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Bibliometric Analysis of Silvopasture Systems: Integrating Trees, Livestock, and Crops

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ABSTRACT

Silvopasture systems, which integrate trees, livestock, and crops, are gaining recognition for their ecological and socioeconomic benefits. This bibliometric study examines the progression of silvopasture research, emphasizing key contributors, major thematic areas, and its alignment with the United Nations Sustainable Development Goals (SDGs). The three primary questions it aims to address are: how silvopasture research has evolved in terms of publication trends and key contributors; which thematic areas are most prevalent in the field and how they relate to SDGs, especially those that deal with poverty alleviation, food security, climate action, and biodiversity conservation; and what ecological and socioeconomic impacts are most commonly seen. Data for this research were drawn from Scopus, spanning the years 2013 to 2023. Citation networks, co-authorship relationships, and keyword co-occurrence were analyzed using VOSviewer software to provide a clear depiction of research patterns and collaborative frameworks. The analysis identified influential researchers like Bruno C. Pedreira and Dalton H. Pereira, who have significantly contributed to advancing silvopasture studies. The study identified many important topic clusters, including as carbon sequestration, pasture management, agronomic practices, and biodiversity conservation. The potential of silvopasture to address important global concerns in sustainable agriculture is highlighted by these themes, which are well aligned with SDGs 1, 2, 12, 13, and 15. The relevance of silvopasture in promoting sustainable development is highlighted by its ecological and economic advantages, which include improved soil health, increased biodiversity, and increased resistance to climatic variability. The study highlights the need for more research to fully comprehend these benefits and how they affect rural development.

Keywords: Silvopasture; Sustainable Agriculture; Sustainable Development Goals (SDGs); Ecological Impacts; Socioeconomic Benefits

INTRODUCTION

Bibliometric analysis (BA) is a useful method for methodically reviewing advancements in the field of silvopasture. According to Torres et al. (2023), this approach aids in locating prominent researchers, important networks of collaboration, and evaluating the caliber of academic institutions and peer reviewers. However, previous reviews lack comprehensive bibliometric mapping, leaving gaps this study addresses.

This review analyzes the research landscape of silvopasture, emphasizing its alignment with global sustainability goals. By highlighting ecological and socioeconomic impacts, this study aims to provide insights for policymakers, researchers, and practitioners to optimize silvopasture practices.

BA has grown in popularity as a method for assessing scientific material in recent years. Its efficacy in identifying patterns in publications, journals, cooperation networks, and other research components is highlighted by Donthu et al. (2021). By using bibliometric tools, researchers may map institutional and worldwide partnerships, identify relevant articles, evaluate crucial keywords, and obtain a greater understanding of the intellectual landscape of certain themes. Furthermore, Ellegaard and Wallin (2015) point out that by quantifying and visualizing scholarly contributions, BA is essential to comprehending academic research processes.

According to Chen (2017), scientific mapping is important because it is a useful technique for illustrating knowledge domains and improving our comprehension of how research has changed over time. Velastegui-Montoya et al. (2022) demonstrated a useful use of bibliometric analysis in their study of worldwide research trends in tropical forest land use and cover, revealing significant regional and thematic patterns. Similarly, Huang et al. (2020) used bibliometric techniques to investigate developments in forest carbon sequestration, pinpointing important areas of interest and networks of cooperation. These examples demonstrate the usefulness of bibliometric analysis in a variety of study domains.

Since this bibliometric study is essential to the advancement of many Sustainable Development Goals (SDGs) of the UN, its significance goes well beyond academics. Integrating trees, forage crops, and livestock, silvopastoral systems support sustainable food production under SDG 2 (Zero Hunger), mitigate the effects of climate change through carbon sequestration under SDG 13 (Climate Action), and promote biodiversity conservation, sustainable land management, and soil restoration under SDG 15 (Life on Land). Additionally, silvopasture supports rural livelihoods and improves resource efficiency, which is in line with SDGs 12 (Responsible Consumption and Production) and 1 (No Poverty).

Silvopastures, a specialized type of agroforestry, offer sustainable strategies to address the rising demand for food, fuel, and fiber while reducing the environmental footprint of agriculture, particularly under the pressures of climate change. The ecological advantages of silvopasture systems are well-established, including enhanced soil and water quality, increased carbon sequestration, moderated microclimates, and greater biodiversity (Sharrow et al., 2009; Belsky et al., 1993; Schroth, 1995; Jackson et al., 2000; Haile et al., 2008; Bambo et al., 2009; Boyer and Neel, 2010; Ramakrishnan et al., 2021; Poudel et al., 2022; Karki and Goodman, 2013).

