sustainability

MDPI

Article

Forest Resources Management and Sustainability: The Specific Case of European Union Countries

Vítor João Pereira Domingues Martinho [1,*] and António José Dinis Ferreira [2,3]

[1] CERNAS-IPV Research Centre and Agricultural School (ESAV), Polytechnic Institute of Viseu (IPV), 3504-510 Viseu, Portugal
[2] CERNAS—Study Center for Natural Resources, Environment and Society, Escola Superior Agrária de Coimbra, P-3045-601 Coimbra, Portugal; aferreira@esac.pt
[3] Polytechnic Institute of Coimbra (IPC), Agricultural School (ESAC), P-3045-601 Coimbra, Portugal
* Correspondence: vdmartinho@esav.ipv.pt

Abstract: Forest land provides several environmental services and goods with significant implications for different socioeconomic and environmental dimensions. Forestry and its management are determinant activities for sustainable development, specifically in the current context of urgent mitigation of climate change. In this perspective, one objective of this research was to survey the main insights from the literature about the forest and management dimensions put together, highlighting the contributions of these activities to mitigate climate change. Another objective was to explore indicators related to forest management (land, employment, output, and net emissions) in order to obtain a forest sustainability index through factor analysis. As main insights from this study, we can quote that the literature survey pinpoints the most relevant factors framing forest management: soil characteristics, ecology, ecosystems, biodiversity, deforestation, climate change, socioeconomic frameworks, local knowledge, public policies, institutional context, and new technologies. Forest indicators reveal a strong relationship between forest land, employment and output, and a weaker relation with net emissions. We concluded that there is a need for stakeholders to explore and improve the interlinkage with climate change impact, specifically with regard to improving the relationships of forestry greenhouse gas emissions impacts with forest size and output.

Keywords: European Union; forest indicators; factor analysis; forest sustainability index

Citation: Martinho, V.J.P.D.; Ferreira, A.J.D. Forest Resources Management and Sustainability: The Specific Case of European Union Countries. *Sustainability* **2021**, *13*, 58. https://dx.doi.org/10.3390/su13010058

Received: 16 November 2020
Accepted: 19 December 2020
Published: 23 December 2020

1. Introduction

A sustainable forest management is of paramount importance for sustainable development at all levels, specifically in rural areas where forestry activities may contribute to create employment and add value for land owners and related stakeholders [1]. These contributions have a socioeconomic dimension but also an environmental facet since they are expected to retard or even revert land abandonment. In fact, a sustainable forest management must maintain the forest productive and renewal capacities, as well as its contribution to biodiversity and ecology [2].

Adding to the contributions for a better socioeconomic dynamics, an improved management may prevent several damages that biotic and abiotic agents may cause on forests. These questions are of the utmost important for Mediterranean countries dealing with forest fire problems. Forest fires have several consequences on socioeconomic and environmental domains for regions impacted by these abiotic forests disturbance agents [3], compromising the forest contributions for climate change mitigation [4]. This is a major problem due to forest contributions on climate change mitigation [5]. Nonetheless, forest planning is also impacted by global warming [6], almost in self-reinforced processes. Public policies play a determinant role in this context [7] to prevent forest fires implications, and the setting of a vicious negative feedback dynamic. To this end, they need to be designed and implemented in a proactive way [8]. In this framework, post fire scenarios were properly addressed by the full range of stakeholders, specifically regarding concerns soil [9] and water [10] conservation.

This paper aimed to explore several dimensions of forest resources management, presenting the specific case of 28 European Union countries. In total, 91 documents were screened from all databases on the Web of Science (WoS) [11]. Specifically, we considered domains where forest and management were put together, which, in our searches, were labelled "*forest* and *manage*". This approach to forest and management topics allows for a broader search about these fields [12], capturing expressions such as "forest and management", "forest and managed", "forest and unmanaged", "forestry and management", and "agroforestry and management". There are few documents that address these topics in a European Union context. Documents were analyzed in a bibliographic perspective and were surveyed via a literature review. Finally, considering data from the Eurostat and FAOSTAT, we analyzed the specific case of European Union countries. We considered statistical information for variables related with forest sustainability and management (e.g., area, employment, output and contributions for the greenhouse gas emissions). We developed a forest sustainability index through factor analysis. The dimensions related with the forest management area were wide, which is highlighted in the literature. Nonetheless, this research focused on the socioeconomic and environmental fields in the European Union.

2. Bibliographic Sample Characterization

Since 1990 and until mid-September 2020, the publication of scientific documents about the topic "*forest* and *manage*" was almost cyclical in sources indexed in all WoS databases [11]. In 2016, the most published research papers on this topic were found (Figure 1). Over the entire period, there was an increasing trend regarding the actuality of subjects related with forest management and the interest of research on these issues in recent years.

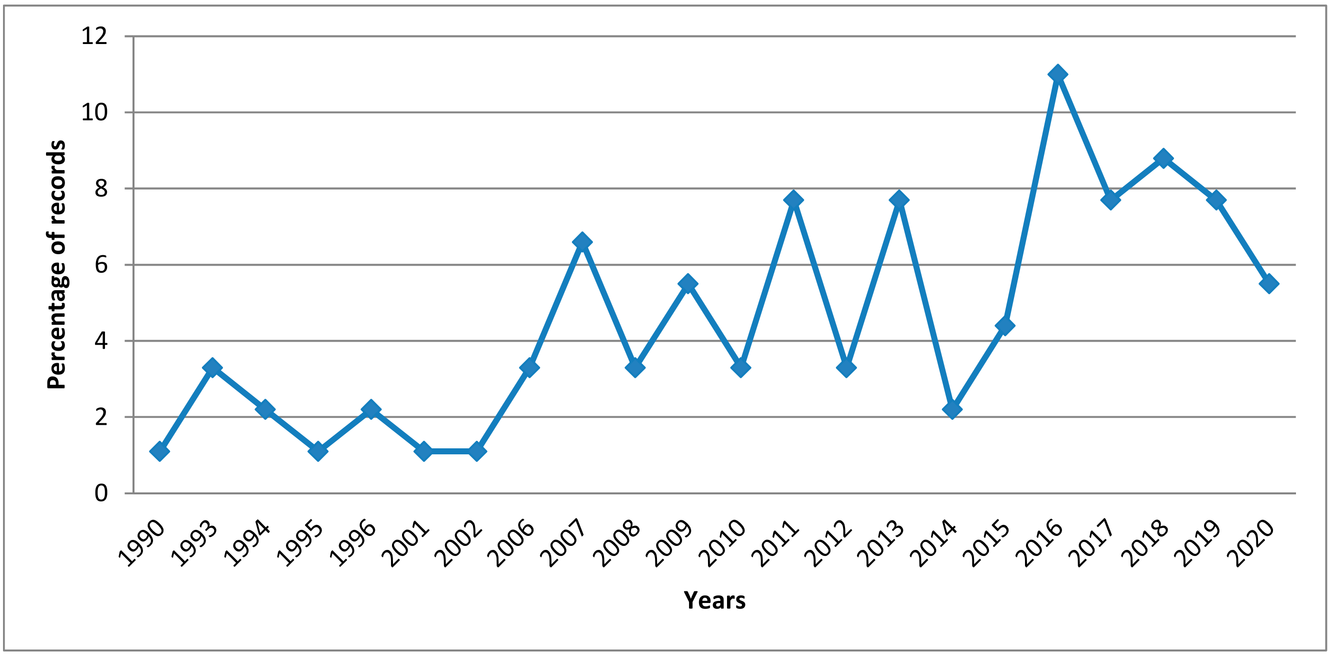


Figure 1. Records by year of publication (% of 91 documents).

The studies published were carried out mainly in the following research areas (Figure 2): environment sciences ecology; forestry; biodiversity conservation; plant sciences; agriculture; business economics; science, technology, and other topics; zoology; meteorology atmospheric sciences; geography; public administration; life sciences, biomedicine, and other topics. The diversity of research areas where the documents were published were also related with the multidisciplinary and transversal dimension of forest management. In fact, these research areas are related with domains spanning from ecology to economics. Therefore, we contend that the main barriers for effective and efficient forest management are linked with the relevant stakeholders' (i.e., owners and policymakers) poor understanding about the multifunctionality of forest resources. In fact, owners usually do not understand the forest as a sector where it is possible to obtain outputs beyond wood production. As such, the policymakers are, often, more concerned with the management of fire impact.

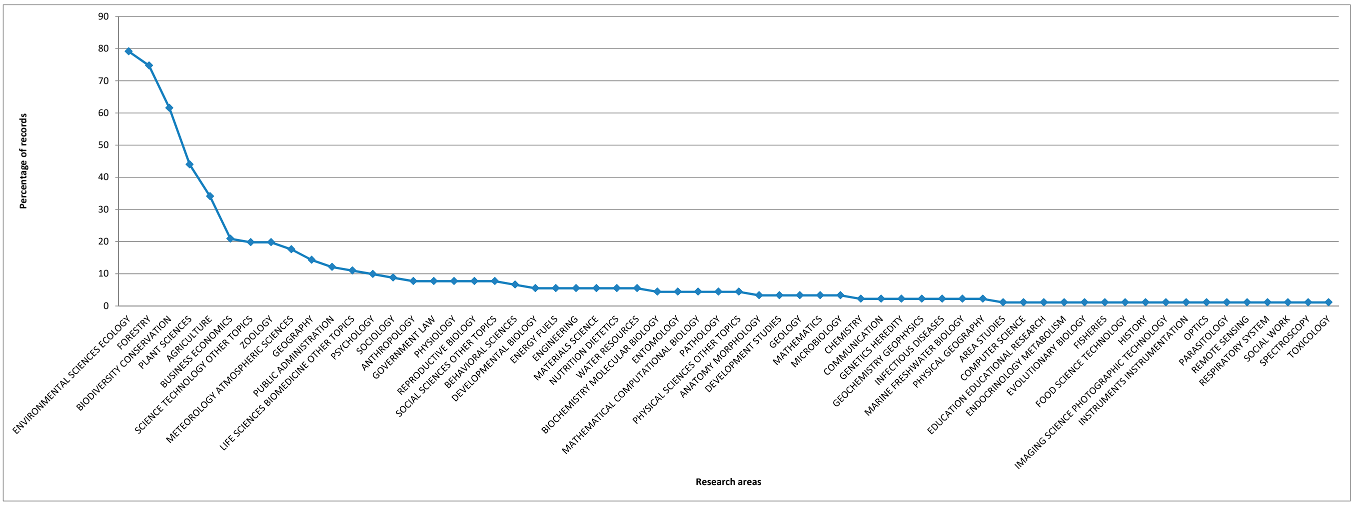


Figure 2. Records by research area (% of 91 documents).

In general, the documents published related to the topic were developed by researchers who belonged to institutions from countries such as the USA (32% of the 91 studies), Brazil, Germany, Sweden, Finland, India, and Canada (Figure 3). This framework showed that US researchers expressed much interest on these topics. Brazil also had numerous publications due to the Amazonian Forest. In the European Union, the leading countries were Germany, Sweden, and Finland. Despite the problem of forest fires, Mediterranean countries presented a lower research interest in forest and management, especially vis-à-vis climate change adjustments.

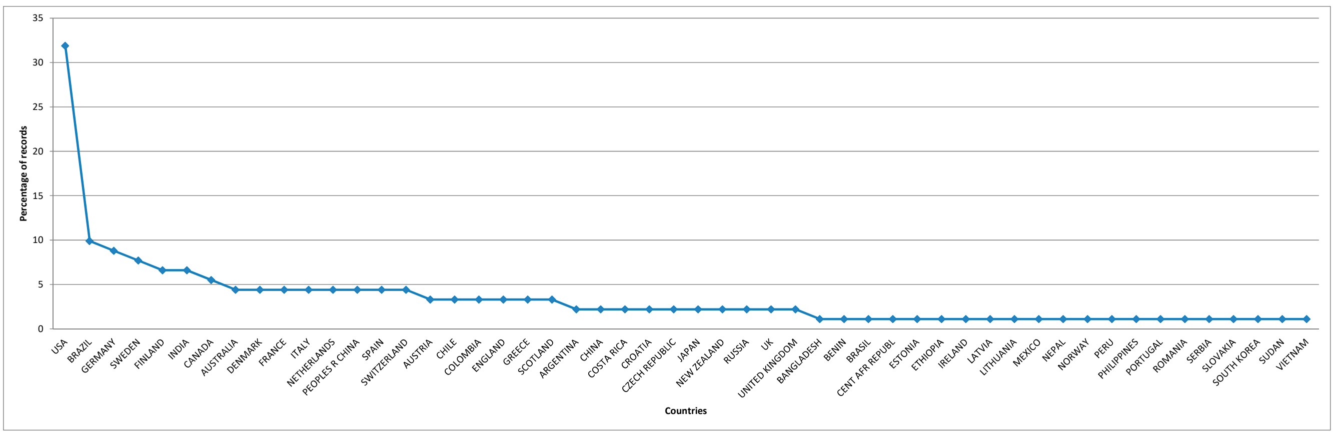


Figure 3. Records by country/region (% of 91 documents).

