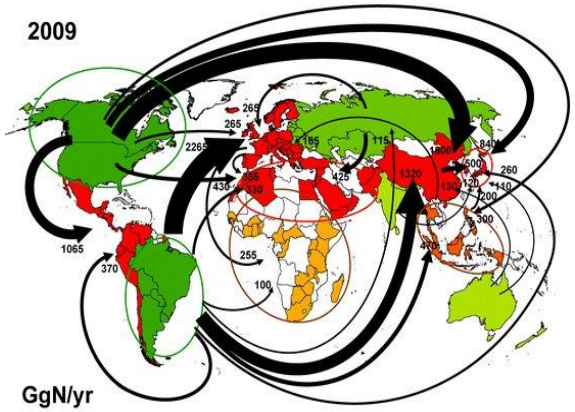
Using local feed resources for livestock farming: Illusion or real promise?

Guillaume Martin, Myriam Grillot, Clémentine Meunier, Marc Moraine, Julie Ryschawy, Fabien Stark



Lassaleta et al., 2014

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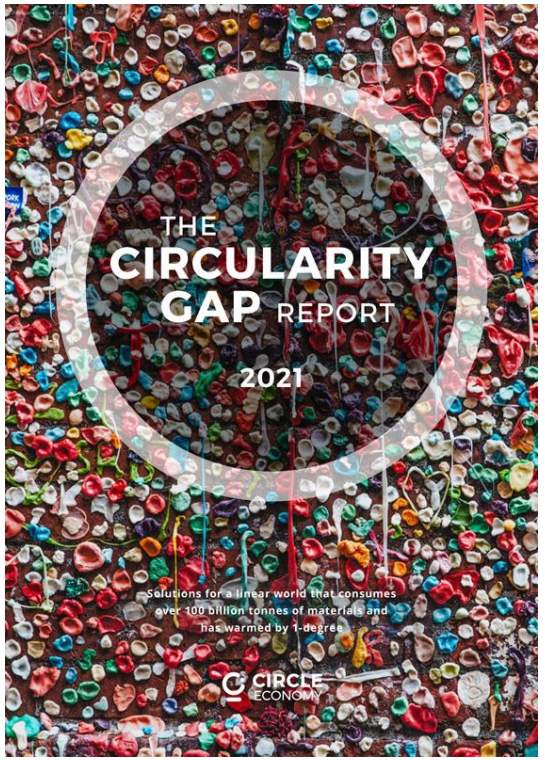


Guillaume Martin[1], Myriam Grillot[1], Clémentine Meunier[1],

Marc Moraine[2], Julie Ryschawy[3], Fabien Stark[2]

[1] INRAE Toulouse, France; [2] INRAE Montpellier, France; [3] INPT-ENSAT, France

FAO -CIHEAM 2022

JOINT SEMINAR OF NETWORKS ON PASTURE AND FORAGE CROPS AND ON SHEEP AND GOAT NUTRITION

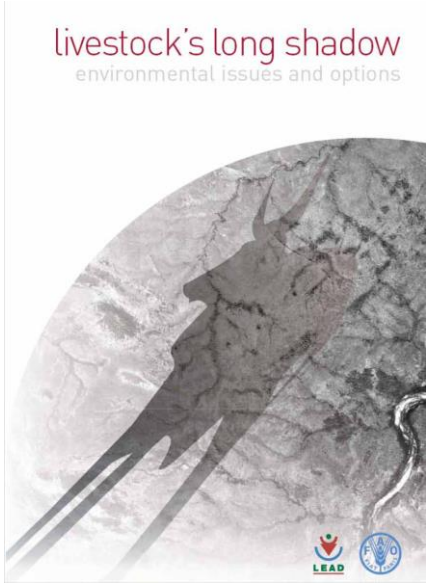
CATANIA / SICILY 27-29 SEPTEMBER

Food and Agriculture Organization of the United Nations

CIHEAM ZARAGOZA

Hard times for livestock production

Multiple criticisms originating from science



Environmental Research Letters

LETTER

Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity

Adrian Leip[1], Gilles Billen[2], Josette Garnier[2], Bruna Grizzetti[1], Luis Lassaletta[2,3], Stefan Reis[4,9], David Simpson[5,6], Mark A Sutton[4], Wim de Vries[7,8], Franz Weiss[1] and Henk Westhoek[3]

INRAE

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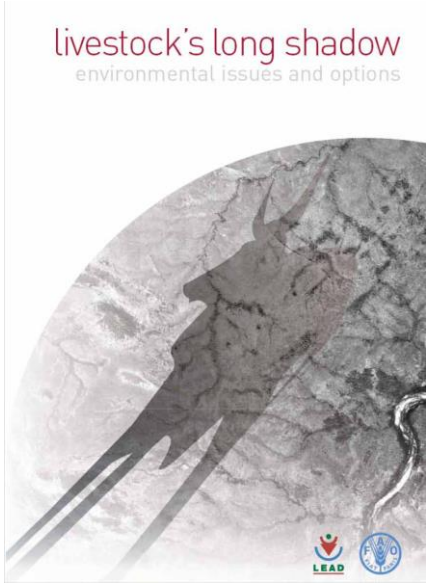

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taken back by some policy-makers and medias

The Guardian

Meat accounts for nearly 60% of all greenhouse gases from food production, study finds

Production of meat worldwide causes twice the pollution of production of plant-based foods, a major new study has found

A single kilo of beef creates 70kg of emissions. This feedlot in Colorado can hold 98,000 cattle. Photograph: Jim West/Alamy Stock Photo

