

TECHNICAL AND ADMINISTRATIVE TRENDS IN TIMBER HARVESTING IN ROMANIA AND ACROSS EUROPE

Camelia Elena MOGA¹, Claudia Simona TIMOFTE^{2#}

¹University of Oradea, Faculty of Environmental Protection, 26 General Magheru St., 410048, Oradea, Romania
PhD student of the "Ștefan cel Mare" University of Suceava, 13 Universitatii, 720229, Suceava, Romania email:
cameliamoga90@gmail.com

²University of Oradea, Faculty of Law, 26 General Magheru Street, Oradea, Romania, email: clau_timofte@yahoo.com

REVIEW ARTICLE

Abstract

The paper analyzes the technical and administrative developments in timber harvesting in Romania and Europe, highlighting the transformations driven by machinery modernization, process digitalization, and the adoption of forest policies oriented toward sustainability. The study shows that developed European countries have reached a high level of mechanization, particularly through the use of cut-to-length systems and digital monitoring technologies, while Romania is undergoing a gradual alignment process influenced by mountainous terrain, limited forest infrastructure, and fragmented ownership. At the administrative level, the new Forest Code (Law No. 331/2024), the implementation of the SUMAL 2.0 system, and the shift toward the valorization of processed timber represent important steps toward increasing transparency and professionalization within the sector. A comparison of European management models—public, private, associative, and corporate—highlights the need to strengthen institutional capacity and increase the degree of mechanization in Romania. The conclusions emphasize the necessity of an integrated approach that combines technical modernization, administrative reform, and responsibility toward forest resources in the context of climate change and European legislative requirements.

Keywords: *mechanization, governance, sustainability, digitalization, biodiversity, regulation*

#Corresponding author: Timofte Claudia Simona

INTRODUCTION

Timber harvesting is undergoing profound transformation both in Romania and across Europe, driven by technological progress, pressures generated by climate change, and increasingly stringent environmental protection requirements (Forest Europe, 2020; FAO, 2020). Over the past two decades, the demands of sustainable forest management, the digitalization of administrative processes, and the implementation of complex European policies have significantly reshaped the way timber harvesting is organized. In this context, professional standards, traceability, and low-impact technologies have become central pillars of modern forest operations.

As highlighted by Horodnic (2014) in his work on forest operations engineering, the current direction of development aims at adapting technologies to ecological principles, marking the emergence of a new field: "forest operations ecology." This approach seeks to reduce negative effects on soil, water, biodiversity, and the atmosphere through energy-efficient technologies, spatially optimized extraction systems, and interventions

adapted to natural conditions (Horodnic, 2014; Proto et al., 2018).

At the European level, timber harvesting has rapidly evolved toward full mechanization, particularly through cut-to-length (CTL) systems based on harvesters and forwarders. This process has been facilitated by the high density of forest infrastructure, advanced environmental policies, and European regulations concerning traceability and supply-chain responsibility. The adoption of Regulation (EU) 2023/1115 on deforestation-free products (EUDR) marks a defining moment, imposing strict due-diligence and geospatial traceability obligations on operators (European Commission, 2023).

In Romania, the evolution of the sector is distinct and strongly influenced by natural conditions, particularly by the mountainous terrain and the less developed forest road network (Abrudan, 2012; Popa & Bann, 2012). These realities maintain the predominance of semi-mechanized systems—especially articulated forest tractors (TAFs), skidders, and cable yarding systems—and lead to the widespread application of the tree-length method, characterized by the extraction of long logs and by extended skidding distances (Borz

et al., 2016). Studies conducted in the Carpathians show that skidding distances frequently range between 250 and 1,000 meters, depending on accessibility, which significantly affects productivity and operational costs (Borz et al., 2013; Kaakkurivaara et al., 2022).

