Systematic Review of Policy Drivers and Barriers in the Development of the Forest-based Bioeconomy

Camilo Muñoz Arenas[1*], Carmen Avilés Palacios[1]

[1]Universidad Politécnica de Madrid

*camilo.munoz.arenas@upm.es

Abstract

Societies are transitioning towards new models where sustainability is the guiding vector. Bioeconomy has become an essential tool in this transition, allowing the substitution of fossil-based resources or traditional polluting processes with more nature-based products or solutions. But, to do this, entrepreneurship and innovation are needed. Nevertheless, for certain sectors like the forestry industry or forestry bioeconomy, in which complexity is a limiting factor, we need to clarify the different ingredients of this complexity to develop entrepreneurship, or even entrepreneurial ecosystems that could help to increase innovative products. This paper provides a comprehensive view of the different political factors that are limiting or pushing the development of entrepreneurship and innovation related to the forestry bioeconomy.

Keywords

Forestry, Bioeconomy, Policies, Entrepreneurship, Innovation.

Introduction

The bioeconomy is an increasingly important sector of the global economy, with its potential to create new sources of economic growth and provide sustainable solutions to some of the most pressing environmental and social challenges (Kuckertz, 2020). In order to fully realise this potential, it is essential to create an enabling environment for innovation. This means investing in research, development and innovation (R&D&I),

creating a supportive policy framework, and establishing innovation ecosystems that bring together all relevant stakeholders . Innovation ecosystems are made up of a variety of elements, including institutions and organisations, policies and regulations, markets, infrastructure and networks of actors: ”A set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organizations (e.g., firms, venture capitalists, business angels, and banks), institutions (universities, public sector agencies, and financial bodies), and entrepreneurial processes (e.g., the business birth rate, numbers of high growth firms, levels of “blockbuster entrepreneurship,” number of serial entrepreneurs, degree of sell-out mentality within firms, and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment.” (Mason and Brown, 2014.) They are dynamic and interdependent, requiring collaboration between multiple actors to support the development, commercialisation and delivery of new products and services. The role of innovation ecosystems in the bioeconomy is to facilitate the flow of knowledge and resources, create the conditions for collaboration, and accelerate the development and commercialisation of new products and services. In order to create innovation ecosystems that are effective in driving the development of the bioeconomy, governments, industry and academia need to work together to create an environment that encourages innovation and entrepreneurship. This requires the development of a supportive policy framework, investment in research and development, and the establishment of collaborative networks between public and private organisations. Additionally, the development of infrastructure and markets that are conducive to the development of new products and services is also important. By working together to create an enabling environment for innovation, governments, industry and academia can ensure that the bioeconomy reaches its full potential.

This research attempts to shed light on drivers and barriers of the policy factors that favour or limit the development of entrepreneurship and innovation in the forest bioeconomy sector. The analysis has identified key strengths, weaknesses, opportunities, and threats within these policies, aiming to understand their current impact on the development of more entrepreneurship ecosystems that could develop innovative forest-based solutions.

Methodology

Drivers and barriers have been identified in two steps. First, a comprehensive review of relevant literature and policy documents has been employed, by applying the basis of the PRISMA methodology, which ensures the correct realisation of systematic reviews (Moher et al., 2009). Second, based on the results of the literature review, a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis has been realised to obtain drivers

(Strengths and Opportunities) and barriers (Weaknesses and Threats) of the European policies to develop a forest-based bioeconomy.

First, the literature review has been realized by a bibliographic review based on academic publications of the Scopus and Web of Science (WoS) databases. Inclusion and exclusion criteria have been established. The inclusion criteria have been:

- Including in keywords main search terms,
- Papers published between the years 2013 and 2023,
- Papers no being published between above mentioned years but highly referenced and, as a consequence, relevant for this research,
- The forestry sector must be analysed from a political point of view or including policies consequences.

