SIGNaal

News from the Dutch Foundation for Innovation in Greenhouse Horticulture

ANNUAL REVIEW
CIRCULAR HORTICULTURE

The Farm-to-Fork action plan and the nationwide Nederland Circulair (Circular Netherlands) programme are aimed at building a circular economy. In addition to technical tasks relating to water, energy and nutrients, the greenhouse horticulture sector's wide-ranging sustainability strategy for 2040 also includes social objectives. In this SIGNaal newsletter we outline a number of development directions and circular applications.

Growers in the greenhouse horticulture sector not only use smart growing techniques to close loops. They also replace fossil-based inputs and material such as fertilisers, packaging and growing media. The strategy focuses on using the small amounts of post-harvest residual crop biomass in new closed loops: for additional food production, to reduce growers' own energy and material needs (peat substitutes) and as bio-based raw materials for the construction sector. In addition, the sector aims to reduce its dependency on raw materials from abroad.

The greenhouse horticulture sector provides added value for the local community by setting up circular processes that tie in with regional tasks, such as composting regional biomass next to the greenhouse, using heat and CO2 for cultivation and using residual biomass as a soil improver. This will enable the sector to be both circular and smartly connected to other sectors by 2050.

By using biobased materials to build staff accommodation, the horticulture sector can contribute to social objectives such as affordable housing. A model home made of 75% sweet pepper crop residues was on display at the Floriade World Expo 2022.

Biobased model home

Total use valorisation

In terms of the crop waste streams from the horticulture sector, making smart choices for raw material use means first recovering water, nutrients and possibly protein, followed by low-mineral biomass for peat substitutes and soil improvers. Generating energy from low quality dry biomass is a final processing option. In short: it's about moving from recycling to redesign, smart multiple cascading for more food, nutrients, fibre applications (materials) and, lastly, end-of-life energy generation (incineration).

Circularity is relevant to major societal issues:

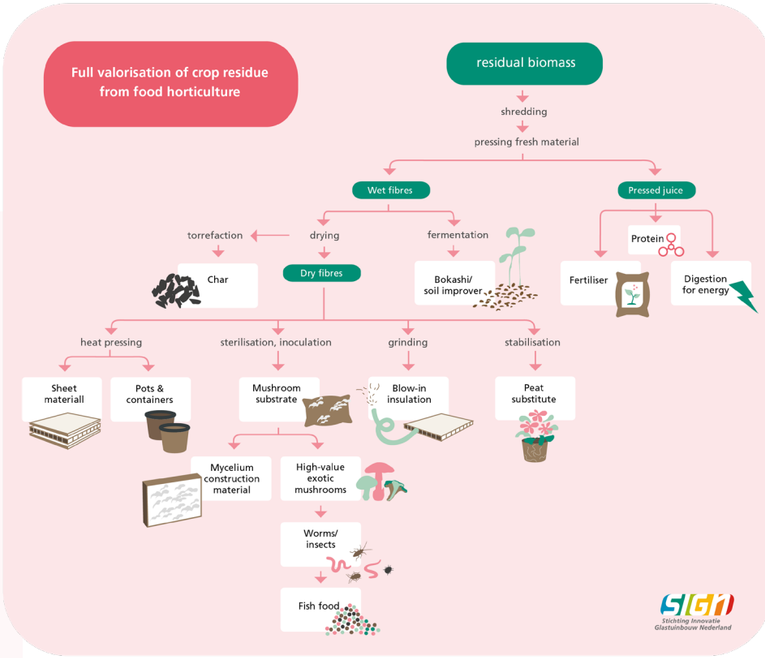
Sustainable and circular use of raw materials →

1. Combating climate change
2. Improving biodiversity
3. Preventing air, water and soil pollution
4. Reducing raw material supply risks

On-site fermentation

VARTA is exploring uses for residual agricultural and horticultural biomass. In 2022 the company looked at various fiberisation and fermentation techniques for storing and stabilising plant residues and pressed juice on the grower's site. The fibres can be used to develop flower packaging, substrates and pressed juice with valuable nutrients for the plants. SIGN initiated and funded these first development steps.