At the legislative level, Romania is gradually narrowing the gap with Central European countries through the adoption of the new Forest Code—Law No. 331/2024, published in the Official Gazette No. 7/2025. This law strengthens the principles of sustainable forest management, redefines administrative structures (including the National Forest Guard), and uniformly regulates the system for timber evaluation, harvesting, and transport, in close correlation with the requirements of the SUMAL 2.0 digital system. The digitalization of traceability flows, transport verification, and stock monitoring in depots enables closer alignment with European standards (MMAP, n.d.).

Traditionally associated with manual or semi-mechanized activities, the timber harvesting sector is thus entering a phase of profound modernization. This process is amplified by the broader European context, in which the need to comply with climate objectives, adapt to extreme events (storms, fires, windthrow), and increase the social responsibility of operators requires high-performance technologies, efficient administration, and full transparency throughout the timber supply chain (FAO & UNEP, 2020; EFI, 2019).

In Romania, major challenges include insufficient infrastructure, fragmented ownership, limited financial resources for many owners and companies, and a public perception that is often critical of timber harvesting (Halalisan et al., 2014). However, the introduction of modern harvesting technologies, the expansion of digital monitoring systems, and the improvement of the legal framework indicate a positive shift toward professionalization and efficiency (Nicolescu et al., 2018).

Against this backdrop, analyzing technical and administrative trends is essential for understanding how Romania's forest sector adapts to current and future requirements. This study offers a comprehensive synthesis of developments in Romania and other European states, highlighting modernization directions, emerging tools, and their impact on timber

harvesting, with the aim of supporting a coherent and sustainable approach to forest resource management.

MATERIAL AND METHODS

The study focuses on the technical and administrative trends that characterize timber harvesting in Romania and Europe. Although the two dimensions are addressed separately for conceptual clarity, they do not function independently: mechanization, infrastructure, and harvesting methods directly influence administrative structures, while organization and regulation determine the technical possibilities of forest operations. Thus, the study follows a complementary approach, highlighting the permanent interdependence between technology and administration in the process of sustainable forest management.

TECHNICAL TRENDS IN TIMBER HARVESTING

The technical trends in timber harvesting in Romania and Europe reflect an accelerated modernization of harvesting methods, a continuous increase in mechanization levels, and an adaptation of forestry practices to climatic challenges, socio-economic pressures, and European legislative requirements. In the developed countries of Europe, modern technologies have been systematically integrated over the past decades, leading to higher efficiency and reduced environmental impact. In Romania, the process follows the same direction, but the pace is shaped by terrain characteristics, existing infrastructure, and the economic performance of sector operators.

In most European countries with accessible forests, timber harvesting has evolved toward the fully mechanized cut-to-length (CTL) system, in which the harvester-forwarder pair performs all felling, processing, and primary extraction operations (Table 1). This system has become dominant in Scandinavia, where over 95% of the annual volume is harvested using CTL. Its adoption is explained by high efficiency, operational flexibility, standardized assortments, and integration with digital planning tools. Research conducted in Central Europe and Scandinavia shows that CTL technology enables the optimization of timber flow and a significant reduction in soil pressure—important aspects in the context of climate change and sustainability requirements (Mederski, 2022; Labelle & Lemmer, 2019).

Table 1
Level of Forest Mechanization in Different European Regions

Region	Mechanization level	Dominant harvesting system	Observations
Romania	Medium	Semi-mechanized (TAF)	Mountainous terrain, few forest roads
Central Europe	High	CTL + modern cable yarding systems	Good accessibility
Scandinavia	Very high	95–100% CTL	Excellent infrastructure
Southeast Europe	Low–Medium	Chainsaw + tractors	Fragmented ownership

In contrast with these developments, countries with predominantly mountainous terrain—such as Romania, Slovakia, Bulgaria, and partly Austria or Italy—still retain a significant share of semi-mechanized harvesting systems. In Romania, the dominant harvesting method continues to rely on manual felling and bucking using chainsaws, followed by timber extraction with articulated forest tractors (TAF) or skidders (table 2).