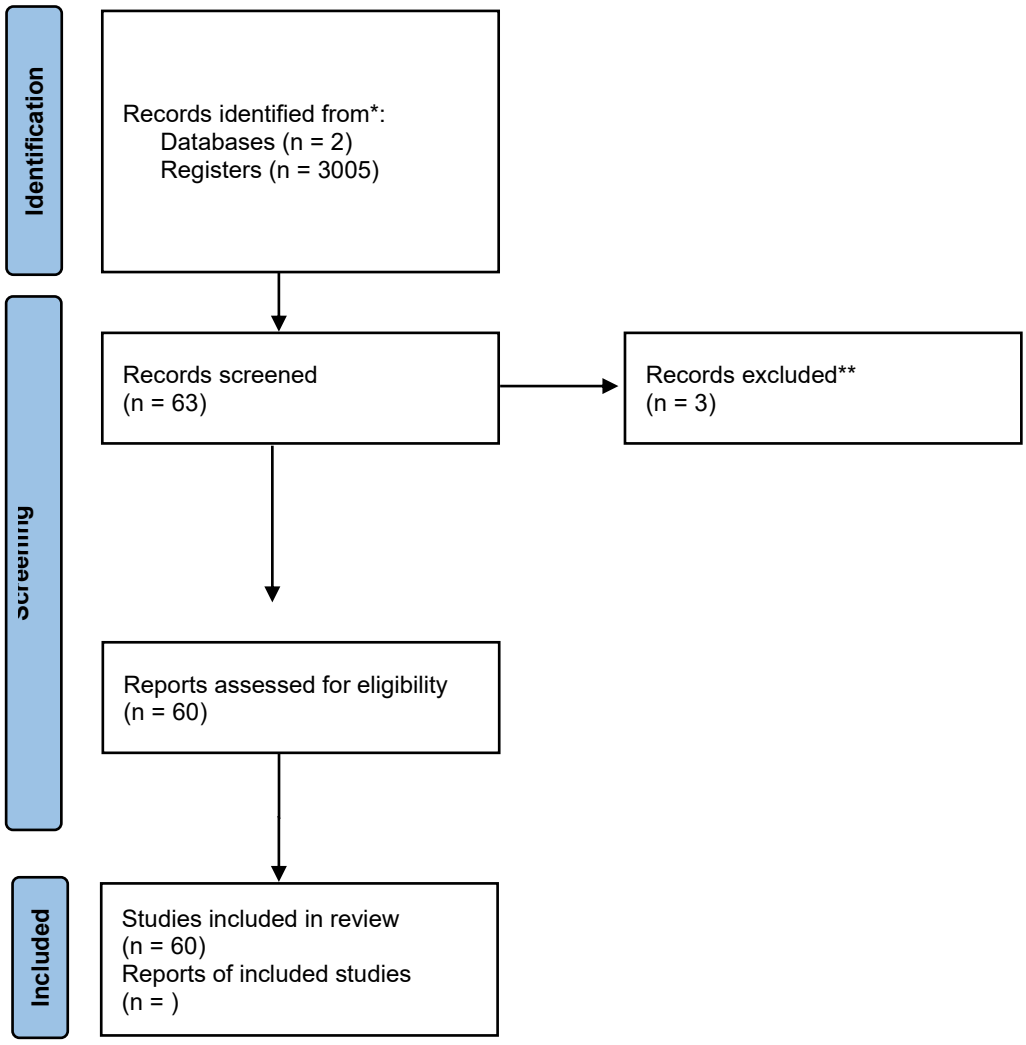
Exclusion criteria have been:

- Papers that do not take into account the political consequences of the issues analyzed,
- Papers analysing non-European countries, except what had consequences for them.

