Soil-sensitive insights into land-system change : vulnerability and ecosystem services losses under artificialisation in Wallonia

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Planetary Limits and Complex Risks: Developing Interdisciplinary Perspectives

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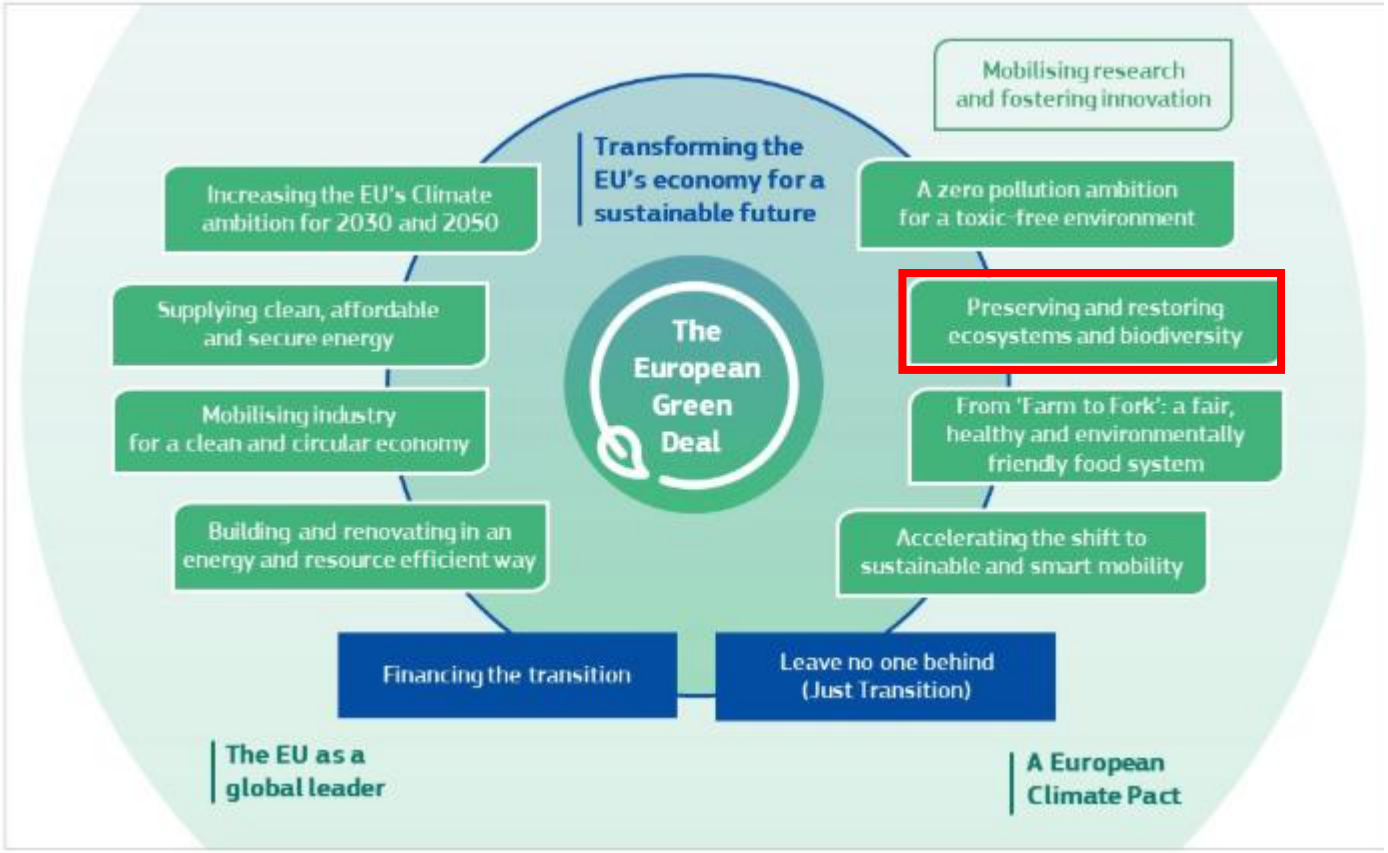
WHY LAND-SYSTEM CHANGE MATTER ?



