Deal for Green?

Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

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: Preface

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After fifteen years the IUFRO 4.05.00 *Managerial economics and accounting* international conference returned to Slovenia. This time the organizing team joined forces with the colleagues from the IUFRO 9.05.03 *Cross-sectoral policy impacts on forests* research group to deliver a transdisciplinary event to review the state of the art in forest-related managerial economics, forest and environmental accounting, and cross-sectoral policy impacts on forests. The conference was held in Ljubljana, Slovenia, from September 25th to September 27th, 2023, and it held a title *Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management*. The event was organized by the Department of Forestry and Renewable Forest Resources of the Biotechnical Faculty of the University of Ljubljana, and the Slovenian Forestry Institute.

The decision to organize an international conference is based on current issues related to implementation of the European Green Deal policy initiatives and the New EU Forest Strategy for 2030 European Commission. In the search for environmentally friendly practices for the use of natural resources while maintaining necessary economic growth, countries and unions have chosen different strategies. In many ways, forests and forestry are part of the solution, although their condition is deteriorating in some countries. Still, forests provide multiple ecosystem services and are a place for people's diverse activities, which in some loactions compete with each other. In such situations, it is important that we make additional contributions from all disciplines and levels to bridge the challenges in a transdisciplinary effort.

The international IUFRO conference in Ljubljana brought together more than 50 participants who presented the results of their studies and encouraged a constructive dialogue among all. During the two days, the scientific program of the conference included 35 top presentations that were divided into eight sessions. In addition, four invited lecturers gave inspiring talks on innovative approaches to collective action, sustainability, and policy implementation. The present proceedings include four invited lecture papers and 34 extended abstracts. The

attendance at the conference was internationally very diverse (number of participants in parentheses); presenters came from the Czech Republic (7), Italy (6), Slovakia (6), Germany (4), Hungary (3), Serbia (3), USA (2), Bosnia and Herzegovina (1), Croatia (1), Ecuador (1), Finland (1), Norway (1) and United Kingdom (1). There were sixteen participants from Slovenia, for a total of 53 participants.

The titles of eight session are Environmental accounting and economic appraisal, Cross-sectoral policy analysis, Social and economic aspects of green deal, Ecosystem services: synergies and trade-offs, Ownership role in short and long-term planning, Labour and employment in forestry, Forest management and decision-making, and Forest products for greener future. The presentations covered topics of managerial economics, social, and environmental accounting and cross-sectoral policy impacts on forests and the environment; illustrating the impact of the new EU Forest strategy and the European Green Deal on society, forests and the economy; revealing the characteristics of the labour market in different regions of the World; exploring multifaced role of owners within forest management systems, their perceptions of policies and forest management planning, including harvesting behaviour; evaluating the features of timber and non-timber forest products market in relation to other markets and economies; and discussing (forest) ecosystem services, their synergies and trade-offs in relation to existing and future markets. The conference shed new light on the listed topics and allowed for a fruitful discussion among the participants.

At the very end of this preface the organizing committee would like to express its deep gratitude to all the sponsors and supporters who made this event possible. We would like to thank the Pahernik Foundation, the Ministry of Agriculture, Forestry and Food and its Forest Fund, the company SiDG Ltd., publishing house MDPI and their open access journal Forests, and the University of Ljubljana, Biotechnical Faculty. We are grateful to all invited speakers for their opening speeches: John Parrotta, PhD (IUFRO president; U.S. Forest Service), prof. Donald G. Hodges, PhD (IUFRO division 4 coordinator; University of Tennessee), prof. Klemen Jerina, PhD (vice-dean for forestry of the Biotechnical faculty), prof. Marina Pintar, PhD (dean of the Biotechnical Faculty), Nike Krajnc, PhD (director of the Slovenian Forestry Institute), Darij Krajčič, PhD (state secretary at the Ministry of Agriculture, Forestry and Food), and Mr. Gregor Danev (director of the Slovenia Forest Service). Many thanks to the invited speakers prof. Andreja Kutnar, PhD, prof. Marija Nijnik, PhD, prof. Davide Pettenella, PhD and prof. Mersudin Avdibegović, PhD for the scientific enrichment of the conference. The content of the proceedings is highly scientific thanks to the reviewers, the program is well balanced thanks to the members of the Programme Committee, and the conference ran smoothly thanks to the help of engaging students. Special thanks to the IUFRO organization and the Secretariat in Vienna for their help and support in communicating the event and spreading the news through various channels. Finally, a big thank you to all the authors and participants for their extraordinary contribution, reverently dedication, and endless cheerfulness.

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Invited lectures

The New European Bauhaus Academy Pioneer Hub for Sustainable Built Environments with Renewable Materials

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ABSTRACT

The urgency of the climate crisis requires accelerating the transfer and adoption of climate change mitigation knowledge and capabilities to businesses, policy makers, and the public. The New European Bauhaus Academy Pioneer Hub for Sustainable Built Environments with Renewable Materials (NEBAP Hub) is a newly established university centre focusing on sustainable built environments that are regenerative and inclusive spaces that minimise environmental impacts through decarbonisation and lead to positive societal and economic impacts, including health and wellbeing. Non-exhaustively this includes design and use considering beauty and functionality, land, and material use (natural renewable materials emphasis), user perspectives and co-creation, low environmental impacts via circular principles (construction, maintenance, life-extending solutions, and deconstruction for reuse). In this presentation the NEBAP Hub will be presented together with its activities in multilateral forum for policy making, exchange of knowledge and experience between public and private forest-based sector actors at national and regional level to share best practices and an opportunity to coordinate approaches in developing policy solutions.

KEYWORDS

European Green Deal, partnership, knowledge exchange, university centre

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Social innovation to address sustainability challenges and enlarge the opportunities provided by forests for a green and just transition of marginalised mountain areas

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ABSTRACT

In this paper, we provide conceptual and practical insights into social innovation, highlighting its role in achieving a more sustainable provision of ecosystem services from forests, as well as its role in tackling societal challenges and utilising the opportunities available in marginalised mountain areas across Europe. The findings indicate that social innovation and innovative governance mechanisms are crucial for the promotion of sustainability and multi-functionality in mountain forestry, as well as for the enhancement of a smart, green, and just transition of marginalised rural areas, so that forest-dependent communities, living and working in the vicinity of woodlands, can become healthier, happier, and more prosperous. The results show that social innovation has a power of enabling forest-dependent communities and woodland-based social enterprises to build and realise their capacities, while reducing existing inequalities, and promoting social justice and inclusion. There is also empirical evidence to suggest that by adding to improving human wellbeing, social innovation can create new responses to pressing social demands (e.g., for climate neutrality) that are not adequately addressed by markets or existing (e.g., public) institutions. We believe that the conceptualization and operationalisation of social innovation in the context of multi-functional forestry, offered by this research and its findings, can help informing forest policy and management decisions and the design of practice measures for Green Recovery and a long-term sustainability of socio-ecological systems in marginalised mountain areas.

KEYWORDS

Natural capital, ecosystem services, woodlands, communities, stakeholder engagement, sustainability, resilience

1 INTRODUCTION

Social innovation (SI) creates new responses to pressing social demands which affect the process of social interactions. As defined by the EU funded project SIMRA, SI is "*the reconfiguring of social practices, in response to societal challenges, which seeks to enhance outcomes on societal well-being and necessarily includes the engagement of civil society actors*" (Polman et al., 2017). The reconfiguration of social practices includes the creation of new institutions, networks, and governance agreements in forestry that seeks to enhance societal outcomes, especially but not exclusively for disadvantaged groups, and recognizing the likelihood of trade-offs among competing interests. And while social practices may include diverse institutions, they necessarily rely on the voluntary engagement of civil society actors.

Social innovation comprises new institutional environments (e.g., formal, and informal rules) and arrangements (spatial and procedural), related actors' relationships and interactions (e.g., new attitudes, values, behaviours, skills, interactions, networks, collaborations, learning processes) and new fields of activity (e.g., social entrepreneurship, social enterprises). Social innovation manifests itself in participation, in social relationships and collaborations, and new governance mechanisms that it initiates advance the social capital further and can create new SIs (Nijnik et al., 2019).

The objective of this paper is to share a synthesis overview of key results of forest research within the EU H2020 SIMRA project (Social Innovation in Marginalised Rural Areas) and its follow ups, as well as the authors' work supported by their national governments. The article provides some conceptual and practical insights into social innovation, highlighting its role in achieving a more sustainable provision of ecosystem services (ES) from forests, tackling societal challenges, and utilising the opportunities available in marginalised mountain areas of Europe. The findings (e.g., in Barlagne et al., 2021a; Nijnik et al., 2021; Nijnik et al., 2022), indicate that social innovation and enhanced governance mechanisms are crucial for transition towards a more sustainable development of forestry, as well as for the enhancement of smart and inclusive growth of forest-dependent communities that are living and working in the vicinity of mountain woodlands.

2 METHODS

2.1 Methodological considerations

This paper is underpinned by the work of the SIMRA project, the overarching aim of which was to improve existing understanding of social innovation and increase the prospects for its successful implementation on the ground. The SIMRA work tackled the following main areas: i) development of frameworks for the categorization, understanding, and operationalizing SI in different settings of marginalized rural areas in Europe and North Africa (Vercher et al., 2019; Sarkki et al., 2019) and pertaining to the forest sector (Barlagne et al., 2021b; Ludvig et al., 2018a; Nijnik et al., 2021; Slee et al., 2021); ii) identification and understanding of reasons for diverging paths of SI development in regions with similar conditions (Kluvankova et al., 2022); iii) advancement of an integrated set of methods for evaluating SI, and its impacts (Secco et al., 2019); iv) evaluation of success factors for SIs co-constructed by scientific and stakeholder labs in selected case studies (Ravazzoli et al., 2021); v) communication of new knowledge to policy makers (Ludvig et al., 2018b; Slee et al., 2022) and communities of practice; and vi) promotion of collaborative learning and research networking in forestry (e.g. establishment of IUFRO Unit 4.05.05) and new partnerships, and galvanizing innovation actions (Melnykovych et al., 2018) for making viable and durable impact.

The trans-disciplinary science has addressed the complexity and causalities of SI actions, linking abstract (i.e., system) knowledge through the innovation and learning processes (i.e., transformation knowledge) towards the development of experience-based competencies and skills for making impacts (i.e., target knowledge, which is e.g., a set of SI outputs, such as new policy recommendations; proposals for institutional or behavioural changes), as illustrated in Figure 1.

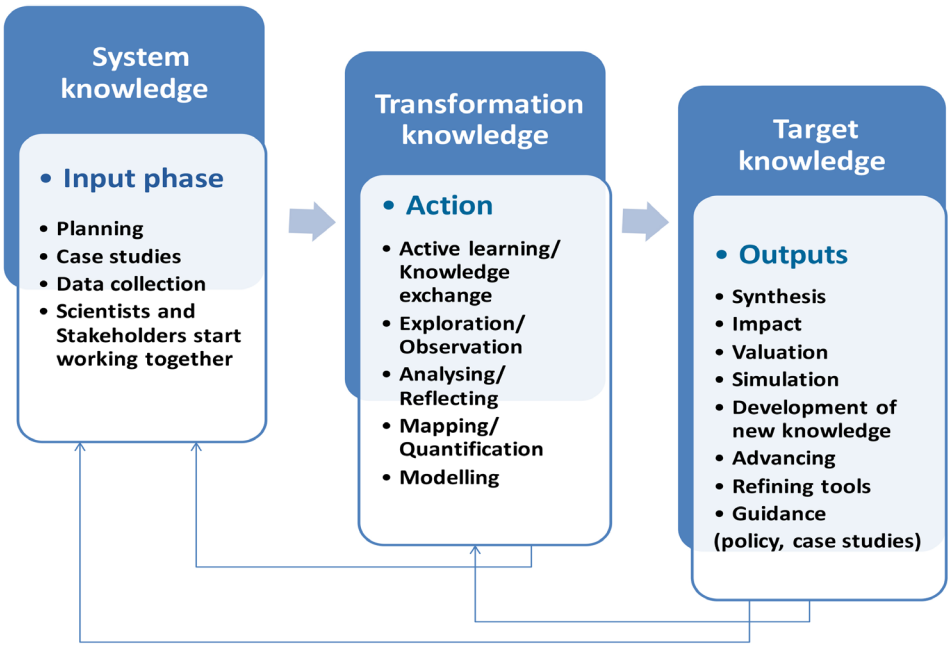

Figure 1. Systems model of knowledge flow (Nijnik et al., 2022)

The multi-actor driven approach adopted first of all targets case studies where researchers 'set the scene' on existing scientific knowledge, and stakeholders provide input to developing trans-disciplinary knowledge and co-constructing investigations. The innovative knowledge and approaches developed jointly in the science and stakeholder labs flow throughout the research phases to support the build-up and promotion of SIs on the ground. The integration of participatory approaches into the designing and implementing of solutions to addressing sustainability challenges instigated by SIMRA has been reinforced by the trans-disciplinary knowledge of FirEuRisk (concerning forest fire risk management) and through a science-society-policy interface by SHERPA. Along with SIMRA, these EU H2020 projects have added value to the formulation of recommendations for future policies relevant to rural areas, including the forest sector, while their follow-up, the Horizon Europe RURACTIVE project, aims to empower marginalised rural communities to act for change.

2.2 Detailed method description

The research followed a semi-qualitative route and applied, amongst other methods, a review of relevant literature and 'face-to-face' questionnaire surveys of respondents in selected case studies as well as participatory approaches, with application of visualization tools (e.g., a Virtual Landscape Theatre; Wang et al., 2022) and quantitative methods to analyse the data (e.g., PQ-method of MCA; PCA; SNA, and statistics). Stakeholder evaluation approaches and participatory techniques were advanced, refined, and applied innovatively, including for natural capital valuation. The PQ method, for example, was used to identify, analyse, and explain attitudes and perspectives, amongst representatives of local communities and forestry associated stakeholders, regarding sustainability changes in selected European mountain areas, and on the role of SI in multi-functional present and future developments of forestry (Nijnik et al., 2020; Miller et al., 2020a). Among others, the following methodological approaches, linked to the theory of social innovation, were elaborated:

1. A spiral model (adapted from The Young Foundation, 2012) for examining SIs through the entire cycle: from *ideas, to prototyping and piloting, to implementation, and up-scaling (or out-scaling, or spreading deep).* It is also a cycle from ideas to products and markets (e.g., new entrepreneur opportunities), and towards innovative policy and governance mechanisms. The ultimate aim was to enhance SIs that are both driven by end-users and relevant to them. Attention was given to new social partnerships, horizontal and vertical networks, specifically those involving representatives of the forest sector and forest-dependent communities.
2. A systematic *theoretical framework* for categorising, understanding, and operationalising social innovation in different settings (Kluvankova et al., 2018; 2021; Nijnik et al., 2020; 2021). This framework relies on novel systematic ways of integrating different types of knowledge, existing data, tools, and approaches with the beyond-the-state-of-art science to produce operational methods for end-users to practically initiate SIs, and to innovate and spread their initiatives (e.g., scale up, scale out and scale deep) through innovation actions.

3. An *innovative methodological framework* that integrates qualitative and quantitative methods (Secco et al., 2019; Secco et al., 2022). It is based on a critical review and categorization of existing evaluation techniques and the designing of an integrated set of approaches and tools for assessing and evaluating social innovation's and of their impacts.

3 RESULTS

The EU H2020 SIMRA (2020) project has advanced the state-of-the-art understanding of social innovation and innovative governance in the forest sector (and beyond), and how to boost them to enhance societal well-being in marginalised rural areas. Drawing on the theories identified above, and connecting them to policies (Slee and Mosdale, 2020) and practices in an open society (BEPA, 2011), a new theoretical and context-specific knowledge of social innovation was co-created and operationalised. The knowledge was advanced of how social innovation emerges and develops, and how it can be scaled up and out and make adaptive or transformative changes on the ground.

An *online SIMRA database of examples* of social innovations was produced with an interactive map interface and filters to enable easier searching by topic and characteristic. A Catalogue of Diversity of social innovations comprises N≥ 400 (243 validated) examples, including on woodland development and innovative forest governance (Valero and Bryce, 2020; Miller et al., 2020b). Social innovations for reconfiguring rules for the use and management of forests include collaborative management groups for planning loggings, changing ownership of forests, introducing innovative grassroots practices to evaluate natural capital of woodlands and monitor sustainability in using natural assets, as well as pilot projects to introduce and develop new participatory practices in forest management.

The results improved existing understanding of how the diversity of opinions on forestry changes could influence the selection and evaluation of sustainable forest policy decisions. Social innovations associated with reconfiguring perceptions of sustainable forest management primarily aim at securing continuity of local ways of life and increasing well-being. Revitalization of forest-dependent communities requires that forest management is economically beneficial for people, providing the material basis for them to continue living in the locality. Sustainability is perceived as a sense of community and identity, good social relationships within and between communities and towards other stakeholders (e.g., forest companies; authorities), and also as local stewardship which respects and connects people and nature.

The different importance accorded by respondents to the integration of woodlands in landscapes, made us aware of public priorities and of factors that can hamper ecosystem-based adaptation policies and management practices. At times, entirely opposite attitudes towards forestry development and the key objectives of the future of forestry in uplands were revealed (Nijnik et al., 2018). However, people interviewed from across European mountain areas placed strong emphasis on woodland regeneration. The respondents paid particular attention to the recognition of the importance of biodiversity conservation and nature preservation, forest multi-functionality, and people's rights to enjoy the beauty of landscapes (Nijnik et al., 2010; Nijnik et al., 2017). The heterogeneity of existing

perspectives, and attitudinal commonalities and differences across stakeholder groups and individuals within these groups were identified and explained. The results represent a consensus on the importance of woodlands, as offering a range of benefits to people, and to the environment and economy.

In addition to the unique database of examples of SIs, the innovations identified and explained built on the empirical evidence received from SIMRA 11 Type A Case Studies and its 7 social Innovation Actions, the majority of which had some association with woodlands. The cases highlight capacities for the revitalisation of continuous cover forestry practices, locally beneficial nature-based tourism, use of non-wood forest products, grazing practices, gaming, etc. These practices do not necessarily require discontinuing commercial forestry, but rather that the reconfiguring of forest management and use is characterised by changes towards a more sustainable and multi-functional forestry.

Divergent Development Pathways (DDPs) of social innovation were identified and explained on the basis of empirical evidence from the case studies, and the knowledge developed enabled an explanation of why regions with similar initial conditions for social innovation may display diverging paths (Nijnik et al., 2018; Kluvankova et al., 2021). The knowledge was advanced in relation to: i) barriers, success factors and lessons learned from the social innovations initiated and/or advanced in different contexts and scales; ii) how to launch, boost and spread social innovations and help revive local, forest-dependent communities, and improve their well-being; iii) how to build capacities and develop collaborations to promote innovative forest governance and make forestry more sustainable and resilient under conditions of the climate changes (e.g. with the increase of forest fires) and other challenges, from global to local.

The findings indicate that social innovation usually emerges as a response to triggers, both positive and negative, and that policy instruments and management strategies can also be negative triggers. For example (Nijnik and Sarkki, 2019), industrial loggings may have negative impacts on local and small-scale use of the forest by communities (e.g., for nature-based tourism or non-wood forest products). Local people would benefit from more sustainable forest management and could respond with social innovations that advance sustainability.

The conceptualisation of social innovation (e.g., with respect to what it is; how it evolves; how local knowledge and cultures can be integrated into decision-making processes) is being supported by new knowledge of how the impact of social innovation on the ground can be assessed (SIMRA, 2020). An evaluation manual, consisting of a set of tools and evaluation criteria (underpinned by a database of frameworks, approaches, and methods for evaluation) that can be adapted to the specific needs, has been developed (Secco et al., 2019). It is designed for use by researchers and practitioners and improves their understanding of the methodological implications of the evaluation of social innovations and their impacts. It also provides guidance for operationalizing the practice of evaluation: for an internal, self-evaluation of SIs, or for external evaluation of the programmes, including in the forest sector (Secco et al., 2022).

4 DISCUSSION AND CONCLUSION

An advanced understanding of SI and innovative forest governance is of importance for inter-disciplinary forest science and for decision-makers (Ludvig et al., 2018; SIMRA, 2020). This concerns the realization that: i) forward-thinking and well-designed policies can nurture transitions towards sustainability (Rametsteiner and Weiss, 2006); ii) multi-level policy interventions can strengthen innovation systems and best solutions can be upscaled through multilevel processes (Weiss et al., 2020); iii) top-down stimulating policy must be properly connected with bottom-up endogenous actions; iv) strong social capital can contribute positively to the advancing and spreading of knowledge (Buttoud et al., 2011) and triggering SIs (Bock, 2016), therefore, promoting sustainability (whereas weak social capital undermines civic engagement and good forest governance).

Social innovation is a critical component for addressing sustainability challenges and leveraging the opportunities offered by multi-functional forests in marginalized mountain areas (Nijnik et al., 2019; 2021; Melnykovych et al., 2019; Kluvankova et al., 2021). Social innovations usually emerge at a grassroots level but may be mainstreamed. Local innovations are often manifestations of global trends. However, without stakeholder engagement and concrete changes on the ground and at various locations, global trends remain hypothetical. Therefore, social innovations need to be supported at multiple levels, including as part of global change strategies by forest relevant policy and governance towards futures that secure environmentally sustainable and socially equitable forest management and use. However, there are underlying challenges that must be overcome to facilitate the emergence and development of social innovations. The ways forward may lie through:

- *Enhanced inter- and trans-disciplinary collaboration.* Multi-functional forests are complex social-ecological systems, requiring a deep understanding of the interplay between ecological, social, and economic factors. Thus, success of social innovations would require close collaboration amongst academia-policy-practice experts from diverse fields, including forestry, ecology, and social sciences.
- *Participatory approaches that involve local stakeholders in the evaluation of natural capital and ecosystem services and the co-creation and implementation of social innovations.* In mountain areas, where local communities are often marginalized and lack access to resources and the decision-making power, participatory approaches that engage the communities in innovation processes (e.g., to tackle forest fires) are therefore crucial, as well as knowledge sharing (e.g., of good practices and lessons learned) and continuous encouragement of SIs and of innovators. These actions are necessary to ensure that the innovations meet the needs of people and are sustainable.
- *Development of social innovations responsive to the cultural and ecological contexts of the localities.* A one-size-fits-all approach will likely be ineffective and could even lead to unintended negative consequences. Social initiatives must be tailored to the place-specific needs, opportunities and challenges and account for the local culture, and ecological and socioeconomic conditions.
- *Adequate funding and policy support.* Social innovations may need significant upfront investment, and the returns on investment may not be apparent, especially in the short term. Therefore, it is important to make SIs attractive to

policymakers and funders, so that they recognize the long-term benefits of SI initiatives and provide the resources and policy support necessary to enable the emergence and sustaining of social innovations. Exploiting new opportunities for raising external funds and/or making SIs more self-sufficient (e.g., through social enterprises) is important either.

This research is ongoing. The knowledge of social innovation in forestry is still less advanced than in other sectors of the economy. Social innovation pertaining to forest management and use is not that easy to design, initiate, and to develop, and spread. New relationships among citizens, forest-dependent communities, public-private bodies, foresters, advisors, and researchers need to be developed. In our new EU Horizon Europe project of RURACTIVE we aim to share the state-of-the-art knowledge around smart solutions (developed by SIMRA, SHERPA, FirEUrisk and other projects) to enhance the capacities of local communities to act for societal change.

Issues that merit further attention include: what are development paths of social innovation in forestry and what are the implications for their effectiveness? How to empower the development of forest-based SI solutions to climate and environmental challenges? What models of social innovation are most effective for improving mental health and the well-being of people? What are the perceptions and motivations of the innovators initiating and developing social innovations? How to foster, deepen and sustain social innovations, and to scale them up and/or out?

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Payments for forest ecosystem services with focus on CO_2 removal

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ABSTRACT

The demand for forest products and services is changing in very significant terms internationally and also in Europe. The New Green Deal is stimulating decarbonisation and replacement with forest biomass the fossil energy and the fossil resources-based industrial products (textiles, plastics, paints, additives for the pharmaceutical and cosmetics sectors, etc.). But there is very significant growth in demand not only for provisioning services, i.e., products with market prices, but also for unpriced cultural and regulatory services. In the case of unpriced services, suppliers are often not motivated to keep or increase the supply. Even in cases where the supply of unpriced services is a spill over of market ones (e.g., the protection of biodiversity as a spill over of the productive plantations), the services are provided at sub-optimal levels and much less than social demand.

To solve these problems, it has been proposed the creation of systems for the Payment for Environmental Services (PES) in addition to or replacing traditional public instruments under public control (passive tools like constraints and obligations; active tools like subsidies and tax incentives). PES are based on free bargaining between suppliers and beneficiaries who must pay for their additional environmental services that are using, in such a way creating a financial motivation for their supply. In Europe, the recent discussion on the PES, the formal public statements, the commitments set out in the plans were much larger than the development of new PES. The reasons are different, first the presence of traditional public regulatory systems that oblige suppliers to offer unpriced services, leaving limited spaces to an additional offer based on voluntary exchanges, the complexity of legal agreements between beneficiaries and suppliers, the hostility towards the idea of "commoditisation" of publicly available environmental services, which many perceive as a basic right of citizens-consumers. More frequent are the cases of quasi-PES (or PES like) where some of the contractual conditions between suppliers and beneficiaries have been regulated by the State. Indeed, the difficulties in the organisation of "pure" PES systems have resulted in a new State's attention to dictate the rules and to perform functions of stimulus, monitoring, control, and information of operators. The presence of more active public authorities in regulating the supply of forest ecosystem services can be highlighted by analysing the role of the European Commission in preventing deforestation and forest degradation, in the protection of old-growth forests and in general of forest biodiversity, in defining the criteria and indicators of sustainable forest investments. But perhaps the most significant case of the activation of the regulatory role of public authorities is that of the voluntary market for credits linked to forest activities of carbon removal.

At the end of 2022, the EC approved the Carbon Removals Regulation (CRC) with framework principles for regulating three sectors of investment: the activities in agriculture and forestry, the removal of carbon in wood products with long life cycle and the industrial carbon removal. The just started process of finalising the legislation will be very critical. The EC expects to define the methodologies for the certification of the carbon removals credits with the support of an unelected expert group, that will have to addressing permanence, additionality, reversals, and measurement.

The risk is that these public interventions to regulate the market, which are not limited to soft tools like monitoring, valuation, and information actions, but which create new institutions and top-down rules, will re-propose in a different version the traditional role of a strong State that regulates and manages the market, reducing the role and responsibility of civil society and increasing transaction costs. *"What has been will be again, what has been done will be done again; there is nothing new under the sun"*.

KEYWORDS

European Green Deal, policy measures, European Union, Carbon Removals Regulation

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Contribution of forest certification to sustainable development goals

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ABSTRACT

Over the past few decades forest certification (FSC) has evolved from a theoretical model to a concept that has gained acceptance in forestry practice worldwide. As market-driven approach, drawing on end-user concern about global environmental issues, forest certification solidified the position of specific forest policy instrument, responding to the dynamic changes in societal demands on forest ecosystems, the emergence of new stakeholders, and the complexity of global international processes. Sustainable forest management, as the ultimate goal of forest certification, contains the essence of the paradigm of sustainable development - meeting our current needs without compromising the needs of future generations. The methodological approach in this paper is based on analysis on how implementation of FSC Principles (Forest Stewardship Council) contributes to the Sustainable Development Goals (SDGs) from the 2030 Agenda. As FSC certification has been widely adopted in most of the Western Balkan countries, the analysis particularly addresses forestry realities in this region. The results show that FSC certification contributes to various SDGs through conservation and restoration of forest ecosystems, biodiversity protection, maintenance high conservation value forests and forest ecosystem services, securing freshwater supplies, improving relations with local communities and other stakeholders, better worker's rights and safety, economic growth, and job security in rural areas as well as socially responsible production and consumption. While forest certification is a significant tool for achieving the SDGs, sustainable forest management, grounded on understanding of diversity of forest ecosystem services and dynamics in society's requirements towards forests, can be an important factor in the future of sustainable development.

KEYWORDS

Forest certification, sustainable development, forest policy

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1

Environmental accounting and economic appraisal

Application of the typical enterprise approach in forestry: a pilot study to collect economic key figures in small-scale private forest enterprises in five EU countries

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ABSTRACT

The European small-scale private forest is facing major challenges as a result of climate change and increasing societal demands. For evidence-based decision-making e.g., for economic impact assessments, comparable information on the economic situation of small-scale private forest enterprises is of growing importance. So far, however, there are no or only few economic key figures on forest management available for small-scale private forest enterprises (SSPFE) in many EU Member States. Furthermore, the few existing key figures are hardly internationally comparable. Therefore, in a pilot-study within the joint research project "Valorising small-scale forestry for a bio-based economy (ValoFor)" comparable key figures on forest management in SSPFE in Germany, Finland, Austria, Sweden and Slovenia were collected for the first time, using a modified "typical enterprise approach". For each country, a typical SSPFE with typical management measures and economic indicators was created through in-depth literature analysis and expert interviews. For example, it was found that in the reference year 2021, the highest timber revenues in typical SSPFE were achieved in Austria (66 €/m^3). This was followed by Germany with 57 €/m^3. For the typical enterprises in Finland, Sweden and Slovenia, timber revenues of 41 - 42 €/m^3 were calculated. The "typical forest enterprise" approach, which can be realized with comparatively little effort, can serve as a valuable basis for further forest economic impact assessments for EU policy processes.

KEYWORDS

Typical enterprise, small-scale private forest, EU, key figures of forest management

1 INTRODUCTION

Forestry in Europe is economically significant and an important source of employment and income, especially in rural areas. To date, about 50% of the forest area in the EU is privately owned. Private forests under 20 ha have a share of 33% of the total EU private forest area (Hirsch et al., 2007).

Currently, the (small-scale) private forest in the EU is confronted with increasingly competing demands. On the one hand, there is the growing demand for wood for bioeconomy, and on the other hand, the provision of ecosystem services such as climate and biodiversity protection, which are not necessarily in line with timber use. Similarly, small-scale private forest enterprises (SSPFE) are challenged by the consequences of climate change and the resulting need to adapt forest management.

Against this background, information on the economic situation of SSPFE is of great importance as a foundation for evidence-based decision-making on enterprise and political level, e.g., for economic impact assessments of modified forest management to provide additional ecosystem services. In many European countries, however, key figures on forest management in SSPFE are not available at national level or are collected in a time-consuming and costly manner in national forest accountancy data networks for medium and large forest enterprises (Bürgi et al., 2016). Therefore, in a pilot study within the research project "Valorising small-scale forestry for a bio-based economy (ValoFor)", the "typical enterprise approach" was applied for the first time to collect key figures of SSPFE in Germany, Finland, Austria, Sweden and Slovenia.

2 METHODS

In the "typical enterprise approach", instead of a complex data collection in many (sample) enterprises, one type of enterprise, which represents a large (= typical) group of enterprises according to expert assessment, is examined in detail. Thus, the aim is not to map average values representing the entirety of enterprises but to represent one (or more) typical group. The research economic advantage of this approach is the relatively low-cost data collection in a few case study enterprises and/or by expert assessments, supplemented by secondary data. The approach is already successfully applied in agriculture and fisheries worldwide (Deblitz et al., 1998; Lasner et al., 2016; Chibanda et al., 2020; Lasner, 2020).

Due to the corona situation, a "fast-track approach" (Deblitz et al., 1998) was applied for defining and for collecting data on the typical SSPFE, with its characteristic management measures and economic key figures, in each ValoFor partner country. For this purpose, a typical SSPFE per country was first pre-defined from literature research and a profile was created for it (Table 1). Furthermore, a simplified and standardized operational accounting sheet for forest management was developed for all partner countries (Table 2), based on the operational accounting sheet of the German forest accountancy data network and including natural and economic key figures. For the simplified operational accounting sheet, the following cost centers structured in operational activities were chosen: forest protection, forest infrastructure, regeneration, pre-commercial thinning, thinning and final felling. Further, we classified a cost center for consulting and support as well as for forest owner associations. In order to reduce the effort for the interview partners, all other costs were subsumed in the position "remaining fixed costs".

The operational accounting sheet was pre-filled as far as possible by in-depth data research in literature, statistics and websites of forestry stakeholders. In the next step, by means of 14 in-depth expert-interviews, the pre-defined data was discussed and adapted were necessary and data gaps were filled. These interviews were conducted online in the year 2021 with a representative of a forest owners association, a forestry association and of forest economic science in each country. After the synoptic evaluation of the collected key figures, they were validated again by the national experts and the project partners. The key economic figures were, in a next step, used for a calculation of the contribution margins and the net yields.

3 RESULTS

3.1 Country profiles of the typical SSPFE forest enterprises

Table 1 shows the country profiles of the typical SSPFE developed in this way. The typical SSPFE in the five ValoFor project partner countries show similarities and differences. Noteworthy are the significant differences in the definition of SSPFE by forest area in the Scandinavian countries (35 ha and 50 ha) and the Central European countries (1.5 ha to 5 ha). Due to the different ownership sizes, the opposite is true for the relative own consumption of raw wood (depicted as share of total harvest). This is relatively low for Scandinavian SSPFE (5% to 10%) and significantly higher for Central European SSPFE (30% to 50%).

Table 1. Characteristics of typical SSPFE in the five ValoFor partner countries.

	Finland	Sweden	Germany	Austria	Slovenia
Forest area	35 ha	50 ha	2.5 ha	5 ha	1.5 ha
Forest owner	Sole owner or family ownership	Family ownership or multiple owners	Sole owner or family ownership	No information available	Fragmented with about three parcels, several owners.
Relation to agriculture	Hardly any agricultural background	No agricultural background	No agricultural background	With agricultural background	No agricultural background
Operational goals	Interested in forestry income, but not dependent on it	Interested in forestry income, but not dependent on it	Low economic orientation	Interested in forestry income, but not dependent on it	Low economic orientation
Own consumption (share of total logging)	5%	5-10%	30%	40%	50%

Forest infrastructure (maintenance and new construction)	Maintenance of forest roads by service providers	Maintenance of forest roads by service providers; annual fee according to cutting volume	Investments in forest roads only irregularly	No information available	Maintenance of forest roads by public service providers; annual charge
Regeneration	Artificial regeneration by service provider	Artificial regeneration by service provider	Natural regeneration supplemented by planting in own activity	Natural regeneration supplemented by planting in own activity	Mainly natural regeneration
Pre-commercial thinning	service provider	motor-manual; own activity	motor-manual; own activity	motor-manual; own activity	motor-manual; own activity
Thinning and timber felling	Clearcutting; highly mechanized timber harvesting; Service provider	Clearcutting; highly mechanized timber harvesting; Service provider	Single log harvesting; motorized (manual) harvesting; own activity.	Single log harvesting; motorized (manual) harvesting; own activity.	motorized (manual) harvesting; own activity.
Timber marketing	Stumpage sale to wood processing companies	Stumpage sale to wood processing companies	Delivery sale „at the forest road", from forest owner directly to wood processing companies	Delivery sale „at the forest road", from forest owner directly to wood processing companies	Delivery sale „at the forest road", from forest owner directly to timber merchant
Member in Forest Ownership Association	Yes	No, but long-standing relationship with companies	No	No	No
Consultation	Forest Owner Associations, Service providers	Forest Owner Associations; wood processing companies	Forest Service	Chamber of Agriculture	Forest Service
Additional costs	Fee for Forest Owner Association, marketing costs	Consulting and support	Consulting and support	--	--
Remaining fixed costs	Insurance, administrative expenses, depreciation	Insurance	Insurance, taxes, administrative costs	Insurance, taxes, administrative costs, fee for Chamber of Agriculture	---

Similarly, in terms of timber harvesting and sales, highly mechanized harvesting by service providers and stumpage sales of raw timber are common among Scandinavian SSPFE, while motorized harvesting by own activity and delivery sales at the forest road are considered characteristic among Central European forest enterprises. In order to establish comparability between these two groups, delivery timber sales were also calculated for the Scandinavian SSPFE in Table 2. Also, the own consumption in Table 2 was valued at market prices. Except for Austria, the typical SSPFE in all ValoFor countries have in common that there is no/hardly any agricultural background anymore.

3.2 Comparison of key figures of typical SSPFE

Table 2 presents the results in the form of a contribution margin accounting for an average hectare and cubic meter in each country. In Finland and Sweden, there are no direct property tax and Chamber of Agriculture levies; instead, these are collected via an increased income tax rate, which complicates the comparison between the countries. A direct comparison of subsidies and government support between countries is also limited, as some measures receive indirect public support and do not reflect actual costs. Future forest management in SSPFE was modelled by the ValoFor project partners based on national inventory data and using country specific forest growth models. The typical SSPFE are therefore based on the tree species and age class distribution in the national average small private forest. Stands were assumed to be managed on a regular basis (i.e., no intermittent management). As a result, Table 2 shows the (future) potential volume of raw logs of a "status quo management" rather than actual raw logging.

- Logging: In the "status quo management", modeled by the project partners, Germany and Austria showed the highest volume of raw wood with 8.2 and 7.2 m^3/ha/a, respectively. The Scandinavian countries and Slovenia ranged at 3.5 - 4.4 m^3/ha/a. The economic indicators per hectare are therefore significantly influenced by the amount of raw wood. However, when interpreting the total operating result, the forest area size of typical SSPFE should also be considered.
- Revenues: The highest timber revenues were achieved by the typical SSPFE in Austria with 471 €/ha/a (66 €/m^3) followed by Germany with 464 €/ha/a (57 €/m^3). For Finland, Sweden and Slovenia, timber revenues of 41 - 42 €/m^3 were calculated. In relation to the hectare, this results in 186 €/ha/a (Sweden), 149 €/ha/a (Finland) and 144 €/ha/a (Slovenia).
- Costs: The costs for stand establishment were highest in Germany and Austria, which is due to own work and a high imputed entrepreneurial salary (33 €/h and 25 €/h). In Finland and Sweden, only low costs are listed for establishing a stand, as service providers offer efficient planting procedures. The lowest stand establishment costs were reported in Slovenia, as this is mainly based on natural regeneration and subsidized by the state.
- The highest harvesting costs in the final felling were recorded in Austria with 263 €/ha/a (46 €/m^3), followed by Germany with 151 €/ha/a (28 €/m^3). The high harvesting costs in Austria are due to high logging costs in steep slope terrain and a high imputed entrepreneurial salary for own work. In Finland and Sweden, imputed harvesting costs are lowest at 25 €/ha/a (10 €/m^3) and 28 €/ha/a (11 €/m^3), respectively, primarily due to highly mechanized harvesting

methods used by service providers. Slovenia is in the middle of the five countries with 57 €/ha/a (18 €/m^3).

- The highest total costs were incurred in Austria at 402 €/ha/a. In Germany, the calculated total costs were 343 €/ha/a. In Finland and Sweden, the total costs are in the middle range with 98 €/ha/a, and 92 €/ha/a, respectively. The lowest total costs were in Slovenia with 70 €/ha/a.
- Net yields: The highest net yields were achieved in Germany with 125 €/ha/a (15 €/m^3), which is primarily due to the felling amounts. In Sweden, net yields of 94 €/ha/a (21 €/m^3) were calculated for the typical SSPFE. In Finland, the lowest net yields per hectare were achieved with 55 €/ha/a (15 €/m^3). The main factors influencing this are the low timber revenues per hectare, due to the low volume of raw timber, and the comparatively high fixed costs. The highest timber revenues were achieved in Austria. Due to the high total costs for forest management, this country, with 76 €/ha/a (11 €/m^3) net yields, is only in the middle of the ValoFor country comparison. Slovenia recorded the lowest average felling, but management costs are heavily subsidized and there are no significant fixed operational costs. However, with 74 €/ha/a (21 €/m^3) net yields, a comparable result to Austria was achieved.

Table 2. Simplified operational accounting sheet of typical SSPFE in the five project partner countries (including own consumption valued at market prices).
Notes: In italics and gray are shown the key figures for a stock sale of raw wood. For the calculation of costs per m^3, average costs for final felling and thinning are assumed. Proportionate costs for end-use and thinning are used to calculate the sum of variable costs of timber revenues per m^3. (see next page)

	Finland		Sweden		Germany		Austria		Slovenia	
I.) Raw wood potential	**m^3/ha**		**m^3/ha**		**m^3/ha**		**m^3/ha**		**m^3/ha**	
Average amount from thinning	1.2		1.9		2.8		1.4		0.3	
Average amount from final felling	2.4		2.5		5.4		5.7		3.2	
Total amount of timber	**3.6**		**4.4**		**8.2**		**7.2**		**3.5**	
II.) Income	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**
Timber production	149	42	186	42	464	57	471	66	144	41
	105	29	124	28						
Subsidies	4	1	-	-	4	0.5	7	1	-	-
Total income	153	43	186	42	468	57	478	67	144	41
	108	*30*	*124*	*28*						
III.) Costs	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**
Forest protection	-	-	-	-	-	-	-	-	1	0.3
Forest infrastructure	2	0.4	11	3	-	-	-	-	4	1
Regeneration	13	4	8	2	46	6	41	6	2	1
Pre-commercial thinning	5	1	3	1	5	1	-	-	-	-
Final felling	44	12	62	18	229	28	329	46	63	18
	-	-	-	-						
Subtotal of costs	**64**	**18**	**84**	**23**	**280**	**34**	**370**	**52**	**69**	**20**
	19	*5*	*22*	*5*						
Consulting and support	-	-	2	1	15	2	-	-	-	-
Forest Management Association	-	-	-	-	-	-	-	-	-	-
Annual fee	2	1	-	-	-	-	-	-	-	-
Timber marketing	4	1	-	-	-	-	-	-	-	-
Subtotal of costs	**6**	**2**	**2**	**1**	**15**	**2**	**0**	**0**	**0**	**0**
Remaining fixed costs	28	8	5	1	48	6	32	4	0	0
Total costs	**98**	**28**	**92**	**21**	**343**	**42**	**402**	**56**	**70**	**20**
	54	*15*	*30*	*7*						
IV.) Total revenues	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**	**€/ha/a**	**€/m^3**
Contribution margin	**105**	**30**	**124**	**28**	**235**	**29**	**142**	**21**	**81**	**23**
Net yield	**55**	**15**	**94**	**21**	**125**	**15**	**76**	**11**	**74**	**21**

4 DISCUSSION AND CONCLUSION

With this pilot study, the "typical enterprise approach" in SSPFE was applied in several European countries for the first time. Based on the collected data and modelling of a status quo forest management, it was also possible in the ValoFor project to further evaluate the impacts of alternative forest management scenarios in a comparative manner. The approach of the "typical forest enterprise" offers a promising possibility to realize forest economic impact assessments for ongoing EU policy processes with reasonable effort (e.g., EU biodiversity strategy). For this purpose, it would be desirable to establish a permanent, international, forestry indicator network, which in particular also allows time series analyses. There is a need for research, among other things, in the delimitation and identification of different national forms of indirect subsidization of small private forests.

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Environmental Accounting in the Slovak Republic: Assessing the Current State and Exploring Potential Applications in Forest Enterprises

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ABSTRACT

Not only financial indicators, but also non-financial information related to the fields of ecology, sustainability, or ethical business, are currently of interest to stakeholders both within and outside the business. Environmental accounting is a multidimensional discipline that integrates economic and environmental data. The goal of this article is to propose the implementation of innovative environmental reporting procedures in accordance with the requirements of EU Directive 2014/95/EU, as amended by Directive (EU) 2022/2464, in Slovak forest enterprises. The analysis reveals a number of challenges associated with the implementation of environmental accounting. These challenges encompass the absence of standardized and consistent methodologies for conducting environmental accounting, the complexities involved in accurately measuring and valuing environmental impacts, and the pressing requirement for more comprehensive and dependable data concerning environmental costs and benefits. Moreover, results indicate potential resistance to change and limited acknowledgment of environmental accounting's pivotal role in management and decision-making.

KEYWORDS

Environmental accounting, reporting, forest enterprises, non-financial information, sustainability

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Financing of national parks in Serbia in period 2008-2020: analysis of financing mechanisms and trends

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ABSTRACT

Management of protected areas includes interaction of different components, strategic, legislative and institutional frameworks, towards structural characteristics and financing mechanisms. The importance of protected areas is very significant since they include different forest ecosystems and is intended for protection of biological, geological and cultural features. One of the important components of protected areas management is sustainable financing, which is defined as the ability to provide sufficient, stable and long-term financial resources. Protected areas cover around 6.5 % of territory of Serbia while national parks (NP) involve around 31.0 % of this land. This research analyses different financing mechanisms/revenue structures (EUR/ha) in managing four NP as well as approaches in the financing in the region and abroad. In order to determine the structure of revenues in the financing, statistical technique based on analysis of time series for 13 years is used while non-reactive method is used for data collection. The results show that NP "Tara" has the highest average incomes (171.9 EUR/ha), while NP "Đerdap" lowest average incomes (31.0 EUR/ha). Looking at the revenues structure, business revenues are highest for all four NP, NP "Tara" (147.8 EUR/ha) and NP "Đerdap (17.1 EUR/ha). On the other hand, revenues from other business revenues, I.e., fees, are highest within NP "Kopaonik" (24.0 EUR/ha) and lowest for NP "Đerdap" (10.6 EUR/ha). By analyzing annual exponential growth rate, results of this research show that the highest level of exponential growth rate are present within revenues from fees for all NP and that NP "Kopaonik" has the highest indicator (11.2 %), opposite to NP "Đerdap" (5.3 %). Based on these results, we can conclude that in all NP

in Serbia revenues from business activities mostly are present in their management, but growth rate for fee revenues is highest and has the potential to increase more. This is somehow in correlation with the financing of protected areas in Europe and especially NP, since their financing management should mostly rely on fees and project activities/donations. Recommendations for improvement include development of a better system for increasing fee revenues and project activities/donations both from domestic and international side.

KEYWORDS

Protected areas, national parks, financing mechanisms, Serbia

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The economic outcomes of high pedunculate oak (*Quercus robur* L.) forest management in Croatia

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ABSTRACT

Pedunculate oak (*Quercus robur L.*) is an important economic species in forestry and in forest-based industry in Croatia because it covers 4.07% of the total forest area (105,090 ha). This species is highly susceptible to changes in habitat conditions that occur due to unfavourable biotic and abiotic factors. In changing climate conditions, as well as in disrupted ecological balance, the vitality of pedunculate oak stands is impaired. The signs of decay are becoming visible, and are manifested through impaired tree vitality, irregular and increasingly low seed yield, and impaired natural regeneration of forests. Difficult conditions have a long-term effect on the decrease of yield and the increase of management costs. Therefore, this study analyses the economic components of sustainable forest management as a long-term investment, including Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP) and Discounted Payback Period (DPP). According to the calculation parameters used, it is not justified to invest capital in an investment with the estimated values of the stands and the prescribed rotation of 140 years.