Policy factors have been analysed specifying six sub-factors: 1) European and national laws, 2) Regional laws, 3) Trade regulation, 4) Taxation policies, 5) Vulnerable people, and 6) Bureaucracy. For every sub-factor several papers have been identified, then filtered and at least the most appropriate with the aim of the research have been selected and included for the systematic review (Figure 1). Finally, a specific prompt has been used in both academic databases:

1. Global and national policies search terms: *Forestry AND policies AND (Spain OR Europe)*
2. Regional policies: *Forests OR Forestry AND Regional AND Policies AND (Spain OR Europe)*
3. Trade regulation: *Trade AND Policies AND (Forestry OR Forests OR Forest) AND (Spain OR Europe)*
4. Taxation policies: *Taxation AND Policies AND (Forestry OR Forests OR Forest) AND (Spain OR Europe)*
5. Vulnerable people: *Vulnerable AND People AND (Forestry OR Forests OR Forest) And (Spain OR Europe)*
6. Bureaucracy: *Bureaucracy AND (Forestry OR Forests OR Forest) And (Spain OR Europe)*

Figure. Identification of studies via databases and registers using PRISMA flow diagram.



Results

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Figure 2) has been conducted, identifying and classifying the key drivers and barriers to the development of the forestry bioeconomy.

Figure 2. SWOT analysis

STRENGTHS	***WEAKNESSES***
1. Demonstrated correlation between Economic development and conservation policies and strategies 2. Actually developing Innovation and Business Models in forest management 3. Identified risks and resource management 4. Institutional participation and collaboration 5. Several tools have already been developed for supporting planning and decision 6. Positive economic and m arket indicators for forest-based bioeconomy development 7. High potential for carbon stocking and synergies between incentives, subsidies and taxes	1. Low forest reference levels indicating lack of adaptation to historical changes. 2. Coordination and planning difficulties between territorial administrative units 3. Socio-economic and operational challenges related to owners collaboration and products certification 4. Barriers to innovation and cooperation 5. Economic risks and market impacts on carbon markets and timber supply 6. Legal and regulatory challenges related to labour conditions, bureaucratic charges and data management 7. Demographic and generational relevance issues 8. Diversity of challenges and differences in perception between stakeholders
OPPORTUNITIES	***THREATS***
1. Improvement of conservation policies and strategies related to carbon markets and land management 2. Innovation and development of new models for planning forest management 3. Training and institutional strengthening on priority Bioeconomy programs to improve research and management 4. Improved planning and fire risk management through public perception and knowledge 5. Collaboration and strategic partnerships for territorial growth and integrative governance 6. Boosting technological innovation and modelling for emergent markets and data bases development 7. Funding and economic incentives on carbon capture national and international policies 8. Adaptive and flexible approaches to facing Climate Change	1. Economic and market challenges on conventional markets 2. Technical and operational constraints in emerging countries 3. Predictive models limitations due to quality and availability of data 4. Territorial conflicts and policy misalignment between different territory levels 5. Land abandonment and changes in agricultural practices increasing fire risks, in addition to Climate Change. 6. Displacement of problems to less regulated areas and reduced efficiency in resource allocation. 7. Difficult balance between conservation and production 8. Challenges of carbon credits markets and Inequalities in Carbon Credit Capacities.

SWOT analysis shows four main areas in which policies on forestry are leading to developing a forest-based bioeconomy or blocking it.

Public-private partnerships currently have strong alliances that allow the participation and collaboration of different actors, thus fostering the exchange of resources and innovation: as indicated by Lainez, M., et al. (2018): *"public-private sector collaboration is quite well established in this area, although there is room to further strengthen this relationship".* There are great opportunities in this collaboration, increasing the participation of local communities, thus making policies more effective. Nevertheless, owners collaboration could be improved, which is a weakness and a real barrier to forestry development. Forest associations seeking to establish operational collaboration platforms indicate an effort to improve communication and collaboration among private forest owners, potentially strengthening cohesion and information exchange in forest management. – *"From a weak or inexistent network of communication among private forest owners, forest groupings aim to establish operative collaboration platforms"* (Górriz-Mifsud et al., 2019). Institutions play crucial roles, and recognizing those roles of both formal and informal institutions in forest management underscores the need to consider existing structures for decision-making. In Spain *"common property is structured by formal and informal institutions, and how these institutions can play a role in preventing environmental degradation by sanctioning mechanisms and by enhancing communication and cooperation"* (Pecurul-Botines, M. et al., 2014).