This situation is influenced by the low density of forest roads, property fragmentation, and the limited accessibility of certain forested areas. Studies by Borz et al. (2016) and Kaakkurivaara et al. (2022) show that, under such conditions, extraction distances often exceed 300–600 m and, in difficult terrain, may reach up to 1,000 m, which significantly affects productivity, fuel consumption, and operational costs.

Table 2
Characteristics of the main harvesting systems

Characteristic	CTL System (cut-to-length)	Tree-length system (semi-mechanized)
Type of equipment	Harvester + forwarder	Chainsaw + TAF / skidder
Soil impact	Low	Medium–high
Terrain suitability	Ideal in accessible terrain	Suitable for mountainous areas
Productivity	High	Variable
Infrastructure requirements	High	Medium
Investment cost	Very high	Medium

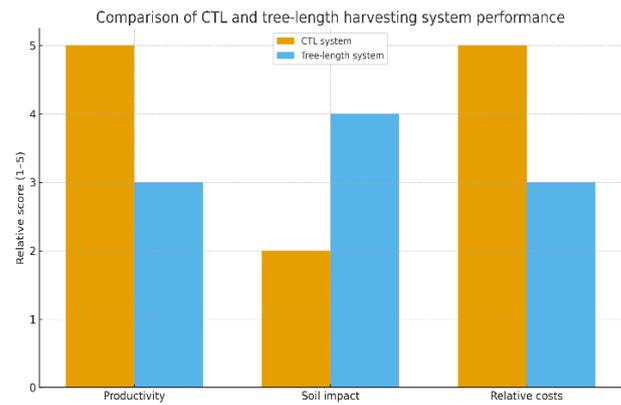


Figure 1 Comparison of CTL vs. tree-length performance

A distinctive element of forest operations in Romania is the traditional and still necessary use of cable yarding systems, which are essential on steep terrain. These cable systems allow timber to be harvested safely and with reduced soil impact, avoiding the need to build forest roads in sensitive areas. Popa and Borz (2019) highlight that the yarders used in the Carpathians can operate over distances of 150–500 m, while recent European research shows that modern cable yarders can exceed 600 m, using computerized winches and automated carriages, which reduce downtime and increase work safety (Spinelli et al., 2020; Stampfer, 2015). Although high initial costs and the need for a specialized crew limit their large-scale application, cable yarders remain the optimal technical solution in mountainous conditions.

The differences between Romania and the Nordic countries become even more evident when analyzing forest infrastructure. Countries such as Sweden or Finland benefit from dense forest road networks, which allow timber extraction over average distances of 50–150 m. This infrastructure supports full mechanization, reduces logistical costs, and minimizes equipment wear. In Romania, the significantly lower forest road density results in much larger extraction distances, leading to higher energy consumption and lower productivity. Romanian research in this field emphasizes that the optimal extraction distance for TAF operations should remain below 400–500 m, a threshold beyond which costs increase considerably (Borz et al., 2013; Borz et al., 2016).

The technological flows of primary transport and handling in Romania are organized around primary landings, located at the edge of harvesting sites, and intermediate depots situated along public roads. These points serve for sorting, weighing, and loading timber

for final transport. This structure is compatible with the requirements of the SUMAL 2.0 system, which mandates full traceability of timber and strict control over each logistical stage, in accordance with the provisions of Regulation (EU) 2023/1115 (EUDR). In other European countries, intermediate depots are often equipped with automatic measurement systems, high-performance loading machinery, and integrated digital technologies, which optimize operational times and reduce losses (EFI, 2019).

In Western Europe and Scandinavia, recent trends include the use of winch-assist technologies, whereby harvesters are supported by winches anchored at the upper part of the slope, enabling safe mechanization on gradients exceeding 35–45%. There is also a marked shift toward electric or hybrid machinery, reduced soil pressure through wide contact-area tracks, the use of sensors and drones for route planning and stand monitoring, as well as the integration of LIDAR models in operational analyses. Romania has begun to adopt these technologies gradually, particularly through projects financed by the NRDP or the NRRP, but the overall level of mechanization remains lower than in Western countries.