By combining trees, forage, and livestock, silvopastures create a comprehensive system that effectively balances agricultural productivity with the delivery of ecosystem services. This integrated approach provides a robust framework to address environmental challenges while ensuring long-term agricultural sustainability.

Moreover, silvopastoral systems enhance both animal welfare and productivity, underscoring their importance in sustainable farming practices. Research has shown that these systems create favorable microclimates, reducing heat stress and supporting optimal physiological and behavioral outcomes for livestock. For instance, animals in silvopastures benefit from improved thermoregulation and experience lower levels of chronic stress compared to those in conventional pastures (Pent et al., 2020a, 2020b, 2021; Poudel et al., 2022; Vieira et al., 2020; Skonieski et al., 2021; dos Santos et al., 2021). Additionally, enhanced animal performance, including better weight gain and efficient forage utilization, highlights silvopastures' potential to harmonize animal welfare with agricultural productivity (Pent et al., 2020a, 2020b; Vieira et al., 2020).

These findings underscore the pivotal role of silvopastoral systems in advancing sustainable livestock management while addressing pressing environmental and welfare concerns. Recognizing the importance of these systems and the gaps in understanding their research landscape, this bibliometric review aims to bridge that gap by offering a comprehensive resource for exploring the multiple facets of silvopasture adoption. Through this effort, it seeks to provide valuable insights for researchers, policymakers, and practitioners, enabling more informed decisions to guide future research directions, practical applications, and policy development. Ultimately, the findings of this review can align silvopastoral practices with global sustainability objectives, significantly contributing to the achievement of key Sustainable Development Goals (SDGs).

As a branch of agroforestry, silvopasture has become a cornerstone of sustainable agriculture by integrating trees, forage crops, and livestock into a unified productive system. This innovative land-use strategy delivers both ecological and economic benefits, making it a promising solution to the growing demand for food, fuel, and fiber while tackling environmental challenges such as climate change, soil degradation, and biodiversity loss.

Pent and Fike (2021) highlight that silvopastures enhance ecosystem services by improving soil health, supporting animal welfare, and mitigating greenhouse gas emissions. Similarly, research by Sharrow, Brauer, and Clason (2015) demonstrates the contribution of silvopastoral practices to ecological sustainability. Furthermore, De Stefano and Jacobson (2018) emphasize their potential to sequester soil carbon, playing a vital role in combating climate change. Sow et al. (2024) also note that silvopastures exhibit higher levels of soil organic carbon, improved water retention, and better overall quality, with cooler temperatures compared to conventional pastures, underscoring their effectiveness in promoting soil health and mitigating climate challenges.

The integration of trees and forage within silvopastures, as highlighted by Pent and Fike (2021), not only aids in carbon sequestration but also helps reduce enteric methane emissions from livestock, thereby supporting efforts to mitigate greenhouse gases. Moreover, silvopastoral systems contribute to improved soil health, increased fertility, and enhanced conservation efforts. Research by De Stefano and Jacobson (2018) and Mayerfeld et al. (2023) further supports these findings, emphasizing the role of silvopastures in maintaining ecological balance and promoting sustainability.

Silvopastures are increasingly recognized for their capacity to foster sustainable agricultural production, particularly in the face of climate change. They enhance ecosystem service delivery without compromising agricultural productivity, offering an efficient land-use strategy with lower environmental impact, as noted by Tully and Ryals (2017). A study in the United States demonstrated that silvopastures can achieve productivity levels comparable to conventional pastures while occupying just a quarter of the land area, showcasing their economic viability (Tully & Ryals, 2017). Furthermore, research by Shi and Conway-Anderson (2022) and Poudel et al. (2024) emphasizes that the integration of trees, forages, and livestock in silvopastures generates both immediate and long-term economic benefits, significantly enhancing the sustainability of agricultural operations.

A lack of information and insufficient research knowledge have been identified as significant obstacles for farmers and landowners considering the adoption of silvopasture systems. Paciullo et al. (2024) highlight that these knowledge gaps create an urgent need for targeted educational and outreach initiatives to ensure producers are well-informed about the benefits and challenges associated with silvopasture. This is especially crucial in light of the

absence of region-specific studies that could offer practical guidance for various geographical contexts. Additionally, Paciullo et al. (2024) points out the shortage of professionals with expertise in silvopasture, which further complicates the adoption process.