The analysis of different studies and strategies suggests that the basis for developing a forestry-based bioeconomy is very present in Spain and there exists an entrepreneurial and innovation focus where *"forests' important role as a nature-based solution for achieving climate neutrality is recognized*" (Lier et al., 2022). The integration of local policies for economic development and conservation, local participation, and diverse planning models allow for mix a sustainable forestry management and territorial economic growth. It exists a correlation between economic development and conservation policies. Economic development influences both the reduction of deforestation and the enhancement of forest quality and extent. This knowledge is essential for crafting informed environmental policies and economic strategies: "*The most important outcome is the understanding that economic development promotes, in the long term, not only a reduction in deforestation...but also an increase in the extent and environmental quality of forest*" (Benedek y Fertö, 2020).

Innovation and new business models in forest management are being developed in different ways in Europe: *The core business model elements of the infrastructure and the offering include the following building blocks: key resources (e.g., human resources), customer relationships (e.g., uniqueness) and key activities (e.g., reinforced cooperation)* (Kajanus et al., 2019).

Forestry counts with identified risks and resource management. Pérez et al. (2006) highlighted the importance of identifying forest property and management. In the same way Skulska et al. (2020) obtained that a clear understanding of the relationship between the spatial distribution of fires and factors like protection, ownership, and management types provides insight into fire occurrence factors: *"The EFFIS Annual Fire reports indicate that the spatial distribution of fires is not random and is partly related to factors such as protection, property, and management types in agroforestry systems".* On the administration's side, coordination and planning could be limited between different territorial units, and it could be even more difficult without the correct policy alignment between them.

The last big topic is about carbon capture and carbon markets. The big potential for carbon stocking and the possible synergies between incentives, subsidies and taxes have many opportunities for its development. The main barrier for carbon credit markets lies in the possible inequalities between countries with different capacities, which leads to several challenges as Robert D. Cairns and Pierre Laserre (2004) argue: *"Markets are not perfect in developing countries, may have to be developed, and themselves have costs".*

Public policies are tackling the Climate Change issue. Main barriers are related to fire risk increasing, due to temperature rise and land use changes. Scenarios play a significant role in supporting policy formulation in the forestry sector, including their use in modelling climate change, offering a useful tool for planning and policymaking: "*Scenarios continue to play an important role for the forestry sector community in supporting policy-making, including the use of climate change scenarios in both policy-making and in forest modelling"* (Aggestam et al., 2018).

Conclusions

Forest-based bioeconomy plays an important role in steering to a sustainable global economy. In the analysis presented in this paper, through a systematic literature review, the main drivers and barriers influencing the development of the forest bioeconomy in Europe have been identified and assessed. By integrating these findings with existing forest policies, the study reveals several opportunities and challenges that demand critical attention from policymakers, researchers and stakeholders in the forest sector.

Public-private collaboration emerges as a crucial driver, catalysing innovation and facilitating the sharing of knowledge and resources. This synergy is essential to drive progress towards a sustainable forest bioeconomy. However, fragmentation in planning and limited financial resources present significant challenges that could hinder the implementation of effective and coherent long-term strategies.

Policies should therefore aim to strengthen existing infrastructures, promote inclusive policies that integrate local knowledge and technological capacities, and ensure that legal and financial frameworks are sufficiently robust to support these initiatives. Furthermore, it is imperative that forest policies not only address immediate economic needs but also consider long-term environmental and social impacts.

In conclusion, while the forest bioeconomy in Europe has the potential to play a transformative role in the sustainable management of natural resources and in fostering a greener economy, realising this potential requires constant reassessment and adaptation of policies to address both emerging challenges and evolving opportunities. Through a more integrated and strategically aligned approach, Europe can ensure that its forest sector contributes effectively to both economic and environmental sustainability goals.

