

---

## **Alternative futures of circular food systems: the environmental consequences of adopting circularity at different spatial scales**

*B van Selm<sup>1,2,\*</sup>, IJM de Boer<sup>1</sup>, MK van Ittersum<sup>2</sup>, R Hijbeek<sup>2</sup> and HHE van Zanten<sup>1</sup>*

<sup>1</sup>Animal Production Systems Group, Wageningen University & Research, the Netherlands

<sup>2</sup>Plant Production Systems Group, Wageningen University & Research, the Netherlands

\*Correspondence: ben.vanselm@wur.nl

Applying circularity to the food system is increasingly seen as an important pathway to a sustainable food system. Circular food systems increase resource use efficiency to reduce the environmental impact by closing the loop of materials and utilising residual streams (e.g. manure, co-products, food-waste). However, the scale at which the loop of materials should be closed (e.g. regional, national, continental, global) and how these residual streams should be utilised (e.g. feeding to animals or applying to soils as fertiliser) is currently unknown. The availability of residual streams in the food system is highly dependent on the dietary choices of the population (i.e. the availability of the co-product wheat middling's is determined by the consumption of wheat flour). Therefore, a food systems approach is required to understand the full extent of applying circularity in the food system. A food systems approach assess the environmental impact of the whole food system rather than focusing on the chain of a specific food product (i.e. a lifecycle approach). We propose creating a circular food system optimisation model using a food system approach to minimise the environmental consequences (e.g. land-use, greenhouse gas emissions, eutrophication) while providing an adequate diet for the population. Using two case studies: the Netherlands and New Zealand we will apply circular food system models to give insights into which crops should be grown were, how many animals should be kept, how residual streams should be utilised, and at which scale a circular food system should be applied under different production conditions.