NETFLIX

INRAE

A growing sector

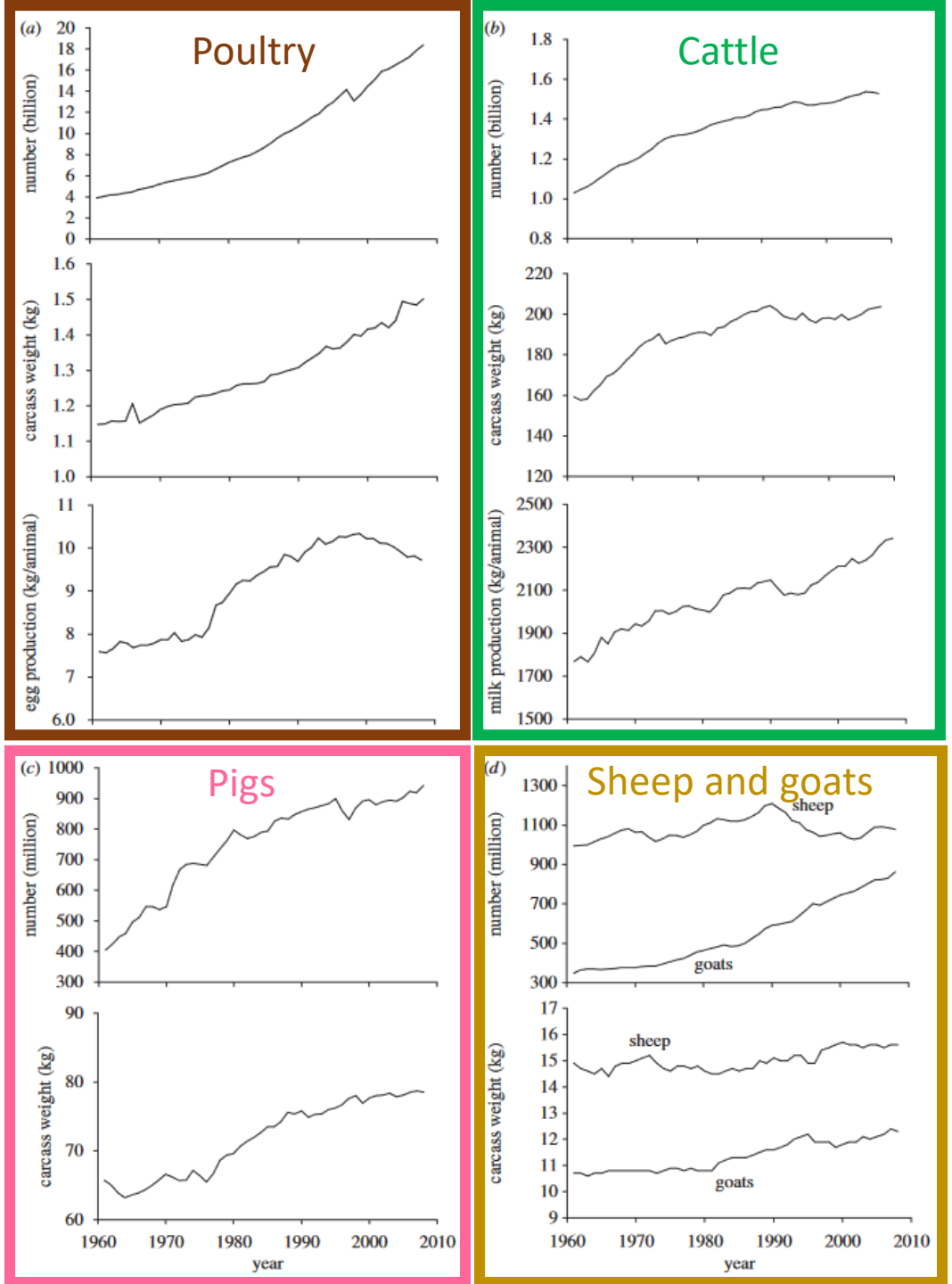
PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2010) **365**, 2853–2867
doi:10.1098/rstb.2010.0134