References

Aggestam, F., Pülzl, H., 2020. Downloading Europe: A Regional Comparison in the Uptake of the EU Forest Action Plan. Sustainability 12, 3999. https://doi.org/10.3390/su12103999

Aggestam, F., Wolfslehner, B., 2018. Deconstructing a complex future: Scenario development and implications for the forest-based sector. Forest Policy and Economics 94, 21–26. https://doi.org/10.1016/j.forpol.2018.06.004

Barton, D.N., Ring, I., Rusch, G.M., 2017. Policy Mixes: Aligning instruments for biodiversity conservation and ecosystem service provision. Environmental Policy and Governance 27, 397–403. https://doi.org/10.1002/eet.1779

Benedek, Z., Fertő, I., 2020. Does economic growth influence forestry trends? An environmental Kuznets curve approach based on a composite Forest Recovery Index. Ecological Indicators 112, 106067. https://doi.org/10.1016/j.ecolind.2020.106067

Cairns, R.D., Lasserre, P., 2004. Reinforcing economic incentives for carbon credits for forests. Forest Policy and Economics, Economics of Sustainable Forest Management 6, 321–328. https://doi.org/10.1016/j.forpol.2004.03.007

Carbon and market effects of U.S. forest taxation policy - ScienceDirect [WWW Document], n.d. URL https://www.sciencedirect.com/science/article/pii/S0921800920306273

Carbon taxation as a means to incentivize forest and fire management | Environment, Development and Sustainability [WWW Document], n.d. URL https://link.springer.com/article/10.1007/s10668-021-01953-5

Daigneault, A.J., Sohngen, B.L., Sedjo, R., 2020. Carbon and market effects of U.S. forest taxation policy. Ecological Economics 178, 106803. https://doi.org/10.1016/j.ecolecon.2020.106803

Edwards, P., Kleinschmit, D., 2013. Towards a European forest policy — Conflicting courses. Forest Policy and Economics, Forest Land Use and Conflict Management: Global Issues and Lessons Learned 33, 87–93. https://doi.org/10.1016/j.forpol.2012.06.002

Farinha, J., Cunha, L., Dimuccio, L.A., 2022. Exploratory Spatial Analysis of Social Vulnerability and Forest Fire Risk in the Pinhal Interior Sul (Central Portugal). Sustainability 14, 3010. https://doi.org/10.3390/su14053010

Garcia-Gonzalo, J., Bushenkov, V., McDill, M.E., Borges, J.G., 2015. A Decision Support System for Assessing Trade-Offs between Ecosystem Management Goals: An Application in Portugal. Forests 6, 65–87. https://doi.org/10.3390/f6010065

Giessen, L., Krott, M., Möllmann, T., 2014. Increasing representation of states by utilitarian as compared to environmental bureaucracies in international forest and forest–environmental policy negotiations. Forest Policy and Economics 38, 97–104. https://doi.org/10.1016/j.forpol.2013.08.008

Giurca, A., Jonsson, R., Rinaldi, F., Priyadi, H., 2013. Ambiguity in Timber Trade Regarding Efforts to Combat Illegal Logging: Potential Impacts on Trade between South-East Asia and Europe. Forests 4, 730–750. https://doi.org/10.3390/f4040730

Górriz-Mifsud, E., Olza Donazar, L., Montero Eseverri, E., Marini Govigli, V., 2019. The challenges of coordinating forest owners for joint management. Forest Policy and Economics, Forest ownership change: trends and issues 99, 100–109. https://doi.org/10.1016/j.forpol.2017.11.005

Hyyrynen, M., Ollikainen, M., Seppälä, J., 2023. European forest sinks and climate targets: past trends, main drivers, and future forecasts. Eur J Forest Res 142, 1207–1224. https://doi.org/10.1007/s10342-023-01587-4

Jansen, S., Konrad, H., Geburek, T., 2019. Crossing borders – European forest reproductive material moving in trade. Journal of Environmental Management 233, 308–320. https://doi.org/10.1016/j.jenvman.2018.11.079

