

Introduction

Residual forest biomass (RFB) plays a key role in decarbonization strategies and the valorization of endogenous resources. Derived from forestry operations, RFB is a renewable resource with high potential for energy production, wildfire risk reduction, and the creation of value chains in the primary sector. Maritime pine and eucalyptus are the main productive forest species in Portugal, subject to regular silvicultural interventions. Their effective utilization requires rigorous quantitative and spatial assessment of production and availability, considering environmental, technical, and logistical constraints.

Methods

The adopted methodology for assessing RFB is based on an integrated approach that combines multiple data sources and analytical techniques:

- **Field inventories, dendrometric measurements, and weighing trials** were conducted in stands of *Pinus pinaster* and *Eucalyptus globulus*, aiming to quantify the available biomass.
- **Biomass equations and updated forest harvesting models** were applied to estimate annual production and average RFB availability factors per territorial unit (NUTS III). The average values per NUTS II are presented in Table 1.
- These availability factors were multiplied by the **forest area mapped in COS2023**, enabling the calculation of potential production and available RFB per NUTS III (see Figure 1).
- To assess the **available RFB**, a **utilization rate of 70%** was applied, incorporating limitations related to topography, accessibility, and environmental constraints, thereby **ensuring resource sustainability**.



Table 1 - Average Annual Availability Factors by NUTS II^(a)
(t/ha*year, dry weight)

NUTS II	Maritime Pine (Pb)	Eucalyptus (Ec)
Norte	0.95	0.73
Centro	0.90	0.77
Oeste e Vale do Tejo	1.01	0.88
Área Metropolitana de Lisboa	0.86	0.88
Alentejo	0.50	0.68
Algarve	0.73	0.66

^(a) Detailed NUTS III data available in the full paper.

