long—March to July and September to December—while that ofthe densest is from March to May and July to November. Moreover, the less dense stand can triplicate the number of cells compared to the dense one. The same happens with the ring length width. These results were obtained by studying the number of early- and late-wood cells and features such as width.

sciforum-100015: The Role of Extractives on the Fire Performance of *Tectona grandis* L.f. (teak) Wood

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Wood from teak (*Tectona grandis* L.f.) is a commercially prized material due to its strength, color, and natural resistance to decay and insects. Some of these properties are attributed in part to its high extractive content. The subject of this study was to investigate the influence of extractives on the fire performance of teak wood. Two sets of dimensionally identical (100 mm × 12.5 mm × 12.5 mm) samples were prepared. One set of samples was extracted using soxhlet extraction equipment in three steps: first, for 24 h, using a mixture of acetone, ethanol, and toluene (1:1:4); next, for 8 h, using ethanol; and last, with distilled water to remove water-soluble extractives. The fire performance of both sets was evaluated using a rate of burning test according to BIS IS: 1734 (Part 3)—1983. Extracted wood samples exhibited a significant change in weight and surface color compared to their non-extracted counterparts. The surface color tended to become lighter and weight reduced significantly for extracted wood samples. Importantly, the extracted samples displayed a significantly slower burning rate than the non-extracted ones. These findings of the present study highlight the role of extractives in determining the fire performance of teak wood and demonstrate that the presence of wood extractives negatively influences the fire performance of teak wood.

sciforum-099953: Atmospheric Contamination of Lutetium in Leicestershire (England) Using Tree Bark Biomonitoring

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The presence/distribution of lutetium (Lu) in topsoils from Leicester city and surrounding areas (England) represents a low risk for the population (ingestion and dermal contact); meanwhile, its content in wild mushrooms could present some oral risks. To monitor the air quality, about 2–5 g were collected from a sample of of bark with a length of 2–6 millimetres from 55 different trees across Leicester and 41 from surrounding rural/suburban areas; samples were taken at 1.50–1.80 m from the ground to limit contamination from topsoil/dust. Lu was monitored by ICP-MS in cleaned/ground/homogenised samples mineralised with HNO_3/H_2O_2 [LoD = 0.066 ng/g dry weight (dw)]. Results were compared with previous studies performed on 106 mushrooms and 850 topsoils collected in the same areas. Levels of Lu were similar in both main areas; data were presented as medians and ranges for urban and rural areas, respectively (in ng/g dw): 0.580 (0.182–2.118) and 0.584 (0.402–1.071). This results are in line with the distribution observed in topsoils, i.e., Lu did not show statistical differences between urban and rural areas (*p*-value = 0.602; 0.117 vs. 0.123 mg/kg). However, some bark samples collected in the city presented higher levels of this element. This pattern is similar to levels observed in wild mushrooms, in which the higher presence of Lu was detected in mushrooms collected in urban areas (0.347 vs. 0.196 ng/g dw). Results suggest similar sources of air contamination by Lu across the main areas monitored, in which topsoils might play a role that should be further assessed, although these made minor contributions to the levels monitored in wild mushrooms. Although preliminary, in general, levels of Lu found in the tree bark were lower than the natural background reference concentration of Lu reported in plant materials collected in a forest in northwest Germany (2.5–5 ng/g dw), suggesting a minor contamination by Lu in Leicestershire.

sciforum-091471: Challenges for Wood–Plastic Composites: Increasing Wood Content and Internal Compatibility

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Wood–plastic composites (WPCs) are interesting materials as the bio-based content is determined by the inclusion of wood particles regenerated from residual wood sources of biomass products. At present, the aim is to increase the wood content in WPCs above 60%, while it is currently limited to around 40%. The rationale behind this is based on the increase in performance of the WPC, the relatively cheap price of wood and the aim to augment the biobased content. Most studies are presently carried out with a maximum of 50% wood particles (preferably ranging around 30–40%), while there are only very few sources where the wood concentration was increased to 70%, but the formulations were not yet optimized and there were problems in interface compatibility, leading to weak mechanical properties. Problems in augmentation of the wood content have to be controlled, e.g., aggregation, dimensional stability and water absorption. Alternative approaches for the treatment of the wood chips before (or during) compounding with the polymer matrix should be developed. As water resistance is mainly related to control of the surface properties of the hydroscopic wood particles, possible solutions should consider better protection of the individual wood particles' surface against water ingress, better development of the wood–polymer interface and the hindrance of the formation of a continuous network with contacting wood particles. Therefore, this presentation gives an overview of the technological feasibility of various processing routes together with economic feasibility potential based on various sources from the literature, including the effects of compatibilizers and additives, spray-coating of wood particles, chemical pretreatment, physical modifications and thermal treatment of the wood fillers.

sciforum-099908: Comparative Study on the Destructive and Non-Destructive Evaluation of the Modulus of Elasticity of Six Hardwood Species