Review

Livestock production: recent trends, future prospects

Philip K. Thornton*



A growing sector

- in response to rapidly increasing demand for livestock products

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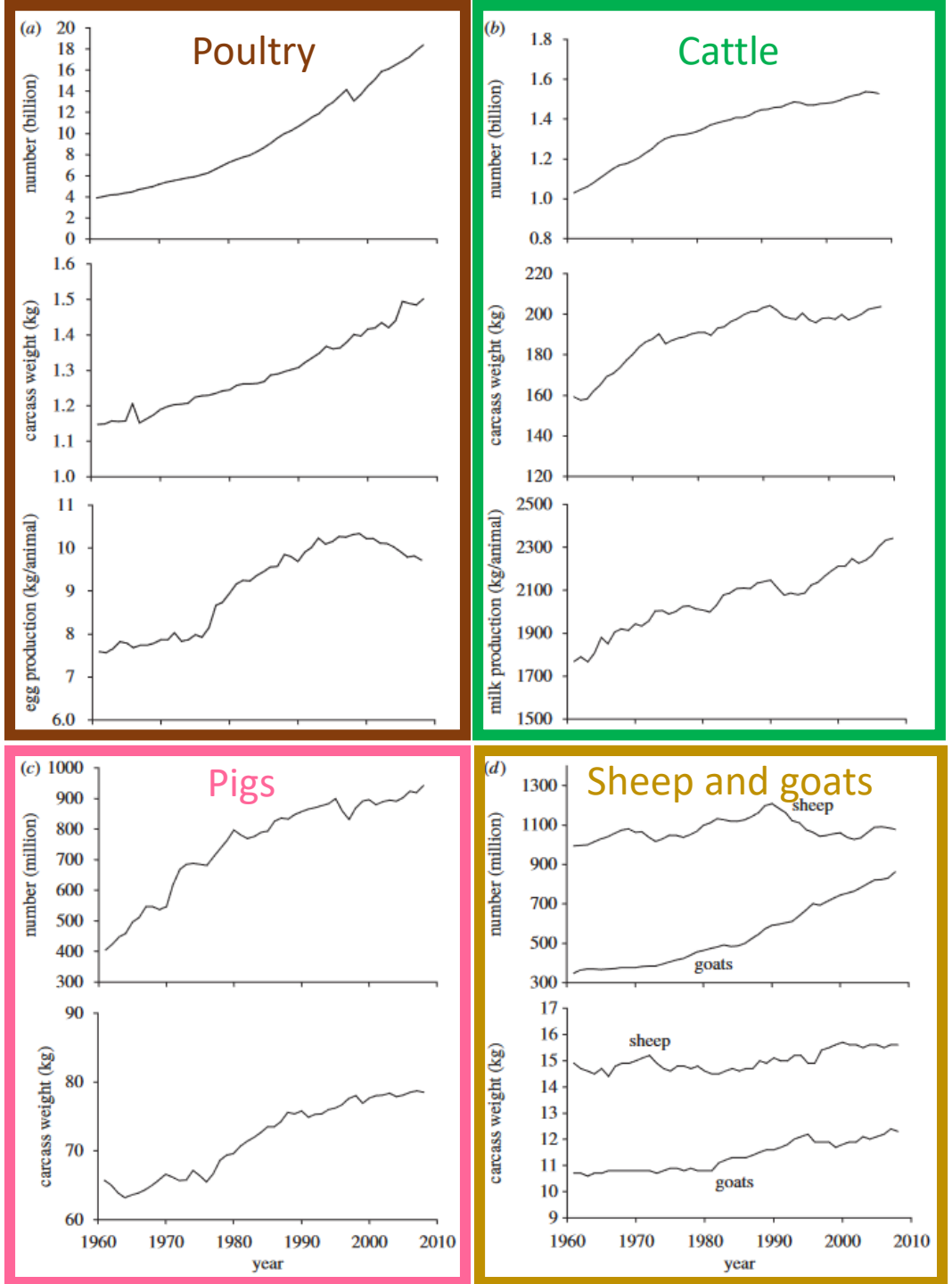

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A growing sector

- in response to rapidly increasing demand for livestock products
- driven by human population growth, income growth and urbanization

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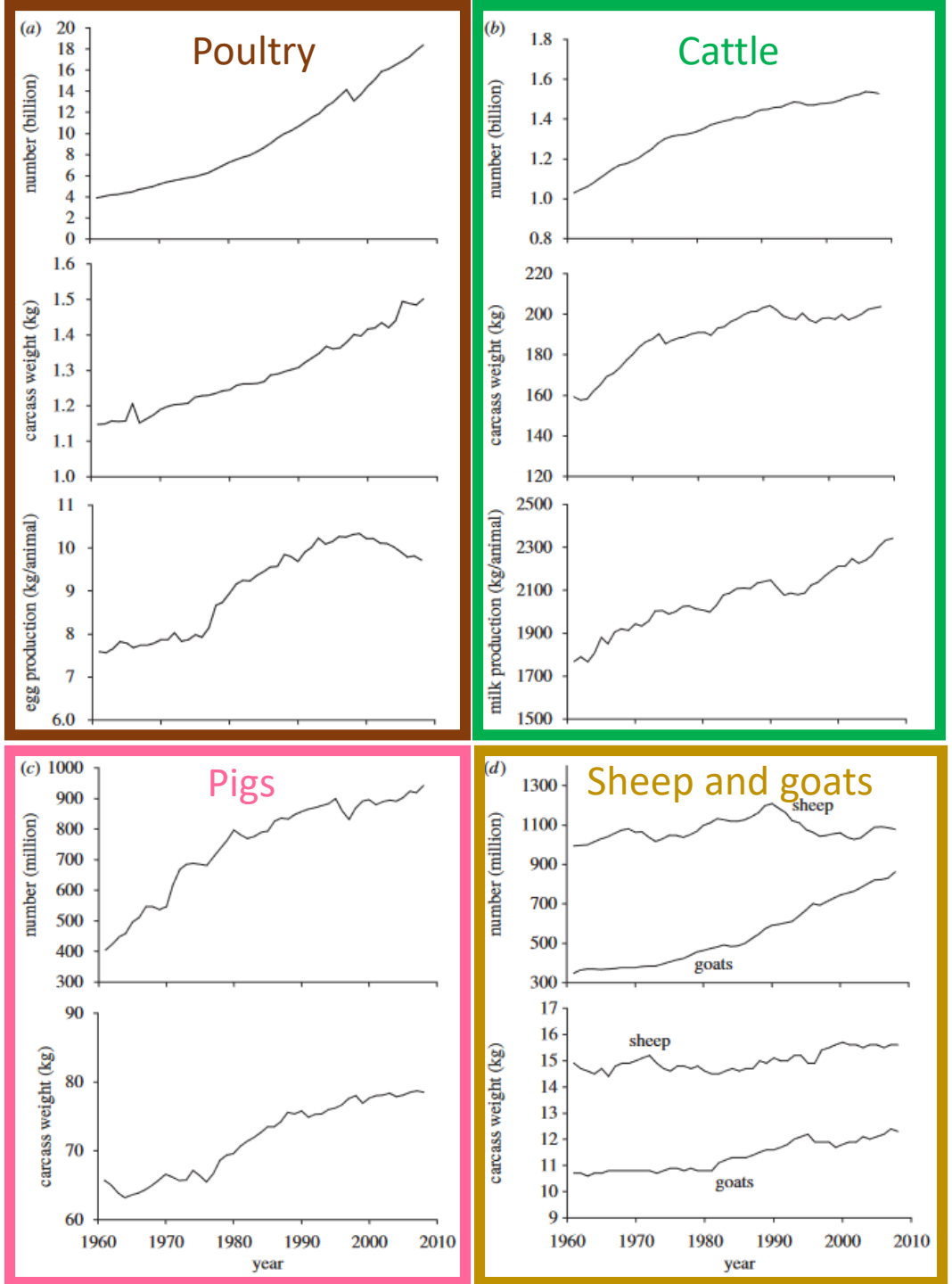

