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Redesigning agricultural supply chains to valorise perishable crops fully

Humanity is facing an immense challenge in feeding the growing world population, whereas food is wasted significantly. Therefore, our limited resources on earth should be used more efficiently. So, food valorisation is becoming increasingly important to sustain a healthy population in a sustainable way. However, this remains a challenge because edible and valuable food streams are not used to their full potential currently. For example, cauliflower leaves and carrot foliage are often left on the land (Bockstael, T., De Mey, V., & Miserez, A., Bioboost-Interreg, 2019). Nevertheless, leaves and foliage are fit for human consumption. They could be used for processed products such as soups or sauces. Valorising these streams could, hence, improve food security and result in more efficient land use, especially in low-income countries. The question is: how can we profitably and sustainably valorise these streams?

To address this issue, this research focuses on strategic decision-making related to the use of resources at the harvesting stage and the processing units of food supply chains. Hence, this research looks at ways to redesign the supply chains such that crops are valorised for food purposes to the greatest extent possible. To facilitate such decision-making, we develop a mathematical programming model that defines the product portfolio by selecting from a set of recipes that can be made from the ingredients. The considered options include the wholesale of raw materials but also highly processed products that often have longer shelf lives. An important factor determining the possible production options and the shelf life of products is quality decay. Thus, the model tracks the quality decay in the supply chain to better decide which products can be processed and sold at which stage.

We use two performance indicators to find the best product portfolio and corresponding supply chain configuration: profit maximisation and environmental impact minimisation. By analysing the Pareto frontier, we investigate the trade-offs between different objectives. Moreover, we give insights into the optimal processing setup.