

Land use

Introduction: The fight for land resources

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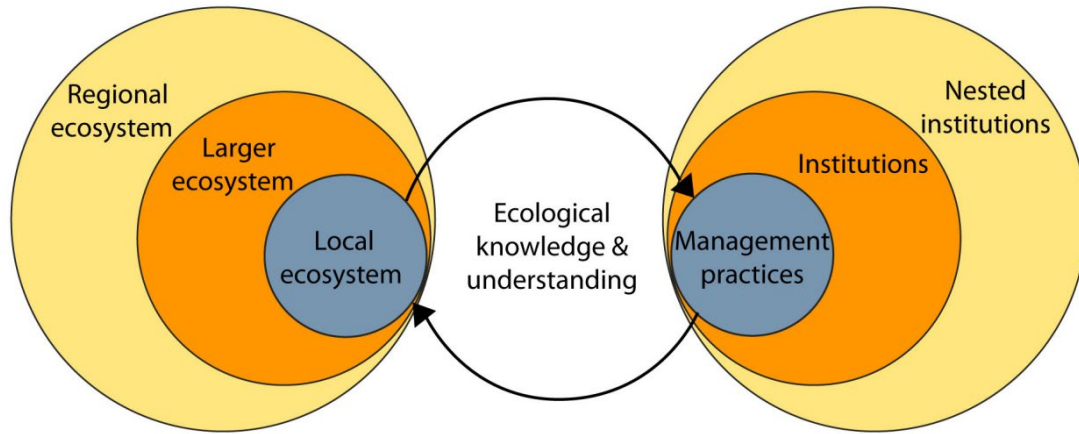
TRANSITIONS – Sustainability Transitions and Environmental Planning



Roskilde University



Land use: Flows of social-ecological interaction at the planetary surface



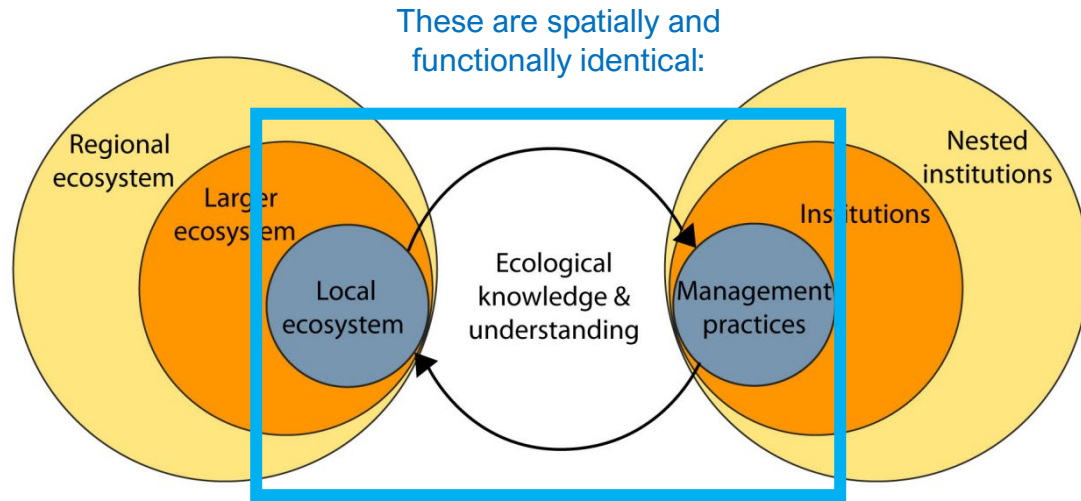
Model of a social-ecological systems:

“social-ecological emphasizes that the two subsystems are equally important”

Colding, J. & Barthel S. (2019) Ecology and Society , Vol. 24, No.1.



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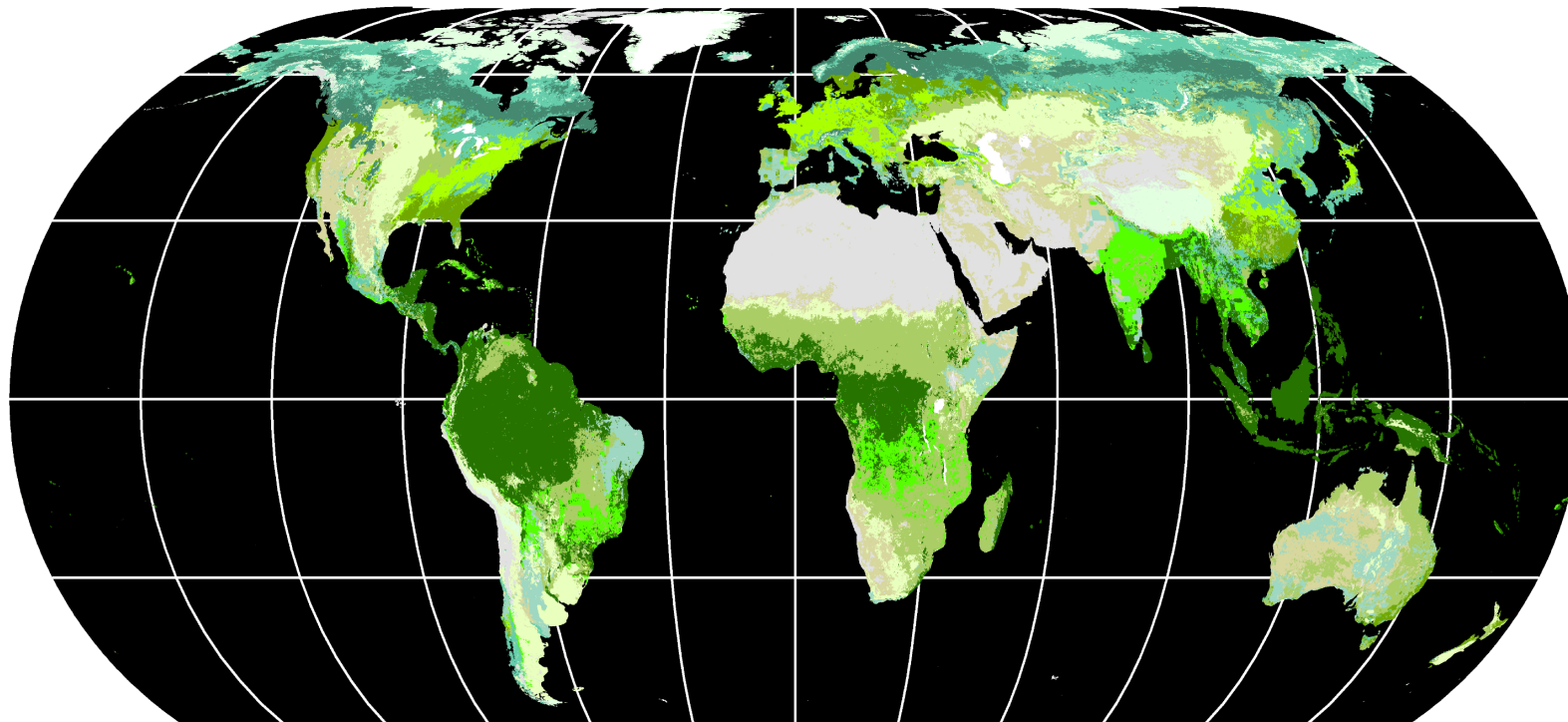
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Terrestrial biomes of the world













“Holocene landscapes without humans” – a reference point for modern biogeographical research