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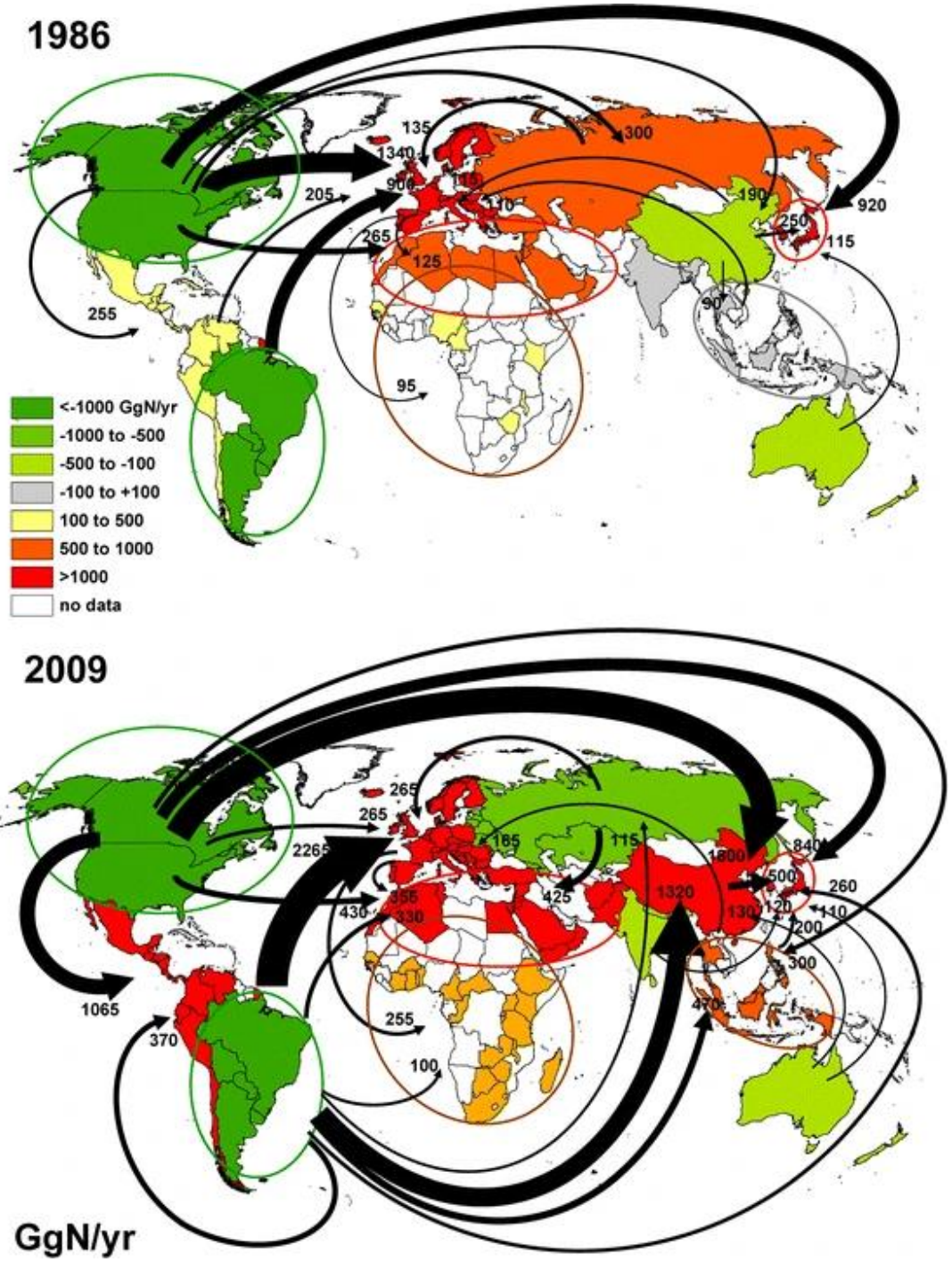
A sector embedded in international trade