The studies performed on "*forest* and *manage*" were published in the following journals (Figure 4), considering 2 or more records: *Forest Ecology and Management; Human Ecology; Applied Geography; Biodiversity and Conservation; Conservation Biology; Geoderma;*

Global Change Biology; Journal of Forestry; Land Use Policy; Restoration Ecology; Revista Arvore; Tropical Ecology. Considering the transversal perspective of forest management, it could be relevant to see more documents in publications outside of the forestry, ecology, and biology areas. This research may be a contribution for this gap, because it focused on socioeconomic and environmental variables from inside the forest sector, some of which could impact the relationships between forest management and sustainability.

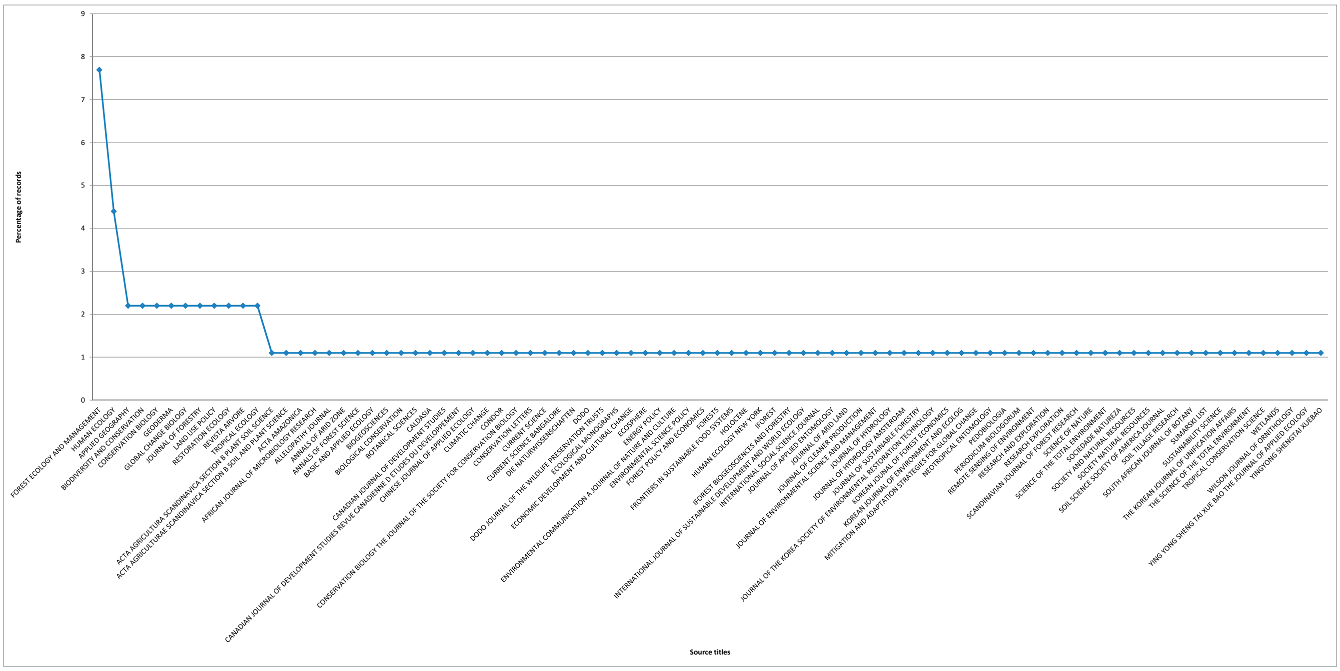


Figure 4. Records by source title (% of 91 documents).

3. Literature Review

Forest management depends on several factors [13], given the influence of different dimensions and factors upon forestry ecosystems [14], such as soil characteristics [15], soil acidity [16], sodic concentrations [17], and other soil functions (e.g., seed banks play a determinant role in these frameworks) [18]. Moreover, other factors that forest management depends on are climate changes, human, social, and economic contexts, historical records, local knowledge, public policies, and institutional frameworks.

Soil composition is crucial for forest regeneration [19]. Ecosystems regeneration is often impacted by various biotic and abiotic agents, such as the level of phenolic compounds [20]. Nonetheless, forest and land use practices influence several dimensions [21], including soil characteristics [22] in terms of fungal population [23] and agricultural production that may be affected by the surrounding forest ecosystem, specifically as hosts for pathogenic agents [24]. Afforestation has implications on soil proprieties [25]. In any case, forest practices have often less negative impacts on soil characteristics than agricultural activities [26].

The dimension of the impact of forest practices on soil characteristics is dependent on specific local particularities [27]. Deforestation is an example of practices with great implications on soil quality, particularly in organic matter levels [28]. Deforestation is also a main factor contributing to the reduction in wild species' diversity [29]. Forest management plans with mixed species are more resilient to stress factors [30] and have less organic matter decomposition [31].

Climate change and its associated uncertainties are variables that frame the design of well-defined management instruments [6] (i.e., land cover) and also influence the responses to future climate characteristics [5].

Factors related with human, social, and resource dimensions also influence the capacity of stakeholders to efficiently perform forest planning [32] and wilderness protection [33]. Bioenergy crops, for example, may be a real threat to forestland maintenance [34], as socioeconomic changes across Europe are increasing the demand for food, which has a toll on forest areas [35]. Renewable sources of energy, such as biomass [36], are determinant issues in the forestry community [37]. Forest resources, such as fuelwood [38], may contribute to socioeconomic alternatives in certain regions where traditional sectors are in decline [39]. The importance of fuelwood as a biomass source depends on specific conditions for each country and region [40]. Forests have several dimensions, all with economic relevance to stimulate the owners and other relevant key actors to implement integrated management plans [41]. Forest-provided ecosystem services and its recognition by public institutions may be an interesting contribution to society and economic dynamics [42]. In this context, land tenure and the management authority have their implications and should be addressed when designing plans [43].

In the present context, economic and financial crises could prompt reflection regarding several natural and economic resources, especially with regard to reform measures needed for more balanced development [44]. However, pressures to find immediate answers often do not allow for the development of adequate strategies, which typically require participatory approaches among the full range of relevant stakeholders.

Forest fires are a relevant factor that may support management in savannas or forest practices [45]. Fires and drought are the main causes of deforestation in Mediterranean countries in the EU [46]. The spread of nematode communities also influences, or are influenced by, forest management options [47]. In fact, agroforest systems are susceptible to other biological agents [48], sometimes in a negative way.

Forest management is not always adjusted to maintain ecosystems and biodiversity. This is observed when managed forests are compared with unmanaged areas [49]. This is true for flora and fauna, where human interventions impact biodiversity resilience [50].

The reduction in biodiversity is a concern for stakeholders around the world [51]. While this is particularly true for Brazil, given its rich biomes [52], it is also the case for Costa Rica [53], the USA [54], Puerto Rico [55], Sudan [56], Korea [57], Japan [58], Canada [59], Peru [60], Greece [61], Finland [62], the European Union [63], Ethiopia [64], Argentina [65], Switzerland [66], and Russia [67].

Therefore, it is important to find solutions to mitigate the impact from inadequate forest practices [68] (i.e., afforestation [69]) or promote adjusted management [70]. Generally, local populations agree with sustainable forest planning [71]. Nonetheless, the attention given by the international community to the Brazilian forests, specifically the Amazonia forest, is underwhelming. This is a relatively unexplored field of study, specifically with regard to dry forests [72].

Local knowledge may significantly contribute to the discovery of adequate options and public policies that could support and promote community involvement [73]. For effective stakeholder participation, it is important to understand their perceptions and attitudes [74], since sometimes conservation is not well understood [75]. Local stakeholder involvement is fundamental since land use systems are part of the local identity [76], with important social, cultural, and religious dimensions, as revealed by studies from Chile [77,78]. In certain contexts, local actors are able to interlink local and traditional knowledge with modern insights [79].

Public policies have a determinant role in the relationships between land use and sustainability [80], specifically in terms of water management [81] and deforestation [82]. The interrelationships with water management are a great future challenge [83]. Policy instruments are also crucial in regions where forests may significantly contribute to carbon storage [84] and mitigate climate change [85]. In some cases, such as the boreal forest, there are uncertainties about net carbon balance and, consequently, the impacts on climate change [86]. The net carbon balance from forests is influenced by several variables [87], including spatial and temporal factors [88]. The negative impacts of forest management in China are also not negligible [89].

Entangled with strategic measures is the role of the institutional frameworks, which are crucial to attaining sustainable development in rural areas [90]. Nonetheless, the main concern about forest policy and legislation is the inadequacy or conflict between various measures and instruments [91]. Another important aspect relates to the complexity of rules that make compliance difficult. Stakeholders prefer simple and clear policy instruments [92].

It is important to highlight that sometimes land use practices impact forests in non-profitable ways [93]. This finding could be replicated in other contexts to show that, often, more sustainable practices have negative economic effects.

Forest management is a complex framework that needs to address several dimensions. This calls for multidisciplinary approaches and agents, such as sociologists, historians [94], and geneticists, who could consider the relevance of genetics in forest management [95], specifically with regard to supporting the artificial selection of more resilient plants and seeds [96].

The description of historical facts is important for understanding forest evolution over the years, decades, and centuries in countries such as India [97]. This may be important for analyzing the policies and their implications [98], as well as for proposing new and better adjusted measures/instruments for more friendly ecosystem development [99].

This assessment may contribute to design more adjusted strategic instruments and to implement more efficient management actions and robust plans. New technologies may also bring significant contributions to forest assessment [100], inventory and planning [101]. These advantages were recognised over the last decades [102]. Some of these technologies allow collecting data that is crucial for adequate forest and soil management [103]. The availability of statistical information may make the difference in supporting the decision making process [104].

Highlighting Linkages between Forest Management and Climate Change

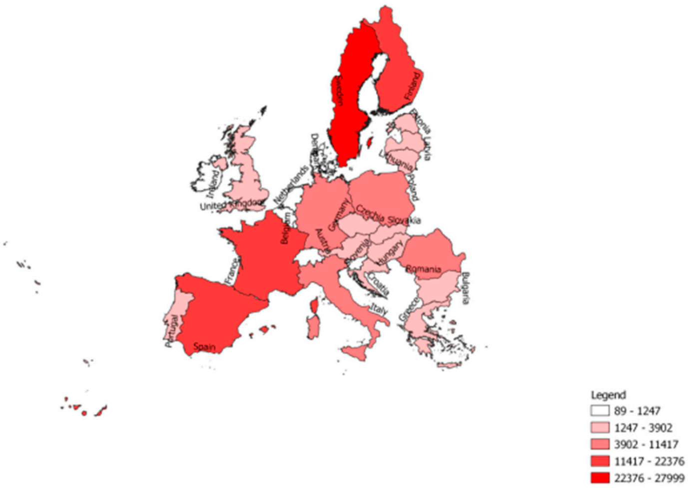
Forestry activities play a determinant role in climate change mitigation [5]. In this context, local knowledge (e.g., from indigenous communities) may bring relevant insights [73]. Public policies can lead to sustainable development and mitigate greenhouse gas emissions [80]. In these contexts, initiatives such as the Reducing Emissions from Deforestation and Forest Degradation (REDD+) may add important contributions [85]. However, the real environmental impact of some mitigation policies, namely those related with bioenergy crops, is unclear [34]. Climate change mitigation strategies should consider stakeholder involvement and understand the attitudes of the full range of actors about the problems related to global warming, including households [105], since they may compromise the efficacy of forest plans [74].