The European green deal. **Source:** European Commission, COM(2019) 640 final

"Soil strategy for 2030"
Long-term objectives laid down by the soil strategy is for the continent to achieve no net land take (NNLT) by 2050

"Directive on Soil Monitoring and resilience (soil monitoring law)" – September 2025
To contribute to that long-term objective, it is important to assess the various processes of land take, and aim to reduce and mitigate their impact on soil health and ecosystem services.

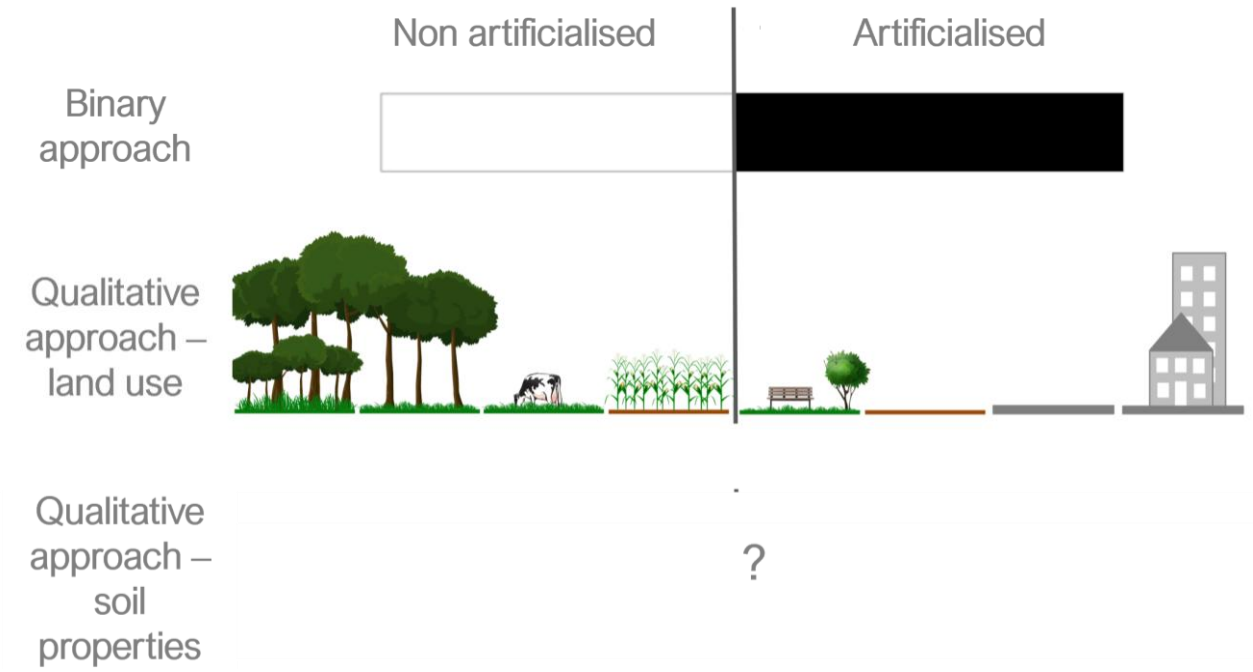
WHY LAND-SYSTEM CHANGE MATTER ?

Land take is a process which causes a modification of land use **and of the characteristics of the soil**. It can be seen as an overarching concept that can be subdivided into multiple aspects.

The first aspect of land take is a change from natural and semi-natural land uses towards settlement areas.

The second aspect of land take is soil artificialisation caused by the **durable alteration of the soil components and soil characteristics**, resulting in a loss of the capacity of soils to provide ecosystem services.

