

Perspectives on further integration of dairy and arable crop production

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Take home messages

- Sustainable food systems require a well-balanced ratio between plant based and animal source foods
- There is an urgent need to increase the sustainability of both plant production and animal production
 - within chains
 - by connecting chains

→ towards more integrated plant-animal systems



- There are synergies as well as trade-offs related to more integrated plant-animal systems

What will be discussed?

- Sustainable food systems
 - Circularity & ratio plant-animal
- Sustainability increase
 - Vision Animal Task Force
- Integrated plant-animal systems
 - Categories
 - Synergies, trade-offs
 - Showcases



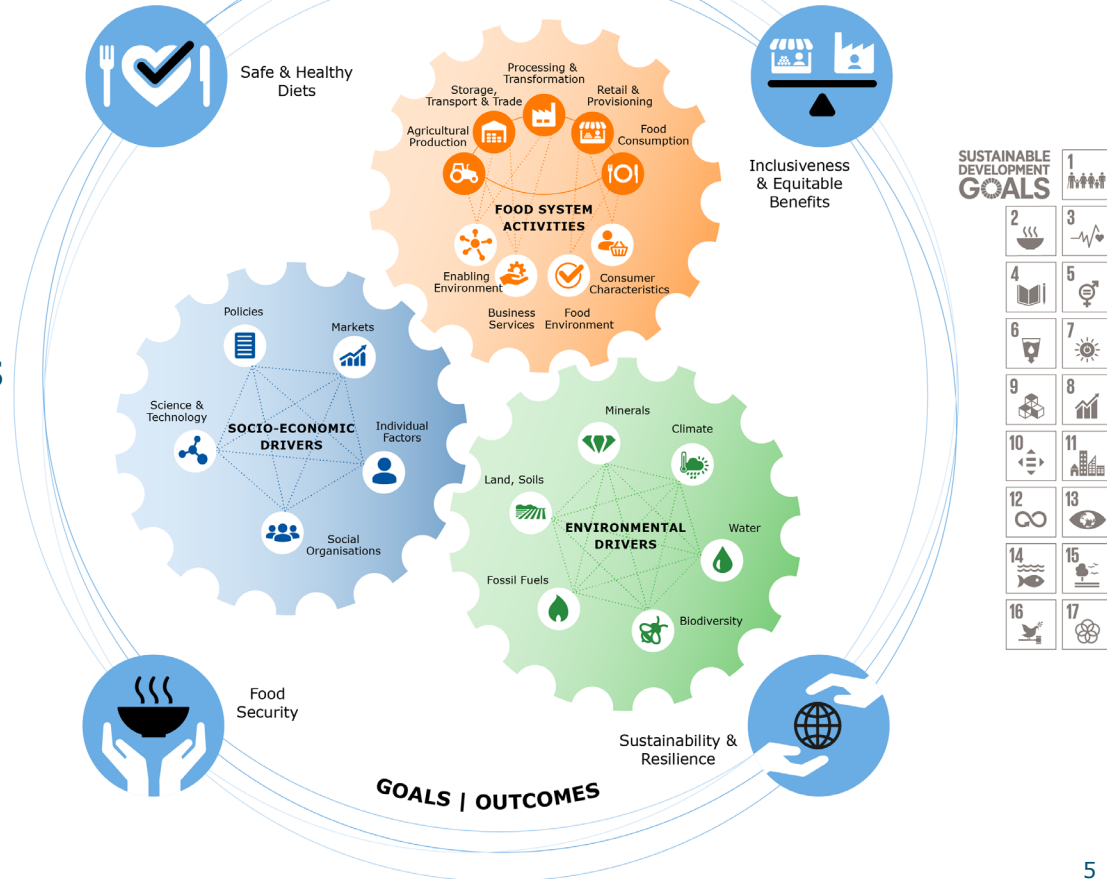
Sustainable food systems

Main connected domains

1. Food security
2. Safe & healthy diet
3. Fair distribution of costs and income
4. Environmental sustainability, biodiversity & resilience

Food systems framework

Van Berkum et al. 2018, Wageningen University & Research



Circularity as a key response to improve sustainability

- If livestock production systems only use **feed products that are not in competition with humans** → protein from animal source food is estimated at 21 g/capita/day (van Zanten, 2016)
- Optimal use of current **resources unsuitable or undesired for human consumption** in livestock diets → supply of 27 g human digestible protein per capita per day (Van Hal, 2020)
- Simon et al, 2024: 40:60 ratio of animal-sourced to plant-sourced proteins in **circular food system**