On the other hand, climate change has several implications on biodiversity [59] and land management, especially when considering its impact on soil characteristics and quality [6]. It is expected that climate change will particularly and severely impact regions at high latitudes [86]. Other climate change dimensions include droughts and fires [13], which will likely lead to forest and agricultural land abandonment in southern Europe as a result of poor climate conditions and hampering productivity [35]. In any case, real impacts are specific to each locality, making it difficult to predict and obtain a common framework [31].

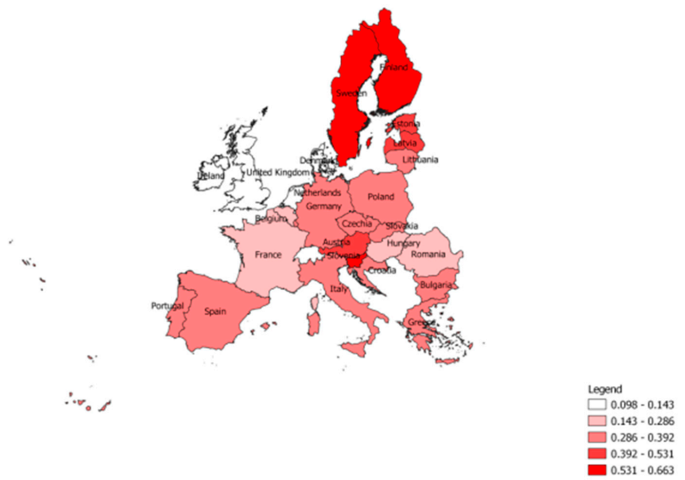
4. Relationships between Forest Management and Sustainability

Considering the main insights obtained from the literature review, this section focuses on the socioeconomic and environmental dimensions of forest management and its relationship with sustainability. In fact, forest management establishes several strong interactions with the environment, yet it seems to have less of a negative implication in other sectors [26]. In addition, land cover characteristics influences the capacity to respond to climate change [5]. In this way, forest land and forest greenhouse gas emissions impact indicators may be interesting variables to consider in the correlations established between forest management and sustainability. The human and social domains also play an important role in the interrelationships among forest and sustainability [32]. In general, forests may contribute to a better local socioeconomic dynamic [39] that support the creation of more employment and additional income for landowners [41]. Since strong forest management is compatible with sustainable development, it is also dependent on the capacity to create jobs in communities where it is important to highlight the relevance of these variables. Fields related with water, soil, forest fires, and local stakeholders, for example, present wider dimensions that deserve deeper analysis in future research.

Figures 5–11 were obtained using the QGIS (A Free and Open Source Geographic Information System) [106] software, considering statistical information from Eurostat [107] and FAOSTAT [108]. The shapefiles were obtained from the Eurostat. To simplify the analysis, overseas regions were not considered. Malta and Cyprus were removed due to a lack of data in the databases. The variables chosen were related with forest management and sustainability.

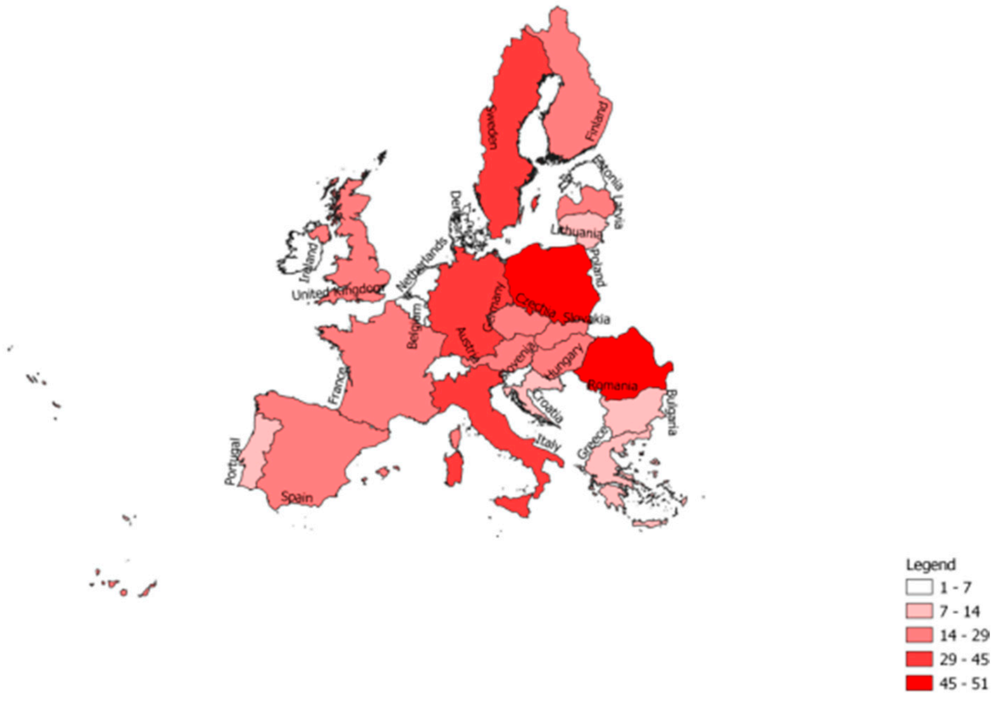


Absolute values

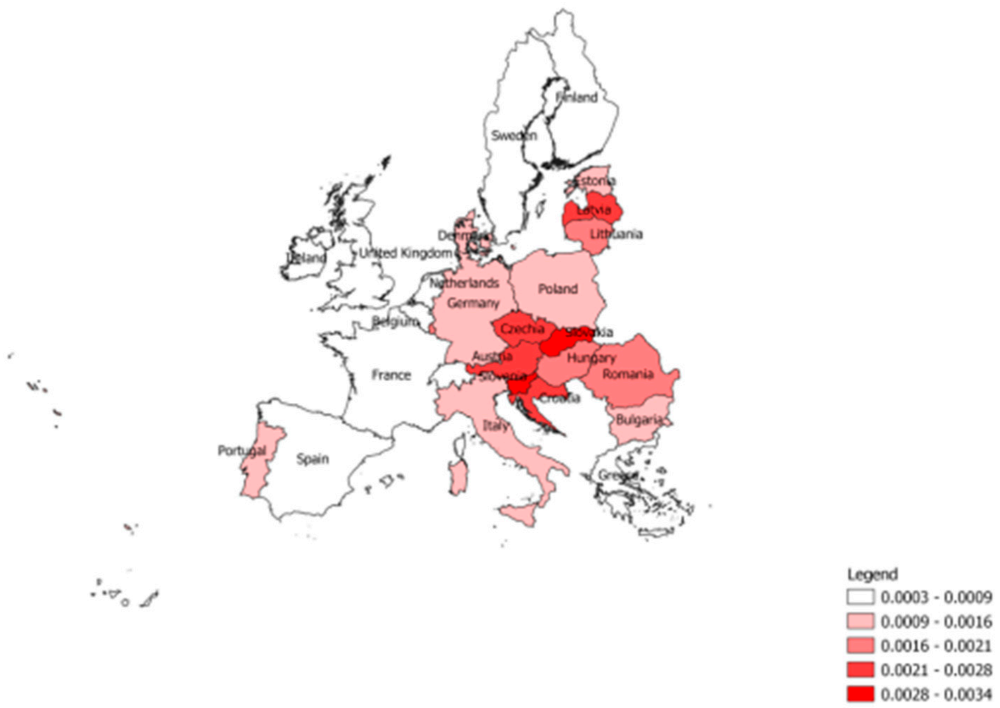


Relative values weighted by total area of each country (1000 ha)

Figure 5. Average area of forest land (1000 ha) from 2012–2017 across European Union countries.

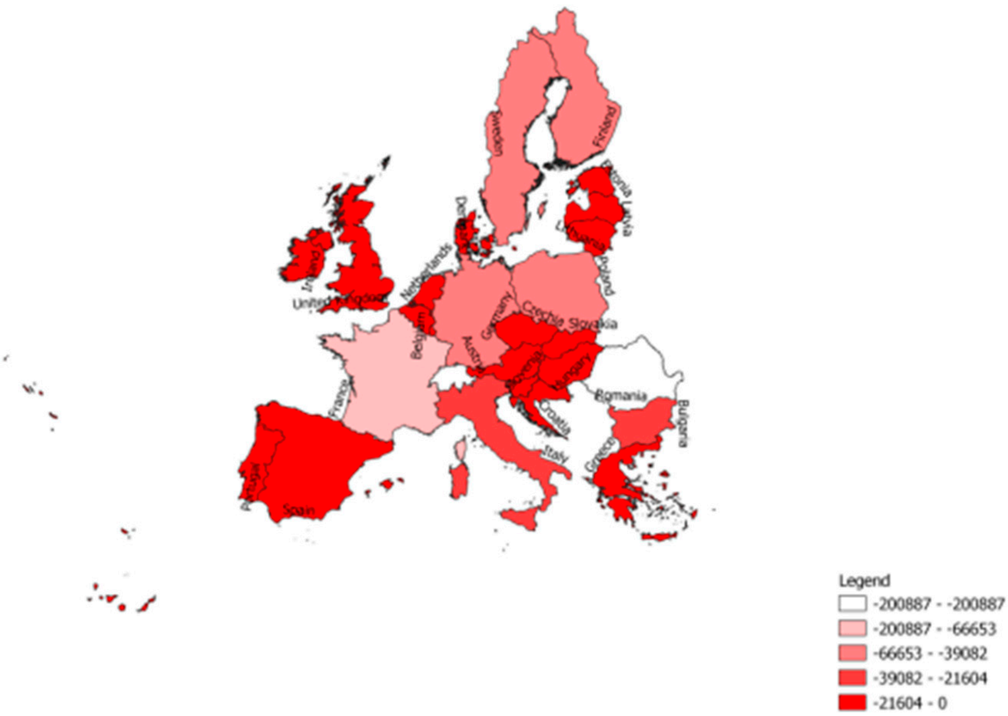


Absolute values

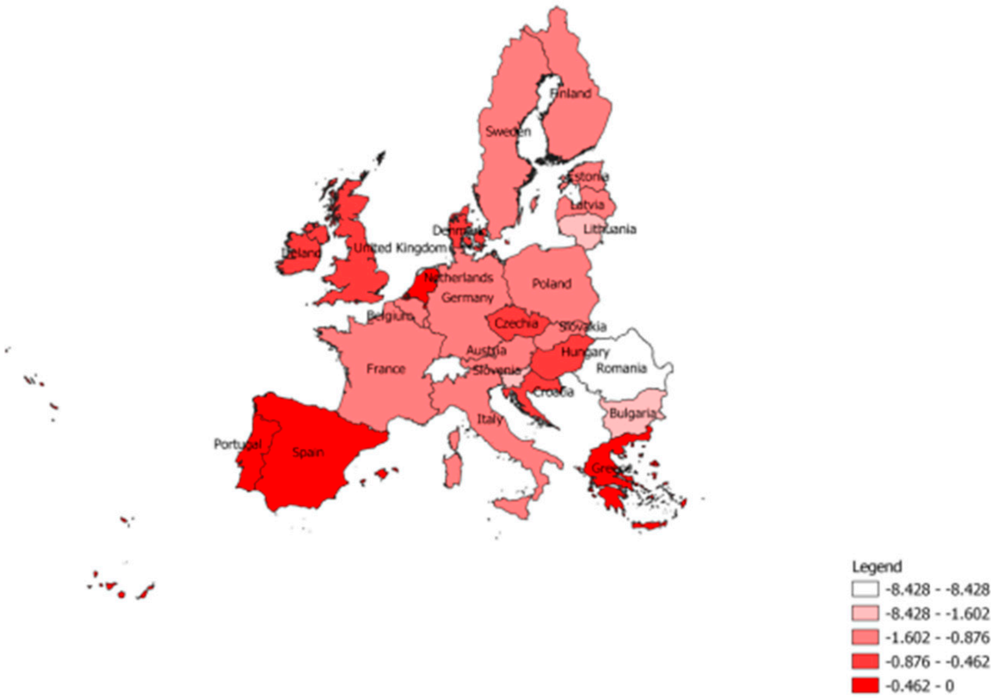


Relative values weighted by total area of each country (1000 ha).

