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Environmental Impacts Derived from A Spanish Crop Producing PGI White Bean Using Life Cycle Assessment

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Abstract

Growing population, dwindling resources, and changing climate have increased the pressure on agriculture. Pulses, which include leguminous crops such as beans, peas, chickpeas, and lentils, can play a major role in increasing production of the agricultural sector while enhancing sustainability. In this context, the availability of reliable tools to evaluate environmental aspects is crucial. Life Cycle Assessment (LCA) has proved to be a valuable methodology for researchers, growers, and policy makers. Annual global production of common bean (Phaseolus vulgaris L.), which has been reported as the most important legume for direct human alimentation, exceeds 26 million tons. Additionally, Spain is one of the principal EU-countries producing and consuming legumes. This work has evaluated the environmental impacts derived from the production of PGI “Faba Asturiana” by means of LCA methodology with the aim to widen the knowledge on the environmental behaviour of legume crops in Europe. The case study has been a small-scale organic crop sited in the North of Spain that annually produces around 1,000 kg of dry beans. The system boundaries included from the production of raw materials to the orchard gate (“cradle to gate” perspective), being 1 kg of dry beans the functional unit (FU). Impact assessment has been carried out with the LCA Simapro 9.5 software using the ReCiPe 2016 Midpoint (H) V1.08 method. In addition, the Greenhouse Gas Protocol (GHG) V1.03 method has been employed to calculate the carbon footprint (CF). Results showed that the main contribution to the environmental impacts was the electricity consumption, accounting for more than 30% in 13 of the 18 categories analysed. This subsystem was especially harmful in ionizing radiation (96%), non-carcinogenic toxicity (75%), mineral resource scarcity (68%), fine particulate matter formation (55%) and in those categories related to ecotoxicity (terrestrial, freshwater and marine) (>50%). A CF of 1.20 kgCO2eq per kg of dry beans was obtained, value within the range reported by other authors for leguminous crops (0.1-1.24 kgCO2eq per kg of seeds). Again, electricity consumption was the major responsible for CF value, followed by emissions to atmosphere derived from waste incineration and diesel use. Another key factor for CF was land productivity. It has been reported that a crop of PGI “Faba Asturiana” adequately exploited can produce annually above 1,500 kg/ha, whereas in the case study

analysed here only 884 kg of dry beans were obtained per ha. One of the main reasons of this low yield might be the repetition of this specific crop on the same land, which could negatively affect productivity. According to the results obtained, the proposals to reduce the CF in the crop considered would be related with decreasing electricity consumption (or using renewable energy sources) and/or implementing good agricultural practices that allow incrementing productivity.

Keywords: LCA, Phaseolus vulgaris, leguminous, carbon footprint, environmental assessment