SPLENDID: Spatial PLanning for ENvironmentally Diverse cIrcular Development

Summary

When conceiving plans for environmentally friendly agriculture, policy makers and scientists often overlook a key element: the spatial organization of land use. Specifically for circular agriculture, the spatial organization is important, as the closer the source and destination of residues are located, the better loops can be closed at minimum risk and cost. SPLENDID provides policy makers with a scientific valid methodology to assess the spatial implications of implementing circular agricultural practices. It also looks at barriers and solutions to overcome these. This allows policy makers to realize circularity visions with a clear attention for all important landscape values. SPLENDID investigates how circular options match with their surroundings and what ecosystem services they yield in their geographical context. In Noord-Brabant – a Dutch province which exemplifies a range of agriculture-related sustainability issues – SPLENDID assesses three types of circular agriculture (nature-based, technology-based and transport-based), their spatial organization and the ES they deliver. Circular agriculture probably requires a rigorous reorganization of the land use pattern, leading to farmers adjusting their farming practices, swapping land with other land owners or even relocating the entire farm to achieve geographical zones with farming and processing facilities ideally located to optimize the benefits of food production and related ES like animal welfare, preservation of biodiversity, landscape quality and water retention. SPLENDID is funded by NWO and allows one postdoc and three PhD students to produce clear policy guidelines for realizing these objectives.

Case Description

Background

When contemplating ways to achieve more sustainable agriculture – be it circular, nature-inclusive, or regenerative agriculture – policymakers and scientists often overlook a crucial aspect: that of the spatial organization of land use. Spatial organization is important for achieving circularity, because the closer the source and destination of residues, the lower the costs and risks of transport, and thus the more viable the exchange of residues and the closing of cycles. Without an efficient spatial organization of land use, any attempt to convert to sustainable practices tends to remain at the level of pin pricks: flower strips surrounded by biocide-treated fields do not increase biodiversity; ecosystem restoration near ammonia-emitting farms is doomed to fail; attempts to improve soil-water retention in agricultural soils will run afoul of intensifying farmers; and so on. Moreover, spatial fragmentation of sustainable practices hampers the potential synergies that could be achieved with a more consolidated and clever spatial organization. This often leads to adopters of sustainable practices remaining at a disadvantage compared to those who stick to conventional practices that rely on existing, efficient and therefore cheap infrastructures.

We expect that a breakthrough towards the massive adoption of sustainable practices, including the partial closure of nutrient and carbon cycles, can be achieved by a rigorous reorganization of the land use pattern. We envision a diversity in variants of circularity, derived from three different circularity archetypes, which all have a role to play in the overall circular system. The degree to which the different variants can achieve circularity may vary, but so will the delivery of other important values such as landscape quality and biodiversity. In any case, a crucial success factor for the plurality of variants will be their spatial coherence and match with their surroundings. We therefore take a landscape / ecosystem services (ES) approach to investigate how circularity can take shape, which ES are delivered by what circularity variant, and what spatial organization results in the highest environmental quality.

Research objectives

SPLENDID hypothesizes that circular agriculture can be grouped into three types of implementation: the nature-based implementation, that aims at restoring natural cycles and makes use of so-called regenerative farming; the technology-based implementation, where complementary types of non-land-based farms (livestock, horticulture, etc.) are

combined in fully closed systems, to maximally re-use waste streams; and the transport-based implementation, where farmers make an effort to either capture and upgrade their own waste for re-use by others, or by replacing of their input by the upgraded waste of others. Each type has a specific ecosystem service delivery profile, and only in combination with each other we can achieve the societally-desired palette.

Part of the SPLENDID research questions focus on the (diversity of) circularity variants, and how they should be spatially organized to strike a good balance between all desired ecosystem services (ES):

- Which variants of the three circularity archetypes can be distinguished, and what is their general performance in terms of ES delivery?
- How is the actual ES delivery of each variant affected by how it is located and shaped?
- Which overall mix of circularity variants is needed – and how should they be organized in space – in order to meet society's need for a wide range of ES?

And part of our questions focus on how the desired spatial organization can be realized:

- Which instruments of land policy exist to implement the desired spatial organization of the various circularity variants?
- How effective are these instruments, given the institutional (property and user rights), societal (public support), and financial (available budgets) constraints?
- Will the new spatial organization be viable? How to redirect gains in ES to farmers, and what supporting institutional regime is required to secure the clusters?