Biogeochemistry (2014) 118:225–241
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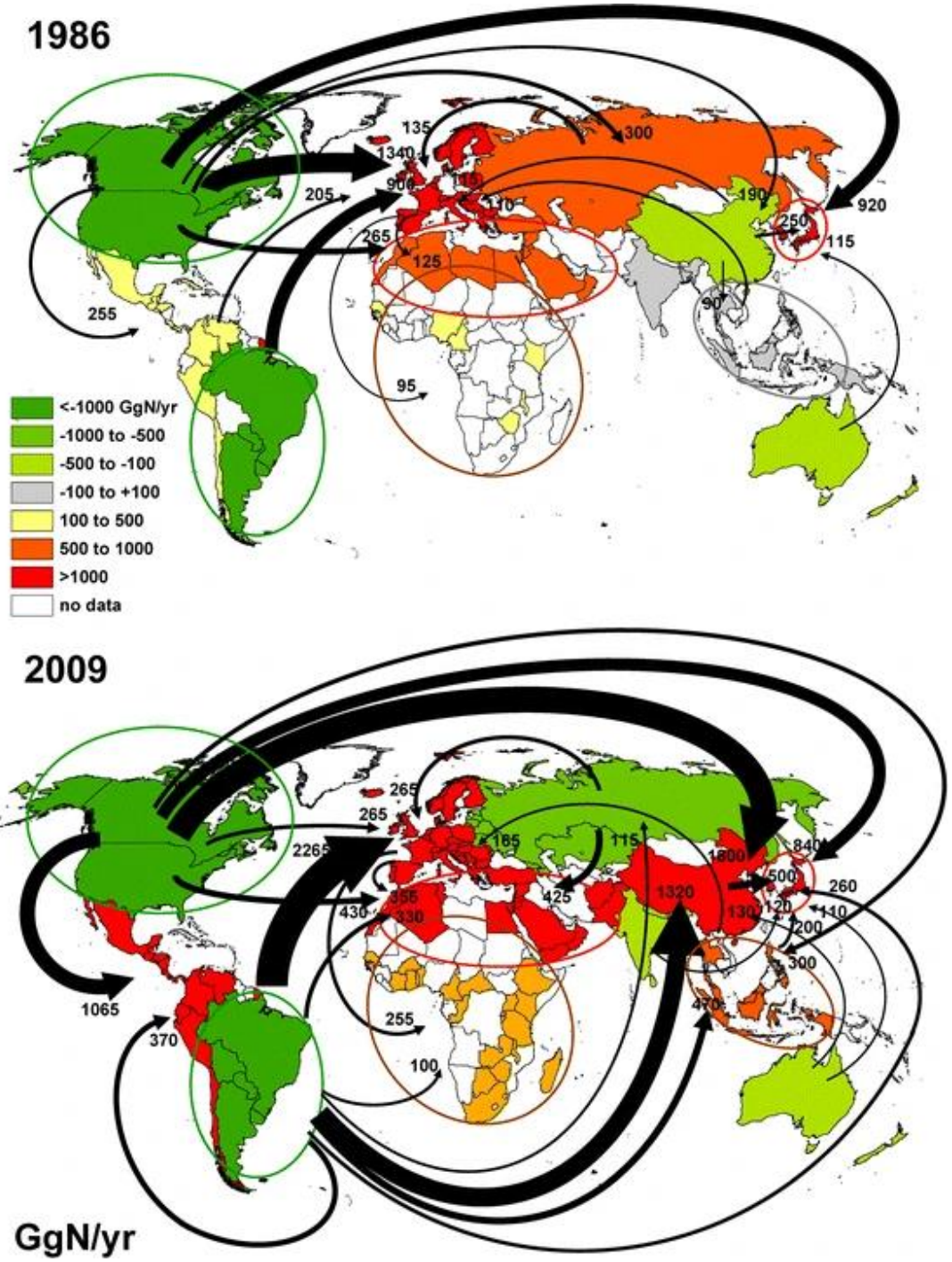
Food and feed trade as a driver in the global nitrogen cycle: 50-year trends

Luis Lassaletta · Gilles Billen · Bruna Grizzetti · Josette Garnier · Allison M. Leach · James N. Galloway

INRAE

A sector embedded in international trade

- A small number of countries (USA, Argentina and Brazil) exporting feed to the rest of the world



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INRAE

A sector embedded in international trade

- A small number of countries (USA, Argentina and Brazil) exporting feed to the rest of the world
- At the global scale, disconnection between crop and livestock production across specialized regions, increasing environmental impacts.

