

Sustainability assessment of forest biomass supply chain at local scale: carrying capacity of the system for energy valorisation

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1. Introduction

The multifunctionality of forest has been remarked constantly in European policies. Forests can ensure several ecosystem services: providing raw material for goods, regulating local and global climate, buffering weather events, regulating the hydrological cycles, protecting watersheds and their vegetation [1]. The valorisation of forest biomass is recognized as a new frontier of economically sustainable and environmentally friendly processes, however it is not possible to assume a positive comprehensive balance in term of sustainability of products based only on the fact that they are bio-based [2].

Evaluation of the trade-off between the benefits coming from forest resources' use and the conservation of forest ecosystems is needed. Considering the use of biomass for energy purpose, on one hand the use of wood resources should be based on an evaluation of the "carrying capacity" of the forest ecosystem and site-specific characteristics (e.g. the local accessibility of raw material and the distance from the processing plant to the delivery point); on the other hand, the role of biomass valorisation has to be assessed considering the socio economic benefit or drawbacks due to the further development of the supply chain. E.g, positive effect related to an increase employment in less developed mountain areas and to a direct relation between population and territory needs to be quantified. In the context of a site-specific sustainability assessment of a wood energy supply chain, the research focuses on development of an expeditious methodology to obtain georeferenced quantity of biomass at local scale for mountain forest areas, in order to facilitate energy planning that considers the local system carrying capacity and the potential of substitution of fossil fuels.

2. Methodology

Proposed methodology for a comprehensive sustainability assessment was presented in [2]. The methodology developed for the site-specific assessment of the biomass availability, with respect to carrying capacity, is summarized in Figure 1. It consists of quantification and mapping (using Geographic Information System) of forest biomass that considers local features (e.g. abundance, spatial distribution and type of species) as reported in local territorial plans and it applies Life Cycle Assessment for supporting the overall environmental assessment.

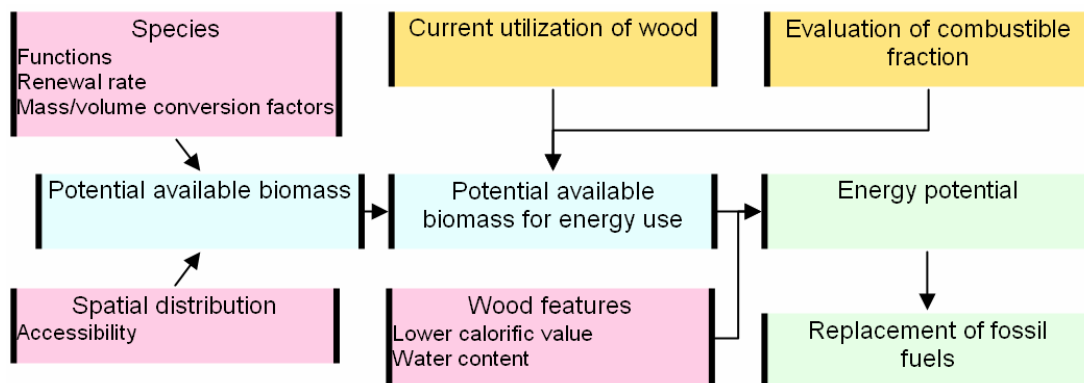


Figure 1 – Methodology to evaluate forest biomass availability for energy valorisation

Biomass value calculated has been converted from volume to mass, considering species features and water content. The result is compared with current utilization of wood, and waste products from forestry processing are estimated, in order to quantify the mass available for energy valorisation. Then, the Energy potential is

estimated, from biomass quantity and from wood features, principally the lower calorific value and water content for each species. Finally, the potential of substitution of fossil fuels is calculated, knowing energy potential from available biomass for energy use.

3. Results

The methodology is applied to two mountain areas, Comunità Montana Lario Intelvесе (CMLI) and Comunità Montana Triangolo Lariano (CMTL), in Northern Italy (Como Province). Results are summarised in Table 1. Humidity content considered was 20% and 40% (threshold values of the fuel in the case of forest chips boilers). Current utilization is estimated through the elaboration of Forest Activity Statements: 62% for CMLI and 66% for CMTL. Considering data from [3] and [4], combustible fraction adopted to estimate potential available biomass for energy use is 80%.

Local authority area	Potential available biomass (t/y)	Current Utilization of wood* (t/y)	Potential available biomass for energy use* (t/y)	Energy potential* (GJ)	Replacement of fossil fuels* (tep)
CMLI	25,277 ± 3,636	15,672	7,684	89,486	2,138
CMTL	31,110 ± 4,475	20,533	8,462	98,395	2,351

*Table 1 - Results (*medium values)*

Policy of the Province of Como identifies small biomass plants (power below 1 MW thermal) as optimal solution in order to use the resource in energetic valorisation. CMLI area has already a thermal power plant forest chips for district heating. Considering the consumption of such facilities and the biomass availability calculated, it is estimated that for each study area can be provided for 20-30 similar plants. The location of these facilities should be based not only on the demand for energy, but also on the spatial distribution of biomass and accessibility of forests, considering the different types of roads and paths for transport and storage of firewood. LCA was used to assess the overall environmental impact.

Considering the study conducted by Joint Research Centre (JRC) with CATI (Computer Assisted Telephone Interviewing) methodology and related to the use of wood for domestic heating in Lombardy Region, the value of wood used is 92,290 t for the Province of Como, comparable with results of elaboration of Forest Activity Statements, approximately 80,900 t. Considering that values from Forest Activity Statements could be overestimated, that not all the wood is used for the combustion and that consumption data of the study refer only to domestic heating, it is reasonable to assume that a portion of the wood used for domestic heating comes from outside the province of Como. On the basis of available data, this amount is about 30,000 t. This value is partially bridgeable with full use of the resource in the two local authority areas.

4. Conclusions

The proposed methodology evaluates the possibility for forests to provide the supply of raw material for energy production among ecosystem services. In addition, this assessment aims to integrate considerations to protect the other ecosystem services. Moreover, the methodology is useful for a preliminary assessment of the possibility to considering woody biomass in energy planning at local level. Finally, spatial distribution, quantity and accessibility of wood resources should be compared with the energy demand in order to identify the best location and characteristics of the plants for energy production and to minimize the transport within the supply chain.

5. References

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