Source: European Commission (2025), DIRECTIVE (EU) 2025/… OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of … on Soil Monitoring and Resilience (Soil Monitoring Law)



Source : Adapted from Groupe de travail artificialisation, LEPUR – Sébastien Hendrickx - 2020

OBJECTIVE AND CONTRIBUTION OF THE STUDY

Move from a surface-based binary approach to a soil-integrated perspective on artificialization.

Case study : Wallonia, 2007-2018

Aims:

1. Quantify land take and type of land use changes
2. Identify soil properties of artificialized soils
3. Assess the loss of ecosystem services provision

METHODS – INTEGRATING LAND USE AND SOIL CHARATERISTICS

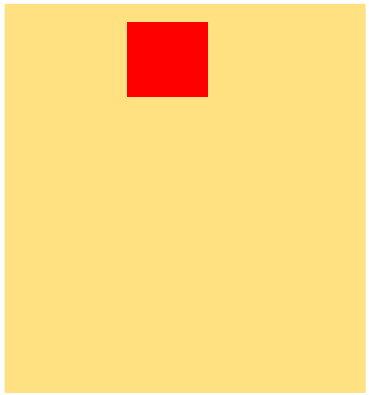
1 Quantify land take and type of land use changes

Non artificialised
Meadow

Based on cadatral data

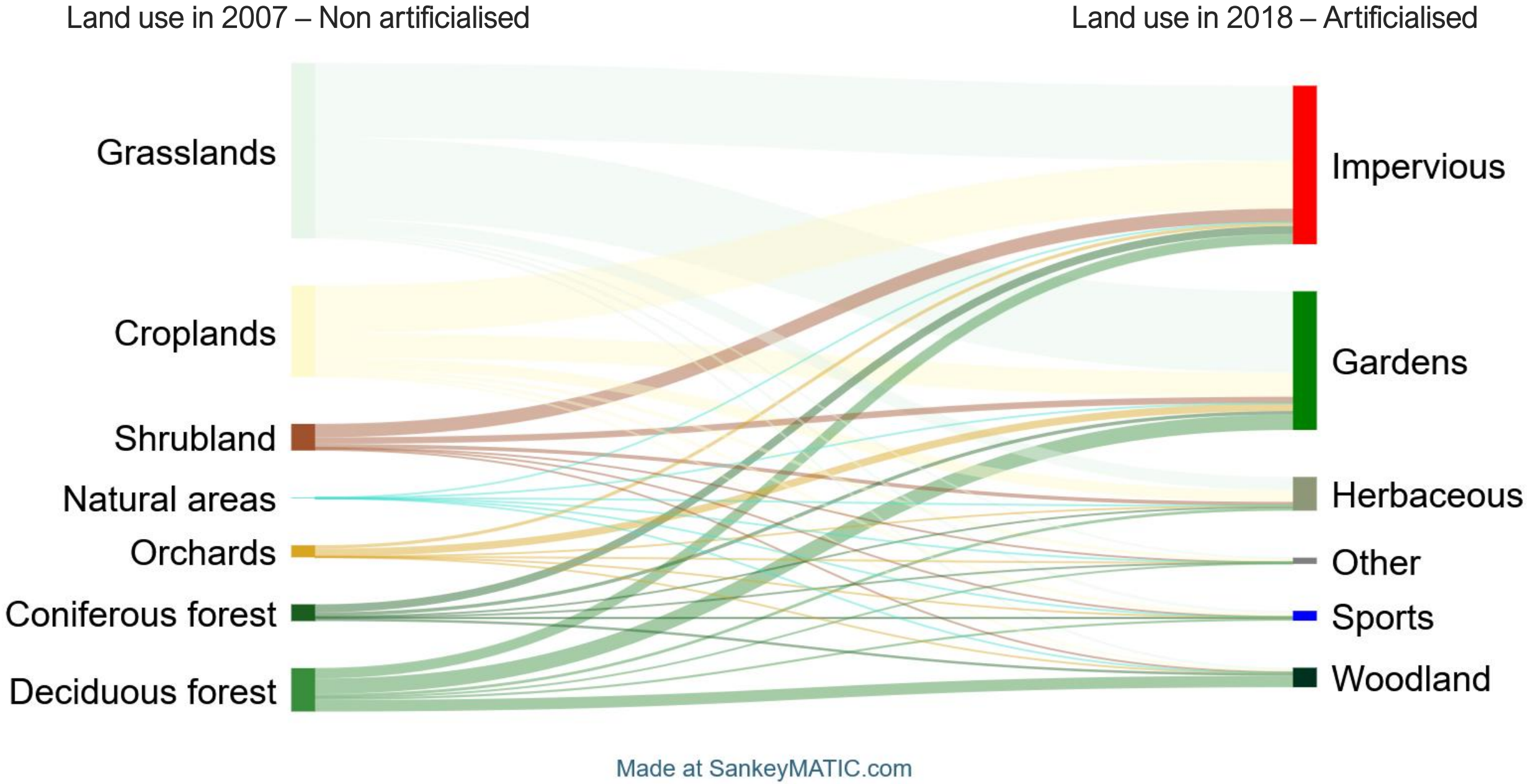
Land use in 2007

Artificialised
Garden
Building



Land use in 2018

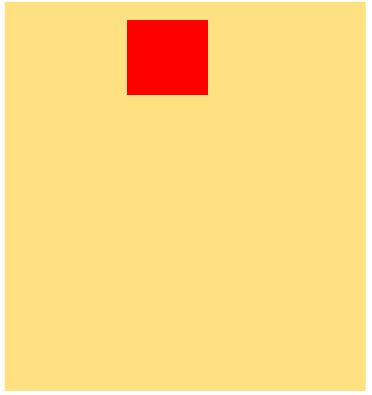
RESULTS - SURFACES



METHODS – INTEGRATING LAND USE AND SOIL CHARATERISTICS

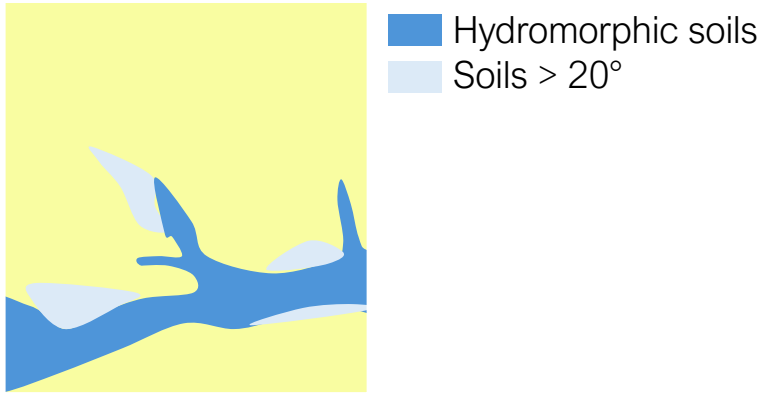
2 Identify soil properties of artificialized soils

Land use in 2007



Land use in 2018

Key abiotic properties relying on physical, chemical, and biological soil indicators (e.g. texture, depth, hydromorphy, slope)



Soil properties (Belgian soil map and slopes)

Results :

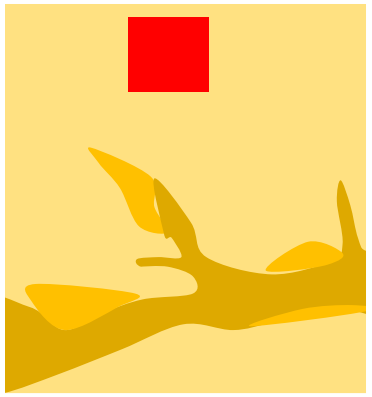
78% of the land that was taken from 2007 to 2018 was on 'non marginal' soils'

BUT

Up to 12% on peaty, para-peaty soil and hydromorphic soils (and 22% on environmentally constrained soils)