Regarding the structure of the sector, Romania is characterized by a very large number of small and medium-sized enterprises, most of which have limited financial capacity, making the acquisition of CTL equipment or modern cable yarders difficult (table 3). In contrast, Nordic countries operate through strong cooperatives and integrated corporations that own extensive fleets of modern machinery and can invest consistently in advanced technologies (Moskalik et al., 2017). This difference in capitalization partially explains the mechanization gap between Romania and Western Europe.

Table 3
Synthetic parameters for forestry harvesting companies (CAEN 0220), Romania (2022)

Indicator	Value (2022)
Number of active companies	2,295
Number of employees	11,267
Total turnover (RON)	4,284,911,798
Total net profit (RON)	579,197,496

Sources: RisCo – Top Companies 2022, CAEN code 0220 “Logging”.

Overall, European technical trends indicate a quick shift toward full mechanization,

digitalization, and the use of technologies with reduced impact on soil and biodiversity. Romania follows the same directions, but at a pace influenced by terrain characteristics, existing infrastructure, and the economic structure of the sector. Strategic directions for the future include the modernization of machinery, the diversification of technologies used on steep terrain, investments in forest infrastructure, and the strengthening of the operational capacity of harvesting companies.

ADMINISTRATIVE TRENDS IN TIMBER HARVESTING

Administrative trends in the Romanian and European forestry sector reflect a profound reorganization of institutions, valorization processes, control instruments, and the responsibilities of economic operators, in line with new environmental policies and the need for sustainable resource management (table 4). Forest administration can no longer be viewed solely as a technical activity, but as a complex system integrating economic, social, ecological, and legislative requirements. Differences among European countries arise from property structures, forest management traditions, levels of economic development, and institutional heritage, yet the overarching directions are largely convergent.

Table 4
Administrative models of forest management in Europe

Administrative model	Representative countries	Share in Europe (approx.)	Main characteristics
State public	Romania, France, Finland	~35–45%	Continuity, long-term planning
Individual private	Germany, Sweden, Austria	~45–50%	High investment, full mechanization
Community / communal	Austria, Switzerland	~10%	Local decision-making, strong tradition
Cooperative	Sweden (Södra), Finland	~5%	Economic efficiency, advanced mechanization

In Romania, the new Forest Code – Law no. 331/2024, published in the Official Gazette no. 7/2025 – represents the central element of current regulation. It redefines the framework for forest management, establishes the principles of sustainable administration,

strengthens the role of the National Forest Guard, and updates the mechanisms for timber appraisal, harvesting, and circulation. The Code emphasizes management continuity, the responsibility of forest administrators, as well as the need for digitalization, transparency, and alignment with European legislation. The introduction of stricter sanctions, the explicit regulation of forestry services for private owners, and the formalization of stringent procedures for timber harvesting, transport, and sale provide a more robust administrative framework designed to reduce illegal activities and increase the level of professionalization in the sector.

At the level of public administration, forests in the public ownership of the state are managed by the National Forest Administration – Romsilva, an institution that administers approximately 48% of Romania’s national forest fund. This model is similar to that of France, where the National Forest Office (ONF) manages both state and communal forests, or to Finland, where Metsähallitus administers state-owned forest lands, integrating them into a coherent national strategy (table 5). In these public models, ecological, social, and economic objectives are addressed simultaneously, with long-term planning at their core. The advantage lies in management continuity and high administrative capacity, while risks include bureaucratic rigidity and reduced ability to rapidly adapt to market changes.

Table 5

Examples of state forest administrators in Europe

Country	Organization	Managed area (million ha)	Notes
Romania	Romsilva	3.13	State-owned public forests
France	ONF	≈11	Public forests (state and local authorities)
Finland	Metsähallitus	≈9	State lands (including forests)
Latvia	Latvijas valsts meži (LVM)	≈1.4	State forests
Austria	ÖBf	≈0.51	State-managed forests

Sources: Romsilva, ONF, Metsähallitus, LVM, ÖBf – official reports. Values are approximate.