Local and regional climatic and associated geocological factors determine ecosystem cover and functionality



$$\text{Ecosystems} = f(\text{C})$$

C = Climate

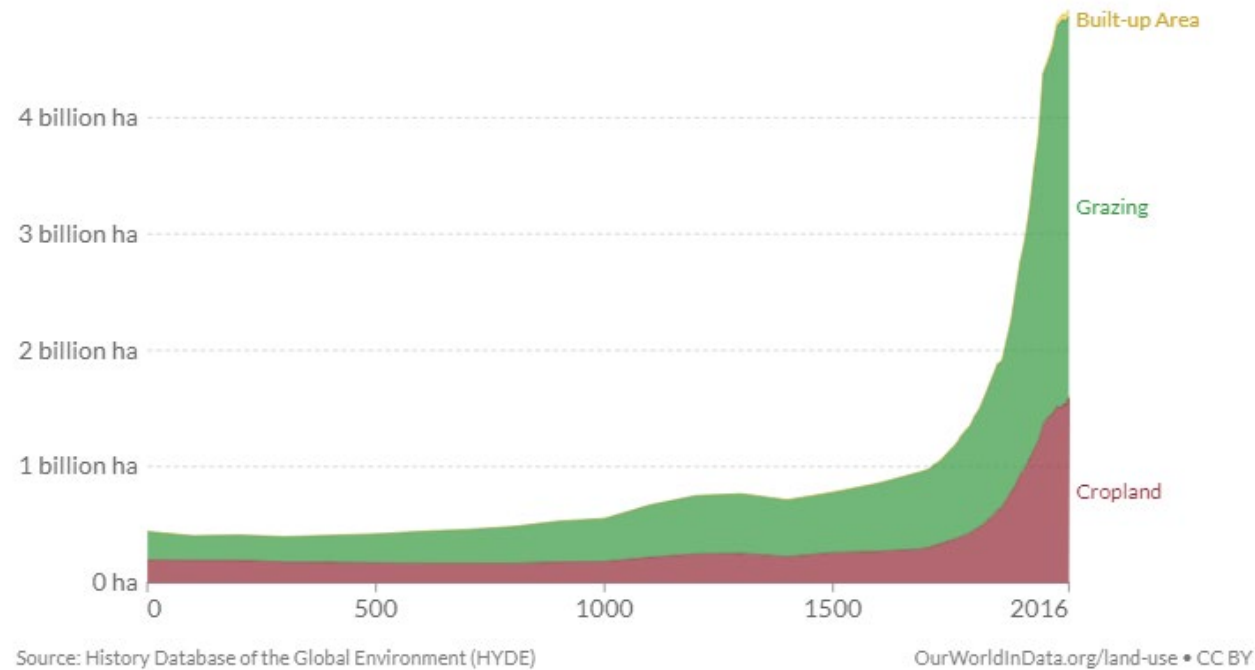
 Tropical Evergreen Woodland	 Savanna
 Tropical Deciduous Woodland	 Dense Shrubland
 Temperate Evergreen Woodland	 Grassland & Steppe
 Temperate Deciduous Woodland	 Open Shrubland
 Boreal Woodland	 Tundra
 Mixed Woodland	 Deserts & Barren

The great acceleration:

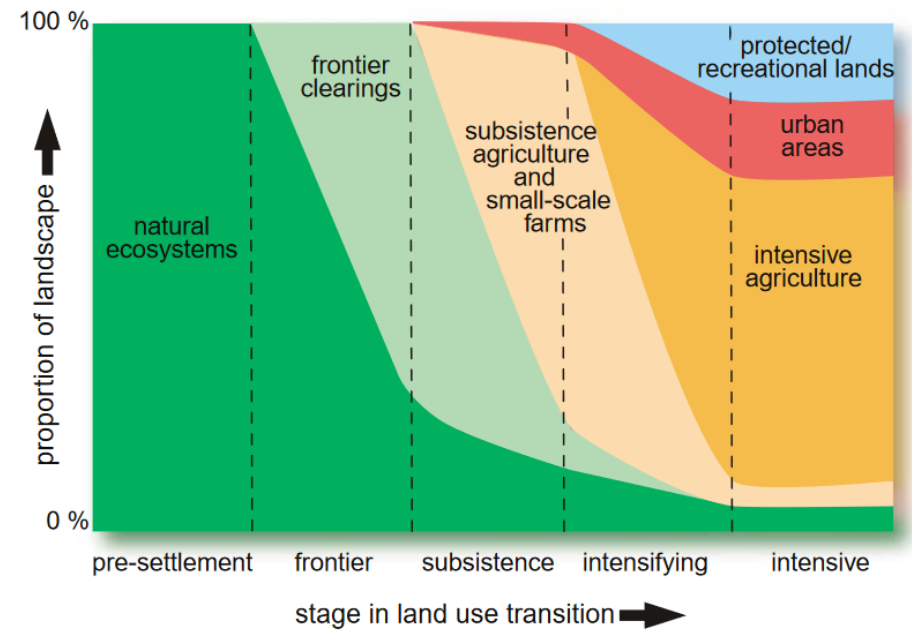
Land use change is accelerating within a zero sum game of land resource allocation

- Expansion and intensification of has changed global land use patterns
- Availability of land resources is becoming increasingly scarce

Estimated global land use 0 – 2016:



Phases of modern industrial land use development:



Typical land use transitions. Concept: Foley 2005, Nature. Observations: Ellis et al 2021.

Anthropogenic Biomes of the World (v1): The landscapes we inhabit today

Urban & dense settlements

- 11 Urban
- 12 Dense settlements

Villages

- 21 Rice
- 22 Irrigated
- 23 Cropped & pastoral
- 24 Pastoral
- 25 Rainfed
- 26 Rainfed mosaic

Croplands

- 31 Residential irrigated
- 32 Residential rainfed mosaic
- 33 Populated irrigated
- 34 Populated rainfed
- 35 Remote