KEYWORDS

Economic valuation, long-term investment, revenues, costs, oak stands

1 INTRODUCTION

Pedunculate oak is a climatogenic species and it forms permanent forest communities. Due to changes in habitat conditions, the dieback of oak significantly affects the quality and consequently the value of assortments. Oaks are threatened by the oak lace bug (*Corythucha arcuata*), a pest which was first recorded in Spačva forests in 2013, and was transmitted by global transport. It originates from North America and has no natural

enemies in Croatia, while no means have proven to be effective enough to suppress its spread. Pedunculate oak stands with even-aged structure compose regular high forests. In the same development stage of even-aged forests, trees are of similar height, diameter, and age (Anić, 2007). The bell-shaped distribution of trees by breast diameters and the clearly expressed horizontal or vertical shape of the assembly characterizes regular management (Čavlović, 2013). According to the first National Forest Inventory, in Croatia, the stand class of floodplain oak forests amounts to 4.07% of the area or 105.09 thousand ha, i.e. it amounts to 13.01% of the growing stock in state and private forests, which is in total 71,830 million m^3. Recently, the economic consequences of the dieback of oak stands (in forestry and wood processing) in relation to the impact of climate change have not been investigated. As stated in the National Report of the Republic of Croatia according to the UN Convention on Climate Change (OG 347/2014), it is necessary to observe long-term resilience, i.e. the natural ability of the ecosystem to adapt as a result of climate variability, extreme weather and natural phenomena (floods, droughts, fires, pests etc.), as well as changes in land use, soil pollution and unsustainable exploitation of natural resources. Further, Nabuurs et al. (2015) are referring on the same postulate when it comes to a role for forests and the forest sector in the EU post-2020 climate targets.

In 2021, Croatian Forests Ltd. performed a prescribed cut in the amount of 6.08 million m^3 of gross wood volume. Deviation by tree species in relation to the average prescribed cut in the General Forest Management Plan for the Republic of Croatia in the period 2016-2025 is present in fir, spruce, field ash and pedunculate oak. Higher than the average prescribed felling for each species is a result of the occurrence of natural disasters and invasive pests, which is both a direct and indirect consequence of climate change. In 2021, the company produced 5.2 million m^3 of wood assortments: 2.3 million m^3 of roundwood, and 2.9 million m^3 of stacked wood for processing and firewood. The largest amount of wood assortments of 1.97 million m^3 were produced from beech, followed by 733,389 m^3 from oak. In 2021, Croatian Forests Ltd. sold 5,617,931 m^3 of wood assortments, including energy wood, and thus achieved sales revenue of 281 million EUR. A significant increase in sales compared to the previous year was achieved in the amount of 409,000 m^3, and sales revenue increased by 26.15 million EUR. In 2021, a huge increase in demand for wood assortments was recorded, especially for high-value assortments such as pedunculate oak and sessile oak (FMP, 2016; Croatian Forests Ltd, 2021).

2 METHODS

Professional services of the state forest company (Croatian Forests Ltd.) established standard technologies for raising stands of individual forest management classes. The cost of raising per hectare is determined by multiplying the price of labour from the price list of works for the accounting year by the multiplicity coefficient for the work and by summing the calculated amounts. For the growing stock above the first age class, the present cutting value method was used. Estimation of the growing stock value by this method is determined according to the value of growing stock with the assumption that everything is cut, made into assortments and sold at average prices established in the

accounting year, minus operating costs. Assortments table and the price list of the main forest products of Croatian Forests Ltd. (2019) are the primary inputs when estimating value.

With each economic component of forest management, the amount of income and expenses incurred in the production cycle should be known in advance (Beljan, 2015). Capital budgeting is the process of making decisions about long-term investments in active business assets of the company. It is a decision-making process, with focus on long-term projects. This process includes forecasting cash flows of projects and evaluating their financial efficiency by applying financial decision-making criteria (Orsag, 2002; Orsag and Dedi, 2011). The subject of capital budgeting are primarily projects that have a long-term character. In the case of long-term projects, the time disparity occurs between the creation and the effect of the investment. Based on the cash flow, an investment analysis of the initial investment is made, and information on the justification of the capital investment is obtained through calculations (Beljan, 2015). Investing in the present is necessarily associated with a certain degree of risk and uncertainty that the expected effect of the project will not be realized as planned, meaning that there is a possibility of accomplishing the project with a certain degree of variability of results (Knoke et al., 2001). In the case of a regular forest that consists of 100 stands and that is managed with a 100-year rotation period, intermediate yield is generated on an annual level, both in young and old stands, including one main yield from the old stands. That is, annually, at the level of the forest, a yield equal to the sum of all yields of one stand over a period of one hundred years is generated. The sum obtained in terms of monetary value is not completely the same due to the time preference of money, therefore the sum at the forest level is significantly higher, depending on the amount of forestry interest rate used.

In order to calculate and present the economic importance of pedunculate oak forests, several basic tools of capital budgeting according to Damodaran (2002) have been applied: Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP) and Discounted Payback Period (DPP). Firstly, the cash flow is created from the data presented in Table 2 and the tools for capital budgeting used. For those that are influenced by the cost of capital (NPV and DPP), the range of discount rates from 0.5 to 5% is used.

3 RESULTS

According to the General Forest Management Plan for the Republic of Croatia in the period 2016-2025, a one-time or a regular management type has been prescribed for the oak stands. Most of the stands of pedunculate oak owned by the Republic of Croatia and managed by Croatian Forests are divided into two management classes: economic pedunculate oak high forests (167,563 ha) and pedunculate oak high forests with special purpose (36,562 ha). The total economic value of the stands of the management class of economic oak high forests, determined by the cost method for the stands of the first age class and the method of the current felling value for the stands of other age classes, amounts to 3.3 billion EUR, out of which around 323.8 million EUR accounts for the growing stock of the first age class, while around 2,884 billion EUR accounts

for growing stock on stumpage. The total growing stock of stands of this management class is around 49.55 million m^3 (296 m^3/ha), and the average stumpage value is 58 EUR/m^3. The largest growing stock is found in stands of age class VI (100-120 years), and the highest value of growing stock is in stands of age class VII, i.e. 120-140 years old (Table 1).

Table 1. The economic value of oak stands (General Forest Management Plan for the Republic of Croatia in the period 2016-2025)

Age class	Area	Wood volume	Total wood volume	Growing stock stumpage value	Total growing stock stumpage value	Raising costs for I age class stand	Total stand value
years	**ha**	**m^3/ha**	**m^3**	**EUR/m^3**	**EUR**	**EUR**	**EUR**
I.	25,124					324682,976	324,682,976
II.	30,122	129	3,885,738	17.65	68,591,566	0	68,591,566
III.	10,068	252	2,537,136	24.29	61,622,654	0	61,622,654
IV.	15,006	342	5,132,052	49.90	256,108,773	0	256,108,773
V.	23,666	407	9,632,062	52.56	506,244,151	0	506,244,151
VI.	35,700	451	16,100,700	58.66	944,523,114	0	944,523,114
VII.	27,877	440	12,265,880	85.34	1,046,779,593	0	1,046,779,593
Total	167,563	296	49,553,568	58.13	2,883,869,850	324,682,976	3,208,552,826

In the stands of the management class of economic pedunculate oak high forests, General Forest Management Plan for the Republic of Croatia in the period 2016-2025 prescribes the average annual cut of previous yield of about 496 thousand m^3 and the average cut of the main yield of about 576 thousand m^3, resulting in a total average annual cut of about 1.07 million m^3. The average annual income from cutting in the stands of this management class is estimated at around 68.5 million EUR, i.e., around 63.8 EUR/m^3 of gross wood volume. The average annual cost of managing stands of this management class is around 45.8 million EUR.

Table 2. Cash flow assessment

Age class	Area	Total average annual cut	Total annual income from cut	Cost of fellings, production and skidding	Total cost of fellings, production and skidding	Total annual costs of silviculture, protection and management	Water fee	Forest fee	Total average annual cost	Economic result
years	ha	m^3	EUR	EUR/m^3	EUR	EUR	EUR	EUR	EUR	EUR
I	25,124		0.00	0.00	0.00	16,232,481.52	50,017.92	0.00	16,282,499.44	-16,282,499.44
II	30,122	120,488	3,502,139.76	23.89	2,878,t.03	823,562.55	59,968.15	185,661.42	3,947,663.15	-445,523.39
III	10,068	40,272	1,827,994.43	18.58	748,301.81	227,163.05	20,043.80	121,224.90	1,116,733.56	711,260.87
IV	15,006	60,024	3,441,551.26	18.58	1,115,317.54	338,578.54	29,874.58	245,210.56	1,728,981.22	1,712,570.04
V	23,666	94,664	6,244,343.75	18.58	1,758,970.07	533,973.06	47,115.27	460,221.91	2,800,280.31	3,444,063.44
VI	35,700	142,800	10,253,474.02	18.58	2,653,394.39	805,494.72	71,073.06	769,294.84	4,299,257.02	5,954,217.00
VII	27,877	614,688	43,239,041.87	18.58	11,421,633.69	873,179.64	55,498.71	3,230,690.69	15,581,002.72	27,658,039.15
Total	167,563	1,072,936	68,508,545.09	0.00	20,576,088.53	19,834,433.07	333,591.48	5,012,304.33	45,756,417.41	22,752,127.68

When observing the results (Table 2) on the economic outcomes, it is evident that economic result of forest management in the first two age classes (I and II) is negative. Furthermore, as the age of the stand increases, the dimensions of felled timber have higher selling price. All of this affects the economic result of forest management, which is most profitable in the situation when stands are classified by their age into age-class VII (from 120 to 140 years). However, that kind of economic calculation neglects the time preference of monetary values (Price, 2011).

Table 3. Investment analysis results

Valuation parameters	Discount rate (%)					
	0.5	1	2	3	4	5
NPV (EUR/ha)	142.34	-216.94	-512.24	-601.70	-631.01	-641.44
IRR (%)	0.66					
PP (years)	121					
DPP (years)	123	127	137		140<	

When the range of discount rates (from 0.5 to 5%) has been applied positively and negative net present values are revealed. The only calculation that can be considered as a good investment is the one with the minimal cost of capital (only 0.5%). All other types can be considered as an investment that will end in negative figures. Moreover, the internal rate of return equals only 0.66% and in comparison, to other low rate of

return investment possibilities (i.e., latest issued Croatian government bonds in year 2023 ensure return of 3.25%) seems relatively modest. Due to the long time period of this particular investment analysis, it should be clear that 1€ invested today will be worth 2.51€ in 140 years (according to the formula for calculating compound interest). Invested capital will be more than doubled, but the time preference is not an advantage when investing in forestry. Resulting values of payback period and the discounted version of payback period confirm that.

4 DISCUSSION AND CONCLUSION

The presented economic figures on the management of pedunculate oak forests in Croatia are neglecting the costs of forest land purchase. Since the state company Croatian Forests Ltd. manages state-owned forests, i.e. forests that it was given for management, acquisition does not take place. This is especially important in business when it comes to commercial forestry in developed market-oriented countries (Posavec et al., 2020). If the calculations in this research considered the mentioned cost, it is to be expected that all of the economic indicators would be negative. Compared to a similar study related to high oak forests performed by Beuk (2012), it is clear that the internal rate of return is reduced from 1.98% to 0.66% (in nominal terms). The reason for this is the calculation of log prices below the market levels. In situation where the government supports wood processing industry with regulated raw material prices, this influences sustainable forest management and economic performance of state forest companies.

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2

Cross-sectoral policy analysis

: Forest genetic resources and forest reproductive material at the cross-section of multiple policy domains in Europe

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ABSTRACT

Conservation, management, and use of Forest Genetic Resources (FGR) and their related forest reproductive materials (FRM) are of key importance for fostering the resilience of forest ecosystems. FGR and FRM issues in Europe are facing several gaps related to their integration in policies, improper policy instruments, insufficient financing, siloed knowledge, uneven policy implementation, and limited monitoring. While FGR are increasingly acknowledged as an integral part of biodiversity, embedding them under this wider concept may lead to poor recognition of the relevance and specificities of FGR, and the exclusion of FRM specificities. Within the 5-years Horizon Europe project OptFORESTS, we aim to identify policy gaps pertaining to FGR and FRM and what leverage points to use to overcome them. As a first goal, we intend to explore how FGR and FRM are addressed by current European policies, by analysing domains that directly and indirectly influence FGR. Our preliminary results indicate that there are at least five relevant policy domains to consider, thus broadening the traditional, "siloed" approach that typically focuses on forest policy. To identify leverages for unlocking the potential of FGR and FRM for a more resilient environment and society, we propose a four-partite division of the policies based on their relation to FGR, thus providing a better understanding of what policies will be key for future actions.

KEYWORDS

Forest genetic diversity, forest biodiversity, sustainable forest management, policy gap analysis, FGR, FRM

1 FOREST GENETIC RESOURCES AND FOREST REPRODUCTIVE MATERIAL IN EUROPE

Forest genetic resources (FGR) are the heritable materials maintained within and among tree and other woody plant species that are of actual or potential economic, environmental, scientific, or societal value (FAO, 2014). They include the genetic diversity inherent in seeds, standing trees, and entire forests, within and between species and populations (EUFORGEN, 2021). FGR allow forest tree species to adapt and evolve over time and in space, making the basis of forest biodiversity at the genetic, species, and ecosystem levels. As such, FGR play a key role in the long-term survival of a species and the stability of forest ecosystems, providing the basis for tree growth, adaptation, and evolution and underpinning a wide range of ecosystem services, such as wood production, carbon sequestration, and water regulation (FAO, 2014; EUFORGEN, 2021).

There are between 120 and 200 major forest tree species in Europe of which about 100 are partially conserved in about 3500 genetic conservation units with 4000 populations (http://portal.eufgis.org). Selection of suitable genetic resources through selection and breeding programs is vital for producing Forest Reproductive Material (FRM) - seeds, plants, and parts of plants of tree species - which is used in forestry to establish and regenerate forests (EUFORGEN, 2021; European Commission, 2023a). In turn, ensuring proper FRM is vital for safeguarding sufficient genetic diversity and sustainable management of future forests. Thus, both FGR and FRM are essential components of forest ecosystems and are

"valuable for present or future human use, and thus an invaluable asset and a cornerstone of sustainable forest management" (de Vries et al., 2015, p.v).

To ensure sustainable conservation, management and use of FGR, and their FRM, various initiatives and actions have been taken over the course of time, at the international, national and regional levels. These include the development of frameworks and policies that specifically address FGR conservation and management, such as the Pan-European strategy for genetic conservation of forest trees, and the establishment of a core network of dynamic conservation units (de Vries et al., 2015), as well as Forest Genetic Resources Strategy for Europe (EUFORGEN, 2021). Certain efforts are also made to improve the integration of FGR considerations into existing policies and frameworks related to forest management, biodiversity conservation, and climate change mitigation, such as the EU Biodiversity Strategy (European Commission, 2020).

Recent studies show that considerable time and effort are made in developing and testing forest genetic indicators as part of Sustainable Forest Management (SFM) criteria and indicators processes and forest certification schemes (Graudal et al., 2020). Recently, Lefèvre et al. (2020) proposed an indicator to monitor the status and the changes in FGR in Europe, which was adopted by the Forest Europe Process in 2021 in its Bratislava Ministerial Declaration (Forest Europe, 2021). In addition, Hoban et al. (2021) point out that genetic diversity (including forest genetic diversity) is considered important but interpreted narrowly in country reports to the Convention on Biological Diversity while stressing the importance of including state, pressure, response, and effect indicators for FGR. Furthermore, additional policies developed by other sectors (e.g., agriculture, energy, and trade) have also addressed many forest-related issues, thus being relevant for FGR or FRM. All these policy instruments have direct and indirect implications for the forest sector. "Within the forest sector, the conservation and use of forest genetic resources is one of the topics that have remained at the crossroads of many global, European, and national policies. This means that various policies often influence the conservation and use of forest genetic resources in one way or another, even if the policies themselves do not specifically target forests or genetic resources" (Bouillon et al., 2015).

Indeed, as the efforts to conserve, protect, sustainably manage and use FGR were facing challenges such as limited financing, uneven implementation of strategies on national levels, as well as the need for research, persist. While the FGR and FRM policy research and practice tended to focus mostly on the policies from forestry, biodiversity, rural development, and agriculture which directly address FGR or FRM, it might tend to oversee other policy domains and policies not directly addressing, but still influencing the state of FGR or FRM (i.e. employment and social policies, innovation policies) and thus identify structural policy gaps as potential deep leverage points (e.g., Kim, 1994; Meadows, 2008; Abson et al. 2017; Sterman, 2000) which could be used for strategic interventions. Starting from the premise that FGR are a basic constitutive part of forest tree species and ecosystems underpinning biodiversity, adaptation, and resilience of forests and other social-environmental systems, our contribution illustrates the complexity of polycentric forest governance based on the case of FGR in Europe. More specifically, our research aims to identify policy gaps that could be used as deep leverage points for ensuring sustainable management and use of FGR and FRM in Europe.

2 SYSTEM COMPLEXITY, LEVERAGE POINTS, AND POLICY GAPS

In complex systems (Plummer and Armitage, 2007), leverage points are points for strategic intervention that have the potential to change or influence the system's behaviour significantly (Abson et al., 2017; Meadows, 1999, 2008). They can be seen as the doors of opportunity for targeted actions that can result in substantial and lasting impacts (Sterman, 2000). Meadows (1999) identified policies as one of the higher-level leverage points within systems, as policies shape the behaviour of systems by establishing guidelines and regulations that influence the actions of individuals, organisations, and institutions. Abson et al. (2017) highlight that policies act as strategic interventions that can modify the rules, regulations, and incentives within a system to steer it toward more sustainable trajectories. Policies can target specific leverage points within a system to influence the underlying structures or parameters that drive system behaviour. By identifying and understanding the leverage points within a system, policy makers can develop policies that influence the system's behaviour (Kim, 1994) and drive transformative changes toward sustainable management and the use of FGR and FRM. European forests, as well as FGR, are characterized by high diversity, not only in the sense of genetic diversity but also the diversity of site conditions, forest management practices, as well as cultural, economic, and policy conditions. In our research on the European level, we were interested in policy integration notably across broad EU environmental, agricultural, social and economic policy domains.

3 METHODS

Within the OptFORESTS project, we are conducting a multiple, mixed method case study (Yin, 2009) on a European level focusing on the European policies, as well as the policies of eight partner countries (IT, FR, SI, RO, FI, SW,ES, NW), being interested in any policy domain and with it associated policies that might address FGR and FRM directly (e.g. Legislative proposal on the production and marketing of forest reproductive material in the Union (EC, 2023b), indirectly (e.g. referring to biodiversity, forests, or landscape restoration like in proposal of new European Nature Restoration Law), or potentially (e.g., by being relevant for engagement of broader "forest community"), and that were not analyzed within the previous studies (e.g., Lovrić et al., 2023; Guierde et al., 2008). In our research, we use policy gap analysis (PGA) as a method (Hoberg et al., 2016; Maniak-Hesser et al., 2021) focusing on regulatory gaps (Gjerde et al., 2008). The first step of PGA is establishing the current policy state by identification of potentially relevant policy domains and the latest current and forthcoming policies of European programming. With that purpose, we conducted desktop research[1] and a literature review to identify potentially relevant policies and policy domains. For identifying policies and domains, we took a broader system perspective guided by the EU's overall political goals, as well as existing Directorates-General and topics under them (https://european-union.europa.eu/priorities-and-actions/actions-topic_en). The full list of potential domains was narrowed to eight policy domains and their respective policies (see Table 1 in the Result section) following three criteria: i) addressing FGR and/or FRM explicitly (e.g. forest genetic resources, gene pool, etc.); ii) addressing FGR and/or FRM implicitly (e.g.

[1] In progress: planned period April – September 2023

as forests and/or biodiversity and/or nature); iii) relating to FGR and/or FRM implicitly. For each criteria, a list of keywords was defined. The preliminary list of policy domains and identified policies was presented to internal OptFORESTS experts with a two-fold purpose: 1) to complement the list with potentially overlooked policies and regulations; 2) to identify those they perceive most relevant for sustainable management and use of FGR and FRM on the European as well as national levels. The initial list of 56documents was revised based on feedback from internal experts, and a final list was created to be further used in the research and selected policies will be analysed using qualitative content analysis (Mayring, 2014).

4 RESULTS

As the research is in an early stage, our preliminary results focus on system mapping of potentially relevant policy domains and with them related policies on the European level. Based on the desktop research and a literature review, there are eight policy domains that are relevant for sustainable management and use of FGR and FRM. Within them, we identified total 56 polices potentially relevant for FGR or FRM, examples of which are provided in Table 1.

Table 1. Identified policy domains, subdomains, and example policies potentially relevant for sustainable conservation, management and use of FGR or FRM

Domain	Subdomain	Example policies (non-exhaustive list)
Agriculture and rural development	Forestry Agriculture Rural Development	The new EU Forest Strategy 2030 The guidelines on Biodiversity-Friendly Afforestation Reforestation, and Tree Planting The 3 billion trees initiative The new Common Agriculture Policy (CAP); Farm to Fork Strategy
Environment	Nature and biodiversity Soil and land Urban environment Water Air Marine and coastal environments Chemicals	The European Green Deal The forthcoming new Nature Restoration Law Bio-economy Strategy EU Flood Directive Directive 2000/60/EC - framework for Community action in the field of water policy Directive 2007/60/EC Urban Agenda for the EU

Health and Food safety	(e.g. protect the health of crops and forests)	Regulation (EU) No 1143/2014 Regulation (EC) 1830/2003EN Legislative proposal on the production and marketing of FRM (COM(2023) 415 final)
Energy and climate	Industry and energy Climate	The new EU Strategy on Adaptation to Climate Change EU Climate Law 2050 Long-term energy strategy (EU/2018/1999 Renewable energy Directive Industrial strategy and raw materials alliance
Economic and financial affairs	Business and industry	Circular economy action plan A sustainable bioeconomy for Europe: an updated bioeconomy strategy European industrial strategy Entrepreneurship and small business
Trade	Internal market International trade	Council Decision 2008/971/ EC on the equivalence of forest reproductive material produced in third countries Council Directive 1999/105/ EC on the marketing of forest reproductive material Regulation (EC) 1946/2003 on transboundary movements of GMO.
Employment, Social Affairs, and Inclusion	Employment and labor Social affairs	Employment and Social Innovation (EaSI) programme REGULATION (EU) No 1296/2013; The New European Bauhaus Initiative
Research and innovation	Research Innovation Informatics	Horizon Europe General Union Environment Action Programme to 2030 A renewed European Agenda for Research and Innovation New EU Artificial Intelligence Regulation.

Source: own elaboration

5 DISCUSSION AND CONCLUSION

As our research is in an early stage, our discussion and conclusion are related to the preliminary mapping of relevant domains and policies. Our results further indicate that eight identified domains and respective policies can be categorized by their sensu relation, by which we understand the manner by which they relate to FGR:

1. policies sensu eminenti (most significant policies) - explicitly regulating conservation, management, and use of FGR;
2. policies sensu stricto (in the strict sense) - policies explicitly regulating management and use of FRM;
3. policies sensu lato (in the broad sense) - policies explicitly relating to FGR & FRM;
4. policies sensu amplo (in ample sense) - policies implicitly relating to FGR & FRM.

Based on the previous research (i.e., Graudal et al., 2020; Kramer et al., 2016; Kelleher et al., 2015; FAO, 2014; Lefèvre et al., 2013), the most common policy gaps identified so far are: fragmented policies and regulations, uneven national implementation, unsuitable instruments, lack of coordination mechanisms, over-regulation. Those policy gaps are related to policies from mostly forestry and biodiversity sub-domain, as well the sub-domain of rural development and health. As they are belonging to policies sensu eminenti and sensu stricto, it indicates that mostly internal policy coherence from the three to four policy sub-domains was addressed (forestry, biodiversity, rural development, health), while external and broader policy coherence remains under-researched.

Regardless of the early stage, our contribution already illustrates the complexity of forest governance on the European level, based on the mapped policy domains and potentially relevant policies on the country level for sustainable management and use of FGR and FRM. While policies belonging to agricultural and rural development domains were predominantly analysed until now, we strive to provide a broader, systemic picture of eight European policy domains and their sensu relation to FGR and FRM. In this way, our contribution highlights some of the relevant but under-investigated policies for sustainable management and the use of FGR and FRM. For better integration of FGR and FRM aspects in the European Union policy framework, increased efforts in policy coherence, including both context-dependent and deliberated integration and coordination within and across policy domains, as well as better deployment of existing policy instruments (especially from sensu lato and sensu amplo policies) are needed.

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Impacts of Nature and landscape protection Act on forest management in Slovakia

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ABSTRACT

Nature conversation policy in Slovakia is focused on territorial and species protection. Nature protection is regulated by the Nature and landscape protection act. This regulation framework also affects forest policy and applies to forest management. The implementation of nature protection has a cross-sectoral character and oftentimes restricts forest ownership rights. Therefore, the scientific goal of the paper was to analyse the impact of specific legislative changes of the Act on Nature and Landscape Protection on forest management practices. We analysed 36 essential amendments to this act, defined the changes, and described their impact on forest management or owner. The most amended part of the act was the implementation of mandatory compensation payments for legal restrictions and forest management regulations at individual levels of nature protection. The most current amendment has changed the administration of national parks, which mainly affected state-owned forest land.

KEYWORDS

Forest policy, nature protection, cross-sectoral impacts, compensation payments

1 INTRODUCTION

The country's historical, political, economic, and social factors influence forest management. The events after 1989, when Slovakia started its separation from Czechia and formed an independent state, radically affected the field of nature protection among others. The most significant change was the creation of a separate Ministry of Environment in 1992 and introduction a new Act on Nature and Landscape Protection nearly ten years later (Burkovský, 2006).

Nature and landscape protection is secured in Slovakia by territorial and species protection. The dominant form of protection is the territorial protection provided through the system of protected areas. Species protection is applied irrespective of the type and category of the protected area, i.e., applies throughout the whole territory of Slovak Republic. Protected areas are divided into "National Network of Protected Areas" and "NATURA 2000 areas". These areas make up almost 50% of the forest area under the management of state forest enterprise Lesy SR. Compared with the whole Slovak territory, protected areas cover more than 23% of it. It means that almost one-quarter of the Slovak territory falls within areas with some nature and landscape protection. With such an extent of protected areas, the Slovak Republic is at the top of all European countries. In other European countries', areas of nature and landscape protection are much smaller (Forest Europe 2020; Šulek and Šálka, 2007).

Restrictions on forest owners' rights in the protected areas arise from the nature protection law and cause a discourse between forest and environmental stakeholders. This currently points to the more than twenty-year struggle of non-state forest owners in the Slovak Republic for proper compensation for the restrictions on forest management due to nature protection requirements (Šálka et al., 2015). The Nature and landscape protection Act tries to solve this issue through environmental policy instruments (Kovalčík et al., 2012).

We consider Act No. 543/2002 Coll. on Nature and Landscape Protection, as amended, the most important law outside the forest policy. Therefore, the paper aims to analyse the impact of specific legislative changes of this Act on forest management and forest ownership rights.

2 METHODS

Regulatory instruments, including laws, decrees, and regulations, determine how certain target groups should act. They prevent forest owners and managers from acting, which could restrain environmental goals in forests (Krott, 2005). Nature protection implementation as a national goal is secured through Act no. 543/2002 Coll. on Nature and Landscape Protection, as amended.

We used document analysis in legal research to reason and interpret act paragraphs related to forest owners´ activity in forests. Social studies frequently use document

analysis to analyse interview transcripts, strategic documents, and laws (Rapley, 2018). We analysed the wording of the Act on Nature and Landscape Protection since the first date of the text.

Firstly, we reviewed all amendments to the law. Next, we identified those amendments in which some changes could impact forest administration and/or forest ownership. We also investigated the actors who formulated the new wording of the law.

3 RESULTS

The Act on Nature and Landscape Protection was enacted on 25 June 2002. Since then, it has been amended a total of 36 times. From these changes, we analysed only those that influence forest owners (Table 1).

Table 1. Overview of relevant changes to Act No. 543/2002 Coll. on Nature and Landscape protection, as amended

No. of amendment	Retention date	Identified change	Formulators	Effect
1.	First declared wording	Implementation of the system of protection of the natural species composition of ecosystems, implementation of territorial protection (national and international importance), the introduction of compensation payments for restrictions of the non-state ownership rights (economic instrument) that cover costs on differential management or no management activities due to nature protection (payment per hectare).	Ministry of Environment	Restriction to forest management.
5.	01.05.2004 - 30.06.2004	Financial compensation for the limitation of forest management "as usual" reduced by property damage or other compensation payment following special regulations and the amount of subsidy or contribution from the state budget provided to cover the increased forest management costs compared to normal management (e.g., NATURA 2000 payment).	Ministry of Environment	Implementation of the compensation payments due to the restrictions on forest management.
8.	01.04.2005 - 31.10.2005	The right to compensation expires if the compensation is applied in protected forests and special purpose forests, except forests in protected areas and other parts of forests important from the point of view of nature conservation.	Ministry of Environment	Decreased the compensation payment for the forest owner.

9.	01.11.2005 - 31.01.2006	The right to compensation expires if the compensation is applied in protected forests and special purpose forests, except forests in protected areas and other parts of forests important from the point of view of nature protection; 93b) the right does not expire if the nature protection authority issues a decision not to issue consent, not to allow an exception or a decision with specified limiting conditions and thereby restricts the procedure of the land owner according to special regulations in removing the consequences of extraordinary circumstances and unforeseeable damage in forests. 93c).	Ministry of Environment	Granting compensation payments for forest owners in the case of certain forest categories.
13.	01.01.2009 - 30.04.2010	After approval of the change to the forest management plan (FMP), the owner was entitled to compensation, including reimbursement of the costs of elaboration of the FMP.	Ministry of Environment	Till this time the payment also covered increased costs for the forest owner.
19.	01.01.2014 - 31.03.2014	Compensation is: a) exchange of the forest land for another suitable forest land owned by the state (if possible), b) forest land lease, c) purchase of the non-state forest land by the state, d) contractual care, e) compensation payment.	Ministry of Environment	Changes in methods of compensation – more compensation methods for forest owners.
30.	01.01.2020 - 31.12.2020	An eligible applicant for compensation payment: a) the forest owner; if the owner is the state, the eligible applicant is the administrator of the land, b) a representative appointed by the co-owners (in case of joint ownership), c) forest land community, if the forest is part of joint real estate or jointly managed forest.	Ministry of Environment	Eligible applicants are non-state and state forest owners.
35.	15.01.2022 – 30.11.2022	Transfer of the administration of national parks to the State Nature Conservancy Agency.	Parliamentary proposal	Changed rights to forest administration and management. Changes without participation process and external scientific/ professional expertise.

The Nature and Landscape Protection Act lists five levels of nature and landscape protection. As the law states, the forest owner must apply differentiated forest management practices (or not management at all) at individual levels. The changes in this law, which impact the forest owners most, concern mainly the rights and obligations in protected areas (changes in the management practices) and the compensation payments due to them. The analysed changes brought the development of compensatory payments from simple financial support to expanded compensation possibilities and widened the groups of recipients.

Over the years, the conditions related to the foundation of protected areas and compensation payments for ownership restrictions have been amended. Most of these amendments /seven of eight/ were formulated by the Ministry of Environment.

The first compensations were only financial and covered administrative costs for elaborating the new forest management plan. This was cancelled during the 13th Amendment to the act. The 19th amendment to the law brought about a more significant change in the payment of compensation, which expanded the possibilities of compensation from purely financial compensation to the possibility of land renting, land exchange, selling the land to the state, and contractual care. Another important change was the implementation of compensation in 2020 when the range of eligible applicants was expanded from exclusively non-state owners to managers of forests owned by the state. One of the last amendments (35th out of 36) significantly changed forest conservation and protection management in the Slovak Republic. This amendment was formulated and proposed by a few national parliament members and ratified in abbreviated legislative proceedings. State nature protection authorities are allowed to manage state forests in the territory of national parks. This mainly affected the TANAP State enterprise (Tatra National Park) and Agro-forest property Ulič State enterprise, whose task was to ensure comprehensive and integrated nature protection since its establishment.

4 DISCUSSION AND CONCLUSION

In Slovakia, nature protection is associated with restrictions on forest management practices/activites at individual levels of nature protection, which affects forest owners (Šálka, et al., 2016). This fact has stimulated the long-term emergence of conflicts, mitigated by the compensation payments for ownership rights restrictions. Therefore, its implementation did not work long (Kovalčík et al., 2012).

The forest owners could apply for compensation payments from mandatory legal restrictions related to specific forest management activities (or no intervention at all) in protected areas. The analysed changes to Act on Nature and Landscape Protection were mostly related to this issue. The implementation process of these payments was ineffective and only an amendment to the law valid from 01.01.2014 brought improvement (Báliková, 2020). Establishing protected areas is perceived as the most common source of conflict among stakeholders also in other European countries (Paletto et al., 2019).

The newest change focused on transferring the administration of forest land at national

parks. This issue has stimulated extensive discussions at the national level as well as the emergence of conflicts. Even though this change was announced in the national Strategy of the Environmental Policy of the Slovak Republic until 2030, Envirostrategy 2030 (Ministry of Environment of Slovak Republic, 2018), it came as a parliamentary proposal without an interdepartmental commenting procedure and the participation of other actors (National Council of SR, 2021). The Envirostrategy 2030, approved on February 27, 2019, by Resolution of the Government of the Slovak Republic no. 87/2019, stated that an evaluation of the existing system of land management in protected areas owned by the state in terms of effectiveness, economic, social, and environmental impacts is needed. After in-depth analysis, the evaluation should assess the possibility of achieving integrated management of protected areas. As Pezdevšek Malovrh et al. (2019) also stated various legal, policy, economic and social environmental factors influence the implementation of nature protection policy. Unfortunately, In Slovak case, these factors were not analysed when the amendment was proposed.

The Act on Nature and Landscape Protection is the fundamental document for Slovakia's environmental policy and environmental development goals. The protection of nature has a high priority in the Slovak Republic. Nevertheless, the environmental policy also greatly impacts the forest sector and owners, who must implement related measures. The changes to the law must be prepared following the public dialogue and participation of all stakeholders from forestry and nature protection.

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Investments related to infrastructure and access to forest land – the evaluation analysis

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ABSTRACT

Financial support from the Rural Development Program is an essential economic forestry policy instrument in Slovakia. The study aimed to evaluate the implementation process of measure No. 4.3 Investments to infrastructure and access to forest land from Rural Development Program 2014-2020. The study was methodology based on document analysis and a questionnaire survey. The evaluation analysis was based on qualitative indicators. The results reveal that the measure supported road reconstructions and construction projects, including forest roads and other necessary properties for sustainable forest management. It is effective, and the forest owners were interested in it. Based on the presented evaluation of measure 4.3, we found that this measure fulfilled the expected goals, and the identified implementation shortcomings affected its effectiveness to a very low extent.

KEYWORDS

Forestry measures, Rural Development Program, Slovak Republic, implementation process, evaluation analysis

1 INTRODUCTION

Forestry in Slovakia can be supported by national or structural funds of the European Union (Šulek, 2004). Forest policy belongs to the EU rural development policy, understood as the second pillar of the Common Agricultural Policy (CAP). CAP is constantly evolving to respond to new challenges in national rural and forest areas (Papadopoulos, 2005). Rural development policy deals with the need for multifunctional development of the forest sector and solves complex environmental problems within the European Union (Dobšinská et al., 2013) and is implemented through different measures (Jarský et al., 2014). The forestry measures of the Rural Development Program of the Slovak Republic are an essential economic instrument of forestry policy, as they provide financial support to achieve the goals set in strategic forestry documents, such as National Forestry Program (Jarský et al., 2014). Among many problems that forest policy addresses, the financing of new innovative technologies and forest roads reconstruction have a strong position when speaking about financial support in forestry (Štěrbová and Šálka, 2016).

The area of forest land in Slovakia is 2,025,525 ha with a total length of forest roads of approximately 39,036 km, of which 6,607 km are haulage forest roads of the first class (1L), 15,303 km of second class (2L) roads and 17,126 km of third class (3L), the surface of which is without surface reinforcement (Ministry of Agriculture and Rural Development, 2022). The forest roads must still be built and reconstructed , because to their lower quality and insufficient length (Ministry of Agriculture and Rural Development, 2022; Krykorková et al., 2022). Starting from this consideration, the scientific goal of the paper is to evaluate the European financial support focused on forest road reconstruction in Slovakia.

2 METHODS

The study aimed to evaluate the implementation process of measure No. 4.3 Investments to infrastructure and access to forest land from the Rural Development Programme of Slovak Republic 2014-2020 (RDP). The evaluation method was based on specific criteria adapted to conditions for evaluating forestry measures of the RDP.

The evaluation criteria (Table 1) were chosen from the theory of policy analysis (Windhoff-Heritier, 1987), and the theory of state intervention (Streit, 1991), and the object of the evaluation analysis was the process of measure implementation. Data for indicators evaluation were collected through the document analysis and survey method.

Table 1. Evaluation criteria and data collection

Criteria	Performance (points)			Data collection
	1	2	3	
Administrative difficulty[1]	High	Moderate	Low	Survey for applicants, document analysis.
Implementation gaps[1]	Gaps occur, are relevant and decrease the effectiveness.	Gaps occur but are not relevant to the effectiveness.	Gaps do not occur.	Survey for applicants, document analysis.
Information asymmetry[1]	High – nor implementors and recipients have no information related to the program.	Moderate – implementors or recipients have no information related to the program.	Low – implementors/ recipients have sufficient information about the program.	Survey for applicants, document analysis.
Changes in program parameters during the implementation process	The changes appeared that decreased the program's effectiveness.	The changes did not occur; if yes, this change did not impact the program's effectiveness.	The changes appeared but had a positive impact on the program's effectiveness.	Document analysis.
Program implementation „time lags"	„Time lags" occurred and negatively affected the goal achievement.	„Time lags" occurred but had no/neutral effect on the goal achievement.	„Time lags" did not occur.	Document analysis.
Policy impacts	The goals were fulfilled, but the recipients had no interest in applying for financial support.	The goals were partially fulfilled; the recipients will be interested in applying for financial support.	The goals were fulfilled, and the recipients changed their behaviour and applied for financial support.	Document analysis.
Effectiveness	The goal is achieved in less than 50%.	The goal is achieved between 50% – 75%.	The goal is performed on more than 76%.	Document analysis – quantitative assessment.

Analysed documents were:

- Coll for applications submission no. 1/PRV/2015 from 18.05.2015
- Rural Development Programme of Slovak Republic 2014-2020 (date operation of the statute 16.02.2015)

[1] Criteria specified in more detail through questions for applicants

- Applications received from eligible applicants (total 126 applications; source: Agricultural Paying Agency).

The questionnaire survey was used to map the experience of the eligible applicants while applying for financial support. We analysed three closed-ended related to chosen evaluation criterion:

1. *Administrative difficulty:* How difficult was it to prepare the application?
   a) Exceedingly difficult (e.g., we could not do it ourselves; it took much time; we had to hire new employees and/or allocate exceptional capacities for it; we had hired an external consultant).
   b) Moderately difficult (e.g., we spent much time preparing the application or obtaining permits and information, but we managed it within company employees).
   c) Not difficult (we managed the process with our capacities without a more significant extent).
2. *Implementation gaps:* Did you face problems while applying for measure 4.3? If yes, please choose from the options:
   a) Need more time to submit the application form.
   b) Unclear conditions of the coll no. 1/PRV/2015.
   c) The difficulty of securing the necessary attachments.
   d) Frequent changes in the coll no. 1/PRV/2015.
   e) Weak feedback from the authorities.
   f) Weak feedback from the APA.
   g) Other (please identify)
3. *Information asymmetry:* Did you have enough information in the application process? (Yes/No). Did you have enough information in the implementation process, from the approval of the application to receiving the money? (Yes/No).

The online questionnaire survey is still open; to the date of paper preparation, we have received fourteen completed surveys. We present preliminary results concerning related criteria.

3 RESULTS

Measure 4.3 Investments related to infrastructure and access to forest land from Rural Development Programme 2014-2020 aimed to reconstruct and build forest roads. The eligible applicants for the measure were state and non-state forest owners. The Agricultural Paying Agency of the Slovak Republic (APA) was responsible for the implementation process of measure 4.3. The evaluation analysis revealed the high implementation effectiveness of the measure (Table 2).

Table 2. Results of measure 4.3 evaluation

Criteria	Evaluation	Points
Administrative difficulty	High	1
Implementation gaps	Relevant	1
Information asymmetry	Moderate	2
Changes in program parameters during the implementation process	Yes – positive change	3
Program implementation „time lags“	“Time lags“ occurred but did not affect the goal achievement	2
Policy impacts	The recipients had an interest in the support that exceeded the allocated funds.	3
Effectiveness (goal fulfilment)	Goal: to reconstruct 200 km of forest roads Response: reconstructed 259,902 km and build 14,353 km of forest roads	3
Implementation effectiveness: 0-7 p. (low) / 8-14 p. (moderate) / 15-21 p. (high)		**15** (high)

Application forms for the measure had to be submitted in paper form, on the prescribed form “*Application form for a non-refundable financial contribution*”, with 20 pages. They required 27 mandatory attachments, the applicant’s sworn statement, and a tabular part in EXCEL format. Mandatory attachments also contained several confirmations from various state authorities. The applicants considered administration difficulty moderate (42.86% of respondents) to exceedingly difficult (50.00%). Similarly, as respondents, we evaluate the administrative difficulty as high with one point.

More than half of the respondents faced problems during the application process. They indicated the following implementation gaps: i) The difficulty in providing the necessary attachments (100% of respondents assigned the answer); ii) Unclear conditions of the call (55.56% of respondents assigned the answer) and iii) Weak feedback from the authorities (44.44%) of respondents assigned the answer). We evaluate these implementation gaps as relevant.

It is explicitly stated in the call no. 1/PRV/2023 that APA does not provide individual advisory services in the announced call. From the very wording of the call itself, the degree of information asymmetry on the part of the PPA is obvious, as it requires from the applicants’ various attachments and decisions that need to be requested from multiple public (State Forest Administration, National Forest Centre, courts) and private bodies (banks) to which the PPA does not have access. Conversely, the applicants had enough information (88.89% of respondents answered positively). We evaluated the fulfilment of this criterion with two points.

In the eighth modification of the RDP 2014-2020, the budget for measure 4.3 was increased by 25 million EUR. At this time, the contracting rate was 97%. This change in program parameters made it possible to support even more projects and applicants. We

evaluate this change as positive, which increased the goal fulfilment (evaluation with three points).

According to the schedule, the decision to deny/approve the application should be issued within 140 days from the last possible date for the application delivery, which was, in this case, the 25th of October 2015. The „time lags" were evaluated based on the median time of agreement closure between the eligible applicant and the APA. The analysis of the call and submitted applications revealed that the median time of agreement closure was 156 days (modus value 141 days). The median time from agreement closure till the last part of the payment was 433 days (modus value 390 days). Nine specific cases caused this long implementation time, as agreements were closed too late because of constraints. The delay effect has appeared but has not negatively affected the fulfilment of the goals. We evaluate the criterion with two points.

The APA published one call No. 1/PRV/2015 on May 18, 2015. The APA received 126 applications, and 63 projects were financed. The distribution of successful applicants was as follows: i) 28 micro-enterprises, ii) 18 big enterprises (the branches of LESY SR, state enterprise), iii) 13 small enterprises and iiii) four medium enterprises. We evaluated this criterion with three points; as measure 4.3 fulfilled goals, the recipients changed their behaviour, and their demand was higher than allocated finances.

More than 250 km of forest roads were reconstructed within measure 4.3, and more than 14 km of new roads were constructed. This exceeded the program goal; therefore, we assessed the measure's effectiveness as high, with three points on a scale of one to three.

4 DISCUSSION AND CONCLUSION

High-quality forest road density reduces damage in the forest stands and is essential for implementation close to nature forest management or adverse climate change in soil erosion (Navrátil et al., 2019; Ministry of Agriculture, 2022; Juško et al., 2022). That is why the development of forest roads emerges in Slovak forest policy. As Jarský et al. (2014) concluded, it is evident that financial support from European Union is an important financial instrument for the development of the forestry sector. Therefore, the object of the evaluation analysis was measure 4.3 from RDP 2014-2020. Measure 4.3 was intended to support projects focused on constructing and reconstructing the forest road network in Slovakia.

Objectives of measures set unclearly and not measurable are important factor that reduces their effect (Krott, 2005). The goals of the Measure 4.3 was formulated precisely and clearly, which made it easier for us to make ex-post evaluation.

The results show that there was a high demand for measure 4.3 from the side of the eligible applicants, which exceeded the allocated finances. A total of 126 companies participated in the call, thereof 63 were supported. By the end of 2022, 25,856,846.69 EUR had been paid to applicants. The goal of reconstructing 200 km of forest roads was also met even though the relevant implementation shortcomings appeared. However, we assume that identified deficiencies in submitting applications will help remove barriers for applicants, and the process of implementing the measure will be simplified.

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Associating forest sector's actors to encourage forest management, an urgent response to land abandonment processes: an assessment of the Italian context

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ABSTRACT

This research investigates the phenomenon of forest land abandonment and some solutions proposed to address it. Land fragmentation, poor or missing management, is recognized to be a major issue that hinders forest management in many countries, especially in Southern Europe, and land abandonment is a critical factor that improves exposure to risks related to climate change and their impacts. The paper focusses on the Italian context, where this issue is particularly relevant, first trying to give a quantitative representation of this problem, recurring to some proxy statistical data, since no precise assessment is available, and then describing the organisational solutions available to encourage active forest management and to support the forest supply chain.

KEYWORDS

Land abandonment, fragmentation, associative solutions, associate forest management

1 INTRODUCTION

Land abandonment and ownership fragmentation, often accompanied by uncertainty about landownership, are important and related issues that hinder forest management in some parts of Central East Europe and in Mediterranean Europe (Lawrence et al., 2020), exacerbating the magnitude of impacts and risks of climate change, e.g. forest fires (Rodríguez Fernández-Blanco et al., 2022). Management of small forest parcels is not profitable, many smallholders give it up, and their abandonment accelerates the loss of land value and fosters a vicious cycle that definitively depletes forest-related communities. Various types of innovation have been supported through, e.g., the EU RDP and CAP funds, to consolidate forest properties or to support forest-related supply chains, in order to encourage forest management, including organisational,

institutional and social innovations. The issue of land abandonment, together with the need for redistribution of abandoned farmland, has been a "strong" theme in Italy, in rural development policies, already since the first postwar decades (from the '50s), culminating in Law n. 440/1978, 4 August, which dictated rules for the use of uncultivated, abandoned, or insufficiently cultivated land. More recently, the creation of Land Banks[1] was introduced as an instrument for the reallocation of unused agricultural land (Povellato and Vanni, 2017). Another common policy approach to encourage the management of fragmented forest holdings is based on supporting the establishment of forest associations. This paper aims to provide a summary of the problem of land abandonment, with specific reference to the Italian context, where this issue is recognised as a priority and some important political actions are underway to address it, and to review organisational and contractual solutions aimed at activating the management of forest land.