Figure 6. Average employed persons in forestry and logging (thousand annual working units) from 2012–2017 across European Union countries.

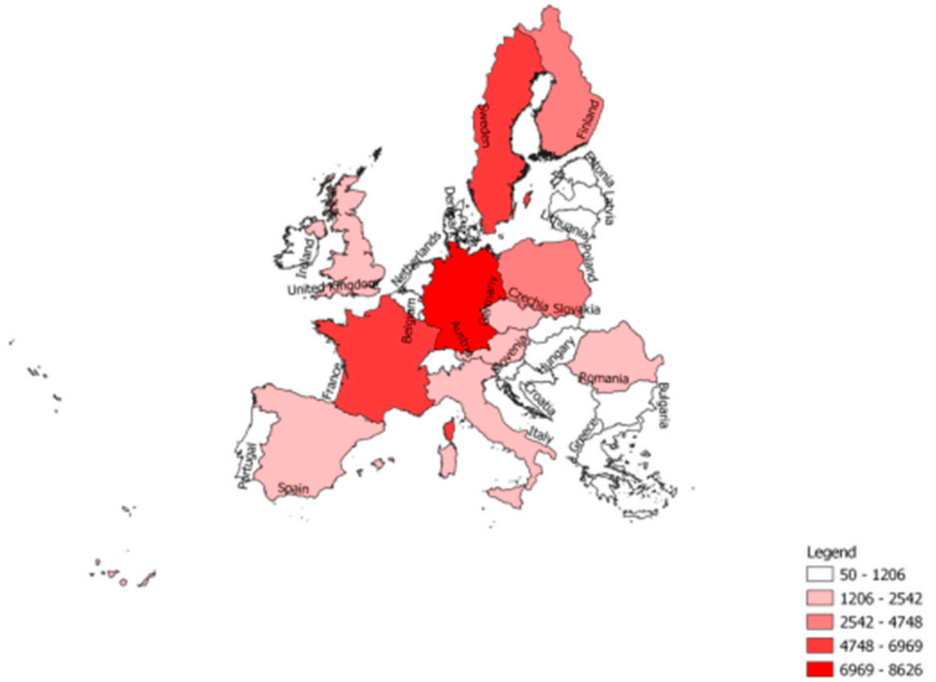


Absolute values

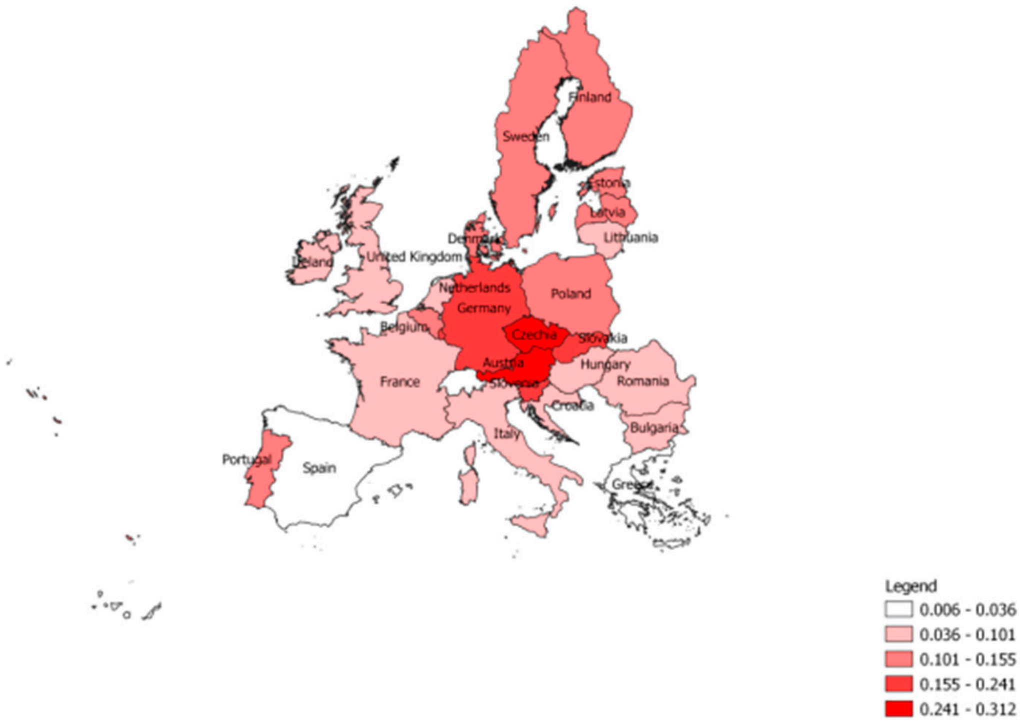


Relative values weighted by total area of each country (1000 ha)

Figure 7. Average net emissions/removal of CO_2eq from forest land (gigagrams) from 2012–2017 across European Union countries.

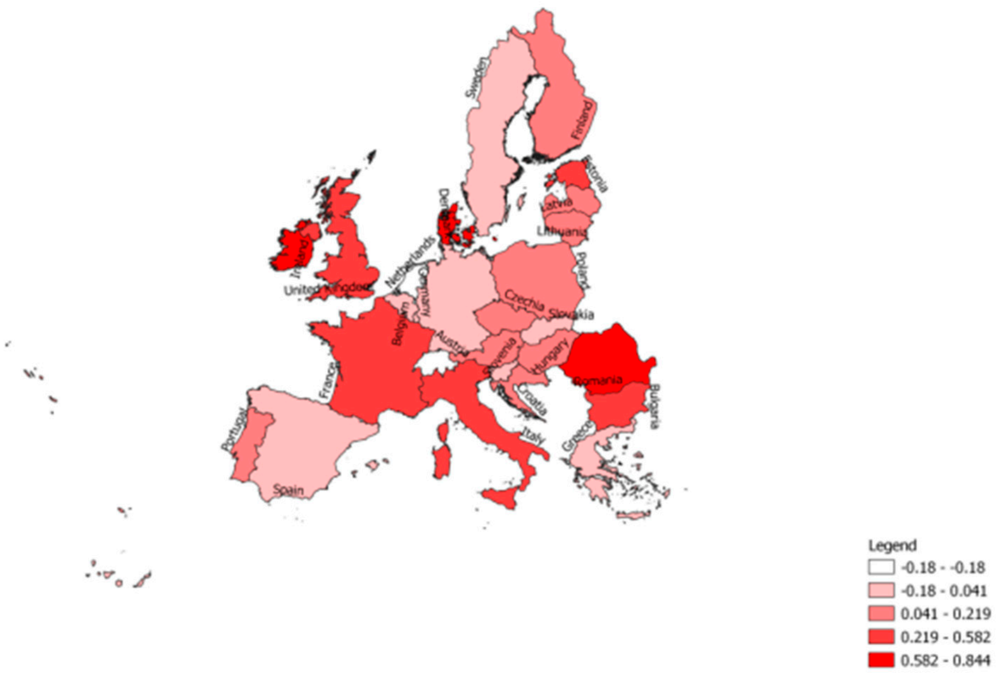


Absolute values

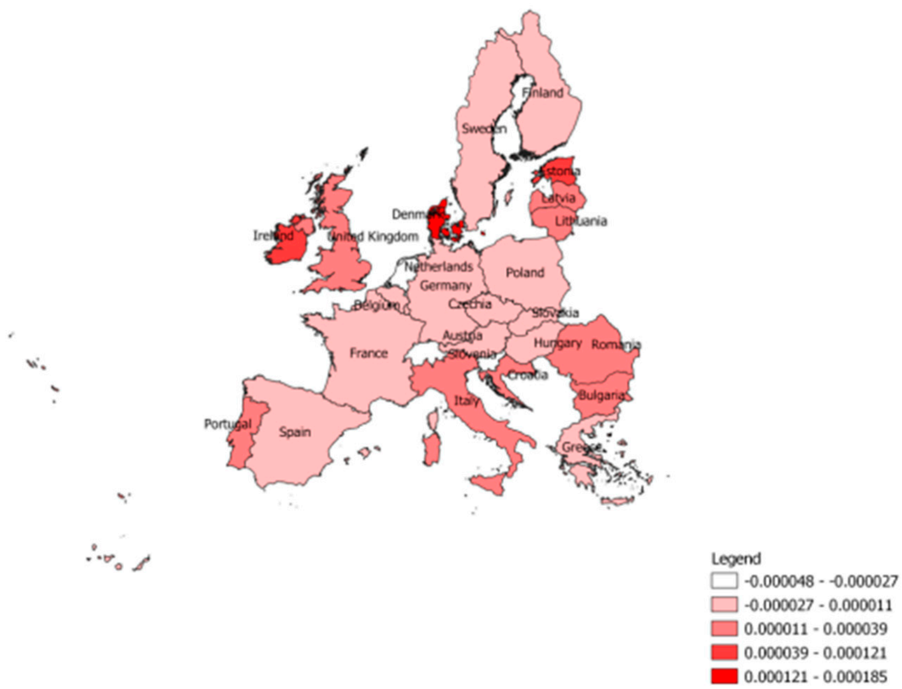


Relative values weighted by total area of each country (1000 ha)

Figure 8. Average output of forestry and connected secondary activities (million euro) from 2012–2017 across European Union countries.

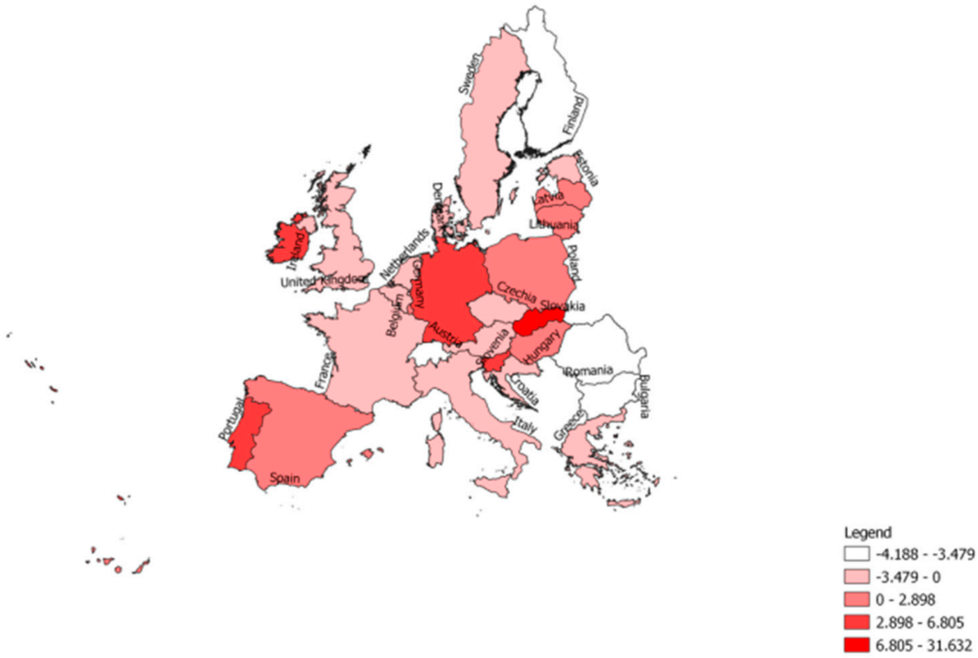


Absolute values

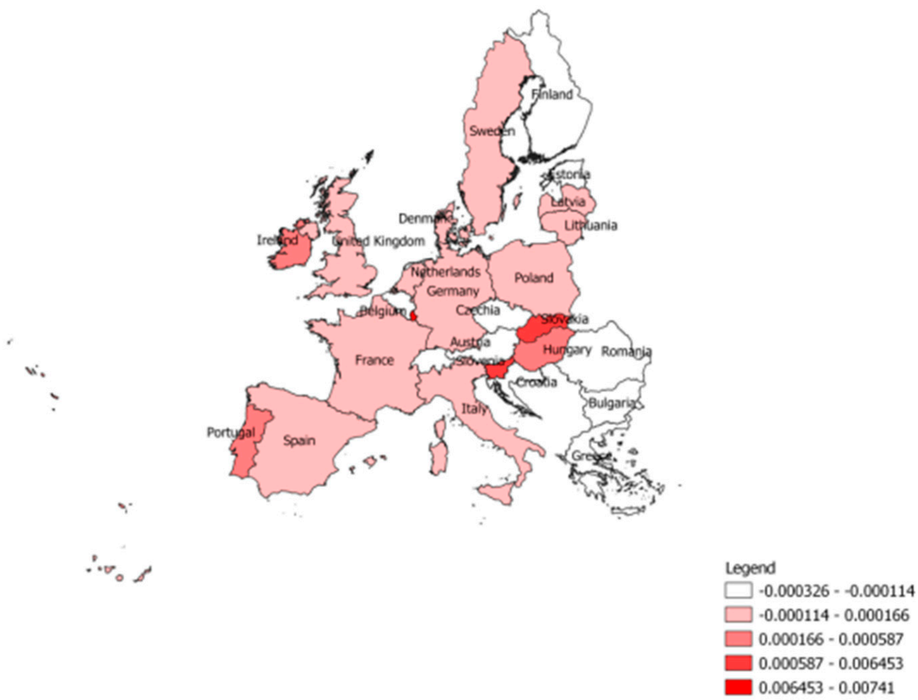


Relative values weighted by total area of each country (1000 ha)

Figure 9. Average area of forest land growth rates (%) from 2012–2017 across European Union countries.

