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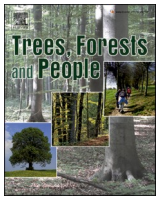

Special issue: Forest science navigating sustainable development—A third task☆

The recently completed International Union of Forest Research Organisations, IUFRO, World Congress in Stockholm 2024 aimed at streamlining the forest research agendas, furthering dialogues and cross-sector collaboration, and promoting the multi-functionality of forests and their services. The outcome of this once-in-five-year Congress should affect the future research agenda and roadmap for the next generations, this time focusing on Forests & Society Towards 2050.

Researchers have three tasks, all of which are important to forests and society. The first two duties are to conduct research and educate students. The third task is hard to accomplish but simple to describe: reaching out to the public and work to ensure that the research benefits society. To be successful in meeting the 2024 Stockholm Congress's aim of setting the agenda and roadmap for the next generation, research results need to be transformed into policy frameworks and workable action. Forest science navigating sustainable development depends on the third task as a crucial policy-practice interface.

However, there are challenges in fulfilling this third task. An increasingly impatient media landscape creates difficulties. To quote the Swedish Research Council Good Research Practice 2017, page 53, "it is important for researchers to understand that the task of the media is to discover and transmit what goes on, openly or below the surface, or what is under development. An urge to be the first to report things that could challenge the established wisdom and a tendency to stress the dramatic is part of the basic strategy in most media. Some researchers may be put off by the media and what can be felt to be a blunt and oversimplified way of presenting important research problems, while others may be tempted to succumb to this media pressure and announce results prematurely, or to exaggerate their importance. Both these extremes can have harmful effects. The public's trust in research is the very foundation for public funds being used to support research. Therefore, researchers should make it a point of informing the public about new research results, but also of discussing topical scientific issues brought up in the general news flow, and in societal debate". Such trust in research as an enterprise and research results relies heavily on researchers' conduct, which in practice may involve difficult choices between different courses of action. The question is how one should act in a complex reality in which various principles and interests sometimes come into conflict with one another.

In the absence of knowledgeable and politically savvy representatives of science, the public arena is left open to agenda-driven and cherry-picking actors. Policymaking has always, and rightly, been value-driven. Thus, it can be tempting to highlight research results that support one's values, even if those results are not supported by strong evidence. Researchers without experience in a specific research field often dive into the debate and into other researchers' fields with political aims, taking advantage of the halo-effect of a successful career in science. Op-eds are signed with scientific titles which gives the reader the impression that their research is behind what is presented, which not always is the case. It may not be a new phenomenon, but the problem of values-based rather than science-based ways of fulfilling the third task seems to be growing, and social networks seem to worsen it.

The important message and main takeaway is that if the media sets the agenda and some researchers set good research conduct aside, this will create a situation where science would become just another lobbying voice in the debate.

The purpose of this Special Issue in *Trees, Forests, and People* is to bridge the gap on how forest science can support evidence-based decision-making for sustainable development across the globe. The broad aim is to further the dialogue on how the scientific community, with solid evidence-based research as a foundation, makes itself better heard in the social and political debate, thereby navigating sustainable development. What should diverse stakeholders—from academicians to politicians, private and public partnerships, or civil societies and the people that are directly impacted—be doing differently?

Our starting point is that policymaking and efforts to improve sustainable development should be founded on evidence-based science and proven experience and that the scientific basis needs to be regularly scrutinized based on evidence-based research. At the same time, politicians and decisionmakers (even those with a science background) will always want to interpret the evidence-based research results in a direction consistent with their basic values and, thus, the view of what social development they want to see. This, together with an awareness of how media work, is a context scientists need to be aware of when they fulfill their third task by reaching out to the public. Here, though we have emphasized so far the 'scientists' as creators of knowledge we are equally aware that the 'public' is not just the receiver anymore. The public involved in scientific research is gaining importance. Scientists, therefore, should connect with society and expand their knowledge through co-creation and co-production with the help of citizens. Citizen science is a growing trend that connects the sciences with the public.