Beyond these informational challenges, broader issues related to the social acceptability, economic sustainability, and environmental impacts of silvopasture systems also play a crucial role in influencing farmers' willingness to adopt these practices. Smith et al. (2022) argue that these factors are pivotal in shaping adoption decisions. The economic viability of silvopasture systems remains an area of ongoing research, with many farmers seeking tangible evidence of their profitability. Moreover, the integration of trees, forages, and livestock within silvopastures requires careful management to ensure that ecosystem services are enhanced without compromising productivity.

The successful adoption of silvopasture systems will likely depend on overcoming these challenges through collaboration. Smith et al. (2022) emphasize that fostering wider adoption requires active partnerships among researchers, extension agents, and farmers to develop regionally tailored solutions and best practices. Such collaborations are essential not only for advancing technical knowledge but also for addressing the social and economic aspects of silvopasture adoption, ensuring its long-term success.

Silvopasture systems provide substantial ecological benefits that enhance ecosystem services. Research consistently shows improvements in soil health, water quality, carbon sequestration, and biodiversity (Belsky et al., 1993; Schroth, 1995; Jackson et al., 2000; Haile et al., 2008; Bambo et al., 2009). Notably, silvopasture's ability to sequester carbon through tree growth is a key strategy for mitigating climate change (Boyer & Neel, 2010; Ramakrishnan et al., 2021). This aligns with SDG 13 (Climate Action) and SDG 15 (Life on Land), as silvopastures encourage sustainable land use that enhances ecosystem resilience and supports long-term environmental health.

The economic advantages of silvopasture systems are equally compelling. By diversifying income streams through livestock, timber, and non-timber products, these systems offer farmers economic stability and boost farm productivity (Fannon et al., 2019; Pent et al., 2021). The integration of silvopastoral practices also improves livestock welfare, which in turn contributes to increased farmer income. These benefits are particularly important for achieving SDG 1 (No Poverty), especially in rural areas where traditional agricultural systems face challenges. The adoption of silvopasture systems opens new opportunities for income generation, supporting the economic sustainability of farming operations amid climate change and market volatility.

Silvopasture systems have demonstrated promising outcomes in enhancing livestock welfare and productivity. The shade provided by trees helps reduce heat stress, a significant factor affecting livestock performance. Studies have shown that animals raised in silvopastures experience better weight gain, improved reproduction rates, and overall better health (Poudel et al., 2022; Vieira et al., 2020; Skonieski et al., 2021). These findings are especially relevant for SDG 2 (Zero Hunger), as they suggest that silvopastures promote more sustainable and productive livestock systems, thereby supporting food security and ensuring the long-term viability of livestock farming. By improving the health and productivity of animals, silvopasture systems play a crucial role in advancing agricultural sustainability and making food systems more resilient to climate change.

The shift in focus from ecological to socioeconomic factors in silvopasture research reflects a growing understanding that the adoption of these systems is driven not only by their environmental benefits but also by their economic feasibility and

impact on local communities. Early research primarily highlighted the ecological benefits of silvopastures, such as enhancing biodiversity, improving soil fertility, and supporting carbon sequestration. However, recent studies have expanded their focus to include socioeconomic aspects, recognizing that the long-term sustainability of silvopasture systems depends on the economic realities and livelihoods of the farmers who implement them (Torres et al., 2023; Villarroel-Molina et al., 2019). This broader perspective is critical for aligning silvopasture practices with SDG 12, which promotes responsible consumption and production. These studies emphasize the need for systems that are both environmentally sustainable and economically viable, underscoring the importance of developing practices that ensure ecological health and economic stability.

Another emerging trend in the literature is the regional variation in the adoption of silvopasture practices. In Latin America, for example, silvopasture has been widely promoted not only for its environmental benefits but also as a strategy for poverty alleviation. Policies and incentives introduced in these regions have played a key role in facilitating the widespread adoption of sustainable farming practices (Rangel et al., 2020; Mancilla-Leytón et al., 2022). These policy frameworks serve as valuable examples of how government support can accelerate the implementation of silvopasture systems, particularly in developing countries where both ecological restoration and economic development are pressing concerns. This body of research highlights the essential role of policy in promoting the integration of silvopasture into agricultural systems, particularly in regions where sustainable practices can address both environmental degradation and economic challenges.

Despite the expanding body of research on silvopasture, several key gaps remain that require attention. One major gap is the absence of comprehensive studies that map the global research landscape using tools like bibliometric analysis. Torres et al. (2023) emphasize the need for a clearer understanding of the key contributors and collaboration networks driving innovation in this field. Their study underscores the value of bibliometric analysis in identifying emerging trends and influential leaders, which could help shape future research and practices in silvopasture.

