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Editorial

The Ecological Management and Sustainable Development of Forests

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Forest ecosystems play a dominant role in regulating climate change and sustainable development. In the context of climate change and rapid urbanization, forest ecosystems exchange energy and materials with other open natural–social–economic systems and face threats of degradation to their structure, function, and services. Climate change alters forest structure due to variations in physical conditions, and social and economic activities result in considerable land-use and land-cover change (LUCC), as well as having complex impacts on forests and other natural systems. In line with the requirements of the Sustainable Development Goals (SDGs), many ecological protection measures and programs have been established to strengthen forest ecosystem function. To summarize, it is urgent to investigate the ecological conditions of forest, analyze their ecological process, assess their ecological status, and explore effective measurements and policies to ensure their ecological management and sustainable development.

This Special Issue, entitled "The Ecological Management and Sustainable Development of Forests", presents 12 high-quality original research papers, including both micro- and macro-scale studies (Figure 1), that are critical to clarifying the mechanisms that alter the structure and function of forest ecosystems, strengthening ecosystem restoration and conservation, and supporting the achievement of the SDGs. This Special Issue gives an overview of the most recent advances in the ecological management and sustainable development of forests.
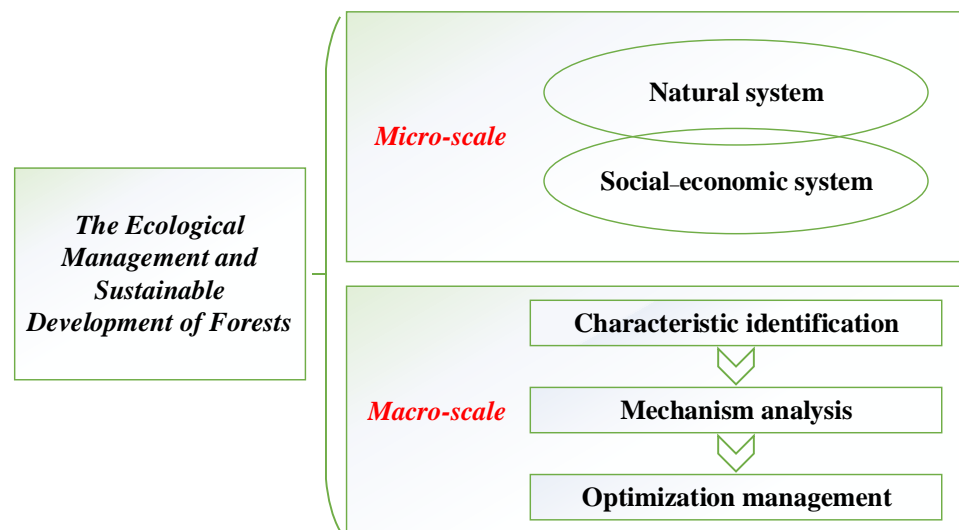

Figure 1. The 12 papers published in this Special Issue.

At the micro-scale, the included authors carried out field experiments and surveys, investigated the characteristics of the forestry economy, and explored the mechanisms and influencing factors in the alteration of trees or forests. Three papers [1–4] were published on the topic of natural systems. Hua et al. (2023) [1] conducted a field experiment in a Eucalyptus plantation to compare the effects of three-year fertilization and five-year dry-season irrigation on height growth rate during the wet and dry seasons. The results revealed that long-term dry-season irrigation significantly increased the height growth rate of *Eucalyptus urophylla* $\times$ *E. grandis* by improving the hydraulic conductivity and photosynthetic rate of leaves during the dry season. Moreover, the results revealed that the leaves' photosynthetic capacity contributed more to accelerating height growth than water conduction within the leaves. Oszako et al. (2023) [2] analyzed the responses of young pine seedlings to different types of soil media mixtures: phosphogypsum mixed with organic ash or with sewage sludge. The results showed that the phosphogypsum-based preparations used showed no harmful (toxic) effects on the potted pine seedlings. The loosely prepared preparation made from a mixture of phosphogypsum and organic ash began to positively affect the development of the seedlings' root systems, and it was also easier to mix with the soil surface than phosphogypsum with sewage sludge, which was also sticky. The authors also found that obtaining detailed conclusions regarding heavy metals and their effects on seedling development, and the changes in the microbiome, required observations to be made over a longer period. Shi et al. (2022) [3] compared three models for assessing aboveground biomass based on a sample of 30 trees, introduced a linear seemingly unrelated regression (SUR) approach to determine the best model, and estimated the biomass and carbon storage of *T.* Zhongshanshan stands in the Yangtze River Basin (YRB) in China. The results showed that the total tree biomass values were 53.43, 84.87, 140.67, 192.71, and 156.65 t ha^{-1} in 9-, 11-, 13-, 15-, and 22-year-old *T.* Zhongshanshan. The current *T.* Zhongshanshan stands in the YRB area can store 124.76 to 217.64 t ha^{-1} of carbon. Wang, Zhao et al. (2023) [4] carried out household surveys and found that cooperative membership (herbal medicine planting) leads to considerable improvements in forest farmers' household income and assets. Householders who were migrant workers were more likely to make the decision to participate in cooperatives compared with non-migrant workers. In addition, this paper outlined the problems in the current development of cooperatives and proposed feasible strategies and policy recommendations to guide policy for sustainable forest development.