Sustainability increase

Vision Animal Task Force

Animal Task Force, 2024

ATF:

A European Public-Private Partnership and a leading body of expertise linking European industry and research providers for developing innovation in the livestock sector



ATF, 2024

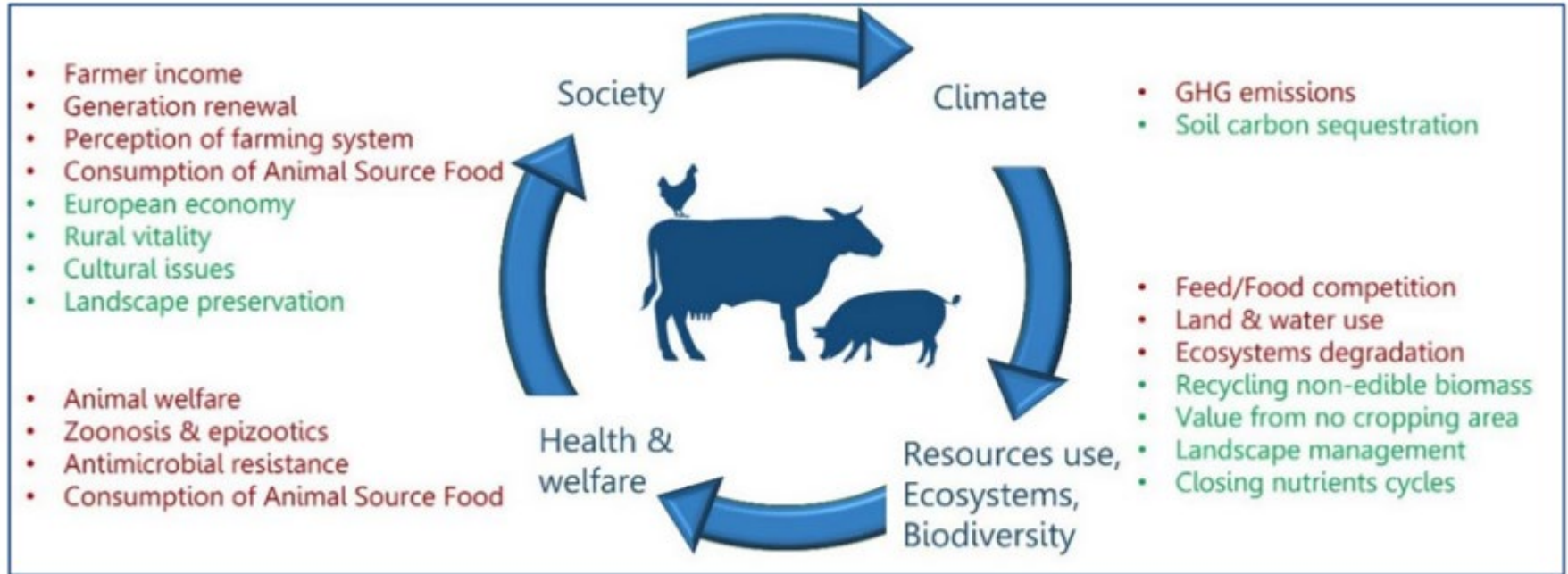


Figure 1. The negative (red) and positive (green) impacts of livestock farming

ATF, 2024

- “How can we increase the net social and environmental benefit of livestock, while ensuring the costs are distributed equitably?”
- “Redesign the place and role of livestock within sustainable agri-food systems”