Private forest management plays an important role in most European countries, where individual owners, companies,

foundations, or industrial corporations manage large forest areas. In Sweden and Finland, cooperatives such as Södra or corporations such as Stora Enso and UPM-Kymmene administer extensive forest holdings, using integrated digital systems, full mechanization, and intensive production planning. Romania finds itself in a different situation: although roughly half of its forests are privately owned, they are highly fragmented, with many plots being small or very small. Under these conditions, management is ensured by private or public forest districts, which contributes to the standardization of practices but limits the ability of owners to invest in modern technologies. Studies by Abrudan (2012) and Halalisan et al. (2014) show that although the diversity of ownership forms can be an advantage, the lack of financial resources and technical expertise poses major challenges for small owners.

Community and communal ownership forms play a particularly important role. These structures—traditional in Romania (traditional community forest associations and joint ownership forest associations) and well developed in Switzerland, Austria, or Germany—allow community involvement in decision-making, and revenues from timber harvesting are reinvested locally. However, their technical and financial capacity is limited, and management often depends on forest districts. In Romania, these entities administer significant areas in mountainous regions where harvesting is difficult, making their success dependent on collaboration with professional forest managers.

Timber valorization in Romania is carried out through three main modalities: standing timber sales, processed (roadside) timber sales, and contracting harvesting services. The current strategic direction, supported by the new Forest Code and national policy, is to reduce the volume sold as standing timber and increase the share of processed timber delivered at forest roads or depots (table 6). This model, already dominant in Central and Northern Europe, provides superior control over work quality, allows accurate monitoring of volumes, and reduces the risk of overharvesting. In countries such as Germany, Austria, or Sweden, standing timber is sold only in small proportions, while most timber is processed and sorted in modern depots managed by administrations or cooperatives.

Table 6
The stages of the wood supply chain in Romania

Stage	Description	Involved actors
Primary landing	Wood is collected from the harvesting site	Logger / harvesting company
Intermediate depot	Sorting, weighing, SUMAL 2.0 documentation	Forest district / company
Final depot	Industrial reception, document verification	Industry / local authority (UAT)
Transport	Transport monitored through SUMAL 2.0	Transport operator

Digitalization of forest administration is one of the most important recent trends. In Romania, the SUMAL 2.0 system serves as the central digital infrastructure for recording timber volumes, issuing and verifying transport documents, and monitoring stocks. The public interface “*Forest Inspector*” enables real-time verification of timber transports, increasing transparency and reducing the potential for fraud.

Environmental organizations’ assessments have shown that the implementation of SUMAL 2.0 has led to a decrease in unjustified transports and improved identification of vulnerable areas. At the European level, the EUTR and EUDR regulations impose strict due diligence obligations on operators, including geospatial identification of origin parcels, risk assessment, and maintaining chain-of-custody systems. This requires forest administrations and economic operators to adopt complex IT systems capable of managing parcel-level data.

Across Europe, forest administration is becoming increasingly transparent and better integrated into environmental policies. Countries such as Finland and Norway publish detailed data on harvesting, planning, silvicultural works, and environmental impacts, and their national GIS systems are interoperable with European platforms. Romania is advancing in the same direction, but at a gradual pace, marked by the consolidation of the legal framework and the expansion of digital tools—yet limited by the financial capacity of local administrations and the level of staff training.

Timber valorization by local administrative units (UATs) and communal forests follows specific procedures: local councils annually approve the volumes according to the management plan, while auctions for timber sales are organized by forest

districts, based on clear transparency criteria. This model ensures a certain procedural uniformity, but efficiency depends on the administrative capacity of each UAT. In practice, differences are significant, and some local administrations face difficulties in applying legislation or in ensuring transparent management of the process.