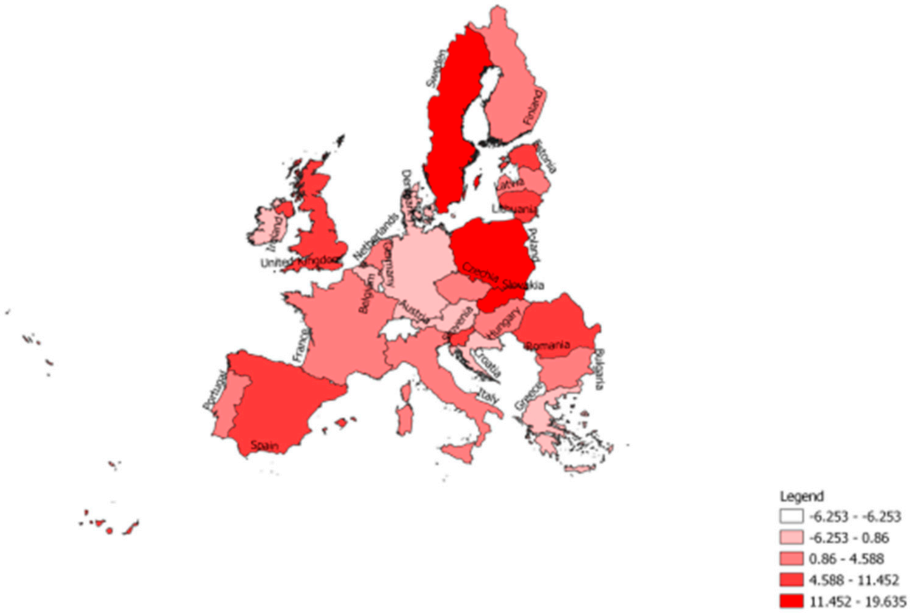


Absolute values

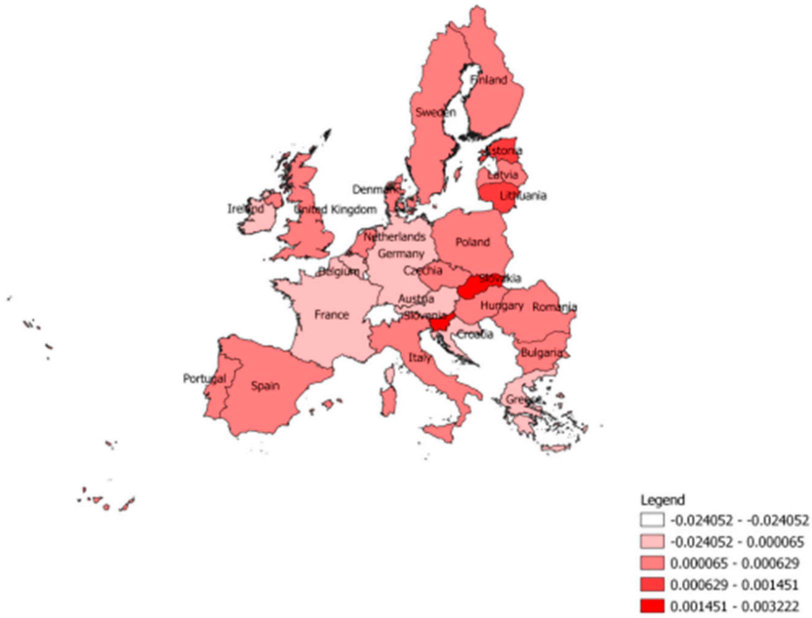


Relative values weighted by total area of each country (1000 ha)

Figure 10. Average employed persons in forestry and logging growth rates (%) from 2012–2017 across European Union countries.



Absolute values



Relative values weighted by total area of each country (1000 ha)

Figure 11. Average output of forestry and connected secondary activities growth rates (%) from 2012–2017 across European Union countries.

Forests have an important role in storing carbon aboveground and in soil, and thus play an important role in combatting climate change. This interaction is nevertheless complex since climate change and, in particular, extreme events, may jeopardize the capacity of soils to store carbon and other nutrients [109]. This could be a result of a higher prevalence of wildfires throughout Europe. In this context, it is relevant to improve forest management practices and to identify countries where efforts to stimulate carbon sinks via forests will bear the highest impacts.

This paper highlights countries where investment in proper forest management could have a more profound impact on climate change dynamics. Nevertheless, forests also deliver and provide value and green employment if the forest is to be fully sustainable.

Spain and France belong to the group of countries with an abundance of forest land. However, when this land is weighted against the total area of the respective country, two sub-groups with higher percentages of forest are evident: the Scandinavian and Mediterranean countries. In addition, a small country, Slovenia, has a limited forest area yet presents one of the highest percentages of forest land uses (placed between the Alps and the Mediterranean). In fact, Sweden, Finland, Estonia, Latvia, Austria, and Slovenia are the European Union countries with the highest ratios (Figure 5). These are the countries where measures should be taken to protect forests against catastrophic natural or man-induced events, especially considering the relative relevance of forest land for these countries. The average growth rates (%) over the period considered were higher in countries such as Ireland, the United Kingdom, and Denmark, where the increase represents an increase in scarce forest land; whereas, for Estonia, Romania, France and Italy, forests already cover a wide territory, which represents a strong commitment to expand forest even further (Figure 9). Thus, we contend that for wet Mediterranean countries, such as Portugal and Spain, forest fires play an important role in hampering the growth of forest areas, since part of the afforestation effort is made to recover derelict areas as a result of forest fires. We would like to stress the interesting weight of forest land in countries such as Estonia with growth dynamics (Figure 9). This highlights the many potential opportunities that should be explored by the relevant stakeholders.

When the employed persons in forestry and logging are analyzed, data shows that Sweden, Germany, Poland, Romania, and Italy are the countries where forests makes the greatest contribution to employment. However, when these employed persons are weighted by the area of the respective country (Figure 6), the relative social importance of the forest sector is higher in Latvia, Czechia, Slovakia, Austria, Slovenia, and Croatia. In turn, the growth rates are higher in Ireland, Portugal, Germany, Slovakia, and Slovenia (Figure 10). This reflects an increasing in investment and in green jobs in a mixture of all types of countries, from those who have little forest to those with a well-established and significant part of their territory under forest. Further research is needed to understand the dynamics of job creation in each country, especially if we are to promote green jobs related with forests throughout Europe. This is nevertheless good news for countries such as Portugal, where more forest-related employment is important to create additional dynamics and to deal with forest fire damage.

The net emissions/removal of CO_2eq (emissions by sources minus removals by sinks) from forest land is limited in some Mediterranean countries where the forest is important (mainly in Portugal or Greece but also in Italy and Spain). This is similar in countries with limited forest, i.e., Ireland, the United Kingdom, Czech Republic, Denmark, and the Netherlands. This is the result of forest fires, which are responsible for enormous quantities of carbon and other pollutants seeping into the atmosphere [109] (Figure 7). This witnesses a positive feedback expected to reinforce climate change impacts.

The output from forest-related activities is higher in countries such as France, Germany, and Sweden, as they have the capacity to economically explore their forest land. Nonetheless, when the forest output is weighted by the total area (Figure 8), higher values are shown in Germany and neighbor countries (i.e., Czech Republic, Slovakia, Austria, and Slovenia). Regarding forestry output growth rates, higher values occur in Spain, the United Kingdom, Sweden, Estonia, Lithuania, Poland, Slovakia, and Romania. When these growth rates are weighed by the total area of the countries, the higher values are limited to Estonia, Lithuania, Slovakia, and Slovenia (Figure 11). Estonia appears to have a great potential of development for the forest sector; however, forest land growth has greater economic impacts than social ones.

We have to stress the good forest management performance for all sustainability-related dimensions in countries such as Sweden and Slovenia when we used relative values weighed by the total area of each country. In turn, some weaknesses can be found for countries such as Spain (considering its total forest land). Nonetheless, there are signs of improving the economic dynamics, especially considering the growth rates for the forest output. These economic performances are obtained at environmental costs, considering the levels of net CO_2 emissions. In any case, the database may be better explored in terms of relationships between forest management and sustainability. This is performed in the next subsection through factor analysis to obtain a sustainability index.

Considering the data analysis carried out and the different forest contexts presented in European Union countries, we suggest a common forest policy that utilizes better forest management and better adjusted investment forest policy. This would be particularly useful in countries such as Slovenia, where increases in socioeconomic impacts were not accompanied by increases in forest area.

Forest Sustainability Index

Considering the previously analyzed variables related to the forest dimensions, namely those linked with forest size (area), socioeconomic impact (persons employed and output), and environmental implications (net emissions/removal of CO_2eq), we obtained a forest sustainability index through factor analysis (the only factor obtained with principal-component factors (orthogonal varimax (Kaiser off)), following Stata [110–112] and Torres-Reyna [113] procedures.

This index explained 67% of the total variance (Table 1) in the model. The sustainability index was mainly defined by forest land, employed persons, and output, which highlighted the relevance of the socioeconomic dimensions for forest planning (Table 2). Forest environmental impacts were measured through net emissions/removal CO_2eq and had less relevance for this index, as witnessed by the value for uniqueness (higher than 0.5). The weaker relationship between the environmental dimension and other considered variables is also confirmed in Table 3 for KMO (Kaiser-Meyer-Olkin) results related with the sampling adequacy.

Table 1. Principal-component factors (orthogonal varimax (Kaiser off)).

Factor	Variance	Difference	Proportion	Cumulative
Forest sustainability index	2.687		0.672	0.672

Table 2. Rotated factor loadings and unique variances.

Variable	Sustainability Index	Uniqueness
Forest land	0.829	0.312
Employed persons	0.897	0.195
Net emissions/removal CO_2eq	−0.649	0.580
Output from forest activities	0.880	0.226

Table 3. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy.

Variable	KMO
Forest land	0.727
Employed persons	0.653
Net emissions/removal CO_2eq	0.585
Output from forest activities	0.614
Overall	0.646

This framework revealed that one of the objectives in the relationship between forest management and sustainability should take advantages from forest land dimensions that promote the creation of improved socioeconomic dynamics and performances. Another aim was the design of an adjusted strategy to improve the interlinkages between forest management and climate change, since environmental preservation of forest activity seemed not to have an implicit consequence.

The values obtained for the forest sustainability index for all EU countries are presented in Figure 12, showing an average for the 2012–2017 period. Countries with better correlation between variables were Sweden, Germany, Romania, France, Poland, Finland, Italy, and Spain (the context for this country could be better, considering the level of forest land). These are more sustainable countries, from a socioeconomic perspective (considering the weak correlation of the environmental variable with the other variables in the model). These results are in line with the data described before, presenting a clearer picture about the interrelationships between the various indicators.