As guest editors, we have chosen the word "navigating" in the title. This implies an understanding of the difficulties in reaching out to policy- and decisionmakers when conducting the third task. This is thoroughly described by Thomas A Heberlein's book "Navigating

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Environmental Attitudes," from which we quote: by balancing natural science with social science, we can step back from false assumptions and unproductive, frustrating programs to work toward fostering successful, effective environmental action. Heberlein compares with rafting where you must read the rapids and watch out for hidden obstacles. We suggest that Heberlein's conclusion is valid for long-term sustainable development as well as for short-term environmental action. An important question is of course, how these research disciplines and approaches are combined to improve sustainable development as effectively as possible.

For Forest Science to navigate sustainable development, the participation of fellow citizens—either public initiative or deliberate engagement by the scientists—could bring meaningful impact.

The articles in this Special Issue cover a wide range of topics and bring evidence from diverse geographical areas across the globe. Below, we compile the synopsis of the articles into geographical zones without any objective of comparative analysis, but rather to give the readers a glimpse into the contributions and diversity of each continent.

We hope that readers find 'food-for-thought' in the articles and actively navigate the field of science and science communication for a better future for all.

Europe

Håkon Aspöy, highlights a historical philosophic perspective in the article *"Forest science between human and nonhuman agency"* (Aspøy, 2024). Referring to René Descartes' (1596–1650) view on mathematics, in particular algebra and geometry, as the means for humanity to become "the masters and possessors of nature," Aspöy refers to Descartes' influential divide between humans and nature, related to his philosophy of knowledge and notes that the influence of the Cartesian dualisms of human-nature and subject-object are not restricted to the natural sciences. By defining humans in opposition to nature, the humanities and social sciences were effectively separated from natural science. What influence has the Cartesian dualism had on forest science? In his article Aspöy compares forest science of the past, Forstwissenschaft, a sub-discipline of the German Kameral- or Staatswissenschaften, in the second half of the 18th century with today's much more diverse definition of forest science. Historically German foresters turned to algebra and geometry. Thus, they could calculate timber mass, estimate growth, and determine ideal moments for felling to maximize growth and the production of timber. Aspöy notes that when forest science is confronted by environmental changes, there is a growing need for empirically grounded accounts of its responses. His research attempts to mitigate such a need. The paper observes how students and lecturers at the Norwegian University of Life Science (NMBU) actively distanced themselves from the forest science of the past for ignoring the requirements of trees and the services of their surrounding environments. Aspöy concludes that "thus, can we move towards a sociology of forests that does not assume human exceptionalism but is conceptually rigged for understanding a multitude of dynamic human-nonhuman relationships" (Aspøy, 2024).

Robert Jandl and colleagues (Jandl et al., 2024) from the Austrian Forest Research Center (BFW) provide the article *Management and Biodiversity Conservation in Central European Forests* focusing explicitly on Central Europe. They claim that there is a need for a better understanding of site-specific impacts of forestry practices on species richness, communities, and species migration under climate change and other threats to biodiversity. Improving this knowledge could enhance future planning of conservation and forest management, supporting their synergies. In the study, they evaluate the impact of silviculture practices at the stand level on biodiversity. The findings can be aggregated on a larger spatial scale. This study aims identifies weaknesses and strengths of multipurpose forestry practices to strengthen synergies and pinpoint knowledge gaps that need to be addressed in the future, accepting that not in all cases, diverging interests can be reconciled. After having described different Central European Forest management cases and their impacts on biodiversity, the study concludes that "sustainable multipurpose forestry is a valid concept for Central Europe that supports many but not all of the objectives of biodiversity conservation" (Jandl et al., 2024).

Africa

Globally, over two billion people rely on fuelwood for cooking and heating. In sub-Saharan Africa, about 81 % of the population depends on woody biomass for household cooking energy and as a source of income by selling charcoal and firewood. Cooking by biomass is used by about 85 % of the population in Rwanda. Current fuelwood extractions from natural forests and plantation forests exceed the demand in most sub-Saharan African countries. Therefore, integrating on-farm multipurpose tree species has been suggested to be one of the most effective ways to increase fuelwood availability and other environmental services.

