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Comment

# Comment on Verteramo Chiu, L.J.; Gomez, M.I. A Tale of Two Strawberries: Conventional and Organic Open-Field Production in California. *Sustainability* 2023, 15, 14363

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We appreciate Verteramo and Gomez's Life Cycle Analysis (LCA) work on conventional and organic strawberry production systems in California [1], showing that organic production can produce more greenhouse gases for transporting low-nutrient organic fertilizers than conventional systems. However, we find that their work, solely based on the cost study of each system [2,3], has major problems in terms of both the conventional and organic strawberry production systems' analyses. As we directly work with these systems and one of us is the first author of the cost studies that Verteramo and Gomez's paper is based on, we feel obliged to point out these problems for readers of this paper.

For conventional systems, the paper failed to include fumigation in their analysis. Chemical fumigation is a core technology and is always used in conventional strawberry production systems in California to control soilborne pathogens and weeds [4,5]. The cost study [2] assumes broadcast fumigation using chloropicrin. The typical application rate of broadcast chloropicrin is 350 lb/acre. Due to the high application rate and toxicity, regulations for fumigants are increasingly stringent in California. Fumigants may be eliminated in California by 2050 as priority pesticides under the sustainable pest management roadmap [6]. Since 2003, the California Department of Pesticide Regulation (CDPR) has documented hundreds of acute illnesses caused by accidental fumigant exposure to agricultural workers and people living near fumigated fields [7]. A study also showed that the continuous use of fumigants in California strawberry fields reduced the populations of arbuscular mycorrhizal fungi, beneficial microbes, in the soil [8]. Broadcast fumigation also requires an extra, specific tarp (totally impermeable film: TIF, a 5- to 7-layered thin plastic film including ethylene vinyl alcohol layers embedded in standard polyethylene film [9]), covering the entire ground surface of a treated field before planting strawberries. Besides fumigant, therefore, this additional TIF tarp (not regular polyethylene tarp) and the labor and energy for applying, removing, and disposing of the TIF tarp should be included in the LCA analysis for the conventional systems. Further, their analysis might also need to consider the administration costs of fumigant regulations at the federal and state levels.

For organic systems, the paper assumed that composts and feather meals are equivalent to "manures" regarding nutrient dynamics in the production systems because of the lack of compost data in the libraries they used. This is a problem. First, manure is rarely used in organic strawberry production in California. The USDA National Organic Standard regulates the application of manure at least 90 days before harvest [10]. However, very few strawberry growers in California use it due to the inconsistency of the nutrient contents, difficulty in handling, and food safety concerns [11]. Second, manure and compost behave differently in the soil, and composting manure decreases the solubility of nutrients in manure [12]. For example, the nitrogen mineralization rate of poultry manure is much greater on average and more variable than that of composted poultry manure [13]. Therefore, their



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conclusion that organic systems cause more marine eutrophication than conventional ones is most likely exaggerated, especially if the LCA model assumes nitrogen is the limiting nutrient in marine waters, as it typically does. Further, compost application is known to increase soil carbon sequestration in California row crop systems [14,15]. This is not included in the LCA analysis in this paper.

We hope the paper will be revised based on these points, and a fairer comparison between the two systems weighing greenhouse gas-producing potential, carbon sequestration potential, and ecological toxicity will be made. It was unfortunate that the paper was not reviewed by someone who had enough knowledge of the systems before publication. Although current large-scale industrialized organic strawberry production systems might have some issues, the consumer behavior of purchasing organic strawberries may be much more legitimate than this paper indicates when the negative impacts of fumigants on the environment and human health in conventional strawberry production are considered.

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