With its Circular Horticulture programme, SIGN promotes higher-value, multiple total-use applications of raw materials for a circular economy.

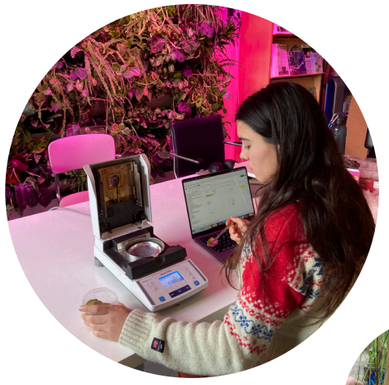


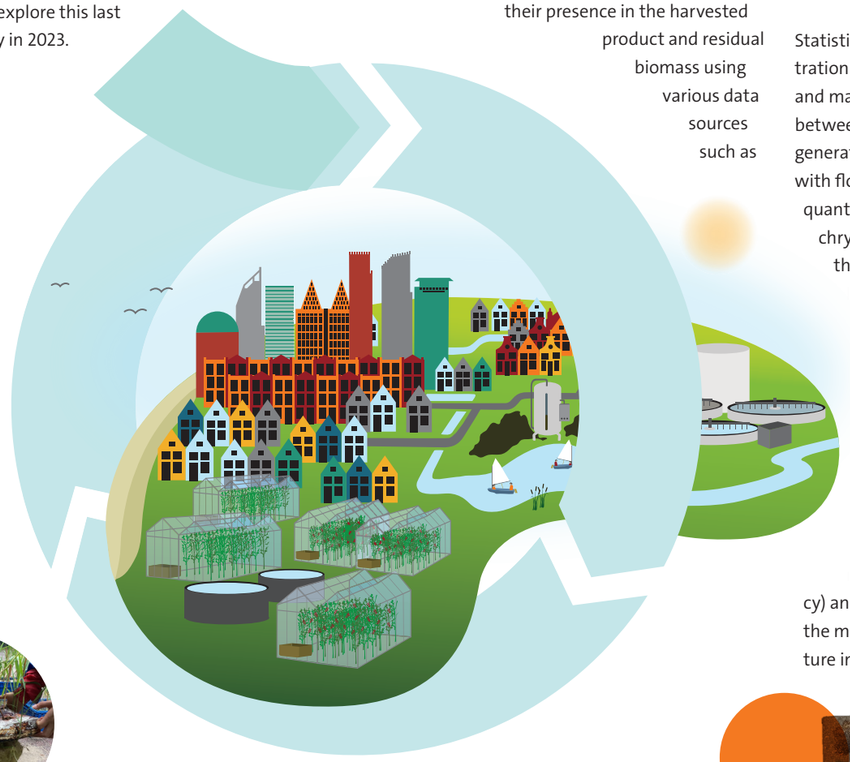
Circular greenhouse horticulture

Smartly connected for tomorrow

Peat substitutes

Dutch substrates used in horticulture still contain more than 80% peat, with potting compost manufacturers importing 4.7 million cubic metres of peat annually. At the same time, organic waste streams in the Netherlands are sent for low-value composting without making use of the energy, biomass and nutrients stored in them. At SIGN's request, Laila Kestem investigated which local waste streams might be suitable for use as peat substitutes. She not only looked at their physical suitability but also at whether there was sufficient volume available to make an impact. She analysed the electrical conductivity (EC), acidity (pH), water-retaining capacity and structure of a range of waste streams. Processing steps such as pressing, drying, shredding and carbonisation make it possible to modify the properties of a raw material, with valuable by-products being released in the process. Pressing moist biomass, for example, produces pressed juice containing high concentrations of nutrients, and carbonisation (heating at high temperatures without oxygen) creates syngas, heat, CO_2 and biochar, which can be used as a peat substitute. SIGN plans to further explore this last pathway in 2023.