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The modulus of elasticity (MOE) of wood is a crucial characteristic as far as its utilization is concerned. Nevertheless, the conventional approach to determine the MOE of wood is time-consuming and destructive in nature. Techniques based on vibration frequencies and the propagation of ultrasonic and stress waves are becoming increasingly popular for the non-destructive evaluation of the dynamic modulus of elasticity (DMoE) of wood. The utility of non-destructive techniques for determining the DMoE of clearwood specimens of six hardwood species, namely, *Acacia* spp., *Ficus* spp., *Swietenia* spp., *Mangifera indica*, *Millingtonia hortensis*, and *Ailanthus excelsa*, was investigated in the current study. The DMoE of wood specimens was estimated using three methods, namely, longitudinal vibration ($DMoE_{long}$), flexural vibration ($DMoE_{flex}$), and the ultrasound method ($DMoE_{us}$), and DMoE values were compared with the static modulus of elasticity determined through destructive testing in a universal testing machine. The DMoE values were found to be greater than the static MOE, and the order of increasing MOE values was as follows: static MOE followed by $DMoE_{flex}$, $DMoE_{long}$, and $DMoE_{us}$. A statistically significant correlation was observed between dynamic and static MOE. An observable strong relationship exists between density and MOE, as established by both non-destructive and destructive testing, suggesting that density significantly affects the mechanical properties of wood. The current study's findings suggest that non-destructive techniques (resonance vibrations and ultrasonic waves) have the potential to serve as a simple, reliable, and quick approach for evaluating wood stiffness.

sciforum-099965: Effects of Chemical Modification with Citric Acid on Wood

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In this study, fir (*Abies nordmanniana*) and poplar (*Populus* sp.) woods were modified with citric acid and five different polyols (glucose, sorbitol, glycerol, sucrose, and maltodextrin) at 10% concentration for 2 h at 150 °C. Equilibrium moisture content, water uptake, anti-swelling efficiency, compression strength parallel to the grain, anti-bacterial test, and decay test were applied to measure the changes in the modified wood. As a result, the equilibrium moisture content at 90% RH and the water uptake rates of the modified woods decreased, but the anti-swelling efficiency increased up to 57%. Compression strength parallel to the grain increased by 10% in fir wood and 21.3% in poplar wood. Anti-bacterial properties were observed withcitric acid in fir wood and citric acid, citric acid/sorbitol, citric acid/glycerol samples in poplar wood. As a result of the fungal decay test, the weight loss of the wood samples was between 4.46 and 7.65% in fir wood and between 6.51 and 12.70% in poplar wood. The modification conditions of wood samples were optimized with citric acid, which improved wood properties by blocking reactive groups by cross-linking on wood fibers. As a result, citric acid treatment improved some physical, mechanical, and biological properties of fir and poplar wood, and it is recommended as a promising, environmentally friendly, and cost-effective wood preservation method.

sciforum-100074: Efficacy of Citrus Peel (*Citrus sinensis* (L.) OSBECK) as a Preservative against Termite Attack on *Hollarhena floribunda* (G.DON) T. Durand & Schinz. Wood

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Introduction

The need for sustainable wood utilization whilst ensuring environmental protection necessitates aggressive research into the development of potent environmental benign wood preservatives. Developing such biocides from raw materials that are considered an environmental menace could help address serious environmental pollution peculiar to most developing countries like Nigeria. Hence, this study investigated the efficacy of Citrus (*Citrus sinensis* OSBECK.) peel oil in the protection of non-durable wood of *Holarrhena floribunda* (G.DON) T.

Materials and Methods

Citrus sinensis peels were gathered from orange sellers at Agbowo market in Ibadan, Oyo State. The peels were air-dried, ground into powder, and oil was extracted from them mechanically. The extracted oil was used in the treatment of *Holarrhena floribunda* wood samples of dimensions 6 × 2 × 2 (cm), using the soaking method (SM) and the hot and cold open tank method (HCOTM), while the untreated samples served as a control. The treated and untreated wood samples were exposed to termite infestation for 12 weeks in accordance with the ASTM D 1758-06 method. The oil yield of the peels, oil absorption in the wood, phytochemical analysis of the oil, and weight loss of the wood after termite attack were evaluated. Data analysis was conducted using t-test and ANOVA at a 5% probability level.

Results

The mean oil yield of the peels was 1.41%. The phytochemical analysis revealed the presence of alkaloids (0.5% w/w), flavonoids (0.12% w/w), saponins (0.25% w/w), terpenoids (1.4% w/w), and phenols (1.6% w/w). The wood treated with the SM (319.47 kg/m^3) had significantly higher oil absorption than the HCOTM (71.58 kg/m^3). Both treatment methods significantly reduced the weight loss in the termite-infested wood samples (SM [3.49%]; HCOTM [7.02%]), comapred to the control samples (24.41%).

