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Life-cycle assessment of irrigated and rainfed sunflower addressing uncertainty and land use change scenarios

Filipa Figueiredo, Érica G. Castanheira, Fausto Freire



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1 **Life-cycle assessment of irrigated and rainfed sunflower addressing**
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4 Filipa Figueiredo¹, Érica G. Castanheira^{1,*} and Fausto Freire¹

5 ¹ADAI-LAETA, Department of Mechanical Engineering, University of Coimbra, Pólo II

6 Campus, Rua Luís Reis Santos, 3030-788 Coimbra, Portugal

7 *Corresponding author. Tel.: +351 239790739; Fax: +351 351239790701; E-mail address:

8 erica@dem.uc.pt

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10 **Abstract**

11 Sunflower is an important feedstock for food and energy purposes in southern European
12 countries. The main goal of this article is to present an environmental life-cycle
13 assessment of sunflower cultivated in Portugal comparing irrigated and rainfed systems,
14 incorporating parameter uncertainty and assessing alternative land-use change scenarios.
15 The functional unit adopted was 1 kg of sunflower seeds (hectare of land was also
16 addressed in a sensitivity analysis). The average productivity ($\text{kg ha}^{-1} \text{ year}^{-1}$) of irrigated
17 sunflower was 3.5 times higher than of rainfed. Irrigated sunflower presented higher
18 acidification impact than rainfed. Similar greenhouse gas intensity and eutrophication
19 impact were found for irrigated and rainfed systems taking into account the high variability
20 and uncertainty levels calculated. Higher uncertainty levels were observed for the impacts
21 of irrigated sunflower compared with rainfed, due to field emissions. Greenhouse gas
22 intensity of sunflower greatly depends on land use change scenarios (the lowest emissions
23 occur for the conversion of severely degraded grassland into irrigated sunflower and the
24 highest emissions for the conversion of improved management grassland into rainfed
25 sunflower). The sensitivity analysis performed for the functional unit showed very different

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