METHODS – INTEGRATING LAND USE AND SOIL CHARATERISTICS

3 Assess the loss for ecosystem services provision



Ecosystem typology	Ecosystem services		
	Provisioning	Regulating	Cultural
Meadow on non marginal soil conditions Meadow on hydromorphic soils Meadow on soils > 20°			
Garden on non marginal soil conditions Garden on hydromorphic soils Garden on soils > 20°			
Building			

Not relevant	0
Very low	1
Low	2
Medium	3
High	4
Very high	5

Scale for ranking ES supply, flow or demand

METHODS – INTEGRATING LAND USE AND SOIL CHARATERISTICS

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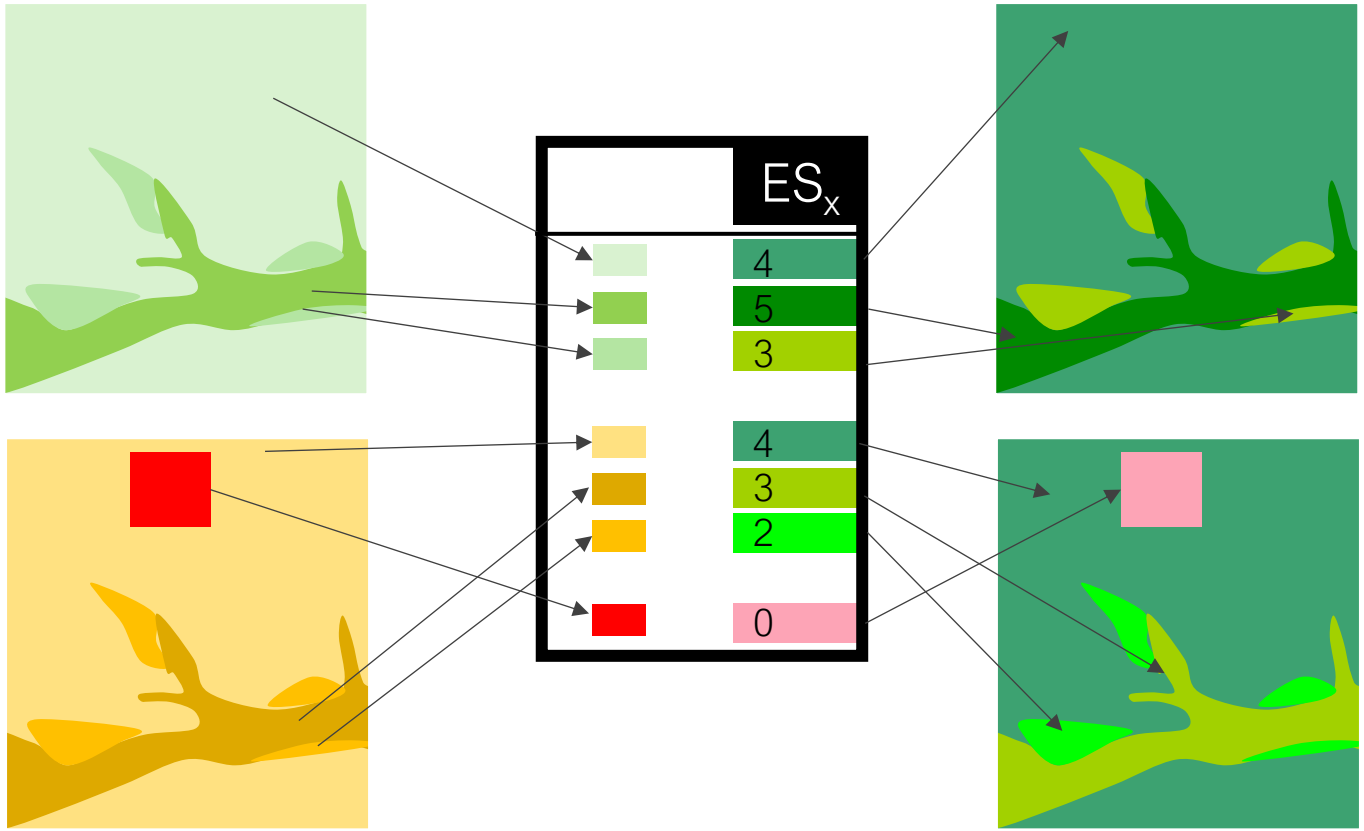
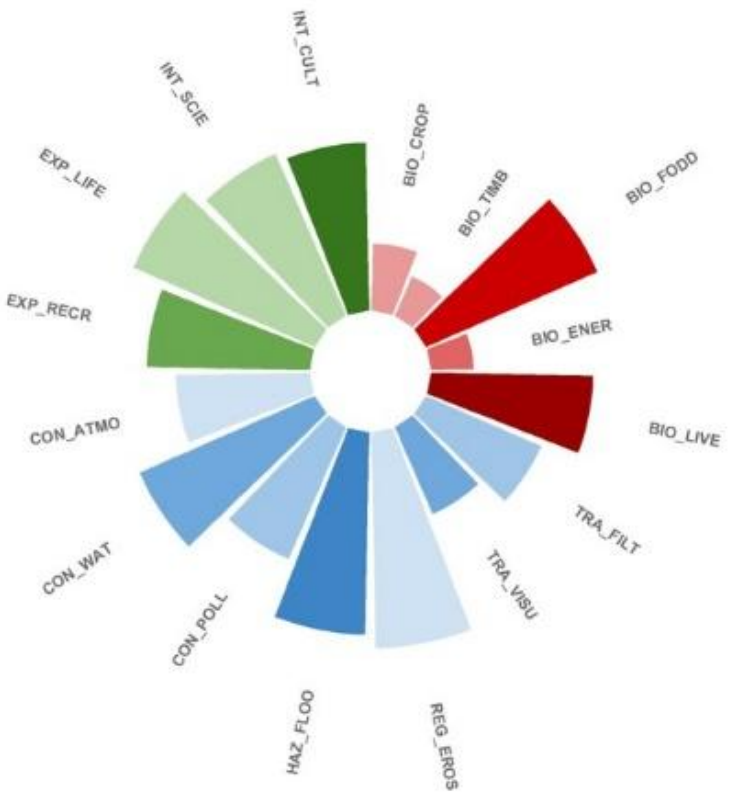