Conclusion

It is concluded that the oil from *Citrus sinensis* peels possesses biocidal efficacy against termite attack in the wood of *Hollarhena floribunda*.

sciforum-101482: Estimating Extractive Content in *Dalbergia latifolia* Wood Using Near-Infrared (NIR) Spectroscopy and Three Solvent Systems

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Near Infrared (NIR) spectroscopy has emerged as a pivotal analytical tool for the non-destructive estimation of extractive content in various wood species. This study focuses on *Dalbergia latifolia* (Indian rosewood), renowned for its high-quality timber, by employing NIR spectroscopy to estimate extractive content using three distinct solvent systems: water, iso-propanolol, and hexane. Our objective is to evaluate and compare the efficacy of these solvents in extracting wood constituents, which are critical for enhancing wood properties and industrial applications such as preservation and quality control. The methodology involves preparing wood samples of *D. latifolia* and treating them with each solvent. NIR spectroscopy is then applied to measure the extractive content. The spectral data obtained were analysed to identify the most effective solvent system. Preliminary results indicate significant variations in extractive yields depending on the solvent used, showcasing the sensitivity and accuracy of NIR spectroscopy in detecting these differences. This study underscores the potential of NIR spectroscopy as a rapid, reliable, and environmentally friendly technique for assessing wood quality. These findings contribute to sustainable wood management practices and offer insights that can drive innovations in wood processing industries. We invite further discussions on the application of NIR spectroscopy in forestry and material sciences at the conference.

sciforum-096197: Evaluating the Effects of Thermal Pretreatment of Bamboo Fibers on Characteristics of Bamboo–Polypropylene Thermoplastic Composites

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This study investigates the influence of thermal pre-treatment on the properties of bamboo fiber-reinforced polypropylene composites (BPCs). Reinforcement with bamboo fibers (BFs) is known to enhance mechanical performance but typically leads to hydrophilicity, restricting the use of bamboo–polypropylene composites (BPCs) for indoor applications. To overcome this, Dendrocalamus stocksii (Munro) BFs were subjected to vacuum-assisted thermal pre-treatment at 160 °C, 180 °C, and 200 °C before incorporation into a thermoplastic polypropylene (PP) matrix. The primary objective was to augment hydrophobicity and chemical compatibility by diminishing the presence of free hydroxyl groups. Additionally, the impact of a coupling agent, maleic anhydride-polypropylene (MAPP), on the composites was also assessed. The BPCs were fabricated using a twin-screw extruder, maintaining a 40% BFs to 60% PP ratio. This study comprehensively evaluated the physical, mechanical, and morphological characteristics of the BFs pre-heat treatment, including density, water absorption, flexural and tensile properties, and Scanning Electron Microscopy analysis (SEM), to investigate their synergistic effects on composite performance. The results indicated that thermal treatment temperature positively correlated with improvements in the density and water absorption of the BPCs. Notably, after 2000 h of water absorption, improvements ranged from 0.67% to 38.30% through the various temperature treatments. The incorporation of MAPP into composites with thermally modified fibers (BPCT) collectively enhanced the flexural and tensile strength. Specifically, the BPCTs' flexural strength at 180 °C demonstrated a 21.9% increment compared to untreated BFs, while tensile strength at the same temperature increased by 31.92%. Although most mechanical parameters improved with thermally modified bamboo, elevating the temperature beyond 180 °C adversely impacted the strength properties. SEM micrographs revealed improved compatibility between the thermally modified BFs and the PP matrix, further enhanced by MAPP addition, as evidenced by void-free mechanical interlocking. With desirable improvements in quality parameters, thermally treated bamboo-reinforced polypropylene thermoplastic composites exhibit a strong potential as substitutes for chemical pre-treatments.

sciforum-099896: Evaluating the Efficacy of Organic Biocides in Amalgamation with Inorganic Salts as Wood Preservatives

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Wood is a versatile and remarkable building material that has been utilized for a long time in an assortment of applications. Despite the fact that untreated wood is more prone to deterioration and has less inherent resilience, preservatives are used to prolong the service life of wood. Numerous preservatives are available to extend the durability of wood against deterioration. The environmental concerns associated with first- and second-generation wood preservatives encompassing pentachlorophenol (PCP), chromated copper arsenate (CCA), etc., such as the leaching of preservative chemicals from the treated wood, leads to air, soil, and water contamination and disposal-related issues, which have driven the emphasis on the use of carbon-based third-generation wood preservatives, particularly triazoles. The development of preservative solutions with minimal adverse impacts on human health and the environment has received more attention. In the present study, we investigated the possibility of developing a formulation using organic fungicides (tebuconazole) and inorganic salts (copper sulphate and boric acid), and their efficacy was screened using the petri plate bioassay. At low concentrations, few of the formulations exhibited 100% inhibition against the white rot (*Trametes versicolor)* and brown rot (*Oligoporus placenta*) fungi. Additionally, the screened formulation was used in mango wood (*Mangifera indica*) and exposed to fungal decay. The wooden specimens treated with the screened formulation improved decay resistance. The rResults indicated a gradual reduction in percent weight loss, of 2.37% and 3.39% against white rot and brown rot fungi, in treated samples after exposure. The changes in chemical structure and microstructure after exposure to fungi were studied using Fourier transform infrared spectroscopy and scanning electron microscopy techniques. The potential effect of organic fungicide incorporated with inorganic salts increases resistance against fungi. Further SEM micrographs and FTIR spectroscopic analysis of decayed wood confirmed less degradation in treated wood compared to untreated specimens.

sciforum-100024: Exploring the Torrefaction Potential of *Acacia mangium* Leaves for Biocoal Production: An Oxidative Thermogravimetric Analysis Study