Research approach

This project will follow a research-through-design approach (RTD). The RTD process starts with a creative, inspiring vision, derived from a participatory process with a wide range of stakeholders and experts. In this case this vision will concern the spatial distribution of the various circularity variants throughout the research area (i.e. the spatial designs; see Figure 1 for an illustration). What follows is a systematic iteration between (a) the use of scientific methods to answer the questions brought about by the vision, and (b) re-imagining the vision based on the outcomes of the scientific research. RTD is highly suitable for real-world situations in which a multitude of related, yet ill-defined problems (so-called 'wicked problems') are at play. RTD is participatory, area-based, and make use of visualisation techniques to involve a wide range of stakeholders (ensuring transdisciplinarity).

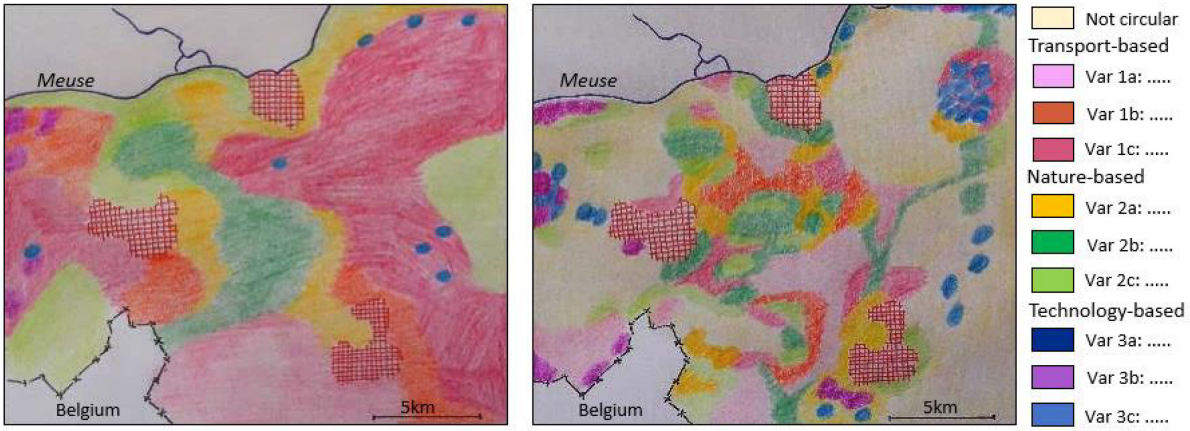

Figure 1: An illustration of what spatial designs could look like (at the largest scale level).

Our research area is larger than in most area-based approaches (>200 km2), which is necessary to evaluate the holistic effect of having all circularity variants in one spatially coherent design (i.e. a landscape approach, bridging the scale-gap between national strategies and local implementation).

For this reason, research in-between the design workshops is model based. Model studies can simulate effects of large-scale implementation of circular agriculture, replace costly or risky real-world experiments, and are highly complementary to pilots and living labs (which are embedded in the research area, and which we will tap into). The effects and experiments which we expect to make a real difference, and which require a modelling approach, are the following:

1. The strategic implementation of instruments such as land consolidation schemes, tradeable development rights, payment schemes for ecosystem services, and land banking;
2. The experimentation with other modes of governance (e.g. top-down versus bottom-up);
3. The effect of the plurality of the circularity variants, so that there will be a place for each farmer type and trade-offs can be managed so that overall ES provision remains high;
4. The agglomeration benefits that follow from large-scale implementation;
5. The effects of a long-term spatial land-use policy, so that farmers can make investments;
6. The synergistic effect of implementing all measures at the same time.

To evaluate these effects three PhD students will conduct scenario studies using (1) environmental models that predict ES delivery for each spatial design (and that allow to systematically investigate effects of location, scale and shape of circularity variants on ES delivery); (2) a land regime analysis to map constraints and opportunities from legislative and economic perspectives; and (3) an agent-based model (ABM) that explores how farmers will respond to instruments, new business models, and long-term spatial policy. All models will be spatially-explicit and cover the entire research area (minus the urban areas).

Stakeholder involvement

There will be three integration and design workshops. Preparation for the first workshop entails system analysis; stakeholder analysis; collection of GIS data; preparing a short documentary to present circularity variants, including a provisionally ES profile; and prepare interactive software environment. In the workshop, circularity variants are discussed and adjusted based on stakeholder knowledge; we establish which ES to include and assess their minimal delivery; smaller groups of participants are asked to distribute variants over the research area (i.e. a spatial design).

At the second workshop, stakeholders receive feedback on their spatial designs in the form of overall ES delivery. Groups may try to improve their design and receive on the spot information of the ES performance of their adjusted design; stakeholders are asked to reflect on (a) the longlists of potential measures and define a coherent strategy and (b) on the Agent Based Model prototype.