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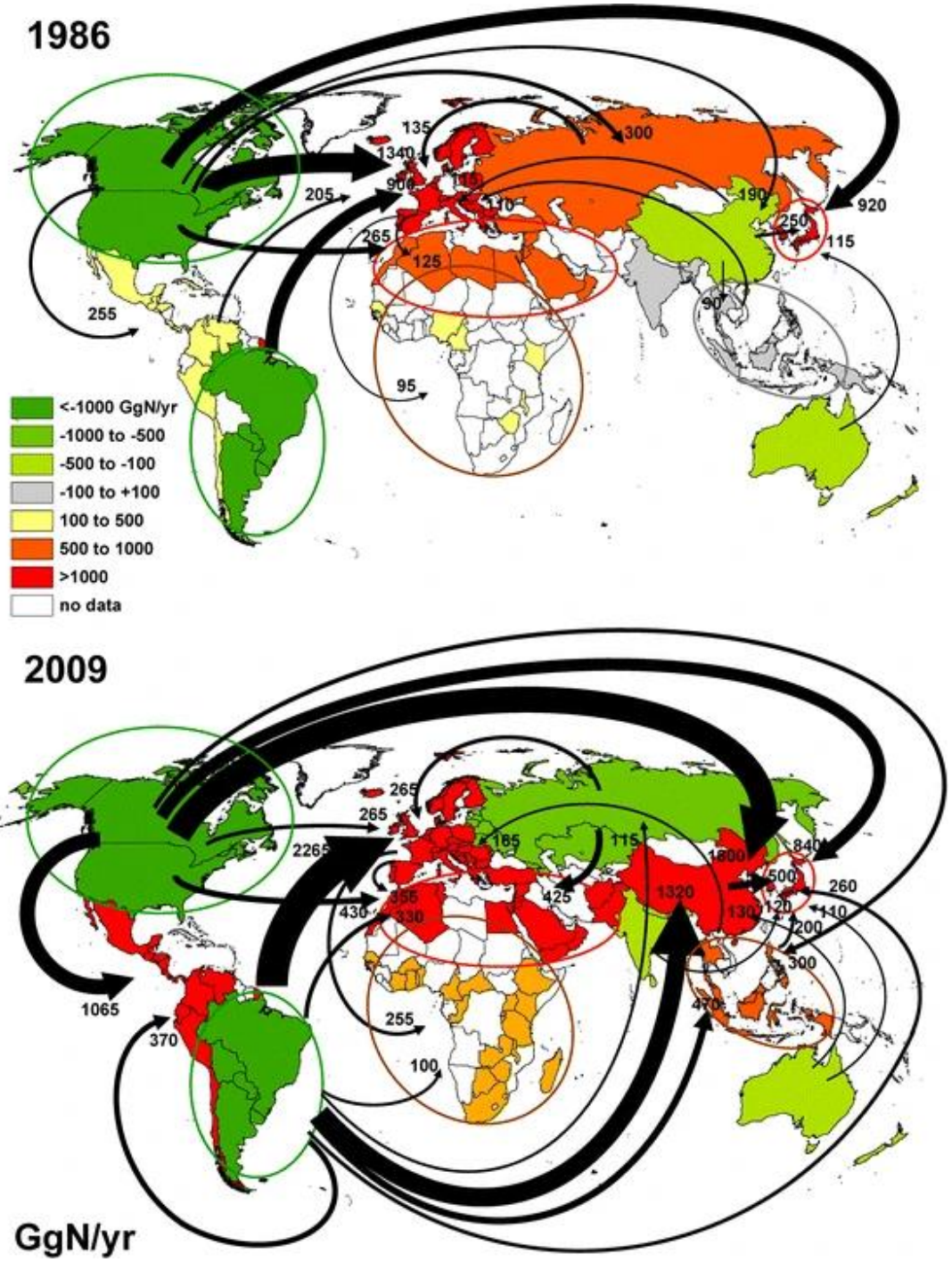
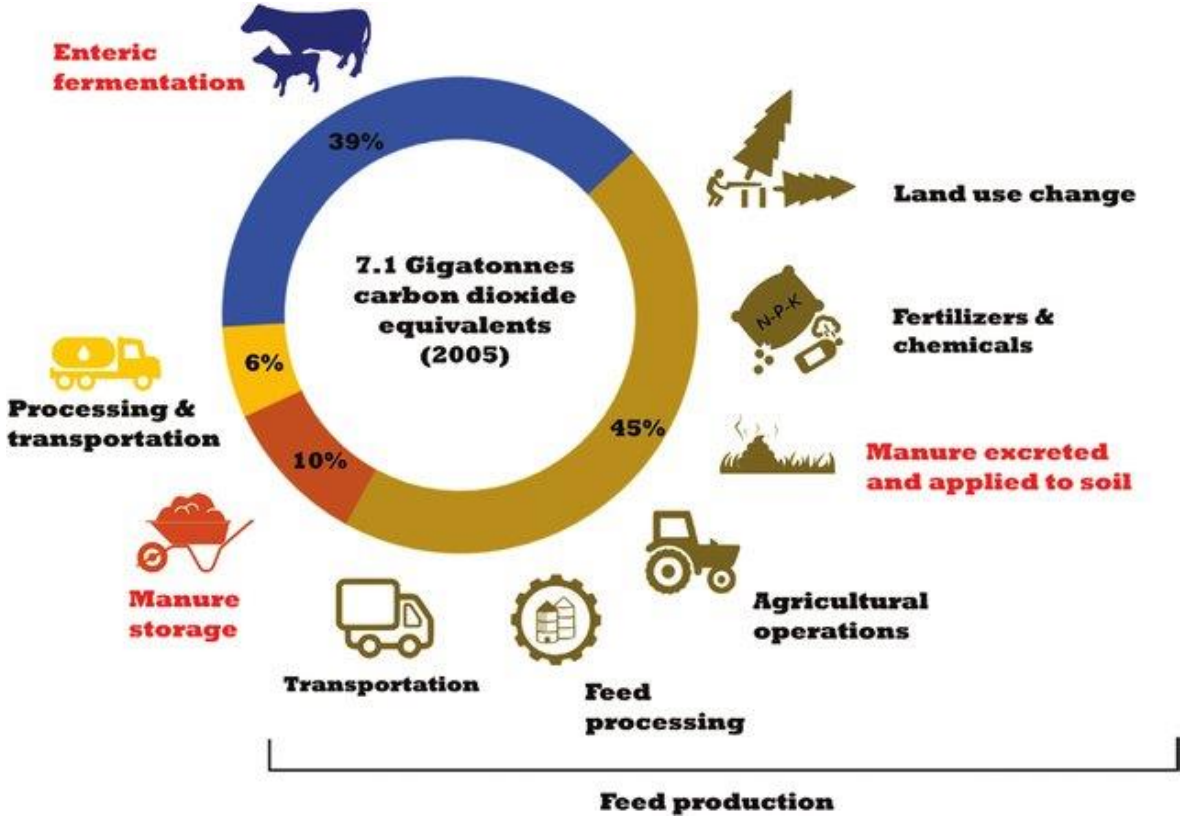


Feed production causing most environmental impacts



Feature Article

Livestock and climate change: impact of live-stock on climate and mitigation strategies

Giampiero Grossi,[†] Pietro Goglio,[‡] Andrea Vitali,[||] and Adrian G. Williams[‡]