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Acacia mangium is a flowering tree species native to Papua New Guinea and Australia. It is widely used in agroforestry, forestry, and reforestation due to its fast-growing and adaptable nature. Due to its semi-evergreen or semi-deciduous nature, *A. mangium* has a high leaf litter rate of 8.8–10.5 tonnes/hectare/annum. However, its high leaf litter presents potential biomass for conversion into biocoal and other solid fuels through torrefaction. The torrefaction of *A. mangium leaves* (AML) as previously reported yielded good biocoal properties. However, using ultra-pure nitrogen gas for torrefaction is expensive, impractical, and unsustainable, particularly in industrial biocoal production. Therefore, this study examines the potential of oxidative (in air) torrefaction of AML through thermogravimetric analysis from 200–300 °C (ΔT = 25 °C) at 20 °C/min for 30 min. The results revealed that mass losses (M_L) increased from 15.63 to 62.98%, whereas mass yields (M_Y) decreased from 84.37 to 37.02%. The higher heating value (HHV) increased from 21.31 to 25.73 MJ/kg, and energy density (D_E) from 1.01 to 1.22, whereas energy yield (E_Y) decreased from 85.17 to 45.12%. The variations in M_L and M_Y may be due to the impact of temperature on the thermo-chemical degradation of AML's lignocellulosic components. In contrast, the high HHV and D_E values may be due to carbon deposition and oxygen depletion. In comparison, the oxidative process yielded higher HHV (25.73 MJ/kg) and D_E (1.22) at 300 °C, when compared to the non-oxidative process (HHV = 24.15 MJ/kg; D_E = 1.14) reported in the literature for AML. Overall, the study findings reveal that AML torrefaction is a practical approach for valorising streams of agroforestry wastes into biocoal—a solid biofuel with fuel characteristics comparable to lignite and sub-bituminous coals.

sciforum-100307: Integral Evaluation of the Cellulose of *Tibouchina lepidota (Bonpl.) Baill.* for the Valorisation of Residues in Sustainable Forestry Management

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This study focuses on the extraction and characterization of cellulose from *Tibouchina lepidota (Bonpl.) Baill.*, a native forest species of Ecuador. Our research highlights the industrial potential of this cellulose, emphasizing its relevance in the circular economy and in carbon footprint reduction. The methodology includes botanical identification, sample pretreatment, and cellulose extraction through an alkaline process. The extracted cellulose was characterized using Fourier Transform Infrared (FTIR) spectroscopy and optical microscopy, examining its morphology, structure, and solubility.

The results reveal that particle size significantly influences cellulose extraction yield, with smaller particles showing higher efficiency. Solubility tests in alkaline solutions confirmed that the extracted cellulose is of the beta type. Microscopic observations indicated a high-quality filamentous structure, with thin, long, and non-oriented filaments. This research demonstrates the viability of *Tibouchina lepidota* as a sustainable cellulose source, highlighting its potential for industrial applications and its contribution to more balanced and sustainable forestry management practices.

Detailed characterization by FTIR revealed significant peaks that confirm the presence of typical cellulose functional groups, such as hydroxyl groups and C-H and C-O-C bonds. These structural characteristics are essential for industrial applications, as beta-type cellulose is valued for its mechanical strength, thermal stability, and ability to form high-quality fibres and films. The extraction's feasibility was demonstrated with homogeneous and reproducible yields, suggesting that the methodology is robust and suitable for laboratory-scale studies and potential industrial applications.

This study not only expands the available cellulose source options for the industry but also promotes a more holistic and sustainable approach to natural resource management. By leveraging underutilized forest residues, *Tibouchina lepidota* can significantly contribute to the bioeconomy and the composite materials industry, aligning with global sustainable development goals and meeting the growing demand for renewable and eco-friendly materials.

sciforum-099643: Microwave Drying of *Melia dubia* and Its Effect on Mechanical Properties

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This study explores the microwave drying of *Melia dubia*, with a comprehensive approach that addresses various facets. The primary objectives were to examine drying behaviour and evaluate the drying defects. The drying rates for various treatments were calculated both above and below the fibre saturation point (FSP). The most optimal treatment, characterized by minimal defects, exhibited a drying rate of 0.77 g/min above FSP, 0.39 g/min below FSP, and an overall drying rate of 0.59 g/min. The drying process showed nearly an uniform distribution of moisture, and there were no observable drying-induced defects in the dried wood, suggesting a promising aspect of microwave drying. Static bending and compression tests parallel to the grain were carried out to analyse the impact of microwave drying on mechanical properties. Microwave-dried wood exhibited reductions of 7 ± 3%, 10 ± 2%, and 9 ± 2% in the modulus of elasticity (MOE), the modulus of rupture (MOR), and the maximum compressive strength (MCS), respectively. Examination under light microscopy revealed damage to wood microstructures like ray cells, perforation plates, and vessel walls. The decline in mechanical properties may be attributed to these micro-cracks or damage in its microstructures. These findings emphasize the need for a balanced approach in optimizing microwave drying methods to mitigate the reduction in mechanical properties while capitalizing on the advantages of reduced drying time and uniform drying.

sciforum-100065: Physical and Mechanical Properties of Polyurethane-Bonded Cross-Laminated Timber Made with *Pinus roxburghii* Wood

