



Divergences on the environmental impact associated to the production of maritime pine wood in Europe: French and Portuguese case studies



Sara González-García^{a,b,*}, Ana Cláudia Dias^a, Gumersindo Feijoo^b, María Teresa Moreira^b, Luis Arroja^a

^a CESAM, Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal

^b Department of Chemical Engineering, School of Engineering, University of Santiago de Compostela, 15782 Santiago de Compostela, Spain

HIGHLIGHTS

- Energy and environmental profiles were quantified for maritime pine stands.
- Different forest scenarios were inventoried and analyzed in Portugal and France.
- Remarkable differences on forest practices were identified between both countries.
- Logging related activities were identified as the *hotspots* mainly due to the fuel requirements.
- Comparing the results with other forest LCA studies, slight differences were reported.

ARTICLE INFO

Article history:

Received 6 May 2013

Received in revised form 5 November 2013

Accepted 6 November 2013

Available online 30 November 2013

Keywords:

Extensive management

High intensity

Intensive management

Life Cycle Assessment

Low intensity

Pinus pinaster

ABSTRACT

Life Cycle Assessment (LCA) has become a common methodology to evaluate the environmental performance of forest systems in recent years. This study aims to estimate the environmental profile associated with maritime pine wood production in two representative European countries: Portugal and France. Different forest management regimes based on low and high intensive conditions were evaluated and differences in logging equipment, biomass yield and lifespan were also reported. The study was completed with a sensitivity analysis based on two allocation approaches (economic and volumetric) since biomass from thinning processes is harvested and can be used as a co-product.

The production of maritime pine in Portugal under low intensity conditions should present the best environmental results with reductions of 50–94% in comparison with the worst scenario. It is mainly associated with the absence of forest activities in periods previous to the logging stage.

French intensive forest scenario ranks as the second best alternative of pine wood production. The remaining scenarios reported worse results in terms of environmental impacts mostly due to the remarkable repetition of a selection of those forest activities with large fuel requirement (mainly on site preparation and stand establishment and tending).

Regardless of the scenario, logging related activities such as final cutting and forwarding were identified as the *hotspots* mainly due to the fuel requirements. Fertilizer production (if required), thinning and cleaning processes reported also remarkable contributions to the categories under assessment.

In addition, an economic estimation for each forest management scenario has been performed mainly considering fuel, machinery and labor costs. According to the results, the Portuguese low intensive scenario is the best choice together with the French intensive scenario under an economic point of view because of the lowest production costs per functional unit. Activities related with the logging stage have also been identified as economic *hotspots*.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

Life Cycle Assessment (LCA) has become a common and standardized methodology to evaluate and report the environmental performance of

services and products, due to its holistic approach, guaranteeing the comprehensiveness of the environmental evaluation (ISO, 14040, 2006). The assessment of the environmental consequences derived from forestry has been performed since the nineties paying special attention on global warming. In fact, greenhouse gas (GHG) emissions from forest operations were first reported for Finland (Karjalainen and Asikainen, 1996) and Sweden (Berg, 1997), both countries with a long-tradition forest culture.

Forests are considered as carbon sinks in the Kyoto Protocol (UNFCCC, 1997), due to CO₂ uptake by photosynthesis (Nabuurs et al., 2008). There

* Corresponding author at: CESAM, Department of Environment and Planning, University of Aveiro, 3810-193, Aveiro, Portugal. Tel.: +351 234370387.

E-mail addresses: sara.gez.garcia@gmail.com, sara.gonzalez@usc.es (S. González-García).

is a rich body of scientific literature concerning the effects of forest management on growth, productivity, carbon sequestration and environmental effects. Environmental assessment of forest operations has been carried out for a number of tree species: Norway spruce and Scots pine in Finland and Sweden (Berg and Karjalainen, 2003), maritime pine in Portugal (Dias and Arroja, 2012), eucalyptus in Portugal and Spain (Dias et al., 2007; Dias and Arroja, 2012; González-García et al., 2009a), willow in Sweden (González-García et al., 2012a); poplar in Italy and Spain (Gasol et al., 2009; González-García et al., 2012b), and European beech in Germany (Berg et al., 2012). In these countries, the forest sector is an integral part of the society, income and work opportunities.

In the last years, special attention has been paid on the introduction of improvements in the LCA methodology when it is applied to the analysis of dynamic (non-steady-state) systems such as forest or aquatic ecosystems (Baird et al., 2009; Levasseur et al., 2012; Schaubroeck et al., 2012). Examples of potential ecological indicators in forest systems

should be carbon sequestration and temporary carbon storage. However, there are not yet strict standards giving room for uncertainties in the results (Schaubroeck et al., 2012).