Difference in the ability to provide service x between the projected situation and the initial situation

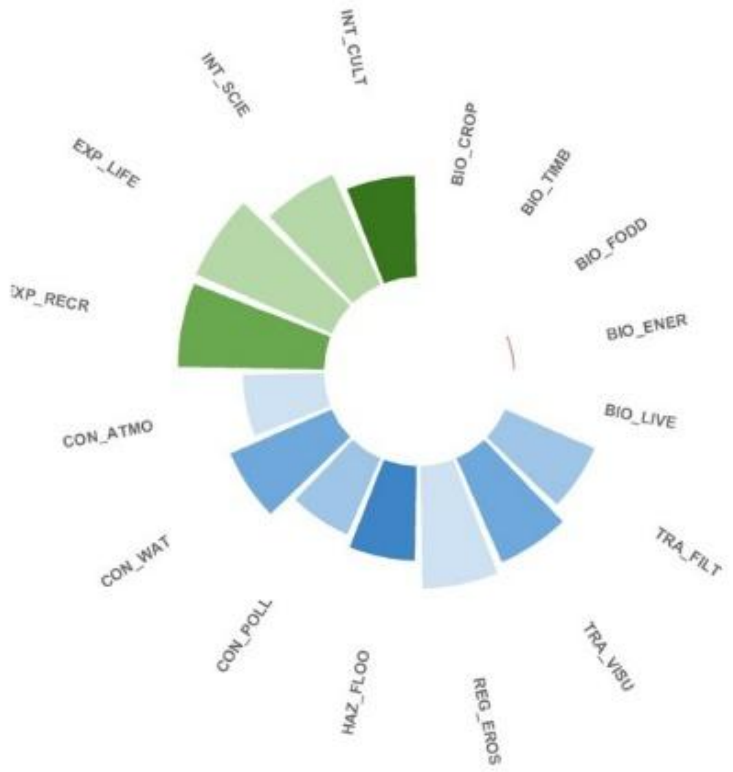
- Strong (positive)
- Medium (positive)
- Medium (negative)
- Strong (negative)