Bapfakurera et al. (2024) use forest inventory methods in "*Assessment of stocking, productivity, and aboveground biomass of tree species used as fuelwood in Rwanda's agricultural landscapes.*" Adopting on-farm fuelwood production is crucial for ensuring a sustainable fuelwood supply and other significant wood products. It also serves as a strategic approach to alleviating pressure on the remaining natural forests and woodlands. Tree-based systems in the agricultural landscape of Rwanda supply considerable amounts of fuelwood to the local communities. However, there needs to be more information on the available stocking, aboveground biomass (AGB), and productivity of the trees used for fuelwood. The study shows which tree-based systems and species provide the highest AGB production. Bapfakurera et al. (2024) conclude that the observed correlations offer valuable insights into tree species growth trajectories and the productivity potential of tree species, offering opportunities for optimizing tree species and promoting sustainable resource management. By understanding the AGB-age relationship, practitioners and policymakers can make informed decisions regarding tree species selection and agroforestry management practices, ultimately contributing to environmental sustainability and ecosystem resilience.

South–East Asia

The conservation and sustainable development of mangrove forests play a critical role in stabilizing livelihoods, creating employment opportunities for neighboring communities, and preserving valuable ecosystems. At the same time, mangrove forests create an ideal environment for aquaculture.

The Ca Mau province in the southernmost point of Vietnam is home to expansive mangrove forests. Ca Mau is Vietnam's leading shrimp-producing and exporting province. Significantly, the shrimping industry contributed 80 % of the GDP in the province's aquaculture and agriculture sectors and engaged 60 % of the regions rural labor force. Simultaneously, the shrimp farming contributes to excessive, partly illegal, deforestation of mangrove forests and increases the susceptibility of coastal areas to the impacts of changing climate . As a countermeasure, policies and regulations are implemented to foster a balance between conservation and economic development. Recommended fixed mangrove-to-pond ratio (MPR) is a key component in the policy toolbox. However, there is currently no research that examines the practical sustainability of imposing fixed MPR on shrimp farming communities. In Anh et al. (2024) study titled "*Economic effects of a controlled mangrove-to-pond coverage ratio policy on mangrove conservation and shrimp farming: A case study in Vietnam using instrumental regression analysis,*" a mix of qualitative and quantitative approaches are used to examine the economic viability of shrimp farming and predict impacts of MPR. Findings reveal that almost half of the surveyed farmers do not meet recommendations, prioritizing pond expansion over mangrove protection. Based on the study's results, the authors present extensive policy recommendations for successful management of natural resources

and sustainable forest management.

In another article Thuy et al. (2024) investigates "*Households' willingness-to-pay for mangrove environmental services: Evidence from Phu Long, Northeast Vietnam"*. The Theory of Planned Behavior, along with demographic factors, is utilized to investigate the willingness-to-pay (WTP) for mangrove forest services among residents in Phu Long commune. Recognizing the economic value of mangroves and the services they provide is increasingly crucial in coastal management. If the value of ecosystem services cannot be clearly determined and quantified, intangible values may be overlooked in policy decisions and livelihood activities, leading to a decline or loss of these vital ecosystem services. Willingness-to-pay serves as the basis for monetizing nonmarket ecosystem services, which mangrove services mostly fall under. The authors note that the neoclassical consumer model has certain weaknesses when it does not consider the socio-psychological factors related to the preferences and needs of buyers. Economic decisions are not solely driven by budgets but also by individuals' specific attitudes towards behavior and social norms that shape their behavior. When discussing policy implications, the authors note that the analysis of factors reveals that attitudes, perceived behavioral control, and knowledge about mangrove forests have the most positive and significant impact on residents' WTP. Based on these findings, several policy implications are proposed to enhance residents' WTP for mangrove forest environmental services and promote the conservation and sustainable development of mangrove forests.

Americas

Korhonen et al. (2024) point out that our ability to progress on several SDGs depends on reducing inequalities between demographic groups based on, for example, gender, race, and ethnicity. Workplace diversity also generates benefits for organizations, since evidence suggests that more diverse organizations achieve a greater level of performance.