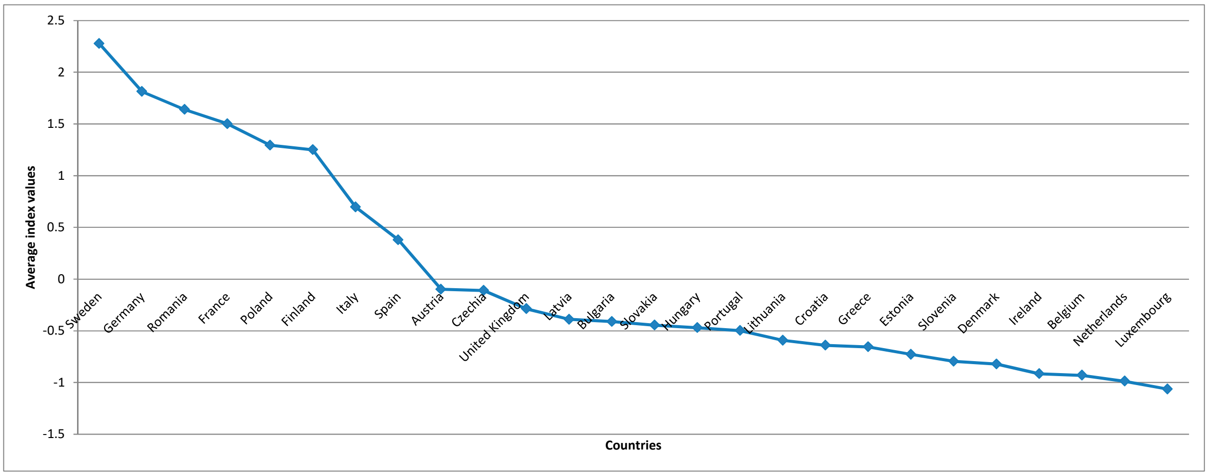


Figure 12. Average forest sustainability index from 2012–2017 across European Union countries.

5. Conclusions

The main objective of this research was to analyze the several dimensions of forest and management topics, which were highlighted in the scientific literature and complemented these insights with the correlations. in a European Union context, between indicators linked with forest sustainability and management (i.e., land, employment, output, and net emissions). We screened and surveyed 91 documents from the Web of Science. The forest indicators were then analyzed through factor analysis to obtain a forest sustainability index.

The literature review highlighted the interrelationships between forest management, soil characteristics, and water quality. We found that forestry activities may contribute to a better soil and water quality, but unsustainable forest management plans may render the forest more vulnerable to biotic and abiotic disturbances. This is expected to have direct and indirect impacts on soil potential. Other dimensions referred to in the literature with implications arising from forest management are those linked with ecology, ecosystem services, biodiversity, climate change, and the role of public policies and institutions. Forests play a determinant role in climate change mitigation. Nevertheless, forests are also impacted by these changes, especially in contexts that seem circular, cumulative, and self-reinforced. Herein, we discerned that public policies were crucial for breaking these vicious cycles and promoting better forest development where socioeconomic dimensions should be compatible with environmental impacts.

The analyzed data highlighted (for absolute values) the performance of countries such as Sweden for indicators related with forest sustainability and management, such as forest land, employment, output, and net CO_2eq emissions. In what concerns the relative values (i.e., variables weighted by the total area of each country), the best performing country was Slovenia. From another perspective, the statistical information showed weaknesses for countries with great forest land areas, as was the case of Spain. In fact, Spain is among the European Union countries with high levels of forest area, but had better performances in the output average growth rates than in the area growth rates or in the expected levels of net emissions. Forest fires play an important role as they have consequences for forest land. Increases in outputs were the result of better performances in productivities at environmental costs.

Factor analysis and the forest sustainability index confirmed this trend and showed a stronger correlation between forest dimension (forest land) and socioeconomic indicators (forest employment and output). The correlation of these variables with climate change impacts (net CO_2eq) was weak. In other words, countries with greater forest areas and forestry outputs did not coincide with those that presented lesser net CO_2eq emissions. There are some motives of concern here, given that the greater and more competitive countries (in terms of forestry) do not take advantages of this context to develop forests with more positive environmental impacts. This relationship thus deserves special attention by its several stakeholders, namely European Union policymakers, national institutions, forest owners, and researchers.

6. Future Research

In accordance with the literature review, future research should analyze the relationships between forest management and soil, water, biodiversity, endangered species, protected areas, and representative ecosystems. These fields involve specific dimensions that deserve deeper research. These are variables outside of forestry, but they are interrelated within forest management and require a different approach that considers diverse interrelationships between sectors and activities where the concept of externalities should be considered. Another relevant aspect that should be addressed is forest management efficiency.

Author Contributions: V.J.P.D.M.: Idea, data collection, writing, discussion. A.J.D.F.: Discussion, revising, English improvement. All authors have read and agreed to the published version of the manuscript.

Funding: This work is funded by National Funds through the FCT—Foundation for Science and Technology, I.P., within the scope of the project Refª UIDB/00681/2020.

Acknowledgments: Furthermore we would like to thank the CERNAS Research Centre and the Polytechnic Institute of Viseu for their support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Pereira Domingues Martinho, V.J. Alternative Productions and Employments in the Portuguese Forest Activities: Highlighting the Dimension of the Sector in the Farms. In Proceedings of the 3rd International Conference on Energy and Environment (ICEE 2017), Porto, Portugal, 29–30 June 2017; Soares, I., Resende, J., Eds.; Faculdade de Economia da Universidade do Porto: Porto, Portugal, 2017; pp. 180–186, ISBN 978-972-95396-9-5.
2. Aird, P. Conservation for the Sustainable Development of Forests Worldwide—A Compendium of Concepts and Terms. *For. Chron.* **1994**, *70*, 666–674. [CrossRef]
3. Martinho, V.J.P.D. Socioeconomic Impacts of Forest Fires upon Portugal: An Analysis for the Agricultural and Forestry Sectors. *Sustainability* **2019**, *11*, 374. [CrossRef]
4. Martinho, V.J.P.D. Estimating Relationships between Forest Fires and Greenhouse Gas Emissions: Circular and Cumulative Effects or Unidirectional Causality? *Environ. Monit. Assess.* **2019**, *191*, 581. [CrossRef] [PubMed]
5. Combalicer, E.A.; Im, S. Change Anomalies of Hydrologic Responses to Climate Variability and Land-Use Changes in the Mt. Makiling Forest Reserve. *J. Environ. Sci. Manag.* **2012**, *15*, 1–13.
6. Basche, A.; DeLonge, M. The Impact of Continuous Living Cover on Soil Hydrologic Properties: A Meta-Analysis. *Soil Sci. Soc. Am. J.* **2017**, *81*, 1179–1190. [CrossRef]
7. Carreiras, M.; Ferreira, A.J.D.; Valente, S.; Fleskens, L.; Gonzales-Pelayo, Ó.; Rubio, J.L.; Stoof, C.R.; Coelho, C.O.A.; Ferreira, C.S.S.; Ritsema, C.J. Comparative Analysis of Policies to Deal with Wildfire Risk. *Land Degrad. Dev.* **2014**, *25*, 92–103. [CrossRef]
8. Mourao, P.R.; Martinho, V.D. Forest Fire Legislation: Reactive or Proactive? *Ecol. Indic.* **2019**, *104*, 137–144. [CrossRef]

9. Shakesby, R.A.; Bento, C.P.M.; Ferreira, C.S.S.; Ferreira, A.J.D.; Stoof, C.R.; Urbanek, E.; Walsh, R.P.D. Impacts of Prescribed Fire on Soil Loss and Soil Quality: An Assessment Based on an Experimentally-Burned Catchment in Central Portugal. *CATENA* **2015**, *128*, 278–293. [CrossRef]
10. Stoof, C.R.; Slingerland, E.C.; Mol, W.; van den Berg, J.; Vermeulen, P.J.; Ferreira, A.J.D.; Ritsema, C.J.; Parlange, J.-Y.; Steenhuis, T.S. Preferential Flow as a Potential Mechanism for Fire-Induced Increase in Streamflow. *Water Resour. Res.* **2014**, *50*, 1840–1845. [CrossRef]
11. Web of Science Web of Science (All Databases). Available online: https://apps.webofknowledge.com/UA_GeneralSearch_input.do?product=UA&SID=F5KHO5pPj7wHQ4fDadf&search_mode=GeneralSearch (accessed on 13 September 2020).
12. Türkeli, S.; Kemp, R.; Huang, B.; Bleischwitz, R.; McDowall, W. Circular Economy Scientific Knowledge in the European Union and China: A Bibliometric, Network and Survey Analysis (2006–2016). *J. Clean. Prod.* **2018**, *197*, 1244–1261. [CrossRef]
13. Chiteculo, V.; Surovy, P. Dynamic Patterns of Trees Species in Miombo Forest and Management Perspectives for Sustainable ProductionCase Study in Huambo Province, Angola. *Forests* **2018**, *9*, 321. [CrossRef]
14. Migliavacca, M.; Reichstein, M.; Richardson, A.D.; Colombo, R.; Sutton, M.A.; Lasslop, G.; Tomelleri, E.; Wohlfahrt, G.; Carvalhais, N.; Cescatti, A.; et al. Semiempirical Modeling of Abiotic and Biotic Factors Controlling Ecosystem Respiration across Eddy Covariance Sites. *Glob. Chang. Biol.* **2011**, *17*, 390–409. [CrossRef]
15. Brunet, J. Environmental and Historical Factors Limiting the Distribution of Rare Forest Grasses in South Sweden. *For. Ecol. Manag.* **1993**, *61*, 263–275. [CrossRef]
16. Nair, K.M.; Kumar, K.S.A.; Lalitha, M.; Shivanand; Kumar, S.C.R.; Srinivas, S.; Koyal, A.; Parvathy, S.; Sujatha, K.; Thamban, C.; et al. Surface Soil and Subsoil Acidity in Natural and Managed Land-Use Systems in the Humid Tropics of Peninsular India. *Curr. Sci.* **2019**, *116*, 1201–1211. [CrossRef]
17. Toky, O.P.; Srinivasu, V. Response of Sodium Bicarbonate Sodicity on Survival, Seedling Growth and Plant Nutrients of Four Multipurpose Arid Trees. *Ann. Arid Zone* **1995**, *34*, 115–120.
18. Abella, S.R.; Hodel, J.L.; Schetter, T.A. Unusually High-Quality Soil Seed Banks in a Midwestern US Oak Savanna Region: Variation with Land Use History, Habitat Restoration, and Soil Properties. *Restor. Ecol.* **2020**. [CrossRef]
19. Islam, M.; Salim, S.H.; Kawsar, M.H.; Rahman, M. The Effect of Soil Moisture Content and Forest Canopy Openness on the Regeneration of Dipterocarpus Turbinatus CF Gaertn. (Dipterocarpaceae) in a Protected Forest Area of Bangladesh. *Trop. Ecol.* **2016**, *57*, 455–464.
20. Mitrovic, M.; Jaric, S.; Djurdjevic, L.; Karadzic, B.; Gajic, G.; Kostic, O.; Oberan, L.J.; Pavlovic, D.; Pavlovic, M.; Pavlovic, P. Allelopathic and Environmental Implications of Plant Phenolic Compounds. *Allelopath. J.* **2012**, *29*, 177–197.
21. Anic, I.; Mikac, S.; Orsanic, M.; Drvodelic, D. Structural Relations between Virgin and Management Beech-Fir Stands (Omphalodo-Fagetum Marincek et al. 1992) in Forests of the Croatian Dinaric Karst. *Period. Biol.* **2006**, *108*, 663–669.
22. De Andrade, N.L.R.; Sanches, L.; Pinto Júnior, O.B.; Dias, C.A.A.; Nogueira, J.d.S. Macro-Nutrientes No Lençol Freático Em Floresta Intacta, Floresta de Manejo e Pastagem No Norte de Mato Grosso. *Acta Amaz.* **2008**, *38*, 667–671. [CrossRef]
23. Sharma, G.; Pandey, R.R.; Singh, M.S. Microfungi Associated with Surface Soil and Decaying Leaf Litter of Quercus Serrata in a Subtropical Natural Oak Forest and Managed Plantation in Northeastern India. *Afr. J. Microbiol. Res.* **2011**, *5*, 777–787.
24. Panassiti, B.; Hartig, F.; Fahrentrapp, J.; Breuer, M.; Biedermann, R. Identifying Local Drivers of a Vector-Pathogen-Disease System Using Bayesian Modeling. *Basic Appl. Ecol.* **2017**, *18*, 75–85. [CrossRef]
25. Rytter, R.-M.; Rytter, L. Effects on Soil Characteristics by Different Management Regimes with Root Sucker Generated Hybrid Aspen (Populus Tremula L. x P. Tremuloides Michx.) on Abandoned Agricultural Land. *Ifor. Biogeosci. For.* **2018**, *11*, 619–627. [CrossRef]
26. Tiwari, K.R.; Sitaula, B.K.; Bajracharya, R.M.; Borresen, T. Runoff and Soil Loss Responses to Rainfall, Land Use, Terracing and Management Practices in the Middle Mountains of Nepal. *Acta Agric. Scand. Sect. B-Soil Plant. Sci.* **2009**, *59*, 197–207. [CrossRef]
27. Baumann, K.; Schoening, I.; Schrumpf, M.; Ellerbrock, R.H.; Leinweber, P. Rapid Assessment of Soil Organic Matter: Soil Color Analysis and Fourier Transform Infrared Spectroscopy. *Geoderma* **2016**, *278*, 49–57. [CrossRef]
28. Eleftheriadis, A.; Lafuente, F.; Turrion, M.-B. Effect of Land Use, Time since Deforestation and Management on Organic C and N in Soil Textural Fractions. *Soil Tillage Res.* **2018**, *183*, 1–7. [CrossRef]
29. Kierulff, M.C.M.; DeOliveira, P.P. Re-Assessing the Status and Conservation of the Golden Lion Tamarin Leontopithecus Rosalia in the Wild. *Dodo-J. Wildl. Preserv. Trust.* **1996**, *32*, 98–115.
30. Wedjangnon, A.A.; Kuiga, N.B.S.; Houetchegnon, T.; Ouinsavi, C.A.I.N. Spatial Distribution and Interspecific Association Patterns between Mansonia Altissima A. Chev., Ceiba Pentandra (L.) Gaertn and Triplochiton Scleroxylon K. Schum. in a Moist Semi-Deciduous Forest. *Ann. For. Sci.* **2020**, *77*, 6. [CrossRef]
31. Jandl, R.; Lindner, M.; Vesterdal, L.; Bauwens, B.; Baritz, R.; Hagedorn, F.; Johnson, D.W.; Minkkinen, K.; Byrne, K.A. How Strongly Can Forest Management Influence Soil Carbon Sequestration? *Geoderma* **2007**, *137*, 253–268. [CrossRef]
32. Antinori, C.; Rausser, G.C. Ownership and Control in Mexico's Community Forestry Sector. *Econ. Dev. Cult. Chang.* **2008**, *57*, 101–136. [CrossRef]
33. Simanonok, M.P.; Anderson, C.B.; Martinez Pastur, G.; Vanessa Lencinas, M.; Kennedy, J.H. A Comparison of Impacts from Silviculture Practices and North American Beaver Invasion on Stream Benthic Macroinvertebrate Community Structure and Function in Nothofagus Forests of Tierra Del Fuego. *For. Ecol. Manag.* **2011**, *262*, 263–269. [CrossRef]