Overall, European administrative trends converge toward a model characterized by advanced digitalization, increased transparency, professionalization, strengthening of the public role of forest administrations, and greater accountability for economic operators. Romania is gradually aligning with these directions, and the evolution of the legislative and technological framework demonstrates a clear intention to modernize the sector. The development of institutional capacity, the expansion of control systems, and the support for associative forms of forest management will play a key role in accelerating this transition.

DISCUSSIONS AND CONCLUSIONS

Wood harvesting in Romania and across Europe is undergoing a broad process of transformation, driven by climate challenges, socio-economic pressures, sustainability requirements, and the rapid evolution of forestry technologies. A comparative analysis of technical and administrative trends highlights both shared directions and the specific features of each national context. Although development models and investment capacities differ significantly between Northern Europe and Central-Southern Europe, the objectives converge toward the sustainable, efficient, and transparent management of forest resources.

On the technical side, the evolution of the European sector is dominated by full mechanization and the adoption of modern harvesting systems such as CTL (cut-to-length), supported by the development of forest infrastructure and the use of advanced digital technologies for planning and monitoring operations. Romania is gradually aligning with these trends, albeit at a moderate pace, influenced by the challenges posed by mountainous terrain, the low density of forest roads, and fragmented ownership. The use of skidders (TAF), semi-mechanized systems, and cable yarders remains characteristic of inaccessible areas; however, the gradual introduction of harvesters, forwarders, winch-assist systems, and monitoring tools based on

drones and GIS marks the beginning of a consistent modernization.

On the administrative side, the changes are equally profound. The new Forest Code – Law no. 331/2024 – has strengthened a modern legislative framework oriented toward responsibility, efficiency, and environmental protection, integrating the requirements of Regulation (EU) 2023/1115 on deforestation-free products (EUDR). Digitalization, through SUMAL 2.0, has become the central tool for monitoring timber, ensuring transparency of flows, and reinforcing the fight against illegal logging. At the same time, the reform of timber valuation procedures, the shift toward selling processed (cut-to-length) timber, and the professionalization of the management of private and community-owned forests contribute to improved forest governance.

At the European level, forest administrations—whether public, private, associative, or corporate—have developed a management model that is adaptable and integrated with climate and biodiversity conservation policies. Romania is in a process of converging with these standards, benefiting

from a modern legal framework, strong digital tools, and a professional community increasingly connected to international trends. However, significant challenges remain, such as infrastructure modernization, strengthening the administrative capacity of local authorities (UATs), increasing the level of mechanization, and developing forest cooperatives that would allow small forest owners to access professional services and modern technologies.

Overall, both technically and administratively, the direction of evolution is clear: advanced mechanization, digitalization, transparency, responsibility, and sustainability. Romania has considerable potential, and through strategic investments, institutional strengthening, and the adoption of European best practices, the forestry sector can reach a high level of efficiency, competitiveness, and compliance with international standards. The modernization of wood harvesting is not only a technical necessity but also an administrative, economic, and social one, and harmonizing these components is essential for the sustainable management of forests