The authors note that workplace diversity is a societal imperative that responsible organizations must take seriously. They use the forest sector in the United States as a case in the article titled "*Gaps in diversity representation and data insufficiencies in the U.S. forest sector workforce analysis."*. Forestry and logging, the wood products manufacturing industry, and the paper manufacturing industry is examined. The study covers the timeframe spanning from 2005 to 2021. The forestry sector's workforce has declined but shows different patterns in different parts of the workforce. Common to all sectors is that the number of loggers and machine workers has declined strongly but management occupations have increased. In the forest industry, the share of women varies between 5 % in logging and forestry and 24 % in the paper product manufacturing industry. The only field where women represent half or more of the workforce are management occupations and conservation scientists. Foresters and paper machine workers are the only fields where the share of women in the workforce has increased significantly during the period. The balance of Man, Women, Black, Asian, White, and Hispanic or Latino show minimal changes during the studied timespan. The authors highlight that general economic research has concluded that women are more inclined towards roles involving human interaction rather than ``inanimate things and mechanical systems'' (Korhonen et al., 2024), a pattern reflected in the reported results. Ecosystem-focused roles, emphasizing human interaction and innovation, appears to be intricately linked to the increasing diversity within the sector, influencing not only gender representation but also, in certain instances, the representation of various racial and ethnic groups.

Puc-Kauil et al. (2024) focus on the Yucatan Peninsula in their article titled "Second-growth forests of the Mexican tropics are reservoirs of timber species similar to old-growth forest: Perspectives for sustainable forest management". This region is a historically important forestry region where its own production system, i.e., Peninsular Silviculture Method (MSP), has been developed. The MSP consists of silviculture principles that promote second-growth sustainability under a socio-cultural productive framework termed "ejidos" (e.g., communities with rights to land use and profits), ultimately leading to financial viability and community outreach. However, Yucatan Peninsula forest has been constantly disturbed by the milpa agricultural system (a polyculture agriculture system sustained through the cyclical application of slash-and burn), changes in land use, and other factors giving rise to a mosaic of forests in different stages of succession. The purpose of the study is to determine if the structure and adequate number of species change as a function of secondary forest age and, if so, the magnitude of that change compared to old-growth forests. The results indicate that second-growth forests are important tree species reservoirs (including those for timber-production purposes), compared to old-growth or mature forests. Therefore they are relevant not only as biodiversity conservation areas or carbon sinks but also for planned sustainable forest management.

The multifunctional landscapes model has gained significant interest in science and policy. Multifunctional landscapes offer an integrated approach to production, conservation, and human well-being. Ortiz et al. (2024) explore and deconstruct the multifunctional landscape model in the context of the complex socio-ecological systems of South-Central Chile. The results presented in the article titled "*Exploring the multifunctional landscapes model in areas dominated by non-native tree plantations,"* shows a need to deepen the knowledge of how to move the model into practice, such as how to identify and decide compatible activities in the landscape. In the study, a review of the literature and semi-structured interviews with regional experts were used to better understand the challenges and opportunities presented by multifunctional landscapes.

Concluding remarks

The different articles in this Special Issue highlight different aspects of how research can support the achievement of sustainable development goals. They reflect diverse research landscapes across the globe, highlighting the key Sustainable Development Goals (SDGs) and encompass, at least SDG #2: no hunger, SDG #5: gender equity, SDG #13: climate action, and SDG #15 life: on land. These landscapes range from the global north forestry industry of Europe and the United States to the supply of firewood in Rwanda's communities. They also show the emergence of common themes like human actor diversity (as in the Chilean case) or the lack of it (as in the United States's. Forestry sector) that resonate across the need for forests multiple vs. often competitive uses (such as Mexican milpa agriculture or Vietnamese shrimp aquaculture). Moreover, they provide a glimpse into approaches from disciplines outside the natural sciences, such as participatory science and in-depth interviews, which understanding is sorely needed if we want to adequately address our third task. Besides, taken together they suggest to some of us that, perhaps in more situations than we would like to accept, not only natural and social sciences have to be involved in management decisions but also some inevitable negotiations in the political arena.

As a final remark, quoting one of the articles in this Special Issue "A strong, opinionated and dichotomous discourse on forest management versus nature conservation has developed, insufficiently reflecting win-win situations" (Jandl et al., 2024). The different articles in this Special Issue are interlinked in one way or another, opening the way to solutions that, if properly communicated and implemented, will contribute to win-win outcomes allowing the fulfillment of different SDGs.

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