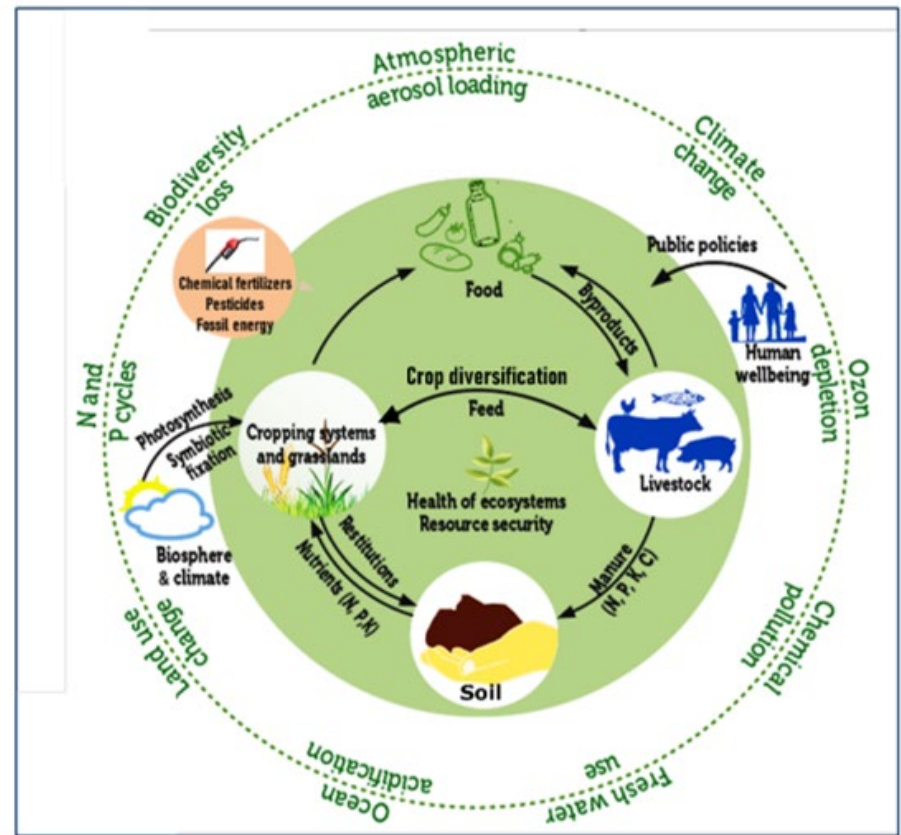
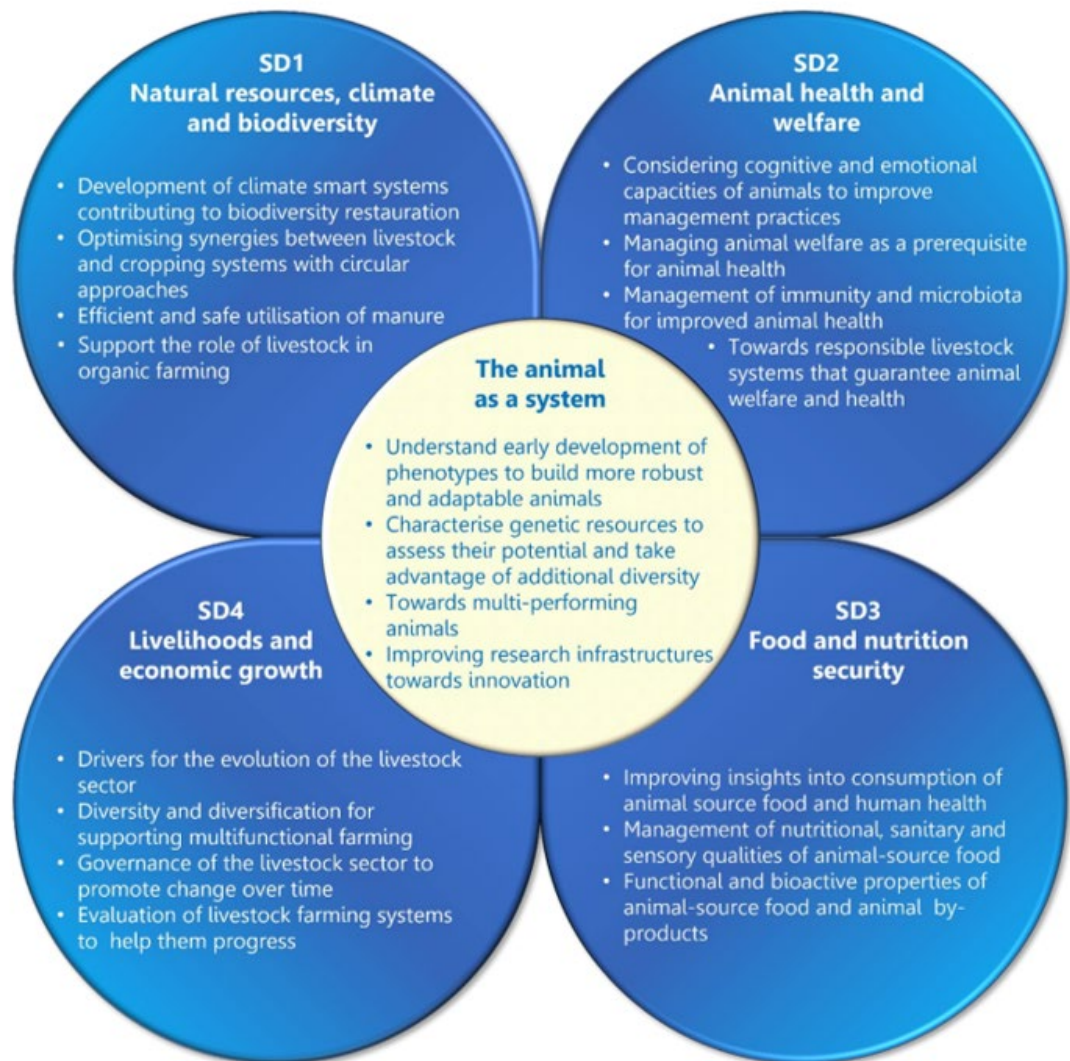