Additionally, although the ecological benefits of silvopasture, such as improved biodiversity and soil health, are well-documented, more research is needed on the long-term socioeconomic impacts, particularly in smallholder farming contexts. Fannon et al. (2019) highlight the importance of understanding how silvopasture adoption affects rural communities, especially in terms of income, social equity, and resilience to climate change. Vieira et al. (2020) also stress that these aspects need further exploration, as they could significantly influence the livelihoods of farmers in developing regions.

Moreover, there is a lack of research connecting silvopasture practices to the Sustainable Development Goals (SDGs). While it is clear that silvopasture can contribute to several SDGs, especially SDG 12 (Responsible Consumption and Production) and SDG 15 (Life on Land), only a few studies have explicitly linked these practices to the global sustainability agenda. Poudel et al. (2022) argue that more research is necessary to quantify how silvopasture can help achieve these SDGs. Similarly, Skonieski et al. (2021) suggest that aligning silvopasture practices with the SDGs could not only enhance their adoption but also highlight their potential as a sustainable agricultural system.

METHODOLOGY

Data Sources

This review used Scopus as the exclusive data source, chosen for its broad coverage of peer-reviewed literature across various disciplines, including agriculture, forestry,

and environmental science. Scopus was well-regarded for its vast collection of scientific publications and reliable citation data, making it an ideal tool for tracking research trends, identifying key contributors, and mapping collaboration networks in the field of silvopasture. The search period was set from 2013 to 2023, reflecting the recent development and progression of silvopasture research. The 2013-2023 timeframe captured the recent evolution of silvopasture research, reflecting emerging themes and practices. Scopus's credibility and VOSviewer's analytical depth provided a robust framework for this study.

Data Collection Process

To carry out the data collection, a structured search query was designed using key terms such as "silvopasture," "silvopastoral systems," "agroforestry," and "sustainable agriculture." The creation of Boolean characters and keywords was supported by ChatGPT, ensuring a thorough and focused search approach. These keywords were applied to titles, abstracts, and keywords in Scopus, guaranteeing that the results were relevant and specific. The search focused on peer-reviewed journal articles, conference proceedings, and review papers, with inclusion criteria limited to studies addressing the ecological, economic, and social impacts of silvopasture. Non-peer-reviewed articles, opinion pieces, and editorials were excluded to ensure the quality of the data. The resulting data was exported to a citation management tool, such as EndNote or Mendeley, for further analysis, including details like publication year, author, title, affiliation, citation count, and keywords.

Tool for Analysis

For the analysis, VOSviewer was used to visualize citation networks, co-authorship relationships, and keyword co-occurrence. VOSviewer generated network diagrams that provided a visual representation of research collaborations, thematic clusters, and influential authors. These visualizations facilitated the identification of leading research groups and highlighted the primary areas of focus within the silvopasture field.

Step-by-Step Plan for Data Collection and Analysis

The methodology was implemented in a step-by-step process, starting with the creation of a precise search query in Scopus. This was followed by the extraction and cleaning of the data to eliminate duplicates and irrelevant studies. Descriptive analysis was conducted using VOSviewer to identify key trends and contributors within silvopasture research. Network mapping was employed to visualize co-authorship and citation patterns, helping to uncover collaborative relationships. The thematic analysis focused on keyword co-occurrence networks to identify major research themes and evaluate their alignment with SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land).

Justification of Methods and Tools

This approach, using Scopus as the primary data source, was supported by the database's comprehensive coverage and its reliability in providing high-quality citation data. The application of VOSviewer offered a strong framework for visualizing collaboration networks and conducting detailed analyses. Together, these tools facilitated an in-depth exploration of silvopasture research and its alignment with the Sustainable Development Goals (SDGs), providing valuable insights for researchers, policymakers, and practitioners.

RESULT AND DISCUSSION

Identifying Key Contributors, Influential Institutions, and Collaboration Networks

The network visualization (Figure 1) highlights the leading contributors in the field of silvopasture research. Researchers such as Bruno C. Pedreira, Dalton H. Pereira, and Lynn E. Sollenberger are

central within their respective clusters, underscoring their significant influence in advancing silvopasture research. These prominent figures are likely affiliated with institutions that emphasize agroforestry and sustainable agriculture, helping to position silvopasture as a vital element of these fields. Recent contributions highlighted increased collaboration, addressing emerging sustainability challenges.