34. Gillingham, K.T.; Smith, S.J.; Sands, R.D. Impact of Bioenergy Crops in a Carbon Dioxide Constrained World: An Application of the MiniCAM Energy-Agriculture and Land Use Model. *Mitig. Adapt. Strateg. Glob. Chang.* **2008**, *13*, 675–701. [CrossRef]
35. Harrison, P.A.; Dunford, R.; Savin, C.; Rounsevell, M.D.A.; Holman, I.P.; Kebede, A.S.; Stuch, B. Cross-Sectoral Impacts of Climate Change and Socio-Economic Change for Multiple, European Land- and Water-Based Sectors. *Clim. Chang.* **2015**, *128*, 279–292. [CrossRef]
36. Arabatzis, G.; Malesios, C.H. An Econometric Analysis of Residential Consumption of Fuelwood in a Mountainous Prefecture of Northern Greece. *Energy Policy* **2011**, *39*, 8088–8097. [CrossRef]
37. Karasmanaki, E.; Tsantopoulos, G. Exploring Future Scientists' Awareness about and Attitudes towards Renewable Energy Sources. *Energy Policy* **2019**, *131*, 111–119. [CrossRef]
38. Arabatzis, G.; Malesios, C. Pro-Environmental Attitudes of Users and Non-Users of Fuelwood in a Rural Area of Greece. *Renew. Sustain. Energy Rev.* **2013**, *22*, 621–630. [CrossRef]
39. Lee, S.D.; Kang, H.K. Ecological Planning and Mitigation of Deterioration Technique for Plan of Mountainous Experience Theme Park. *J. Korea Soc. Environ. Restor. Technol.* **2009**, *12*, 142–163.
40. Kolovos, K.G.; Kyriakopoulos, G.; Chalikias, M.S. Co-Evaluation of Basic Woodfuel Types Used as Alternative Heating Sources to Existing Energy Network. *J. Environ. Prot. Ecol.* **2011**, *12*, 733–742.
41. Da Silva, M.L.; da Silva, R.F. Aplicação Da Programação Dinâmica Na Substituição de Povoamentos Florestais. *Rev. Árvore* **2007**, *31*, 1063–1072. [CrossRef]
42. Ovando, P.; Oviedo, J.L.; Campos, P. Measuring Total Social Income of a Stone Pine Afforestation in Huelva (Spain). *Land Use Policy* **2016**, *50*, 479–489. [CrossRef]
43. Oyono, P.R. Local Players, Representations and "Politics" of Eco-Power in Rural Cameroon since 1994. *Can. J. Dev. Stud. Rev. Can. D Etudes Dev.* **2006**, *27*, 163–185. [CrossRef]
44. Berthelot, Y. The International Financial Architecture—Plans for Reform. *Int. Soc. Sci. J.* **2001**, *53*, 585–596. [CrossRef]
45. Aleman, J.C.; Blarquez, O.; Bentaleb, I.; Bonte, P.; Brossier, B.; Carcaillet, C.; Gond, V.; Gourlet-Fleury, S.; Kpolita, A.; Lefevre, I.; et al. Tracking Land-Cover Changes with Sedimentary Charcoal in the Afrotropics. *Holocene* **2013**, *23*, 1853–1862. [CrossRef]
46. Karavani, A.; Boer, M.M.; Baudena, M.; Colinas, C.; Diaz-Sierra, R.; Peman, J.; de Luis, M.; Enriquez-de-Salamanca, A.; Resco de Dios, V. Fire-Induced Deforestation in Drought-Prone Mediterranean Forests: Drivers and Unknowns from Leaves to Communities. *Ecol. Monogr.* **2018**, *88*, 141–169. [CrossRef]
47. Bjornlund, L.; Vestergard, M.; Johansson, S.; Nyborg, M.; Steffensen, L.; Christensen, S. Nematode Communities of Natural and Managed Beech Forests—A Pilot Survey. *Pedobiologia* **2002**, *46*, 53–62. [CrossRef]
48. Frigeri, E.; Cassano, C.R.; Pardini, R. Domestic Dog Invasion in an Agroforestry Mosaic in Southern Bahia, Brazil. *Trop. Conserv. Sci.* **2014**, *7*, 508–528. [CrossRef]
49. Andersson, J.; Gomez, E.D.; Michon, S.; Roberge, J.-M. Tree Cavity Densities and Characteristics in Managed and Unmanaged Swedish Boreal Forest. *Scand. J. For. Res.* **2018**, *33*, 233–244. [CrossRef]
50. Cirule, D.; Krama, T.; Krams, R.; Elferts, D.; Kaasik, A.; Rantala, M.J.; Mierauskas, P.; Luoto, S.; Krams, I.A. Habitat Quality Affects Stress Responses and Survival in a Bird Wintering under Extremely Low Ambient Temperatures. *Sci. Nat.* **2017**, *104*, 99. [CrossRef]
51. De Oliveira, F.P.; Fernandes Filho, E.I.; Soares, V.P.; de Souza, A.L. Mapping of Forest Fragments with Mono-Dominance of Aroeira by Supervised Classification of Rapideye Images. *Rev. Arvore* **2013**, *37*, 151–161. [CrossRef]
52. Boelter, C.R.; Zartman, C.E.; Fonseca, C.R. Exotic Tree Monocultures Play a Limited Role in the Conservation of Atlantic Forest Epiphytes. *Biodivers. Conserv.* **2011**, *20*, 1255–1272. [CrossRef]
53. Boza, M. Conservation in Action—Past, Present, and Future of the National-Park System of Costa-Rica. *Conserv. Biol.* **1993**, *7*, 239–247. [CrossRef]
54. Brooks, E.W.; Bonter, D.N. Long-Term Changes in Avian Community Structure in a Successional, Forested, and Managed Plot in a Reforesting Landscape. *Wilson J. Ornithol.* **2010**, *122*, 288–295. [CrossRef]
55. Davis, J.B.; Vilella, F.J.; Lancaster, J.D.; Lopez-Flores, M.; Kaminski, R.M.; Cruz-Burgos, J.A. White-Cheeked Pintail Duckling and Brood Survival across Wetland Types at Humacao Nature Reserve, Puerto Rico. *Condor* **2017**, *119*, 308–320. [CrossRef]
56. Hasoba, A.M.M.; Siddig, A.A.H.; Yagoub, Y.E. Exploring Tree Diversity and Stand Structure of Savanna Woodlands in Southeastern Sudan. *J. Arid Land* **2020**. [CrossRef]
57. Lee, T.-S.; Lee, K.-J.; Choi, B.-U.; Park, S.-C. Planting Managements for Improvement of Species Diversity in Recreational Forest—A Case Study of Chukryongsan Recreational Forest, Gyeonggi-Do. *Korean J. Environ. Ecol.* **2010**, *24*, 351–362.
58. Maeshiro, R.; Kusumoto, B.; Fujii, S.; Shiono, T.; Kubota, Y. Using Tree Functional Diversity to Evaluate Management Impacts in a Subtropical Forest. *Ecosphere* **2013**, *4*, 70. [CrossRef]
59. Morissette, J.L.; Kardynal, K.J.; Bayne, E.M.; Hobson, K.A. Are Boreal Riparian Bird Communities Unique? Contrasting Riparian and Upland Bird Assemblages in the Boreal Plain of Western Canada. *Wetlands* **2018**, *38*, 1299–1311. [CrossRef]
60. Rasmussen, C. Diversity and Abundance of Orchid Bees (Hymenoptera: Apidae, Euglossini) in a Tropical Rainforest Succession. *Neotrop. Entomol.* **2009**, *38*, 66–73. [CrossRef]
61. Potts, S.G.; Petanidou, T.; Roberts, S.; O'Toole, C.; Hulbert, A.; Willmer, P. Plant-Pollinator Biodiversity and Pollination Services in a Complex Mediterranean Landscape. *Biol. Conserv.* **2006**, *129*, 519–529. [CrossRef]