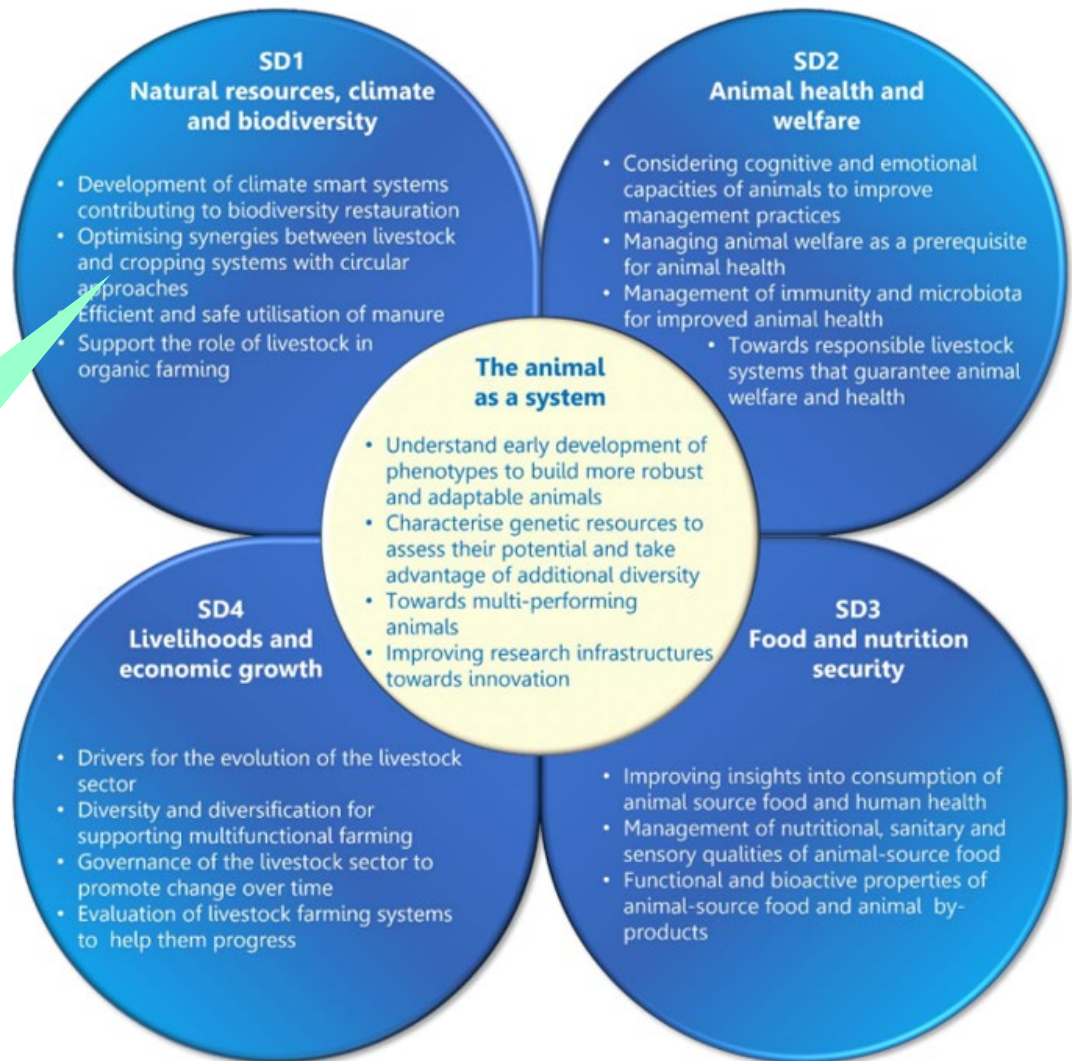
Figure 3. Role and place of livestock in balanced circular food production within planetary boundaries

ATF, 2024

Sustainability domains to improve European livestock farming systems



Optimising synergies between livestock and cropping systems with circular approaches



“Crop and livestock systems should become more integrated at multiple scales, e.g. on farm with arable and livestock rotations or at a regional/national scale through exchange of by-products and manures/slurries between livestock and arable farms.”