2 METHODS

The focus on the Italian context was based on a hybrid methodology due to the scarcity of scientific literature on this topic. The first part of the research was built on the analysis of proxy statistical data available from Italian national research institute (ISTAT[2], ISPRA[3]) and the national forest inventory, while the second part, to describe organisational solutions, was completed with an analysis of policy and legislation integrated with a review of national grey literature, carried out following three steps, represented in Fig. 1.

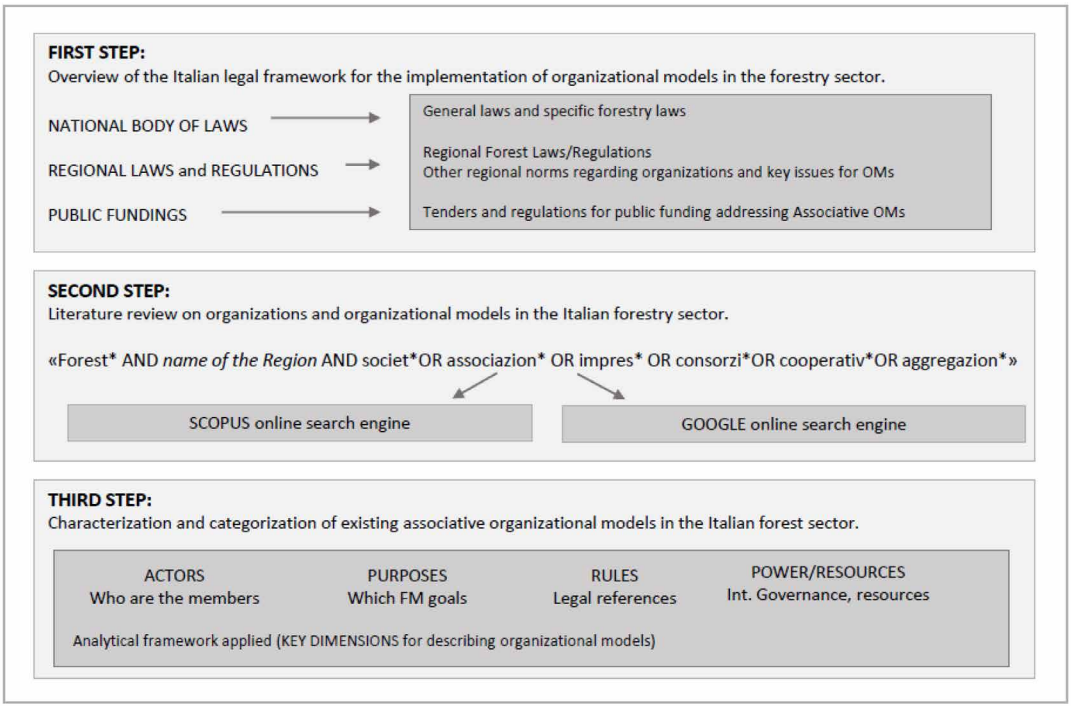

Figure 1. Scheme of the methodological framework applied in the second part of the research.

[1] Italian Law, n.154/2016, 28 July
[2] ISTAT (Istituto Nazionale di Statistica) is a national research institute controlled by the Italian Government.
[3] ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) is a national research institute controlled by the Italian Ministry of Environment.

In the first step, national and regional institutional sources were analysed. References to land abandonment, land fragmentation, "silent lands"[4] , to organisational solutions were searched and analysed. Then a second step was done searching for keywords resulting from step 1 analysis (see Fig. 1), within the scientific literature (Scopus engine) and the grey literature (Google engine). Finally, in a third step, the organisational solutions detected during the previous steps were analysed and categorised, according to a framework that considers four key dimensions: i) actors (who the members are); ii) purposes (which objectives they aim to reach); iii) rules (the legal/formal framework); iv) power and resources distribution (Loreggian et al., 2023).

3 RESULTS

3.1 Land abandonment in Italy

The biggest change in national land use patterns probably consists of management abandonment of agricultural and forest land, though the monitoring process for abandonment is discontinuous, sporadic, and with different outcomes. Missing precise quantification, some proxies can be considered to try to understand the phenomenon. According to data from the ISTAT Agriculture Censuses summarised in Table 1 (ISTAT, 2022a), the Agricultural Area (UAA) decreased by 26.4% from 1982 to 2020 (from 15.8 to 12.5 million hectares - Mha). In the last decade surveyed, UAA decreased by 33,100 ha/year, with the closure of 48,257 farms/year. According to ISPRA (Munafò, 2022) in its latest annual report on soil consumption, from 2006 to 2021, 115,300 ha of "natural and semi-natural soil" (i.e. agricultural, forest and uncultivated land) were lost, corresponding to 7687 ha/year, equal to 23.2% of the average annual decrease in UAA over the 2010-20 decade. Although these data are not perfectly comparable, together they allow for a perception of these two processes, the main reasons for land use change in Italy.

Table 1. Evolution of the number of farms, UAA, TAA and WA in the last 5 ISTAT Censuses of Agriculture. Our elaboration of ISTAT data from 7th General agriculture census and former reports.

YEAR	Absolute data				WA/TAA	Indexes referred to 1982=100			
	N° of farms	(thousands of hectares)				N° of farms	UAA	TAA	WA
		UAA	TAA	WA					
2020	1,133,023	12,535	16,474	2,865	17.40%	36.2	79.2	73.6	50.8
2010	1,615,590	12,856	17,081	2,901	17.00%	51.6	81.2	76.3	51.4
2000	2,393,161	13,182	18,767	4,580	24.40%	76.4	83.3	83.8	81.2
1990	2,848,136	15,026	21,628	5,510	25.50%	90.9	94.9	96.6	97.7
1982	3,133,118	15,833	22,398	5,640	25.20%	100	100	100	100

[4] "Silent lands" is used to define forest lands whose owner is unknown, or unavailable after a proper search was carried out, within the national forest law (D.Lgs. 24/2018, art. 3 and 12)

ISTAT also records the evolution of the Total Agricultural Area (TAA), which includes wooded land, unutilised agricultural land and buildings. Wooded areas have always been an important part in active farms (a quarter of the surface area in the 1980s), witnessing a traditional integration between land cultivation activities and hydrogeological protection, the use of timber for energy purposes, the production of pole wood and occasionally of timber for internal use and for sale. Gradually, this farming model is disappearing, with a reduction in both absolute and relative terms of wooded areas. Compared to the 1980s, the forest area is half and now covers about 17% of the total farm area.

Looking at data from the National Forest Inventory, as reported in Table 2, we can try to complement the Census with forests. There is a relevant gap between the estimated area in the 2020 Census of 2.9 M ha of wooded areas in active farms and the "high forests" in the third INFC, equal to 9.0 M ha in 2015. One could say that the two-thirds gap between the census and the inventory data is due to the presence of "specialised" forest holdings, which are accounted for in the ISTAT sample. However, this hypothesis is unlikely when we look at other indicators that suggest that a significant part of the national forest heritage is not managed or is managed in very extensive, occasional, unplanned terms. Let us look at other proxy variables that may justify this assertion.

Table 2. Evolution of forest area (our elaboration from the last 3 National Forest and Carbon Sinks Inventories).

YEAR	Absolute data (thousands of hectares)			Indexes referred to 1982=100		
	"High" forests	Other woodlands	Total	"High" forests	Other woodlands	Total
2015	8,957	1,097	10,054	145.8	82.8	127.4
2005	8,759	1,708	10,467	142.6	67.4	120.7
1985	6,142	2,533	8,675	100.0	100.0	100.0

According to the latest INFC, on 37.4% of the forest area there is no silvicultural intervention, a significant index of abandonment of management. Only 15.5% of the total forest area has a management plan, a ratio even lower than the already low value of 16.3% in 2005. More than 60% of Italian forests are located at an altitude above 500 m, that is, in hilly and mountainous territories that have been characterised by depopulation phenomena in recent decades. Among the reasons that limit the economic and social opportunities that could derive from the use of primary resources in these territories, land fragmentation, which characterises most private forest areas, has been recognised as a crucial driver (Rizzo et al., 2019; Secco et al., 2018). The average size of private forest properties does not exceed 8 hectares (Secco et al., 2017). This fragmentation, which often results in a real pulverisation of private properties into an unspecified number of owners, is a huge problem that hinders economically viable forest management.

3.2 Associating: organisational solutions for land abandonment

In Italy, for over a century, the legislator has encouraged the adoption of both horizontal (e.g., between public and private forest owners) and vertical (between producers and primary wood processing industries) forms of association. The Forest Law 3267/1923 gave the right (and financial resources) to 'several municipalities and moral entities, to form a consortium, for 'the recruitment of a single director for the technical management of forest heritage.' Following this national regulatory intervention, from the 1980s onwards, it was the Regions that defined the details of associative organisational models in the forestry sector, in the framework of the administrative decentralisation that regarded also the forestry sector (Baldini and Baldi, 2014), further spurred on by a new solicitation at the national level at the beginning of the 2000s, through Legislative Decree 227/2001 (art. 5 c.3). This decree urged regions and local authorities to promote forms of association in the forest sector, to promote a more rational and efficient management of forest stands. Several Italian regions have integrated regional forest laws, making explicit the strategic role of different types of associated forest management that were promoted also through incentives and dedicated funding calls, within the framework of rural development plans. Finally, the two recent and main acts signed by the Ministry of Agriculture, Food and Forestry (MIPAAF): the Consolidated Text on Forests and Forestry Supply Chains (Legislative Decree 34/2018) indicated 'associated forms of management' as one of the strategies to be pursued, in order to increase forest planning to foster sustainable forest management (Ferrucci, 2019) and the National Forestry Strategy, approved in February 2022, confirmed this orientation. In addition to these, three other significant interventions can be found in recent years, confirming the relevance of this issue in recent national policies: (i) the call for funding (for a total of 5 million €) to support the promotion and/or the start-up phase of associative forms for the management of forestry-pastoral areas, (ii) the creation of 'Forest Agreements' which is a regulatory instrument, and (iii) the call for funding 'Forest Supply Chain contracts' in April 2023 (10 million € within the RRF[5]) supporting initiatives of innovation and development of the forest supply chain that must be proposed by interregional associations of actors, signing a contract with the Ministry itself to enforce their agreement.

In Italy, the management of forestry-pastoral areas in associated form can be achieved through the adoption of different organisational models, each characterised by distinctive features. Peculiar models can be found, some originating from regulatory (regional) initiatives, others from innovative solutions developed by the civil society, without any specific regulatory framework and direction, finally composing a multitude of solutions which can be traced back to a few main categories, within two typologies of instruments: i) adoption of formal organisational entities to associate different actors, such as consortia, associations and cooperatives; ii) contracts, which are binding cooperation agreements between two or more independent subjects to produce legal effects, such as concessions, network contracts[6], and 'Forest Agreements'.

[5] Resilience and Recovery Facility, the temporary instrument that is the centrepiece of NextGenerationEU -the EU's plan to emerge from the Covid-19 crisis.

[6] Introduced in Italy with Law n°33/2009, 9 April.

Conventional contractual instruments that allow the management of forest resources or some of their services to be entrusted to third parties (free loan contracts against land investments, concession contracts, contracts for multi-year sales of forest plots, contracts for cost and profit sharing in the management of economic activities, etc.) have recently been joined by an innovative contractual modality: the 'Forest Agreements', introduced with Law 108/2021, as a "tool for the development of business networks in the forest sector". The additional purpose of "valorising public and private areas with agro-sylvo-pastoral vocation, as well as for the conservation and provision of ecosystem services provided by forests" preludes to one of the innovative (and distinctive) features of the 'Forest Agreement' compared to the network contract, since it is not necessary that all contractors are entrepreneurs, as in the case of the former instrument. The participation of forest owners is a characteristic requirement of the 'Forest Agreement', which aims to directly involve those private forest owners who do not perform active forest management.

Finally, in addition to these types of instruments, there are the entities set up for the administration and management of collective properties, which represent the oldest and most traditional form of associated management of agro-sylvo-pastoral assets, only recently organically regulated by Law 168/2017, which recognises collective properties of all types, giving legal personality under private law and statutory autonomy to the entities that exercise their rights. The expression 'collective domain' is now used to univocally name all collective properties, beyond the different names they have assumed in the different territorial realities and the historical modalities through which they were constituted, such as the Regole present in Veneto and in the province of Trento, the vicinie in Friuli Venezia-Giulia, the Comunelle, the Comunanze, the Partecipanze, etc. (Bassi & Carestiato, 2016). According to the law, collective domains have their source of legitimacy in a 'primary legal order of the original communities' characterised by autonomy ('capacity for self-regulation') with regard to the management of assets, which form a patrimony qualified by the law as 'intergenerational co-ownership' (Daici, 2021).

4 DISCUSSION AND CONCLUSION

In summary, three main dynamics characterise the processes of land abandonment in Italy: i) the SAU has been progressively decreasing; ii) the forest area within actively managed holdings is progressively decreasing, and iii) forests are characterised by a process of expansion fuelled by the decreasing dynamics of the UAA, in a logic that is in any case dominated by a tendency towards extensification that in many cases turns into total abandonment, confirmed by the fact that Italy is among the large European countries the one that has the lowest average rate of timber withdrawal, both per hectare of wooded area and with respect to the net annual increase.

The abandonment of many forest stands has significant environmental and social consequences. The loss of management in environmental contexts that for centuries have been intensively managed safeguarding the resilience of forests can expose them to causes of degradation with the reduction of their ability to provide not so much raw materials, but services to regulate ecosystem and socio-cultural cycles (Romano, 2017).

Moreover, the vulnerability of forests tends to increase in the presence of a higher frequency of extreme events, an increase in average temperature, and instability in the availability of water resources. In these contexts, active forest management is required primarily because of the need to maintain a flow of public goods. If this flow can also be maintained through the enhancement of commercial activities, with the creation of added value and employment, a reduction in the public costs of forest protection can be achieved. Such considerations can be confronted with the indication that Stefano Rodotà, a prominent Italian legal expert, expressed many decades ago (1960): "*the failure to exercise ownership over an asset, its abandonment can be considered antisocial conduct and, therefore, determine a supervening lack of legitimacy to the ownership or exercise of the right of ownership.*" Based on this indication, it would be appropriate to raise civic and political awareness and consistent measures of action, following the trend that seems to have started, relying on associative solutions.

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3

Social and economic aspects of green deal

Projections of the European Green Deal into national strategic documents in the Czech Republic: the case of forestry

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ABSTRACT

The paper deals with the projections of the European Green Deal strategy on the selected strategic and conceptual documents related to forestry in the Czech Republic. According to the chosen methodology, six relevant documents were found, three of them were analysed, namely Circular Czechia 2040, Biodiversity Protection Strategy of the Czech Republic for the period 2016-2025 and the Concept of state forestry policy until 2035. These strategic materials also contain measures directly addressed to forest owners, mostly related to the topic of climate change. The paper is intended to help orientation in the documents and in the key issues that affect the forest management sector in the Czech Republic, including impacts on forest owners, and helps to disseminate information from the Czech strategic documents to the actors of forest practice.

KEYWORDS

Forestry, circular economy, sustainability, bioeconomy, content analysis

1 INTRODUCTION

A European Green Deal (EGD) is a document with the goal of achieving climate neutrality by 2050 (Zelená dohoda pro Evropu, 2023). The proposed measures are then mirrored in the *Fit for 55* package, which is a set of proposals for changes to EU legislation. Although these are up-to-date documents, it should be recalled that the principles contained in the EGD build on other international agreements, such as the *Kyoto Protocol* and the *Paris Agreement*.

The European Green Deal covers the following areas: clean energy, sustainable mobility, renovation of buildings, decarbonisation of industry and circular economy, sustainable agriculture, protection of biodiversity and ecosystems, zero pollution (Fakta o klimatu, 2023). Actions targeting these areas tend to have an interdisciplinary overlap. Circular economy, biodiversity and ecosystems, and carbon neutrality are primarily related to

forestry. Circular economy is particularly relevant regarding its positive contribution to climate neutrality. In the Czech Republic, non-profit organisations, such as INCIEN (Institute for Circular Economy) or the Czech Association of Circular Economy, also focus on circular economy. Activities aimed at promoting the circular economy focus on reducing the extraction of primary raw materials, mitigating the environmental impact of human activities, and extending the lifetime of materials. All these topics are subsequently considered in strategic documents at the national level. In the Czech Republic, these are topics that fall under the responsibility of several ministries, such as the Ministry of Agriculture, the Ministry of the Environment, and the Ministry of Industry and Trade.

The paper focuses on the analysis of selected Czech strategic documents that thematically address the priority areas highlighted in the European Green Deal.

2 METHODS

The documents included in the paper were selected based on the following criteria:

- direct relevance to the European Green Deal strategy,
- issuance of the document by an authority that has the relevant competences (ministries with subject and sectoral competence),
- document 'in force' (temporal validity of the document over several years, document still valid in 2023),
- public availability of the document.
- The documents were found in Czech language. Documents were then subjected to content analysis, which is a qualitative methodological approach that helps to sort the information in the text with respect to relevant keywords. Selected information with an overlap with the forestry sector is included in the results. A similar approach of the documents selection based on keywords was applied, for example, in the works of Palátová et al. (2022) or Rinn et al. (2023).

3 RESULTS

3.1 Overview of the strategic documents

Overall, six relevant documents were identified that meet the criteria defined in the methods. Abbreviations used in the table refer to the Ministry of Environment (MoEnv), Ministry of Agriculture (MoA) and Ministry of Industry and Trade (MoIT) of the Czech Republic. Table 1 gives an overview:

Table 1. Czech strategic documents selected according to the description in Methods

Guarantor	Original Title (Title in English in brackets)	Year of issue
MoEnv	Cirkulární Česko 2040 (Circular Czechia 2040)	2021
MoA	Strategie ochrany biologické rozmanitosti České republiky pro období 2016-2025 (Biodiversity Protection Strategy of the Czech Republic for the Period 2016–2025)	2016
MoA	Koncepce státní lesnické politiky (Concept of State Forestry Policy Until 2035)	2020
MoEnv	Strategie resortu Ministerstva zemědělství ČR s výhledem do roku 2030 (Strategy of the Ministry of Agriculture of the Czech Republic with a Wiew to 2030)	2016
MoEnv	Politika ochrany klimatu v ČR (Climate protection policy in the Czech Republic)	2017
MoIT	Státní energetická koncepce (State energy concept)	2015

Considering that the circular economy is one of the transformation policies of the European Green Deal, since forestry factually falls under the responsibility of the Ministry of Agriculture of the Czech Republic, and considering the scope of the paper, most attention is paid to the strategies listed in the three top most rows of the table.

3.1.1 Circular Czechia 2040

Circularity is inspired by natural ecosystems. The Circular Czechia 2040 strategy focuses on three priority areas and a total of ten areas and although the document was published by the Ministry of Environment, a total of five ministries are responsible for the implementation of the strategy. The document is valid for the period 2021 to 2040 (Cirkulární Česko, 2023). Circularity is also in line with the concept of bioeconomy, which is a widely discussed topic at the European level.

In the area of forestry and wood-processing industry, measures aimed at promoting sustainable forestry, sustainable biomass production, taking measures against forest soil degradation and promoting the use of wood as a renewable raw material can be mentioned (Databáze strategií, 2023). The use of wood has been at a low level in the Czech Republic for a long time.

However, circularity is also present in other documents such as the Strategic Framework Czech Republic 2030, which is based on the Agenda 2030. Other documents encompass the Waste Management Plan of the Czech Republic for the period 2015-2024, the State Environmental Policy of the Czech Republic 2030 with outlook to 2050, the Bioeconomy concept in the Czech Republic from the perspective of the Ministry of Agriculture (2019-2024), but also, for example, the waste prevention and secondary raw materials policy.

3.1.2 Biodiversity Protection Strategy of the Czech Republic for the period 2016–2025

The strategy reflects forestry directly in priority 3 (sustainable use of ecosystems). Forest owners are also directly mentioned in objective 3.2. Others are, e.g., ecosystem services (priority 4 - strategic planning and policy, objective 4.2). The strategy includes indicators, deadlines, and responsibilities. The strategy builds on previous Czech strategies and considers European strategies, such as EU biodiversity strategy (MoEnv, 2016).

3.1.3 Concept of state forestry policy until 2035

The Concept of the State Forestry Policy Until 2035 identifies several problem areas, including the reduced resilience and deteriorated condition of forest ecosystems with calamitous occurrence of pests (mostly bark beetle infestation), the low competitiveness of forestry, the complicated and chaotic system and performance of state administration in relation to forestry and the lack of public awareness of the complexity and importance of forests for society in the Czech Republic. The Concept directly lists measures to improve this situation, which, from the perspective of the forest owner, relate to:

- motivation and financial support of forest owners for sustainable forest management and fulfilment of public services;
- promoting the natural proportion of standing timber, logging residues and habitat trees - including incentives for owners and addressing liability in the event of damage resulting from this requirement;
- reducing legislative restrictions on forest management and maintaining public use of forests, including financial support for ecosystem services to owners; aligning the system of support to forest owners;
- improving the level of advisory services to forest owners.

These measures are in the document across all long-term objectives. However, long-term objective “C” also mentions, for example, the circular economy in the context of the use of wood as a renewable raw material. Biodiversity is mentioned directly in long-term objective “B”, as is energy (use of woodchips and pulpwood), and also, for example, the carbon balance of the landscape (MoA, 2020).

The content analysis of the documents confirms that the measures related to the EGD are inter-ministerial not only in their content but also in their impact and, in particular, inter-ministerial cooperation is required to achieve both the sub-objectives and the required synergies. The documents also contain similar or identical keywords. The measures are primarily directed through the ministries, in particular the MoEnv and MoA. In the Czech Republic, MoA is responsible for forestry with several exceptions – national parks/MoEnv and military sites/Ministry of Defence (Zákon o lesích, 1995). The subsequent wood-processing industry belongs under the Ministry of Industry and Trade, as does the energy policy. Based on the analysis of the documents, many of them are created in direct relation to the objectives and requirements of supranational policies, especially European policies.

4 DISCUSSION AND CONCLUSION

The paper dealt with the link between the European Green Deal and relevant strategic documents that have a connection to forestry of the Czech Republic. Three valid documents issued by the MoA and the MoEnv were analysed in more detail. In the Czech Republic, the EGD raises a number of concerns across the lay and professional public. In the public space, the EGD is mainly associated with negative information in the Czech Republic (Kolářová, 2023), however, it should be noted that the debate on the EGD seems to have been influenced by concurrent circumstances such as the impact of the covid pandemic, the energy crisis, the conflict in Ukraine, but also in the Czech Republic by the change of government. EGD is linked to several principles that are also continuously emphasised in the national strategies. For example, circularity, which is part of the strategies already adopted, also applies to biomass cascading in forestry. The use of forest biomass for materials, products and services is also one of the possible definitions of the bioeconomy concept (Hetemäki, 2017). Cascading biomass use has been part of several studies (e.g., WWF, 2016; EC, 2016). The direct link of cascades to agriculture, forestry, livelihoods, energy, and climate change is included in the EU study (EU, 2019). The Netherlands is the furthest along in accepting the circular economy principles (Hrtúsová and Novák, 2020), and Finland is most frequently mentioned as a pioneer country of the bioeconomy.

In the Czech Republic, the principles of the EGD are also linked to the so-called National Recovery Plan (NPO, 2023), which allows the Czech Republic to use funds from European sources - specifically from the EU's Recovery and Resilience Facility. The National Recovery Plan aims to reduce the impact of the covid and restart the Czech economy. Forestry is included in the NPO in the context of, among other things, building resilient forests, supporting biodiversity, combating drought, and retaining water in forests.

Although the strategic documents from the EU level are reflected in national strategies (and conceptual materials), the specific content and objectives are, for example, more or less difficult to get into operational practice of forestry companies. The results of ongoing research projects should also help to raise awareness of the activities and measures contained in the strategies. For example, the project on sustainable forest management in small-owner forest estates is intended, among other things, to provide smallholders with evidence to help them improve the forest management practices of their properties. The formulation and validation of the proposed practices is now more urgent, precisely because it should consider not only the emphasis on the (traditional) economic side of the measures, but also the future demands on forest enterprises resulting from long-term commitments at supranational level (including European strategies). Carbon neutrality is also a major challenge for the whole forestry sector, including forest owners.

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Learning from forestry innovations for the European Green Deal. A research approach

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ABSTRACT

Forests and wooded lands are important in the European Green Deal (EGD). This growth strategy for a sustainable green transition in Europe goes hand in hand with constraints for production-oriented forestry and emergent bioeconomy strategies, thus challenging established practices. Therefore, forestry innovations may be key to facilitate the implementation of the EGD. Linking innovations with broader policy goals requires lesson-drawing of policymakers at different levels of European governance. The article reveals enablers and barriers of innovations in forestry and arrives at two hypotheses on forest-related policy learning for the EGD: First of all, policymakers' beliefs determine lesson-drawing on the role that forests and forestry can and should play in Europe's ambitious growth strategy. Secondly, genuine interest in experiential knowledge and deliberation about 'what works' in innovation practice can help generate ownership of the forest sector in the EGD.

KEYWORDS

Forest, forestry, innovation, policy learning, European Green Deal

1 INTRODUCTION

The European Green Deal (EGD) is the current growth strategy of the European Commission (EC). It was published in December 2019 when Ursula von der Leyen took office as President. It aims at transforming the European Union (EU) into a „modern, resource efficient and competitive economy", and is committed to zero emissions of GHG by 2050, a decoupling of economic growth from resource use, and the social principle of "no person and no place left behind."

Forests and wooded lands play important roles in the EGD. They account for 43% of the land in the EU and provide a wide range of ecosystem services, including natural habitats and water regulation, carbon storage and sequestration, wood and non-wood products. Without forests, the commitment for carbon neutrality in 2050 will not be achievable. For example, the annual mitigation effect of EU forests via contributions to the forest sink, material and energy substitution was estimated at 567 Mt CO_2eq per year or 13% of total EU emissions (Nabuurs et al., 2017). This figure informed adoption

of the Land Use and Land Use Change & Forestry (LULUCF) regulation in 2018, which included forests into the Union's climate mitigation targets.

The EGD emphasizes the supporting and regulating ecosystem services of forests but downplays forests' provisioning and cultural services. Its focus on biodiversity, nature protection and carbon sequestration in current forest-related EU policies hampers production-oriented forest management regimes and the forest-based bioeconomy (Aggestam and Giurca, 2021; Köhl et al., 2021). Moreover, the EGD does not acknowledge needs for adaptations in forest management. Forests play multiple functions for society, business, and the environment. To sustain them under global climate change impact, however, requires dedicated efforts and increased skills of forest owners and managers.

Accordingly, forests and forestry have great potential to facilitate the ambition of a sustainable green transition in Europe yet face significant challenges. Innovations in forestry may be key to support the implementation of the EGD. Innovation is understood here as "the process of making changes to something established by introducing something new" (Mann et al., 2022: 283; Weiss et al., 2020). Such processes of making changes include technologies, products, processes, or management approaches that seek to improve the provision of forest ecosystem services (FES) (Hansen et al., 2019; Louda et al., 2023).

The present article argues that EGD implementation can benefit from forestry innovations if facilitated by policy learning. Empirically, it directs attention to "lesson-drawing" about adoption of a specific innovation program of Common Agricultural Policy (CAP) in forestry and how it relates to the EGD. The lesson-drawing notion was introduced by Rose (1993; 2004) and is used frequently in policy and science. Lesson-drawing can lead to the "updating of knowledge and beliefs about public policy", as Dunlop and Radaelli (2020: 1125) have put it, and result from social interaction, personal-organizational experience, and/or provision of new or different evidence. Clearly, "policymakers do not seek fresh ideas for their own sake but to promote political satisfaction" (Rose, 2004: 2).

To develop the research approach that links learning from forestry innovations with the EGD, the article progresses in three steps. First, the methods and research context are explained, including document study and the policy learning approach. Secondly, initial results from the desk research are presented. The article concludes with hypothesis about policy learning from innovation practice in forestry in the context of the EGD.

2 METHODS

This section describes the bodies of literature and documents which underlie the methodology for research on policy learning about forestry innovations in European governance. These include: (1) Policy documents on the EGD and its assessment in forest policy analysis, (2) Recent studies on innovations in forestry, and (3) Conceptual articles on policy learning. The implementation of a specific CAP measure for innovations in agriculture and forestry is the research context. It is described at the end of this section.

2.1 LITERATURE STUDIES

2.1.1 EGD-related policy documents

EU policies and strategies that relate to forests and forestry are abundant. Here a narrow focus on the EGD is applied and a content analysis conducted to single out how forests and forestry are covered in the text and which cross-references to other policy documents are made. Moreover, literature from forest policy analysis that examines the EGD is referenced to highlight the contested landscape of EU forest-related policymaking.

2.1.2 Research on innovations in forestry

Eighteen articles and one book chapter on innovations in forestry and agroforestry, published mainly between 2019 and 2023, are reviewed (Table 1) to identify definitions of innovation in forestry and the influencing factors (facilitators and barriers). Moreover, contributions from management studies and a MSc thesis are included to explore the OECD definition of innovation ("Other"), which informs many studies on innovations in forestry. The search was based on existing knowledge of the research field, ScienceDirect (key words: forest, innovation), and recommendations from peers.

Table 1. Research base innovations in forestry

No of articles	Journal Title	Country of research context	Methodology
9	Forest Policy & Economics	Cross-country (Europe, international)	Literature review Case study Comparative analysis
2	Ecosystem Services	Cross-country (CZ, SK, AT, FI, DE, IT)	Comparative analysis
2	Land Use Policy	Cross-country (Europe)	Comparative analysis Case study
2	Land	Cross-country (Europe)	Comparative analysis Case study
3	Other journals dedicated to land use, environment, and policy	Individual countries (PT, SI, USA)	Case study Comparative analysis
4	Other	Cross-country (international)	Literature review Case study

2.1.3 The lesson-drawing concept in the policy learning literature

Research on policy learning is based in political science. It emerged in the late 1980s/ early 1990s to broaden the range of explanatory variables for policy change. Whereas power and interests have dominated past accounts, debate and argument have then been emphasized (see Héritier, 1993; Majone, 1989; Sabatier and Jenkins-Smith, 1999; Sotirov et al., 2017). The "argumentative turn" to policymaking directs attention to beliefs and assumptions about causality and responsibility, needs and interests, preferences, and obligations. It allows us "to examine closely the communicative and rhetorical strategies that planners and analysts use to direct attention to the problems and options they are assessing" (Fischer and Forester, 1993: 14).

The "lesson-drawing" notion is a pragmatic concept that fits nicely with the research context of the present article. It refers to policymakers' lesson-drawing from "foreign experience" to improve public policy "at home" (Rose, 2004: 4). This process evolves through different stages, including search for lesson-drawing opportunities and scanning of alternatives, sensemaking to decide how lessons from abroad can fit national circumstances, identification of means and ends of a lesson, adoption, and evaluation. Outward looking behaviour and problem-oriented search trigger learning.

2.2 Research context

In the last CAP programming period (2014-2020), the EU introduced funding for so-called Operational Groups (OGs). These are action and result-oriented groups of at least two partners such as farmers, forest managers, researchers, advisors, businesses, environmental and interest groups who are interested to jointly advance a new idea and put it into practice. The legal basis is the EU Regulation 1305/2013 on support for rural development. It includes the European Innovation Partnership approach. This approach aims at knowledge transfer, cooperation, and development of knowledge bases in rural areas and at strengthening the links between research and innovation for the purpose of a "competitive agricultural and forestry sector that works in harmony with the natural resources on which it depends".

So far, 2,788 OGs have been implemented in Europe, yet only 141 in forestry (status: April 2023) (Eyenga, 2023). OGs meet several enablers of innovation in forestry: they provide access to new knowledge and financial resources, are multi-actor partnerships, and facilitate adaptations to changes in markets and society (see below). The research on policy learning from innovation practice in forestry will therefore focus on OGs in forestry. Since forestry is often characterized as traditional and mature with a weak innovation orientation (see Weiss et al., 2020; 2021), forestry OGs represent more-likely cases of innovation.

3 RESULTS

3.1 Forests and forestry in the EGD

The EGD consists of eight elements. Forests and forestry are mentioned in three of them, namely: (1) Preserving and restoring ecosystems and biodiversity, (2) Increasing

the EU's climate ambition for 2030 and 2050, and (3) From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system. Table 2 shows, which goals the EGD foresees for forests, the legislative basis it is referring to for pursuance of these goals, and the type of policy instrument for definition of measures.

The combination of EGD goals with policy instruments reveals that "these instruments represent policy domains where the EC has competences [whereas] the EGD barely gives any consideration to the multiple benefits forests provide to society" (Aggestam and Giurca, 2021: 8). Moving beyond this account, Gordeeva et al. (2022: 10-11) argue that the EGD is a policy that furthers economic interests despite its environmental rhetoric, stating that it represents a clever political manoeuvre to gain public and NGO support as well as more power vis-à-vis the Member States on the one hand, while not contradicting the Member States' national (economic) interests on the other hand."

Table 2. Forests and forestry in the EGD and related legislation

EGD element	Forest-related goals	Legislative basis	Policy instruments (and description)
(1) Preserving and restoring ecosystems and biodiversity	- Strictly protect primary and old-growth forests - Increase forest and tree coverage, their resilience and contribution to biodiversity, incl. 3 billion tree pledge - Reduce use of forest biomass for energy production	EU Biodiversity strategy, Nature legislation (Natura 2000 network, Nature Restoration Law *proposal*) RED III	- Regulative - National management planning for Natura2000 sites, with MS monitoring and reporting, and EU infringement procedure; National Restoration Plans to plan and monitor restoration measures for Natura2000 and non-Natura2000 sites, with MS monitoring and reporting - Restriction of forest biomass for energy purposes in favour of cascade use, implementation of stricter sustainability criteria and GHG savings obligations for plants up to 5 MW
(2) Increasing the EU's climate ambition for 2030 and 2050	- Increase forest and tree coverage, their resilience and contribution to climate mitigation and adaptation - Increase natural C removals in EU (forests are major sink on land) - Restrict timber harvesting to increase natural forest sink	LULUCF (*new*), EU climate package "Fit for 55"	- Regulative - Implementation of National Forestry Accounting Plans to reach Fit For 55 obligations: increase of forest sink effect from 268 million t CO_2 annually to 310 million t CO_2 in 2030; sink effect can be increased in different ways (Köhl et al. 2021): increase net increment of forests while maintaining same timber harvest level, abandon forest management on portion of forest area, increase forest area; National accounting plans according to common methodology and monitored by COM

(3) From 'Farm to Fork': designing a fair, healthy and environmentally friendly food system	- Increase the mitigation potential of land use and forestry through sustainable production of biomass and afforestation - Provide support for agroforestry systems	CAP (2023-2027)	- Economical (subsidies and incentives) - Measures for forestry are funded in second pillar of CAP (EAFRD = European Agricultural Fund for Rural Development); afforestation measures traditionally most popular, yet representing a very small share of overall funding (less than 5% EAFRD for forestry in past programming periods) - Growing recognition for agroforestry to increase biodiversity and soil organic carbon in farmed landscapes; MS started to provide funding for maintaining existing or setting up new agroforestry systems in their national CAP strategic plans (eco-schemes)

3.2 Enablers and barriers of innovations in forestry

Analysis of selected studies in the literature on innovations in forestry revealed different influencing factors (enablers and barriers). Table 3 gives an overview. The factors are described with reference to a range of indicators.

Table 3. Enablers and barriers of innovation in forestry

Factors influencing innovation in forestry	Enablers	Barriers
Knowledge and information	- access to new knowledge - information about support programs	- new knowledge not available/accessible - information about support programs not available/not accessible
Technology	- availability of digital tools ready for practice - shared data standards, interfaces - fairs and platforms for new providers/ solutions	- new technology not available/accessible - shared data standards and/or platforms missing
Values and attitudes	- open mindset - entrepreneurial attitude - positive attitude towards change - regional innovation focus	- closed mindset - sceptical attitude/resistance towards change - perceived costs and risks
Cooperation	- intra-sectoral cooperation - participation in networks - inter-sectoral cooperation - vertical cooperation across value chain	- small-fragmented forest ownership - closed forestry circles
Resources	- skilled labour - finance schemes - tax/subsidy incentives	n.a.

Market	- competition - new narratives (forest and health, forest bioeconomy, PES etc.) - market for PES	- competition - dominance of commodity-/production-orientation
Society	- changing demands of people in society	- sustained conflict with civil society actors
Government and policy	- accessible/supportive guidance in applications for public funding - forest-related policies (climate, nature conservation, hunting, RE, rural development, construction, health, other)	- (perceived) high level of bureaucracy - lack/limited guidance in applications for public funding - command-and-control style of public decision-making - dominance of state forest enterprise/ administration - commodity-centred forest policy

The focus on enablers and barriers of innovations in forestry allows to test most factors with Likert-type survey questions. The issue is different with respect to government and policy as influencing factor(s) in innovation. Whereas governments perceived as accessible, supportive, and collaborative may be more likely to facilitate innovation in forestry, there is less clarity about the goals and means of forest-related policies and how they affect innovation.

Nichiforel et al. (2020) showed that the decision-making power of owners and managers is rather different across Europe, depending strongly on domestic legislations for forestry, while subsidies and incentives can effectively target policy goals to environmental discourse. Mann et al. (2022: 283) suggested that the current revision of the forest policy framework at EU level under the EGD "poses a window of opportunity for more sustainable FES [Forest Ecosystem Services] provision." Varela et al. (2022) arrived at a different conclusion for the CAP (2014-2020), which they consider as "inadequate" for maintaining multi-purpose habitats. Hence, the influence of government and policy in forestry innovations seems to be far from unequivocal.

4 DISCUSSION AND CONCLUSION

Linking innovations in forestry with learning for policy goals and measures implies that public policy is not just the result of power and interests but also of debate and argument for the sake of enhanced problem-solving. Forest policy debate, however, is often polarized between environmental-conservationist interests on the one hand and forestry and commodity-oriented interests on the other. Previous studies on forest policy-oriented learning in Germany showed that actor beliefs tend to remain stable and divided in terms of present and future aspects of sustainable forest management (Sotirov et al., 2017). Similar divisions can be observed in European forest governance (Winkel and Sotirov, 2016).

Drawing on Sotirov and colleagues', it can be hypothesized that policy actors who "largely project their past and present core beliefs onto the images of the future scenarios"

(Sotirov et al., 2017: 11), including one in which forests play key roles in Europe's green transition, do not learn substantially but in strategic ways. For example, forest policy actors convinced of the crucial role of multi-functional forestry for the decarbonization of Europe's economy will cooperate with others if it serves their interest to promote the forest-based bioeconomy. In this view, learning from innovation practice will be limited to those areas that fit with the legislative basis of the EGD while stabilizing or even deepening the divisions between the actors involved.

On the other hand, lesson-drawing about 'what works' in innovation practice (and what doesn't) has potential to effect policy change – in terms of reframing and/or abandoning (parts of) policies. As Ludvig et al. (2021) pointed out, such change is not simply the result of experience with bottom-up initiatives but rather the result of a complex dynamic between different levels in forest governance, of networking and coordination, and a shared interest in forestry innovations that are not (merely) profit-oriented (Callegari and Nybakk, 2022). Viewed from this perspective, it is hypothesized that lesson-drawing from innovation practice can generate ownership of the forest sector in the EGD if it is not market-based and due attention given to the feedback loops and sense-making activities of the various actors involved.

Empirical research in the field of forestry OGs and the policy learning setting that encourages lesson-drawing for the EGD will be conducted in the frame of the Horizon Europe FOREST4EU project to test both hypotheses and explore the underlying research approach.

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Does price matter? A case in Slovenia private forest management

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ABSTRACT

In addition to planning appropriate measures and their dynamics, foresters are often faced with the problem of implementing measures and activating forest management. The latter is particularly relevant on small private forest property and in times of intense climate change impacts. This study analyses data on timber purchases from private forests in Slovenia. Based on timber purchases, the study analyses the factors influencing the activity of forest owners to implement forest management in their forests. In a market economy, the price of products or services encourages or discourages management activity. We wanted to find out whether the price and the purchase of timber from private forests in Slovenia are positively correlated. Using an online application, we obtained data from the Statistical Office of the Republic of Slovenia on the volume, value and average price of timber purchased at the national level. The Pearson correlation coefficient was used to evaluate the relationship between the unit price and the volume of purchases by type of use and by group of tree species. The study showed that, for the vast majority of timber purchases, the dynamics of timber purchases from private forests is not driven by price, but on the contrary - the price of timber depends on the dynamics of timber supply on the market. The study also showed that the price of timber and the dynamics of timber purchases from private forests in Slovenia are positively correlated in the case of some of the less exploited tree species.

KEYWORDS

Wood purchase, wood price, private forests, forest management, Slovenia

1 INTRODUCTION

Forests perform a variety of functions, classified as ecological, social and productive. The relationship between these functions can vary considerably in terms of emphasis, and the measures of forest management is adapted accordingly. The combination of functions may vary, requiring specific and more complex treatment with different levels of active involvement of stakeholders.

The conditions necessary for the provision of forest functions are ensured by a system of forest management plans, which define measures to ensure the fulfilment of individual

forest functions. It is not enough to plan measures. It is also necessary to ensure that they are implemented. In addition to the planning of appropriate measures and their dynamics, foresters are often faced with the problem of implementing the measures or activating forest management - especially when the structure of forest owners is unfavourable in terms of their motivation to manage the forest (small and fragmented ownership, (in)dependence on income from forestry, lack of skills and knowledge to carry out the forest work, remoteness, co-ownership, etc.). In countries where private forests dominate, the implementation of forest management measures depends to a large extent on the motivation of forest owners. However, the motivation of forest owners to manage their forests and thus to implement forest management plans can vary considerably. Several studies and typologies of forest owners have been carried out to analyse the motives and preparedness for managing private forests (Ficko et al., 2019; Poje et al. 2016; Tiebel et al., 2022; Malovrh et al., 2015).

In a market economy, besides a number of other factors (knowledge about forest management, forestry equipment, accessibility of the forest, development of the market for forest operation, the organisation of forest owners' cooperation, the activity of the public forest service, the incentive system provided by the state, and many others), supply and demand are certainly among the most important factors that motivate forest owners to manage forests and, consequently, determine the price of forest products and services.

In this study, we wanted to find out whether the price of wood influences the dynamics of purchasing wood from private forests in Slovenia. We hypothesised that a higher timber price on the market would have a positive effect on the volume of timber purchased from private forests in Slovenia.

2 METHODS

To analyse the relationship between the price of wood and the purchase of wood from private forests in Slovenia, we used publicly available data from the Slovenian Statistical Office (SiStat, 2023). The data on purchases of different wood assortments (logs, pulpwood and panels, other industrial roundwood, firewood) are collected from units (purchasers) that buy wood from private producers or private forest owners. The representative enterprises are selected as units that buy wood directly from private forest owners. Slovenian Statistical Office collects monthly the data on the quantities and values of wood purchased. The average price per unit is calculated on the basis of the value and quantity of wood purchased.

Data were analysed for the last decade (2013 to 2022). Pearson's correlation coefficient was used to analyse the relationship between the quantities purchased by species group and wood assortment and by the corresponding average wood value.

3 RESULTS

The application of the Slovenian Statistical Office (SiStat, 2023) provided queries showing the volumes of wood purchased by year and by wood assortment and by group of tree species, their values and average prices per unit purchased (Table 1).

Table 1. Total volumes and average prices of timber purchased from private forests over the last decade, by type of wood assortment in Slovenia.

Year	Volume [m³]				Average price [EUR/m³]			
	Sawlogs	Wood for pulp and panels	Other industrial roundwood	Firewood	Sawlogs	Wood for pulp and panels	Other industrial roundwood	Firewood
2013	389,220	145,656	26,299	46,667	72.90	34.65	38.77	38.19
2014	482,240	263,667	36,671	86,523	64.51	26.89	34.19	36.10
2015	645,842	259,325	36,700	106,452	59.33	25.23	34.46	29.43
2016	902,225	293,431	30,668	85,075	60.67	25.16	35.71	30.90
2017	741,278	242,156	29,150	60,381	63.34	30.07	39.90	36.26
2018	697,237	254,592	27,572	88,434	65.67	35.34	42.46	41.88
2019	640,119	236,738	27,986	91,889	63.42	34.93	43.19	45.66
2020	524,202	240,781	25,523	90,254	63.03	35.07	38.67	40.36
2021	542,986	244,204	16,079	59,122	86.71	37.65	38.52	43.45
2022	527,923	199,543	23,303	52,082	102.00	47.09	53.97	56.75

The volumes of wood purchased and their average values show slightly different dynamics. While prices, after an initial fall in 2014, show a predominantly upward dynamic, the volumes purchased are also generally increasing, but with a more intense dynamic, which also shows distinct intermediate periods of rapid increases and decreases in the volume of timber purchased.

The correlation between the volume of wood purchased from private forests and its average price was also tested using Person's correlation coefficient for each species group and its assortment (Figure 1).

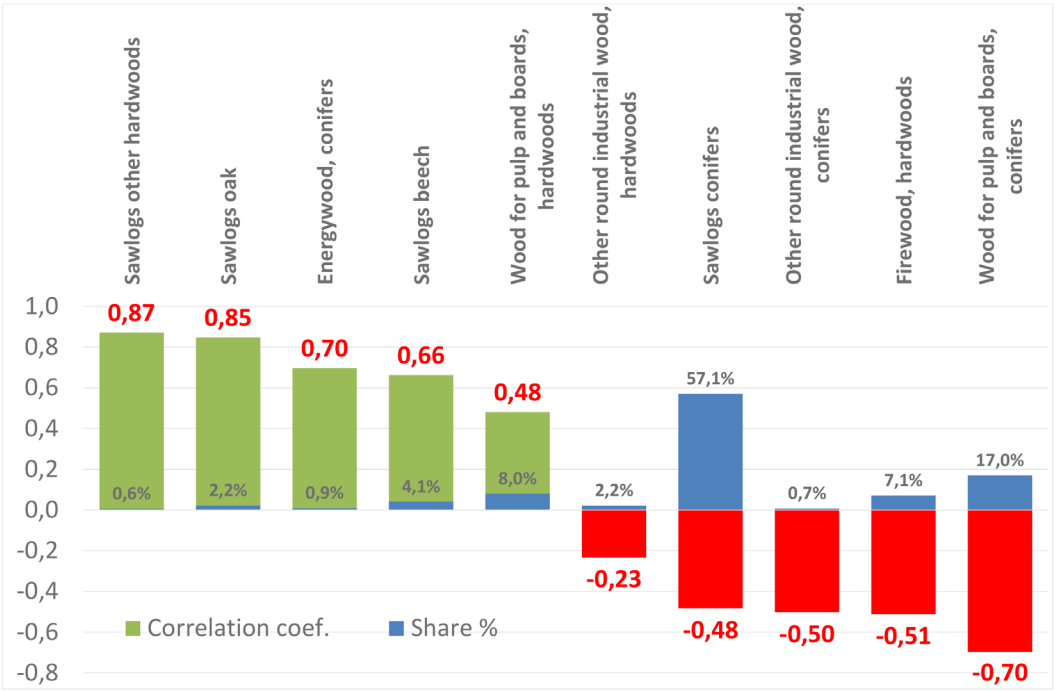

Figure 1. Correlation coefficient between the volume and value of timber purchased by tree species group and wood assortment, and their shares.