At the macro-scale, this Special Issue discusses three aspects of forest ecosystem characteristics and management, i.e., characteristic identification [5–8], mechanism analysis [9–11], and optimization management [12].

Identifying the spatio-temporal characteristics of land use, ecosystem services, vegetation cover, etc., can provide basic evidence of impact mechanisms and inform related policy formulation. Xing et al. (2023) [5] focused on the ecological impacts of ecological restoration strategies and projects, and investigated the evolution of the land-use transition (LUT) pathways and ecosystem service value (ESV) in four geomorphological regions of the Beiluo River Basin. The results indicated that forest land increased by 18.27%, and the overall ESV increased by USD 3.209 billion (54.16%). The authors suggested that ecological restoration projects enhanced the main ecological function of individual regions, and conducted a detailed analysis of the impacts of the "Grain for Green" project. Wen et al. (2023) [6] proposed a three-step approach to explore the multi-aspect dynamics of land change, including the differences among land-use categories, spatial characteristics of urban expansion, and forest fragmentation, and explored the characteristics of land-use change in a low-income mountainous city (Enshi City, China). The findings confirmed that recent planning measures were effective in restoring the natural environment, and that the identified key areas can support sustainable forest management during urban growth. Liu et al. (2023) [7] explored the overall change characteristics of vegetation cover and the distribution patterns of different terrains on the complex terrain of arid and semi-arid Xinjiang. The authors integrated the ESTARFM model, the dimidiate pixel model, unary

linear regression, and the digital elevation model. The results showed that the overall vegetation cover was high, and serious degradation and improvement phenomena were both identified. Forest land is important in resolving the ecological risks of the lakeside area and building its ecological base. Wang, Wu et al. (2023) [8] explored the spatial and temporal evolutionary features of forest land in the Erhai rim region using bivariate spatial autocorrelation and multi-scale geographical weighted regression (MGWR) models. The results revealed that reasonable forest land expansion can effectively alleviate the growth of landscape ecological risk in the Erhai rim region, whereas the shrinkage of forest land would aggravate this risk.

Clarifying systemic mechanisms is conducive to understanding the relationships between forest ecosystems and other related systems, and more comprehensively and accurately identifying the key aspects of forests. Teng et al. (2023) [9] analyzed the characteristics of vegetation coverage (VC) change based on high-resolution remote sensing data in the Qilian Mountains (QLM) and identified the climatically and anthropogenically driven pattern of VC change. They found that VC presented a remarkable upward trend from 1990 to 2018 and identified a significant positive correlation with precipitation change and annual average temperature, as well as a significant negative correlation with annual average precipitation, current VC status, livestock density, and slope. Dong et al. (2023) [10] aimed to understand the determining factors of the spatial distribution of forest cover, conducting a nuanced case study in Fujian Province, China, in 2020. The paper showed the specific relationships between the spatial distribution of forest cover and natural conditions and socio-economic factors. The results indicated that natural factors could shape the spatial distribution of forest cover, while socio-economic factors could play a more significant role in the spatial distribution of forest cover. Mo et al. (2023) [11] focused on the *Pinus massoniana* (PM) plantations on Guangxi Paiyang Forest Farm and studied the synergistic and trade-off relationships between ecosystem services. The results showed that the ecosystem services maintained significant positive correlations (synergy), with a mutually reinforcing relationship. Their results and conclusions are essential for maintaining the structure, function, and health of plantation forest ecosystems.

Achieving the sustainable management and high-quality development of forest ecosystems is the ultimate goal of this Special Issue, with most of the papers presented proposing specific strategies according to their results and conclusions. Taking Poland as a typical case, Referowska-Chodak and Kornatowska (2023) [12] analyzed the effects of Poland's forest management evolution over the last 75 years on forest biodiversity. The evolution of forest management practice implemented in Poland's forests by the State Forests National Forest Holding led to the restoration of/an increase in biodiversity. Their paper also found some unsolved organizational, political, financial, conceptual, and natural/anthropogenic issues.

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