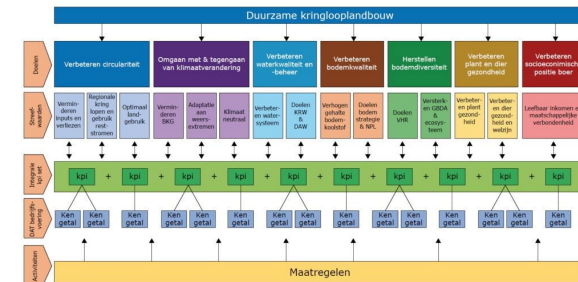
R&I priorities under "*Optimising synergies between livestock and cropping systems with circular approaches*"

- Identification and development of mixed crop-livestock systems adapted to local contexts
- New (protein rich) feed sources
- Upgrading the ability of livestock to utilise a diverse range of inedible biomass
- Addressing the wide geographical and regional specificities for the reconnection between livestock and crop farming
- Supporting efficient organisation of stakeholders and innovative public policies



KPIs (Key Performance Indicators) play an important role

- Determine KPIs which relate to your sustainability goals
- Use KPIs
 - for monitoring and control
 - to evaluate synergies and trade-offs
- Connect recognition and reward mechanisms to the KPIs
- Use integral set of KPIs: combination of KPIs provides insight
- Be aware of the relevance of metrics

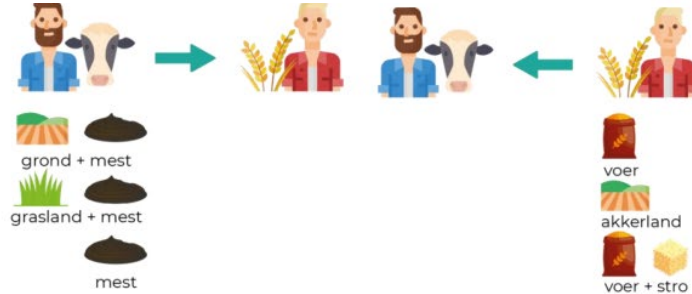


Integrated plant-animal systems

Categories of cooperation

A

Transactional cooperation



Functional cooperation



B

C

Advanced cooperation



Joint crop rotation, land use and fertilisation planning. Focus on closing nutrient cycles.

Entrepreneurial cooperation



Integrated operations

D

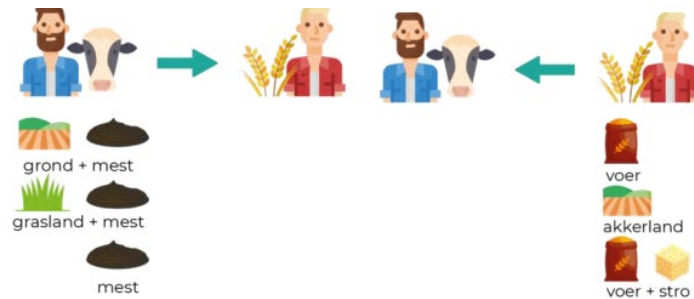
In practice: even more complex....

- Cooperations beyond 1-on-1 relations
- Networks of “land-users” within regions, or even across regions
- Manure trading between regions
- Feed (material) trading through feed business
- Broad range of crop producers and livestock producers
- Co-products by food (and biofuel) industry
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Integrated operations

Effect of cooperation on sustainability goals



- CO2 footprint: methane, carbon sequestration soil, energy use
- Sustainable feed, impact on biodiversity
- Protein self-sufficiency
- Economic sustainability

CO2 footprint

	Methane	Carbon soil	CO2 abroad	Energy use
A	0	0	?	+
B	0	0 / -	-	+ / -
C	+ / -	0 / -	+	+
D	+ / -	0 / -	+	+

0 = no effect

+ = favorable

- = unfavorable

- Less permanent grassland
- Risk of lower soil organic matter
- Less transport of manure and feed

