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# Understanding the Complexity of the Food System: Differences and Commonalities between Two Optimization Models †

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**Abstract:** Background and objectives: There is a compelling need for a more sustainable food system because of climate change and contemporary Western diets, which pose a threat to human and planetary health. The food system is a social–ecological system, consisting of both biophysical and social sub-systems which are interlinked. This implies that changes in one sub-system can lead to synergies and trade-offs elsewhere. To identify such synergies and tradeoffs, researchers are integrating work from a range of disciplines in optimization models. This has resulted in models that are unique but have a similar overarching aim: 'to create a sustainable food system by understanding the implications of food system choices'. However, the results of these models may differ. Therefore, the aim of this paper was to understand the differences and complementarity of two optimization models to grasp the complexity of the food system. Methods: we compared the Circular Food System (CiFoS) model with the Sustainable, Healthy, Acceptable, Realistic, and Preferable diets (SHARP) model. CiFoS is a biophysical optimization model that aims to produce a healthy diet for a growing population within planetary boundaries. SHARP is a benchmarking model that optimizes current diets for health and sustainability for consumers. Both models propose a healthy and sustainable diet. While CiFoS is detailed on how environmental impacts are calculated, SHARP has a finer grid on the consumption aspects. Results: based on previously modelled scenarios that showed different results in diet composition, we identified that these differences could be explained by fundamental characteristics of the model (e.g., environmental impact calculations or the consideration of distance to the current diet), data input and scenario settings. Besides, the models work complementary regarding the time scale (i.e., solutions for the upcoming years versus upcoming decades), geographic scale and an individual versus population approach. Conclusion: Optimization models may be used for the same goal, e.g., finding an optimal diet, but the nuance chosen will lead to different outcomes. The outcomes of such models are complementary and can therefore be used in conjunction to inform policy or other food system stakeholders.

**Keywords:** CiFoS; SHARP; Sustainable food system; diet modelling; diet optimization; healthy and sustainable diet



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