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Editorial: New frontiers in forest landscape restoration

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Editorial on the Research Topic
New frontiers in forest landscape restoration

Introduction

Forest landscape restoration (FLR) is inherently multifaceted and spans ecological, economic, and social dimensions. Forest restoration is critical for reversing biodiversity loss and enhancing ecosystem functioning, which underpins services such as carbon storage, water regulation, and nutrient cycling (Aerts and Honnay, 2011; Aerts and Honnay, 2011). Beyond its ecological benefits, FLR is recognized as a central strategy for mitigating climate change through carbon sequestration (Song et al., 2023), fostering community engagement, and generating economic returns via ecosystem services and sustainable forest management (Sacco et al., 2021). However, some challenges remain. Socioeconomic factors, including governance quality and the diverse experiences and beliefs of stakeholders, can hinder restoration outcomes (Tedesco et al., 2023). Equally pressing is the need for effective monitoring programs, which increasingly rely on advanced technologies, such as remote sensing (Almeida et al., 2025). Addressing these barriers requires scientifically informed, integrative approaches that bridge ecological processes and social realities. Against this backdrop, the present Research Topic was conceived to highlight innovative strategies for overcoming current challenges in FLR, with particular emphasis on technological advances in monitoring and integration of socio-ecological perspectives.

Overview of the Research Topic

Restoration begins with the practical challenge of establishing vegetation, and innovations in seed technology are helping to make this process more efficient and scalable in the future. Pedrini introduces multi-species pelleting (MSP), a novel technique designed to improve the efficiency of seed-based ecological restoration. MSP is faster and more cost-effective than traditional single-species pelleting, particularly in highly diverse ecosystems with many small-seeded species. By reducing the time and cost of seed preparation, MSP makes seed enhancement technology more accessible for large-scale FLR efforts. This advance highlights how methodological innovation at the start of

restoration projects can lower barriers to implementation and expand the feasibility of restoring complex forest landscapes.

Advances in remote sensing have transformed the monitoring of restoration progress. Luo et al. introduce the concept of Effective Forest Area (EFA), a model that integrates forest structure and quality into remote sensing assessments. Their case study in Heshan, China, showed that traditional approaches can overestimate ecosystem service values, masking the loss of stable, high-quality forest patches. Parente et al. apply spectral diversity metrics from Sentinel-2 imagery to track restoration in the Eastern Amazon, demonstrating strong correlations between spectral indices and field-based measures of recovery. Their results suggest that spectral diversity offers a robust and scalable tool for long-term monitoring, complementing and extending traditional field surveys. Together, these studies highlight how technological innovation can provide more nuanced and cost-effective insights into ecological recovery, underscoring the importance of integrating remote sensing with ecological understanding in FLR.

In addition to methodological and technological advances, FLR must grapple with its social dimensions, where human values, governance, and community engagement are central to its long-term success. Mansourian et al. emphasize that restoration cannot succeed without fully integrating human dimensions throughout the process. Using the forest transition curve model, they show how social factors shape shifts from net forest loss to net forest gain, arguing that equitable and durable FLR requires moving beyond tokenistic stakeholder engagement. Manley et al. (1) present the TPOR Framework, an integrated socio-ecological model designed to guide land management toward resilience under climate pressures. By structuring socio-ecological conditions across three hierarchical levels, TPOR provides managers, scientists, and stakeholders with a tool to support large-scale restoration. Shelton et al. contribute a systematic review of critical social perspectives in FLR, revealing that despite the stated goals of enhancing human wellbeing alongside ecological integrity, social dimensions are often marginalized. They call for stronger interdisciplinary engagement, greater representation of local stakeholders, and rebalancing of power in governance, knowledge, and funding. Together, these contributions underscore that restoration is as much a social endeavor as an ecological one and that durable progress depends on embedding equity, participation, and resilience at the heart of FLR.

Building on the need to integrate social perspectives, Manley et al. (2) present a case study from the central Sierra Nevada that compared two management scenarios in fire-prone forests. The “Fire” scenario prioritizes rapid risk reduction for communities, while the “Ecosystem” scenario emphasizes long-term resilience and multiple resource benefits. Rather than treating these approaches as mutually exclusive, the authors show that they are conditionally complementary: a dual investment strategy that balances both objectives at intermediate levels can minimize conflicts and maximize overall benefits. This study illustrates how careful planning and design can reconcile short-term safety concerns with broader ecological and social goals.

Mesa-Sierra et al. provide a systematic review of Tropical Dry Forest (TDF) restoration, highlighting both constraints and successes in this highly threatened biome. They identified persistent challenges, including knowledge gaps, limited use of rigorous study designs, and neglect of social dimensions. Simultaneously, they point to promising strategies, such as combining seedling planting with fertilization and watering, which improve survival rates and accelerate recovery. Restoration treatments have been shown to move degraded sites away from their initial conditions, underscoring the potential for meaningful progress even under difficult circumstances. Importantly, many of the factors identified extend beyond TDFs, offering lessons that are applicable to restoration efforts in other forest biomes.

Final remarks

Taken together, the contributions to *New frontiers in forest landscape restoration* illustrate the breadth of innovation and reflection currently shaping the field. From methodological advances that lower the barriers to initiating restoration, through remote sensing tools that enable scalable monitoring, to critical insights into socio-ecological dynamics, planning frameworks, and biome-specific lessons, the articles collectively highlight the need for integrative approaches. They show that successful FLR depends not only on ecological knowledge but also on governance, equity, and long-term resilience. This Research Topic demonstrates that FLR is both a scientific and societal endeavor that requires collaboration across disciplines, sectors, and communities.

We thank all the authors, reviewers, and contributors for their efforts in shaping this Research Topic, which we hope will inspire further research and practice toward resilient and equitable FLR.

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