Rangelands

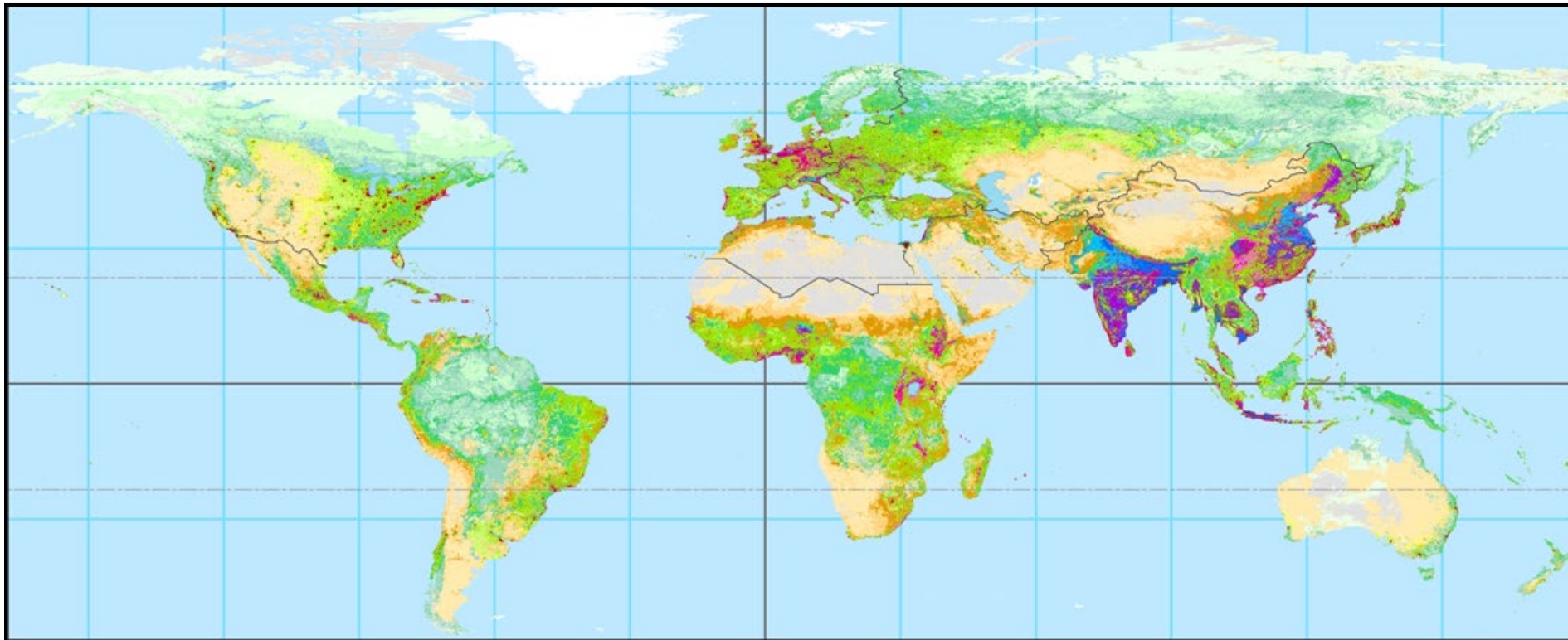
- 41 Residential
- 42 Populated
- 43 Remote