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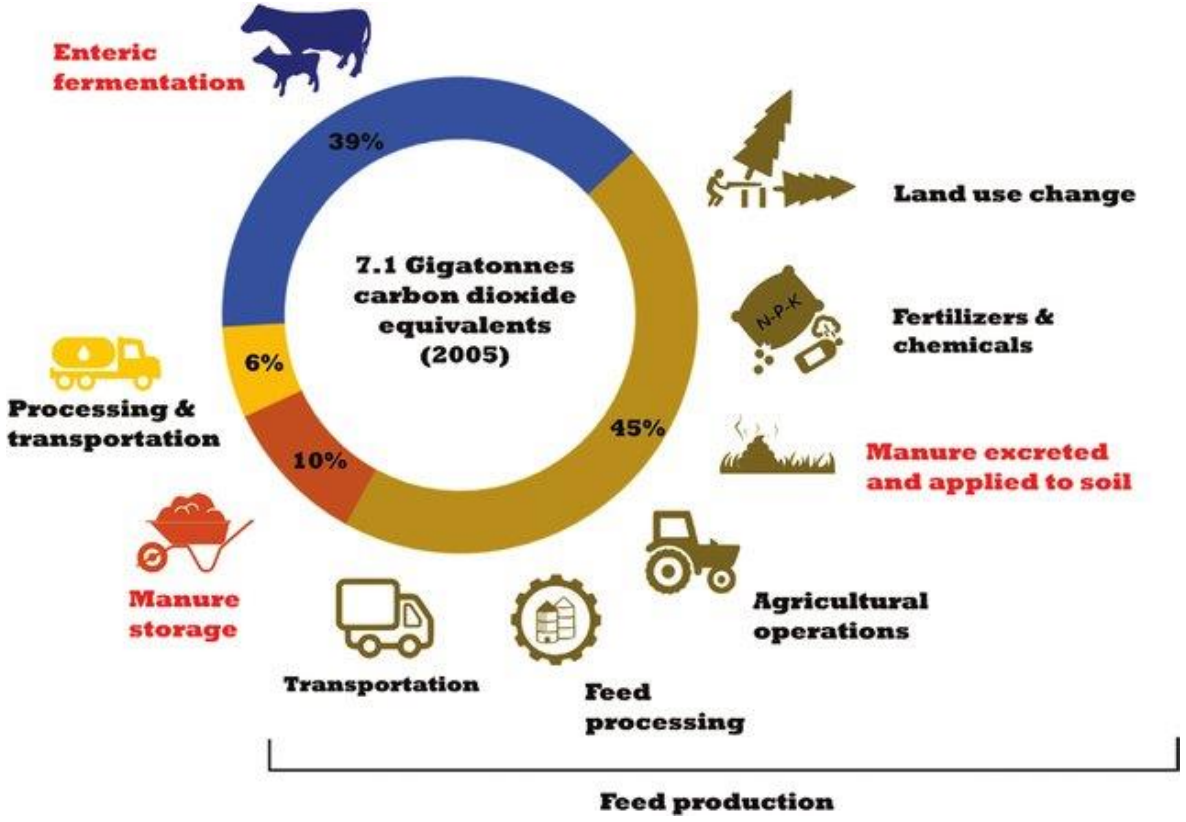

- Feed production and processing is the main source of livestock-induced emissions (45%)
- Need for more efficient livestock feed production limiting environmental impacts

Feature Article

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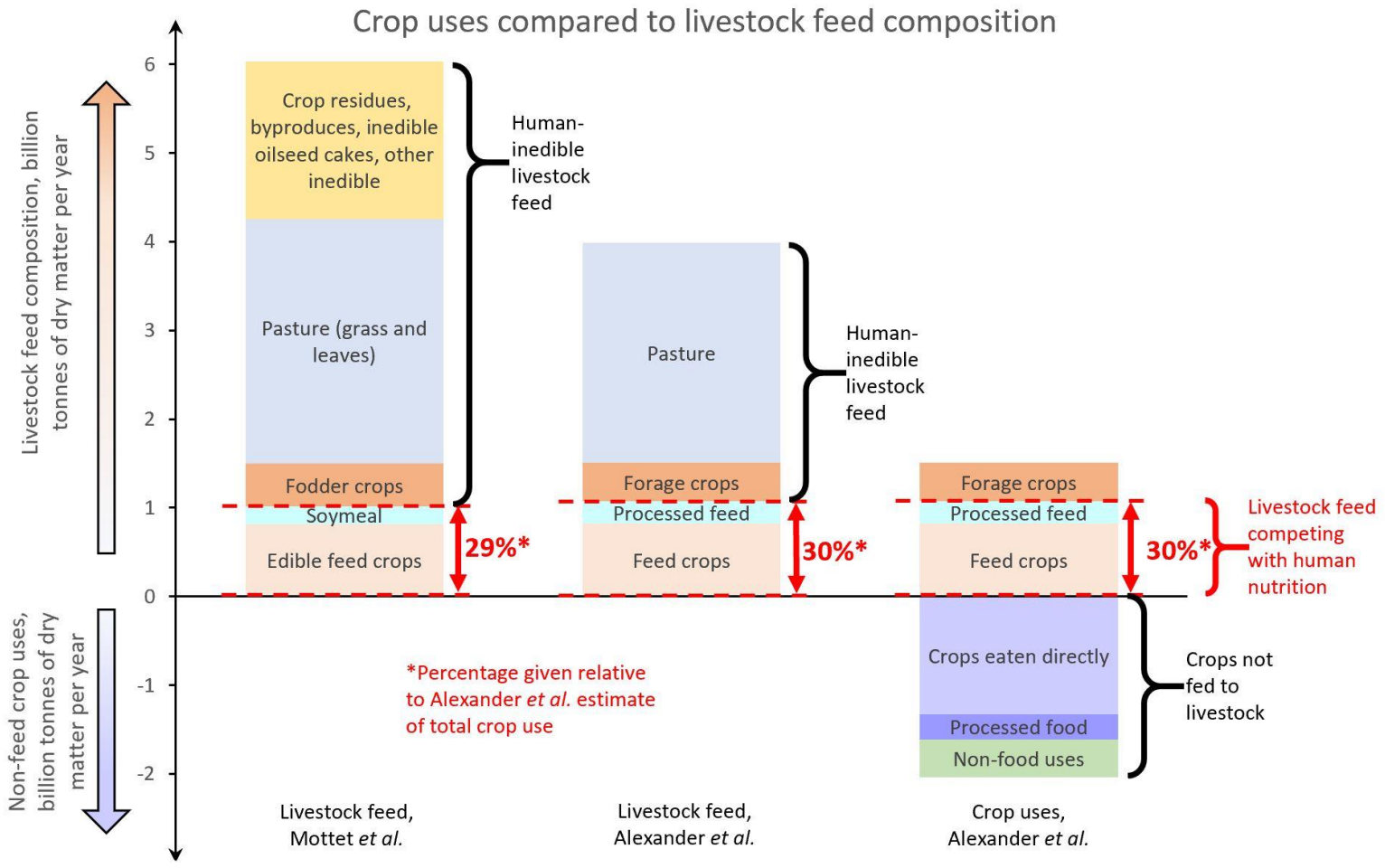
Feed production competing with food production