The visualization also reveals dense co-authorship clusters, illustrating strong collaboration networks that foster knowledge exchange, encourage interdisciplinary research, and promote innovative approaches to silvopasture practices. These networks are critical for building partnerships across various disciplines, including forestry, animal science, and environmental management, which are essential for furthering silvopasture research. The temporal overlay visualization (Figure 2) further illustrates the evolution of collaboration networks, showing increased activity from researchers such as José Ricardo Macedo Pezzopane and Cristiam Bosi in recent years, as indicated by the yellow nodes. This indicates a growing influx of contributors addressing emerging topics related to global sustainability challenges, thereby strengthening interdisciplinary collaborations within agroforestry research.

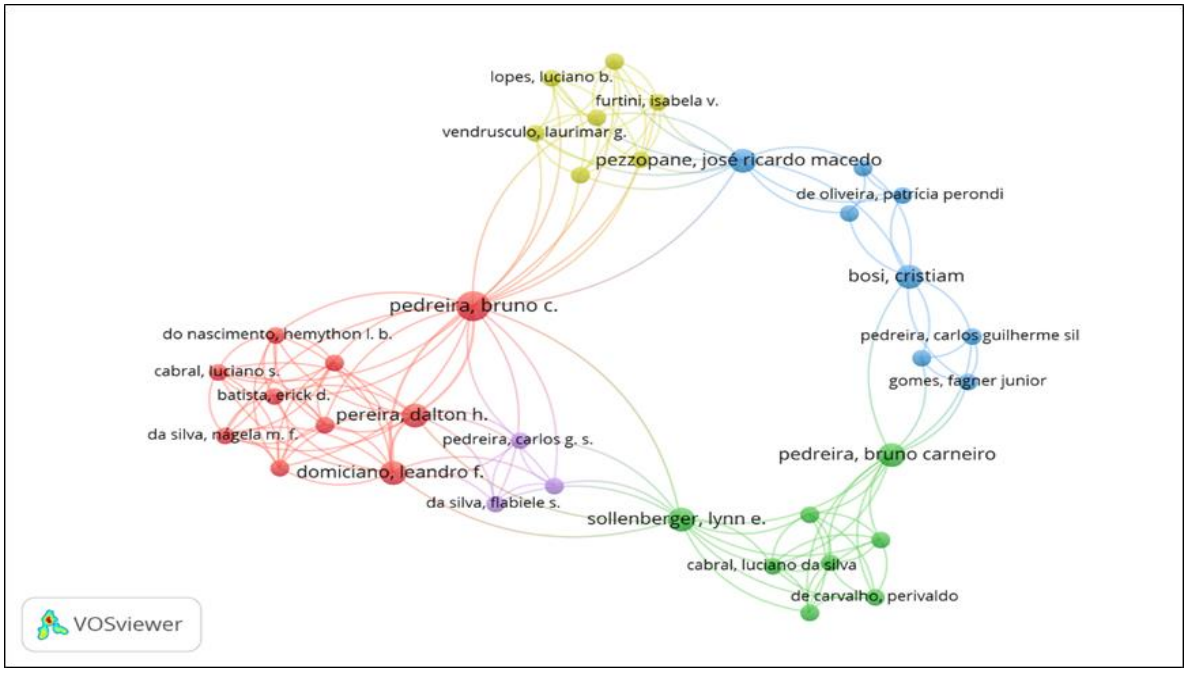

Figure 1. Network visualization of silvopasture research, showing key contributors, collaboration clusters, and thematic focus areas.

Assessing Thematic Focus Areas and Alignment with SDGs

The thematic focus within silvopasture research is illustrated by distinct clusters within the network (Figure 1). For example, the red cluster, dominated by Pedreira, Bruno C. and Pereira, Dalton H., likely focuses on agronomic aspects of silvopasture, such as forage management, crop-livestock interactions, and nutrient cycling—key areas relevant to SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production). The green cluster, centered on Sollenberger, Lynn E., is likely focused on forage quality and pasture science, which supports sustainable livestock production and aligns with SDG 15 (Life on Land) by promoting biodiversity conservation and habitat protection.

The blue and yellow clusters appear to address environmental impacts, including carbon sequestration, water conservation,

and erosion control, aligning with SDG 13 (Climate Action) by highlighting silvopasture's potential to mitigate climate change. This alignment with the SDGs underscores silvopasture's contributions to sustainable agriculture by incorporating practices that benefit both people and the planet. The overlay visualization (Figure 2) further reinforces these findings by illustrating the temporal shift in thematic focus. More recent studies, indicated by yellow and green nodes, likely concentrate on sustainability and climate resilience, reflecting a deliberate shift in research priorities to address ecological impacts and socioeconomic benefits.