The analysis shows that for 84.2% of the volumes purchased, the volumes purchased and their prices are not positively correlated (correlation coefficient less than zero). The species with the highest proportions of purchases (coniferous pulpwood, hardwood energy wood and especially coniferous logs) show a high negative correlation. On the other hand, for some of the less used species (other broadleaved species, oak logs, coniferous energy wood) there is a positive correlation between the volume of purchases and the average price of wood. A positive relationship is also observed for some of the more common species, such as beech logs and hardwood pulpwood.

4 DISCUSSION AND CONCLUSION

Price increases and the purchase of wood from private forests in Slovenia do not follow each other for the vast majority of wood assortments. This is mainly due to the circumstances affecting forest management in the last decade. During this period, the increase in forest management activity by forest owners was strongly influenced by the salvage of timber from the consequences of storms and subsequent damage caused by destructive mechanisms (mainly by bark beetles, but partly also by catastrophic floods and fires). At the time of the storm and the resulting damage, there was an increase in the supply of timber on the market, which undoubtedly had a negative impact on the price of timber. The latter can be seen as a slight price decrease after the ice break in 2014, followed by a slight price dynamic until the pandemic year 2020. The price stagnation can also be explained by the fact that the supply of wood has also increased in neighbouring countries (Austria, Italy), which were not affected by the ice break, but whose forests were increasingly affected by climate change (and the resulting bark

beetle outbreak). The resilience of forests to the increasingly pronounced effects of climate change is important for the long-term success of forest management and the associated wood processing industry, and for ensuring the ecological and social role of forests. Forest management has an impact on the ecological and social functions of forests and on the business performance of wood processing industry. The ecological and social functions are better fulfilled by vital and stable forests with a mix and age structure of forest stands, appropriate to the forest site. The wood processing industry, on the other hand, needs a stable wood supply at a reasonable purchase price.

The analysis shows that the dynamics of wood purchases from private forests is not driven by price for the vast majority of wood purchases - on the contrary, the price of wood depends on the dynamics of wood supply. This is particularly evident in the current climate change-induced dynamics, where the forest management activities of most forest owners are motivated by mitigating the effects of climate induced disasters. Thus, we rejected the hypothesis that a higher timber price on the market has a positive effect on the volume of timber purchased from private forests in Slovenia.

At the same time, the study showed that the price of timber and the dynamics of timber purchases from private forests in Slovenia are positively correlated in the case of some less used tree species. However, the less used tree species have a higher future potential due to climate change, as they are more resilient to future climate change.

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Political and socio-economic limits to counteract the bark beetle calamity in South Tyrol

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ABSTRACT

Significant transitions are taking place in South Tyrol's forests. In recent years disturbances like windthrows (VAIA 2018) or snow-pressure events (2019/2020) have formed an optimal substrate for an explosive bark beetle calamity, which had never been experienced before in South Tyrol. Each bark beetle pair has a reproduction rate of 2.5 generations per vegetation period, including at least one sibling brood. 6,400 ha of spruce forests were destroyed in 2022 alone. With high probability it is expected that the calamity will continue even more extremely in 2023. Thus, South Tyrol, with its 50 % forest landcover in the middle of the Alps that hosts millions of tourists every year, fears enormous societal and economic consequences, as 24% of these forests are object protection forests. Accordingly, this has risen an enormous media attention and awareness among society on the health situation of local forest ecosystems. Hence, divergent discussions on woodlands are evolving among people, between local authorities and even experts from abroad. Different views from protection, ecological functions, and recreation to economic usage, generated a never-before-seen level of controversial debates about South Tyrol's forest management practices and strategies. Discussions are fueled as forest authorities, which would be obliged to mark every single tree to be felled, are overwhelmed. Additionally, there is uncertainty about the right balance of keeping dead bark-beetle trees in forest stands to guarantee a certain protection of forest soils but also of infrastructure objects and for also avoiding a significant change of the micro-climate for the surrounding tree-stands as this may increase their predisposition to bark beetle attacks. These controversial debates about felling bark beetle-affected forest stands, inevitably leads to conflicts between forest authorities, logging companies and forest owners. In addition to forest ecological considerations, the forest owners' room for manoeuvre are practically limited due to the lacking availability of freight companies and the declining prices for spruce logs.

The concept of natural forest management, which was highly appraised until recently, approaches its limits on some forest sites. Less than 20 years ago, the forestry expert Hellrigl published that Norway spruce in South Tyrol reaches its optimum at the montane and subalpine altitudes between 800 and 1800 meters and that, as a result of near-natural forest management practices, bark beetles will not pose a significant threat in the future. Therefore, there is now a lack of experience in dealing with such a large-scale calamity and the processing of the damaged wood. This high degree of uncertainty

about the stability of forest stands and the consequences for the forest-based value chain and climate change on forest ecosystems are causing societal concerns. Forest owners are worried, whether the timber market can absorb the large quantities of calamity without lowering the timber price below producer costs. And people are wondering, which tree species will be able to adapt to the changed climatic conditions in the future, because they fear that the calamity harms the ecological balance of forests and thus their multifunctional services for society.

The forest authority in South Tyrol, which is in close contact with forest owners, has thus issued in the Forest Agenda 2030, a seven-point plan to meet these current challenges for managing forests in South Tyrol sustainably. It gives the highest priority to strengthening forest owners and their forest mindset, as only they can initiate the transformation towards climate protection, conservation of the forest's biodiversity, and a sensitive management of the forest soil and its water cycle. To ensure their motivation, the forest-based value chain must also be strengthened, by increasing the policy's reliance on wood as a building material and by securing appropriate prices for the various wood assortments. Communication and the creation of trust are essential in this regard, and thus the 7th point of the Forest Agenda 2030 aims to pay more attention to this.

However, when looking at European forest policies, a less harmonic impression emerges. Although forest topics are high on the agenda of Europe's Green New Deal through the LULUCF directive, the EU Biodiversity and New EU Forest Strategy for 2030, and the Deforestation-Free Products Regulation, the impression arises that the more distant the decision-makers in Brussels are from the sector, the more impractical appear the forestry decisions taken in the Commission. Ambivalently guided discussions lead to a twofold view on the role of forestry for climate mitigation. Firstly, forests suffer from geopolitical crisis and climate change, we are all responsible for. Secondly, we place great hope in the forest's capacity of carbon sequestration to become climate neutral by 2050, whereby it is questioned whether sustainably managed forests store more CO_2 than those put off-use. Even the use of forest biomass for heat production has recently been intensely debated under the principles of cascading usage in the Renewable Energy Directive III, whether it is a renewable source contributing to climate neutrality. And with the Covid-19 pandemic, public services of forests close to settlements and urban areas have moved into the spotlight of socio-economic and socio-ecological interests from the general public to apply recreational activities in forests or to collect non-wood forest products. The associated increased demand from society to co-determine the multifunctional use of forests, how their multiple ecosystem services can be optimally delivered, is putting increasing pressure on forest governance and the interests and objectives of forest owners.

Now, under these more than complex framework conditions, the Commission tightens its influence even further on EU member states by granting itself the right to exercise delegated acts, e.g., to set reference values for CO_2 sequestration in the LULUCF guidelines, to comply with the Deforestation-Free Products Regulation, or the cascading use of wood flows under the Renewable Energy Directive III. Here, with just involving a committee of experts from the member states, who need not to be political

representatives, the Commission can directly specify implementation guidelines within the regulation's framework. This is seen critically by the member states as an interference in the democratic process because it would limit their participation in the legislative process.

Despite contradictory policy settings, we target to support the affected small forest owners in South Tyrol with a quadruple helix approach. Because its them, who are facing the tremendous task to cope with disturbances properly and to apply appropriate strategies to adapt their forests to climate change. We need to show solidarity as forest damages have destroyed the entire forest stands of some forest owners. Their forests will not be usable for the next generations. Hence, we see it as our task, to inform provincial decision makers in time on emerging legal novelties through our international networks of forest actors, such as IUFRO, ERIAFF, EUSALP or the contact group for international forest policy in Vienna, so that forest owners can adapt to them more easily. The aim is to encourage them in their responsibility to keep managing their forests despite the bark beetle disaster and not to abandon their forested areas. In that case, we would lose the autonomy of action over an ecosystem that contributes decisively to meet climate neutrality in 2050.

KEYWORDS

Small-scale forest owners, natural disturbances, bark beetle, diverging interests, forest-based value chain, forest policy

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4

Ecosystem services: synergies and trade-offs

Exploring the Interplay between Future Wood Demands and Ecosystem Services Trade-Offs in Norway

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ABSTRACT

Many European countries are promoting a bioeconomy based on renewable resources to mitigate climate change. However, using renewable resources will increase timber and biomass demand and will conflict with other ecosystem services. Here, we analysed whether Norwegian forests could meet the projections for wood and biomass demands from the international market while also meeting targets for other FES. Using data from the NFI we simulated the development of forests under different management regimes and defined forest policy scenarios, according to the most relevant forest policies in Norway: national forest policy (NFS), biodiversity policy (BIOS), and bioeconomy policy (BIES). Through multi-objective optimization, we identified the combination of management regimes matching best with each scenario. Our results revealed that Norway will be able to meet demands for wood and biomass in all policy scenarios, but that the future provision of FES will be strongly determined by policy targets at the national scale.

KEYWORDS

Forest ecosystem services, forest management, forest policy, multi-objective optimization

1 INTRODUCTION

The 2030 Sustainable Development Goals of the United Nations and the Paris Climate Change Agreement have recently prompted several European countries to develop strategies promoting bioeconomies based on renewable resources (European, 2018). It is anticipated that these strategies will increase wood demand since they promote the use of renewable biological resources to produce food, materials, and energy (Schulz et al., 2021). However, the increased wood and biomass demands may conflict with other ecosystem services provided by forests (Blattert et al., 2022) such as biodiversity conservation, flood control, or climate regulation. Additionally, bioeconomy development is only one of many policy targets that influence forest resources and management in most countries (BMU, 2007). For example, many countries have a biodiversity strategy, which focuses mostly on forest ecosystem services (FES) related to biodiversity. In Norway, the main policies that impact forest management, and therefore forest ecosystem services, are the bioeconomy strategy [BIES] (Skog 22) (INNR, 2015), the biodiversity strategy [BIOS] (Natur for livet) (MCE, 2015) and the white paper on forest policy and the wood industry [National forest strategy, NFS] (Verdier i vesk) (NMAF, 2016). The extent and diversity of objectives related to Forest Ecosystem Services (FES) addressed in these policies vary significantly due to their specific policy focus. For example, BIOS acknowledges the significance of conserving biodiversity and enhancing resilience, NFS takes more of a value chain perspective, and BIES strives to augment timber and biomass production (Nilsson et al., 2012; Nabuurs et al., 2019). This can result in a lack of coherence, causing a mismatch in policy objectives and leading to suboptimal management and divergent flows of FES (Aggestam and Pülzl, 2018). Here, determining the "optimal" forest management regime -or combination of them- will rely on the specific policy objectives for FES and the presence of trade-offs between them (Temperli et al. 2012; Schulz et al., 2021). In this context, a diversified forest management approach, which allocates areas to different management objectives, can reconcile these trade-offs, as opposed to maintaining a single management regime for all FES targets (Eyvindson et al. 2021; Messier et al., 2021).

This research offers insight into how ecosystem services can be integrated into decision-making in the Norwegian context. Prior research has successfully assessed conflict arising from diverse policy objectives utilizing NFI data and multi-objective optimization (Blattert et al., 2022). In this case, these conflicts were effectively resolved by identifying management programs that offer optimal combinations of regimes, meeting the demands of the Forest Ecosystem Services (FES). Our main questions here were:

1. Can Norwegian forests meet the projected wood and biomass demand for achieving climate mitigation targets while simultaneously meeting FES demands under the three different national policies?
2. What is the optimal combination of forest management to meet these demands? What is the effect on the rest of FES?

2 METHODS

2.1. Forest data and management regimes

We used data collected during 2005- 2019 as part of the Norwegian National Forest Inventory (NFI). The NFI is based on a five-year cycle, so each plot is resampled every 5th year with 1/5 of all NFI plots visited annually. These NFI plots are 250 m2 in size and were established at each intersection of a 3 × 3 km (easting x northing) grid in the lowlands, a 3 × 9 km grid in the mountains excluding Finnmark, and a 9 × 9 km grid in Finnmark (Fig. 2). In the study, plot-level forest inventory data served as input for a single-tree forest growth simulator integrated into the SiTree platform (Antón-Fernández and Astrup, 2022). This modelling approach enabled an assessment of the potential impacts of climate change on Norwegian forests, providing valuable insights into their future dynamics (Antón-Fernández et al., 2016).

Using SiTree, we simulated different management alternatives, classified into seven management regimes. These management regimes represent different levels of harvest intensities, rotation times, green tree retention levels, numbers of thinnings, and types of regeneration. Seven management regimes were examined, including modifications of the prevalent "business as usual" regime (BAU) in Norway. These regimes consisted of extensified BAU (EBAU) with a longer rotation age, intensive (INT) with heightened management intensity, and intensive-short (SINT) with a shortened rotation age. Additionally, the multispecies (MULT) regime aimed to promote mixed stands of spruce, pine, and birch, while the continuous cover forestry (CCF) regime sought to diversify forest structures without a final clear-cut. Lastly, the set aside (SA) regime represented the alternative of no management activities.

2.2. Forest Ecosystem services and policy scenarios

We examined six key ecosystem services (FES) in our study: timber production, bioenergy, biodiversity conservation, erosion and water regulation, climate regulation, and recreation. To capture the complexity of estimating these services, we employed multiple indicators, as outlined in Table 1. For a comprehensive explanation of how these indicators were calculated, please refer to the work of Vergarechea et al. (2023).

Based on the main national policy documents reflecting Norway's goals and governance mechanisms for FES provision, we defined three policy scenarios: The white paper on forest policy and wood industry, labeled here National Forest Strategy, NFS, (Verdier i vekst) (NMAF, 2016). This scenario aims to raise the value of the forestry and timber industry, increasing the production and sustainable extraction of raw materials, as well as the profitable production of bioenergy and biofuels. It also establishes objectives related to the conservation of biodiversity, through restrictions that prevent a decrease in the MIS area from its initial state. The Biodiversity Strategy, BIOS, (MCE, 2015) (Natur for livet), focused mainly on the promotion and conservation of biodiversity as well as the role that forests play in regulating services, such as erosion control. And finally, the Bioeconomic Strategy, BIES (INNR, 2015) (Skog 22). This scenario assumes more intense forestry, with a special focus on wood production, but also granting an important role to the rest of the ecosystem services, such as the increase in biodiversity or recreational aspects. Details of the policy scenarios are provided in Table 1.

Wood and biomass demand targets for Norway were expressed as timber demands and modelled using the GLOBIOM-forest model (IIASA's Global Biosphere Management Model, (Lauri et al., 2021)). GLOBIOM is an economic model that jointly covers the forest, agricultural, livestock, and bioenergy sectors, allowing it to consider a range of direct and indirect origins of biomass used. Therefore, by using multi-objective optimization, we matched the projected wood and biomass demand with the simulated timber harvest to determine whether Norway is capable of meeting climate mitigation targets.

2.3. Optimization

Using a multi-objective framework, we addressed the wood (GLOBIOM) and FES demands of the national strategies. Based on the preferences defined (Table 1) we designed policy-specific multi-optimization problem formulations to find a specific solution for each policy scenario while meeting the wood demands from GLOBIOM. Through specifying constraints and objectives, representing the policy targets, the optimization aimed to seek an efficient solution for individual forests defined from NFI plots. To do so, we followed a step-wise approach: 1) the hard targets or epsilon constraints were included, so we constrained timber harvest to match GLOBIOM demands; 2) the national policy targets for FES were then optimized (as a reference point), considering the objectives and constraints defined in Table 1. For a more detailed description of the mathematical formulation and individual functions used here see Vergarechea et al. (2023).

3 RESULTS

Figure 1a shows that Norway can meet GLOBIOM biomass demands for wood and bioenergy in all scenarios, NFS, BIOS, and BIES, due to the harvest volume aligning perfectly with GLOBIOM demands. Notably, there was a substantial and consistent increase in volume during the initial 50 years of the simulations, rising from 11 million m3 in 2018 to 16.8 million m3 in 2073. Following this period, the growth of the harvest volume became more gradual, ultimately reaching 17 million m3 by the end of the simulation in 2093.

In the NFS scenario, the extensive regime class (BAU) - traditionally employed in Norway - covered nearly 40% of the area, while in the BIOS scenario, it only accounted for 20%. Conversely, BIOS had a reduction of approximately 2 million ha in the area allocated to BAU (Figure 1b), with an increase of 1.2 million ha for set-aside and a 0.5 million ha increment for continuous cover forest. In the BIES scenario, BAU and extensified BAU (EBAU) held almost equal proportions at 28.1% and 30.7% respectively, followed by set-aside at 15.3% and intensive management (INT) at 11.8%. Compared to NFS, BIES exhibited a smaller area (1 million ha) assigned to BAU, but had an increased allocation for intensive (INT), extensified-BAU (EBAU), set-aside (SA) and continuous cover forestry (CCF).

Table 1. Set of indicators and constraints used in each of the policy scenarios, NFS, BIOS, and BIES. MiS area = set-aside areas of "Complementary Hotspot Inventory".

Forest ecosystem service (FES)	Indicator (unit)	NFS objective / constraint	BIOS objective / constraint	BIES objective / constraint
Wood production	Harvest net value (NOK) Harvested volume (Mm^3)	Maximize	 Maximize (even-flow)	Maximize
Bioenergy	Harvested residues (kt)	Maximize		
Biodiversity	MiS* area (ha) Deadwood volume (Mm^3) Bilberry (%) MIS area (ha) Deadwood volume (Mm^3) Bilberry (%)	No decline allowed		No decline allowed
Water protection	Harvest vol. in steep terrain and mountain forests (Mm^3)		No decline allowed	
Climate regulation	CO_2 storage in harvested wood product (kt) CO_2 storage in harvested wood product (kt) Flow of carbon sink in forests (Million kt)	Maximize No decline allowed		Maximize Maximize
Recreation			No decline allowed No decline allowed	No decline allowed No decline allowed

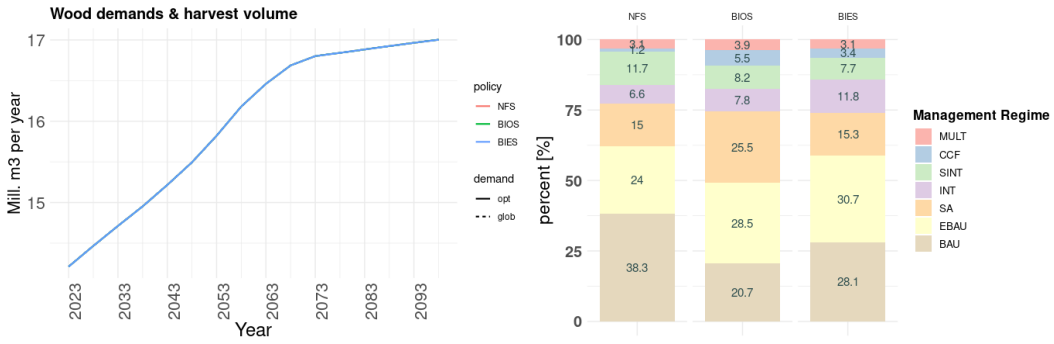

Figure 1.

a) GLOBIOM wood and biomass demands for the NDC scenario, and provision of harvested volume under the three policy scenarios. Here, the attained harvest volumes and GLOBIOM wood and biomass demands for the NDC scenario completely match all 3 scenarios

b) Optimal management solution for the three policy scenarios.

MiS area showed a consistent increase under both BIOS and BIES scenarios. Initially, the most significant increase was observed under BIOS, where the indicator served as both an objective to maximize and a constraint to prevent a decline from the current state in 2018. However, starting from 2042, there was a notable upward trend in the BIES scenario, resulting in higher values compared to BIOS by the end of the simulations. The BIOS scenario maintained a steady yield of bilberry, demonstrating the impact of constraints in preventing a decrease from the current state. Conversely, the other two scenarios, particularly NFS, experienced a decline in the bilberry area particularly during the initial years (Figure 2).

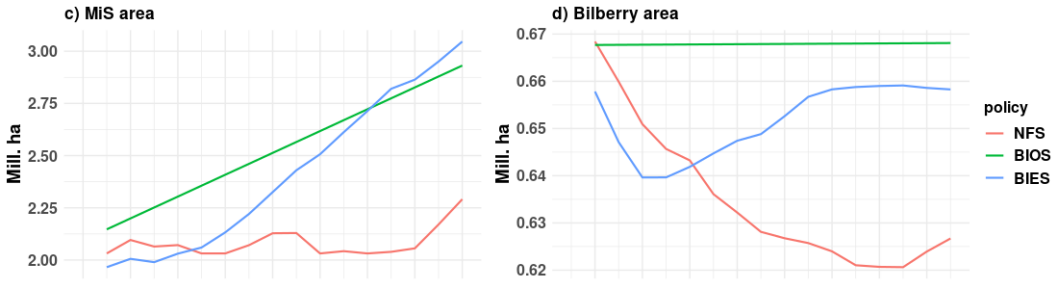

Figure 2. Effect of optimal solution on the future development of some biodiversity indicators

4 DISCUSSION AND CONCLUSION

Wood and biomass demand for climate mitigation targets (GLOBIOM) were easily met in all scenarios. By 2093, the demand reached almost 17 million m3, a 64% increase from 2018. This agrees with the findings of Solberg et al. (2021) who also predicted a substantial increase in Norway's harvest levels, rising from 10 million m3 in 2010 to 15.6 million m3 by 2050. Norway's harvest levels have historically remained fairly stable at around 10-13 million m3, while annual increment net growth has increased from 20 million m3 in 1990 to 24 million m3 in 2020 (SSB, 2020). This could indicate that current growth rates in Norwegian forest are below their potential for production. However, despite wood stocks are predicted or expected to increase in our scenarios, diverse uncertainties could considerably affect forest growth and development in the future.

Under the BIOS scenario, set-aside (SA) and continuous cover forestry (CCF) areas increase significantly. These practices positively impact forest structure and biodiversity, such as canopy structure, amount of deadwood, rotation length, presence of old trees and species mixture, and are crucial for ensuring the long-term sustainability of forests (Castro et al., 2015). However, achieving these benefits while meeting the demands for bioenergy and wood may require compensatory increases in timber harvest from other forest areas dedicated to intensive production (Duncker et al., 2012). Due to this, some areas of the forest may degrade to some extent, especially in NFS and BIES, where biodiversity targets have been more challenging to achieve. To minimize this, policies should establish instruments to encourage forest owners to adapt their management practices so that they can reduce forest degradation by using forest landscapes more effectively. Existing programs in Norway, such as those established by the Norwegian

Ministry of Agriculture and Food (2005) and MCE (2005), already address certain regulations and support for sustainable forestry practices. These include requirements for forest owners to regenerate harvested areas within three years and financial assistance for sustainable activities. Recent efforts have prioritized improving forestry infrastructure, such as forest roads and timber terminals, in areas with limited access, which helps maximize the utilization of forest resources.

According to Figure 2, BIOS and partially BIES were the most consistent scenarios for biodiversity FES indicators. Under the NFS and BIES scenarios, the decline in bilberry cover area could be explained by a lack of constraints on this indicator and could be related with the trade-off between timber production and ecosystem services. In this regard, Lõhmus and Remm (2017) demonstrated the influence of stand density on bilberry habitat. They found that the intensification of forestry brings reductions in bilberry cover, which agrees with the decline of the bilberry cover area under NFS and BIES (Figure 2). Differences in MiS area between scenarios could be explained by the fact that in NFS and BIES the indicator was included in the optimization framework as a constraint and not as an objective to maximize, as in BIOS (Table 1). As a result, BIOS and BIES both exhibit a non-decreasing pattern for MiS area, compatible with policy targets related to this indicator, while NFS shows significantly lower levels of MiS area.

In summary, the comparison of the three policy scenarios highlights that no single management strategy can fully optimize the provision of multiple ecosystem services simultaneously. A combination of these scenarios, incorporating different preferences, may be the most desirable approach. However, the analysis reveals conflicts among policies in terms of management. It emphasizes the importance of aligning future policies to address these inconsistencies.

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Water - the future source of forestry income?

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ABSTRACT

The increasing competition for nature resources usage emerges the highest pressure on ensuring forest ecosystem services. The goal of the paper is to demonstrate that the quality of the water is the forest's positive external effect and the value of this service. The paper points to possibilities for valuation methods based on costs for drinking water treatment in forested water catchments near three water reservoirs in Slovakia. The value of this service in the case of analysed water reservoirs in Slovakia is in the range of 1.67 to 8.90 € ha^{-1} $year^{-1}$. With the alternative payment of a water cent for each m^3 of drinking water consumed, the calculated value per ha of forest in water reservoir catchment is in the range of 3.82 - 12.19 € ha^{-1} $year^{-1}$. The valuation of water quality and quantity regulation enables to compensate forest enterprises for ensuring these services and is also the base for implementing effective forest policy instruments.

KEYWORDS

Water quality, forestry, forest ecosystem services, valuation of forest ecosystem services

1 INTRODUCTION

As a result of limited resources, water is gradually becoming an important capital and strategic natural source. In the Slovak Republic, underground water sources (82.2%) and surface water sources (17.8%) are used to collect drinking water. Almost all drinking water from surface sources is tied to forest ecosystems. This reflects that most water reservoirs used for the "production" of drinking water and drinking water abstraction points are located in forested areas. Although water-related ecosystem services are included among the key forest ecosystem services (Hamilton et al., 2008; Čaboun et al., 2010; Robinson and Cosandey, 2011) and almost all surface water sources are formed in forests, forest managers in the Slovak Republic are excluded from the "water trade chain".

The increment in water prices is related to the increasing costs of its treatment. The operating costs depend on the water source distance from the point of abstraction, the character of the source (surface/underground), investments of water management utility into the distribution network, the number of abstraction points and costs of water treatment. The alternative of decreasing total costs is to take advantage of the positive external effects of forests ecosystem to water quality and quantity. The sustainable and superior water sources descend from forest ecosystems (Šišák et al., 2002; Neary et al., 2009; Sukhdev et al., 2010). Conversely, agriculture and urbanisation are the main source of nutrients and xenobiotics that decrease water quality (Bennett et al., 2001). Forest ecosystems play an important role in water cycling. They increase vertical and horizontal water flows, such as condensation, retain precipitation and reduce surface effluent retention (Papánek, 1978). The existence of the forest as such excludes or significantly eliminates the use of fertilisers and chemical substances that affect water quality (Trenčiansky et al., 2021). In areas with agricultural production transition to ecological farming combined with the exclusion of fertilisers and chemical preservatives improve water quality indicators (Trenčiansky et al., 2022a).

The goal of the paper is to demonstrate the valuation methods of water-related forest ecosystem services on the example of the prior national study (Trenčiansky et al., 2022b). The results of the alternative costs method and „water cent" payment mechanism are presented.

2 METHODS

2.1 Valuation method of water-related ecosystem services

The Water-related ecosystem services are not objects of the market. Therefore, it is essential to make conditions for these services analogically. The valuation principles based on revenues arise from two basic approaches i.e., the producer´s and consumer´s perspectives (Bergen et al., 2002). The valuation from the producer's perspective is based on the fact that for each unit of forest ecosystem service, the producers demand a minimum compensation in the amount of the costs they have to spend on its production in the required quantity. We interpret the valuation from the consumer´s perspective of

the forest ecosystem services as his maximum willingness to pay for the amount of the given service.

From a methodological point of view, we demonstrate an example of quantifying a water protection ecosystem service based on the Alternative cost method. An alternative to ensuring the water protection ecosystem service is the cost of drinking water treatment, formed by the costs of chemical substances for drinking water treatment. We will define a regression equitation formula based on the analysis of water treatment costs in the years 2011-2015 in three water reservoirs (Málinec, Klenovec, Turček) and the analysis of forest cover. Next, we will calculate the difference between the average costs for water treatment of individual water reservoirs in the observed period and the model costs determined by the linear regression equation at 0% level of afforestation. The difference will represent a cost saving in the average cost of water treatment and the contribution of forest stands to the water protection ecosystem service.

We calculated the value of water protection ecosystem service for each catchment using formula:

$$VWS = \frac{DC \cdot W}{FC}$$

where:

VWS - annual value of water protection service (€ ha^{-1} $year^{-1}$)

DC - difference of real average costs of water treatment at the current forest cover and modelled costs in case of 0% forest cover (€ m^{-3})

W - average volume of treated water (m^{-3})

FC - forest cover in catchment area (ha)

We will compare the calculated value of the water protection service with the alternative payment scheme water cent. With this payment scheme, water consumers would pay a fee of 0.01 € m^{-3} $year^{-1}$ to forest owners per each consumed volume of drinking water.

2.2 Study area

The study was made on three water reservoirs (WR) and its catchments located in central Slovakia region: WR Málinec, WR Klenovec and WR Turček (Figure 1). The basic parameters of the reservoirs are shown in the Table 1.

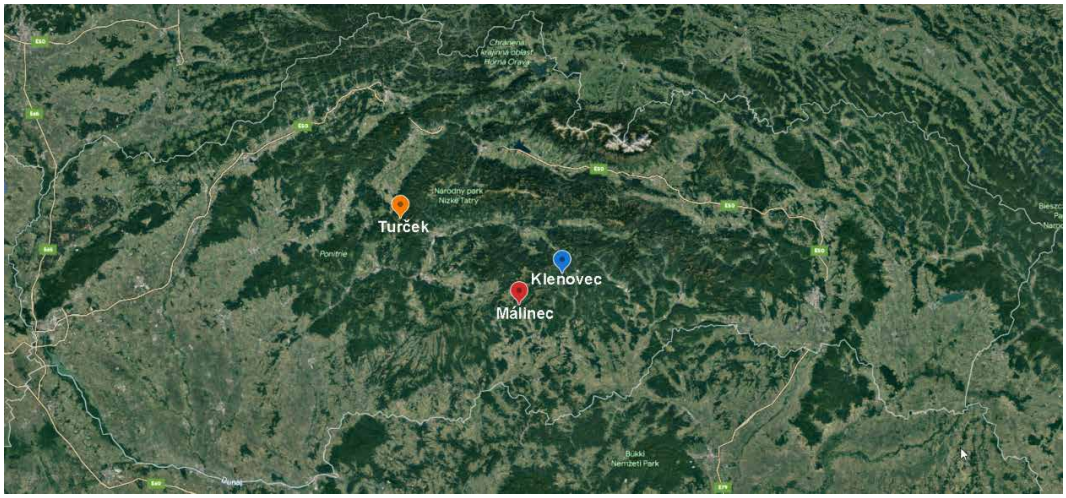

Figure 1. Analysed water reservoirs (source Google Earth)

The input data of the research are average costs of water treatment took from water management utilities and catchment forest cover ratio (Table 1) and qualitative water indices before its treatment.

Table 1. The basic parameters of chosen WR

Water reservoir	Málinec	Klenovec	Turček
Forest cover (%)	56,11	70,80	100,00
Catchment area (km²)	78,7	92,12	28,96
Water area (km²)	1,38	0,71	0,54
Capacity (mil. m³)	26,70	8,43	10,60
Average annual volume of drinking water (mil. m³)	2,6	2,5	3,5
Average costs for drinking water treatment (€ m^{-3} $year^{-1}$)	0,01227	0,01232	0,00940

The lowest costs of water treatment in observed period and highest water quality before treatment was spotted in water reservoir Turček (managed by „Stredoslovenská vodárenská spoločnosť, inc., Banská Bystrica"). Turček catchment has highest forest cover. The costs of water treatment represent costs of used chemical substances, e.g. sodium chlorite, hydrochloric acid, ferric sulphate, potassium permanganate and calcium aluminate.

3 RESULTS

We defined a regression relation based on the results on average costs for drinking water treatment and forest cover of the catchments (Figure 2).

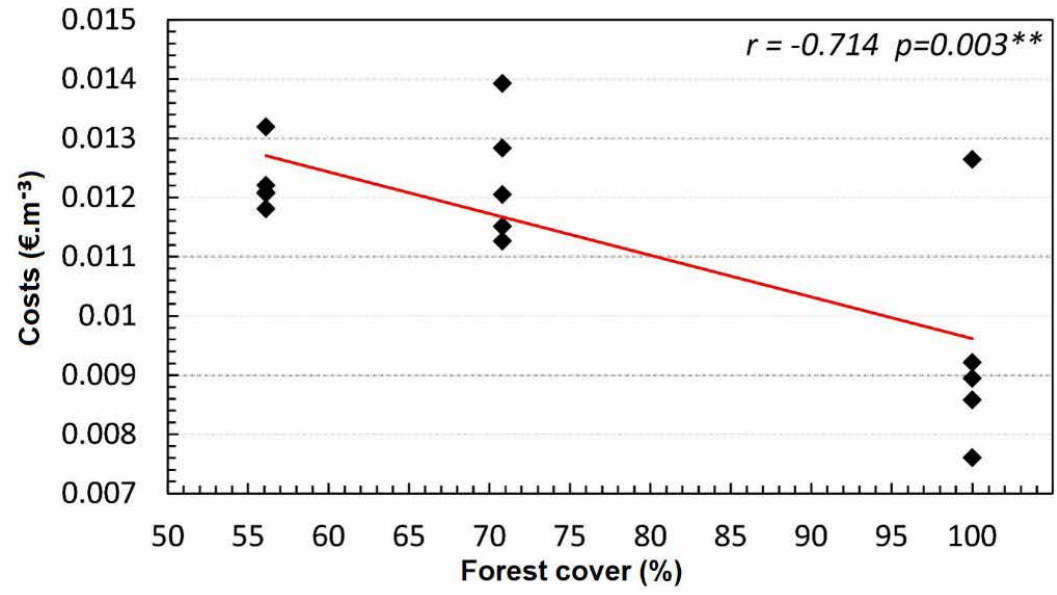

Figure 2. Dependence of average water treatment costs on forest cover of water catchments

Defined regression equitation confirmed relations between costs of drinking water treatment with decreasing forest cover. In case of no forest cover (0 %), the modelled costs are 0,0167 € m^{-3}. The difference between modelled costs in case of no forest cover and real costs of water treatment in each catchment around water reservoirs, represents potential costs saving of water treatment for water management utility. This is caused by the forest and its influence on water quality (Table 2).

Table 2. Saving of average costs for water treatment in individual catchments of water reservoirs

Water reservoirs	Forest cover (%)	Average costs for water treatment (€.m^{-3})	Model costs for water treatment at forest cover 0 % (€.m^{-3})	Saving of average costs for water treatment (€.m^{-3})
Málinec	56.11	0.01227	0.0167	0.00443
Klenovec	70.80	0.01232	0.0167	0.00438
Turček	100.00	0.00940	0.0167	0.00730

The alternative to reduction of the costs of water treatment is increasement of forest cover of catchment. The annual costs savings of water treatment through using positive external effects of forests on water quality represents annual value of water protection service. The annual value of water protection per year and hectare is based on average annual volume of treated water of each catchment (Table 3). The highest costs savings of water treatment for water management utility is in WR Turček. Average value of water protection service falls within 1,67–8,90 € ha^{-1} $year^{-1}$.

Table 3. The value of the water protection function of forests in individual catchments of water reservoirs

Water reservoirs	Forest area (ha)	Average annual volume of treated water (m^3)	The value of the water protection function of the forest (€ $year^{-1}$)	Average value of water protection function (€ $ha^{-1}year^{-1}$)
Málinec	4,417	2,601,392	11,515	2.61
Klenovec	6,522	2,490,399	10,911	1.67
Turček	2,896	3,529,540	25,767	8.90

Table 4 shows the calculation of alternative payment "water cent". The payment is derived from the volume of water treated and consumed by consumers per year. The average annual value of the payment figured per ha of forest is in the range of 3.82 - 12.19 € ha^{-1} $year^{-1}$. The annual value of the water cent payment per 1 consumer reach to 0.35 € $year^{-1}$, with the average annual water consumption 35 m^3 $year^{-1}$ per consumer.

Table 4. Water cent as payment for water protection ecosystem service

Water reservoirs	Average annual volume of treated water (m^3)	"Water cent" (€ $year^{-1}$)	Water cent -average value for forest area (€ $ha^{-1}year^{-1}$)
Málinec	2,601,392	26,013	5.89
Klenovec	2,490,399	24,904	3.82
Turček	3,529,540	35,295	12.19

4 DISCUSSION AND CONCLUSION

Forested water catchments contribute to improvement of water quality and decrement of water costs treatment (Biba et al., 2007). The results of USA study (Ernst et al., 2004) confirmed that costs on water treatment in water utilities that used surface water sources, has varied in relation of the forest cover. Moreover, the operating costs of water treatment had decreasing trend in relation to a higher forest area ratio. Each 10% of higher forest cover decreases water costs treatment by approximately 20%. In our case, the analysis showed that with an average increase in forest coverage by 10%, the average cost of water treatment decreased by approximately 5%. The deviation of costs may be caused by the influence of other factors that may affect water quality. Payments for ecosystem services (PES) are one of appropriate optimal mechanisms for ensuring water-related ecosystem services near water reservoirs. The side of the supply is represented by forest owners or enterprises who manage the forests around the reservoirs. The beneficiaries are water management utilities, municipalities, and residents. The costs related to ensuring water-related ecosystem services defray forest owners without additional compensation. The private PES scheme should compensate management practices focused on water quality and quantity support. The alternative

costs method valuated ensuring of water quality protection near water reservoirs as 1.67 – 8.90 € ha^{-1} $year^{1}$. The "water cent" method assessed value of this services as 3.82 – 12.19 € ha^{-1} $year^{-1}$. The PES focused on water-related ecosystem services are still considered as innovative approach in Slovakia. In case of its successful development, the provision of water-related ecosystem services will increase. It is important to prepare PES schemes consistently and with the support of involved stakeholders.

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Proposals of forest management approach according to identified trade-offs and synergies between forest ecosystems services: A literature review

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ABSTRACT

This paper explores the trade-offs and synergies between forest ecosystem services (FES) by reviewing scientific literature. The focus is primarily on research in European forests, including other countries with boreal and temperate forests. Through content analysis, we reviewed 167 articles from the licensed Web of Science database using specific keywords, from which 38 articles discussed relationships between forest ecosystem services. The research study shows that using one service often affects others due to the complexity of the ecosystem. Wood provisioning with other services often presents a trade-off relationship. However, wood provisioning can coexist with other forest ecosystem services when appropriately managed. It can even positively impact carbon sequestration, water retention and recreation. Based on these findings, the paper offers possible forest management approaches for reducing the number of trade-offs and increasing the share of synergy relationships with an assumed positive impact on the economy of the forest enterprise.

KEYWORDS

Forest management, ecosystem services, trade-offs, forest enterprises, synergy

1 INTRODUCTION

Ecosystem services are the benefits that ecosystems contribute to human well-being. As part of the classification of forest ecosystem services, we know several classification systems at the international level. The 2018 CICES V5.1 updated and extended the older 2013 version CICES V4.3 (CICES, 2018). Based on this classification, ecosystems and ecosystem services have been mapped and assessed since 2013 as part of the program

- Strategy of the European Union in the field of biodiversity until 2020 (MAES, 2013). According to CICES (2018), it divides FES into three sections. Provisioning services (wood supply, wildlife supply, non-wood forest products, water supply), regulatory services (water retention, erosion control, carbon sequestration, gene pool protection, noise reduction, pest protection) and cultural services (recreation, tourism, natural monuments).

Due mainly to anthropogenic influences, FES come into mutual interaction and synergistic "synergies" or competitive "trade-offs" relationships arise between individual services (Vallet et al., 2018). These relationships between FES can be bidirectional. Individual FES can influence each other positively and negatively (e.g., provisioning services influence regulatory ones and vice versa).

Correctly understanding these relationships is essential because, in recent years, the proper use of forest ecosystem services (FES) has been debated more than ever before. The paper aims to identify the relationships between forest ecosystem services within the scientific review and propose possible forest management approaches that decrease the number of trade-offs and support synergies between FES.

2 METHODS

The main objective of this review was to identify the relations between FES according to CICES classification and suggest proposals on how to manage them. Therefore, the search focused on finding publications in this field. As part of the qualitative data collection (Guest et al., 2013), we used the licensed Web of Science (WoS) database. The review process has been carried out following the guidelines applied by Rejeb et al. (2022). Figure 1 shows the research process based on the five phases.

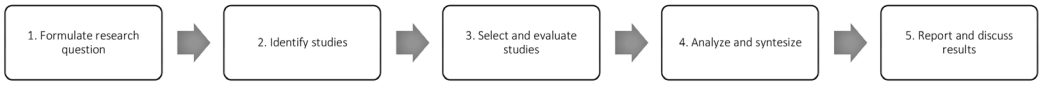

Figure 1. The steps of a systematic literature review

In the first phase, research questions (RQ) have been formulated to guide the research:

- RQ 1: Which ecosystem services are in a trade-off, and which are in a synergy relationship?
- RQ 2: With which managerial approaches can we properly affect identified FES relationships?

In the second phase, we did a preliminary search in the database in January 2023 based on the keywords ("forest ecosystem services" - Title) and ("relationship" or "correlation" or "affect" or "influence" or " impact" - All fields). Subsequently, we supported the preliminary search by brainstorming with other members of the VEGA project [1/0271/22] and determined the exact search terms. Based on the search terms we identified, in the second phase, in February 2023, we searched the database using the keywords ("forest ecosystem services" - Title) and ("trade-offs" or "synergies" - All fields). Such a search yielded 155 ("forest ecosystem services" and "trade-offs") and 73 ("forest ecosystem

services" and "synergies") articles. In the third phase, from the given articles, we selected those whose research area was in Europe, the USA, Canada, or China. The main reason was to find similar conditions to Slovakia due to the maturity and natural conditions of the countries (boreal and temperate forests). In the fourth phase, we used content analysis (Mayring, 2003) to identify and analyse relationships between FES and assign them to sections and classes according to the CICES V5.1 classification. We prepared and applied a coding table (Table 1) for the assignment. In the fifth phase, we used semi-structured interviews (Ying and King, 2003; Horrocks, 2011) with forest managers (heads of forest enterprises) to discuss and evaluate experts' proposals on managing identified trade-offs and synergy relations between FES (Tables 2-3). Proposals for possible forest management approaches to FES relationship management were presented by experts from the university. So, we used the systematic approach of using multiple sociological methods which is commonly referred to as triangulation (Zohrabi, 2013). Suggested forest management approaches (Tables 2-3) include combinations of appropriate silviculture, logging and transportation, distribution services, and economic approaches. In the long run, these approaches aim to reduce the number of trade-offs relationships, reduce costs in forest management, and strengthen the quality of forest management. In the short term, they aim to increase initial investments in renewing logging and transportation, increasing costs due to close-to-nature management, etc.

Table 1. Coding table using CICES classification on the example of one provisioning ecosystem service

Identified key words	Classified by authors	Equivalent class by CICES 2018 (code)	Division by CICES (2018)	Section by CICES (2018)
biomass production, woody biofuel, residues extraction	Biomass provisioning	Cultivated plants (including fungi, algae) grown as a source of energy (1.1.1.3)	Biomass	Provisioning

3 RESULTS

The findings indicate how often the desired relationships (trade-offs and synergy) occurred during the studied timeframe. According to published papers, the period is limited to 2005-2023.

Table 2. Proposals of forest management approaches from the review based on identified trade-offs between

Number of reviewed scientific papers (n)	Identified relations between FES according to		Management approach
	Authors (Bumbera, Halaj)	Equivalent section classification by CICES V5.1 (2018)	
1	Wood provisioning vs. Biomass provisioning	Provisioning vs. Provisioning	Timber sale optimization
2	Wood provisioning vs. Non-wood forest product provisioning		Integrated forest management with emphasis on non-wood forest products
2	Venison provisioning vs. Wood provisioning		
4	Biomass provisioning vs. Biodiversity	Provisioning vs. Regulation and Maintenance	Close-to-nature forest management
4	Biomass provisioning vs. Carbon sequestration		Final processing of biomass at the heating plants
4	Wood provisioning vs. Water retention		Close-to-nature forest management
2	Wood provisioning vs. Erosion control		
19	Wood provisioning vs. Biodiversity		
19	Wood provisioning vs. Carbon sequestration		Partial implementation of sawmilling, pallet manufacturing, etc. at the forest enterprises
10	Wood provisioning vs. Recreation and tourism	Provisioning vs. Cultural	Quality enhancement of supply services Integrating own logging and transport mechanisms
5	Venison provisioning vs. Recreation and tourism		Integrated forest management with focus on cultural services
2	Recreation and tourism vs. Biodiversity	Cultural vs. Regulation and Maintenance	

Table 3. Proposals of forest management approaches from the review based on identified synergies between FES

Number of reviewed scientific papers (n)	Identified relations between FES according to		Management approach
	Authors (Bumbera, Halaj)	Equivalent section classification by CICES V5.1 (2018)	
2	Wood provisioning vs. Biomass provisioning	Provisioning vs. Provisioning	Small-scale silviculture
1	Wood provisioning vs. Venison provisioning		
1	Wood provisioning vs. Water supply		
1	Wood provisioning vs. Erosion control	Provisioning vs. Regulation and Maintenance	Selective logging
5	Wood provisioning vs. Biodiversity		Quality maintenance of supply services
12	Wood provisioning vs. Carbon sequestration		Close-to-nature forest management
2	Biomass provisioning vs. Carbon sequestration		
1	Water supply vs. Soil formation		Selective logging Small-scale silviculture
1	Wood provisioning vs. Natural heritage	Provisioning vs. Cultural	Enhancement of forest road network
7	Wood provisioning vs. Recreation and tourism		
1	Venison provisioning vs. Recreation and tourism		Integrated forest management with focus on game management

The literature review results confirmed the assessment of FES relations to a large extent as trade-offs. The significant share of wood provisioning (provisioning services) in the portfolios of forest enterprises with more than 80% of total sales substantially influences the findings. Most trade-offs were evaluated between provisioning vs. regulation and maintenance services, concretely wood provisioning vs. biodiversity and wood provisioning vs. carbon sequestration. An interesting finding is that even the provisioning services themselves compete (e.g., wood vs. biomass provisioning). The public most criticise the impact of wood provisioning on cultural services (recreation and tourism). As a part of the literature review results, it was confirmed that this relationship was considered one of the most significant trade-offs. On the contrary, the greatest synergy was considered paradoxically between wood provisioning vs. carbon sequestration and between wood provisioning vs. recreation and tourism.