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Cross-Laminated Timber (CLT) is an advanced engineered wood product mostly used for structural applications. Being lightweight, strong, eco-friendly and aesthetically sturdy, this material has gained immense popularity in the construction sector throughout the globe. Since the concept of CLT was originated in Europe, most of the work has been carried out on European softwoods. There is very little information available on the utilization of Indian softwood species for manufacturing CLT. The present study was carried out to investigate the mechanical (flexural modulus, flexural strength, compressive strength and block shear strength) and physical properties (delamination, density, water absorption, thickness and volumetric swelling) of polyurethane-bonded CLT fabricated using *Pinus roxburghii* (chirpine) wood, an indigenous timber species. The flexural modulus was 4.2 GPa. The average flexural, compressive and block shear strengths were 36.2, 15 and 3.5 MPa, respectively. The density of CLT samples was 0.43 g/cm^3. Total delamination and maximum delamination were 6.72% and 25.38%, respectively. The thickness swelling, water absorption and volumetric swelling of CLT samples were 6.60%, 26.96% and 8.81%, respectively. The findings of the present study provide valuable insights into the potential of manufacturing CLT using *Pinus roxburghii* wood as a construction material for low-load-bearing structures. Further studies can be carried out to assess the durability and fire performance of the CLT panels.

sciforum-100082: Preliminary Studies on the Selection of Uruguayan Woods for the Production of Transparent Wood

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Transparent wood has garnered significant attention in recent years due to its high optical transmittance, safety, lightweight nature, excellent mechanical robustness, and low thermal conductivity, all of which make it an energy-efficient building material. To turn it transparent, wood needs to be chemically bleached, a process by which lignin and extractives are removed. Then, a polymer with a refraction index similar to that of delignified wood is integrated into its structure to reach high optical transparency. In this preliminary work, two common wood species in Uruguay were compared to determine which is more suitable for the process, as their characteristics are very different. *Pinus taeda* is a coniferous species of low-density and low extractive content; meanwhile, *Eucalyptus bosistoana* is a hardwood of high density and high extractive content. The behaviour of two wood species was compared. Delignification was carried out with $NaCl_2$; the effects of temperature and $NaCl_2$ concentration were studied; and the delignified wood was finally impregnated with epoxy resin. The FTIR spectra were analysed, and the anatomy of the wood at each stage was analysed with SEM. The results suggest both wood species grown in Uruguay are suitable for the development of transparent wood; the delignification conditions turned out to be the most consequential factor. The best delignification conditions were a reaction time of 300 min, a $NaClO_2$ concentration of 3.5% at a constant temperature of 80 °C, and a second round of bleaching with H_2O_2 for one hour at 80 °C.

sciforum-095493: Preparation and Evaluation of Lignin and Phytogenic Protein (Mustard Oil Cake)-Based Bioadhesive

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The extensive use of composite products in numerous developing countries has significantly impacted human health, primarily due to the toxic synthetic adhesives employed in their production. This study aimed to develop a multifunctional adhesive using lignin and phytogenic protein (mustard oilcake) for producing composites from lignocellulosic materials without aldehydes. The adhesive formation process involved three steps. First, the wood was chipped at a thickness of 4 mm, and cooked in a digester at a temperature of 160 °C, using a 17% NaOH solution to extract lignin (black liquor). Next, the mustard oilcake was ground into a fine powder. The black liquor and powdered mustard oilcake were then mixed with a 35% citric acid solution. Finally, the resulting solid was mixed with a 35% citric acid solution and heated to 350 °C to form the adhesive. The physical, mechanical (shear strength), and chemical (viscosity, Fourier-transform infrared spectroscopy (FT-IR), Glass Transition Temperature (GTT), and Thermogravimetric Analysis (TGA)) properties of the adhesive were evaluated. The adhesive's average shear strength values were determined to be 4.70 and 4.67 MPa, respectively, according to ASTM D 905 and EN 205 standards. Compared to commercial urea-formaldehyde, the adhesive exhibited higher viscosity, longer gel time (58 s), and a higher glass transition temperature (170.6 °C). Therefore, with further necessary studies, this adhesive can potentially be used by wood-based industries due to its lower cost and biodegradability.

sciforum-096743: Review of Lignin Extraction and Isolation Processes: From Lignocellulosic Biomass to Added-Value Materials

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Lignin is one of the three major components of the cell wall of lignocellulosic biomaterials. It is the second-most abundant polymer in nature. It is a complex and heterogeneous polymer found in the cell walls of lignocellulosic biomass. Lignin's predominant composition, rich in carbon and aromatic structures, enhances its value by enabling the development of high-value chemicals and bio-based materials. As one of the most affluent natural renewable sources of aromatic structures and the world's second-largest renewable source of carbon, lignin possesses a thermal value comparable to that of carbon. Its aromatic constituents exhibit unique chemical properties and significant bioactive effects, making lignin a crucial material in various advanced applications. Different chemical fractionation methods have been designed to overcome the lignocellulosic biomass' obstacle to extracting lignin biopolymer. Lignin fractionation is a process that involves separating lignin from other components of biomass feedstocks, such as cellulose and hemicellulose. This process is commonly used in the paper and pulp industry to obtain valuable lignin derivatives that can be used in various applications, including, among others, biofuels, chemicals, and biomaterials. In this review, we provide a comprehensive chemical overview of current processes for extracting technical lignins from wood and lignocellulosic biomass, critically evaluating the advantages and limitations of each method.