Evaluating the Ecological and Socioeconomic Impacts of Silvopasture Practices

Silvopasture's ecological benefits, such as improved soil health and biodiversity, are well-documented. Socioeconomic impacts include diversified income and increased resilience to climate variability. Despite progress, knowledge gaps in long-term impacts and geographic coverage persist. The ecological and socioeconomic impacts of silvopasture are key themes in the literature, as evidenced by the collaborative relationships shown in both visualizations. Researchers from different clusters work together on studies that highlight how silvopasture improves ecosystem services, such as enhancing soil health, boosting biodiversity, and sequestering carbon, all of which provide significant ecological benefits. Additionally, by integrating trees, livestock, and crops, silvopasture creates diverse income sources and increases resilience to market and climate fluctuations, addressing socioeconomic goals aligned with sustainable development.

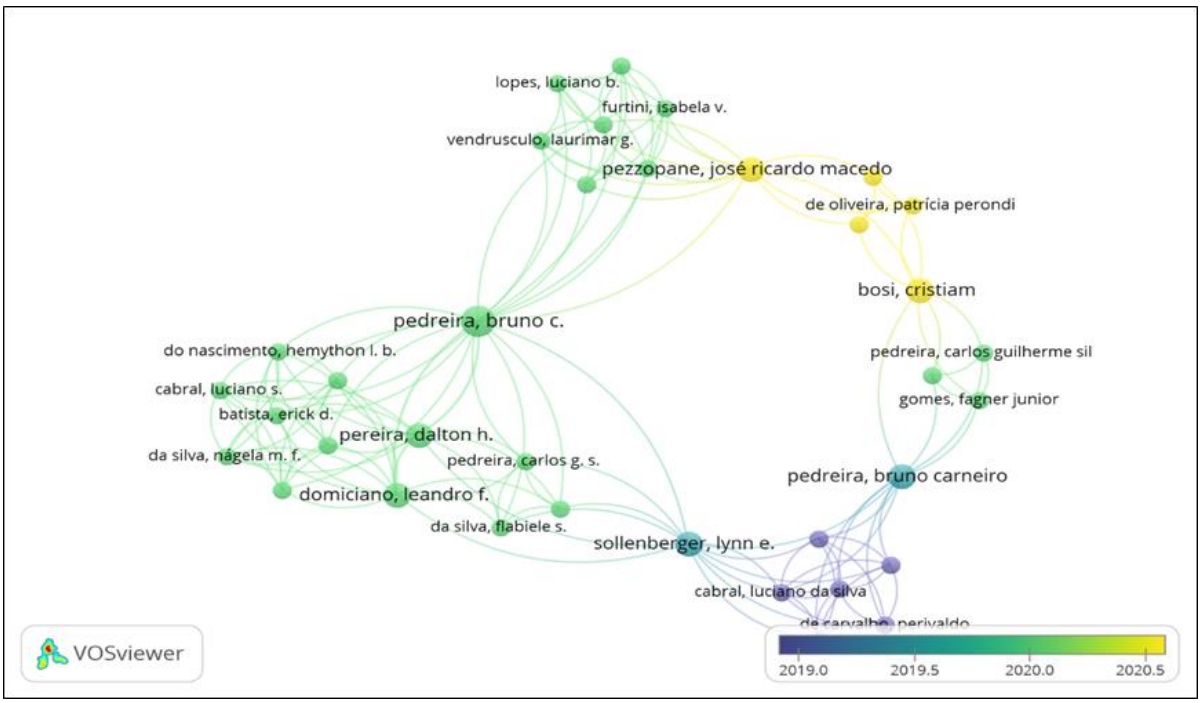

Figure 2. Temporal overlay visualization highlighting the evolution of silvopasture research themes and recent contributions.

The temporal overlay visualization (Figure 2) indicates a growing emphasis on sustainable practices in recent years, including agroforestry systems that promote biodiversity and carbon sequestration while delivering economic benefits to communities involved in livestock and forestry. This shift toward multifunctional landscapes that support both ecological sustainability and economic viability is

reflected in the connections between established researchers and newer contributors. These collaborative efforts highlight the comprehensive value of silvopasture, emphasizing its role in fostering sustainable rural development and alleviating poverty.