62. Vaisanen, R.; Bistrom, O.; Heliovaara, K. Subcortical Coleoptera in Dead Pines and Spruces—Is Primeval Species Composition Maintained in Managed Forests. *Biodivers. Conserv.* **1993**, *2*, 95–113. [CrossRef]
63. Requier, F.; Paillet, Y.; Laroche, F.; Rutschmann, B.; Zhang, J.; Lombardi, F.; Svoboda, M.; Steffan-Dewenter, I. Contribution of European Forests to Safeguard Wild Honeybee Populations. *Conserv. Lett.* **2020**, *13*, e12693. [CrossRef]
64. Tadesse, G.; Zavaleta, E.; Shennan, C.; FitzSimmons, M. Prospects for Forest-Based Ecosystem Services in Forest-Coffee Mosaics as Forest Loss Continues in Southwestern Ethiopia. *Appl. Geogr.* **2014**, *50*, 144–151. [CrossRef]
65. Vanessa Lencinas, M.; Sola, F.J.; Manuel Cellini, J.; Peri, P.L.; Martinez Pastur, G. Land Sharing in South Patagonia: Conservation of above-Ground Beetle Diversity in Forests and Non-Forest Ecosystems. *Sci. Total Environ.* **2019**, *690*, 132–139. [CrossRef]
66. Wermelinger, B.; Flueckiger, P.F.; Obrist, M.K.; Duelli, P. Horizontal and Vertical Distribution of Saproxylic Beetles (Col., Buprestidae, Cerambycidae, Scolytinae) across Sections of Forest Edges. *J. Appl. Entomol.* **2007**, *131*, 104–114. [CrossRef]
67. Ylisirnio, A.-L.; Penttila, R.; Berglund, H.; Hallikainen, V.; Isaeva, L.; Kauhanen, H.; Koivula, M.; Mikkola, K. Dead Wood and Polypore Diversity in Natural Post-Fire Succession Forests and Managed Stands—Lessons for Biodiversity Management in Boreal Forests. *For. Ecol. Manag.* **2012**, *286*, 16–27. [CrossRef]
68. Arnett, E.B.; Kroll, A.J.; Duke, S.D. Avian Foraging and Nesting Use of Created Snags in Intensively-Managed Forests of Western Oregon, USA. *For. Ecol. Manag.* **2010**, *260*, 1773–1779. [CrossRef]
69. Gardner-Gee, R.; Stanley, M.C.; Beggs, J.R. Re-Forestation Restores Native Dominance in an Island Beetle Fauna. *Restor. Ecol.* **2015**, *23*, 268–276. [CrossRef]
70. Mesa, L.; Galeano, G. Palms Uses in the Colombian Amazon. *Caldasia* **2013**, *35*, 351–369.
71. McGrady, P.; Cottrell, S.; Clement, J.; Cottrell, J.R.; Czaja, M. Local Perceptions of MPB Infestation, Forest Management, and Connection to National Forests in Colorado and Wyoming. *Hum. Ecol.* **2016**, *44*, 185–196. [CrossRef]
72. Dombroski, J.L.D.; Praxedes, S.C.; de Freitas, R.M.O.; Pontes, F.M. Water Relations of Caatinga Trees in the Dry Season. *S. Afr. J. Bot.* **2011**, *77*, 430–434. [CrossRef]
73. Assefa, E.; Hans-Rudolf, B. Indigenous Resource Management Practices in the Gamo Highland of Ethiopia: Challenges and Prospects for Sustainable Resource Management. *Sustain. Sci.* **2017**, *12*, 695–709. [CrossRef]
74. Morris, H.L.C.; Megalos, M.A.; Hubbard, W.G.; Boby, L.A. Climate Change Attitudes of Southern Forestry Professionals: Outreach Implications. *J. For.* **2016**, *114*, 532–540. [CrossRef]
75. Singh, S. Governing Anti-Conservation Sentiments: Forest Politics in Laos. *Hum. Ecol.* **2009**, *37*, 749–760. [CrossRef]
76. Gordon, J.S.; Barton, A.W. Stakeholder Attitudes Toward Reforestation and Management of Bottom Land Hardwood Forests in the Mississippi Delta. *J. For.* **2015**, *113*, 308–314. [CrossRef]
77. Manuschevich, D.; Takahashi, B.; Ramirez-Pascualli, C.A.; Nieves-Pizarro, Y. Of Catholicism, Forest and Management: An Analysis of Imaginaries in the Discussion of the Native Forest Law in Chile. *Environ. Commun.* **2019**, *13*, 165–178. [CrossRef]
78. Park, K.; Lee, S.; Park, S. A Study on the North Korea's Change of Forest Policy since the Economic Crisis in 1990's. *Korean J. Unification Aff.* **2009**, *21*, 459–492.
79. Sears, R.R.; Padoch, C.; Pinedo-Vasquez, M. Amazon Forestry Tranformed: Integrating Knowledge for Smallholder Timber Managemet in Eastern Brazil. *Hum. Ecol.* **2007**, *35*, 697–707. [CrossRef]
80. Carbonari, D.E.; Grosjean, G.; Laderach, P.; Nghia, T.D.; Sander, B.O.; McKinley, J.; Sebastian, L.; Tapasco, J. Reviewing Vietnam's Nationally Determined Contribution: A New Perspective Using the Marginal Cost of Abatement. *Front. Sustain. Food Syst.* **2019**, *3*, 14. [CrossRef]
81. Greenwood, A.J.B. The First Stages of Australian Forest Water Regulation: National Reform and Regional Implementation. *Environ. Sci. Policy* **2013**, *29*, 124–136. [CrossRef]
82. Kouadio, B.Y.; Dawson, J.O.; Mendoza, G.A. Deforestation and Managerial Scales in Cote d'Ivoire. *J. Sustain. For.* **2016**, *35*, 397–416. [CrossRef]
83. Schoonover, J.E.; Lockaby, B.G.; Shaw, J.N. Channel Morphology and Sediment Origin in Streams Draining the Georgia Piedmont. *J. Hydrol.* **2007**, *342*, 110–123. [CrossRef]
84. Peng, C.J.; Qian, J.W.; Guo, X.D.; Zhao, H.W.; Hu, N.X.; Yang, Q.; Chen, C.P.; Chen, L.Z. Vegetation Carbon Stocks and Net Primary Productivity of the Mangrove Forests in Shenzhen, China. *Ying Yong Sheng Tai Xue Bao J. Appl. Ecol.* **2016**, *27*, 2059–2065. [CrossRef]
85. Castro-Nunez, A.; Mertz, O.; Quintero, M. Propensity of Farmers to Conserve Forest within REDD plus Projects in Areas Affected by Armed-Conflict. *For. Policy Econ.* **2016**, *66*, 22–30. [CrossRef]
86. Chi, J.; Nilsson, M.B.; Laudon, H.; Lindroth, A.; Wallerman, J.; Fransson, J.E.S.; Kljun, N.; Lundmark, T.; Lofvenius, M.O.; Peichl, M. The Net Landscape Carbon Balance-Integrating Terrestrial and Aquatic Carbon Fluxes in a Managed Boreal Forest Landscape in Sweden. *Glob. Chang. Biol.* **2020**. [CrossRef] [PubMed]
87. Watham, T.; Kushwaha, S.P.S.; Patel, N.R.; Dadhwal, V.K.; Kumar, A.S. Ecosystem Productivity and Its Response to Environmental Variable of Moist Indian Sal Forest. *Trop. Ecol.* **2017**, *58*, 761–768.
88. Wang, T.; Ciais, P.; Piao, S.L.; Ottle, C.; Brender, P.; Maignan, F.; Arain, A.; Cescatti, A.; Gianelle, D.; Gough, C.; et al. Controls on Winter Ecosystem Respiration in Temperate and Boreal Ecosystems. *Biogeosciences* **2011**, *8*, 2009–2025. [CrossRef]
89. Liu, Y.; Guo, M. Environmental Load Analysis of Forestation and Management Process of Larix Olgensis Plantation by Life Cycle Analysis. *J. Clean. Prod.* **2017**, *142*, 2463–2470. [CrossRef]

90. Malatinec, T.; Marisova, E.; Gresova, L. EU Vision of Sustainable Agriculture, Land Use, Forestry and Management of Natural Resources—Level of the Slovak State Administration Convergence to the EU Requirements. *Int. J. Sustain. Dev. World Ecol.* **2016**, *23*, 257–265. [CrossRef]
91. Manuschevich, D.; Beier, C.M. Simulating Land Use Changes under Alternative Policy Scenarios for Conservation of Native Forests in South-Central Chile. *Land Use Policy* **2016**, *51*, 350–362. [CrossRef]
92. Min, K.; Choi, J. Forest Management Status and Perception of Medium or Large Scale Forestry Owners in Korea. *Korean J. For. Econ.* **2018**, *25*, 39–53. [CrossRef]
93. Brondizio, E.; Moran, E.; Mausel, P.; Wu, Y. Land-Use Change in the Amazon Estuary—Patterns of Caboclo Settlement and Landscape Management. *Hum. Ecol.* **1994**, *22*, 249–278. [CrossRef]
94. Douglass, K.; Walz, J.; Morales, E.Q.; Marcus, R.; Myers, G.; Pollini, J. Historical Perspectives on Contemporary Human-Environment Dynamics in Southeast Africa. *Conserv. Biol.* **2019**, *33*, 260–274. [CrossRef]
95. Dunlap, J.M.; Stettler, R.F. Genetic Variation and Productivity of Populus Trichocarpa and Its Hybrids.9. Phenology and Melampsora Rust Incidence of Native Black Cottonwood Clones from Four River Valleys in Washington. *For. Ecol. Manag.* **1996**, *87*, 233–256. [CrossRef]
96. Rodriguez-Morales, J.; Guillen, S.; Casas, A. Consequences of Domestication of Stenocereus Stellatus in Seed Size and Germination in a Water Stress Gradient. *Bot. Sci.* **2013**, *91*, 485–492.
97. Gadgil, M. India Deforestation—Patterns and Processes. *Soc. Nat. Resour.* **1990**, *3*, 131–143. [CrossRef]
98. Istvan, Z. 145 Year of Forestry in Podravina. *Sumar. List* **2020**, *144*, 65–74. [CrossRef]
99. Pandey, R.R.; Sharma, G.; Tripathi, S.K.; Singh, A.K. Litterfall, Litter Decomposition and Nutrient Dynamics in a Subtropical Natural Oak Forest and Managed Plantation in Northeastern India. *For. Ecol. Manag.* **2007**, *240*, 96–104. [CrossRef]
100. Schmitt-Harsh, M. Landscape Change in Guatemala: Driving Forces of Forest and Coffee Agroforest Expansion and Contraction from 1990 to 2010. *Appl. Geogr.* **2013**, *40*, 40–50. [CrossRef]
101. Fagan, M.E.; Morton, D.C.; Cook, B.D.; Masek, J.; Zhao, F.; Nelson, R.F.; Huang, C. Mapping Pine Plantations in the Southeastern US Using Structural, Spectral, and Temporal Remote Sensing Data. *Remote Sens. Environ.* **2018**, *216*, 415–426. [CrossRef]
102. Moran, E.; Brondizio, E.; Mausel, P. Secondary Succession. *Res. Explor.* **1994**, *10*, 458–476.
103. Da Silva, L.C.; Cunha, J.M.; Machado, N.G.; Campos, M.C.C.; Biudes, M.S. Estimativa Do Balanço de Radiação Por Sensoriamento Remoto de Diferentes Usos de Solo No Sudoeste Da Amazônia Brasileira. *Soc. Nat.* **2016**, *28*, 131–146. [CrossRef]
104. Peltoniemi, M.; Makipaa, R. Quantifying Distance-Independent Tree Competition for Predicting Norway Spruce Mortality in Unmanaged Forests. *For. Ecol. Manag.* **2011**, *261*, 30–42. [CrossRef]
105. Stankuniene, G.; Streimikiene, D.; Kyriakopoulos, G.L. Systematic Literature Review on Behavioral Barriers of Climate Change Mitigation in Households. *Sustainability* **2020**, *12*, 7369. [CrossRef]
106. QGIS.org. *QGIS Geographic Information System. QGIS Association*. 2020. Available online: http://www.qgis.org. (accessed on 9 October 2020).
107. Eurostat Eurostat (Several Statistics and Information). Available online: https://ec.europa.eu/eurostat/home? (accessed on 9 October 2020).
108. FAOSTAT FAOSTAT (Several Statistics). Available online: http://www.fao.org/faostat/en/#home (accessed on 9 October 2020).
109. Ferreira, C.S.S.; Pereira, P.; Kalantari, Z. Human Impacts on Soil. *Sci. Total Environ.* **2018**, *644*, 830–834. [CrossRef] [PubMed]
110. Stata Stata: Software for Statistics and Data Science. Available online: https://www.stata.com/ (accessed on 9 October 2020).
111. StataCorp. *Stata 15 Base Reference Manual*; Stata Press: College Station, TX, USA, 2017.
112. StataCorp. *Stata Statistical Software: Release 15*; StataCorp LLC: College Station, TX, USA, 2017.
113. Torres-Reyna, O. Getting Started in Factor Analysis (Using Stata 10) (Ver. 1.5). Available online: http://www.princeton.edu/~{}otorres/Factor.pdf (accessed on 9 October 2020).