RESULTS – LOSS OF ES PROVISION

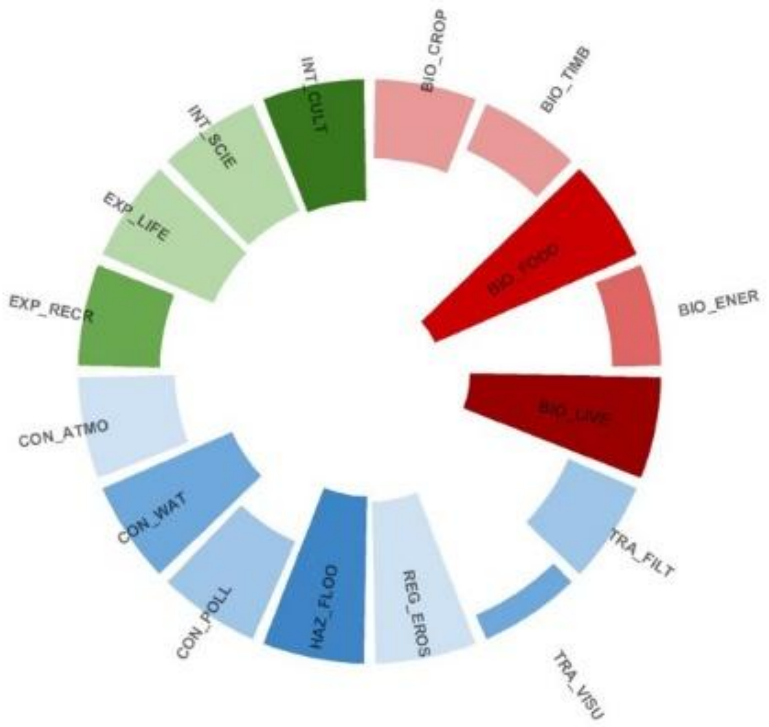
A. ES provision before artificialisation



B. ES provision after artificialisation



C. Difference in ES provision



BIO_CROP :Food crops,
BIO_TIMB: Timber and wood fiber,
BIO_FODD: Fodder (animals feed),
BIO_ENER: Wood and woody biomass for energy,
BIO_LIVE: Livestock production,

TRA_FILT: Filtration of airborne pollutants by ecosystems,
TRA_VISU: Visual screening,
EROS: Soil erosion control,
HAZ_FLOO: Flood risk mitigation,
CON_POLL: Pollination,
CON_WAT: Water quality regulation: surface water,
CON_ATMO: Global climate regulation via GHG sequestration,

EXP_RECR: Recreational experiences in the environment,
EXP_LIFE: Living and working environment
INT_SCIE: Scientific and educational inspiration and knowledge,
INT_CULT: Cultural, aesthetic and spiritual inspiration