4 DISCUSSION AND CONCLUSION

The results of the survey reflect the assessment of relations between FES author teams in individual articles. To a certain extent, despite the literary review, a specific degree of their subjectivity was present in the assessment of relations between FES. In some cases,

the articles we identified dealt only marginally with the relations between FES (Torralba et al., 2020). However, the assessment followed their results. The findings, to a considerable extent, point to the fact that the individual FESs are very connected to each other. It cannot be unequivocally claimed that the relationship between FES data is only a trade-off or synergy. To ensure objectivity in our evaluation, we need to examine FES throughout its entire life cycle rather than just focusing on certain phases (Hardaker et al., 2022). Such an example is the relationship between wood provisioning vs. carbon sequestration.

Proposals for forest management approaches are largely based on close-to-nature management or integrated forest management, focusing on quality maintenance of supply services. These approaches preserve the compliance of provisioning services with regulation, maintenance, and cultural services. Understanding the relationships between FES, looking for intersections between these services, and the degree of their impact on other services is the basis of integrated forest management as well as a way of economic efficiency of forest enterprises.

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Results of the Evaluation of the Supported Forest Effects for the Recreational and Educational Function of Forests in Suburban Forests

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ABSTRACT

The paper presents the results of the author's doctoral thesis entitled 'Quantification, Evaluation and Enumeration of Supported Forest Effects for Recreational and Educational Function of Forests in Special Purpose Forests - Suburban Forests'. By developing the objectives in a step-by-step manner, the values of the supported effects of forests for recreational and educational functions were quantified in a case study of the Chrudim - Podhůra Recreational Forests using three methods. The first method used was from the Czech Republic, the second method was selected from methods developed in the European Union. The third method used was developed in this paper to value the supported effects by quantifying the actual amount of increased costs. Finally, a comparative analysis of the results of the methods used to evaluate the forest's supported effects was carried out. The results of the work can be used for the valuation of other ecosystem services.

KEYWORDS

Societal functions of forests, subsidies, ecosystem services, forest categories, methods, compensation for increased costs, payments

1 INTRODUCTION

An increasing number of people are becoming aware of the irreplaceable role of forests in their lives, especially for their recreation, sport and relaxation. As the urban population grows and the number of people in the countryside decreases, the importance of suburban forests increases. Thus, the vast majority of suburban forests mainly perform recreational and educational effects and functions, cultural (recreational and educational) ecosystem services (ES). However, the provision of cultural ES imposes increased costs on owners and operators. Costs are paid for by the operator of cultural ES mainly from the income from forest management or other activities and with the help of contributions from owners or subsidies.

Due to climate change, forestry is currently undergoing major changes in management. In most cases, these changes have a negative impact on the economic situation of

individual forest owners, which means that owners will have fewer resources to provide some ES.

The main objective of this paper is to present a comparative analysis of the results of the applied evaluation procedures of the social socio-economic significance of the functions of special purpose forests (suburban forests) in the Czech Republic and Italy. The comparative analysis includes testing the hypothesis and developing an interpretation of the results obtained from the application of each method. The quantification of inputs for supporting and maintaining the recreational function of the forest is carried out in a case study on the territory of the Chrudim - Podhůra Recreational Forest due to the author's familiarity with the area.

The hypothesis is tested on whether the amount of compensation for the provision of ES of the forest of non-market environmental health and hygiene (recreational) and cultural and educational (educational) in the special purpose forests - suburban forests determined by this work is sufficient (H+), or whether it is insufficient (H-) and due to the current economic situation in the forestry sector there is a risk that the owners will stop providing these ES or reduce them.

2 METHODOLOGY

2.1 Definition of terms

According to Section 2 of Act No. 289/1995 Coll., the Forest Act, as amended, forest functions are the benefits conditioned by the existence of the forest, which are divided into production and non-production. The functions of the forest can be understood as the realised production of the effects of the forest, which result from its nature and from ecosystem processes (Vyskot et al., 2003).

Forest ES can be divided into market (productive, production, internalities) and non-market environmental services (non-productive, non-production, externalities) and can be defined according to the socio-economic area in which they satisfy social needs. The differentiation of forest functions is similar to the differentiation ES (Šišák et al., 2017).

According to Section 6 of Act No. 289/1995 Coll., Forest Act, as amended, forests are divided into three categories according to their predominant functions: protective forests, special purpose forests and economic forests.

2.2 Literature review

The area of Chrudim - Podhůra Recreational Forests is located almost in the centre of the Czech Republic. The area is part of a larger forest complex called Podhůra Recreational Forests. The owner of the forests in the complex is the town of Chrudim (the forests owned by the town of Chrudim are called the Chrudim - Podhůra Recreational Forests), the town of Slatiňany and the Forests of the Czech Republic, state enterprise.

Podhůra Recreational Forest is in the Iron Mountains Protected Landscape Area (Faltysová and Bárta, 2002) and is also part of the Slatiňansko - Slavicko Conservation Area (Národní památkový ústav, https://www.pamatkovykatalog.cz/slatinansko-slavicko-7663986).

The recreational forests of Chrudim - Podhůra have an area of 122.87 ha, the forests are managed by the company Městské lesy Chrudim, s.r.o. based on a lease agreement with the town of Chrudim, the forests are classified as special purpose forests - suburban forests and as other forests with increased recreational function. The sole owner of the company is the town of Chrudim. The forests are in the Forest Management Unit of Městské lesy Chrudim. The currently valid forest management plan is drawn up for a period of 10 years, valid from 1 January 2020 to 31 December 2029.

In order to carry out a proper quantification, evaluation and enumeration of the supported forest effects for the recreational and educational function of the forests, all supported forest effects and increased costs of cultural ES of the selected area were first studied and described in detail. For the sake of clarity, the quantification and description of the implemented supported effects is carried out in the paper in ascending order according to the year of implementation of the projects from 2004 to 2022, all prices are given in thousands. The implemented projects were divided into three categories according to the financial volume of investment (Odvárka and Meňházová, 2022).

2.3 Analysis of the management of company and the company's recreational forest section for the period 2010 to 2022

The analysis and results of the company Městské lesy Chrudim, s.r.o. is divided into two parts, the results of the management of the company as a whole and the results of the management of the recreational forest section. All data is presented in thousands of Czech crowns (CZK) without VAT.

In order to determine the results of the management, the company's accounting and production documents were analysed, especially budgets and projects, approved annual accounts, accounting audits, etc. On the basis of the analyses, a database of the company's overall management results and a database of revenues, costs, overall management results of the recreational forest section were created. The total economic results, the average results of management in total and per 1 ha of land of the company as well as its recreational forest section, the owner's contributions and the average amount of contributions in total and per 1 ha were quantified.

2.4 Quantifying the value of supported forest effects using two existing methods

Using two selected evaluation methods (the first method was chosen from methods used in the Czech Republic, the second from methods used in the European Union), the value of supported effects (the amount of compensation for the provision of supported recreational and educational ES) on the territory of the Chrudim-Podhůra Recreational Forest will be quantified.

2.5 Developing a new method and using this method to quantify the value of the supported forest effects

The dissertation will develop a new method of valuation of supported effects using the actual amount of increased costs called "Method of quantification, evaluation and quantification of supported forest effects for recreational and educational function

of forests in special purpose forests - in suburban forests". This method quantifies, evaluates and quantifies the supported effects of the forest for recreational and educational functions in the selected area using the actual amount of increased costs, which is determined by analysing the area, the ES (effects) supported and accounting data by quantifying the actual annual revenues, costs and economic results of the supported effects of the forest of the selected area.

This new method will be used to quantify the value of supported forest effects (the amount of compensation for the provision of supported recreational and educational ES) in the Chrudim-Podhůra Recreational Forest.

2.6 Comparative analysis of the results of the applied evaluation procedures

The first step of the comparative analysis of the results of the applied evaluation methods will be the preparation of the Experimental Results Sheet I., which will summarize the results of the three applied methods of quantifying the value of the supported forest effects for recreational and educational function (the amount of compensation for the provision of supported recreational and educational ES) and will compare the individual results of the applied methods of evaluation of supported forest effects, i.e. the amount of annual compensation for services in CZK/ha/year according to the individual evaluation methods.

The next part of the comparative analysis will be the creation of the Experimental Result Sheet II, which will contain the amount of annual compensation for the provision of increased supported ES, determined by the work according to the individual assessment methods, the amount of compensation for services according to the actual results of management, determined for the testing of the hypothesis on the territory of the Recreational Forests Chrudim - Podhůra in thousand CZK without VAT/territory/year and the result of hypothesis testing.

3 RESULTS

3.1 Value of supported forest effects quantified using two existing methods

The total amount of the value of supported effects (the amount of compensation for the provision of supported recreational and educational ES) according to the first selected (in the Czech Republic used) method called "Methodology for assessing the social socio-economic significance of forest ecosystem services" (Šišák et al., 2017) is set at an annual amount of 7 715 CZK/ha.

The total amount of compensation for the provision of supported recreational and educational ES according to the second selected (used in Italy) method called "Assessment, valuation and mapping of ecosystem services in Alpine forests" (Häyhä et al., 2015) is set at an annual amount of 1 857 CZK/ha.

3.2 The new evaluation method and the value of the supported effects quantified by the new method

A new evaluation method called "Method for quantification, evaluation and quantification of supported forest effects for the recreational and educational function of forests in special purpose forests - suburban forests" was developed by the dissertation.

The total value of the supported effects (the amount of compensation for the provision of supported recreational and educational ES) is set at CZK 9 953/ha per year under this (third overall) new method.

3.3 Comparative analysis of the results

3.3.1 Experimental result sheet I

In Experimental Results Sheet I, the results of the applied evaluation procedures for the supported effects of the forest are collected, according to these results the evaluation and comparison of the supported effects of the forest is carried out, i.e. the comparison of the amount of annual compensation of services in CZK/ha/year according to the different evaluation methods.

The arithmetic mean of the annual service compensation amount CZK/ha/year according to the individual evaluation methods is calculated at 6 508 CZK/ha/year, the median is calculated at 7 715 CZK/ha/year.

3.3.2 Experimental result sheet II and hypothesis testing

In the experimental result sheet II, the amount of compensation for the provision of supported ecosystem services of the forest according to the actual economic results of management (excluding forestry profits and owner's contributions to the activity) in the Recreational Forests Chrudim - Podhůra (determined for testing the hypothesis) is quantified at CZK 1 223 thousand CZK/territory/year.

The amount of compensation calculated according to the first method of assessment called "Methodology for assessing the social socio-economic significance of forest ecosystem services in the Czech Republic" (Šišák et al., 2017) in the amount of CZK 948 thousand CZK/territory/year and according to the second evaluation method entitled "Assessment, valuation and mapping of ecosystem services in Alpine forests" (Häyhä et al., 2015) in the amount of 228 thousand CZK/territory/year is insufficient, the test result is H-, the hypothesis is refuted.

The amount of compensation calculated according to the third evaluation method entitled "Methods for quantifying, evaluating and quantifying the supported effects of forests for the recreational and educational function of forests in special-purpose suburban forests" in the amount of CZK 1 223 thousand CZK/territory/year is sufficient, the testing result is H+, the hypothesis is confirmed.

4 DISCUSSION

The results of the work on identified values of compensation for increased costs are mainly influenced by the choice of the specific methods used for the evaluation.

To compare the values of increased costs according to each method, we should value (price) these supported ES at their normal value (normal price). According to Act No 151/1997 Coll., the Act on valuation of property, as amended, normal value means the price or value that would be achieved if the same or similar supported forest ES were provided. However, as is evident from the nature of the variability in the provision of forest ES, each forest asset that provides a supported ES is different. There are differences in the size of the estates, the location of the estates, the species and spatial composition of the forests, the different activities supported, the number of activities etc.

It is therefore very difficult to compare the results of the management of the area according to the observed values of the increased costs and the individual results of the procedures used to assess the supported forest effects per ha of area, because the ES supported by the area are not the same or similar.

Another problem in comparing the total value of the supported benefits and ES of the area is the individual choice of the extent of provision of the supported ES by the forest owner.

5 CONCLUSION

By successive elaboration of the sub-objectives, the values of the supported forest effects for the recreational and educational function of forests were quantified on the case study area in the Chrudim - Podhůra Recreational Forests using three methods of evaluation, a comparative analysis of the results of the used evaluation methods was carried out and the hypothesis was tested.

The application of the work should be in several areas. The results of the work should not only serve the owners of suburban recreational forests who perform the supported ES of the forest, but could also be used by the state administration, ministries, regions, municipalities, etc. to determine contributions and compensation for forest management constraints due to the performance of social (recreational) functions of forests and in determining the amount of compensation for increased costs and payments for the provision of cultural ES of forests.

The method developed by the dissertation can be easily modified and then used to evaluate the supported other effects of forest and forest ES.

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Assessing ecosystem services and threats in rapidly changing landscapes: the case of southwest Slovenia

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ABSTRACT

This study examines the demand for ecosystem services (ESs), focusing on the perceptions of local residents in the southwest of Slovenia. Perceived changes in ESs over time and threats to the natural environment were also investigated. A survey of adult residents was conducted in spring 2021 to collect data on ES perceptions and use. The results show the most important ES, their spatial distribution and changing attitudes towards ES. Perceived threats include local threats such as illegal waste dumping, groundwater contamination and forest fires. The study concludes with implications for managing perceived local threats and conserving ES to meet societal needs.

KEYWORDS

Ecosystem services, land use change, landscape, participatory GIS, questionnaire

1 INTRODUCTION

In recent decades, societal demand for ecosystem services (ESs) in Europe has increased and heterogenized. Winkel et al. (2022) report that forest owners and managers perceive that demand for forest ESs increased or strongly increased, especially for regulating and cultural ESs. There is a supply-demand risk of ESs due to human activities (Wang et al., 2021), suggesting that a lack of monitoring the supply of and demand for ESs could lead to negative ES budgets. Because the supply of ESs remains relatively constant in time, the increased demand could lead to uncertainty in the future use of ESs (Stürck et al., 2015). If the demand assessment methodology does

not consider people's perceptions, a risk exists that the mismatch between ESs supply and demand will be overlooked (Zoderer et al., 2019). ESs supply changes over time, but with different dynamics and impacts than changes of ESs demand (see also Renard et al., 2015), and this could potentially lead to a change in attitudes towards ES relative to other ESs.

The activities and measures of the European Green Deal and related policies may also affect the supply of and demand for ESs (e.g., Green Deal ..., 2023). Alternatively, trade-offs could arise from different, competing ESs uses. For example, a decision to increase the share of field's biomass yield might lead to decreased inspirational and aesthetic values (Rolo et al., 2021). An important role for recognition of (forest) ESs is attributed to various stakeholders on different levels and from different sectors (Sandhu et al., 2008; Winkel et al., 2022), including local residents. The call for more enabling bottom-up participation has also been the motivation for this study. Additionally, we wanted to explore the main perceived threats to environment in the Mediterranean context. Deforestation, forest fires and urban development and other human activities are often quoted to be the main threats to Mediterranean forests (e.g., Anaya-Romero et al., 2016). With this given background, the aim of this study is to assess the demand for ESs, perceived changes of ESs and perceived threats to the natural environment from the perspective of local residents. For this study we set the following research questions:

- What are the key ESs and what is their spatial distribution in the study area?
- How do local residents perceive qualitative/quantitative changes of different ESs over time?
- What are the perceived threats to the natural environment?

2 METHODS

The study was conducted in southwest Slovenia and encompasses five municipalities, namely Sežana, Divača, Komen, Hrpelje-Kozina and Miren-Kostanjevica. The study area is an example of rapidly changing landscapes towards naturalness. This happened firstly due to artificial planting of pine trees in the 19th century, and secondly due to land abandonment and the consequent succession. The proximity to Italy made the area diverse in demographic, socio-economic and cultural terms. Moreover, the area is often referred as one of the biodiversity hotspots with more than 40 different tree species. Forest account for 64.4% of the area, followed by meadows with 17.3% and agricultural land with 7.5%. Since most of the area lies on limestone, water is mainly found below ground, resulting in only 0.1% above ground water surfaces.

A survey of adult residents was conducted in spring 2021 to discover the characteristics of the demand and use of ESs. The calculated survey sample was 379 units (population 29,940, 95% confidence interval and 5% margin of error). Due to the expected response rate of 38% of the questionnaires, the sample size was increased to 1,000 units. The number of units sampled was proportional to the number of residents in each municipality, and units were randomly selected. Respondents received a letter inviting them to participate in the survey, the objective of the survey, and the link to the online questionnaire. One week before the questionnaire was deactivated, we sent them a

thank-you letter and a reminder for respondents who did not have time to submit their answers.

The questionnaire encompassed questions about perceived benefits and use of ES, perceived condition of the natural environment, and demographics. The work of Baró at al. (2016), Schmidt at al. (2017), Wang at al. (2017) and Rodríguez-Morales at al. (2020) served as inspiration for the questions. Some questions were interactive, requiring respondents to delineate an area of ES they use on a given map. Survey data were organized into a single database using MS Excel 2019® and statistically analysed using JASP v0.14.1. Spatial data were manipulated using ArcGIS PRO 3.0 (Esri®) software. Spearman's rank correlation coefficient was used to determine the strength of the correlation between variables.

3 RESULTS

The number of respondents who started answering the questionnaire was 170. Of these units, 126 respondents answered the questionnaire entirely. That is 12.6% of the entire sample and 44.8% of the expected sample of 379 units. The average age of respondents was 50.7 years, ranging between 19 and 82 years. The percentage of female respondents was 49.0%. Most respondents reported living in a rural area (73.6%), some in urban centres (16.8%) and other in suburbs (9.6%). Respondents had a relatively high level of education, with 57.3% having a university degree. More than a quarter (26.0%) of respondents were retired, 62.6% were employed, 5.7% unemployed and 5.7% students. Most respondents (73.9%) had a monthly income up to 1,500 €, and 10.1% of respondents had more than 3,000 €. Of all respondents, 33.1% were forest owners with an average forest area of 3.43 ha.

The results show that the natural and semi-natural environment in the area supports most of the a priori listed ES. Except for ES hunting and ES erosion control, the ESs are quite well represented and distributed. Since respondent were not asked to rate the importance of each ES for them, the following results show the frequencies of responses. Figure 1 shows a tree diagram of respondents' selected ES; the bigger the cell size, the more respondents selected a particular ES. Landscape aesthetics was selected by 90.3% of respondents, followed by recreation (81.5%) and wild plants food (79.0%). Other four ESs were selected by more than half of the respondents, namely climate regulation, crops, wood, and flora observation.

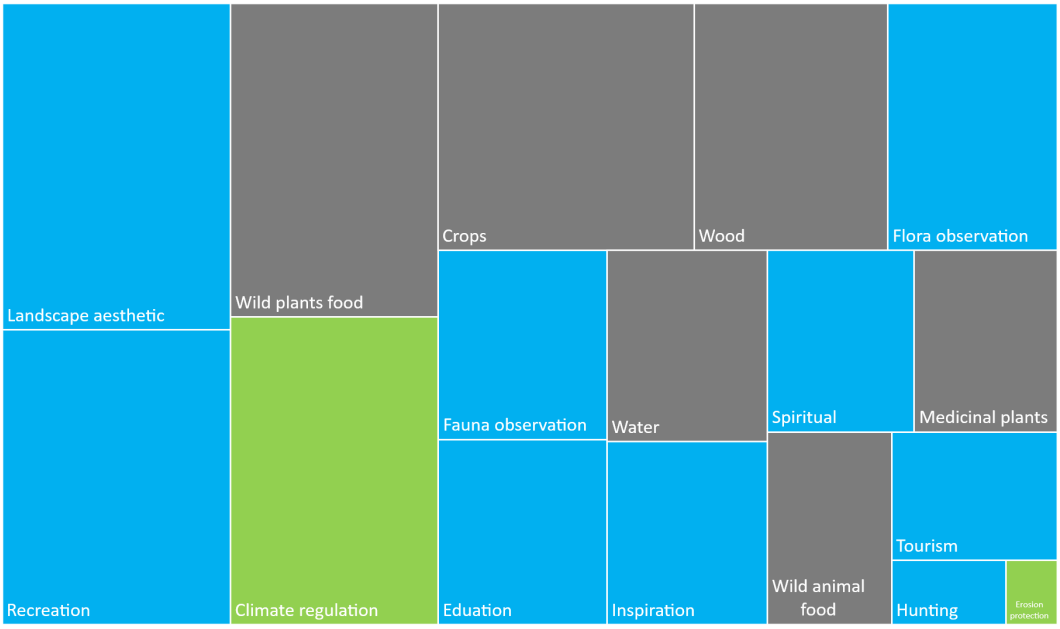

Figure 1. Tree diagram of ESs selected by respondents.

Each respondent selected eight ESs on average, while most respondents selected eleven ESs. Most respondents (58.1%) selected between 5 and 10 ESs. The correlation table reveals that a strong correlation exists (r_s=0.616, p<0.001) between ES flora observation and fauna observation. Medium correlation exists between ES hunting and wild animal food (r_s=0.488, p<0.001), ES tourism and medicinal plants (r_s=0.474, p<0.001), ES climate regulation and recreation (r_s=0.437, p<0.001), ES inspiration and education (r_s=0.428, p<0.001), ES wild plants food and flora observation (r_s=0.405, p<0.001), and ES tourism and wild animal food (r_s=0.394, p<0.001). Although ES was recognized by many respondents, landscape aesthetics had no important correlations with other ESs, except for a low correlation with ES climate regulation (r_s=0.215, p=0.017). Only one relationship was found to be negative, although not statistically significant, and that was between ES crops and landscape aesthetics (r_s=-0.116, p=0.198).

The graphical representation was done through respondents' mapping the ESs they receive. For each selected ES, they were asked to draw one or more polygons on a map where they obtain the ES from. Of the 122 valid responses, 961 polygons were drawn, 57 polygons on average per each ES. The visualisations below were created based on the kernel density feature in ArcGIS PRO. The average size of polygons varied among ESs, with ES inspirational being the larger (18,710.70 ha), and ES recreation the smallest (2,442.96 ha). As shown in Figure 2, some ESs are spatially dispersed, while others are aggregated, indicating their tendency to be less or more specialised in terms of actual use or benefits to respondents. ES spiritual, hunting, erosion protection are strictly confined to a smaller central area with less dispersion.in contrast, ES climate regulation, landscape aesthetics, water and recreation are widely dispersed and found almost throughout the region. The main centres for ESs recreation and landscape aesthetics are scattered, but with a centre north of Sežana – the biggest town in the study area. ES tourism tends to be concentrated near the main tourist centres, such as the Lipica stud farm and the Škocjan caves.

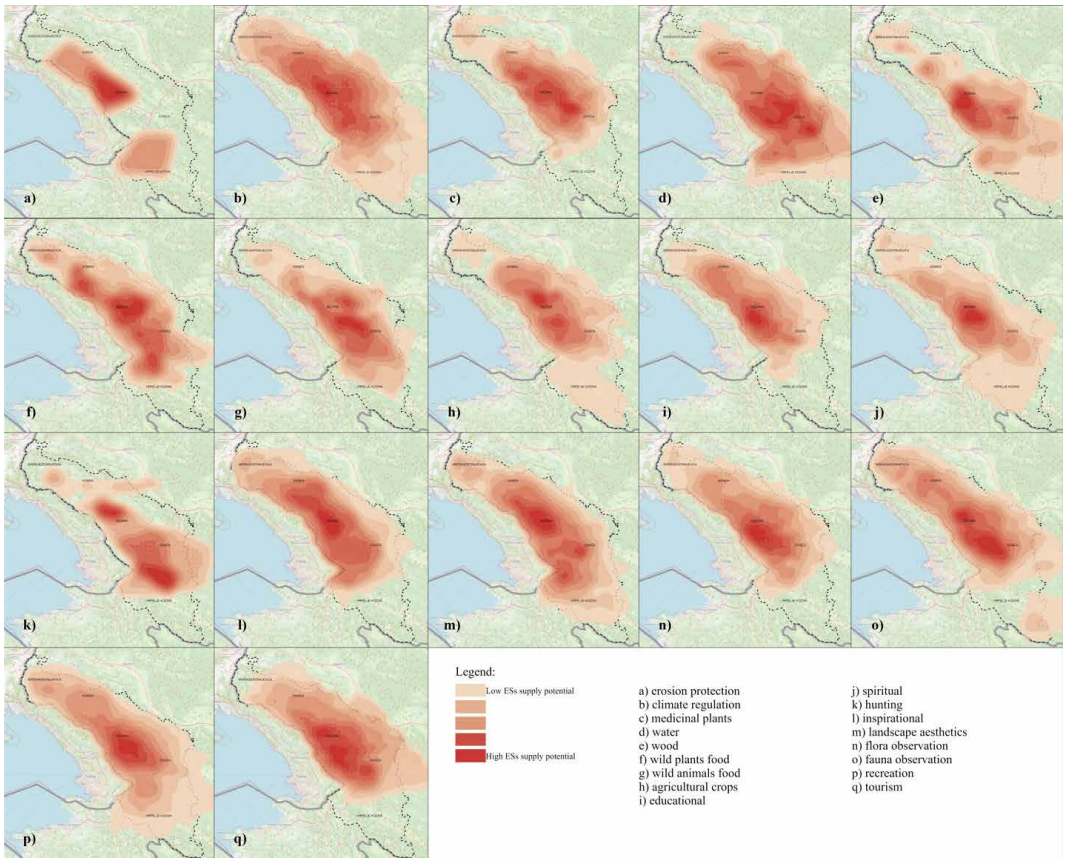

Figure 2. Kernel density maps of seventeen ESs.

The next question asked about perceived changes in the quantity or quality of ESs over the past decade. Respondents were asked to rate the changes on a 5-point Likert scale from (1) *deterioration* to (5) *improvement*. Trend was calculated as the average deviation up or down from the (3) *no change* value. In general, the greatest positive changes were perceived for ES tourism, followed by ESs recreation, spiritual and inspiration. The greatest negative changes were perceived for ES wood, wild plants food and hunting. In all cases, the evaluation results were above average, indicating that the quality or quantity of each ES has improved. However, responses for four ESs diverged towards worsening, meaning that a downward trend was noted for these ESs. On the other hand, respondents perceived no change at all for six ESs and an upward trend was noted for seven ESs.

Residents who perceived positive changes in ES recreation, also perceived positive changes of ES tourism (r_s=0.686, p<0.001) and hunting (r_s=0.728, p=0.063). Similar high correlations were also found between ESs hunting and wild animal food (r_s=0.829, p<0.001), ESs flora observation and medicinal plants (r_s=0.589, p<0.001), ESs medicinal plants and inspirational (r_s=0.641, p<0.001) and others. Perceived threats to the natural environment and ESs provision were also measured on a scale from 1 (strongly disagree) to 5 (strongly agree). The greatest perceived threats to the natural environment and ESs provision were illegal dumping, groundwater contamination and wildfires. Respondents perceived impacts of agriculture, wildlife and tourism as less influential.

4 DISCUSSION AND CONCLUSION

This study highlights the demand for ESs, ES changes and perceived threats to natural environment from the perspective of local residents. Residents derive the greatest benefits from ESs landscape aesthetics, recreation, wild plant food, climate regulation and crops. The least demand is expressed for ESs erosion protection and hunting. The results suggest that the remoteness of (forest) areas or their inaccessibility reduce the potential demand for these ESs. Our results indicate that recreation occurs primarily near urban and agricultural areas, while landscape aesthetics is mainly sought in remote and more forested areas. In addition, other landscape elements (e.g., characteristic plants), remoteness, and perceived wilderness influence demand for these ESs. These findings are consistent with other relevant studies, such as e.g., Kaligarič and Ivajnšič (2014), Rolo et al. (2021), Sasaki et al. (2021).

Respondents generally perceived that ESs tourism, recreation, spiritual and inspiration have improved positively over the past two decades. We did not ask specifically what about the changes, but the positive result itself shows the optimism and pro-development orientation of local policies. The ESs that showed a downward trend in change (e.g., wood, wild animal food, wild plants food) require further investigation and response. These ESs belong to the provisioning ES, and they relate in one way or another to agricultural land abandonment. In the research area, there was a strong succession of old fields in the last century, which contributed to the decline of grassland and wild plant food (e.g., Kaligarič and Ivajnšič, 2014). On the other hand, the increase in forest area led to an increase in the dispersal of larger wildlife, including wolves, wild boar, and red deer, which come into conflict with existing farms (e.g., Otero et al., 2015).

The greatest perceived threats were found to be on a local scale, i.e., illegal dumping, groundwater pollution and forest fires, rather than at the “all-encompassing” and “global” level. The least threatening impacts were those from agriculture, wildlife, and mass tourism. The root cause of this attitude remains unknown and requires further investigation. At the local level, there is evidence that prioritizing threats to the natural environment should focus on the immediate threats that people directly perceive as more threatening, rather than trying to solve the “spatially undefined” global threats.

The approach taken was to assess the magnitude and perceived change of 17 ESs, which proved to be an ambitious but achievable goal. Due to the limited number of respondents (n=126), the results are limited to this specific area, but are still useful practical application by land managers and planners. Eliminating or limiting the potential negative impacts of identified threats would lead to more efficient resident well-being and friendly environment.

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5

Ownership role in forest management

Family forestry issues in climate change mitigation contract policies

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ABSTRACT

Family forest play an important role in climate change mitigation policies. However, several issues may affect their actual mitigation efforts. These are crucial information for policy makers, when dealing with family forest owners. We have conducted two surveys in Finland, first in 2021 and second in 2023, with different choice experiment (CE) settings, focusing on willingness to accept additional carbon in family forests. The common feature in both survey CEs is a payment for increased carbon inventory measured as additional standing stock equivalent (EUR/m^3). The other CE attributes have been in the first survey: initial payment levels of the contract, compensation levels of management plan costs, lengths of contract; and in the second survey: the initiators of the deal, sources of payment financing and inclusion of forest damage risk on standing stock. Other issues, e.g., effects of information and intergenerational issues of possible mitigation policies have been considered in surveys by employing statements and questions.

KEYWORDS

Family forestry, climate change mitigation, contract, choice experiment, information, intergenerationality

1 INTRODUCTION

Carbon sequestration in family-owned forests is subject to roundwood markets and several other issues in managing private forests in the long run. These issues can be substantially different from public forests or even forests owned by forest industries and other private institutions. It is typical, that we do not know the exact importance of these issues for forest owners and their ownership cycle situations, and therefore it is possible that policy makers may focus on insignificant policies instead of the significant ones.

Carbon sequestration in family forests can be considered as a part of carbon markets, where the general public has *willingness to pay* for improvements in forest carbon sequestration and the forests owners have *willingness to accept* these improvements. The policy determination is not simple, as the willingness to pay and willingness to accept differ considerably by individuals. In addition, information may play a crucial role in both sides of the market.

In family forestry, contracts on carbon sequestration are still rather non-existent compared to longer experience of contracts on biodiversity and forest conservation. The optimal compensation cost and payment allocation question related to willingness to pay and willingness to accept has been solved in many countries by employing voluntary conservation approaches. In Finland, these voluntary biodiversity conservation actions have been branded under the METSO-programme.

Willingness to pay as well as the forest owners' willingness to accept climate policies can be estimated by employing survey approaches. Surveys may include fictious decision situations for forest owners, general questions and information on the forest estate and on its owner as well as statements to figure out e.g., the owner attitudes. Choice Experiment (CE) is a method, originally introduced by McFadden (1973), where alternative choice sets are presented to respondents and analyzed with conditional logit analysis.

In this study, we follow the earlier biodiversity related contract experiences with family forest owners. We focus on the issues affecting the willingness to accept additional carbon sequestration in family forests on voluntary basis.

2 METHODS

We have carried out two separate Finnish family forest owner surveys with relatively similar choice experiment settings to collect data for analyses. The background for surveys has been to test theoretically sound result-based contracts, although in practise an estate-level measurement of a result in any natural capital may turn out too costly.

The first survey (N=386) was carried out in spring 2021 in the project CONSOLE, financed by EU Horizon 2020 (Contract nr. 817949). The second survey (N=1,460) was carried out in summer 2023 in the project HILMARI, financed by Ministry of agriculture and forestry in Finland. In both surveys, email contacts and electronic quantitative survey questionnaire with some qualitative open responses was employed. In the CONSOLE survey, the sample was based on Taloustutkimus market research company's panel of frequent respondents, who indicated themselves as forest owners. In the HILMARI survey, the forest owners were sampled from the Finnish Forest Centre database by utilizing existing database information on forest estate sizes by counties in interval sampling.

For a respondent convenience, the number of CE choice sets are usually reduced for a single respondent so that respondents are divided optimally into choice set blocks. In CONSOLE, the choice experiments were provided for respondents in six choice sets, for which the respondents were divided into five blocks (in total 30 choice sets). In HILMARI nine choice sets were allocated to four blocks (in total 36 choice sets). In both projects, a small survey was used first to receive prior information on the coefficients, which was followed by optimization of the choice design to be utilized in the major survey.

The employed CE attributes and their levels are presented in Table 1. The common feature in both surveys is a payment (EUR/m^3) for carbon inventory measured as additional to recommended standing stock equivalent (m^3), paid afterwards every tenth year if the contract had lasted that long. Theoretically, these payments were set to correspond carbon rent for a limited period. Thus, the payment levels are lower than for a permanent carbon stock inventory and there is neither need for repayment when

the contract ends. In the CONSOLE survey, the other employed CE attributes were initial payment of the contract, cost of carbon forestry plan and length of the contract. In the HILMARI survey the other attributes were the initiator of the compensation arrangement, source of payment financing, and forest damage risk on standing stock. In the HILMARI, the contract length was set as ten years with voluntary renewal option. The initial payment for contract was also fixed as 500 EUR for the estate. In both surveys, the only withdrawal cost for forest owner was losing the initial payment. Other issues, like effects of information and intergenerational issues of possible mitigation policies were considered in both surveys by employing statements and questions.

Table 1. Choice experiment attributes and their levels in CONSOLE and HILMARI surveys.

CONSOLE attributes	CONSOLE attribute levels	HILMARI attributes	HILMARI attribute levels
Plan for carbon forestry	No free-of-charge plan Free-of-charge plan in the beginning Free-of-charge plan in the beginning and update every tenth year	Initiator for the compensation arrangement	Own initiative Familiar forest professional makes the initiative Forest representative of public authority makes the initiative
Duration of compensation contract	20 years 30 years 40 years	Source of financing for compensation payments	Government tax revenues Carbon compensation payments paid by domestic companies Carbon compensation payments paid by foreign companies
Initial compensation payment	10 EUR/ha 50 EUR/ha 100 EUR/ha	Risk of forest damage to additional forest inventory	All damaged wood left in and harvested from forest entitle to additional inventory Damaged wood only left in forest entitles to additional inventory
Carbon compensation payment for m^3 (o.b.) equivalent to additional inventory to silviculturally recommended	2 EUR/m^3 5 EUR/m^3 10 EUR/m^3 15 EUR/m^3 20 EUR/m^3	Carbon compensation payment for m^3 (o.b.) equivalent to additional inventory to silviculturally recommended	2 EUR/m^3 5 EUR/m^3 10 EUR/m^3 15 EUR/m^3 20 EUR/m^3 30 EUR/m^3

The CE design optimizations were done with NGENE software, and results were calculated and analysed with statistical tools Stata, SPSS and R.

3 RESULTS

In the CE results, all attributes are statistically significant, and their signs are in accordance with the expectations. The results reveal the importance of carbon compensation payments (EUR/m^3) for contract acceptance. The longer the contract period the lower is the acceptance of a contract is also the case in CONSOLE results, where only very long 20-, 30- and 40-years contracts were introduced rather due to ecological than economic reasons. In fact, it seems to be evitable that these contract periods are too long for current forthcoming forest ownership periods (intergenerationality). In CONSOLE, they most probably resulted into low acceptance of any chosen contract: only half of forest owners did choose any contract.

Therefore, in HILMARI survey the contract period was fixed to ten years, with possible voluntary renewal option upon forest owner's interest. As a result, the acceptance rate of any contract in HILMARI survey was considerably higher (3/4), but it must be beard in the mind that the HILMARI design (9x4) was also slightly different and favoured higher acceptance compared to CONSOLE design (6x5). In HILMARI there was also one higher carbon compensation payment level compared to CONSOLE. Although all other attributes were in minor role, they still have decisive significance in individual cases. Especially the forest damage risk may affect the acceptance.

However, the most interesting and practically applicable results may lie outside the result-based CE outcomes. The HILMARI statements and questions on more traditional policy instruments on tax, forest and support policies provide very interesting results.

4 DISCUSSION AND CONCLUSION

Email surveys with electronic questionnaire reach forest owners with above-average ICT equipment, internet connections and ICT skills. This leads to many ways biased results when considering all forest owners. In some features this bias is possible to overcome by weighting the results. This requires information on the population and nonresponse analysis. Comparisons to the most comprehensive forest owner survey in Finland (Karppinen et al., 2020) reveal that, for instance, although the Finnish Forest Centre manages comprehensive forest data, the data seems to lack contact information on heirs (HILMARI survey), whereas heirs were surprisingly well reached by employing the panel of frequent respondents by Taloustutkimus (CONSOLE survey). The employed languages may also lead to biased results in countries where several languages are present. In Finland, there are two official languages, Finnish and Swedish. The HILMARI questionnaire was provided in both languages whereas in CONSOLE the questionnaire was only in Finnish, with possibly mostly Finnish-speaking sample. As a result, in HILMARI the Swedish speaking forest owners responded as well as the Finnish speaking respondents, but in CONSOLE the responses were almost non-existent in the predominantly Swedish speaking areas.

Result-based contracts may sound fascinating due to their theoretical exactness. Also forest owner attitudes are favourable towards payment for achieved results. However, in practise their relevance may vanish in their variable estate level applicability and high monitoring costs. Employed surveys reveal information deficits among forest

owners, which decrease the applicability of result-based instruments. Therefore, existing policies and markets in line with desired carbon sequestration targets should be evaluated before creating any new instruments. In Finland, for instance, inheritance and gift tax policy, forest legislation restrictions on harvesting, and financial support for forest fertilization could be well worth of amendments instead of establishing new and possibly conflicting estate-level forest carbon policies.

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The heterogeneity of private forest owners affects the wood mobilization from private forests

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ABSTRACT

Private forests are influenced by several factors, including owner attitudes, socio-demographic characteristics and market dynamics. This study examines the heterogeneity of private forest owners in Slovenia in relation to forest management. A comprehensive survey was conducted among 1,515 randomly selected private forest owners, 65% of whom owned up to 4.99 ha and 7.47 ha on average. About 75% of the respondents had harvested wood in the last five years, totalling over 80,000 m^3 or an average of 19 m^3/ha. Rural private forest owners had the highest harvesting intensity (12.3 m^3/ha or 88.4 m^3 per household). Although more male respondents participated, the results showed that male owners harvested more intensively. Participation in forest management has stagnated over the past decade. The study concludes that the size of ownership has an influence on active forest management, with more active owners participating in harvesting.

KEYWORDS

Forest management, non-industrial forests, harvesting, characteristics, private forest owners, survey

1 INTRODUCTION

Private forests are influenced by a variety of factors, such as market dynamics, political influences, socio-demographic characteristics of private forest owners, tenure, internal norms, and natural factors. However, the key aspect determining the use of wood from private forests is the willingness and attitude of forest owners towards their land (Češarek et al., 2018; Ščap et al., 2021). Recent surveys provide interesting insights into the priorities of private forest owners. Some 62% of private forest owners surveyed see the main purpose of managing their forests as using wood for their own needs. Meanwhile, 23% of owners who inherited the forest do not have a specific intention for management. Surprisingly, only 6% of respondents manage the forest with economic intention (Ščap et al., 2021).

The fact that the use of wood for own needs is the main objective of forest management explains the finding that most private forest owners, regardless of the size of their forest holdings, prefer to harvest the wood themselves or with the help of family members (Ščap et al., 2021). It is noteworthy that the characteristics of private forest owners change over time. It has been observed that there are more urban owners, older owners, female owners and owners without forestry knowledge (Pezdevšek Malovrh et al., 2015; Kumer and Potočnik Slavič, 2016; Ficko, 2019). Consequently, these owners are more likely to rely on hired forest service providers. This trend is supported by the fact that a significant proportion (41%) of private forest owners who carried out harvesting in their forests between 2015 and 2019 used the services of hired professional contractors (Poročilo o..., 2021). In addition, a study by Ščap et al. (2021) found that among private forest owners owning between 5 and 10 hectares of forest, a significant number relied exclusively on hired forestry services for wood harvesting. Female forest owners made up 68% of this group, while the share of non-employed private forest owners was 62% (Ščap et al., 2021).

Calculations in recent years show that the annual harvest in state forests is about the same as the planned annual harvest, while the annual harvest in private forests is much lower than planned harvesting quantities. There are several reasons why forest management in private forests is lacking. Especially in thin stands, it is the lack of economic profitability (Poročilo Zavoda..., 2022). Due to the needs of the wood industry, there is a desire for greater mobilisation of wood from private forests. To find out the trends, willingness and motivation of private forest owners for forest management, we conducted an extensive survey. Aiming to answer two research questions: a) Are private forest owners really such a heterogeneous group? and b) How do the different groups of forest owners manage their forests? In the following, we present some of the results of this survey.

2 METHODS

To determine the willingness of private forest owners to manage their forests, an extensive survey was conducted among randomly selected households throughout Slovenia. The questionnaire was divided into five sections and the data from the first section was analysed in this study: basic information on forest ownership (area), forest management characteristics and demographics of respondents (gender, age, employment status, education). The survey was conducted online in March and April 2022. In accordance with the sampling procedure, the basis of the sample was the gross sample, i.e. all households,

regardless of forest ownership, for which representativeness was ensured by quotas according to region and settlement type. In addition, there were so-called soft quotas based on the age of the respondents, which ensured that the online survey did not only include a younger population. A total of 1,515 households owning and knowing a forest took part in the survey. The data were analysed using MS Excel and SPSS statistical software, where the basic analysis of the survey data was performed using descriptive statistics (min and max values, mean values) and frequency distributions of variables.

3 RESULTS

The total forest area of the private owners surveyed is 9,889 ha. The smallest forest property of the surveyed owners was 0.1 ha and the largest 600 ha. The socio-demographic background information of the respondents is shown in Table 1.

Table 1. Socio-demographic background information of the surveyed respondents

Attribute	Value		Proportion (%)
Gender	Male		
	Female		
Age	Average (years)	54	
	≤ 30 years		6.5
	31 - 40 years		10.1
	41 - 50 years		20.6
	51 - 60 years		25.2
	61 - 70 years		27.6
	> 70 years		10.0
Place of residence	< 3,000 inhabitants		55.7
	3,000 - 10,000 inhabitants		23.2
	> 10,000 inhabitants		21.1
Occupation	Self-employed and employed		53.6
	Not employed		45.3
	Insured as farmer		1.1
Education	Elementary school or less		4.5
	High school		50.1
	Bachelor's education or more		45.4
Size of forest property	Average (ha)	7.47	
	Modus (ha)	1	
	≤ 4.99 ha		65.4
	5 - 9.99 ha		16.6
	10 - 29.99 ha		13.4
	≥ 30 ha		4.6

3.1 Harvesting characteristics of surveyed private forest owners

The average harvest was 19.03 m^3/ha in 5 years (min 0.03 m^3/ha, max 400.00 m^3/ha). 24.9% of the surveyed private forest owners did not carry out any harvesting in their forest in the period 2017-2021. Depending on where they lived, the most active were private forest owners living in rural areas in settlements with less than 3,000 inhabitants, who harvested an average of 12.3 m^3/ha or 88.4 m^3/household during the period 2017-2021. The least active in terms of harvest volume were private forest owners living in large cities with more than 10,000 inhabitants, who harvested 6.4 m^3/ha or 48.7 m^3/household. Private forest owners who did not harvest during 2017-2021 were referred to as inactive private forest owners and there were 22% of them in the survey. Less active, i.e. those who harvested between 0.01 and 20 m^3/ha during the period, accounted for 54% of the survey respondents. However, 25% of the private forest owners surveyed had harvested more than 20 m^3/ha during the period 2017-2021. In terms of gender of respondents, both men and women have the highest proportion of less active forest owners (Figure 1).

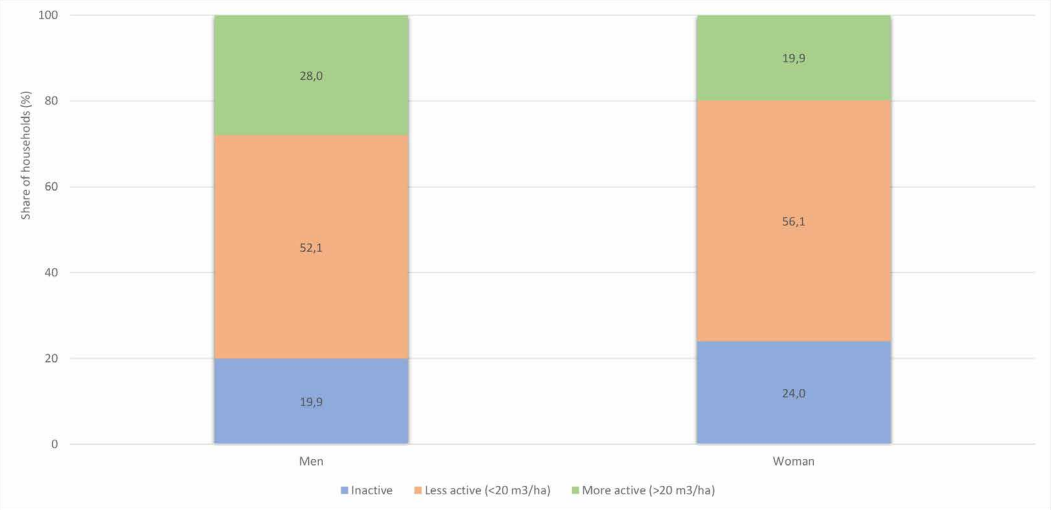

Figure 1. Harvesting activity by gender among private forest owners surveyed in 2017-2021.

The average proportion of wood sales of private forest owners surveyed that have been harvested in the last five years is 25.0%. On average, 26.0% of the harvesting operations were carried out by forestry contractors. As expected, the share of wood sales and hired forestry contractors is higher among the more active private forest owners (Figure 2). The highest share of wood sales is among owners who harvested 200 m^3 or more during 2017-2021. The average share of hired forestry contractors is highest among respondents who harvested 700 m^3 or more of wood during the period (63%), followed by the group of owners who harvested between 80 and 199 m^3 of wood at 39.4%.