Forested

- 51 Populated forests
- 52 Remote forests

Wildlands

- 61 Wild forests
- 62 Sparse trees
- 63 Barren



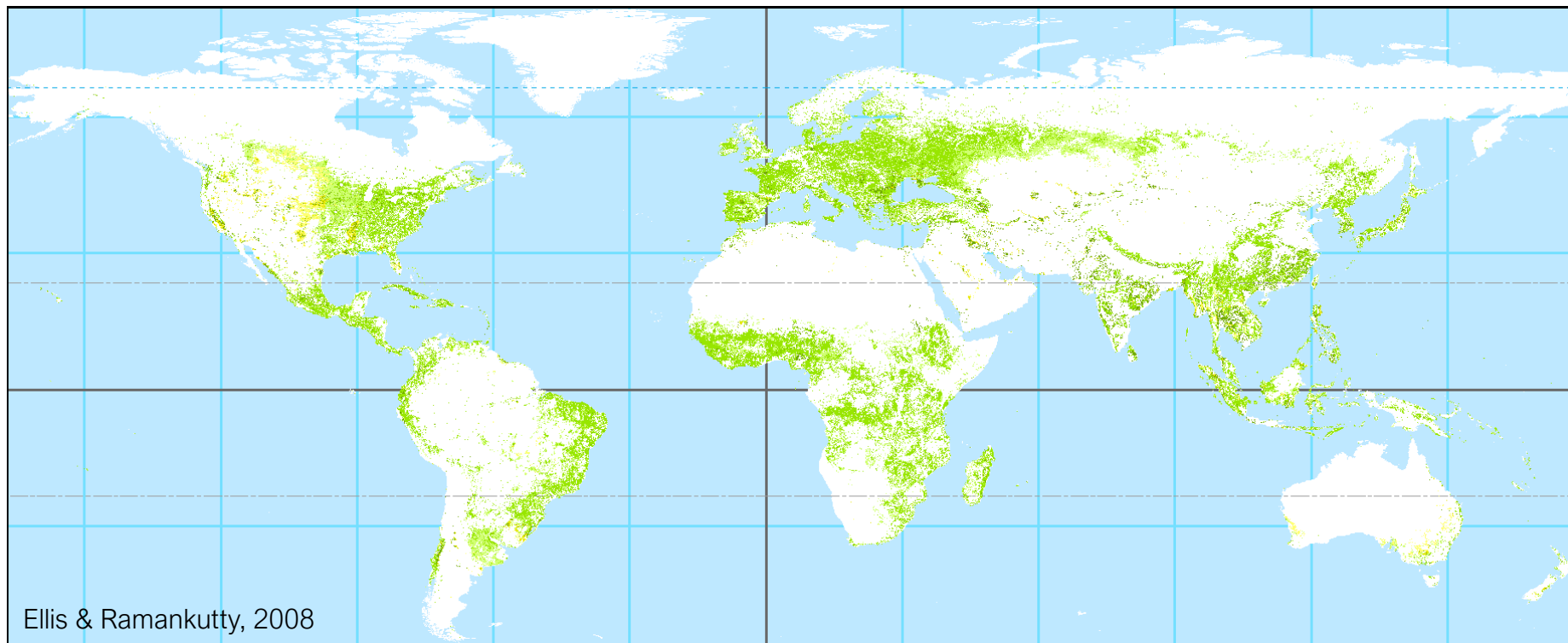


Croplands

Crops mixed with other land uses



27 million km², 0.9 billion people, 25% global tree cover

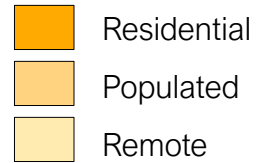


Ellis & Ramankutty, 2008

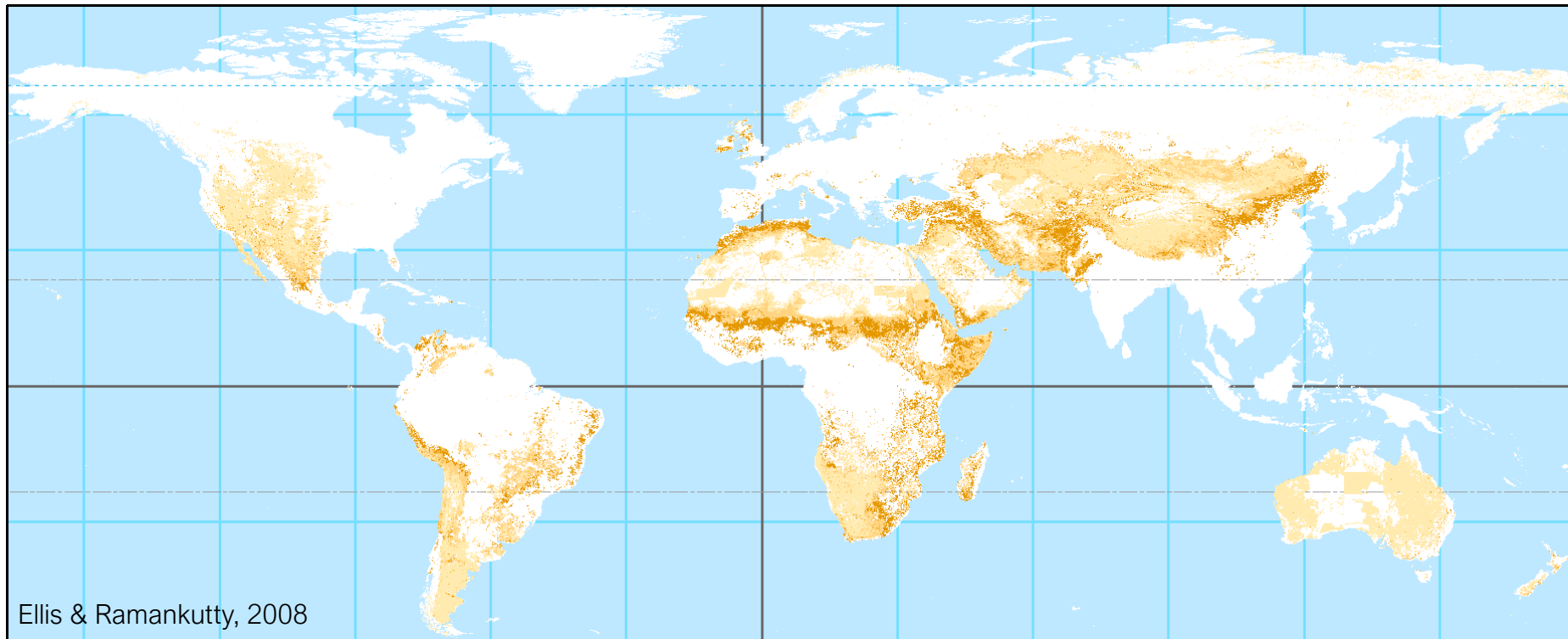


Rangelands

*Grazing land, minimal crops
and forests*

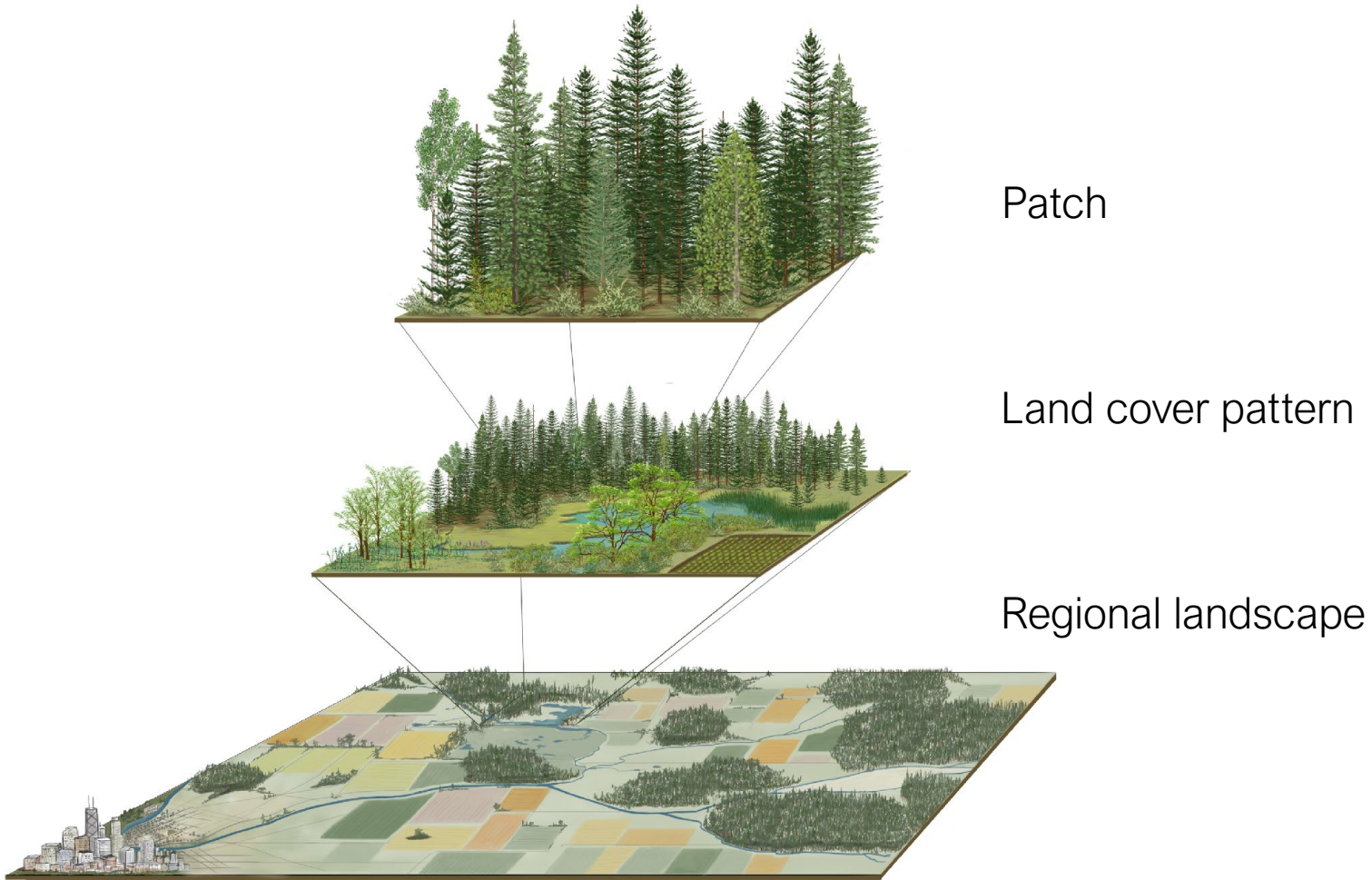


40 million km², 0.3 billion people, 6% global tree cover



