

# Facilitating the transition to a circular greenhouse horticulture sector

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Greenhouse horticulture plays an important role in the efficient and safe production of vegetables, fruit, flowers and plants. The production systems in the greenhouse horticulture sector are characterised by a high degree of efficiency in the consumption of water and raw materials, but the systems have large energy requirements and are not 100% circular. Major bottlenecks prevent the sector from becoming fully embedded in the circular economy, particularly in the incoming and outgoing material flows. Wageningen University & Research, Business Unit Greenhouse Horticulture conducts research aimed at resolving these bottlenecks and facilitating the transition to a sustainable sector. The implementation of innovations in circular agriculture can help to accelerate this transition.

## Analysing the bottlenecks

We started laying the foundations for the analyses of these bottlenecks in 2019. We began by analysing and quantifying all incoming and outgoing flows in greenhouse horticulture to describe the 'metabolism' of the sector. To this end, we have created a database of the properties of the various product flows. We have determined the impact of each of these flows on a number of key factors: resource use, energy use, CO<sub>2</sub> emissions and the availability of land, water and fertilisers. We are also investigating the extent to which each of these flows contributes to the depletion of natural resources and how these flows can be reused on site.

## Joint solutions for bottlenecks

We work together with partners in the sector to find joint solutions for selected bottlenecks, either in consortia or in partnerships with individual businesses. To this end, we redesign existing systems and processes and test crossovers of agricultural systems that can facilitate and accelerate the transition to a circular economy. In this way, we give form to our vision: an Efficient, Clean and Connected greenhouse horticulture sector.

## Efficient, Clean and Connected

A greenhouse horticulture sector that is fully embedded in the circular economy will be characterised by much less dependence on critical external resources such as raw materials. Reuse of residual and side streams, both on-site and off-site, will be the norm. In addition to the primary products, only reusable side streams will be produced to predetermined material specifications. Greenhouse horticulture is already a highly efficient system for producing top-quality foodstuffs. We want to facilitate the connection between the greenhouse horticulture sector and other production systems by developing new systems with only clean incoming and outgoing material flows. We start by examining existing crossover industries, such as fish farming, in order to develop them into circular systems further. The goal is to form a consortium and develop a design for a circular demonstration greenhouse operation by 2022. This demonstration greenhouse will inspire other businesses to follow suit and so facilitate the transition to a circular economy.

