The environmental footprint of pistachio production in Aegina

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Aegina island is located approximately 16.5 miles south of Athens with a total surface area of 87 km^2 and a coastline of 57 km. It is characterized by semi-arid Mediterranean climate, typical topography, coastal plains and mountainous areas with hilly intermediate formations. The north part of the study area is intensively cultivated and the major land uses include family orchards with pistachio trees scattered in the urban areas (63% of the irrigated land). Pistachio waste streams (mainly hulls and shells) account for more than 75 % of the harvested crop and around 7,000 tons are disposed in Greece annually

For the quantification of environmental footprint of the life cycle of pistachio production in terms of energy consumption and greenhouse gas emissions, a Life Cycle Analysis (LCA) was carried out using the commercial GaBi 6 software and related databases. The functional unit considered was 1 t of dry in-shell pistachios. Input data were obtained from different sources, namely primary data from surveys and the AgroStrat project, while secondary data from the literature. Data were obtained also from the available Gabi databases (Ecoinvent, Professional). The main impact categories assessed were acidification potential (AP), eutrophication potential (EP), global warming potential (GWP), ozone depletion potential (ODP), photochemical ozone creation potential (POCP) and cumulative energy demand (CED).

The results of the study showed that the Environmental footprint of pistachio production was 2.04 kg CO_2-eq per tonne of dry in-shell pistachios. Just for comparison, it is mentioned that the environmental footprint of apple and almond production is 0.109 kg CO_2-eq and 2.00 kg CO_2-eq respectively (both were produced in eastern Thessaly, Greece). On the other hand, the energetic footprint of pistachio production was 28.05 GJ per tonne of dry in-shell pistachios compared to 0.96 GJ for apples and 27.33 GJ for almonds. The production cost (fixed and variable) was 12,600 €/ha/year, while the gross production value was 20,000 €/ha/year (8 € per kg of pistachios) and the net return/profit 7,400 €/ha/year.

Regarding the Environmental footprint, the contribution of each main phase/sub-phase was as follows: fertilizers production (25.5 %), irrigation system (22.5 %), cultivation operations (agrochemicals application, machinery use, planting, tillage, ploughing, harvesting) (16.5%), post-harvest (dehulling, sorting, cleaning, drying, grading, storage) (13%), agricultural machinery (production) (9%), waste management (6%), others (transport, nursery) (8 %).

Regarding the Energetic footprint, the contribution of each main phase/sub-phase was as follows: fertilizers production (29 %), irrigation system (22 %), cultivation operations (15%), agricultural machinery (10%), post-harvest (9 %) waste management (7 %), others (8 %)

The specific results of this study show that the assessment of the environmental and energetic footprint of pistachio production allows the identification of “hot spots” (phases/processes with high environmental impacts or phases/processes with high energy consumption) and thus enables the consideration/evaluation of alternative scenarios/processes for a more environment friendly production in order to improve sustainability in agriculture.

The broader results of this study can be summarized as follows:

- Environmental impact assessment tools, primarily LCA, can be used to identify opportunities to improve sustainability in terms of implying eco-friendly farm practices and promoting utilization of waste/byproducts
- Risk assessment is particularly accurate and reliable in terms of delineating the most vulnerable areas that require in-depth and frequent monitoring
- Both tools can be useful for policy/decision makers during the implementation and prioritization of policies for groundwater protection and waste management, especially in areas where intensive agricultural activities in terms of water consumption and use of agrochemicals are carried out
- More data obtained from additional field and survey studies, pertinent to production and application of soil amendments would be extremely useful in order to minimize uncertainty of the obtained results.

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