sciforum-100083: Study of the Best Conditions for the Acetylation of Uruguay-Grown *Pinus taeda*

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In order to protect wood, several preservation methods have been developed, and chemical modification is an environmentally friendly alternative. The chemical modification of wood improves its performance and dimensional stability, increases its resistance to deterioration, and ensures safe disposal once the wood is out of service. The acetylation of wood, which involves the esterification of accessible hydroxyl groups in the cell wall with acetic anhydride, reduces the hygroscopicity of wood. Acetic acid is obtained as a byproduct of the reaction. The aim of this work is to study the best reaction conditions for the acetylation of *Pinus taeda* wood with acetic anhydride. The experimental design used was a factorial design 2^2 with 3 repetitions in the midpoints. The independent variables were reaction temperature and reaction time, both at two levels. Wood's weight gain percentage (WPG) and its chemical changes were used as response variables. The acetylated wood acetylated under the best conditions, as determined by the trials, was subjected to a durability test against decay fungi (*Gloeophyllum separium* and *Trametes versicolor*). Results showed that temperature was most impactful in the reaction process, being decisive for WPG results. Higher WPG was obtained at temperatures above 100 °C. The acetylated wood exhibited high resistance to fungal attack, with very low mass loss.

sciforum-100060: Study on the Involvement of Ethylene Signal Factor in the Synthesis of Heartwood Substances of *Dalbergia odorifera*

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Dalbergia odorifera T. Chen, endemic to China, is the sole plant source for the valuable Chinese medicine Dalbergiae Odoriferae Lignum. Its heartwood, naturally forming over 40 years, is rare due to low formation rates and a scarcity of mature trees. Artificial induction of heartwood formation using ethylene shows promise, though its mechanisms remain unclear. This study investigates the regulation of heartwood biosynthesis by screening related signal factors, constructing and analyzing the transcriptome, and validating findings through suspension systems. Key results include: Ethylene is an effective endogenous hormone involved in regulating heartwood-like substances in *D. odorifera*. Ethephon (ETH) treatment enhanced heartwood characteristics, increasing ethylene synthesis and secondary metabolite production. After 14 days of ETH treatment, branches maintained healthy growth, and heartwood color matched natural heartwood. ETH and H2O2 promoted endogenous ethylene synthesis, enhancing overall metabolism, tree resistance, and enzyme activities. Inhibiting ethylene synthesis prevented heartwood color change and secondary metabolite accumulation. The ethylene signaling pathway is crucial for heartwood substance synthesis. Transcriptome analysis revealed that differentially expressed genes (DEGs) were enriched in pathways related to cysteine and methionine metabolism, phytohormone signaling, and secondary metabolite synthesis. Significant DEGs in the ethylene signaling pathway included upregulated ACO, EIN2, EIN3, and ERF1/2 in transition regions. qRT-PCR validation showed upregulated secondary metabolite synthesis genes (DoNES1, DoCHS1) and consistent expression patterns of ethylene signaling genes (DoACO1, DoEIN3-1). This research enhances understanding of heartwood formation mechanisms in *D. odorifera* and supports the development of artificial heartwood cultivation techniques.

sciforum-100013: Superhydrophobic and UV-Resistant Coating Using Nanoparticles for the Protection of Wood

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Wood is a renewable and versatile material comprising cellulose, hemicellulose and lignin as its main structural components, and is widely used for both outdoor and indoor purposes. However, as a lignocellulosic material, wood suffers degradation mainly from UV radiation and moisture uptake. The degraded wood not only loses its strength and dimensional stability, but also its aesthetic appeal. Therefore, it is necessary to protect wood from the above-mentioned agents of degradation. This study focuses on the preparation of a superhydrophobic and UV-resistant coating for the protection of wood. Superhydrophobic coatings are a smart class of coatings which repel water from the surface of wood, thus increasing its longevity. Achieving hydrophobicity is a two-step procedure which includes inducing surface roughness, followed by treatment with a low-surface-energy material. Certain metal oxide nanoparticles like ZnO, CeO_2, and TiO_2 nanoparticles additionally provide protection against UV light along with adequate surface roughness, and materials like silanes act as low-surface-energy materials. A simple one-step method was used to prepare the nanodispersions. ZnO/TiO_2 nanoparticles and silane were mixed together with a suitable non-volatile and non-corrosive solvent, and homogenised together, followed by ultrasonication to obtain the desired nanodispersion. The size of the nanoparticles was analysed using DLS and found to be within 100 nm. The solution was then coated on the wood surface. Hydrophobicity was measured using a contact angle analyser and the results were between 150° and 160°, which confirmed the coating's superhydrophobicity. The morphology was analysed using SEM. The coated samples were then tested for UV stability in an indoor accelerated UV weathering tester and were analysed on the basis of their colour change, seen with the help of a HunterLab Labscan XE spectrocolorimeter. The photodegradation of the coated samples was analysed using FTIR. The samples thus exhibited superhydrophobicity as well as UV stability.

sciforum-100072: Value Chain and Market Potential Analysis of Nypa Sap and Molasses from the Southern Coastal Region of Bangladesh