Sustainable feed, impact on biodiversity

	Sustainable feed	Impact on biodiversity
A	0	0
B	0	-
C	+	+
D	+	+

0 = no effect
+ = favorable
- = unfavorable

- More divers crop rotation
- Risk of more nutrient leaching
- More local feed, less feed imports
- Less permanent grassland
- Joint responsibility for soil structure and long-term soil health

Protein self-sufficiency, Economic sustainability

	Protein self-sufficiency	Economic sustainability
A	0	+
B	0	+
C	+	+
D	+	+

0 = no effect
+ = favorable
- = unfavorable

- Protein crops increase
- Lower feed protein purchase
- More “cash crops”
- Lower costs manure
- More flexibility

Two practical showcases

1. PAVEx project

- Dairy farming – arable farming collaboration

2. Biobased crops on dairy farms



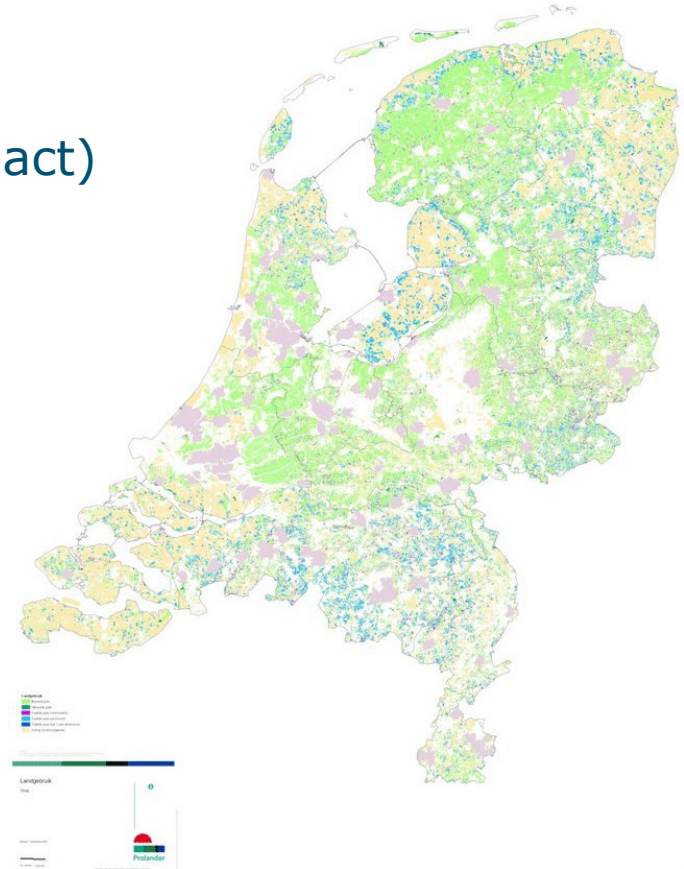
Showcase 1: PAVEx

- Assessing collaborations between livestock farms and arable crop farms
- Focus on environmental sustainability and economic feasibility
- In 6 different regions (the Netherlands)



Showcase 1: PAVEx

- Deming-cycle applied (plan-do-check-act)
- Active use of KPI's



Showcase 1: PAVEx, preliminary results

- Land exchange is the major basis for collaboration
- The role of grassland is changing (e.g., less permanent grassland)
- Location and culture determine the form of collaboration
- There is a great need for policies based on clear environmental goals
→ not policies based on measures
- Collaborators seek recognition from the government and chains for their contribution to achieving environmental goals
- Offers opportunities for optimization of crop rotation plans and fertilization plans based on a larger area

Showcase 2: Crops for biobased construction materials



Miscanthus



Fiber hemp



Flax



Wheat straw

In general:

- Suitable on dry soils → well developed rooting → soil quality improves
- Low input (fertilizers, crop protection, irrigation) → water quality, biodiversity
- Short chains: local production, processing, use
- Economic potential → embedded in carbon credit system

Regional biobased crops → Biobased meeting pavilion



Located at:
Agro innovation centre
"De Marke"
The Netherlands

Take home messages (1)

- More integrated approaches of dairy and arable crop production can be shaped at both farm level and regional level
- More integration offers opportunities to increase ecological, economic and social sustainability of agricultural production
- Synergies and trade-offs need to be assessed and well-balanced
 - customized arrangements between collaborators
 - no generic solutions for integrated crop-dairy systems



Take home messages (2)

- Land-owners and land-users have a shared responsibility for environmental sustainability and long-term soil quality
- Crops for biobased economy offer new opportunities



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Thank you for your attention !