Juutinen, A., Ahtikoski, A., Lehtonen, M., Mäkipää, R., Ollikainen, M., 2018. The impact of a short-term carbon payment scheme on forest management. Forest Policy and Economics 90, 115–127. https://doi.org/10.1016/j.forpol.2018.02.005

Kajanus, M., Leban, V., Glavonjić, P., Krč, J., Nedeljković, J., Nonić, D., Nybakk, E., Posavec, S., Riedl, M., Teder, M., Wilhelmsson, E., Zālīte, Z., Eskelinen, T., 2019. What can we learn from business models in the European forest sector: Exploring the key elements of new

business model designs. Forest Policy and Economics, Forest ownership change: trends and issues 99, 145–156. https://doi.org/10.1016/j.forpol.2018.04.005

Kan, S., Chen, B., Chen, G., 2023. Globalization of forest land use: Increasing threats on climate-vulnerable regions. Land Use Policy 132, 106798. https://doi.org/10.1016/j.landusepol.2023.106798

Koskela, E., Ollikainen, M., Pukkala, T., 2007. Biodiversity policies in commercial boreal forests: Optimal design of subsidy and tax combinations. Forest Policy and Economics 9, 982–995. https://doi.org/10.1016/j.forpol.2006.09.003

Kuckertz, A., 2020. Bioeconomy Transformation Strategies Worldwide Require Stronger Focus on Entrepreneurship. Sustainability 12, 2911. https://doi.org/10.3390/su12072911

Lainez, M., González, J.M., Aguilar, A., Vela, C., 2018. Spanish strategy on bioeconomy: Towards a knowledge based sustainable innovation. New Biotechnology, Bioeconomy 40, 87–95. https://doi.org/10.1016/j.nbt.2017.05.006

Lier, M., Köhl, M., Korhonen, K.T., Linser, S., Prins, K., Talarczyk, A., 2022. The New EU Forest Strategy for 2030: A New Understanding of Sustainable Forest Management? Forests 13, 245. https://doi.org/10.3390/f13020245

Ludvig, A., Zivojinovic, I., Hujala, T., 2019. Social Innovation as a Prospect for the Forest Bioeconomy: Selected Examples from Europe. Forests 10, 878. https://doi.org/10.3390/f10100878

MacDonald, D., Crabtree, J.R., Wiesinger, G., Dax, T., Stamou, N., Fleury, P., Gutierrez Lazpita, J., Gibon, A., 2000. Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. Journal of Environmental Management 59, 47–69. https://doi.org/10.1006/jema.1999.0335

Maier, C., Lindner, T., Winkel, G., 2014. Stakeholders' perceptions of participation in forest policy: A case study from Baden-Württemberg. Land Use Policy 39, 166–176. https://doi.org/10.1016/j.landusepol.2014.02.018

Mason, C., Brown, D.R., 2014. ENTREPRENEURIAL ECOSYSTEMS AND GROWTH ORIENTED ENTREPRENEURSHIP. OECD https://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf

Modelling socio-economic drivers of forest fires in the Mediterranean Europe - UC Digitalis [WWW Document], n.d. . ucdigitalis.uc.pt. URL http://ucdigitalis.uc.pt/pombalina/item/70328 (accessed 2.16.24).

Montiel, C., Galiana, L., 2005. Forest policy and land planning policy in Spain: a regional approach. Forest Policy and Economics 7, 131–142. https://doi.org/10.1016/S1389-9341(03)00026-1

Montiel Molina, C., Galiana-Martín, L., 2016. Fire Scenarios in Spain: A Territorial Approach to Proactive Fire Management in the Context of Global Change. Forests 7, 273. https://doi.org/10.3390/f7110273

Moreno-Fernández, D., Zavala, M.A., Madrigal-González, J., Seijo, F., 2021. Resilience as a Moving Target: An Evaluation of Last Century Management Strategies in a Dry-Edge Maritime Pine Ecosystem. Forests 12, 1151. https://doi.org/10.3390/f12091151