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Nypa fruticans, is a palm species that is found growing both in its natural habitat and in plantations along the coastal regions of Bangladesh. There is significant cultivation of this species through private initiatives in plantations established by rural farmers in coastal areas, particularly in the southern region of Bangladesh. The Nypa Sap Molasses are characterized by a unique and genuine taste profile. The product is strategically positioned to meet the needs of health-conscious consumers who are seeking distinctive culinary experiences. According to the market analysis, a favourable market environment exists in which *Nypa* Sap Molasses has the potential to secure a specialised market segment and emerge as a prominent contender. The business endeavours to enhance its visibility, stimulate engagement, and expand its reach in regional and nationwide markets by implementing proficient branding strategies, digital marketing initiatives, and focused outreach efforts. The business places significant emphasis on achieving operational excellence, which involves optimising production processes, implementing stringent quality control protocols, and ensuring efficient product delivery. Through utilising pre-existing infrastructure, the cultivation of robust partnerships with suppliers and vendors, and efficient resource management, the enterprise guarantees uniformity in product excellence and punctual delivery, thereby satisfying customer demands. The financial forecasts suggest a favourable perspective for *Nypa* Sap Molasses, attributable to its competitive pricing, efficient production techniques, and prospective funding prospects. The Nypa Sap Molasses business plan offers a persuasive prospect within the natural sweetener industry. The business is positioned for success due to its distinct product offering, focused marketing tactics, efficient operations, and optimistic financial forecasts. Through accommodating the changing inclinations of health-conscious customers and safeguarding the cultural legacy linked with Nypa Sap Molasses, the enterprise is poised to establish a significant foothold in the sector and make a valuable contribution to the regional economy.

Session 6. Bioeconomy and Forest Economics

sciforum-100059: Climate Justice: Balancing Deforestation for Developing and Maintaining Food Security in Ghana to Mitigate Global Warming with Fairness

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Ghana is a developing country with 8 million hectares of forest cover, 35% of the total land. Based on the National Determined Contributions (NDCs), Ghana has been committed to reducing its emissions by 15% and 30% if external funds exist. This policy seems good but would harm Ghana's development and food security. Therefore, this research aims to evaluate Ghana's decision making in NDCs and recommend a policy for mitigating global warming without prejudicing developed countries, especially Ghana. This research uses spatial analysis with a time series of forest cover in Ghana and economic analysis with a literature review. SWOT analysis was also conducted to complement this research. This research shows that Ghana's carbon emission per capita is only 0.62 metric tons, while the world's average carbon emission per capita is 4.54 metric tons. It is unfair for Ghana to hold up its development to decrease its carbon emission, which is already 80% lower than the world's average carbon emission per capita, and Ghana's Gross Domestic Product (GDP) per capita is only USD 2500. Furthermore, the results show that Ghana's agricultural land area is only 4% of its total land, while the world's average agricultural land area is 38%. The extensification of agricultural land still needs to be completed to fulfill food security in Ghana, as the population keeps increasing every year, reaching almost 34 million people in 2024. This research recommends that climate justice needs to be served. Ghana's development must not be sacrificed, and the decision maker must have the courage to reject potentially detrimental policies. The policy of NDCs needs to be re-evaluated and revised. To achieve climate change mitigation with fairness, every country needs to emit their emission with a specific number. Climate change mitigation will become an endless debate if not appointed and managed.

sciforum-091005: Rubber Plantations as Eco-Economic Frontiers: Balancing Profitability and Ecosystem Service Conservation

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The expansion of rubber plantations in tropical regions presents a significant challenge and opportunity for balancing economic development with ecological integrity. This study explores the complex interplay between the rubber industry and the conservation of ecosystem services, conceptualizing eco-economic frontiers as zones where economic and ecological interests converge. By combining economic analysis, ecological assessment, and social considerations, we evaluate the sustainability of rubber plantations across various landscapes. Our framework incorporates case studies from Southeast Asia, Africa, and Latin America, with a detailed analysis of 10 specific case studies, highlighting global implications and regional variations in rubber cultivation. The findings reveal that while rubber plantations can significantly contribute to rural development and global markets—covering over 14 million hectares and supporting approximately 10 million livelihoods—they often lead to biodiversity losses, altered hydrological cycles, and decreased ecosystem service quality. For example, in Southeast Asia, rubber plantations have been linked to a 60% reduction in local biodiversity, while in Africa, land-use changes have caused up to a 20% decrease in annual water flow. To address these challenges, we propose best management practices and policy recommendations aimed at optimizing production efficiency while minimizing ecological footprints. These include adopting agroforestry systems, improved land-use planning, and integrating ecosystem service valuation in decision-making. Specifically, agroforestry systems can enhance biodiversity by up to 40% and improve soil quality and water retention, supporting both productivity and ecosystem health. Through our innovative contributions, we provide a comprehensive understanding of the trade-offs and synergies between rubber plantation profitability and ecosystem service conservation. This study contributes to the sustainable land use debate and offers a blueprint for reconciling economic and environmental objectives in the context of global change. By fostering a better understanding of these dynamics, we aim to inform policy and practice, guiding future efforts towards sustainable rubber plantation management.