CONCLUSION

The bibliometric analysis reveals that silvopasture research has evolved into a multidisciplinary field, with key contributors and influential institutions driving innovation through strong collaboration networks. Thematic clusters within the network align closely with the Sustainable Development Goals, particularly those related to food security, responsible production, biodiversity conservation, and climate action. The ecological and socioeconomic benefits of silvopasture, as reflected in the literature, emphasize its value as a sustainable agricultural practice with potential for substantial impact. Future research should continue to explore and quantify these impacts, reinforcing silvopasture's role in promoting sustainable rural development. This analysis demonstrates the progression of silvopasture research, connecting leading contributors, thematic shifts, and the growing focus on ecological and socioeconomic impacts within agroforestry.

Declaration by Author

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REFERENCES

1. Bambo, S. K., Nowak, J., Blount, A. R., Long, A. J., & Osiecka, A. (2009). Soil nitrate leaching in silvopastures compared with open pasture and pine plantation. *Journal of Environmental Quality*, *38*(5), 1870–1877. https://doi.org/10.2134/jeq2007.0634
2. Belsky, A. J., Mwonga, S. M., & Duxbury, J. M. (1993). Effects of widely spaced trees and livestock grazing on understory environments in tropical savannas. *Agroforestry Systems*, *24*, 1–20. https://doi.org/10.1007/BF00705265
3. Boyer, D. G., & Neel, J. P. S. (2010). Nitrate and fecal coliform concentration differences at the soil/bedrock interface in Appalachian silvopasture, pasture, and forest. *Agroforestry Systems*, *79*, 89–96. https://doi.org/10.1007/s10457-009-9272-4
4. Castle, S. E., Miller, D. C., Merten, N., et al. (2022). Evidence for the impacts of agroforestry on ecosystem services and human well-being in high-income countries: A systematic map. *Environmental Evidence*, *11*, 10. https://doi.org/10.1186/s13750-022-00260-4
5. De Stefano, A., & Jacobson, M. G. (2018). Soil carbon sequestration in agroforestry systems: A meta-analysis. *Agroforestry Systems*, *92*, 285–299. https://doi.org/10.1007/s10457-017-0147-9
6. FAO. (2007). *Buena Gobernanza En La Tenencia y La Administración de Tierras/Good Governance in Land Tenure and Administration* (Vol. 9). Food & Agriculture Organization. ISBN 925305753X.
7. Fannon, A., Fike, J. H., Greiner, S. P., Feldhake, C. M., & Wahlberg, M. (2019). Hair sheep performance in a mid-stage deciduous Appalachian silvopasture. *Agroforestry Systems*, *93*(1), 81–93. https://doi.org/10.1007/s10457-019-00397-0
8. Gabriel J Pent, S. P. Greiner, J. F. Munsell, B. F. Tracy, & J. H. Fike. (2020). Lamb performance in hardwood silvopastures, I: Animal gains and forage measures in summer. *Translational Animal Science*, *4*(1), 385–399. https://doi.org/10.1093/tas/txz154
9. Gabriel J Pent, S. P. Greiner, J. F. Munsell, B. F. Tracy, & J. H. Fike. (2020). Lamb performance in hardwood silvopastures, II: Animal behavior in summer. *Translational Animal Science*, *4*(1), 363–375. https://doi.org/10.1093/tas/txz177
10. Gene T. Señeris. Nabaoy River Watershed potential impact to flooding using Geographic Information System remote sensing[J]. AIMS Environmental Science, 2022, 9(3): 381-402. doi: 10.3934/environsci.2022024
11. Haile, S. G., Nair, P. R., & Nair, V. D. (2008). Carbon storage of different soil size fractions in Florida silvopastoral systems.

Journal of Environmental Quality, 37(5), 1789–1797. https://doi.org/10.2134/jeq2007.0509