The European forest sector is characterized by a great diversity of forest types, forest covers, socio-economic conditions and ownership structure (Berg et al., 2012). Concerning its occupation, around 35% of the total European land area is occupied by forests and wooded land (European Commission, 2010). Nordic countries such as Sweden and Finland as well as Germany are the most important European countries in terms of forest cover and wood production (FAO, 2013). However, forest in the Mediterranean region is also very important because of its high ecological value and contribution to human welfare. Mediterranean forests are appreciated, not only for producing wood-based products but also for the provision of non-wood products and services (EFL, 2013). In this sense, Portugal and France receive special attention in terms of roundwood production (FAO, 2013), particularly in the case

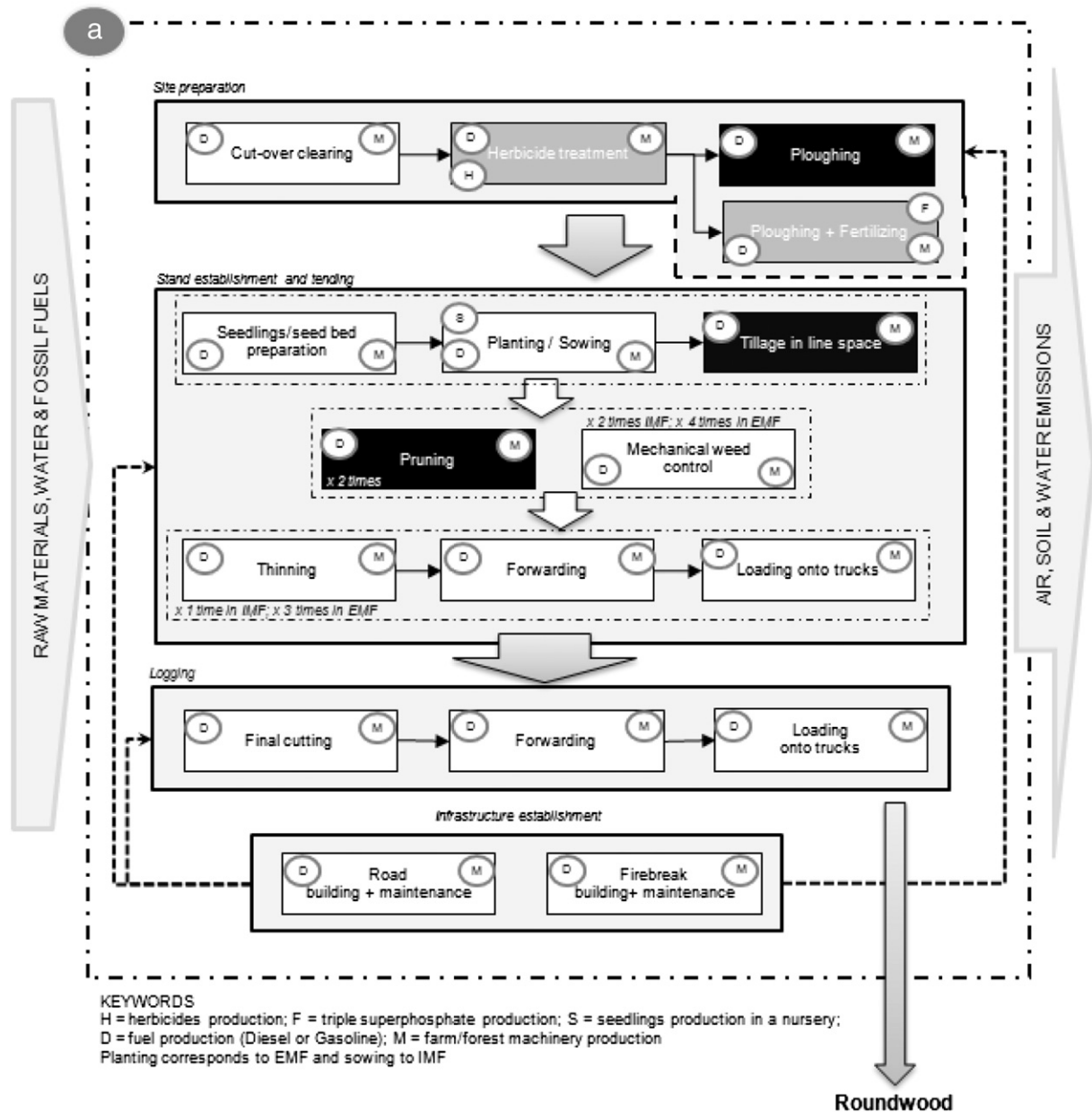


Fig. 1. a. Scheme of the system boundaries for the maritime pine roundwood production scenarios. a) French scenarios. Boxes in black are exclusive for the extensive management scenario (EMF) and boxes in dark gray for the intensive management scenario (IMF). b) Portuguese scenarios. Boxes in dark gray are exclusive for the high intensive scenario (HMP) and boxes in black for the low intensive scenario (LMP).

Download English Version:

<https://daneshyari.com/en/article/6331137>

Download Persian Version:

<https://daneshyari.com/article/6331137>

[Daneshyari.com](https://daneshyari.com)