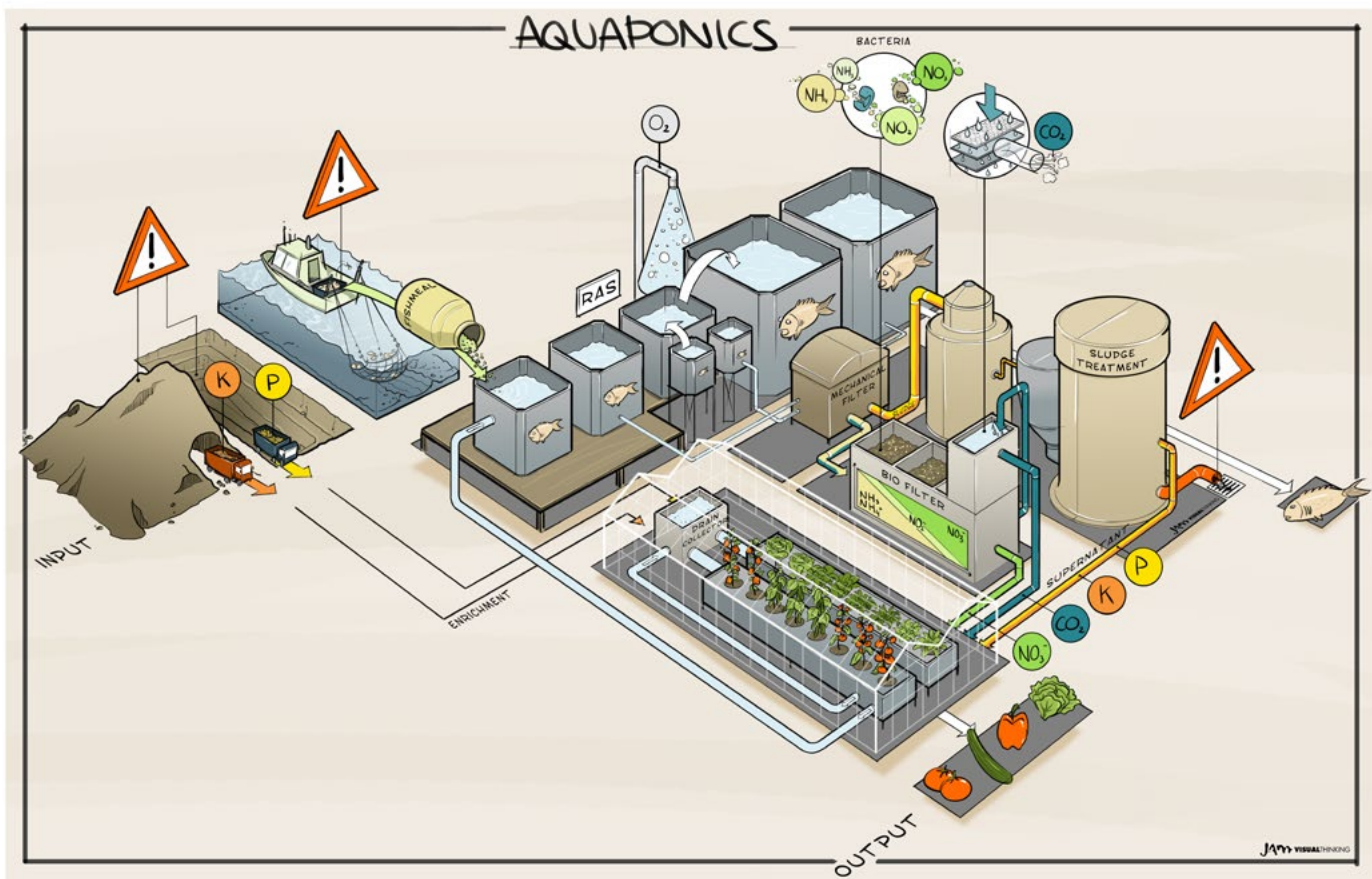
## Progress

Based on our analyses, we will first need to act on four major material flows in greenhouse horticulture: fertilisers, plastics, vegetable residues and substrates. These flows are often interlinked. An important factor for the usability of these flows in other agricultural production systems or industrial processes is the presence of pesticide residues (biocides and plant protection products). Other material flows will not need to be studied as carefully because they are already almost circular (such as paper and cardboard), or because they are already the focus of other initiatives (such as water in the 'Horticulture Waterproof' project and CO<sub>2</sub> in the 'Greenhouse as a Source of Energy' project). Much of the required knowledge is thus already being generated by these long-term public-private partnerships. In addition, we will pay particular attention to a bottleneck we have identified involving the use of temporary coatings in the sector.

Aquaponics is an example of a combination of various production systems. Our model-based approach is generating new knowledge that we can apply to redesign other agricultural systems.

## Participants invited

We are seeking businesses that are interested in applying the knowledge we have developed in practice so we can devise new practical solutions for the sector based on their experiences. We envisage various partnership forms: 1-on-1 partnerships or consortia, and focussed only on greenhouse horticulture or on crossovers with other sectors. Following discussions with the stakeholders, we will redesign the cultivation systems in the greenhouse horticulture sector so that they meet the requirements of the circular economy. We will further analyse the incoming and outgoing product flows in combinations of aquaculture and greenhouse horticulture (aquaponics) and pig farming and greenhouse horticulture, and we will design new circular crossovers as well, again in the form of public-private partnerships.



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