

LCA and LCC for the Evaluation of Sustainability of Rapeseed, Giant Reed, and Poplar Cultivation

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Abstract : The reconversion process of the Italian sugar supply chain to bio-energy supply chains, as a result of the 2006 Sugar CMO reform, have involved research to define the best logistics, the most adapted energy crops for the Italian territory and their sustainability. Rapeseed (*Brassica napus* L.), Giant reed (*Arundo donax* L.) and Poplar (*Poplar ssp.*) are energy crops considered strategic for the development of Italian energy supply-chains. This study analyzed the environmental and the economic impacts on the farm level of these three energy crops. The environmental assessment included six farming units, two per crop, which were extracted from a sample of 251 rapeseed farm units (2751 ha), 7 giant reed farm units (7.8 ha), and 91 poplar farm units (440 ha) using a statistical multivariate analysis. Life Cycle Assessment (LCA) research method has been used to evaluate and compare the sustainability of the agricultural phases of the crops studied. The impact analyses have been performed at mid-point and end-point levels. The results of the analysis shown that the fertilization, is the major source of environmental impact of the agricultural phase due to the production of the fertilizers and the soil emissions of GHG following the treatment. The perennial energy crops studied (*Arundo donax* L., *Poplar ssp.*) were environmentally more sustainable if compared with the annual crop (*Brassica napus* L.) for all the impact categories at mid-point and end-point levels analyzed. The most relevant impact category influenced by the agricultural process result the fossil depletion, mainly due to the fossil fuels consumed during the mineral fertilizers production (urea). Human health was the most affected damage category at the end point level. Poplar result the energy crop with the best environmental performance for the Italian territory, in the distribution areas most suitable for its cultivation.

Keywords : LCA, energy crops, rapeseed, giant reed, poplar

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