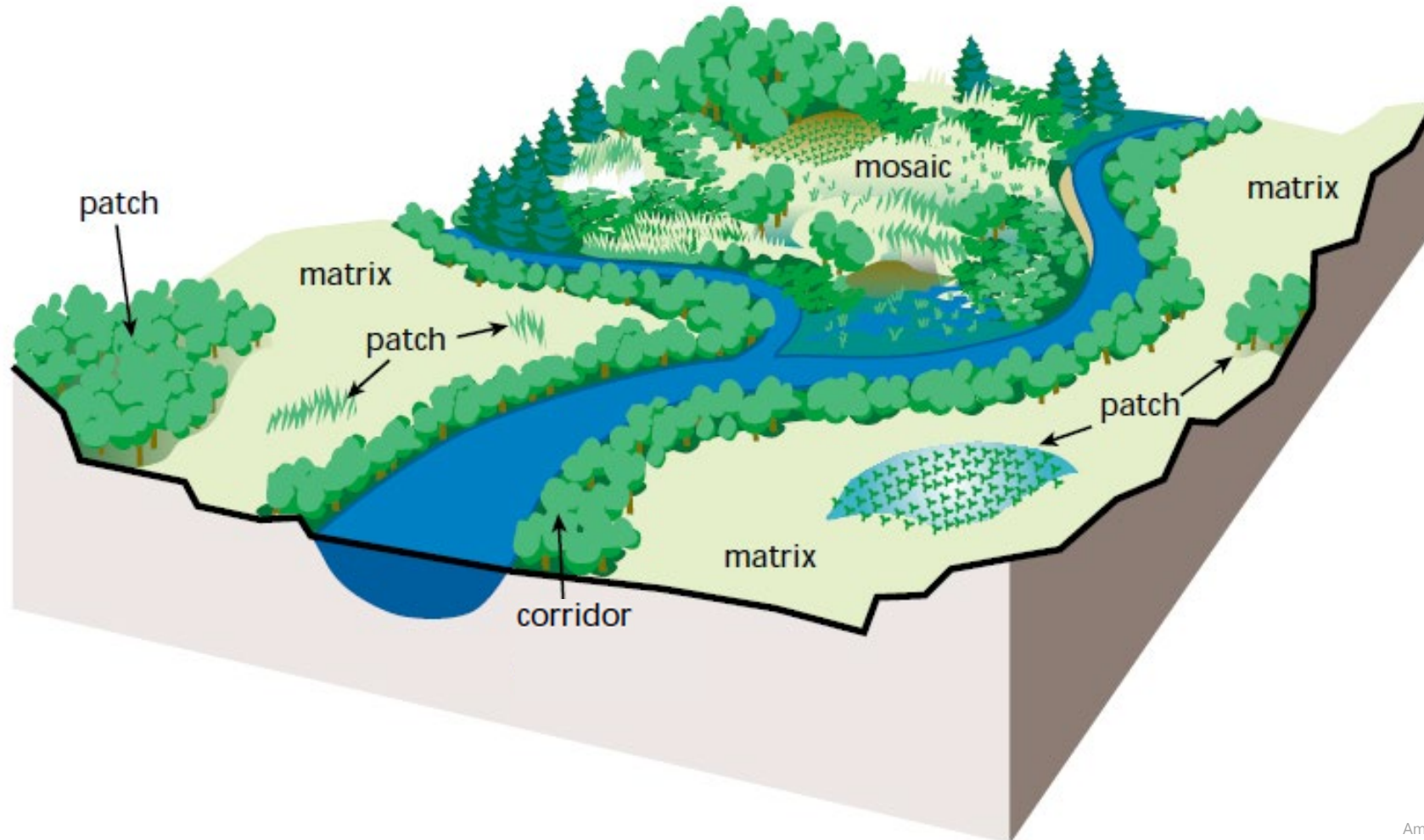
Landscape systems

Scale levels of a landscape system: Patches form patterns, which are repeated across landscapes



Example of a landscape system

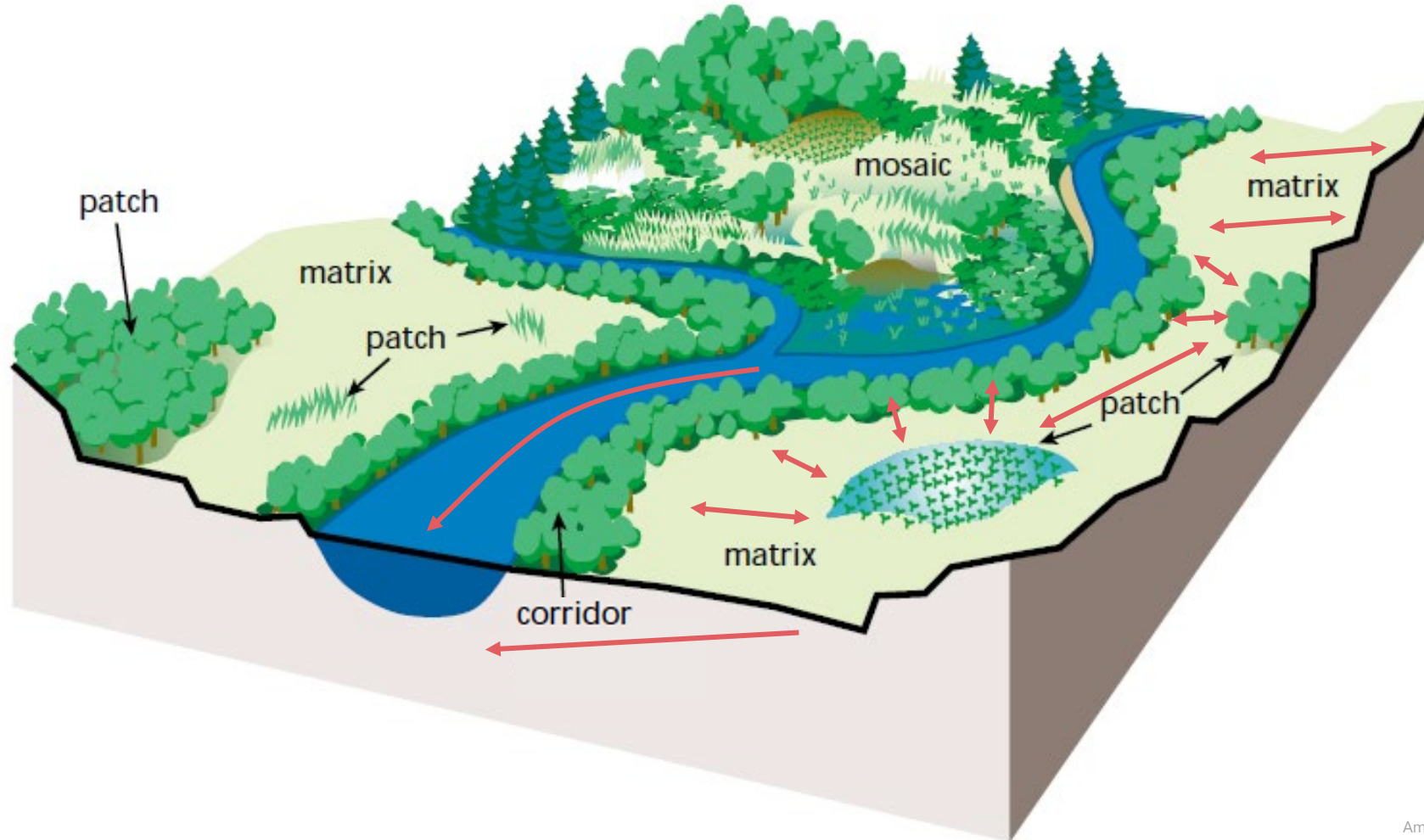
The location of elements within the system codetermines functionality – this constitutes the target for land use planning



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Horizontal flows and neighbourhood relationships characterize landscape pattern

