

Proceedings

Productivity and Life Cycle Assessment (LCA) of Tree Felling by Chainsaw in Thinning of Calabrian Pine Stands

Bruno Bernardi ^{*}, Giorgio Macrì and Giacomo Falcone

Università Mediterranea di Reggio Calabria, Dipartimento di Agraria, Feo di Vito, 89122- Reggio Calabria, Italy; giorgio.macri@unirc.it (G.M.); giacomo.falcone@unirc.it (G.F.)

^{*} Correspondence: bruno.bernardi@unirc.it

Abstract: Forest mechanization plays an important role in increasing labour productivity and reducing production costs. Chainsaw is the most widely common tool used for tree felling and can have both positive and negative environmental impacts on the forest ecosystem. Impacts that should be analysed considering all implemented inputs and outputs related to the involved technology.

This work aims at evaluating the operational and environmental performance of a medium-sized chainsaw during a second thinning carried out on Calabrian Pine high forests. Trees, located at an altitude of 1100 m a.s.l, had an average diameter at the breast height of 30.6 cm and height of 18 m, for a density of 950 trees ha⁻¹. The terrain roughness presents obstacles on less than 1/3 of the surface, while the slope was between I and II classes (0-40%).

A work time study on felling operation was conducted considering a full-tree system. Thirty operational cycles were registered: observed time was separated into working time, which included main and complementary working times, calculated as average gross productivity inclusive of all delays up to the maximum event duration of 15 min.

The life cycle assessment (LCA) approach was adopted for environmental performance. As Functional Unit 1 m³ of round wood was chosen. The inventory data related to background processes were collected from Agribalyse 3.0.1. while data from the foreground, such as materials and fuel consumption, were directly collected. Environmental impact data were processed using OpenLCA software and the ReCiPe 2016 method at the midpoint level.

Team productivity, was equal to 10.30 trees h⁻¹, corresponding to a volume of timber of 11.2 m³ h⁻¹. Considering a working day of 8 h, productivity was equal to 41 trees d⁻¹ worker⁻¹ for a volume of timber of 44.8 m³ d⁻¹ worker⁻¹.

The LCA performed shows that emissions related to the stage of use represented the major hotspot in “Global warming” (2.169 kg CO₂ eq.), “Ozone Formation–Human Health” (0.038 kg No_x eq.), “Fine particulate matter formation” (0.001774 kg PM 2.5 eq.) and “Terrestrial ecotoxicity” categories (4.234 kg 1,4-DCB).

In conclusion, the analyzed site showed a proper level of internal organization but more regular management of the chainsaw is required. Environmental impact is affected by the energy systems in the use phase but is needed to deepen the knowledge of all aspects involved from upstream processes for certain materials to manufacture components.

Keywords: forest mechanisation; work productivity; life cycle assessment (LCA); environmental impact

Citation: Bernardi, B.; Macrì, G.; Falcone, G. Productivity and Life Cycle Assessment (LCA) of Tree Felling by Chainsaw in Thinning of Calabrian Pine Stands. *Environ. Sci. Proc.* **2022**, *4*, x. <https://doi.org/10.3390/xxxxx>

Academic Editor: Rodolfo Picchio

Published: date

Publisher’s Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).