Mutersbaugh, T., Klooster, D., Renard, M.-C., Taylor, P., 2005. Certifying rural spaces: Quality-Certified Products and Rural Governance. Journal of Rural Studies, Certifying Rural Spaces: Quality-Certified Products and Rural Governance 21, 381–388. https://doi.org/10.1016/j.jrurstud.2005.10.003

Pan, W., Chang, W.-Y., Wu, T., Zhang, H., Ning, Z., Yang, H., 2021. Impacts of the China-US trade restrictions on the global forest sector: A bilateral trade flow analysis. Forest Policy and Economics 123, 102375. https://doi.org/10.1016/j.forpol.2020.102375

Paraskevopoulou, A.T., Nektarios, P.A., Kotsiris, G., 2019. Post-fire attitudes and perceptions of people towards the landscape character and development in the rural Peloponnese, a case study of the traditional village of Leontari, Arcadia, Greece. Journal of Environmental Management 241, 567–574. https://doi.org/10.1016/j.jenvman.2018.09.105

Pecurul-Botines, M., Di Gregorio, M., Paavola, J., 2014. Discourses of conflict and collaboration and institutional context in the implementation of forest conservation policies in Soria, Spain. Biodivers Conserv 23, 3483–3499. https://doi.org/10.1007/s10531-014-0823-2

Pérez-Suárez, M., Sánchez-Torné, I., Jaenes, M.A., Troncoso, D.P., 2020. Una aproximación a la economía forestal de España. Revista Cubana de Ciencias Forestales 8, 578–593.

Ranta, T., Karhunen, A., Laihanen, M., 2017. Factors behind the development of forest chips use and pricing in Finland. Biomass and Bioenergy 98, 243–251. https://doi.org/10.1016/j.biombioe.2017.02.004

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C. D., … & McKenzie, J. E. (2021). Prisma 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ, n160. https://doi.org/10.1136/bmj.n160

Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009 Jul

21;6(7):e1000097. doi: 10.1371/journal.pmed.1000097. Epub 2009 Jul 21. PMID: 19621072; PMCID: PMC2707599.

Roe S et al (2019) Contribution of the land sector to a 1.5 °C world. Nat Clim Change 9:817–828

Šálka, J., Dobšinská, Z., Hricová, Z., 2016. Factors of political power — The example of forest owners associations in Slovakia. Forest Policy and Economics, Forest Policy Analysis: Advancing the analytical approach 68, 88–98. https://doi.org/10.1016/j.forpol.2015.05.003

Scheeder, T., Moog, M., Borchert, H., 2002. Bureaucratic financial burdens on privately owned forest companies: Results of a case study in three German federal states. Forest Policy and Economics 4, 21–31. https://doi.org/10.1016/S1389-9341(01)00080-6

Schulz, T., Ohmura, T., Zabel, A., 2023. Sustainable economy trade-offs and conflicts in and with the forest (Research Trend). Forest Policy and Economics 150, 102936. https://doi.org/10.1016/j.forpol.2023.102936

Skulska, I., Montiel-Molina, C., Rego, F.C., 2020. The role of forest policy in Mediterranean mountain community lands: A review of the decentralization processes in European countries. Journal of Rural Studies 80, 490–502. https://doi.org/10.1016/j.jrurstud.2020.10.033

Sténs, A., Bjärstig, T., Nordström, E.-M., Sandström, C., Fries, C., Johansson, J., 2016. In the eye of the stakeholder: The challenges of governing social forest values. Ambio 45, 87–99. https://doi.org/10.1007/s13280-015-0745-6

Using GIS to measure changes in the temporal and spatial dynamics of forestland: experiences from north-west Spain | Forestry: An International Journal of Forest Research | Oxford Academic [WWW Document], n.d. URL https://academic.oup.com/forestry/article/79/4/409/640340?login=true (accessed 2.16.24).