At the final workshop researchers present the final outcomes to stakeholders and illustrate effects of location, size and shape on ES delivery. Stakeholders explore, using the metamodel of PhD1, how they can improve their designs based on these insights. PhD3 presents the extent to which the various designs are feasible given the ambitions of farmers in the area. PhD2 presents the most successful policy strategies for achieving spatial designs: one from the point of view of maximizing ES delivery; one from the point of view of achieving the largest societal support.

Research Highlights

The SPLENDID project has only recently started and therefore most results still need to be generated. Nevertheless, one important result was already produced: a map of The Netherlands where the three circularity archetypes could be located, based on a number of environmental variables. The main result is displayed in Figure 2, which is published in a Dutch professional journal for environmental scientists (Milieu). The map is currently being reproduced to feature in an advice to the new government, written by a formally appointed governmental advice committee.

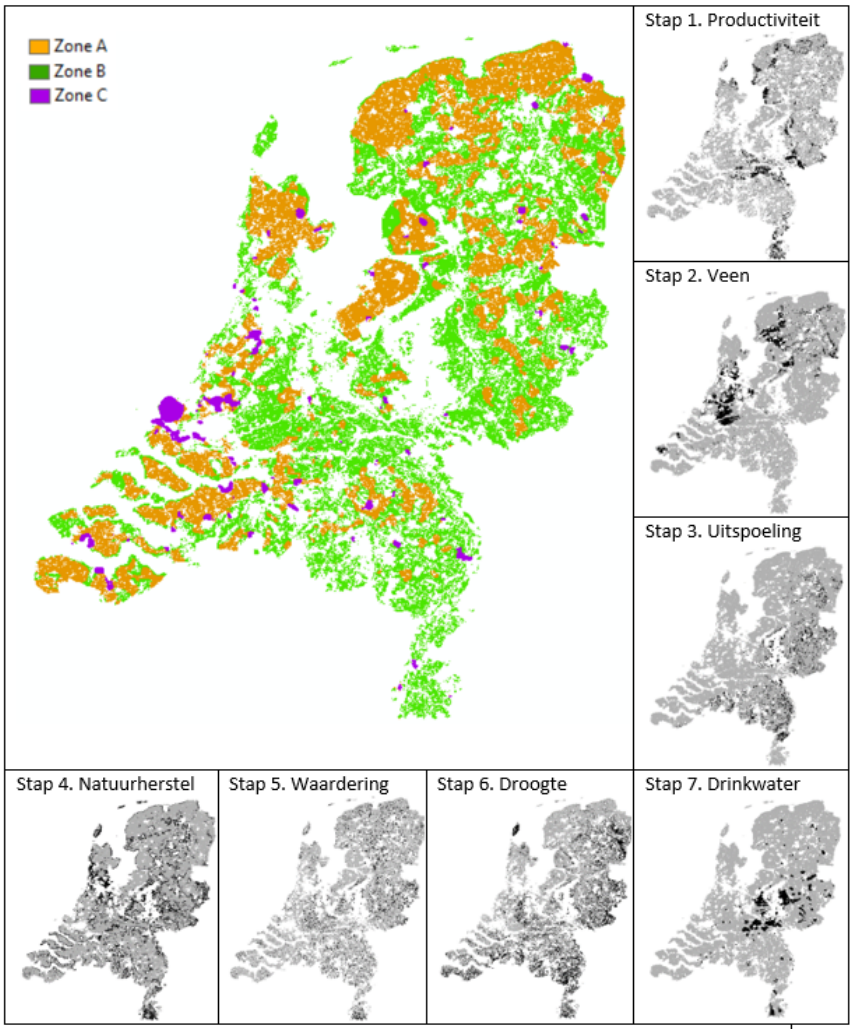

Figure 2: A provisionary map of the three circular agriculture variants, based on a number of environmental constraints

Impact

This research forms a crucial contribution to the actual implementation of circular agriculture. The concept of circular agriculture has been received with great enthusiasm by many societal partners, but it is entirely unclear how to implement it at a scale that exceeds the individual farm or cooperative. Without a clear implementation strategy, also the Circular Agriculture vision published by the Ministry of Agriculture, Nature and Food Quality tends to get stuck at the level of good intentions and propositions. We will provide this implementation strategy by delivering:

- an overview of different variants of circular agriculture, accompanied by an ES delivery profile. Provincial planners can use this to make strategic zoning plans for the rural area;
- design principles for each circularity variant that allows selecting the appropriate location, optimizing scale benefits, and minimizing negative externalities;
- guidelines for redirecting ES gains back to land owners supplying them, hence ensuring viability of circular agriculture, including its less economically competitive forms;
- coherent policy strategies to implement circular agriculture and prevent undesired developments (including guidelines for using the New Environmental Act and integration of the Rural Areas Development Act);
- a detailed reflection on pros and cons of a suite of land policy instruments for achieving the desired zonation.