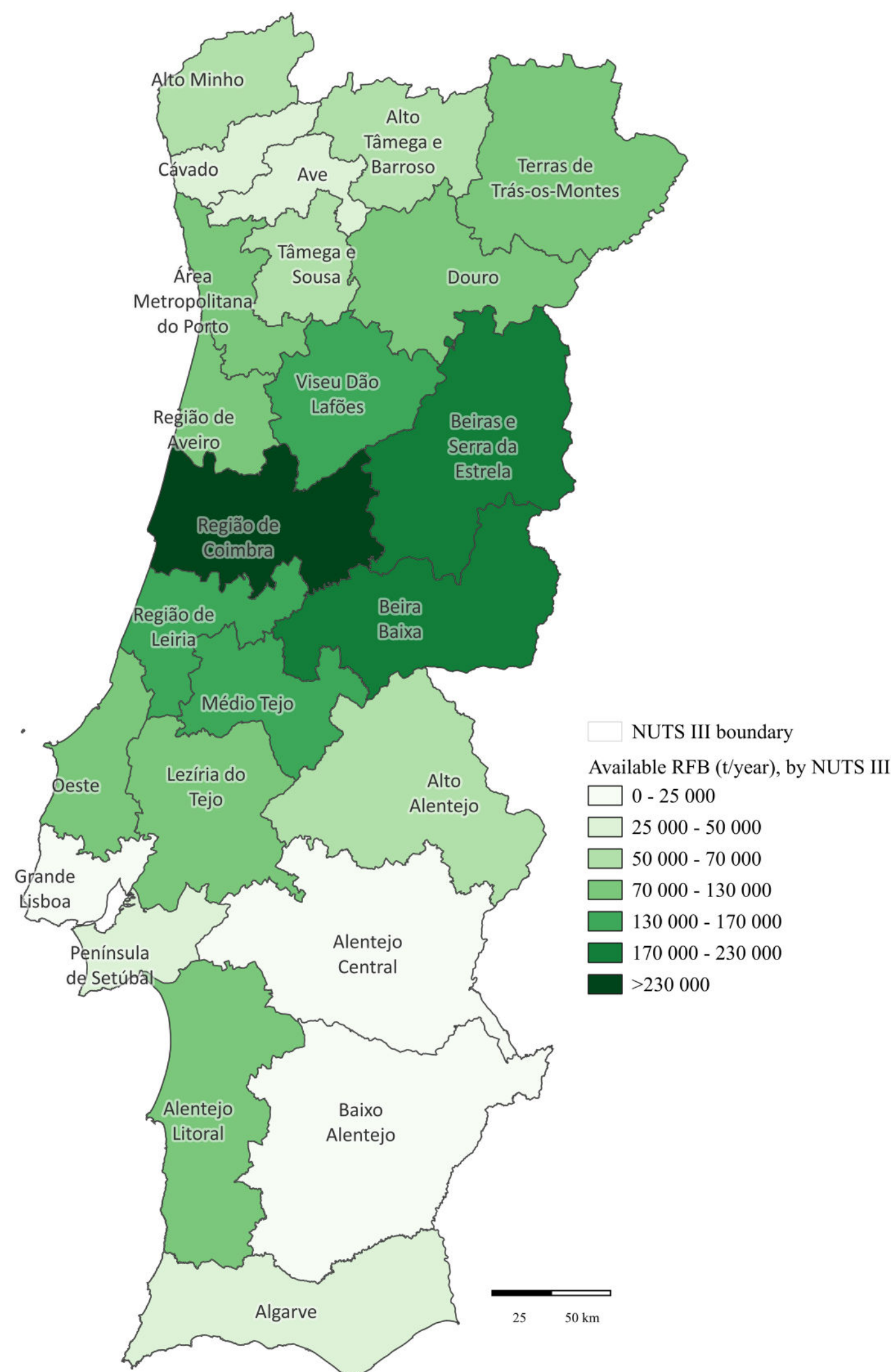


Figure 1 - Spatial distribution of available RFB by NUTS III
(t/yr, green weight)

Results & Discussion

- The **theoretical national production** of RFB is estimated at **3.1 million tonnes per year** (green weight). After applying a **70% utilization rate**, the **sustainable availability** is approximately **2.2 million tonnes per year**.
- **Regional variations** reflect differences in **climate, soil conditions, and forest management practices**. These values represent **regional annual averages** and may fluctuate from year to year.
- To estimate **biomass availability for a specific consumer**, it is important to **consider the relevant area of influence**, as availability may differ from the average values.
- The **mobilization of residual forest biomass** depends on **accessibility, logistical infrastructure, and resource competition**. These **limitations and constraints** must be considered in **planning and land-use assessments** to avoid conflicts over resource use and to ensure **integrated forest management**.
- The results obtained provide **valuable support for regional energy planning and wildfire risk mitigation**, offering **strategic insights for policymakers and investors**.

Conclusions & Future Work

- This study presents a **replicable methodological framework** for estimating RFB in Portugal. It contributes to the development of **bioenergy strategies, sustainable forest management**, and the achievement of **climate policy objectives**.
- However, the results must be interpreted with consideration of **regional variability, accessibility, and logistical constraints** that influence biomass mobilization. Accounting for these factors is essential to ensure **integrated forest management** and to prevent **conflicts in resource use**.
- **Future work** will incorporate **remote sensing technologies, machine learning techniques**, and **updated forest inventory data** to enhance **predictive capacity** and **optimize resource planning**.



REFERENCES

- Direção-Geral do Território (2025). Carta de Ocupação do Solo 2023 – COS 2023. Lisboa: DGT.
- Centro da Biomassa para a Energia (2007). Atlas da Biomassa Florestal Residual produzida em Portugal Continental. Miranda do Corvo: CBE.
- Direção-Geral do Território (2025). Carta Administrativa Oficial de Portugal – CAOP (versão 2024). Lisboa: DGT.
- Fernando Páscoa, F. Martins, R. Salas, C. João (2004). Estabelecimento simultâneo de equações de biomassa para Pinheiro bravo. In: II Simpósio Iberoamericano sobre Gestión y Economía Forestal, Barcelona, pp. 18–20.
- M. Tomé, P. Soares, F. Ribeiro (2001a). O modelo GLOBULUS 2.1. Publicações GIMREF RTC 1/2001. Departamento de Engenharia Florestal, Instituto Superior de Agronomia, Lisboa, Portugal.