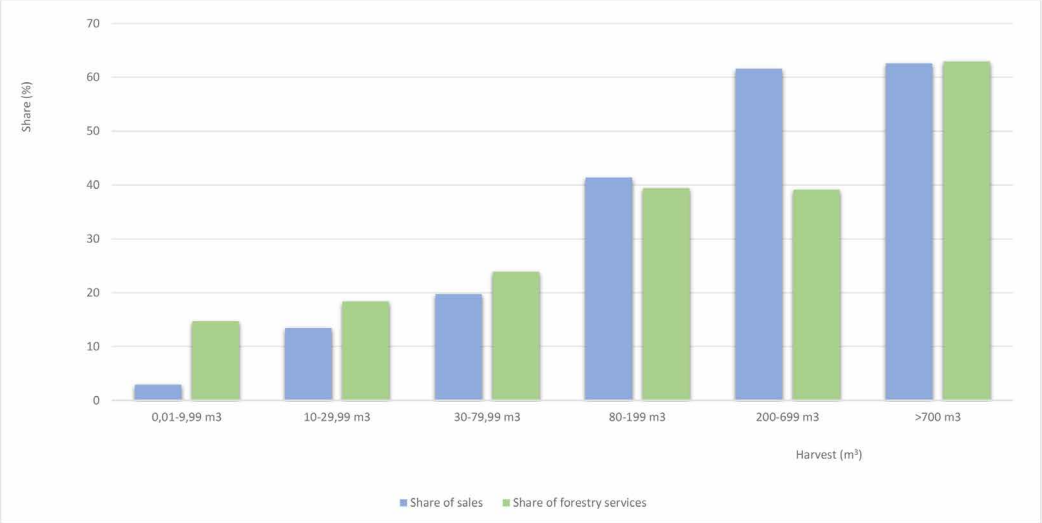

Figure 2. Share of wood sales and forestry services hired by surveyed private owners who harvested in the period 2017-2021, by volume of harvesting.

The private owners surveyed were categorised according to their harvesting intensity and compared according to their plans on future forest management. Among those who have not harvested in 2017-2021, the predominant opinion (64%) is that they will not harvest their forest in the future (Figure 3). In the other categories, the prevailing opinion is that they will continue to manage their forest as usual. Among the households that have harvested 50 m^3/ha or more in the last five years, there is a high proportion (34%) of those who will harvest less in the future, and 45% of those who will harvest same or more intensively than in the period 2017-2021. The remaining 21% will not harvest in the future.

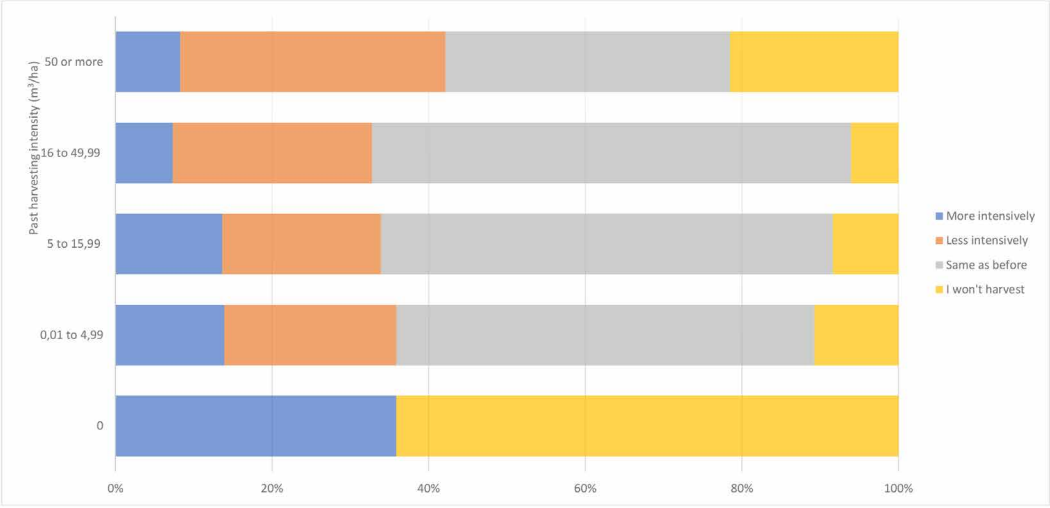

Figure 3. Percentage of households with an opinion on future harvesting intensity, by amount of past intensity.

On average, the surveyed forest owners spend 20.6 days annually on the management of their forest property, which in addition to wood harvesting also includes silvicultural work, the construction of forest roads and other administrative work. Of these, 10.2 %

do not manage their forest, which means that they do not spend even one day per year on forest management. The average forest area of these owners is 4.6 ha and they are dominated by those who did not carry out any harvesting in the period 2017-2021. By size class of forest ownership, owners with 30 ha or more spend the most time on forest management, with an average of 52 days per year. However, smaller forest owners are expected to spend the least time on forest management.

4 DISCUSSION

The survey of 1,515 randomly selected private forest owners was dominated by 65% of owners with forest ownership of up to 4.99 ha and an average forest ownership size of 7.47 ha. In comparison, the national structure of private forest owners is dominated by 67% of private forest owners with a forest ownership of up to 1 ha and an average forest ownership size of 2.6 ha. Of the private forest owners surveyed, 75% have harvested timber in the last five years (2017-2021). In total, they have harvested slightly more than 80,000 m^3 of wood, which corresponds to an average of 19 m^3/ha. Private forest owners living in rural areas (settlements with less than 3,000 inhabitants) had the highest harvesting intensity: an average of 12.3 m^3/ha or 88.4 m^3 per household. This factor is mainly related to the owner's distance from their forest property, i.e. rural dwellers live closer to their forest and motivation for forest management is higher among those who live closer to their forest (e.g. Silver et al., 2015; Bashir et al., 2021). One should note that higher proportion of male respondents than female respondents participated in the survey. However, the results of the survey show that male private forest owners harvested somewhat more intensively during the period under consideration. Studies abroad also confirm that male forest owners harvest more than female forest owners (Kuuluvainen et al., 2014; Ščap et al., 2021).

Results show that the participation of private forest owners in forest management has not increased in the last ten years. According to the Slovenian Forest Service (Poročilo Zavoda..., 2023), the implementation of potential wood harvest does not reach the planned level: in the last years (2020-2022), the registered wood harvest reached on average 60% of the planed annual harvest (in 2020 – 59%; in 2021 – 57%; in 2022 – 64%), and the implementation of planned silvicultural works is even lower. Similarly, results show an average harvest of 19 m^3/ha, which has further decreased compared to the period 2015-2019, when the average harvest was 24 m^3/ha (Ščap et al., 2021). The study concludes that the size of private forest ownership has an influence on active forest management. Larger private owners (30 ha or more) spend the most time on forest management. In addition, more active owners sell more timber and use services more often. Most studies confirm a positive effect of forest ownership size on the interest and intensity of logging and harvesting activities (e.g. Beach et al. 2005; Eggers et al. 2014; Poje et al. 2016; Bashir et al., 2021).

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The effect of forest parameters on the change of forest management structure in Hungarian private forest from 2010 to 2019

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ABSTRACT

In Hungary private forests account for the 43% of all forests and have a relative higher harvest potential, but the potential of these stands is underutilized. The legal framework for forest management in Hungary is quite unique and complicated, so more than half of private forests is not managed by the owners but so called forest managers, and all the technical documents must be signed by professionals. The authority keeps records of the managers for each forestry unit, so based on data from the National Forest Database it can be examined which factors have major effect on the presence and type of forest manager. This also correlates with legal harvesting events. This can help determine which forest sub compartments are more likely to stay without management in the future. Tree species, stand quality, area and age seem to have the strongest effect on management.

KEYWORDS

Private forest, forest manager, harvest potential, stand parameters, National Forest Database

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Willingness of Private Forest Owners for Business Cooperation in Slovenia: Current State and Way Forward

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ABSTRACT

The business cooperation of private forest owners has been recognized in many countries with prevailing private forest ownership, as a key instrument to support sustainable management. This study identifies the willingness of private forest owners for business cooperation between each other and with forest service providers or forest managers. In 2022, a survey of randomly selected private forest owners was conducted. The results show that private forest owners are willing for business cooperation, however, none of the existing business forms were considered as very appropriate. As the most appropriate forms of business cooperation between owners were identified producer groups under CAP and various short-term business cooperation forms with forest service providers or forest managers. To motivate private forest owners for business cooperation, it is important to identify the profile of owners who are willing for business cooperation, determine actors that will promote such cooperation and ensure appropriate policy instruments.

KEYWORDS

Private forest owners, business cooperation, forest service providers, forest management activities

1 INTRODUCTION

In Europe where private forest ownership prevails, explaining and predicting the management behaviour and practices of private forest owners (PFOs) is an increasingly important topic in forest policy and research arenas (UNECE/FAO, 2020). This is especially true, as management objectives of PFOs have changed considerably over the last two decades mainly due to demographic, economic, and social changes, such as urbanization of lifestyles, disengagement from agriculture, economic restructuring (Weiss et al., 2019). These changes have resulted in PFOs lacking sufficient knowledge and experiences in forest management which is reflected in the underutilization of forest resources.

In Slovenia, where PFOs control a large part of forest resources (77.0% of forests are privately owned) (SFS, 2023), the management of these forests is far from optimal (only 64 % of planned timber is harvested in private forests and less than half of silvicultural work is carried out in accordance with forest management plans) (SFS, 2023), due to the diversity of ownership and tenure (Pezdevšek Malovrh et al., 2022).

The governments, not only in Slovenia, but also across the world, have responded to that problem related to private forest management by different policy instruments. Among them, they have recognized cooperation and joint action between PFOs and with forest service providers or forest managers as a key instrument to support sustainable forest management and to implement policy objectives (Sarvašová et al., 2015; Põllumäe et al., 2016; UNECE/FAO, 2020). In Slovenia, different forms of voluntary interest (i.e., forest owners associations) and business cooperation (i.e., cooperatives, PFOs companies, producer groups) exists, but only a small percentage of PFOs cooperate (Pezdevšek Malovrh et al., 2022). Accordingly, to Aurenhammer et al. (2017), in Slovenia voluntary forms of PFOs cooperation generally lack the human capacity to transfer information and resources. Therefore, more knowledge is needed about the intention of PFOs to manage their forests within different organizational forms or about their willingness for business cooperation.

The aim of this study is therefore, to identify PFOs willingness for business cooperation between each other or with forest service providers or forest managers to perform forest management activities or sell timber to the market in order to improve private forest management efficiency. Moreover, this study also explains how certain factors, such as property characteristics, forest management activities and previous experiences with forest service providers and socio-demographic characteristics of PFOs, influence their willingness for business cooperation.

2 METHODS

In order to collect data, a structured questionnaire was developed within the project "*Efficient management of private forests to support wood mobilization – CRP V4-2013*". The questionnaire consisted of 34 questions, divided into five sections. Only data from the fifth section were analysed in this study. In 2022 (March-April), an online survey of randomly selected households throughout Slovenia was conducted. In accordance with the sampling procedure, the basis of the sample was the gross sample; all households, regardless of forest ownership, for which representativeness was ensured by quotas according to region and settlement type. In addition, there were so-called soft quotas

based on the age of the respondents, which ensured that the online survey did not only include a younger population. A total of 1,515 households owning a forest took part in the survey. The collected data were processed in SPSS, version 24 (IBM, 2021). The data were analysed using frequency distribution, mean values/mode and non-parametric tests (Mann-Whitney U test and Kruskal Wallis test).

3 RESULTS

The sample represents 1,515 surveyed PFOs, most of whom are male (54.6%), mainly with high school education (50.0%) or university degree (45.4%), with an average age of 54 years. 55.7 % of PFOs live in a small village with less than 3000 inhabitants. The surveyed PFOs are mainly employed (53.6%) or are retired (45.3%). The average size of the forest property is 7.47 ha (65.4% of PFOs have properties smaller than 5 ha).

The surveyed PFOs have shown a willingness for business cooperation with other PFOs (mean 3.38, mode 4), with 51.6% of PFOs willing and 30.1% indecisive. In addition, the results show that age (*U=219,673.500, p=0.032),* forest property size (*U=145,435.000, p=0.020*) and implementation of forest management activities (*U=61,859.000, p=0.033*) have a significant influence on PFOs willingness for business cooperation with other PFOs, while the intensity of forest management (*K-W H=0.956, p=0.620*) and previous experience with forest service providers (*U=170,368.500, p=0.109*) have no significant influence. Younger PFOs (< 50 years), who own and manage more than 5 ha of forest are more willing for such business cooperation.

PFOs have different motives when it comes to cooperation, therefore various forms of PFOs cooperation were established in Slovenia – both interest- and business-one. The results of the survey showed that none of the existing forms of business cooperation between PFOs is considered as fully appropriate for PFOs. Producer groups under the CAP were rated as the most appropriate (mean 3.26[1], mode 4), followed by PFO-owned companies (mean 3.13, mode 4) and cooperatives (mean 3.10, mode 4). Machinery rings (mean 3.10, mode 3) were rated as partially appropriate by respondents. As unappropriated forms of business cooperation were recognized public-private partnerships (mean 2.90, mode 3). In addition, we were also interested to know which are the reasons why PFOs would choose to cooperate with other PFOs (Table 1). The results show that differences in mean values between reasons were minimal, but all reasons were rated as important. The surveyed PFOs emphasised that they are willing for business cooperation with other PFOs if they would get a better price for forest services (mean 3.97), higher timber price (mean 3.96) or if they would get better information on business cooperation and would know some good practice examples.

[1] Appropriateness of the existing forms of business cooperation were evaluated on the 5-point Likert scale (1 – very inappropriate to 5- very appropriate)

Table 1. Average values of reasons for business cooperation with other PFOs

Reasons	Average values[2]
If I would get better prices for forest services	3.97
If I would get higher timber prices	3.96
If I would get better information on business cooperation and would know some good practice examples	3.87
If I would have the possibility to control the sale of timber	3.84
If I would be in position to influence business decisions	3.82
If I would own larger forest property	3.78
If I would manage my forest more often or every year	3.76

In addition to business cooperation between PFOs, the cooperation between PFOs and forest service providers or forest managers is also important, especially for owners with smaller forest properties or the ones without knowledge, for more efficient private forest management. The results showed that PFOs are willing for business cooperation with forest service providers or forest managers (mean 3.47, mode 4), with 56.9% of respondents willing and 26.8% indecisive. In addition, the results show that forest property size (*U=147,174.000, p=0.020*) and previous cooperation with forest service providers (*U=143,591.000, p=0.000*) influence PFOs' willingness to cooperate with forest service providers or forest managers, while age of the PFOs (*U=230,164.000, p=0.294*), the implementation of forest management activities (*U=67,004.000, p=0.387*) and the intensity of forest management (*K-W H=0.545, p=0.761*) have no significant influence. PFOs that own more than 5 ha of forest and have previous experience with forest service providers are more willing for such business cooperation.

PFOs have different needs related to forest management, which depend on their forest property size, intensity of forest management and their capacity to carry out forest management activities. Therefore, PFOs may entrust forest management to forest service providers or forest managers, through various long-term or short-term business cooperation. The results of the survey showed that none of the analysed existing forms of business cooperation between PFOs and forest service providers or forest managers is considered as fully appropriate for respondents. Short-term business cooperation, such as timber harvesting and skidding services (mean 3.401, mode 4), timber and wood chips transportation (mean 3.33, mode 4) and buying timber on the forest road (mean 3.30, mode 4) were recognized as the most appropriate one, followed by buying timber on the stump (mean 3.12; mode 4) and hiring forest service providers for silvicultural and protection work (mean 3.04; mode 4). Based on the results, less appropriate forms of business cooperation with forest service providers or forest managers are long-term forest management agreements, such as forest leases or forest management (mean 2.49, mode 2, respectively). In addition, we were also interested to know which are the reasons why PFOs would choose to cooperate with forest service providers or forest

[2] The reasons were evaluated on the 5-point Likert scale (1 – very unimportant to 5- very important).

managers (Table 2). The results show that differences in mean values between reasons were minimal, but all reasons were rated as important. Surveyed PFOs emphasised that they are willing for business cooperation with forest service providers or forest managers if they would pay all agreed financial obligations to the PFO within an agreed timeframe (mean 4.21) and if PFOs can cancel the contract at any time without financial consequences in case of inappropriate forest management (mean 4.13), if forest service providers/forest managers would meet agreed or contractual deadlines and if they would carry out the forest work at high standards, considering sustainable forest management.

Table 2. Average values of reasons for business cooperation with forest service providers or forest managers

Reasons	Average values[2]
If forest service providers/forest managers would pay all agreed financial obligations to the PFOs within an agreed timeframe	4.21
If the contract could be cancelled at any time in the event of inappropriate forest management, without financial consequences	4.13
If forest service providers/forest managers would meet agreed or contractual deadlines	4.12
If forest service providers/forest managers would carry out the forest work at a high standard, considering sustainable forest management	4.12
If forest service providers/forest managers would provide sufficient information (e.g., work progress, timelines, forest service prices)	4.04
If forest service providers/forest managers would offer a comprehensive forest management service	3.95
If neighbours/relatives/other PFOs would be satisfied with forest service provider	3.91
If forest service provider/forest managers would contact me personally and offer me their services	3.87

4 DISCUSSION AND CONCLUSION

Private forests in Slovenia are characterized as small-scaled and fragmented, owned by a large number of owners, who are generally elder and independent of forest income as well as lacking the knowledge and information on forest management. To support the sustainable management of private forests and wood mobilization in Slovenia, different organizational models of PFOs cooperation were established (Pezdevšek Malovrh et al., 2022; Iveta and Pezdevšek Malovrh, 2021). Although some experience of PFOs business cooperation between PFOs or with forest service providers/forest managers already exists in Slovenia, previous studies showed that such practices are not yet very common and that mistrust exists in such cooperation (Pezdevšek Malovrh and Laktić, 2017; Iveta and Pezdevšek Malovrh, 2021). The willingness of surveyed PFOs to engage in business cooperation with other PFOs or with forest service providers/

forest managers exists. However, interest exists among PFOs who already manage their forest, who have previous experience with forest service providers, who are younger than 50 years and own more than 5 ha of forest, which is in line with previous research (Pezdevšek Malovrh et al., 2022; Aurenhammer et al., 2017). As the most appropriate forms of business cooperation were recognized producer groups under CAP (for business cooperation between PFOs) and various short-term business cooperation forms, such as timber harvesting and skidding services, timber and wood chips transport and buying timber on the forest road (for business cooperation between PFOs and forest service providers/forest managers). Long-term business cooperation forms, which are more attractive from the cost-effectiveness point of view for the forest service providers or forest managers, have been recognized as less appropriate among surveyed PFOs. Considering that business cooperation between PFOs and with forest service providers or forest managers is recognized as a key instrument to increase the efficiency of private forest management (Fisher et al., 2019) and that the interest for such cooperation among PFOs exists in Slovenia, more attention should be paid to promote different forms of business cooperation at the local level through various campaigns and incentive measures which shown to be one of the most effective ways to encourage PFOs (Wilkes-Allemann et al., 2021).

In order to initiate business cooperation between PFOs and with forest service providers or forest managers, it would be necessary that forest policy actors decide who will be the key actors (e.g., the public forest administration, the Chamber of Agriculture and Forestry, the Association of private forest owners or some private actors) and what will be their role in promoting and informing PFOs about business cooperation. The decision about an appropriate actor can be made based on existing institutional and legal frameworks or previous studies that have shown that in many cases, extension officers, local wood purchasers, and family members are the main source of normative pressure influencing the decision-making process of PFOs regarding forest management and their willingness to cooperate (Feliciano et al., 2017; Upton et al., 2019). Furthermore, it is important to establish a connection between potential business partners (i.e., PFOs and forest service providers or forest managers) via online platforms, such as MojGozdar.si (Triplat and Krajnc, 2021) or similar communication channels. However, it is important to include trustworthy and reliable PFOs, forest service providers or forest managers in the business model, who take care of proper relations, make offers with clear economic indicators, and perform quality work in the forest. This will build trust between PFOs for business cooperation.

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Forest commons responded efficiently – do we understand why?[1]

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ABSTRACT

This contribution aims to analyse the response of private forest owners to an extreme environmental disturbance in the Slovenian karst region in the period 2014–2016. Quantitative and qualitative analysis of empirical forest management data on response time and harvesting time, as well as interpretations of response drivers, led to the identification of forest commons as a fast and efficient type of forest ownership, despite almost a century of state suppression of their local institutions. Among the internal and external response drivers, a norm of responsibility and forest management competence were highlighted. Our study highlights the potential of forest commons for active forest management in Europe. A concerted response from private and state institutions should not only take into account economies of scale, but also traditional knowledge and local social norms.

KEYWORDS

Harvesting behaviour, natural disturbances, climate change effects, forest management, Slovenia

1 INTRODUCTION

The increasing frequency and severity of environmental challenges underscores the need for a collective response (Bodin, 2017). Ecosystems on limestone bedrock are particularly vulnerable to disturbances (Vilhar et al., 2022). Weather-related forest disturbance in Slovenia occurs regularly but on a relatively small scale. In 2014, a large-scale ice storm and the subsequent bark beetle outbreak in 2016 hit the Inner Karst region and stimulated the response of both professional state forest institutions and local forest owners. The inadequate recognition of common-pool resources as public goods motivated our research (Šmid Hribar et al., 2018), so we focused on the Inner Karst- post-disturbance forest management interventions of forest commons (hereinafter FC). They are a local tradition and the best known form of collective action seldom evaluated as a provider of ecosystem services through forest management.

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Activities of FC generally refer to group functioning and property maintenance like infrastructure maintenance and construction, harvesting, initiatives to decision-makers, local investments (Bavec et al., 2021). According to the Agricultural Communities Act (2015), Slovenian FC are formally recognized agrarian communities. Their collaborative activity, joint action and particular governance model in Slovenia has already been presented (Bogataj and Krč, 2014; Premrl et al., 2015; Šmid Hribar et al., 2018; Bavec et al., 2021), as well as related to other European practices (De Moor, 2015; Lawrence et al., 2020; Haller et al., 2021).

This study aims to determine whether FC responded to the ice storm and the bark beetle outbreak in 2016 faster in comparison to other types of forest owners. The hypothesis is that the response of FC was faster than that of other types of private forest owners. The objectives of analysis were 1) to fill the gap in the empirical examination of private forest owner behaviour, 2) to compare the response of FC and other types of private forest owners to forest disturbance and 3) to provide a basis for strengthening the active response to large-scale forest disturbance. In addition, we aimed to get an insight into their specific governance model and presumably its essential element - social norms. Post-disturbance interventions might account for this (Deuffic et al., 2018; Holt et al. 2021) and it is also important in any collaborative governance arrangement, as joint problem identification (e.g., forest management) and negotiated solutions have been found to be effective for socio-environmental sustainability (Bodin, 2017; Tucker et al., 2023).

2 METHODS

The study area was the Postojna regional forest district of the Slovenia Forest Service (hereinafter SFS). Inner Karst is also called the Green Karst for its typical forest cover. The study uses a mixed methods approach, combining quantitative and qualitative analysis. The quantitative part of analysis focuses on the following response indicators:

- **Response time** defined as the difference between the date of realization of the legislative order and the date of its uptake:
  - **minimum response time** refers to the first legislative order,
  - **average response time** refers to the average for all legislative orders, and
  - **maximum response time** refers to the last legislative order.
- **Harvesting time**, defined as the average time difference between the realization of the last and the first legislative order.

Realization of legislative orders, defined as the average time difference between the conclusion of harvest and the deadline prescribed in legislative orders. The forest related data used in this study are derived from the forest management plan for the period 2012–2022 (Zavod za gozdove, 2011) documented in the official database of the SFS. Variables analysed were site and forest stand characteristics and transport distances indicating accessibility. Pearson correlation coefficient were used.

The qualitative part of analysis improved the understanding of the decisions and actions of FC and highlighted the role of social norms. Primary qualitative data were collected by triangulating three methods: semi-structured interviews, focus groups and

surveys. We limited potential bias by iterative communication in the four-year period 2017–2020 and with different target groups, some of which intentionally overlapped (e.g., professional foresters of the SFS, regional forest owners, FC representatives and general regional population). We started in 2017 with pilot interviews and a focus group. In 2018, a web-survey was launched and a repeated focus group were organized. The third focus group in 2019 and the control from the national survey in 2020 tested the interpretations collected in previous years. Interpretation of the qualitative data was based on the framework of Deuffic et al. (2018), who proposed five general decision-making profiles.

3 RESULTS

Nearly 60% of forests in the area are privately owned, covering 47,728 ha (Zavod za gozdove, 2011). Private properties are fragmented into plots that are predominantly between 10 to 30 hectares big, which is larger than before denationalization. Forest management is attributed to the SFS according to the Forest Act (1998).

Three general problems of private ownership in the area are low motivation and inactivity, poor road infrastructure and the strong influence of wildlife, particularly that of large predators (Zavod za gozdove, 2011). There were 49 FC in the Postojna district in 2011 (Zavod za gozdove, 2011), and 46 according to the SFS archives in 2017. FC own forests at the least productive sites, once pastures in the total amount of 4,300 ha. The share of their land in the Postojna district is 9%. Their properties are located on the least productive sites 9% (4,300 ha) of the district forests. Part of these sites were planted with spruce before Second World War. FC can be considered as large forest owners, as most of their properties exceed the average size of individually owned forest land.

Legislative orders prescribed a total of 1,264,680 m3 of timber harvested after the ice storm and 694,906 m3 after the insect infestation in the Postojna district. The average harvest per legislative order was 4.2 times higher for FC than that for other private forest owners after the primary disturbance and 1.4 times higher after the secondary disturbance. Only 4% of the required timber harvest was not realized on disturbed FC plots, while other private forest owners left 57% of the prescribed harvest. Fully mechanized harvesting was FC's dominating approach. For other private forest owners, motorised manual harvesting prevailed. FC were efficient in terms of speed and focused decisions. For example, they primarily focused to conifers and minimized bark-beetles gradation that followed. Interestingly, average response time declined with increased skidding distance ($r = -0.23$, $p < 0.05$). FC with numerous legislative orders started significantly earlier ($r = -0.35$, $p < 0.05$) and their response time for the last legislative order was significantly longer ($r = +0.42$, $p < 0.05$). The average response time of larger FC was significantly lower ($r = -0.25$, $p < 0.05$).

However, short harvesting time was not only attributable to relatively large parcels or to the quick response, but also to other factors. Qualitative analysis clearly informs on competences gained in several past ice storm events of small scale and on ownership responsibility. The qualitative data consistently, and sometimes explicitly, suggest that social norms were the main driver of collective action of FC. A redundant question in our

inquiry asking who the main driver of the response was, yielded responses of »ownership responsibility« (77%), which is indicative of social norms, and »income potential« (43%), which is ultimately subordinate. Furthermore, a higher share of subsidized pastures, indicating the active management of the FC, stimulated action, while the sudden loss of a FC leader suppressed it.

4 DISCUSSION AND CONCLUSIONS

The decision-making process in forest management is becoming increasingly uncertain due to the effects of global warming. When land is predominantly privately owned, as is the case in Europe, swift intervention of private forest owners becomes crucial after natural disturbances. Studying the response of FC to extreme natural disturbances is beneficial because FC members share land and path-dependent relationships (Gatto and Bogataj, 2015; Šmid Hribar et al., 2018). They are large forest owners in the study area and in Slovenia. The share of their property type in Postojna area is three times higher than the national share (Premrl et al., 2015). Their property is less fragmented than other private properties. Furthermore, their interpretation of the extreme event was not catastrophic, in contrast to the shocking reports in the local and national media. Most members are over 60, experienced and cooperative (Bavec et al., 2021) but not equipped with safe and efficient mechanisation. Therefore, not only a large-scale forest disturbance but also legislative orders represented a sudden and substantial pressure because of large amounts of damaged wood and deadlines to be followed.

Harvesting was realized quickly, within prescriptions, and with 56% of the operations using mechanized harvesting, which is substantial in comparison with 10% mechanized harvesting done by other types of forest owners.

FC forest management decision-making competence developed through learning loops during regular ice storms of smaller scale, which resulted in an effective response to the sudden large-scale event. The fast response of older, experienced forest owners hypothesized by de Groot et al. (2018) was therefore not a surprise. New insights into joint forest management based on this analysis inform not only on experiential knowledge but also on elected leadership, (presumably) green competences (Bianchi et al., 2022) but still, on both, active and inactive FC. Active FC reacted immediately, changing their initial decision from training to hiring machinery services and efficient fulfilment of both, private and public duties (focus group 3; Šmid Hribar et al., 2018). For example harvesting prevented bark-beetles gradation and contributed to safe access to forests (in Slovenia citizens have free access to forests). Prescriptions played only a minor role which is in contrast to findings of de Groot et al. (2018), while relatively large plots and the amount of sanitary felled spruce were important. Response was limited where plots were inaccessible and/or the internal cohesion of FC was sometimes dysfunctional. The active and rapid response of FC is an interesting finding given the decades of their suppression (Bogataj and Krč, 2014; Premrl et al,. 2015), the general attribute of passivity of forest owners and the low public awareness of FC at the local, national (Bavec et al., 2021) and European level (Lidestav et al., 2017; Lawrence et al., 2020). Since FC prioritized conifers after the ice storm, bark beetles later caused few problems. Despite suboptimal response of individuals, past investments by FC in

self-organization and governance generally resulted in a comparatively better harvest response to an unexpected extreme event. Importance of social norms has already been highlighted in the international literature (e.g., Holt et al., 2021). As FC have not yet been analysed in relation to harvesting behaviour, identification of their key drivers might be important for future post-disturbance strategies:

- Economies of scale (also taking into account site accessibility, location and proportion of spruce);
- Social relationships (internal FC cohesion in terms of trust and social capital);
- Group action, its leadership experience and competence.

As communities of practice, FC regulate forest management and relationships, and practice collaborative governance (Bodin, 2017). They prioritize leadership quality and reputation over the number of members. They are able to mobilize experiential knowledge from past ice storms which is their important strength. Structural indicators do not provide the best insight into the qualities of FC.

The justifications for the active response are clearly in agreement with the theory of communicative action and practice theory (Deuffic et al., 2018; Wenger, 2000). Furthermore, the logics of cognition and practice described by Deuffic et al. (2018) were more important than those of interest and appropriateness that support eventual conformity to imposed rules. The findings do not oppose those of another model developed in Slovenia based on individual data about forest management conceptualizations (Ficko, 2019). However, there are some limitations of the study, for example the fact that the sample covers less than half of private forest owners in the study area and only part of FC. Furthermore, generalizations are limited by the high degree variation in FC functioning, unevenly spread response: some self-organized, while others waited for state measures or the action of neighbours. The role of the wood market and insurance was not analysed nor mentioned in the qualitative observations and there are challenges with internal cohesion that has been eroded during the Second World War and in the undemocratic regime that followed. Competent individuals are not equally distributed and may be marginalized. We cannot draw definite conclusions about the importance of age due to a lack of data on the social structure of the FC. A challenge are also non-respondents in the qualitative analysis and diverse reasons for inactivity. Further analysis should compare equal sizes of individual and collective private properties and contextual analysis through systematic long-term observation.

Generally, large-scale environmental extremes represent a push that mobilizes diverse actors. The main factors influencing the response of private forest owners were norms, the environment and competences of forest owners. Although owners' competences can be problematic in a society in transition (Premrl et al., 2015; Lidestav et al., 2017; Theesfeld, 2018; Šmid Hribar et al., 2018; Vasile, 2019; Weiss and Nichiforel, 2020), our analysis presents that a vibrant and partly self-organized rural society is able to build shared meanings and actively respond. This may also be a relevant model for other European contexts (Vriens and De Moor, 2020). However, unfortunately FC in Slovenia are currently recognized as examples of good practice and sometimes as owners of relatively large properties, rather than as a model as proposed in the European literature (Lidestav et al. 2017; Weiss et al., 2017; 2019; Lawrence et al., 2020).

Regional empirical data on the post-disturbance forest management intervention of FC provide insights into their effective response through their immediate and rapid collective action. They harvested damaged coniferous forest stands with machinery services well before the deadline and before other forest owners (except large individual forest owners). Iterative qualitative assessment shed light on various response drivers, including social norms of responsibility and forest management competence. This means that even if some FC remain dependent on external empowerment, most have revived the traditional collective action of FC and shifted from passive to active. The practical implications of this analysis lie in organizational approaches in the wake of natural disasters. Professional, timely and efficient private forest owner response requires the following:

- Avoiding generalized measures for artificial target groups in favour of contextualized real local communities.
- Recognizing and supporting existing FC and the pre-conditions for their collective action.

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6

Labour and employment in forestry

Main features of the labour market and economic activity in the native timber sector in the Ecuadorian Amazon

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ABSTRACT

The study aims to understand the economic aspects of timber harvesting (volumes, type of wood extracted, income generated and prices) and the main labor features of the native timber sector of the Ecuadorian Amazon. The literature describes the economic aspects of this activity, but little is known about the labor market. The survey results reveal that around 90% of workers in the Simpli-fied Harvesting plan (PMFSI) are temporarily employed and more than two-thirds work part-time, indicating job insecurity. On the contrary, 75% of the workers in the Sustainable Harvesting plan (PMFSU) are permanent employees. Salaries in the sector are above the national average and mini-mum wage. However, the wage gap between workers in the two plans was up to 50%, depending on the task, with a gender pay gap of up to 40%. Understanding these aspects is essential for poli-cymaking and could contribute to the growth of the sector while generating more employment equi-ty.

KEYWORDS

Native forestry, labor market, wages, Ecuadorian Amazon

1 INTRODUCTION

Ecuador's continental territory covers 24.8 million hectares (MAATE, 2017). The country is divided into three regions: (i) the Coast, (ii) the Andes (Sierra region), and (iii) the Amazon, which accounts for 47% of the total continental territory. Forests cover 51% of Ecuador´s total continental area, representing 12,3 million hectares (SUIA, 2023). The Ecuadorian native forest has great importance for local population (ITTO, Status of Tropical forest management - Ecuador, 2005) since it provides a wide range of employment opportunities and income generation (Mejía and Pacheco, 2013; CEDIA, 2018)

In 2022, the forestry sector contributed 1.1% of the country's gross domestic product (GDP), ac-counting for USD 691.91 million (CFN, 2022). This contribution is relatively low compared to other sectors, given the country's strong dependence on oil and other traditional products, such as agricul-ture and fishing. Nevertheless, the forestry sector is an important source of employment (SECAP, 2014), both in the formal and informal sectors. It boosts the economy and contributes to poverty alleviation (Sanchez Calderón and Reyes Pinengla, 2015), particularly in the Amazon region, where the forest is a main source of income.

The formal forestry and wood manufacturing sector generated an average of 26 thousand jobs be-tween 2010 and 2020; whereas, in 2020, it employed 23 thousand formal employees (INEC, 2022). However, there is limited information available regarding informal employment and the working conditions within this sector, both in the formal or informal segment. This lack of information can be attributed to the absence of public disaggregated statistics (Scholtzhauer and Torres, 2017). Particu-larly, there is limited data on native forest harvesting, including costs and revenues, volumes traded, among other relevant data. It is likely that this data partially exists, but remains unpublished, incom-plete, and is not presented in a coherent and systematic way.

To carry out logging activities in native forests, a license must be requested from the Ministry of En-vironment, Water and Ecological Transition (MAATE by its Spanish acronym), which was established in response to the continued loss of forest cover since 1990 (Mejía and Pacheco, 2013; Sanchez Calderón and Reyes Pinengla, 2015). The objective of MAATE is to promote sustainable forest use, taking into consideration the forest's capacity for regeneration and adaptation to change, and the situation of the people living in these areas (MAATEa, 2022; MAATEb, 2022). The two main types of plans in force are the simplified harvesting plan (PMFSI, acronym in Spanish), where logging must be done on a single property and with non-mechanized timber skidding, and sustainable harvesting plan (PMFSU) for mechanized operations (MAATE, 2015). Both plans are valid for any size of land. In practice, small producers typically apply for PMFSI licenses, while medium and large-scale forestry operators apply for PMFSU licenses. The natural or legal person who applies for the license is called the execu-tor and is the one who carries out the plan.

The existing literature partially analyzed the economic activity of the license holders (executors) and the limitations they encounter in their development; however, information specific to labor market in this activity remains scarce. To address this research gap, we designed a case study aiming to an-swer the following question: what are the main

aspects of the economic activity and labor market situation in the harvesting of native forests by executors holding PMFSI and PMFSU licenses in the northern Ecuadorian Amazon? Additionally, we analyzed what aspects could be strengthened in the native timber sector of the Ecuadorian Amazon.

2 METHODS

2.1 Sample selection and survey sites

To select the executors of PMFSIs and PMFUs, we accessed a list provided by the National Direc-torate of Forestry of the Ministry of the Environment, Water and Ecological Transition (MAATE by its Spanish acronym). The list contained information about the program type, the license expiration date, the main location of the program, the total volume approved, and the program area for both PMFSIs and PMFSUs. Subsequently, we selected executors with valid licenses, focusing on the years 2021 and 2022. This focus was necessary as licenses are typically valid for only one year, ensuring the inclusion of executors within the relevant timeframe for the study. We prioritized executors with a higher number of licenses as it indicated greater experience and a larger workforce.

The study was conducted in two provinces located in the Northern Amazon region of Ecuador: Orel-lana and Sucumbíos. These provinces were selected due to their significant number of harvesting plans authorized and timber volume harvested in the last two years. Esmeraldas (northern Coast) is the third province in this regard, but it was excluded from this study due to the prevailing social and security conditions in the province during this study. For the PMFSIs, we selected 24 executors in Sucumbíos and 25 in Orellana. For the PMFSUs, we selected 5 executors in Orellana, as no PMFSUs were approved in Sucumbíos within the period selected for this study.

Once the executors were identified, we conducted face-to-face interviews using a structured ques-tionnaire. The questionnaire consists of 26 questions, including sub-questions on productivity, pric-ing, marketing, infrastructure, employment quantity, employment characteristics (such as age and gender), training, and the labor situation of employees.

3 RESULTS

3.1 Economic activity

The executors harvest hardwood, semi-hardwood and softwood[1], the latter being the main source of commercialized wood. Mainly because softwood species grow fast and because they are used for very common uses such as handicraft products, pallets, boxes for transporting fruit and are also used in the manufacture of MDF. PMFSI executors marketed mainly softwood and semi-hardwood planks, and hardwood beams. During the analyzed period, 15,600 m^3 of softwood planks, 8,000 m^3 of semi-hardwood planks, and 11,600 m^3 of hardwood beams were produced. PMFSU executors commercialized mainly softwood logs (7,600 m^3) and planks (1,300 m^3).

[1] This is how native wood is traded in Ecuador, softwood is wood with 0.30-0.50 density, semi-hardwood between 0.51-0.80 and hardwood more than 0.81.

Table 1. Harvested volume (m^3) by wood type and product under PMFSI and PMFSU, 2021-2022

Executor harvesting plan	Total Volume (m^3)	Wood type harvested	Total Volume (m^3)	Average volume (m^3)
PMFSI	42,872	Hardwood	14,994	312
		Semi-hardwood	8,630	184
		Softwood	19,248	393
PMFSU	17,065	Hardwood	2,821	940
		Semi-hardwood	2,271	454
		Softwood	11,973	2,395

The volumes harvested resulted in total revenues of USD 273 thousand for PMFSI executors and USD 1.034 million for PFMSU executors during the analyzed period (Table 2). The main difference of revenues between the two types of executors lies in the price of the products obtained, as they vary according to wood species. Pricing was one of the most problematic issues highlighted by respond-ents. They attributed this partly to the consequences of the pandemic, but also to the fact that tim-ber of unknown origin is being sold on the market, which is driving prices down. To address this is-sue, the executors indicated several possible solutions, such as: (i) the government establishing a minimum price (suggested only by the PMFSI executors), (ii) a tax reduction, (iii) more control over the timber marketing channels, (iv) finding new customers who pay more, (v) avoiding the use of intermediaries (who take away some of their margin), (vi) increase mechanization and cost-efficiency (only PMFSUS), among others.

Table 2. Income (USD) by wood type of PMFSI and PMFSU executors, 2021-2022

Executor harvesting plan	Total income (USD)	Wood type harvested	Total Income by wood type (USD)	Average income of executors by type of wood (USD)
PMFSI	273,434	Hardwood	72,041	1,533
		Semi-hardwood	67,539	1,468
		Softwood	133,854	2,789
PMFSU	1,034,476	Hardwood	128,172	42,724
		Semi-hardwood	2,271	454
		Softwood	150,240	30,048

3.2 Employment

The labor market situation in native forest harvesting differs greatly depending on the type of license held by the executors, but both have very little female employment. In the case of PMFSI license holders, most of the employees have temporary jobs[2], while PMFSU holders mostly employ perma-nent workers. Table 3 shows that between 2021 and 2022, there were 387 temporary workers em-ployed by executors holding PMFSI licenses in Northern Amazonia, of which only 10% were perma-nent. Of the 90% of temporary employees, almost two-thirds are part-time workers, which shows how precarious the working conditions are in the PMFSI schemes. Conversely, in PMFSU executors' businesses, 75% of total employees are permanent. The difference reflects that PMFIs are typically larger companies with stable economic activity.

Table 3. Total permanent and temporary persons employed by license, 2021-2022

Executor harvesting plan	Total number of employees for all companies		Weighted average number of employees per company	
	Permanent	**Temporary**	**Permanent**	**Temporary**
PMFSI	30	387	0.6	8
PMFSU	56	18	11	4

According to the survey data, workers in forest operations within PMFUs/PMFIs earn salaries that surpass both the country's average monthly wage based on company-level data (as reported by INEC, 2023), which was recorded at USD 304 between 2021 and 2022, and the government-established minimum wage of USD 425 per month.

The survey findings reveal that the lowest monthly salary was reported among permanent non-productive employees in PMFSU, amounting to USD 600. On the other end of the spectrum, the highest monthly salary noted in the survey was approximately USD 900 for chainsaw operators em-ployed in both PMFSU and PMSFI. Furthermore, the survey data suggests a notable disparity in sala-ry between permanent and temporary workers, with a gap of up to 50%. Moreover, the survey highlights the existence of a gender pay gap of up to 40%.

Although employees are paid better than the national average and the minimum wage, they are not better paid compared to other sectors. The oil sector pays its employees much more, considering that the minimum wage is average around USD 700 per month. More than half of the PMFSI and PMFSU executors who responded to the survey said that it is difficult for them to get people already trained. Most of the workers prefer to work in energy and oil activities, mainly for the better salaries. PMFSI executors also said that a smaller proportion of employees prefer to work in agriculture and mining activities. All license holders agree that the lack of trained personnel in forest management, harvesting and sawing is affecting their sales, in part because of migration to other drylands and that they consider it a priority to be solved. However, they do not have the funds to provide training or hire well trained employees.

[2] They do not have fixed contracts with the implementers for more than one fiscal year or have guaranteed re-newal of their employment (either part-time or full time).

4 DISCUSSION AND CONCLUSIONS

The economic situation of the PMFSI and PMSFU executors differs significantly. Mechanization and the ability to hire specialized employees imply that the PMFSUS executors earn higher revenues than the PMFSIS license holders. Nevertheless, they have many points in common. For example, both types of executors are discontent with the product prices. Although they have ideas on how to deal with the problem on their own, in most of the cases they would like the government to support them more. Specifically, PMFSI executors would like the government to set a minimum selling price to ensure better margins. Conversely, PMFSUS executors disagree with a minimum price, but they want access to credits and further mechanization to improve competitiveness and, consequently, prices. To adopt a measure like a minimum price, it is necessary to analyze the impact for each actor in the sector, the plausibility of the implementation, updating mechanisms, and the consequences of this measure. This is beyond the scope of this study; however, it is noted that this was a strong re-quest from PMFSI executors. Another aspect where support from the Ecuadorian government should focus is on law enforcement to prevent illegal timber activities. Illegal timber creates disincen-tives to conduct harvesting procedures within the legal framework and negatively impacts market prices.

In terms of employment, the data obtained showed that workers earned significantly above average monthly salaries and the minimum wage in Ecuador. However, especially in PMFSISs, most employ-ees work temporarily and part-time, resulting in a lack of security in the employment relationship. PMFSUS executors hire mainly permanent employees. Both sectors have very little female employ-ment. The wage difference within the group of productive workers reached 50%, depending on the task to be performed. On average, female staff earned less than men doing the same job, by up to 40%. Despite being above average, forestry employers compete with other sectors such as oil, min-ing, and agriculture, to retain employees. The lack of wage competitiveness and wage gaps leads to a lack of job security and labor precarity. Identifying this is essential when designing new policies for the sector.

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Comparative analysis of economic performance and employment situation in wood-based value chains: A case study of Viet Nam

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ABSTRACT

This study examines the economic performance and employment situation of the wood industry in Viet Nam, with a focus on wood chip, wood pellet, and fiberboard industry. The results revealed that the fiberboard industry, utilizing the same raw material as wood chip and wood pellet, exhibited higher economic performance and employs a larger workforce. Our analysis shows that the fiberboard industry employed a larger number of workers per unit of input volume, indicating a potentially greater labor demand for workers per unit of processed input volume compared to other wood industries. Additionally, the wood pellet industry offered the highest average monthly wages, followed by fiberboard and wood chip industries. These findings contribute to a better understanding of the differences among industries sharing the same (scarce) resource base and emphasize the importance of strategic resource allocation. Further research is needed to explore the implications of allocating all roundwood exclusively to fiberboard production.

KEYWORDS

Wood chip, wood pellet, fiberboard, wood industries, Viet Nam, employment, economic performance

1 INTRODUCTION

Viet Nam has become a major exporter of wood products, particularly wood chip, and wood pellet, which have contributed significantly increasing the country's income. From 2010 onwards, the production and export of wood chip has experienced remarkable growth (FAOstat, 2020). The export value has increased from USD 0.4 billion to USD 1.7 billion in 2021, with China and other Asian countries being the main destinations (UN Comtrade, 2020). Similarly, the export of wood pellet has witnessed exponential growth, rising from USD 5 million to USD 413 million during the same period. Wood chips are primarily used for energy generation, pulp production, and wood-based panel production, while wood pellet are utilized for energy generation only (Kretschmann, 2010). To meet the demand for wood chip and wood pellet, enterprises in Viet Nam rely on wood from short-rotation plantations of *Acacia mangium* (Pistorius et al., 2016).

The wood industry in Viet Nam has experienced significant growth in various branches such as sawnwood, veneer, plywood, fiberboard, and particleboard manufacturing. According to the General Statistics Office (GSO, 2021), wood processing sector's industrial production index recorded an average annual growth rate of 3.4% from 2016 to 2020. Our study focuses specifically on fiberboard industry, as these, like wood chip and pellet industry, use roundwood as their primary raw material. This industry also experienced a surge in exports over the past decade. In 2021 alone, this sector accounted for USD 1 billion in revenue. The production of these products relies also on wood from domestic short rotation plantations of acacia mangium as well as imported wood (UN Comtrade, 2020).