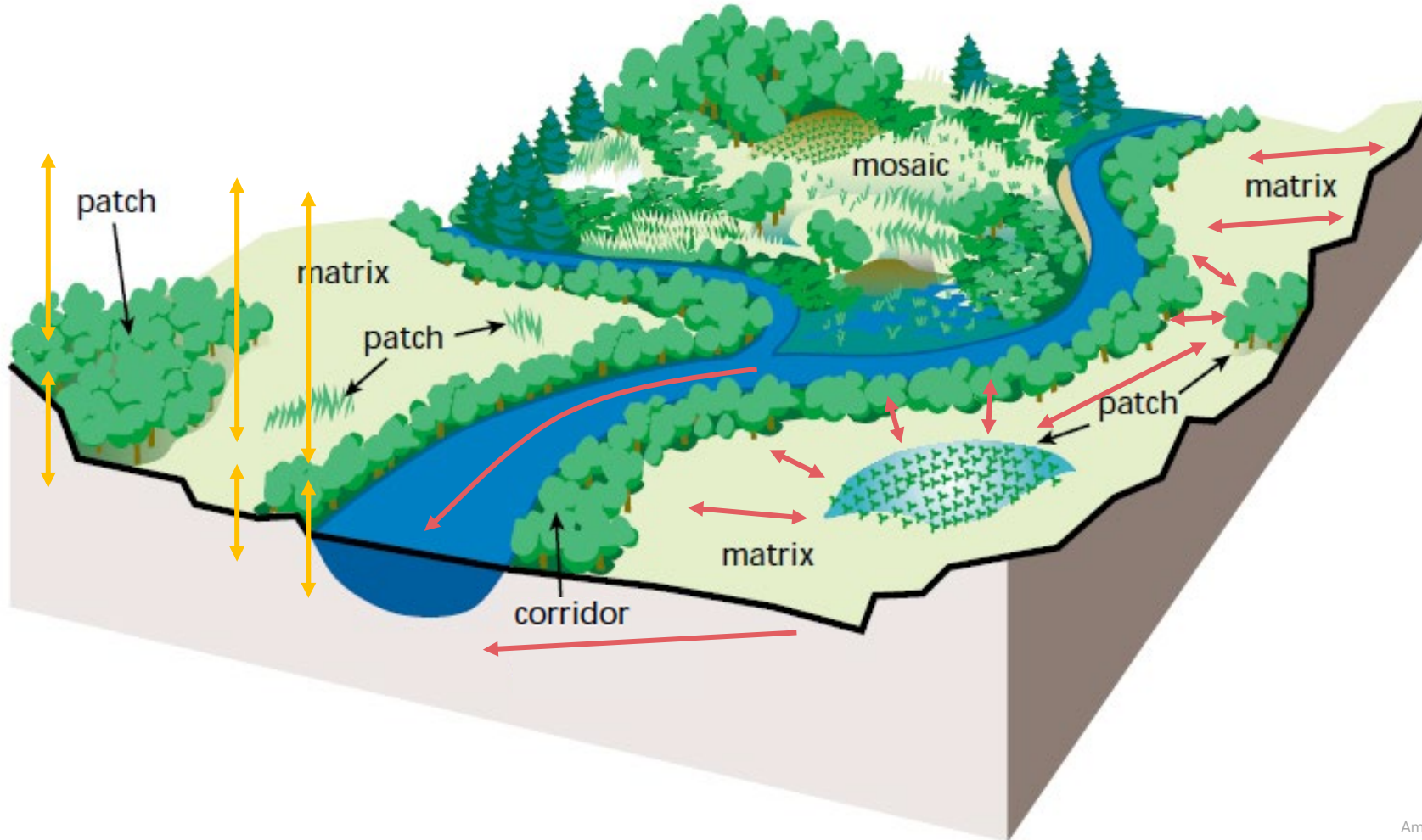


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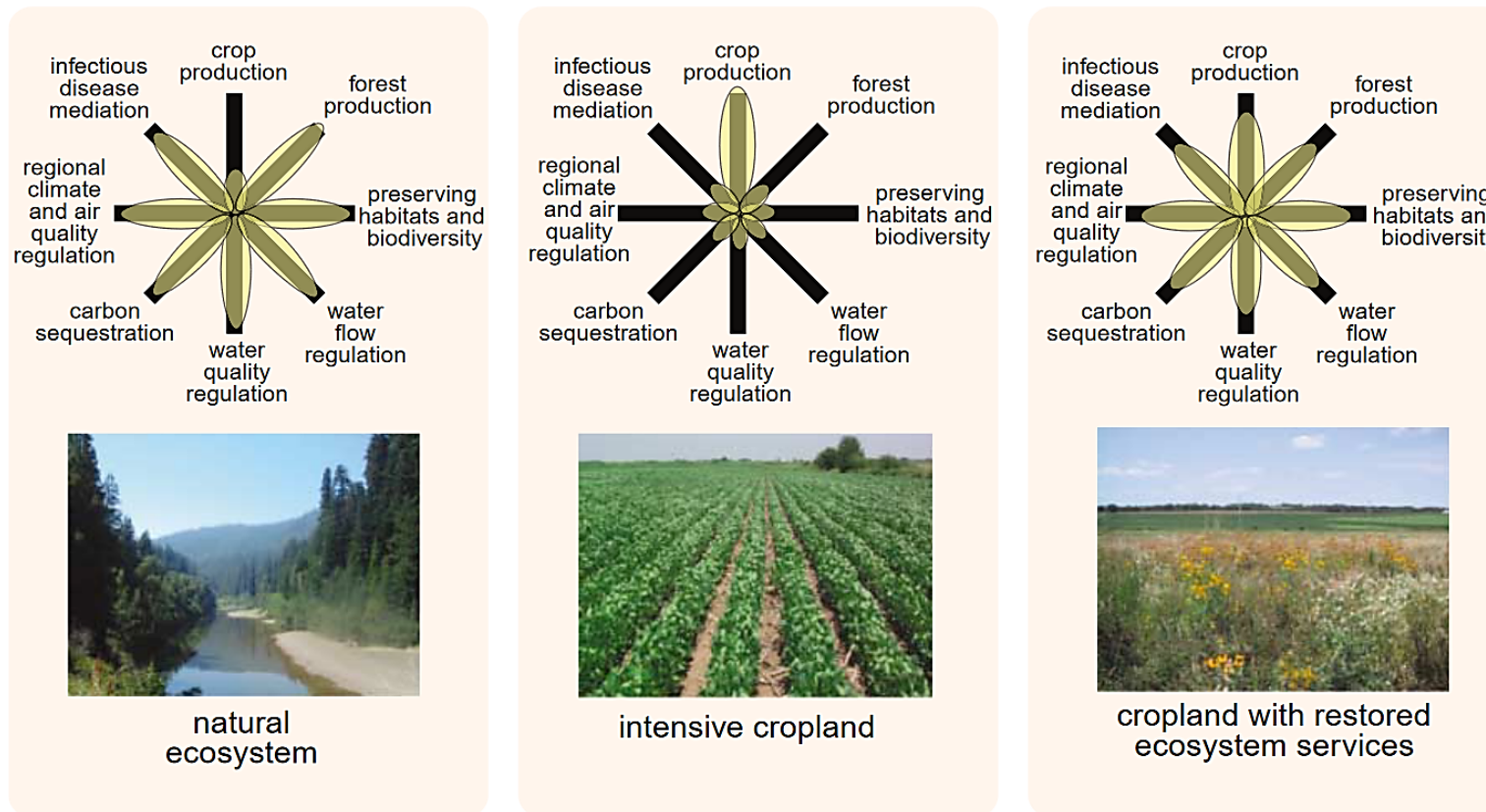
Vertical combinations of substrate, climate, species composition etc. characterize patches



A key problem:

Delivering a broad array of ecosystem services from multifunctional landscapes

- Considered over a long time period, human land use has degraded the functionality and reduced the extent of habitats – while at the same time making space for human societies.
- This has degraded delivery of key ecosystem services important to human societies and economies.