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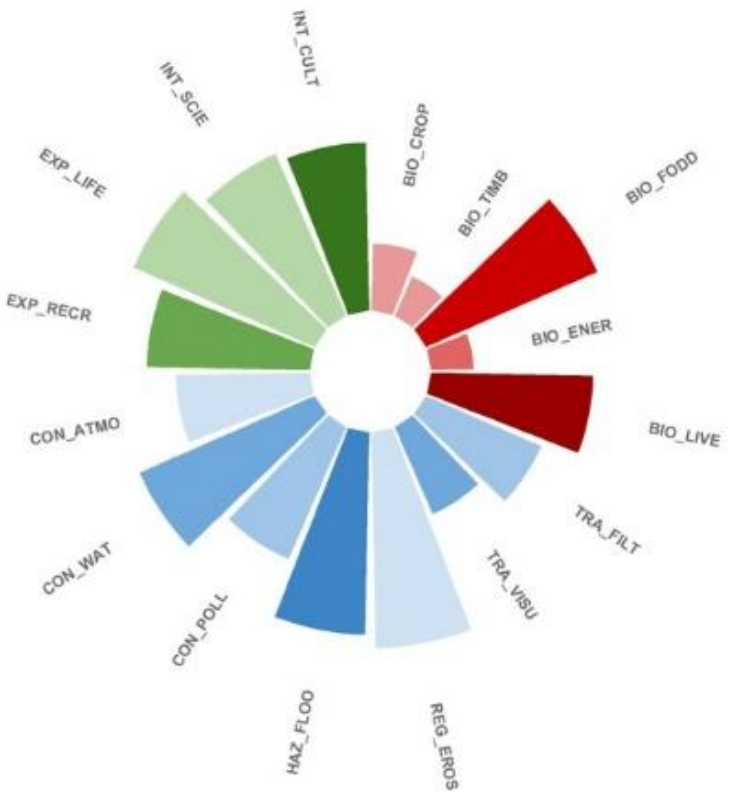

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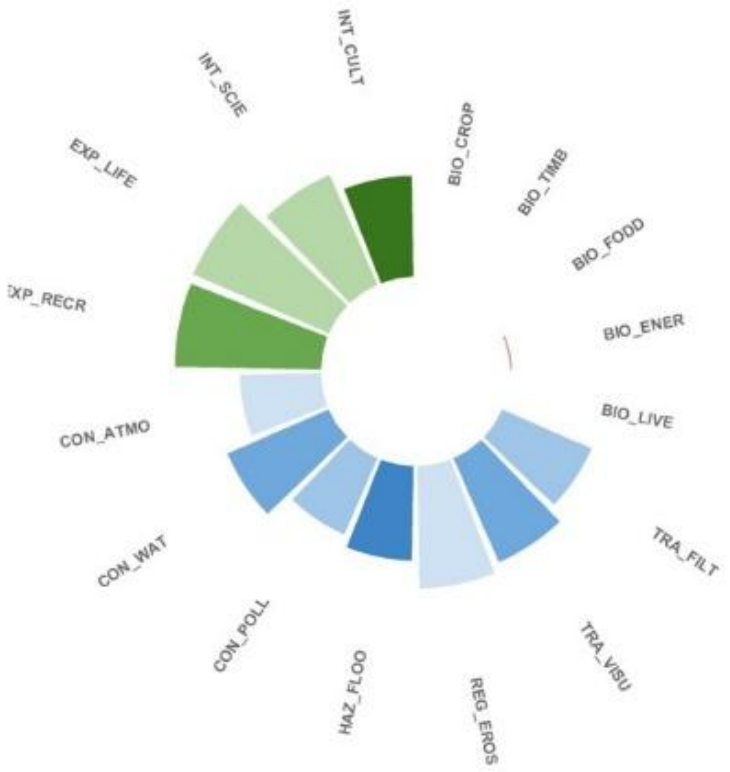

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RESULTS – WHAT IS LEFT FOR RESIDENTIAL DEVELOPMENT ?

11.83 % of the total land reserve for residential development is still on environmentally constrained soils, representing 6 490 ha.

Hydromorphic soils are the most represented categories.

https://ediwall.wallonie.be/schema-de-developpement-du-territoire-sdt-optimisation-spatiale-adopte-le-23-avril-2024-2024-128185

DISCUSSION – KEY MESSAGES

Importance of moving beyond a simple binary distinction when assessing the impacts of land take on ecosystems.

Need for soil-specific indicators in planning:

- Distinguish soils by ecological function, not only by agricultural value.
- Avoid “silent losses” of high-service but low-productivity soils.

This study could help refining:

- Prioritisation frameworks for land protection;
- Soil-informed planning tools.