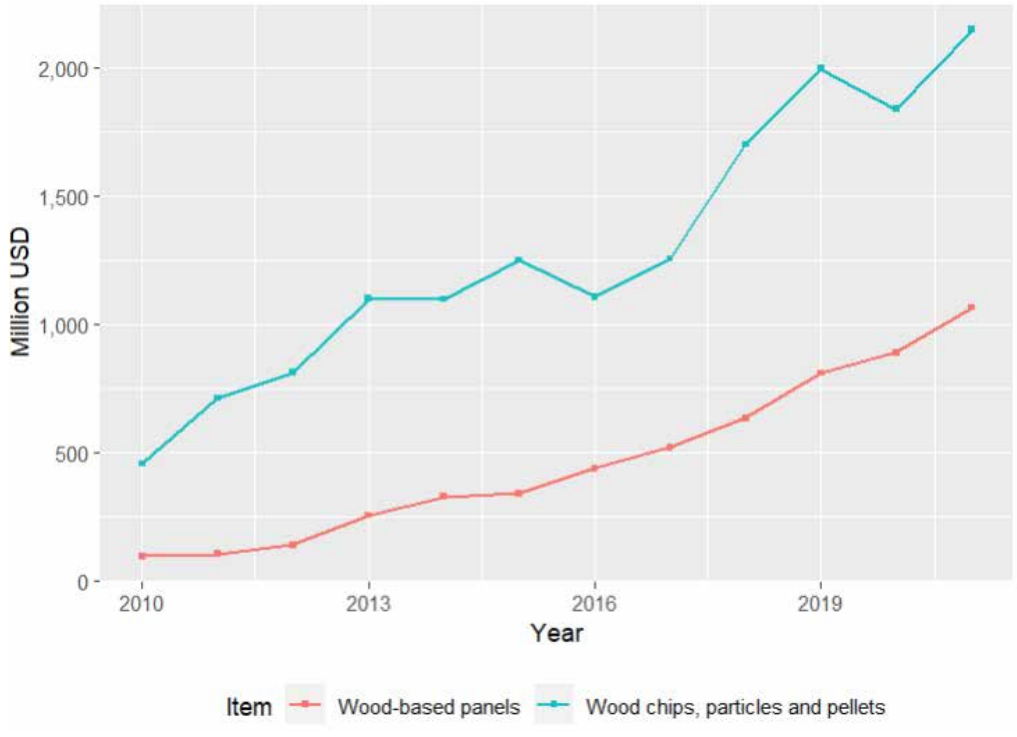

Figure 1. Exports of wood chips, particles and pellets and wood-based panels, 2010-2021 (FAOStat, 2023)

The wood chip, wood pellet, and fiberboard industries all rely on the same source of raw material, for which there is an intense competition in Viet Nam (Vu and Mai, 2021). Considering that these three industries are differently complex (Kretschmann, 2010), it is important to investigate: Are there differences in economic performance and employment situation in wood-based value chains based on the same raw material?

2 METHODS

A case study with filed interviews was conducted to address the research question. The study focused on a sample of companies operating in the wood chip, wood pellet and fiberboard industries in Viet Nam Consultants and fourteen industry experts in Viet Nam were contacted to compile the list of companies. The exponential, non-discriminative snowball sampling method was applied to select the companies for the study. Each person contacted provided multiple referrals. These new referrals then contributed additional referrals and formed a recommendation chain until 31 companies located in Viet Nam were identified: 12 of the companies are producing wood chip, 8 companies wood pellet and 7 companies fiberboard. The reference period for the data collected refers to January-December 2022. The analysis methodology is descriptive and comparative.

3 RESULTS

Economic performance

The surveyed companies producing fibreboard on average generated an annual revenue of USD 25.9 million, whereas wood pellet companies USD 15.8 million, and a wood chip companies USD 6.9 million. The corresponding volumes of roundwood processed for these companies were 297 thousand cubic meters, 64 thousand cubic meters, and 57 thousand cubic meters, respectively (cf. Table 1). Prices for roundwood are similar for all. Table 1 illustrates that fibreboard companies achieved the highest revenue per cubic meter of roundwood processed with 112 USD. Wood pellet companies followed with a revenue of 64 USD per cubic meter of roundwood processed, while wood chip companies achieved only USD 58. These numbers indicate that products requiring more complex processing, such as panels, yield greater revenues compared to products that undergo less complex production processes like wood chip and wood pellet.

Table 1. Revenues, input and output, 2022

Industries surveyed	Number of enterprises	Total revenue (million USD)	Average revenue (million USD)	Average volume roundwood processed (thousand tons)	Revenue/input (USD/ton)
Wood chip	12	82.7	6.9	119	57
Wood pellet	8	94.5	15.8	194	64
Fiberboard	7	181.1	25.9	297	112

Employment situation

As presented in Table 2, in 2022, the fiberboard companies surveyed employed a larger workforce in 2022 than the companies producing wood chip and wood pellet, with an average of 237 employees per company. Wood pellet companies followed with an average of 130 employees, while wood chip companies had an average of 65 employees. Among these companies, fiberboard companies also had the highest number of permanent employees and production workers, with an average of 167. Wood pellet companies had an average of 125 permanent employees per company, while wood chip companies employed 50 workers. The same pattern applies to the average number of production workers. Female employment share is higher in fiberboard companies compare to wood chip and pellet companies. In summary, the fiberboard industry stood out with a larger workforce, employing more permanent employees and production workers compared to wood chip and wood pellet, also having a higher participation of female employees.

Table 2. Total workers, average permanent, temporary and production employment, 2022

Industries surveyed	Number enterprises	Total workers	Average total workers	Average total permanent workers	Average female permanent workers	Average temporary workers	Average female temporary workers	Average production workers (permanent and temporary)
Wood chip	12	781	65	50	17	16	5	59
Wood pellet	8	778	130	125	24	15	2	77
Fiberboard	7	1,657	237	234	49	20	3	90

Salaries payed in the three woodworking industries are summarized in Table 3. The wood pellet industries surveyed offered the highest average monthly wages of the three industries, with employees earning an average of USD 442 per month. Fiberboard industry followed closely with an average monthly wage of USD 373, while the wood chip industry had a slightly lower average monthly wage of USD 364. Permanent

production employees received higher average monthly wages compared to permanent non-production employees, with an exception in the case of fiberboard. The average monthly salary in the fiberboard, wood pellet, and wood chip industries surpassed the minimum monthly salary in various regions of Viet Nam, ranging between USD 139 and USD 200 per month in 2022 (Vietnam Briefing, 2023). Additionally, these salaries were higher than the latest average wage values reported by the General Statistics Office (GSO, 2020) in 2020 for the first wood processing sector, which was 309 USD.

Upon analyzing the data in Table 3, the fiberboard industry exhibits the highest workers rate per input volume, generating 1.4 workers per thousand tons of processed input volume (roundwood). Wood pellet follow with a rate of 1.0, while wood chip have the lowest rate of 0.6 workers per thousand tons of processed input volume. However, it should be noted, that further research is needed that considers additional factors such as employment skills and experience to obtain more comprehensive and reliable results on the employment of workers in Vietnamese woodworking industries.

Table 3. Average monthly wages and employees per unit of input volume, 2022

Industries surveyed	Average monthly wage of permanent production workers (USD)	Average monthly wages of temporary production workers (USD)	Average monthly wages of permanent nonproduction workers (USD)	Workers per thousand-tons input
Wood chip	364	358	353	0.6
Wood pellet	442	406	396	1.0
Fiberboard	373	299	333	1.4

4 DISCUSSION AND CONCLUSION

In conclusion, the case study findings provide valuable insights into the wood industry in Viet Nam and shed light on the economic performance and employment situation across different woodworking industries. The research shows that the fiberboard industry, utilizing the same (scarce) raw material as wood chip and wood pellet, exhibited higher economic performance and employed a larger workforce. The results indicate that the fiberboard industry has a potentially greater demand for workers per unit of processed input volume compared to the other industries studied. However, to gain a more comprehensive understanding of employment dynamics, further research is required that takes into consideration additional factors such as employment skills and experience. The wood pellet industry offers the highest average monthly wages, followed by fiberboard and wood chip industry, with all sectors providing salaries that surpass the minimum monthly wage in Viet Nam and exceed the average wage values for the wood processing sector reported by the General Statistics Office.

Further research is required to examine the potential outcomes of allocating all the roundwood exclusively to fiberboard production given the scarcity of raw material.

This analysis will provide a more comprehensive understanding of the economic and employment generation possibilities in the industry.

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Enterprise formalisation: The case of informal wooden furniture microenterprises in Nairobi, Kenya[1]

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ABSTRACT

The present study aims at understanding the diverse nature of the informal wooden furniture microenterprises in Kenya (locally called “Jua Kali”) and their motivations to operate businesses in the informal economy. The respective information is a prerequisite for supporting decision-makers to facilitate the transition to formality. Our finding reveals that Jua Kali wooden furniture comprises two distinct profiles, i.e. survivalist and opportunity enterprises. Entry costs of registration and ongoing compliance, and the complexity of the registration process, are burdensome issues for Jua Kali to register their businesses formally. Lack of social protection is prevalent among Jua Kali wooden furniture and even more pronounced within those in the survivalist segment. The overall results imply that enabling Jua Kali conditions, such as reducing decent work gaps coupled with registration procedure simplification, can facilitate Jua Kali wooden furniture microenterprises toward possible formalization in the long run.

KEYWORDS

Enterprise formalisation, informal sector, wooden furniture, Kenya

[1] This study has been also accepted for the oral presentation at the FLARE meeting 2023.

1 INTRODUCTION

The informal economy significantly contributes to employment creation and constitutes a substantial portion of the national economy in several developing countries. However, the nature of the informal economy as being largely unregulated can pose severe challenges to attaining environmental and social sustainability. Recent studies revealed that the informal economy could increase environmental degradation in the short and long run (Qayyum et al., 2021; Baloch et al., 2022). The unsustainable and escalating use of natural resources can further limit their availability for future generations and eventually undercut local economic growth and job opportunities (Poschen 2015). Though the informal economic activities can absorb the labour surplus, many of those who work in the informal economy still earn their livelihoods in conditions of decent work deficits. The adverse impact of informality on working conditions, inadequate social protection and denial of rights in the workplace can lead to marginalisation and inequality, which are counterproductive for workers to achieve social justice (Osiki, 2020).

The informal economy primarily comprises of informal employment in the formal sector and employment in the informal sector (ILO, 2018; Lippe et al., 2022). Approximately 81 percent of the global economic units, i.e. enterprises are informal and most of informal workforce are employed by these informal enterprises (ILO, 2023). Enterprise formalisation, as one of the most important policy-related approaches, can pave the way for formal employment and fulfil the agenda of decent work attaining sustainability development goals. Well-tailored formalisation strategies, however, necessitate a clear understanding of the diverse nature of informal enterprises and the drivers underpinning their decision choices.

We selected the informal wooden furniture sector in Kenya as our case study. Generally, the Kenyan informal sector plays a pivotal role in the labour market and national economy (Federation of Kenya Employers, 2021). For the case of the wooden furniture industry, Kenya stands as the leading exporter in the African region (Creapo Oy, 2015). The wooden furniture sector in Kenya has a competitive advantage in wood compared to South Africa and Asian countries (ibid). However, the informal wooden furniture business, locally called Jua Kali, represents over a third of total wooden furniture sales in Kenya (ibid). To understand the nature of Jua Kali wooden furniture microenterprises and drivers of informality, we pose two research questions, i) What is the segmentation and its characteristics of Jua Kali wooden furniture microenterprises? ii) What are the reasons behind their decision to operate the wooden furniture business in the informal economy? The next section presents the methodological approach followed by results and conclusions.

2 METHODS

2.1 Data collection

The data for this study is based on a survey of Jua Kali wooden furniture enterprises in Nairobi, the capital city of Kenya. In response to the fact that a list informal wooden furniture microenterprise does not exist, the sample selection is designed to obtain representative samples of the target populations. Firstly, the five board regions of Nairobi are delineated

using Google Earth-assisted mapping (Figure 1) based on expert knowledge. Region 1, Dagoretti, is located in the western suburbs of Nairobi and approximately 10 km from the centre area. Region 2 is known as Langata and located in the south-east of Nairobi centre with about 7 km from the central area. Makadara & Embakasi East is the name of the third chosen region and on the eastern side of Nairobi. The fourth region is called Kasarani which is also located on the eastern side of Nairobi where also other kinds of informal settlements exist. The last region is Embakasi central which is about 12-15 km away from the city centre areas.

Secondly, our survey team visited the chosen regions to identify the streets and the number of Jua Kali wooden furniture microenterprises in each street. Subsequently, three streets per region were randomly chosen from a list of streets ordered by the number of microenterprises with equal probability of selection. In the last stage, a fixed sample size of four Jua Kali wooden furniture along the chosen street was systematically selected at regular intervals based on the business premise positioned in the respective street. The limitation to three streets per region and four Jua Kali wooden furniture per street results from the organizational aspects as well as the financial and temporal constraints. The respective design allows us to interview small wooden furniture businesses as randomly and as spatially dispersed as possible. Overall, face-to-face interviews were conducted with 60 Jua Kali wooden furniture from February to March 2023. A structure-questionnaire was employed during the survey. It encompasses four main modules to gather information on business formation, Jua Kali characteristics, registration status and business revenue and expenses.

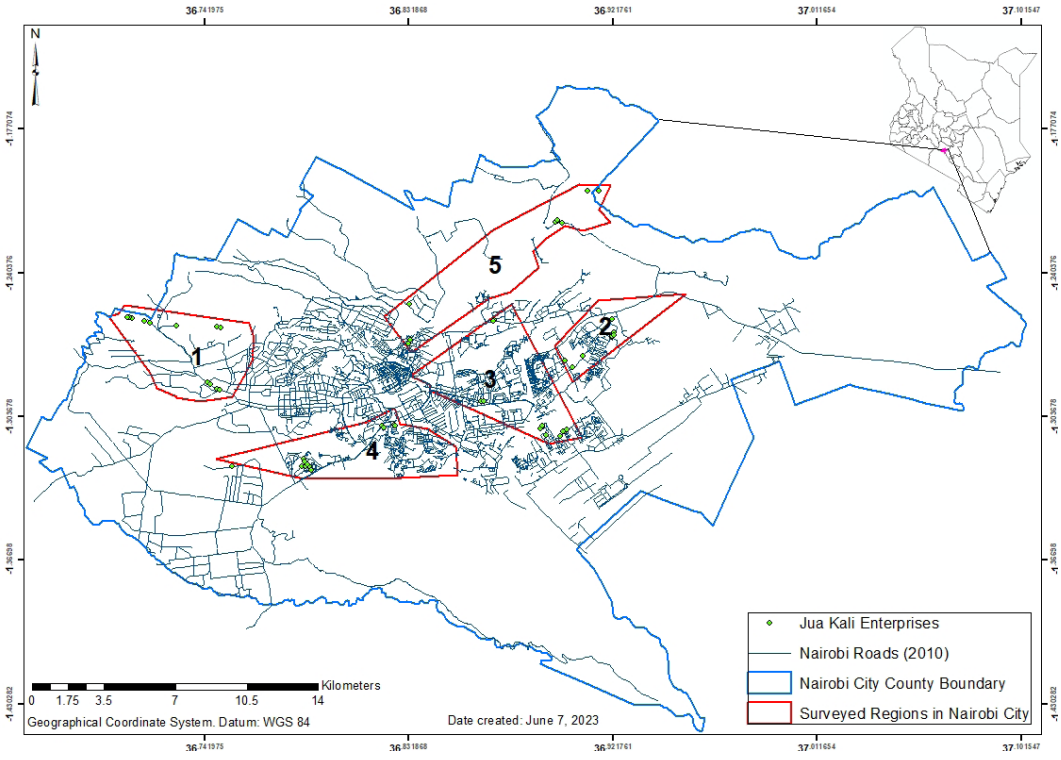

Figure 1. The chosen five regions in Nairobi for conducting interviews with Jua Kali wooden furniture microenterprises.

2.2 Statistical approach

The clustering technique is employed to determine the compositions in a target population, i.e. Jua Kali wooden furniture microenterprises, based on a series of attribute variables. We apply the Partitioning Around Medoids (PAM) or k-medoids because it is more robust in the presence of noise and outliers compared to other techniques such as k-mean (Michinaka et al., 2011). The literature shows that the ability to formalise the business depends on the profile of enterprises and their readiness (Gaarder and van Doorn, 2021). Accordingly, four relevant attribute variables are selected namely level of informality, annual business profit, access status to social security and size of the business (number of workers). The optimal number of clusters is chosen based on the maximal average silhouette width for the entire dataset, which can range from -1 to +1 (Kaufman and Rousseeuw, 2005; Lippe et al., 2021). We further checked the group mean difference between the final chosen clusters or segmentations of the Jua Kali wooden furniture microenterprises.

3 RESULTS

Figure 2 presents the overview of our samples, i.e. Jua Kali wooden furniture enterprises with regard to their business characteristics. As expected, the major business form of informal wooden furniture enterprises is sole proprietorship, accounting for 82 percent of the overall sample. Most of them either have no accounting or possess informal record on revenue and expense for personal use only.

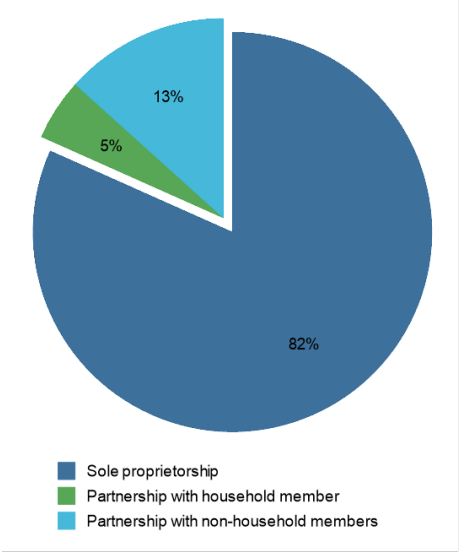

Figure 2a

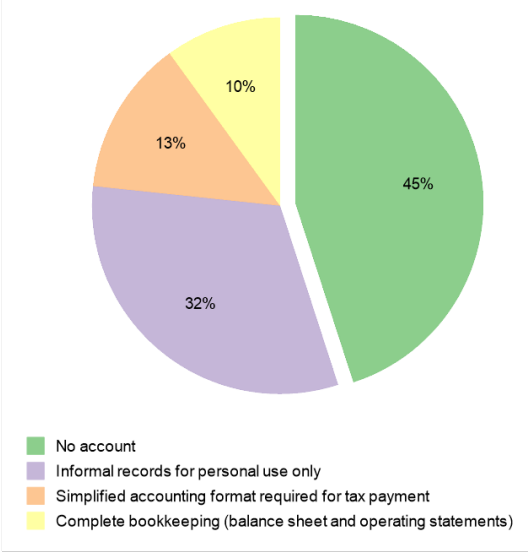

Figure 2b

Figure 2. Form of business (2a) and accounting record (2b)

According to the silhouette index, two is the optimal number of clusters in comparison to the other solutions. The overall average silhouette width is maximised at 0.77 implying that a strong clustering structure is found in our Jua Kali samples. The clustering result suggests that Jua Kali wooden furniture comprises two distinct profiles of informal enterprises, i.e. survivalist (cluster 1) and opportunity enterprises (cluster 2). The two-sample Wilcoxon rank-sum (Mann-Whitney) test further reveals that there is a statistically significant difference in the mean of each attribute variables among two segmentations of Jua Kali wooden furniture enterprises (Table 1).

Table 1. Clustering results and its attributes based on average score

Attribute	Cluster 1 (N = 54)		Cluster 2 (N = 6)		Mann-Whitney test (P-value)
	Mean	SE	Mean	SE	
Level of informality (Index)	0.60	0.03	0.33	0.12	0.022
Annual business profit (USD)	5424.48	718.49	41622.68	21793.40	0.033
No access to NSSF & NHIF (Index)	0.94	0.02	0.17	0.17	0.061
Size of business (number of workers)	3.48	0.22	4.67	0.33	0.000

Note: SE denotes Standard Error. NSSF and NHIF refer to National Social Security Fund and National Health Insurance Fund, respectively.

In addition, we found that both segments of microenterprises conduct their business in the informal economy because of the co-presence of necessity and opportunity-driven motivations. About half of our interviewed Jua Kali confirm that the entry cost of formal registration and ongoing compliance is the most burdensome issue to formally registering their businesses. This is followed by the complexity of the registration process. Lack of access to social protection such as sickness and employment injury benefits is widespread among Jua Kali wooden furniture and even more pronounced among those in the survivalist segmentation.

4 CONCLUSIONS

Understanding the nature of informality and its drivers can support policymakers in developing formalisation strategies that are fitted for the targeted enterprises. Hence, the present study aims to determine the segmentation of Jua Kali wooden furniture microenterprise and understand their diverse nature and motivations to operate their businesses in the informal economy. Using the surveyed data from 60 Jua Kali wooden

furniture microenterprises in Nairobi, we found two distinct profiles of these economic units, i.e., survivalists and opportunity entrepreneurs. As expected, most of Jua Kali are still survivalist entrepreneurs whose degree of informality is relatively high, whereas business profit and social security coverage are comparatively low. The findings shed light on the importance of reducing decent work gaps coupled with a registration procedure tailored to the characteristics of enterprises can enable conditions to facilitate the transition to formality in the long run.

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How many people are globally employed in the forest sector?[1]

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ABSTRACT

The question of how many people are employed in the forest sector globally seems straightforward to answer. However, due to the nature of the forest-related labour markets and insufficient employment data in several countries, it is difficult to capture the total workforce at the global scale. The present study developed a new estimating procedure to deal with missing data points enabling the estimation of total employment in the forest sector. Results reveal that approximately 33 million people were employed globally between 2017 and 2019, accounting for 1 per cent of total employment across all economic activities. The finding underlines the importance of forests and the forest sector in people's livelihood. Further, it highlights the need to ensure the availability of reliable and comparable forest-related employment statistics, as well as method refinement to increase the accuracy of estimates.

KEYWORDS:

Forest sector, employment, forestry, wood industry, paper industry

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1 INTRODUCTION

Information on the number of employed people is a crucial indicator for the distribution of socio-economic benefits derived from forest and forest sector labour activities. However, quantifying how many people are employed and how much they contribute to global employment is not a straightforward exercise, as quantitative information remains limited in several countries. The nature of the forest-related labour market, which is characterised by a high degree of informality, made it difficult to estimate the total workforce. Previous studies attributed to this knowledge gap. For instance, FAO (2014) estimated that global formal forest-related employment was 13.2 million people in 2010-2011, and additionally at least 44 million people were employed in the informal forest sector. For the same period, Li et al. (2019) revealed that the forest sector globally employed over 18 million people directly and supported 45 million jobs through direct, indirect and induced impacts. Another study by Lippe et al. (2021) estimated that at least 64 million full-time equivalent persons were employed in the forest sector in 2015. The different numbers reported in the literature result, among other things, from differences in data used, the units applied, the definition of the forest sector, the estimation procedures and the number of countries included in the analysis. In light of this debate, the present study presents an improved and up-to-date estimation procedure that can accurately determine the magnitude of total employment in the forest sector at the global and regional scales. The method developed in this study can provide further guidance for improving the viability of harmonised employment statistics in the forest sector.

2 METHODS

2.1 Terminologies and definitions

An estimation of forest-related employment necessitates a clear and consistent definition of the forest sector. In this study, the forest sector corresponds to the International Standard Industrial Classification (ISIC), encompassing three main subsectors, i.e. forestry and logging (forestry), the manufacture of wood and products of wood (wood industry) and the manufacture of pulp, paper and converted paper products (paper industry). As specified by ISIC Revision 4 (United Nations, 2008), the forestry subsector (ISIC division A02) incorporates silviculture, raw wood-producing activities, the extraction and gathering of non-wood forest products, and products that undergo little processing in the forest, such as firewood and charcoal. The wood industry (ISIC division 16) covers the manufacturing of semi-finished wood and products of wood. The paper industry (ISIC division C17) refers to the manufacture of pulp, paper and converted paper products.

2.2 Data

The comprehensive review of possible data sources revealed that the ILO microdata is the best available database providing comparable and robust employment statistics. ILO employment microdata is derived from the systematic international standardization

of national Labour Force Surveys (LFS) or similar household surveys. Following the 13th International Conference of Labour Statisticians (ICLS) definition, the concept of total forest-related employment in this study refers to the sum of persons in employment with formal and informal jobs, which the latter cover persons engaged in forest-related production for their own final use and thus constituting an essential basis for their livelihood.

ILO employment microdata are recorded in the unit of headcount. From a time series perspective, however, ILO employment microdata is only available for the years in which LFS or other similar household surveys took place, resulting in information on various data points may be missing in a given year. The employment estimates in this study were thus derived from an average of three years between 2011 and 2019, resulting in three reference periods: 2011–2013, 2014–2016 and 2017–2019, respectively. The analysis covers 185 countries, representing 99 per cent of the global forest area.

2.3 Estimation procedure

The measurement of ILO employment data aligns with international guidelines that allow for comparable and standardized data for all countries and regions. Moreover, ILO microdata allows for a breakdown of employment statistics by nature of jobs and gender. Despite this, an overview of global forest-related employment requires substantial country coverage beyond the current provision. The present study endeavours to fill the gaps in the missing forest-related employment data points. The "wave-based method" was developed on the assumption that the distribution of sub-sectoral forest-related employment and employment of the main economic activities are closely related.

The method involves two main steps. In the first step, a balanced panel of data of countries that reported at least one data point on employment is generated for each forest-related subsector. For instance, a missing data point in forestry is estimated using ILO modelled estimates in agriculture factored by the country employment coefficient. The country-specific employment coefficient is the share of forestry employment in ILO modelled estimates in agriculture to the closest available data point. The same procedure is applied to the wood and paper industry subsectors using the ILO modelled estimates in manufacturing as a benchmark.

The second step is to estimate the forest-related employment figures for countries not covered by the ILO microdata. The procedure assumes that countries in the same geographical domain are likely to be homogeneous in terms of forest-related employment. The balanced panel of forest-related employment data derived from the first step and the ILO-modelled estimates are thus used to generate regional employment coefficients for each subsector and data point. The number of persons employed for countries for which no data is available is therefore derived from the ILO-modelled estimates factored by the regional employment coefficient of the respective subsector.

3 RESULTS

The number of persons employed in the forest sector is estimated to be approximately 33 million for the period 2017-2019, accounting for about 1 percent of total employment

across all economic activities. Among subsectors, most of the workforce is in the manufacture of wood and wood products, representing 58 percent of total forest-related employment. Overall, a declining number of persons employed in the forest sector can be observed (Figure 1). The number of people employed in forest-related activities decreased by around 15 percent from the period 2011–2013 to 2017–2019. Reasons that may explain the decline of forest-related employment include increased productivity, for example, through mechanization and improved forest management practices, and the use of employment ILO-modelled estimates as the benchmark to fill in the gaps in missing data points. Globally, the share of agriculture and manufacturing in total employment has dropped across country income groups (ILO, 2019). Since this trend is reflected (in ILO-modelled estimates for the forest sector, this results in a decreased estimate of forest-related employment during the considered periods.

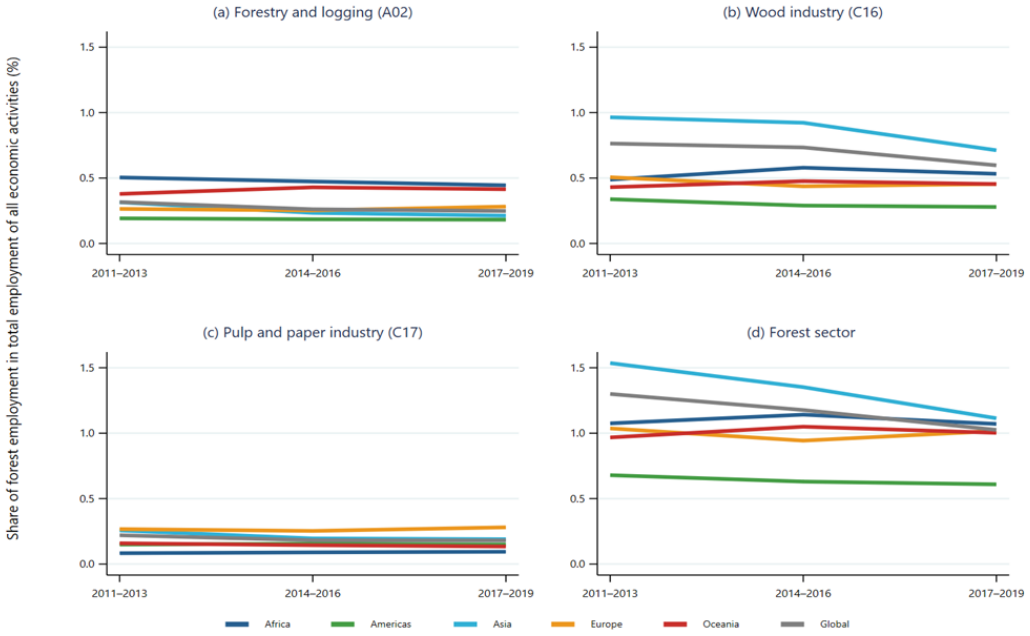

Figure 1. Employment trends by region and subsector (Lippe et al., 2022)

4 DISCUSSION AND CONCLUSION

Quantifying total employment in the forest sector, particularly at the global level, presents methodological challenges due to the lack of country coverage for which reliable employment statistics are available. The nature of forest-related work, which is characterised by a high degree of informality and seasonality, makes it more challenging to capture the full extent of the total workforce. The wave-based method is a promising way to deal with incomplete time series and to get a global overview of how many persons are employed in the forest sector. Nonetheless, some uncertainties should be highlighted. First, the method applied to fill data point gaps use employment estimates modelled by the ILO- as a benchmark. In that sense, the estimated number of persons in employment for missing data points are “imputations on imputations”. This caveat could also affect the accuracy of the estimated number of persons in employment in the forest sector in general. Second, the forest-related employment numbers for several

countries are derived solely from ILO-modelled estimates and estimated regional employment coefficients. The fact that there are countries with no forest-related employment data available could lead to over- or underestimation of global employment in the forest sector. This is true, particularly in countries with a significant forest sector labour market. Finally, the current estimate of forest-related employment is based on all countries included in ILO-modelled estimates. However, some subsectors may not appear in all countries used in the estimating process. The number of employed persons in the forest sector could thus be overestimated. This study, therefore, highlights the need to further refine the method in order to minimise the uncertainties affecting the accuracy of the estimates. The importance of forests and the forest sector for people's livelihoods underlines the need to ensure the availability of reliable and comparable statistical data on forest-related employment.

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A step forward to enhance the wood processing industry: identifying its challenges. A case study in Ukraine

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ABSTRACT

This study aims to identify the challenges for the wood processing industry in Ukraine after 2022. A case study was conducted, and online surveys were employed to gather information from industry stakeholders. The results indicate that both private companies and public State Forest Enterprises (FMEs) were affected. Private companies experienced difficulties in obtaining raw materials due to high prices and limited quantities, as well as logistical problems and increased transportation costs. The labor market also posed challenges, with private companies reporting a decline in their workforce and struggles in finding skilled employees. FMEs, being vertically integrated, encountered fewer supply and logistics problems and employment results were inconclusive. The study highlights the need for further empirical research to gain more conclusive insights and possibly suggest ways to improve the sector.

KEYWORDS

Wood processing sector, employment, reforms, Ukraine

1 INTRODUCTION

The Ukrainian wood processing sector, including wood and pulp and paper, employed on average roughly 76 thousand regular workers by January 2022, accounting for 4% of the industry workforce (State Statistics Service of Ukraine, 2022). The wood processing sector, characterized by its dynamism, accounted for approximately 7% of the total volume of industrial products sold in 2021. Over the past years, this sector has encountered various challenges and undergone reforms, including those related to raw material purchase auctions, which have had an impact on companies' production volume. Currently, the sector is grappling with challenges arising from the consequences of the war that began in 2022. While numerous studies and reports address the economic and labor-related issues Ukraine is currently facing, there remains a gap in identifying the specific challenges confronting the wood processing sector. Thus, the research question we aim to address is: *what are the economic and employment challenges that wood processing sector is facing?* Bridging this knowledge gap is a crucial first step towards formulating future policy recommendations aimed at enhancing the sector. To this end, a case study was developed, and online surveys were conducted to collect direct information from wood industry stakeholders.

1.1 Challenges of the sector since 2022

The Ukrainian Ministry of Economy estimated that the war will decrease the GDP by 30.4 % in 2022 (Reuters, 2023). The war had and still has significant consequences for the Ukrainian forest sector, specifically the wood supply. This is because in total 2.9 million hectares of forests were damaged and about 1 million hectares of forests are within areas of active hostilities. Moreover, the presence of mined areas and a significant increase in forest fires further exacerbate the situation. Climate change has also contributed to heightened fire risks in forests. Furthermore, numerous facilities within the wood processing industry have been destroyed or damaged, compounding the challenges faced by the sector. The decline of local wood supply was also reduced by the ban on imports of Russian and Belarusian timber. As a result, also supply to the foreign markets were reduced, and prices went up (Prins, 2022), affecting wood processing industries production (Prodanova et al., 2022). In addition, the demand for roundwood as a fuel is in direct competition with the demand from the wood processing sector, putting even more pressure on the companies' economic performance. On the other hand, there are also transportation and logistical difficulties (Prins, 2022; Serhii et al., 2022) affecting both the purchase of raw materials and the distribution of the products manufactured by wood processing companies. Part of the infrastructure has been rendered inaccessible due to damages and closed roads, in addition to a considerable increase in transportation costs, which is partly explained by the increase in fuel prices.

Another major problem has to do with changes and unpredictabilities in the labor market in Ukraine (Szajna and Kostrzewski, 2022; Horne, 2023). On the one hand, a labor shortage was triggered, due to many reasons linked to the war, leaving many vacant positions that could not be replaced due to a lack of personnel in the economy or specialized workers in the sector (Prins, 2022; Szajna and Kostrzewski, 2022). On the

other hand, many companies had to relocate due to the war from easter to western Ukraine, which naturally impacted the regional labor force availability (Anastasia et al., 2022). Some employees followed the companies, but many employees did not. The migration of workers from one region to another and the recruitment of workers in the new locations therefore led to movements and complex changes in the industry that still cannot be fully captured.

To better understand and capture the consequences of the war impacts since 2022, we developed a case study. It focuses on identifying the challenges faced by wood processing companies in Ukraine, both public (FMEs, acronym for State Forest Enterprises, which are vertically integrated, and some of them with an integrated wood processing unit) and private, in terms of the economic and labor market aspects of the sector.

2 METHODS

The Ukrainian wood processing sector case study was developed in two stages. The first step was the collection of secondary literature about the economic and employment aspects of the wood processing sector and the Ukrainian economy. As a result, it was possible to understand and capture the main problems of the wood processing sector, which was used to define the objective of the case study. The second step consisted of conducting an online survey that could capture the different questions sought in the previously defined survey related to the economic and employment challenges facing the wood processing sector. An online survey was chosen as the easiest way to collect data, as it was not possible to travel across the country to conduct face-to-face interviews. The online survey was conducted via LimeSurvey. The survey was distributed to the selected companies by E-mail and took place between February and June 2023. Additionally, phone calls were made to reinforce the request or explain the reason for the survey. The survey was conducted in Ukrainian language and was anonymous.

The selection of the online survey sample was defined as follows:

1. public sources were searched for lists of both public and private companies. In the case of public companies, the sources were the following: 1) Database of state-owned FMEs (websites of the Regional Administrations of the SFRA); 2) Web search results of the FMEs of communal property by using the word "агролісгосп" (database for this type of enterprises doesn't exist at the national level; 3) Database of PEFC-certified companies (only FMEs are certified currently) in Ukraine; and 4) FSC-certified companies (FSC Dashboard). For private companies the sources were the FSC list (by selecting of COC type of certificate) and lists of companies available at the websites of the professional associations of wood processing enterprise
2. the sources were cross-checked, and 50 public and 50 private companies were randomly selected.
3. Given that many of the initial batch of companies did not answer, an additional 25 public and 25 private companies were added, following the same random selection procedure.

In total, six (6) FME's and fifteen (15) private companies answered the survey with more than 85 % answers completed. The responding FME's are mainly located in the provinces of Khmelnytskyi, L'viv, Chernivtsi, while the private companies are found in Kiev, L'viv, Rivne, Cherkasy, Transcarpathia, Volyn, Vinnytsia and Ivano-Frankivsk. As Figure 1 shows, all companies are mainly located in the northwest of the country.

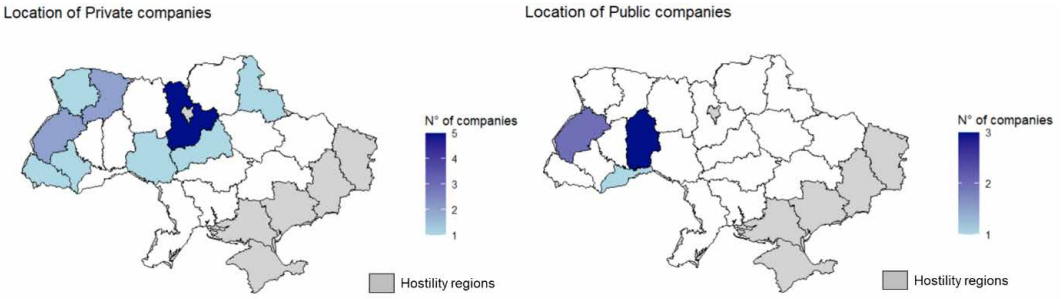

Figure 1. Location of FMEs and private companies surveyed

The survey distributed to the companies has two main sections: part 1 related to productive and economic issues of the companies; and part 2 that seeks to capture information about the labor market in the forest sector. In the first part, questions are asked about the products they manufacture, the raw materials they consume, whether they have shortages of raw materials and what the respective reasons are, whether they receive government subsidies for their operations; marketing aspects (volumes commercialized, prices paid, logistics aspects); net turnover of the company. #The second part asks questions related to the labor market, such as number of employees, types of contracts, gender, skills, wages, hiring issues. The survey includes a total of 22 questions. Descriptive statistics are applied as the analytical framework.

3 RESULTS

The survey results indicate that most of the interviewed companies, both FMEs (84%) and private companies (67%), primarily manufacture sawnwood. This is followed by wood pellets, which is usually a co-product of sawmilling factories. Private companies also produce veneer and boards, ranking third in terms of product variety. Private companies produce between one to a maximum of three products. On the contrary, FMEs produce mainly one or two products, mainly sawnwood or wood pellets, with a low level of processing. This is because they are vertically integrated companies whose core business is forest management and harvesting, with the addition of an integrated but small processing unit.

In 2019, the 15 private companies that responded to the survey employed nearly 1,400 persons, with an upward trend leading until 2021 and 2022, when the number of employees reached 1,500. Although other factors cannot be ruled out completely, this upward trend was disrupted in 2022 by the impacts of the war. In addition, the survey results reveal that over two-thirds of the responding companies have difficulties in finding trained employees in this context.

The situation differs for the FME group of companies surveyed. Figure 2 illustrates that these companies experienced a significant decline in employment during the pandemic

(2020/2021) but managed to return 2019 levels in 2022. However, employment figures of FME's include personnel in forestry and wood manufacturing. Thus, further analysis is required to better understand the underlying determinants of that recovery.

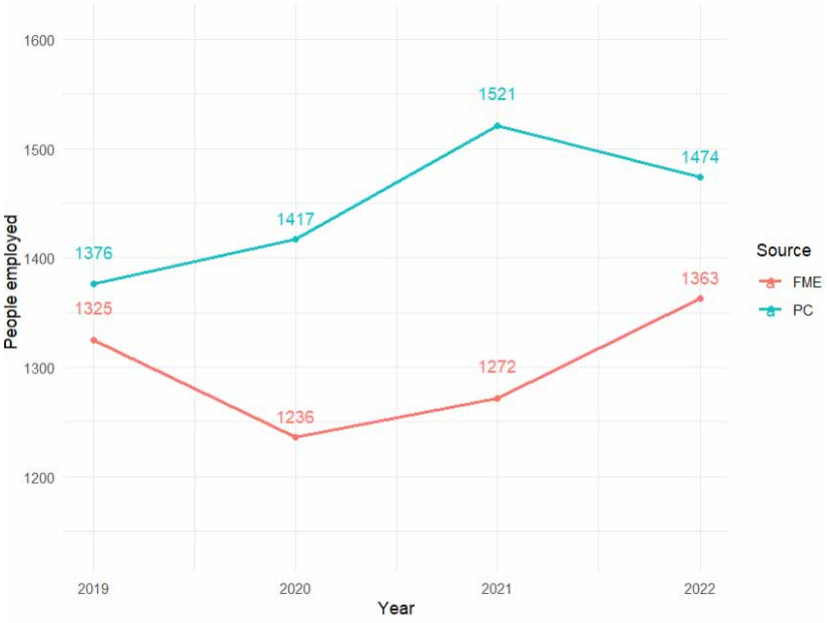

Figure 2. Total number of employees by company type, 2019-2022

The survey shows that FMEs have had minimal disruptions to their raw material supply and very few logistical problems because they are vertically integrated. In contrast, private companies faced numerous challenges, primarily attributed to high prices that restricted their access to raw materials. Furthermore, almost 40% of the responding private companies had difficulties finding the required raw material on the market and mentioned logistical problems and high transportation costs as important factors.

4 DISCUSSION AND CONCLUSION

The ongoing war had varying impacts on public (FMEs) and private companies in the wood processing sector. In terms of employment, private companies have experienced a decline in their workforce and encountered difficulties in recruiting individuals with the necessary skills and qualifications. This is a major obstacle that can hinder productivity and sectoral growth. The survey results related to the employment situation in FMEs did not yield clear results. To obtain more robust and reliable results, it is recommended to either increase the sample size through additional observations or to conduct qualitative interviews to complement the existing data.

In terms of the economic situation, the private companies interviewed had problems accessing raw materials due to high prices and limited availability. They also highlighted logistical problems and high transportation costs, which increased their expenses and hindered their sales. Identifying these aspects is crucial for targeted policy development. FMEs reported that they had minor logistical issues. Qualitative interviews and a workshop are planned to further deepen the study's findings. These activities aim to gather conclusive and robust evidence, as well as to develop suggestions to enhance the sector.

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7

Forest management and decision-making

An approach for integrating stakeholders' participation in forest management planning in Slovakia

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ABSTRACT

Forest management planning had been rather a technical task to match capacity with goals and a political one to give experts the responsibility of developing the plan. Recently, there have been calls for alternatives involving stakeholders (including the public) in the planning process, thereby creating an iterative decision-making framework for integrated forest management planning. Notably, the protected or urban forests are targeted for such claims. As forests play an essential role in achieving biodiversity protection, public participation may help to improve and mitigate environmental, economic, or social inequalities in the future. Against this background, the paper aims to develop an approach to stakeholders' participation in forest management planning in Slovakia. The goal is to integrate the concept of participation with the multiple-criteria decision analysis in forest management planning.

KEYWORDS

Forest management planning, stakeholders' participation, protected areas, Slovakia

1 INTRODUCTION

Forest management planning and the forest management plan (FMP) have long traditions in Slovakia (Table 1). The planning process nowadays consists of four stages: complex forest survey, strategic planning, detailed forest survey, and tactical planning (Decree on Forest Management and Forest Protection No. 453/2006 Coll.). Although revolutionary political and economic changes occurred after 1989, forest management planning remained relatively unchanged (e.g., Schwartz et al., 2009). The paradigms had been, however, challenged by demands for forest management from newly

established forest owners and various stakeholders (Kovalčík et al., 2012; Sarvašová et al., 2014a; Sarvašová et al., 2014b; Sedmák et al., 2019). Their preferences were not considered in forest management planning (Table 1). In recent decades, however, the non-technically oriented concepts (e.g., the idea of public participation) have been promoted in technically oriented planning procedures. For instance, the EU accession in 2004 and new forest legislation (Forest Act No. 326/2005 Coll.) brought the principles of sustainability adopted at the EU level in the national forestry policies, including the idea of participation in forest management planning (Sarvašová et al., 2013). As a result, forest management planning involves obligatory stakeholders (e.g., governmental agencies, forest owners) and concerned parties (e.g., owners of electrical and other lines, environmental NGOs). The concerned parties can enter the planning process if they claim that their rights may be affected by the FMP. In contrast, public participation is based on Administrative Procedure Act No. 71/1957 Coll. The relevant district office had to approve claims to join the planning. As a result, public participation is relatively absent.

Moreover, protected areas in Slovakia need an additional management plan for protected areas (Nature and Landscape Protection Act No. 543/2002 Coll.). Firstly, the Ministry of the Nature Protection of the SR mandates a qualified person (e.g., a governmental nature protection agency) to propose a management plan for the protected area. Secondly, the district offices in the regional headquarters carry out the official discussion of comments on the proposal. Public participation is somewhat restricted (e.g., min. 500 public signatures). Finally, the final version is approved by the government of the SR.

Table 1. Historical overview of forest legislation and stakeholders' participation in forest management planning

Year	Major forest legislation developments related to forest management planning	Public participation	Major political developments
Prior 1426	No regulations (no management, unregulated exploitation of forests)	No	Feudalism - Kingdom of Hungary
1426-1565	Regulation of king Sigismund (sustainability of harvests, introduction of cutting regulations)	No	Feudalism - Kingdom of Hungary
1565-1769	Regulations of king Maximilian II. (sustainability of even-flow harvests, introduction of cutting regulations)	No	Feudalism - Austrian, since 1867 Austro-Hungarian monarchy
1769-1879	Regulations of empress Maria-Theresia (establishment of organized forestry, i.e. forest inventories, time and spatial regulations of harvests, promotion of natural regeneration of stands, development of planned even-aged forestry, introduction of first FMP)	No	Feudalism - Austrian, since 1867 Austro-Hungarian monarchy

1879-1960	Act No. 31/1879 on Forests (sustainability - maximization of volume/later value and even-flow harvests, time and spatial regulations of harvests, introduction of forest tending and silviculture, preference of clear-cuts with gradual increase of using shelterwood and selection system, intensive even-aged forestry)	No	Capitalism/Socialism - Austro-Hungarian empire, since 1918 Czechoslovak Republic, since 1939 Slovak Republic, since 1948 Czechoslovak socialistic Republic
1960-1977	Act No. 166/1960 on Forests and Forest Management (sustainability - promotion of forest production and other functions, shelterwood and selection silviculture system linked to natural regeneration of stands, clear-cutting prohibited, introduction of forest classification and area zonation not based on phytocoenological classification, multifunctional principles, close-to-nature forestry)	No	Socialism – Czechoslovak socialistic Republic
1977-2005	Act No. 61/1977 on Forests, Act No. 100/1977 on Forest Management and State Administration of Forestry (sustainability - promotion of balanced multifunctional forestry, forest classification and area zonation on phytocoenological classification, large-scale less close-to-nature forestry, intensive even-aged forestry - promotion of small-area clear-cutting systems linked to artificial regeneration, shelterwood and selection silviculture system allowed but not supported)	No	Socialism/Capitalism – Czechoslovak socialistic Republic, since 1990 Czechoslovak federal Republic, since 1993 Slovak Republic
Since 2005	Act No. 326/2005 on Forests (sustainability - promotion of shelterwood systems with natural regeneration, small-area clear-cutting allowed but not supported, forest classification and area zonation based on phytocoenological classification, later promotion of close-to-nature forestry)	Restricted	Capitalism – Slovak Republic

As a result, the strong emphasis on expertise in forest management planning, especially in protected and urban areas, could miss many interests at stake (e.g., Folke et al., 2005; Bodin and Crona, 2009). The alternatives involving public stakeholders in planning have been observed in the scientific literature (e.g., Weiss et al., 2002; Martins and Borges, 2007; Baskent et al., 2008; Nordström et al., 2010; Stojanovska et al., 2013; Nikinmaa et al., 2023). Their search for answers to the question, is forest management simply a technical task to match capacity with goals or a political one that gives the administration a range of responsibilities of applicable laws, and how they are fulfilled depends on experts? Or there is an alternative, such as involving public stakeholders in the planning and creating an iterative decision-making framework for integrated forest management planning. This approach does not rely on formal means of management and control, centralized around authority, but on informal standards of governance and discretion (Weiss et al., 2002). Public participation is not just about holding a public meeting to review a proposed plan or talking to people to see what they want and incorporating those preferences or concerns into the planning process. It is a participatory process involving ecological, financial, organizational, and political aspects. The result would be a new approach to planning in forestry, combining the conventional fact and expert-based

decision-making process with decision-making processes based on the preferences of the public stakeholders involved. A few examples exist where the public stakeholders are already included in the planning process within a clear formal framework (Weiss et al., 2002). In this context, it is necessary to ask how to (formally) ensure the stakeholders' representativeness (incl. responsibility) in forest management planning. The aim of the paper is thus to develop an approach to stakeholders' participation in forest management planning. We use a case study from Slovakia to illustrate the development of an approach for integrating stakeholders' participation with multiple criteria analysis in forest management planning. For that purpose, we start characterizing stakeholder participation and stakeholder analysis. This approach aims to innovate and provide an alternative to Slovakia's forest management planning.