Water treatment with floating wetlands

In collaboration with SIGN, Hazel van Waijjen (Wageningen U&R) studied the effect on water quality of floating wetlands containing three different plant species for the Valley and Veluwe Water Board. For this purpose, SIGN designed and produced floating wetlands from waste streams with mycelium (network of fungal threads). Conclusion: reeds and reed-sweet grass have good water purification properties; in addition to nitrogen, they also break down drug residues in the water. However, mycelium floating wetlands made with horticultural waste streams also break down slowly themselves, which can lead to nutrients leaching back into the water. This can be solved by using floating wetlands made of cork or jute, using low-mineral waste streams or stabilising the mycelium so that it lasts much longer. The Valley and Veluwe Water Board plans to continue this research in 2023.

Floating wetlands made of residual biomass

Nutrient recovery for circular fertilisers

In greenhouse horticulture, water containing nutrients is recirculated so nutrient leaks are prevented. SIGN explored the side nutrient runoff in different plant-based material streams as a source for local nutrient recovery. At SIGN's request, Geerten van der Lugt analysed demand for nutrients in the sector and their presence in the harvested product and residual biomass using various data sources such as Statistics Netherlands, MPS, the UO registration organisation, crop sample analyses and market data. There are big differences between crops: leaf crops and pot plants generate small amounts of crop residues; with flowers it depends on the crop (large quantities from gerbera, much less from chrysanthemum); but with fruit vegetables the entire plant is in effect a residue. Nutrient recovery from crop residues at processing hubs definitely has potential. Nutrients can also be recovered from the harvested product (food). Large amounts drain into sewers and end up in sewage treatment plants. SIGN looked into which pathways and innovative technologies could be of interest for nutrient recovery (feasibility, efficiency) and found that sewage sludge will have the most potential for greenhouse horticulture in the future.

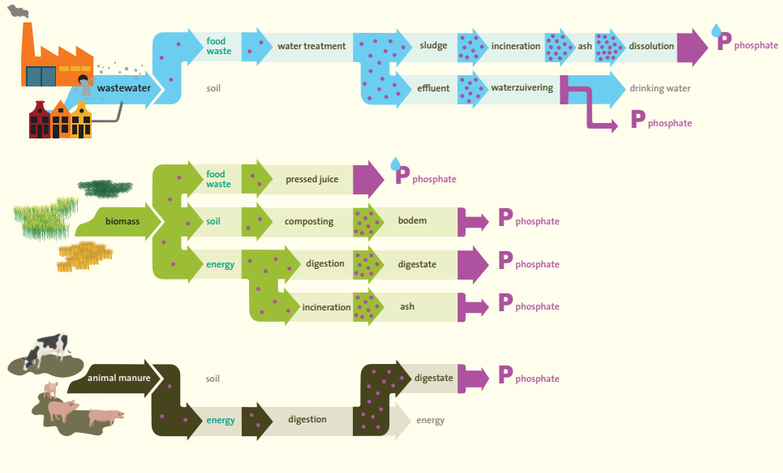
From rose side stream to insect hotel

At SIGN's Living Lab in Bleiswijk, Sofie Castelein worked on product development from crop residues to consumer product on behalf of Groot Packaging. She investigated how to press strong panels ('flowerboard') from the side streams from rose growing. After drying and grinding the waste, she pressed it into sheets using various binders. Tannin (tannic acid) ensured particularly good particle adhesion, so she used it to create biodegradable sheet material out of completely natural raw materials. Castelein also tested the strength and moisture resistance of the sheets: the flowerboard was stronger than plasterboard and roughly as strong as chipboard. The sheet on its own needs to be coated when used outdoors.

Waterproof and 100% biobased material

Bug hotel made of flowerboard

Herwinning van fosfaat



SIGN investigated which pathways and innovative technologies could be of interest for phosphate recovery.

Funding of innovation and education in area development

Are there new ways to secure structural funding for innovation in area development? For the GreenNest Experience in Haarlemmermeer, lawyer Edgar Wortmann analysed various funding and organisation models. These included the *Land van ons* (Our Land) cooperative and wind turbine cooperatives that use part of their revenues for the benefit of the local community. He also looked at what form a cooperative with a municipality could take.

SIGN
Dutch Foundation for Innovation in Greenhouse Horticulture

SIGN collaborates with the Ministry of Agriculture, Nature and Food Quality on innovations that contribute to sustainable society development.

The water treatment floating wetlands project was carried out on behalf of:

waterschap vallei en veluwe

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