12. Jackson, R. B., Schenk, H., Jobbagy, E., Canadell, J., Colello, G., Dickinson, R., Field, C., Friedlingstein, P., Heimann, M., & Hibbard, K. (2000). Belowground consequences of vegetation change and their treatment in models. *Ecological Applications, 10*(2), 470–483. https://doi.org/10.1890/1051-0761(2000)010
13. Jioelle B. Laurente, "Influence of Rhizomal Buds and Soaking Time in ANAA on the Growth Characteristics of Thai Ginger (Alpinia galanga (L.) Willd.)," Universal Journal of Agricultural Research, Vol. 11, No. 6, pp. 1043 - 1049, 2023. DOI: 10.13189/ujar.2023.110611.
14. Karki, U., & Goodman, M. S. (2013). Microclimatic differences between young longleaf-pine silvopasture and open-pasture. *Agroforestry Systems, 87*, 303–310. https://doi.org/10.1007/s10457-012-9551-3
15. Mancilla-Leytón, J. M., Gribis, D., Pozo-Campos, C., Morales-Jerrett, E., Mena, Y., Cambrollé, J., & Vicente, Á. M. (2022). Ecosystem services provided by pastoral husbandry: A bibliometric analysis. *Land, 11*(11), 2083. https://doi.org/10.3390/land11112083
16. Mazaroli, D. N., DeLonge, M., & Carlisle, L. (2024). The potential of silvopasture in California: Producer perspectives. *Agroecology and Sustainable Food Systems, 48*(10), 1413–1427. https://doi.org/10.1080/21683565.2024.2405886
17. Mayerfeld, D., Keeley, K. O., Rickenbach, M., Rissman, A., & Ventura, S. J. (2023). Evolving conceptions of silvopasture among farmers and natural resource professionals in Wisconsin, USA. *Frontiers in Sustainable Food Systems, 7*, https://doi.org/10.3389/fsufs.2023.983376
18. Poudel, S., Bansal, S., Podder, S., et al. (2022). Conversion of open pasture to hardwood silvopasture enhanced soil health of an ultisol. *Agroforestry Systems, 96*, 1237–1247. https://doi.org/10.1007/s10457-022-00783-2
19. Poudel, S., Fike, J. H., & Pent, G. J. (2022). Hair cortisol as a measure of chronic stress in ewes grazing either hardwood silvopastures or open pastures. *Agronomy, 12*(7), 1566. https://doi.org/10.3390/agronomy12071566
20. Poudel, S., Pent, G. J., & Fike, J. H. (2024). Silvopastures: Benefits, past efforts, challenges, and future prospects in the United States. *Agronomy, 14*(7), 1369. https://doi.org/10.3390/agronomy14071369
21. Rangel, J., Perea, J., De-Pablos-Heredero, C., Espinosa-García, J. A., Mujica, P. T., Feijoo, M., Barba, C., & García, A. (2020). Structural and technological characterization of tropical smallholder farms of dual-purpose cattle in Mexico. *Animals, 10*(1), 86. https://doi.org/10.3390/ani10010086
22. Ramakrishnan, S., Kumar, S., Chaudhary, M., Govindasamy, P., Yadav, M., Prasad, M., & Prajapati, K. (2020). Silvopastoral system for resilience of key soil health indicators in semi-arid environment. *Archives of Agronomy and Soil Science, 67*(13), 1834–1847. https://doi.org/10.1080/03650340.2020.1814954
23. Schroth, G. (1995). Tree root characteristics as criteria for species selection and systems design in agroforestry. In F. L. Sinclair (Ed.), *Agroforestry: Science, policy, and practice* (pp. 159–172). Springer. https://doi.org/10.1007/978-94-017-0681-0_6
24. Sharrow, S., Brauer, D., & Clason, T. (2009). Silvopastoral practices. In *North American agroforestry: An integrated science and practice* (2nd ed., pp. 105–131). American Society of Agronomy. https://doi.org/10.2134/2009.northamericanagroforestry.2ed.c6
25. Sharrow, S. H., Brauer, D., & Clason, T. R. (2015). Silvopastoral practices. In *North American agroforestry: An integrated science and practice* (2nd ed., pp. 105–131). https://doi.org/10.2134/2009.northamericanagroforestry.2ed.c6
26. Sow, S., Ranjan, S., Kumar, N., Gitari, H., Dayal, P., & Kumar, S. (2024). Sustainable fodder production in South Asia through silvopastoral systems. *Current Science, 126*(10).
27. Tambong, J. D. (2023). Branch cutting propagation of different bamboo species through varying levels of alpha naphthalene acetic acid supplementation. *International Journal of Research and Review, 10*(11),

393–399. https://doi.org/10.52403/ijrr.20231147

28. Tambong, J. D. (2024). Growth performance of Kawayang Kiling (Bambusa vulgaris Schrader ex Wendland) as influenced by different levels of Alpha Napthalene Acetic Acid. *International Journal of Science, Technology, Engineering and Mathematics*, *4*(3), 85–106. https://doi.org/10.53378/ijstem.353094
29. Torres, B., Eche, D., Torres, Y., Bravo, C., Velasco, C., & García, A. (2021). Identification and assessment of livestock best management practices: Participatory approaches in the Mediterranean area. *Agricultural Systems*, *186*, 102938. https://doi.org/10.1016/j.agsy.2020.102938
30. Zhao, L., Gao, L., & Ren, H. (2024). Carbon sequestration potential in silvopasture systems: A review. *Agriculture, Ecosystems & Environment*, *339*, 108178. https://doi.org/10.1016/j.agee.2024.108178

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