

Bringing science and practice in forestry: Transforming residual biomass into market opportunities

J. Osiadacz¹, D. Włóka², P. Marcinek¹, E. Waluś¹ & M. Smol¹

¹Division of Biogenic Raw Materials, Mineral and Energy Economy Research Institute,
Polish Academy of Sciences, Cracow, Lesser Poland, 31-261, Poland

²GreenBack Ltd., University of Elsewhere, Katowice, Region, 40-600, Poland

Keywords: forestry by-products, circular economy, sustainable resource management, industrial applications, bioeconomy.

Presenting author email: ewalus@meeri.pl

The sustainable use of forestry by-products has gained increasing attention (Wang and Tian, 2023), (Konstantinavičienė, 2023) as industries seek innovative ways to utilise natural resources more efficiently and reduce environmental impact. With growing concerns over deforestation, climate change, and resource depletion, there is a pressing need to develop circular economy solutions that can maximise the potential of forestry residues and minimise waste (De Klerk et al., 2022). The CEforestry project, funded by the European Regional Development Fund (ERDF), aims to address these challenges by exploring innovative and practical approaches to repurposing forestry by-products, particularly focusing on the effective use of bark and conifer needles. These materials contain bioactive compounds with antimicrobial, antioxidant, and preservative properties, making them highly valuable in various industrial applications such as paper production, wastewater treatment, cosmetics, and food preservation (Dessbesell et al., 2017).

The significance of these forestry by-products extends beyond their immediate industrial uses, as their integration into various sectors contributes to broader environmental goals such as reducing reliance on synthetic additives, lowering carbon footprints, and promoting sustainable land-use practices (Petersson et al., 2022). The CEforestry initiative, conducted in May and June 2024, brought together researchers, industry representatives, and practitioners from diverse fields to exchange knowledge and explore novel approaches to utilising these forestry residues across multiple sectors. The discussions facilitated interdisciplinary collaboration and provided participants with insights into the economic, technical, and regulatory aspects of forestry by-product utilisation. By engaging experts from multiple disciplines, the project aimed to bridge the gap between scientific research and real-world implementation, ensuring that innovative forestry management strategies can be effectively adopted at a commercial scale.

As part of this effort, a survey was conducted among participants to assess their awareness and opinions regarding the use of forestry by-products in various industries, such as chemical, water and wastewater, cosmetics, and food sectors. The survey examined respondents' perspectives on the potential applications of these raw materials, their market value, and their impact on both the economy and the environment. Additionally, some questions focused on the willingness of respondents to pay a higher price for products of natural origin and evaluated whether current forest management practices are effectively utilising available resources. The findings from this survey provided valuable insights into industry expectations and consumer preferences, guiding discussions on the feasibility of integrating forestry by-products into various markets.

The research highlighted several key findings and underscored the potential applications of forestry by-products in various industries, such as paper production, wastewater treatment, cosmetics, and food manufacturing. Participants identified key challenges in implementation, including regulatory constraints, the scalability of extraction techniques, and the cost-effectiveness of integrating forestry-derived compounds into existing industrial processes. Several innovative solutions were discussed among participants, focusing on improving extraction techniques, enhancing bioactive compound stability, and optimising processing methods to make the use of these materials more viable on an industrial scale. Additionally, discussions emphasised the need for further research and collaboration between academia and industry to bridge the gap between scientific innovation and practical application.

Survey results provided additional insights into stakeholder perceptions. A majority of respondents (76.9%) were researchers, while 15.4% were representatives of small and medium-sized enterprises. Nearly half (46.2%) of participants had encountered products made from forestry by-products, with tree bark being identified as the most promising material for industrial applications (76.9%). The majority (62.5%) had encountered products derived from forestry by-products, primarily in cosmetics and food sectors. Although 100% of respondents supported the idea of promoting circular economy principles in forestry, only 15.4% believed that current forest resource management fully utilises its potential. Additionally, 69.2% of respondents expressed willingness to pay more for products containing natural-origin ingredients derived from forestry residues, highlighting a potential market for such innovations. However, challenges remain, as concerns about regulatory barriers and market readiness were frequently mentioned. Despite interest, only 12.5% believed that current forestry resource management is fully sustainable, indicating a significant gap between potential and practice.

Concerns about regulatory challenges, environmental impact, and effective commercialisation pathways were frequently highlighted, further underscoring the need for targeted policy support and industry collaboration. These findings provide a strong foundation for further investigation and potential commercialisation of forestry by-products across multiple sectors.

The CEforestry research demonstrated that forestry by-products possess significant potential as valuable raw materials for a wide range of industries, offering a sustainable alternative to synthetic additives and preservatives. While the implementation of these materials faces technical, economic, and regulatory challenges, the insights gained from the initiative indicate that collaborative efforts between researchers, policymakers, and industry stakeholders can facilitate progress and overcome these barriers. Future research should focus on optimising extraction techniques, ensuring regulatory compliance, improving cost-effectiveness, and scaling up industrial applications to enable wider adoption of these innovative solutions. The outcomes of the CEforestry project highlight the importance of bridging scientific research and practical application in order to achieve sustainable and circular forestry management. By fostering interdisciplinary collaboration and supporting innovation-driven initiatives, forestry by-products can be successfully integrated into industrial processes to enhance sustainability and create new economic opportunities.

References:

- De Klerk, S., Ghaffariyan, M., Miles, M., 2022. Leveraging the Entrepreneurial Method as a Tool for the Circular Economy: The Case of Wood Waste. Sustainability. <https://doi.org/10.3390/su14031559>
- Dessbesell, L., Xu, C. (Charles), Pulkki, R., Leitch, M., Mahmood, N., 2017. Forest biomass supply chain optimization for a biorefinery aiming to produce high-value bio-based materials and chemicals from lignin and forestry residues: a review of literature. Can. J. For. Res. 47, 277–288. <https://doi.org/10.1139/cjfr-2016-0336>
- Konstantinavičienė, J., 2023. Assessment of Potential of Forest Wood Biomass in Terms of Sustainable Development. Sustain. 15. <https://doi.org/10.3390/su151813871>
- Petersson, H., Ellison, D., Mensah, A.A., Berndes, G., Egnell, G., Lundblad, M., Lundmark, T., Lundström, A., Stendahl, J., Wikberg, P., 2022. On the role of forests and the forest sector for climate change mitigation in Sweden. GCB Bioenergy 14, 793–813. <https://doi.org/10.1111/gcbb.12943>
- Wang, J., Tian, G., 2023. Sustainability of Forest Eco-Products: Comprehensive Analysis and Future Research Directions. Forests 14. <https://doi.org/10.3390/f14102008>

Acknowledgments

Paper was prepared as a part of the project “Innovation in forestry biomass residue processing: towards circular forestry with added value products” (CEforestry) financed by the European Regional Development Fund (ERDF), project no. C023.



Co-funded by
the European Union