Conceptual framework for comparing trade-offs of ecosystem services in land use regimes

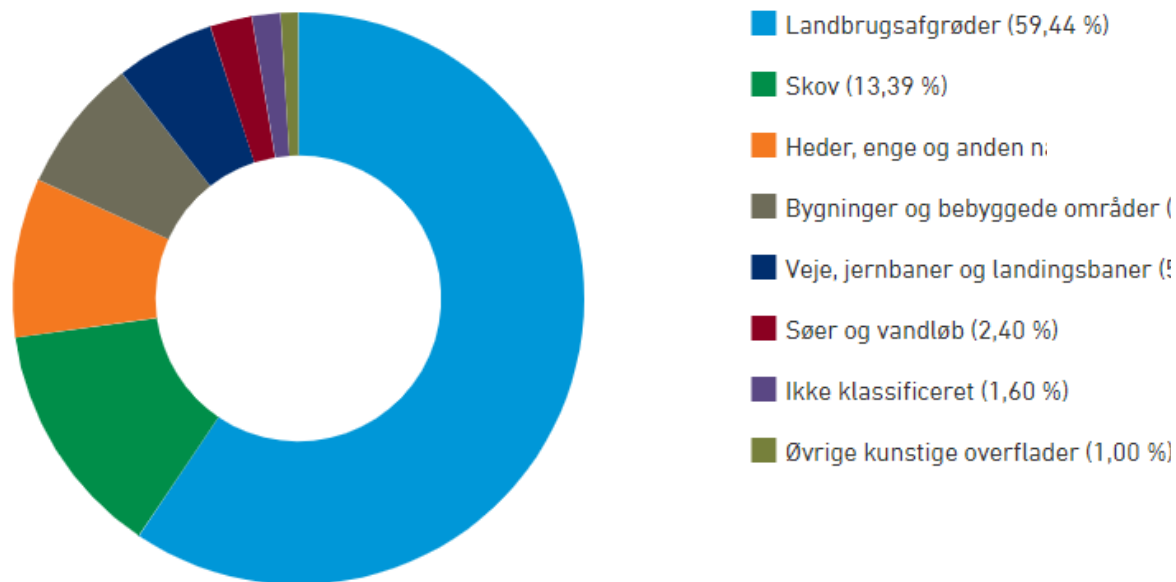
The provisioning of multiple ecosystem services under different land-use regimes is here illustrated with “flower” diagrams, in which the condition of each ecosystem service is indicated along each axis

Foley 2005, Nature.

Land use in Denmark: challenges and solutions

- Land resources use is critical for maintaining and developing food, fibre and biomass production, water resources management, raw material extraction, biodiversity conservation, carbon capture and sequestration, flood management and climate adaptation, and healthy living environments.
- Most of Denmark is in intensive agricultural use and other ecosystem services are under pressure.

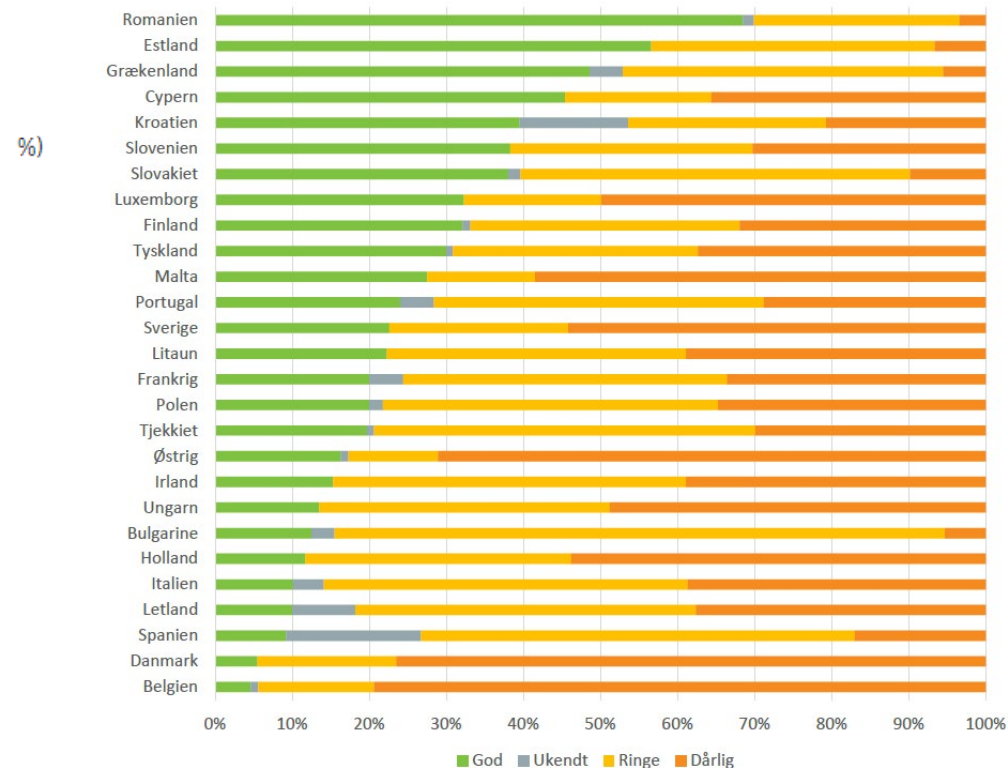
(1) Land use inventory



(1) Land use inventory, Danmarks statistik 2021, Arealregnskab 2021.

(2) Conservation status of habitats in Denmark and the EU countries, EEA. (2020). State of nature in the EU – Results from reporting under the nature directives 2013-2018

(1) Habitat conservation status

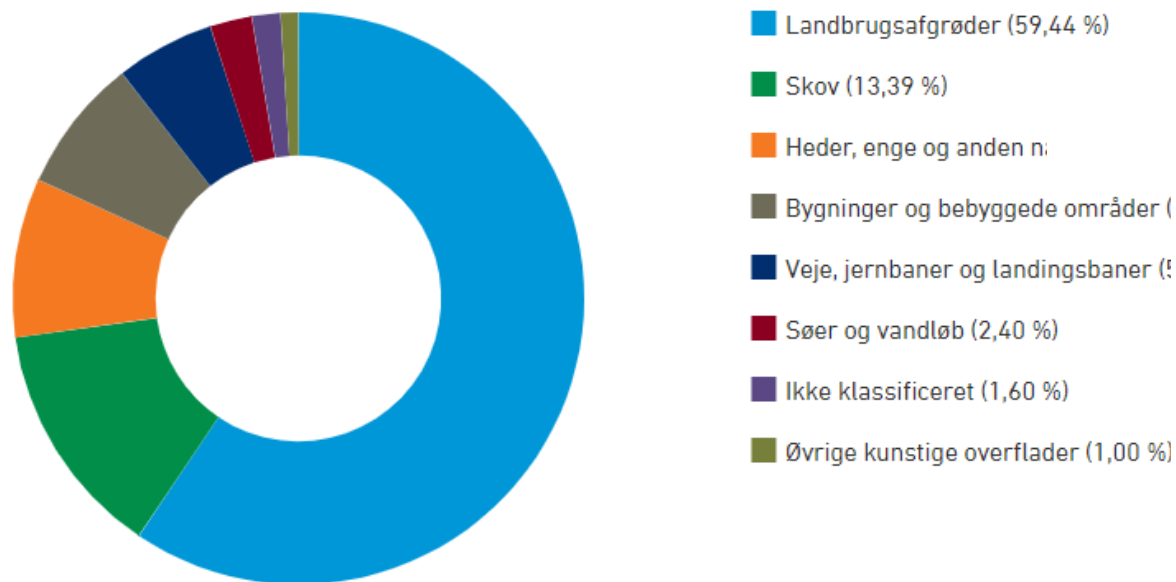


Land use in Denmark: challenges and solutions

Options for improving patterns of land use at the landscape scale include:

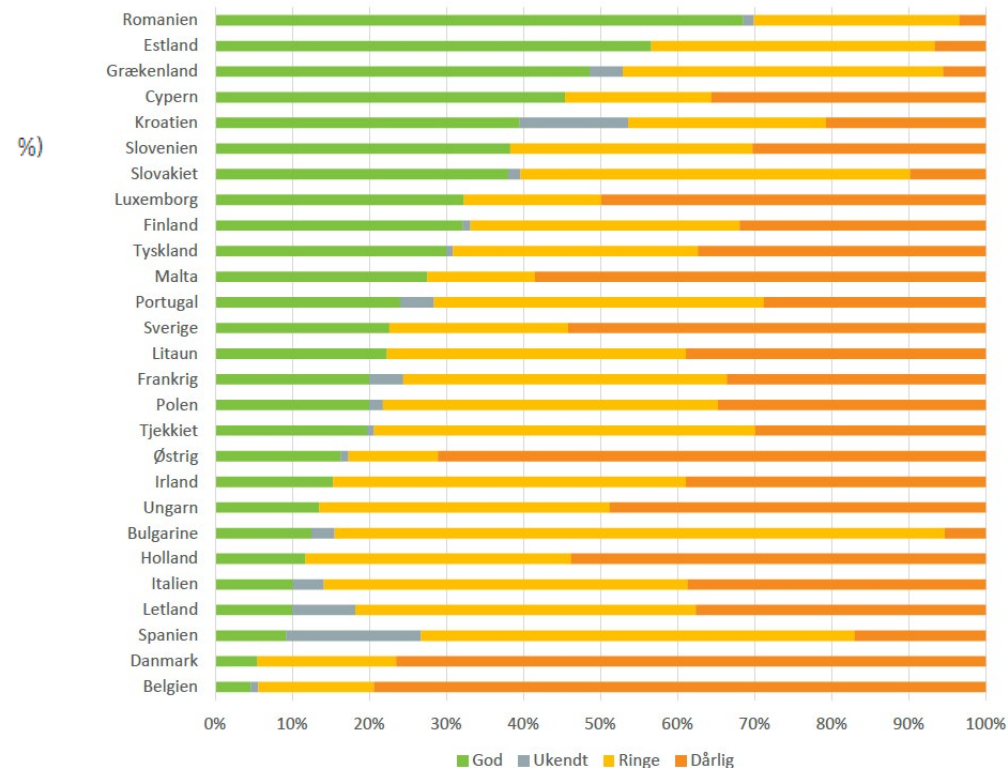
1. Re-allocation: Moving land uses to the most suitable areas, to increase ecosystem service delivery and decrease ecological footprints.
2. Multifunctionality: Optimising concurrent use of land resources for multiple ecosystem services
3. Co-existence: Minimising tradeoffs between land uses in the same landscapes.

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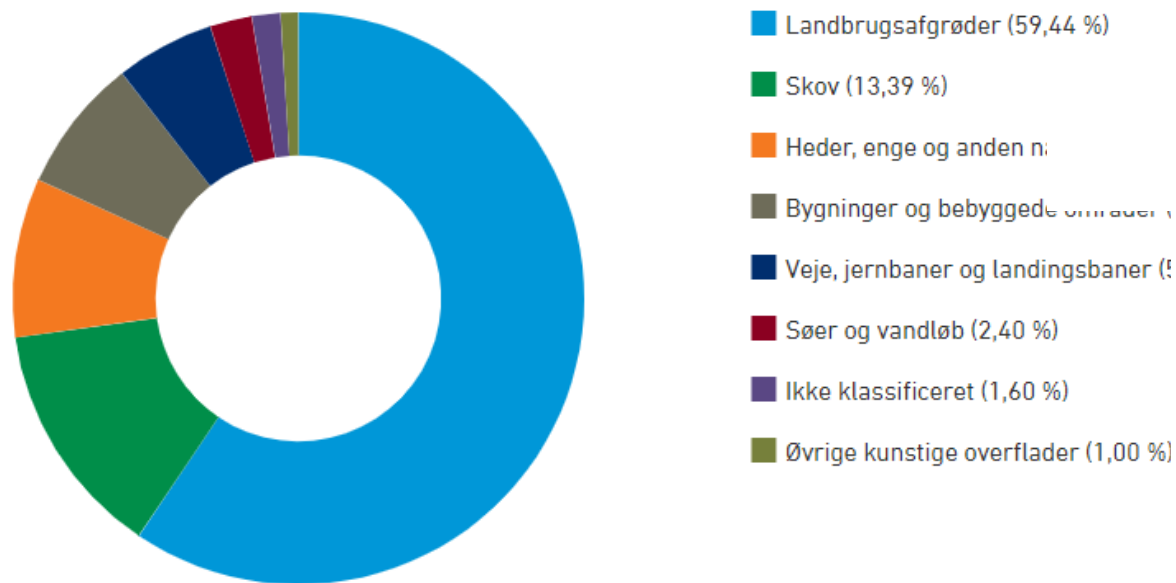


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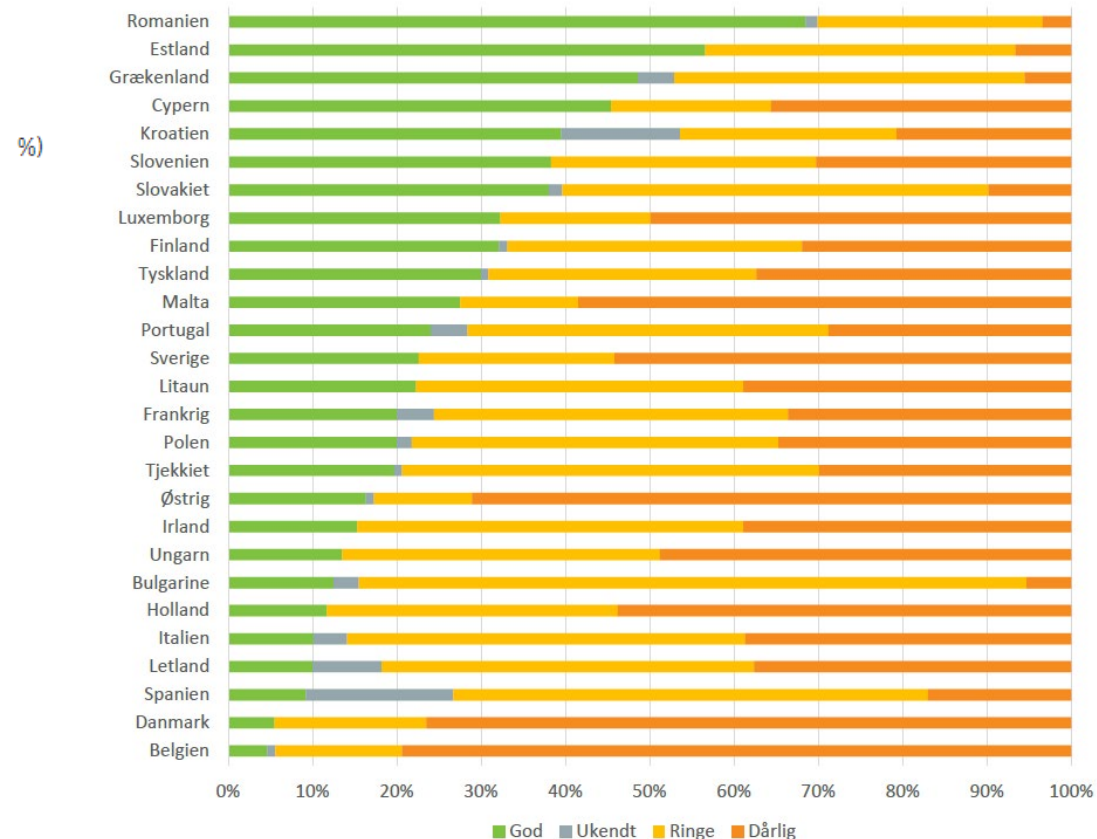
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Thank you for listening