2 CONCEPTUAL BACKGROUND

2.1 Stakeholders' participation characteristics

Stakeholders are any group of people, organized or not, who share a common stake in a particular problem or system (Grimble and Wellard 1997). Stakeholder participation could be generally characterized as sharing an understanding and involvement in decision-making, e.g., forest management planning. The first classification of the public's influence in the participatory process was elaborated by Arnstein (1969). Arnstein's (1969) "ladder of participation" described a continuum of increasing stakeholder involvement, from passive dissemination of information (which she called "manipulation") to active engagement ("citizen control"). Currently, in the literature, there are many different classification systems of participation level (Pimbert and Pretty, 1997; Chess, 2000; Jones et al., 2000; Tabbush, 2004). The participation level commonly distinguishes between unilateral, bilateral, and multilateral forms of participation and is based on the deep involvement of each stakeholder group (Herwig, 2008): i. Information: the level of participation which provides the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities, and solutions (e.g., fact sheets, websites); ii. Consultation: the level of participation which obtains public feedback on analysis, alternatives and decisions (e.g., focus groups, surveys, public meetings); iii. Collaboration: the level of participation which engages the knowledge and resources of stakeholders (i.e., site-based events); iv. Co-decision: the level of participation which shares power and responsibility for the decisions being made and their outcomes creating management groups.

2.2 Stakeholders' analysis

The stakeholders' analysis could be characterized as a holistic approach or procedure for understanding a system and assessing the impact of changes by identifying the key stakeholders and evaluating their interests in the system (Grimble and Wellard, 1997: 175). The outcome of the analysis is knowledge of stakeholders in forest management planning, e.g., their involvement, interests, and conflicts (e.g., Hermans and Thissen, 2009; Marttunen et al., 2017). Popular in many fields, including natural resources management (Bryson, 2004; Prell et al., 2009; Reed et al., 2009), the analysis is often applied ad hoc.

To systematically perform, the stakeholders' analysis ought to be a process that defines the phenomena affected by the decision-making, identifies stakeholders who are affected or could be affected by the decision-making concerning the phenomena, and prioritizes identified stakeholders in participation in decision-making (Reed et al., 2009).

2.2.1 Methods used in stakeholders' analysis

Normative versus instrumental approaches to stakeholder analysis have emerged in the scientific literature (Hwang and Lin, 1987; Coughlan and Armor, 1992; Reed et al., 2009). Within the normative approach, participation means the democratic right to participate in environmental decision-making (Reed, 2008). On the contrary, it is possible to identify, explain and manage the stakeholders involved to achieve the desired result through instrumental approaches. The participation of interested stakeholders could accomplish the goal with better quality decisions. Whether it is a normative vs instrumental approach, Reed et al. (2009) identified various methods suitable for their application in the field of management of natural resources: stakeholders' identification - methods focusing on the individual (in-person interviews, Delphi method) or the interaction between actors (brainstorming, group interview/workshop); stakeholders' categorization - methods focusing on analytical vs reconstructive categorization; stakeholders' analysis - methods such as actor connection matrix, Social Network Analysis (SNA), and knowledge mapping.

2.2.2 Methods for multi-criteria decision making

If a new approach to forest management planning in forestry had to be applied (e.g., combining the conventional process with the stakeholders´ preferences), a wide range of often conflicting management goals must be considered. It means that either the desired level of goal achievement or different goal preferences must be specified (e.g., Mendoza and Martins, 2006; Kangas et al., 2010; Nordström et al., 2010). Several discrete approaches could be identified in the scientific literature aimed at solving decision-making regarding several problems. These include various approaches for multicriteria decision-making, such as Analytic Hierarchy Process (AHP), simple multi-attribute evaluation technique (SMART), outranking methods, voting theory or stochastic multicriteria acceptability analysis (SMAA) (Martins and Borges, 2007; Ortiz-Urbina et al., 2019; Nilsson et al., 2016). The advantage of new decision-making approaches is the provision of additional knowledge and a way to achieve a compromise between management goals and the stakeholders´ preferences (Baskent et al., 2008; 2020). Involving experts and public stakeholders in forest management planning would facilitate the development of socially acceptable plans with specific management goals. On the other hand, when promoting a new approach to forest management planning, one should not forget the sharing of rights and (financial) responsibilities between stakeholders (Baskent et al., 2008; 2020; Estévez et al., 2013; Bruňa-Garcia and Marey-Pérez, 2014). That means that participatory decision-making is financially and time-consuming.

3 INTEGRATING STAKEHOLDERS IN FOREST MANAGEMENT PLANNING

Integrating participation and multi-criteria optimization in forest management planning is familiar in the scientific literature. What is relatively new is its utilization of such an approach in planning (Diaz-Balteiro and Romero, 2008). Although focusing on the numerical properties of multi-criteria decision analysis in the evaluation of participation, the approach's stress should also be placed on the quality of the participatory process. For this reason, we propose a two-phase approach to stakeholder participation. Firstly, based on the stakeholders' analysis, an exploratory in-depth interview with public stakeholders and analysis with Social Network Analysis (SNA) could assess the key stakeholders, their extent of participation and their preferences concerning forest management goals. The stakeholder analysis is important, especially at the beginning of the participatory process (Nordström et al., 2010). Thus, not to leave important stakeholders behind, deliberate selection and the "snowball method" will be applied to the identification of stakeholder panels (e.g., Reed et al., 2009). Data collection itself will take place through in-person interviews (Lamnek, 2010; Hendl, 2016). The goal of in-person interviews is the identification of key stakeholders in the forest management planning process and their forest management goal preferences. Data will be analyzed via SNA assuming that relationships between interactive stakeholders are meaningful (Wasserman and Faust, 1994; Lienert et al., 2013; Bodin and Crona, 2009). The core of the analysis is a systematic and quantitative analysis of stakeholder relations (Lienert et al., 2013; Paletto et al., 2016). That is, the structural importance of the stakeholder will be assessed through the degree of centrality, which considers the links that the stakeholder shares with other stakeholders. The more centrally located the stakeholder – key stakeholder, the better it is integrated into the network and can influence the planning process. Secondly, the stakeholders' preferences for management goals will be numerically evaluated based on multi-criteria optimization, particularly on the Analytical hierarchical framework (AHP). AHP is a measurement theory through pairwise comparisons and depends on the judgment of actors to assign priorities on a scale (Saaty, 1980). It is a methodology tool for modelling problems concerning assessing preferences for multiple criteria (Alho et al., 2020; Franca et al., 2020). A critical step in using AHP for preference structure modelling is the calculation and consistency ratio (e.g., Kangas, 1992; 1999). A consistency ratio ≤ 0.01 indicates a reasonable level of consistency between comparison pairs. Otherwise, it suggests an inconsistency and the original value in the pairwise comparison matrix should be reevaluated and revised. In-person meetings are recommended to avoid any misinterpretation of the alternatives (Nordström et al., 2010).

4 CONCLUSION

In the last decades, forest management planning in Slovakia has been challenged by various factors, ranging from climate change to increasing societal demands towards forests. Notably, the protected or urban forests are targeted for such claims. For instance, claims have been made for more biodiversity or recreation services. To deal with all these challenges simultaneously, developing new alternatives for handling

complex and often competing interests in forest planning situations is necessary. A promising approach has been proposed integrating participation with multi-criteria analysis in forest management planning. Applying multi-criteria analysis could ensure and mathematically elicit the preferences of various stakeholders concerning their desired management goals. It could support transparent, participatory forest planning, thus mitigating interest conflicts. However, practical, and financial guidelines for conducting and assessing the proposed approach could be removed after conducting the case study in Slovakia. The functional outcome considering specific areas could provide an alternative, efficient, realistic plan to current forest management planning.

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The importance of forest owners' understanding of European forest-related policies for their successful implementation

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ABSTRACT

To address the climate crisis, the European Green Deal was adopted at the EU level, with the EU Biodiversity Strategy, the EU Forest Strategy, and the EU Bioeconomy Strategy as flagship initiatives. Forests are a fundamental source of raw materials for most European bioeconomy strategies. The success of achieving the visions of a forest-based bioeconomy and, at the same time, the Green Deal, is highly dependent on the availability of renewable natural resources and other benefits provided by forests that are reflected in the state of their ecosystem services (ES) (i.e., provisioning, regulating and cultural). In a nationwide (Slovenia) survey of forest owners' preferences for European forest-related policies, we primarily examined the perceived importance of individual ES in relation to the bioeconomy. The sample was selected to be regionally representative according to the spatial distribution of forest ownership in the country and the age and gender structure of forest owners. We defined three key aspects related to European Green Deal policies, formulated three sets of statements on different forest ES, and on aspects and potential impacts of European policies for the bioeconomy, forestry, and biodiversity conservation. We assessed respondents' agreement with individual statements related to the willingness of owners to adapt their forest management (forest tending and wood use, biodiversity protection, introduction of non-native tree species). The sets of statements were complemented with questions on the forest owner's current forest management and objectives for future management, as well as socio-demographic characteristics.

KEYWORDS

Forest owners, opinions, ecosystem services, forest management, bioeconomy

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On the significance of subsidies in forest management decision-making in the Czech Republic

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ABSTRACT

There is a long-lasting practice of spruce monocultures out of its natural conditions in the Czech Republic. To suggest policies that will effectively support conversion from spruce monocultures to more natural mixed forest stands, it is important to understand the motivations of forest managers. The aim of the study is to discover the importance of subsidies for decision making on forest management in the Czech Republic. Based on a questionnaire survey, we studied the attitudes towards subsidies in the Czech forest management. The 52 forest managers that participated in the study were in charge of 29% of all forest land in the Czech Republic. We analysed the part of the questionnaire survey data dealing with the role of subsidies in decision-making. We found that subsidies have a substantial incentive effect in favour of stabilising and improving species in the decision-making of forest managers who manage forests with a statistically significantly lower proportion of spruce in forest stands. However, generally the results suggested that the subsidies are not the key drivers of decision making in Czech forest management. Based on the comments of the respondents we conclude with suggestions on improving the legal and administrative framework of incentives in Czech forest management to become more efficient with respect to supporting planting the stabilising and improving species.

KEYWORDS

Subsidies, mixed forest, spruce, decision-making, forest management, conversion

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Decision making tree for determining risks in forest management

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ABSTRACT

Forests have traditionally been used for timber production. However, society's expectations have significantly changed, and other forest functions, such as ecological and social functions, have become more important. Increasing of uncertainty, diverse societal interests, and the abound data have led to the use of multi-criteria models to support decision-making in forestry. The goal of this paper is to develop the decision-making tree, with the help of which we identify the risks that have the greatest impact on forest management. A review of literature of the most frequently used risks in forest management was made. Then the decision-making tree was constructed. The criteria represent different forest functions (economic, social and ecological), sub-criteria are different risks that may affect the selected functions. Decision makers will evaluate the model. The model will be evaluated using Weighted Influence Non-linear Gauge System of finite sum of influences (FSI WINGS) and fuzzy Best – Worst Method (BWM).

KEYWORDS

Decision making, forest management, risks, weighted influence non-linear gauge system of finite sum of influences, fuzzy best – worst method

1 INTRODUCTION

Traditionally, forests have been used and managed mainly for timber production. In recent decades, societal expectations of forests have changed significantly. In addition to the traditional production function, the other (ecological, economic, social and cultural) forest function have become important (Eggers et al., 2019; Standovár et al., 2016).

Increasing uncertainties due to climate change and increasing amount of information have led to a growing interest in decision support systems for forest management (Vacik and Lexer, 2001). Multi-criteria decision making (MCDM) is the collective term for mathematical methods used to solve decision problems with multiple, usually conflicting, goals (Eggers et al., 2019).

Due to the forest management sustainability assessment process is a complex task, mainly because it involves integration of multiple environmental, socio-economic and institutional impacts at different spatial scales of different forest management policies, which are considered for implementation at any forest location, nowadays, the MCDM methods in forestry is significantly increasing (Kazana et al., 2020; Ortiz et al., 2019).

Risks play a significant role in forest management. Understanding their importance is crucial for effective and sustainable forest management. By identifying and assessing these risks, forest managers can implement appropriate measures to mitigate or prevent their negative effects (Pasalodos-Tato et al., 2013).

This paper is part of a work in progress. The objective of the first part of the paper is to conduct a literature review and select the most commonly used forest functions and the most threatening risks in forestry. Based on this research, we develop a multi-criteria model to support forest management and to identify which risks most threaten forest management.

2 METHODS

2.1 Literature review

The first step in building the decision tree is to review the risks. To find out what risks are involved in forest management, we conducted a literature review. The most frequently highlighted risks are listed in Table 1.

Table 1. Most common risks in forest management in the literature

Risks	References
Natural disasters (windthrow, drought)	(Akay et al., 2018; Kazana et al., 2020)
Illegal logging	(Akay et al., 2018; Kazana et al., 2020)
Hunting	(Akay et al., 2018; Kazana et al., 2020)
Diseases	(Lieffers et al., 2020; Marques et al., 2021)
Invasive species	(Lieffers et al., 2020)
Pests	(Kazana et al., 2020; Lieffers et al., 2020; Marques et al., 2021)
Fires	(Kazana et al., 2020; Lieffers et al., 2020; Marques et al., 2021; Sadono et al., 2019)
Biodiversity	(Kazana et al., 2020; Lakicevic et al., 2014; Marques et al., 2021; Sadono et al., 2019)
Erosion	(Kazana et al., 2020; Marques et al., 2021; Sadono et al., 2019)
Risks	**References**
Timber price	(Marques et al., 2021; Sadono et al., 2019; Zhang et al., 2020)
Number of employees	(Sadono et al., 2019; Sironen et al., 2020; Zhang et al., 2020)

Water function (water supply)	(Kazana et al., 2020; Zhang et al., 2020)
Owner activities	(Sironen et al., 2020),
Age of plantations	(Sironen et al., 2020),
Timber stock	(Kazana et al., 2020; Sironen et al., 2020)
Accessibility of forest areas to visitors (recreation)	(Kazana et al., 2020; Lakicevic and Srdjevic, 2022; Marques et al., 2021; Sironen et al., 2020)
Climate change	(Lakicevic et al., 2014; Lakicevic and Srdjevic, 2022)

2.2 Multi-criteria decision-making methods

Multicriteria decision-making (MCDM) is the collective term for mathematical methods for solving decision problems with multiple, usually, conflicting goals (Eggers et al., 2019). There are many different decision methods, such as AHP (Analytic Hierarchical Process), TOPSIS (Technique for Order Performance by Similarity to Ideal Solutions), DEMATEL (Decision Making Trial and Evaluation Laboratory) method and others (Gabus and Fontela, 1972). Two methods of them are also WINGS (Weighted Influence Non-linear Gauge System) and BWM (Best – worst method). On the first level criteria – forest function will be evaluated by FSI WINGS method, while sub-criterion - risks will be evaluated by fuzzy BWM. FSI WINGS method was chosen because it takes into account the influences between the factors and also the strengths of the factors. Fuzzy BWM was chosen because it is relatively new and easier to use than AHP method because it requires fewer pairwise comparisons.

2.2.1 Weighted Influence Non-linear Gauge System

The Weighted Influence Non-linear Gauge System (WINGS) method has been derived from DEMATEL methods and can be used as a structural model for analysis of intertwined factors and causal relations between them. This method includes the influences of the elements in the system and also the strength of each elements (Michnik, 2013). Some authors used fuzzy evaluations to include the uncertainty into the WINGS method. Most commonly used are triangular fuzzy numbers (Tavana et al., 2021). However sometimes the convergence problem can occur and fuzzy WINGS method can not be used. Authors proposed new method FSI WINGS, that instead of an infinite sum, a finite sum of terms is used (Šmidovnik, 2022).

2.2.2 Best – worst method

One of the multi-criteria decision-making methods is Best - worst method (BWM). This method is based on pairwise comparisons. Decision makers select the best (most important) elements of the systems and the worst (least important) elements of the system. Then pairwise comparisons are conducted between each of those two criteria (best and worst criterion) and all the others criterion (Rezaei, 2015). Also, BWM can use triangular fuzzy numbers for evaluations.

2.3 Selection of decision makers

We are interested in the opinion of the different groups of decision makers. This way, we can compare the results between the groups. We selected that our model will be evaluated by four different groups of decision makers - experts on forest management, visitors of forest (recreationists), conservationists and foresters. Each group will consist of 3 to 6 decision makers.

The decision makers are selected with a non-probability judgmental sampling method, where the representors are selected qualitatively, their number is not important by this method (Dobšinská et al., 2020).

3 RESULTS

3.1 Multi-criteria model for consider risk in forest management

We constructed a multi-criteria model of three levels (Figure 1), whose objective is to select the most important risks for forest management. The second level consist of criteria that represent different forest functions. Selected forest functions are ecological, social, and economic functions (Kazana et al., 2020; Sironen et al., 2020; Zhang et al., 2020). The sub-criteria represent the risks in forest management. To find out which risks are most often mentioned in the literature, we made an extensive literature review (Table 1). Then, we reviewed the risks with the experts and selected those that are most relevant in our region. The sub-criteria of production function are illegal logging, timber price and natural disasters. Sub-criteria of social function are social security, recreation, owner's activity, forest pollution. Sub-criteria of ecological function are climate change, insects, non-native species and biodiversity loss.

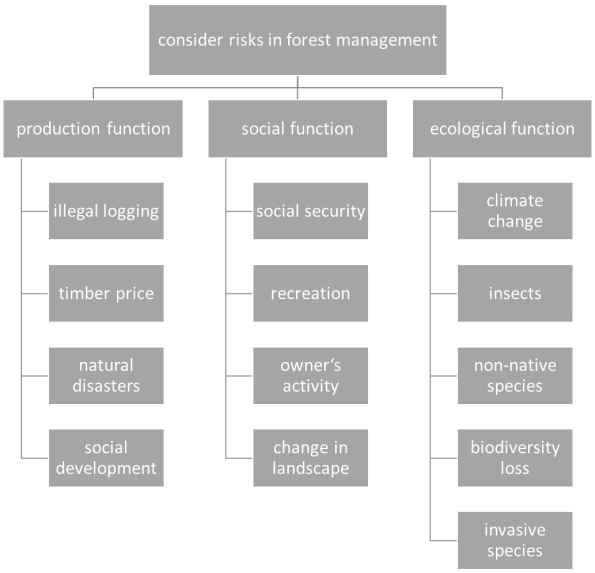

Figure 1. Decision making model for consider risk in forest management

This decision-making model for consider risk in forest management (Figure 1) can be used in generally for a larger area or for a specific area. Also, we can adjust the selection of decision makers or add criteria depending on the selected area.

3.2 Future Work

When the decision-making model was constructed and method to evaluate them was selected, we prepared the questionnaire to evaluate the model. FSI WINGS will be used to evaluate the criteria and fuzzy BWM will be used to evaluated the risks. This questionnaire will be sent to the chosen decision makers. Based on decision makers assessments, we will determine which risk represents the greatest threat to forest management.

4 CONCLUSION

Traditionally, forest was used for timber production, but nowadays society's expectations have changed. The non-productive functions of the forest have also become important. In addition, forest management is also complicated by risks.

The multi-criteria model to consider risks in forest management was created. Three forest functions (production, social, and ecological) are selected as criteria, and their sub-criteria are the risks that arise. Results will show out which risk is most and which is the least threatening for forest management. In the future, the scenarios for forest management can be added.

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8

Forest products for greener future

The use of pioneer tree species in the restoration of forest openings after salvage felling in the Czech Republic

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ABSTRACT

Spruce, and in many places, pine forest stands in the Czech Republic are affected by dieback, which has accelerated since 2015. As a result, there is a need to restore forest openings caused by salvage felling, whose enormous size and total area in the Czech Republic require specific management approach methods. Previous, less frequent approaches to forest restoration, including multi-phase forest regeneration, were being explored. There is also an attempt to use pioneer tree species in forest regeneration. An example is silver birch (Betula pendula Roth.). This implies a change in how silver birch is viewed by Czechs—from a weed tree species to an economically attractive alternative. The economic viability of birch is enhanced by the use of natural regeneration. Therefore, it can be concluded that birch as a pioneer tree for climax species does not affect the economic efficacy of management of a forest property which, by its size, provides the owner with a sustainable yield. On the contrary, the results of the modelled economic calculations show a positive effect on the modelled average annual gross profit of forest production. The summary and comparison of the research results further underscore the importance of the price level of raw timber assortments. The results are useful for both large and small-scale forest owners, who achieve a sustained yield from the perspective of the forest property size.

KEYWORDS

economic efficiency, regeneration, declining spruce, forest management

1 INTRODUCTION

In recent years, Czech forestry has been addressing an issue of declining spruce stands at lower and middle altitudes, especially in northern Moravia. This causes an increase in the amount of salvage felling, resulting in an increase in the volume and cost of silvicultural operations. It is necessary to implement more costly measures to afforest forest openings which often merge into large areas due to the increasing share of salvage felling in threatened areas. Devitalized spruce stands, thinned by salvage felling, often fall victim to destructive winds. Such quickly spreading disaster areas are exposed to natural seeding of pioneer tree species, especially the silver birch (Betula pendula Roth.). The forest openings are not only more difficult and expensive to afforest with target production tree species, but the young forest stands also become more problematic to establish, often requiring multiple removals of weed tree species, including birch (Dudík et al., 2018). Changing the view of the birch from a "weed tree species" to a "worthy" alternative production species was analysed within a project of the Grant Service of the Forests of the Czech Republic, state enterprise, called "Ekonomika a pěstování březových porostů jako alternativa obnovy chřadnoucích smrkových porostů v České republice / The economics and silviculture of birch stands as an alternative to the regeneration of declining spruce stands in the Czech Republic" (Dudík et al., 2021a). Some of the methods and results of that project are presented in this article.

Efforts to change the species composition of forest stands are significantly related to the impacts of climate change. In the Czech Republic, the economic and production effects of tree species change as a result of adaptation to climate change have been addressed, for example, by Remeš (2020). Presently, after a change in Czech legislation (see Decree No. 298/2018 Coll.), birch is even considered a soil-improving tree species in most soil habitats. In terms of the legal framework, this provides a greater opportunity for birch to be used in forest regeneration.

Modelling and decision-making on the forest species composition from the viewpoint of economic efficiency have a long tradition in the Czech Republic. Recently, many papers were published on the topic, e.g., Pulkrab et al. (2014), Kupčák et al. (2016), Švéda et al. (2020a; 2020b), and Dudík et al. (2021b). Several factors enter into the economic modelling of forest production. Various risks affecting production processes and timber markets are of great practical significance in forestry (Mutenthaler and Sekot, 2016). In addition, the specific size or geographical location of forest properties and the possibility of obtaining accurate and complete economic information on these properties are also important; this issue was addressed, for example, by Toscani and Sekot (2017). The significance of the different forest functions on a given forest property also plays a role, and the production function may not be the most important one.

The paper aims to provide information to decide whether it is possible to use birch in the regeneration of declining spruce stands in the Czech Republic, and at the same time, show that changing the species composition utilizing birch can be an appealing (and also economically viable) alternative.

2 METHODS

Economic modelling utilizing birch as a pioneer species for forest opening restoration after salvage felling focuses on the mid altitudes in the Czech Republic, from 400 to 600 m ASL. Three representative groups of forest habitat sites (according to the Czech forest site typology system in Viewegh, 2003) are considered for these altitudes: acidic, nutrient-rich, and enriched by water (pseudogley). Two groups of models are considered in these habitats. In the first group of Birch Pioneer models (models BP1 to BP3), birch is considered a pioneer species for the climax tree species. The birch rotation period in the BP models is 20 years, the climax tree species rotation is expected to be 100 years, and the total regeneration of the model stand is 110 years (at ten years of age, the birch is underplanted with the climax species).

In the second group of Birch Final models (models BF1 to BF3), birch is again considered a pioneer species for the climax ones. In this case, however, birch is expected to stay in the stand until its felling age. The birch rotation in the BF models is 60 years, while a 100-year rotation period is expected for the climax tree species. The total rotation period of the model stand is 110 years (at ten years of age, birch is underplanted with the climax species).

On acidic and nutrient-rich sites (models BP1, BP2, BF1, BF2), European beech is the projected climax species. On water-enriched sites (models BP3, BF3), it is silver fir. The structure of the models regarding the habitat and birch silviculture is shown in Table 1.

Given the nature of birch, we assume that the pioneer stand will be established naturally, i.e., by birch self-seeding. The climax species is then introduced under the birch as part of artificial regeneration. The economic modelling applies to the timber production function of the forest stand in the six models presented. The area of the model forest stand is always 1 ha.

Table 1. General structure and classification of the silvicultural framework

Mid-altitude sites	Method and purpose of birch cultivation	
	Mixed stands	
	Pioneer species for the climax species	Production species of value in mixture with the climax species
Acidic (edaphic category K)	BP1 (birch and beech)	BF1 (birch and beech)
Nutrient-rich (edaphic category B)	BP2 (birch and beech)	BF2 (birch and beech)
Water-enriched (edaphic category O)	BP3 (birch and fir)	BF3 (birch and fir)

The findings on the silvicultural and production potential of birch stands serve as the basis for differentiated modelling of the economic efficiency of the stands' management. The management represents a whole production cycle comprising planting, stand establishment, tending, felling, and the sale of raw timber assortments. The birch timber sorting is based on assortment tables for average-quality stands. We also model silvicultural and harvesting operations in birch stands, considering the range of operations in technical units. Unit costs represent average levels in the Czech Republic in 2020; for the calculations,

the share of overheads is 35% of direct costs. Unit yields (raw timber assortment prices) represent average levels in the Forests of the Czech Republic, state enterprise, in 2020. The calculation is used to quantify costs and yields in particular economic models.

The economic efficiency evaluation of birch management follows the concept of the "Forest Rent Theory." An economically balanced forest is the basic model for sustainable production in forestry, meaning it generates similar annual yield/income (at a usual level of timber sales) and similar costs/expenses, with an average profit rate in the frame of regular management (and technologies used) based on a forest management plan. The only evaluation criterion for this approach is profit, which is generally defined as an annual average difference in yields and total costs. For the model calculation, it is the average annual gross profit of forest production (GPFP).

3 RESULTS

The initial economic modelling results in CZK are recalculated and presented in EUR (rounded to the nearest euro, 1 EUR = 26.444 CZK; source: CNB, 2023).

Figure 1 shows the average annual gross profit (EUR per ha) of forest production results for the six economic models (GPFP), where birch was used as the pioneer species. Models BF1 to BF3 expect cultivation of birch until its felling age.

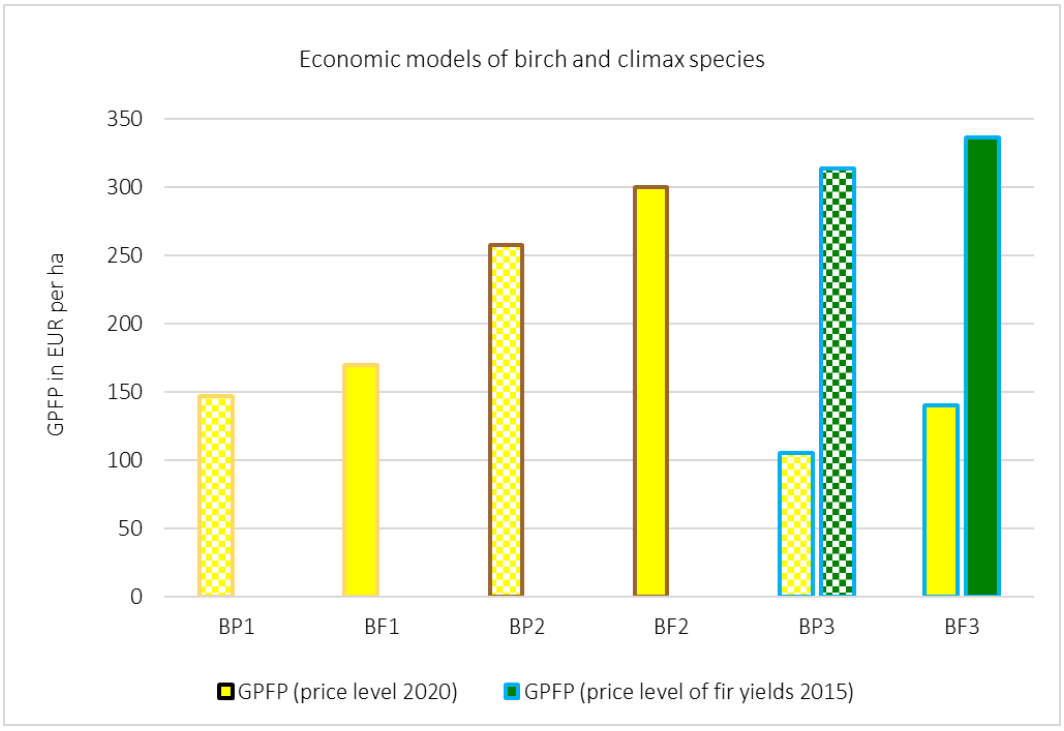

Figure 1. The average annual gross profit (EUR per ha) of forest production models using birch in forest stands.

These results show that the BF2 model (birch grown to its felling age in a mixture with beech in nutrient-rich habitats) appears to be the most profitable model from an economic perspective, where its average annual gross profit of forest production reaches 300 EUR per ha.

The least economically beneficial model is BP3 (birch grown only as a pioneer species up to 20 years of age in a mixture with fir on water-enriched sites). The average annual gross profit of forest production reaches 105 EUR. The reasons for the low gross profit are described in the following chapter.

4 DISCUSSION AND CONCLUSION

The economic calculations of the six "birch models" attempt to show the average situation and conditions where the respective stands will be managed on a given site. In reality, the GPFP of a particular stand will be influenced, for example, by different proportions of successful natural regeneration of birch and thus different proportions of artificial regeneration, and possibly dissimilar numbers of weed and game control interventions.

Based on the information on prices of raw timber assortments published by the Czech Statistical Office (CZSO, 2023), a noticeable decrease in the prices of spruce assortments was observed between 2016 and 2020. In 2020, prices of spruce assortments were the lowest from 2010 to 2020. The Czech Statistical Office does not monitor prices of fir timber assortments. Based on market information, the trending prices of fir and spruce wood assortments are essentially the same. However, for fir, the prices of timber assortments tended to be about 20% lower. The economic models for birch with fir (BP3 and BF3) are marked by the lowest prices of fir timber in the period 2010 to 2020. If we consider the costs in 2020 for BP3 and BF3 and, alternatively, the price level of timber assortments in 2015 (i.e., before the calamity) for yields, we get significantly different GPFP results for these two models. For the BP3 model, the GPFP reaches 314 EUR, and for BF3, 337 EUR. The GPFP values at the 2020 cost and yield price level and, for comparison, the alternative birch-fir models at the 2020 cost and 2015 yield price level are shown in Table 2.

Table 2. GPFP values with the alternative fir price in 2015

	Economic models of birch and climax species—GPFP in EUR per ha					
	BP1	BP2	BP3	BF1	BF2	BF3
GPFP (price level 2020)	147	258	105	170	300	140
GPFP (price level of fir yields 2015)	NA	NA	314	NA	NA	337

NA—not applicable (birch and beech models)

For the sake of comprehensiveness, it should be noted that the price level of fir timber assortments in 2022 was higher than in 2015. On the other hand, it should be mentioned that the cost in the Czech Republic was also increasing compared to 2015 and 2020. The inflation rate between 2020 and 2022 was unprecedentedly high. Although the economic modelling results may signify a low GPFP for the birch and fir mixture, this should not be viewed as typical. The economic modelling was performed in 2021, so the price level of costs and yields in 2020 was taken into account. If we look at the price development of fir timber from 2010 to 2022, the year 2020 shows the lowest prices of that period. The year 2022 shows higher fir timber prices than in 2015. Therefore, we can conclude that a mixture of birch and fir on water-enriched sites is an economically viable alternative to a birch and beech mixture on nutrient-rich sites.

The results of the six birch models with standard spruce or beech models shows that spruce or beech are both the first and the target/climax species used to restore the opening. The comparison shows better results for the birch and climax mixture models, ranging from 10 to 30%, with broadly similar conditions entering the models (e.g., artificial regeneration technology, the extent of and technology needed for young forest stand tending, and harvesting and transport technologies used).

The potential of production and economics of birch stands has been observed for a long time, especially in Scandinavia. Current surveys indicate a high production potential of birch stands and associated economic effects in Central Europe as well (Lockow, 1997; Unseld and Bauhus, 2012). A significant regeneration potential of most sites, an ability to produce pure stands and to grow in mixtures with other tree species, along with the pioneer growth strategy, underpin the potential for early economic yield (Hynynen et al., 2010).

Based on the results, it can be concluded that, in the long run, the relative differences between the economic models are more significant than the absolute gross profit of forest production in EUR per year. At the same time, it is necessary to choose an appropriate and convincing price level for unit cost and yield inputs. In particular, this highlights the comparative results of the alternative models of one tree species with the economic modelling results of the other. If either of these tree species is in a highly favourable situation in the timber market or, conversely, in a highly unfavourable situation, this will significantly affect the results of the economic model comparisons.

Overall, it can be stated that the use and promotion of birch in forest stand regeneration and silviculture is becoming a competitive alternative to traditional timber production tree species—spruce and pine, in the Czech Republic. Economically, the advantage of birch silviculture is strengthened by the use of natural regeneration. Furthermore, it can be stated that the use of birch as a pioneer tree species does not necessarily lead to a deterioration in the economic result of a forest property sizeable enough to provide the owner with a sustainable yield.

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: Designing innovative business models for the wild food products sector in several Mediterranean countries

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ABSTRACT

This study focused on developing innovative and sustainable business models within the wild food products (WFP) sector through participatory living lab sessions in five countries. The goal was to design business solutions addressing real-life challenges faced by stakeholders along the WFP value chain. The living lab approach involved three key phases: understanding the problem, co-creation and refinement of solutions, and evaluation and testing. Each country focused on specific WFPs, such as truffles, acorns, and aromatic plants, aiming to increase supply, economic sustainability, and social inclusiveness. Challenges were faced in engaging stakeholders, but the living lab sessions resulted in multiple innovative business model ideas, providing valuable insights for policy designers and decision-makers in promoting the potential of the wild food sector for rural development and sustainable practices.

KEYWORDS

Wild food products, Mediterranean, business models, innovation, living labs

1 INTRODUCTION

Wild food products (WFP) are edible foodstuffs that can be find in nature and are most likely to be entirely uncultivated. However, some of those wild plant or fungi species are also being grown in plantations and are also being subjected to selection processes to increase some of the desirable characteristics, such as yield, aroma, size, shape etc. Those products can be an important part of peoples' daily diet or collected as a part of recreational or festive activities. In both cases wild food products can provide additional income in potential for creating new jobs, especially in rural areas. This is also recognized in the current EU strategy on forests up to 2030 as a part of the Green Deal initiative, which indicates that WFPs are seen as one of potential generators of future development.

This study focused on developing innovative and sustainable business models within the WFP sector by trying to design altered or new business approaches that would foster social inclusiveness, fair distribution of income, increased yield and quality of WFPs and sustainable harvesting practices.

The overall goal was thus to provide at least three innovative business models, each referring to one WFP. The work was done within WildFood project (PRIMA program). This was to be done in a participatory way, so that different stakeholder would be involved in innovation. By doing so we wished to design business solution that would be grounded upon actual and relevant issues entrepreneurs (i.e., stakeholders along the WFP value chain; producers, processors, retailers, wholesalers) are facing in real life. Thus, the potential uptake of solutions into designing future polices would be increased, helping that issues would indeed be addressed by policies and operational programs.

2 METHODS

The innovation process was designed to be implemented within a series of living lab (LL) sessions, which were held in parallel in five countries: Italy, Spain, Portugal, Tunisia and Slovenia. Sessions were done according to practical guidelines for designing, preparing, implementing, and evaluating LL sessions. Those were based on previous research and already available general frameworks of the LL concept, and in addition to general information included also sets of questions that were to be answered by those participating in the innovation process. Questions were defined in a way to collect data needed to design innovative business models.

2.1 The Living lab approach

Living Labs are a highly participatory, user-centric approach for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts (Erikssonet al., 2006). The concept was first used in the early 1990s in the case of students' experimentation to solve problems in a Philadelphia neighbourhood and was later further developed by prof. Mitchell from MIT, Boston. The use of Living Labs gained momentum after they were recognized as an effective approach to provide a creative environment, where people making use of a solution or innovation or benefiting from it are continuously involved in the process of co-creation. They can act as equal contributors or as those designing solutions themselves. Thus, the idea of Living Labs is to build partnerships between different stakeholders – public organizations, private companies, academia and the general public – that facilitate intentional collaborative experimentation to create innovative solutions for either specific or more general issues (Lupp et al., 2021). Those can also be related to climate change, sustainable management of environment, fair business models etc. The element of creativity can be bolstered by having more people of different backgrounds, expertise and experiences involved in the design of the solution.

The flow-work of the Living Lab usually follows several key phases, which involve key actions. Different authors suggest 3-8 phases (Lupp et al., 2021), however at minimum three are necessary (Fohlmeister et al., 2018), and those were adopted for this study:

- phase 1: understand, investigate, plan, explore,
- phase 2: creative co-design and refinement,
- phase 3: evaluation and testing.

The aim of the first phase is to understand the problem that needs to be solved, and for that we must (1) frame the innovation in terms of what for are we designing it, (2) define the target or to decide who are the end-users of the innovation, (3) pick the most relevant stakeholders that will act as co-creators and plan their involvement, and (4) explore the state-of-art of already known/implemented solutions.

The second phase involves creation of the innovation that is to address the problem defined from the first phase and its testing. There are several methodological approaches of co-creation, such as storyboards, brain writing, designing concept maps, SCAMPER technique, Walt Disney method, SWOT etc.

Finally, the third phase is dedicated to the evaluation of the designed solution, which involves testing for its usability, benefits, and acceptance. This occurs iteratively though the design process and can apply to either single a components of the solution or complete design. There are different methods on testing the solutions, however they are very context-specific and must meet the specifics of the solution. After the evaluation is done and if the outcome is not satisfactory, the process of co-creation loops back at the beginning and starts again.

Having right stakeholders is vital for a successful Living Lab and commonly grounded on so called Quadruple Helix Innovation Model (Carayannis and Campbell, 2009), which predicts intertwining competences and knowledge from four key sectors – public organizations, private companies, (end-) users and academia. Those are usually stakeholders that are to be included in the Living Labs, however this also depends upon the context of the problem and its potential solution(s).

2.2 Implementing LL sessions

All three phases of LL were done either in a series of group events, personal interviews, or even on-line survey, where a series of pre-defined questions were used as a guiding tool to steer discussions or to collect needed input via on-line surveys. LLs were done in five countries focusing on providing innovative business solutions for several different WFPs (Table 1).

Table 1. List of wild food products focused on in LL sessions in each partnering country.

Country	Wild food product	Goal of innovation
Italy	truffles	Stable supply of wild and semi-wild truffles in the IT truffle value chain
Spain	black truffle	Use of fertilizers in black truffle cultivation
Portugal	acorns, pennyroyal, pine nuts	Economic and environmental sustainability of Portuguese value chain
Tunisia	aromatic and medical plants	Development of an innovative BM for the WFP sector, and for aromatic and medicinal plants
Slovenia	truffles	Standardized quality testing facility (know-how) for truffles

3 RESULTS

The results are presented as summarized reporting of all five countries on each of the three LL phases.

3.1 The set-up phase

Initiatives for all seven cases (that is WFPs) in five countries are quite different in terms of the purpose, the needs of stakeholders and consequently needed impact of business models innovation and related living-labs sessions respectively. Some seem to be more general in nature as are those implemented in Portugal and Tunisia that aim to support sustainability (i.e., economic, environmental, and social) and leveraging legitimacy and networking. Others might be considered as more focused on a specific issue, like sufficient and stable provision of raw material (Italy), increasing yields (Spain) and the need to provide effective quality assurance for transparent trade and consumer safety (Slovenia).

Table 2. Key outcomes of the set-up phase indicating the overall purpose of LL sessions in terms of what should the innovative business models provide

Set-up phase	Partnering country				
	Italy	Spain	Portugal	Tunisia	Slovenia
Which purpose shall the LL serve?	To ensure the supply of wild and semi-wild truffles	To advance the use and knowledge of fertilizers in truffle plantations	To ensure economic and environmental sustainability	Developing innovative business models for the wild food sector	To develop quality certification scheme

3.2 The co-creation phase

Co-creation phase involves social innovation, as solutions developed addressed societal challenges, like poverty, inclusivity, community development, inequality and social cohesion. Especially, connecting stakeholders as in Italian case, case of pennyroyal in Portugal and Tunisia are such examples of building communities. The fact that all initiatives for various solutions came from different stakeholders indicates high level of inclusiveness and participation.

Majority of LL cases were focusing on developing an innovative service (5 out of 6), that would in a specific way support the supply of WFP:

- Italian case of the supply chain contract,
- Portuguese case on pennyroyal to increase business (selling) opportunities,
- Tunisian case on connecting stakeholders to overcome market imbalances,
- Slovenian case to assure transparent sales of product,
- Spain's case on micro-nutrient availability to increase production,

while one was focusing to increase demand: Portuguese campaign to strengthen awareness on dietary potential of acorns.

All cases involved focus on fostering economic sustainability, which indicates the need to improve the financial returns in business dealing with WFPs. Throughout the project this was raised as an issue multiple times and LL initiatives reflect that. Social and environmental sustainability were highlighted as well, just not as a priority (except in Slovenian case).

Table 3. Key outcomes of the co-creation phase indicating the proposed solution in terms of what should the innovative business models should be like

	Partnering country					
	Italy	**Spain**	**Portugal: acorn**	**Portugal: pennyroyal**	**Tunisia**	**Slovenia**
Description of the proposed solution	Creation of a **supply chain contract.** Industry and traders guarantee the purchase of raw material for min 50% of the production, max of 70%	Identification of **four potential micronutrients that need to be analysed** in more depth; nitrogen, potassium, calcium and oxalate	Carry out **promotional campaigns** that publicize acorn as a product for human consumption	**Collaboration** with producers and other stakeholders' associations of aromatic and medicinal plants	**Agriculture Development Group** (DGA)	Standardized **quality check system** for truffles

3.3 Monitoring and evaluation phase

Evaluation of LL sessions in terms of number of stakeholders being actively involved highlight significant differences as some LL engaged larger number of participants (Italy, Spain, Portugal), whereas some were smaller (Slovenia). This might also reflect the state of WFP sectors in different countries, which can be supported by a limited participation of Slovenian stakeholders.

Another key issue of evaluation was how successful involvement of stakeholders was, while this had proven to be very challenging. This was highlighted clearly in three cases: two for Portugal LLs, and one for Slovenian LL, where engaging participation was difficult.

All LL sessions had up taken a great dela of participants' know-how and information within the innovation process. This indicates a success of LLs and reassures stakeholders that their inputs were considered seriously. The assessment of how much their demands were considered reflects a similar outcome.

One solution designed in LL sessions was also practically implemented; of supply chain contract in Italy, while the rest were developed up to the stage of a design-level.

4 DISCUSSION AND CONCLUSION

Living labs sessions provided abundant information, supporting environment to connect with other stakeholders and an opportunity to raise awareness on WildFood project, but were challenging to implement as well. Overall goal was to deliver concrete ideas on innovative business models for WFP sector, and this was achieved.

Seven different cases of innovation were defined, discussed, and then refined through at least two LL sessions per country. Two key phases of LL – set-up phase and co-creation phase –, were completed for six cases, dealing with three different individual WFPs (truffles, acorns, pennyroyal), and a general category of aromatic and medicinal plants. Therefore, WildFood provided more novel business models ideas than set in the proposal as a project goal. Moreover, all involved more than just three communities of interest (producers, retailers, sellers, processors, ...) as set in the proposal as well.

LL outcomes are very heterogenous as LL cases were done in five different countries sharing the Mediterranean character, however social-economic and cultural backgrounds can be entirely different, and this is reflected in variety of issues (and solutions) that were addressed in LLs. All but one, LL cases looked at solutions that would increase supply of WFPs, where one focused in supporting demand for WFPs.

One of key challenges, was probably engaging stakeholders. However, LLs were not alike in all countries. Some, as one in Slovenia, experienced major obstacles when involving stakeholders, as there are very few to begin with and moreover, they were reluctant to participate. This was a showcase, where untransparent roles of individuals in the supply chain hamper collaboration, foster individualism, and mistrust. Unclear signals from policy what are future projections for the WFP sector in the past have contributed to that as well.

An obvious outcome of LL sessions was a variety of cases that were undertaken in LL sessions, which reflects the plethora of issues that stakeholders within WFP supply chain are dealing with. They originate from insufficient funds to support business, lack of raw materials for processing, untransparent legislative framework, inadequate connections with other stakeholders in the supply chain, ignorance of decision-maker and policy designers. Those are only few most critical issues WFP sector is dealing with and were raised among others on LL sessions and other project events.

This study provided rich and valuable information for policy designer and decision makers to think how issues pertaining the wild food sector could be approached so that this sector would be more potent to provide new jobs in rural areas, more diverse local cuisine, which might also attract high value-added tourism, increasing the locally produced foods, healthy diet due to practically pesticide-free products, etc. It also adds to understanding which solutions might have most potential.

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