REFERENCES

- Abrudan, I. V. (2009). Developments in the Romanian forestry and its linkages with other sectors. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 37(2), 14–21.
- Abrudan, I. V. (2012). A decade of non-state administration of forests in Romania: Achievements and challenges. *International Forestry Review*, 14(3), 275–284.
- Apăfăian, A. I., Proto, A. R., & Borz, S. A. (2017). Performance of a mid-sized harvester-forwarder system in integrated harvesting of sawmill, pulpwood and firewood. *Annals of Forest Research*, 60(2), 227–241.
- Bann, C., & Popa, B. (2012). An assessment of the contribution of ecosystems in protected areas to sector growth and human well-being in Romania. UNDP.
- Borz, S. A., Ignea, G., & Ciobanu, V. (2016). Workload, productivity, and environmental impact in Romanian forest operations. *Croatian Journal of Forest Engineering*, 37(2), 301–314.
- Borz, S. A., Ignea, G., Talmaciu, M., & Câmpu, V. (2013). Time consumption and productivity of a farm tractor equipped with a winch in winching operations. *Bulletin of the Transilvania University of Braşov, Series II: Forestry, Wood Industry, Agricultural Food Engineering*, 6(2), 23–30.
- Ciucanu, R., Borz, S. A., & Ignea, G. (2021). Efficiency of extraction operations under steep terrain conditions in mixed forests of the Eastern Carpathians. *Journal of Forest Science*, 67(5), 232–243.
- EFI – European Forest Institute. (2019). *European Forest Governance and Policy: An Overview*.
- European Commission. (2023). *Regulation (EU) 2023/1115 on deforestation-free products (EUDR)*.
- FAO – Food and Agriculture Organization. (2020). *Global Forest Resources Assessment 2020*.
- FAO & UNEP. (2020). *The State of the World's Forests 2020: Forests, biodiversity and people*.
- Forest Europe. (2020). *State of Europe's Forests 2020*.
- Giurgiu, V. (2004). *Silvology. Vol. III B. Sustainable Management of Romania's Forests*. Romanian Academy Publishing House.
- Halalisan, A. F., Marinchescu, M., Popa, B., & Abrudan, I. V. (2014). Forest administration in Romania: Frequent problems and expectations. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 42, 588–595.
- Horodnic, S. A. (2014). *Forest Technological Systems with Reduced Ecological Impact*. "Ştefan cel Mare" University Press, Suceava.
- Kaakkurivaara, O., Ala-Illomäki, J., Lamminen, A., & Uusitalo, J. (2022). Productivity and fuel consumption of skidder extraction in varying conditions in boreal forests. *International Journal of Forest Engineering*, 33(1), 25–36.
- Labelle, E. R., & Lemmer, K. J. (2019). Selected environmental impacts of forest harvesting systems with varying degrees of mechanization. *Croatian Journal of Forest Engineering*, 40(2), 239–257.

-
- Mederski, P. S. (2022). Current challenges in mechanized harvesting systems in Europe. *Forest Engineering Review*, 11(1), 15–29.
- MMAP – Ministry of Environment, Waters and Forests. (n.d.). SUMAL 2.0 – Integrated Information System for Wood Material Tracking.
- Metsähallitus. (2023). Annual Report and Forest Statistics. <https://www.metsa.fi>
- Moskalik, T., et al. (2017). State of forest harvesting in Eastern Europe compared to Western Europe: Challenges and development perspectives. *Baltic Forestry*, 23(2), 326–339.
- Nicolescu, V.-N., Hernea, C., & Sbera, I. (2018). *The Practice of Silviculture: Basics for Growing Forest Stands* (2nd ed.). AcademicPres.
- Popa, B., & Bann, C. (2012). Ecosystem services in Romania: Challenges and opportunities. UNDP Report.
- Popa, B., & Borz, S. A. (2019). Harvesting operations on steep terrain in Romania: Challenges and perspectives. *Romanian Journal of Forest Engineering*, 10(1), 45–53.
- Proto, A. R., Macri, G., Visser, R., Harrill, H., Russo, D., & Zimbalatti, G. (2018). Factors affecting forwarder performance: A European overview. *European Journal of Forest Research*, 137(1), 143–151.
- Romsilva – National Forest Administration. (2024). Official data on the administered forest area. <https://www.rosilva.ro>
- Spinelli, R., Magagnotti, N., & Lombardini, C. (2020). Cable yarding productivity and environmental impact: A review. *Forest Ecology and Management*, 475, 118–137.
- Stampfer, K. (2015). Recent developments in steep-terrain timber harvesting technologies. *Journal of Forest Engineering*, 26(3), 190–199.
- Statskog. (2022). Annual Report on State Forest Management. <https://www.statskog.no>
- Södra. (2021). Annual Review and Forestry Operations Report. <https://www.sodra.com>
- Talbot, B., & Suadicani, K. (2015). Influence of forest structure and geo-spatial distribution on machinery efficiency. *Baltic Forestry*, 21(2), 340–348.