sciforum-099563: Increasing the Resilience of Wild Tropical and Subtropical Forests by Promoting Sustainable Development and by Growing Cassava in Soils Degraded by Deforestation: A Circular Bioeconomy Sociotechnical Approach for the Cement Industry

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Abstract

The massive deforestation of wild tropical and subtropical forests causes damage to the entire surrounding ecosystem. It affects soils, habitats, biodiversity, and the water cycle. To reduce deforestation, cassava (Manihot esculenta) can become a potential ally when grown on soils already degraded by deforestation, generating economic, social, and environmental benefits as a circular bioeconomy. On the one hand, we have the 'Opportunity Cost', that is, the idea that labor is used to cultivate degraded lands while preventing this labor from continuing to deforest forests. On the other hand, cassava not only provides food and retains degraded soil, but when its waste is used as an input in cement manufacture, the pollution rates of this industry are reduced, and its resistance and hardness capacity increase. We aim to carry out an open multidisciplinary sociotechnical analysis, which we call sociotechnical systems theory, adding social communicative capacities to benefit the resilience of forests.

Methodology

The methodology consists of qualitative documentary analysis based on the keywords used, i.e., circular bioeconomy, sociotechnical change, cassava, tropical and subtropical wild forests, resilience, sustainable development, and cement industry.

Results

Culturing cassava on degraded soils demonstrated significant benefits, including soil protection, the socio-ecological resilience of forests, and the generation of employment opportunities.

The use of cassava waste in the cement industry was found to reduce dependence on highly polluting materials, providing a sustainable alternative that improves the socioeconomic conditions of local communities.

Conclusion

Cassava cultivation can significantly contribute to the resilience of tropical and subtropical forests by promoting sustainable practices and socioeconomic development. This approach offers a viable solution to integrate circular bioeconomy and sociotechnical change in the forestry and cement industry.

sciforum-099937: The Potential of Agro-Forestry to Enhance Rural Livelihoods in Punjab, Pakistan: A Socio-Economic Viewpoint

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Agroforestry improves the stability and productivity of agro-ecosystems and reduces environmental pressures, making it extremely flexible and useful in a variety of physical and social contexts. This practice is crucial to farmers' livelihoods on both an ecological and economical level. Using an interview schedule, data were gathered from 170 heads of rural families who were chosen at random. Of the responders, the majority (77.5%) were young (25 to 40 years old). Of those who had completed more than five years of schooling, only 46.7% were literate, while a sizable majority (53.3%) were illiterate. For the vast majority of responders (62.4%), farming was their primary source of income. Given that over 54% of the respondents only owned up to five acres of land, small farming is extremely common. The majority (61.3%) were considered poor with a monthly income of less than 18000 PKR. "Good source of fuel wood" was placed at the top (mean = 3.1%) when it came to the effect of agroforestry on the food security of rural households. One of the main obstacles was having a small land holding (mean = 2.52). The majority of respondents believed that the primary benefit of agro-forestry was a reduction in soil loss. The amount of land held, income source, and educational attainment all significantly correlated with the perception of poverty. The study found that the best way of sustainably assuring food security in the study area and satisfying rural residents' needs for food for extended periods of time is to incorporate agroforestry into the current farming system.

sciforum-100028: Torrefaction of *Macaranga gigantea* Leaves for Biocoal Production: Insights from Thermal Gravimetric Analysis

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Macaranga gigantea (otherwise called *Mahang Gajah*, or Giant Mahang) is a large, fast-growing, and dioecious evergreen tree in the *Euphorbiaceae* family native to Southeast Asia (SEA). It is commonly used in traditional medicine, as well as for ornamental, ecological, and cultural purposes. It also plays an important role in the human and ecosystem interactions in the rainforests of SEA. However, *M. gigantea* generates large quantities of biomass from its broad, peltate, and trilobed leaves measuring 20–60 cm in length. Similarly, its high rate of leaf litter accumulation presents opportunities for valorisation into solid biofuels. Torrefaction is considered a technologically efficient and environmentally friendly approach for the valorisation of agroforestry biomass wastes into biocoal for clean energy applications. However, there are currently no studies in the literature on the torrefaction of *M. gigantea* leaves (MGL) into biocoal. Therefore, this study seeks to explore and highlight the biocoal potential of MGL through TGA torrefaction under a non-oxidative environment from 200–300 °C (ΔT = 50 °C) at 20 °C/min and 30 min. Results revealed that MGL experienced mass losses (M_L) which increased from 15.57–40.94%, whereas mass yields (M_Y) decreased from 84.43 to 59.06%. The higher heating value (HHV) increased from 21.30 to 23.67 MJ/kg and energy density (D_E) increased from 1.16 to 1.29, whereas energy yield (E_Y) decreased from 98.02 to 76.19%. The variations in M_L and M_Y may be due to the effect of torrefaction temperature on the dehydration, devolatilisation, and thermochemical degradation of MGL moisture, volatile matter, and holocellulose (hemicellulose and cellulose). In contrast, the high HHV and D_E values may be due to a decrease in the oxygen-to-carbon (O/C) and hydrogen-to-carbon (H/C) ratios. Overall, the study showed that the torrefaction of MGL is a potential route for the valorisation of the agroforestry wastes into biocoal, a solid biofuel with fuel properties similar to lignite and sub-bituminous coals.

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