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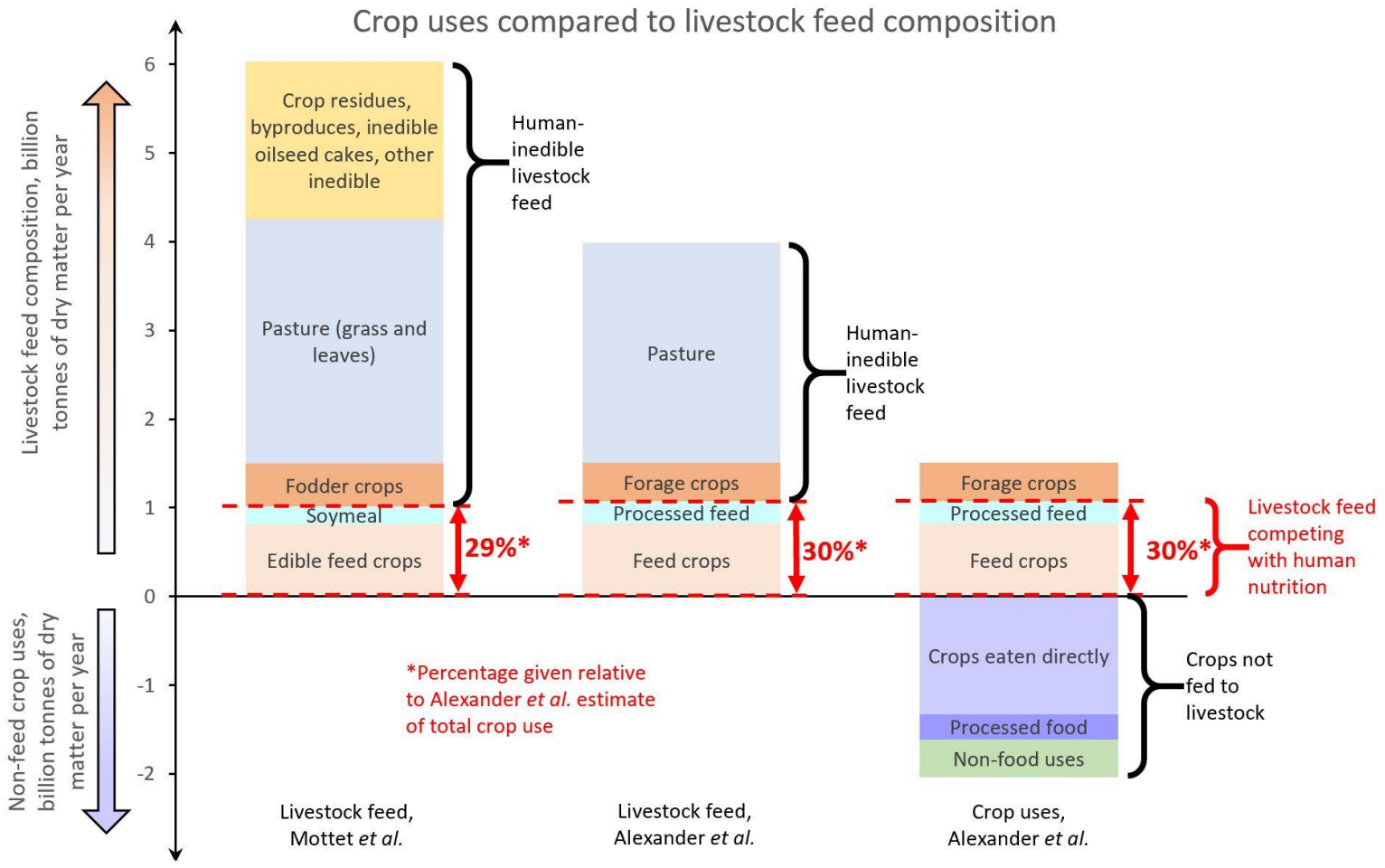

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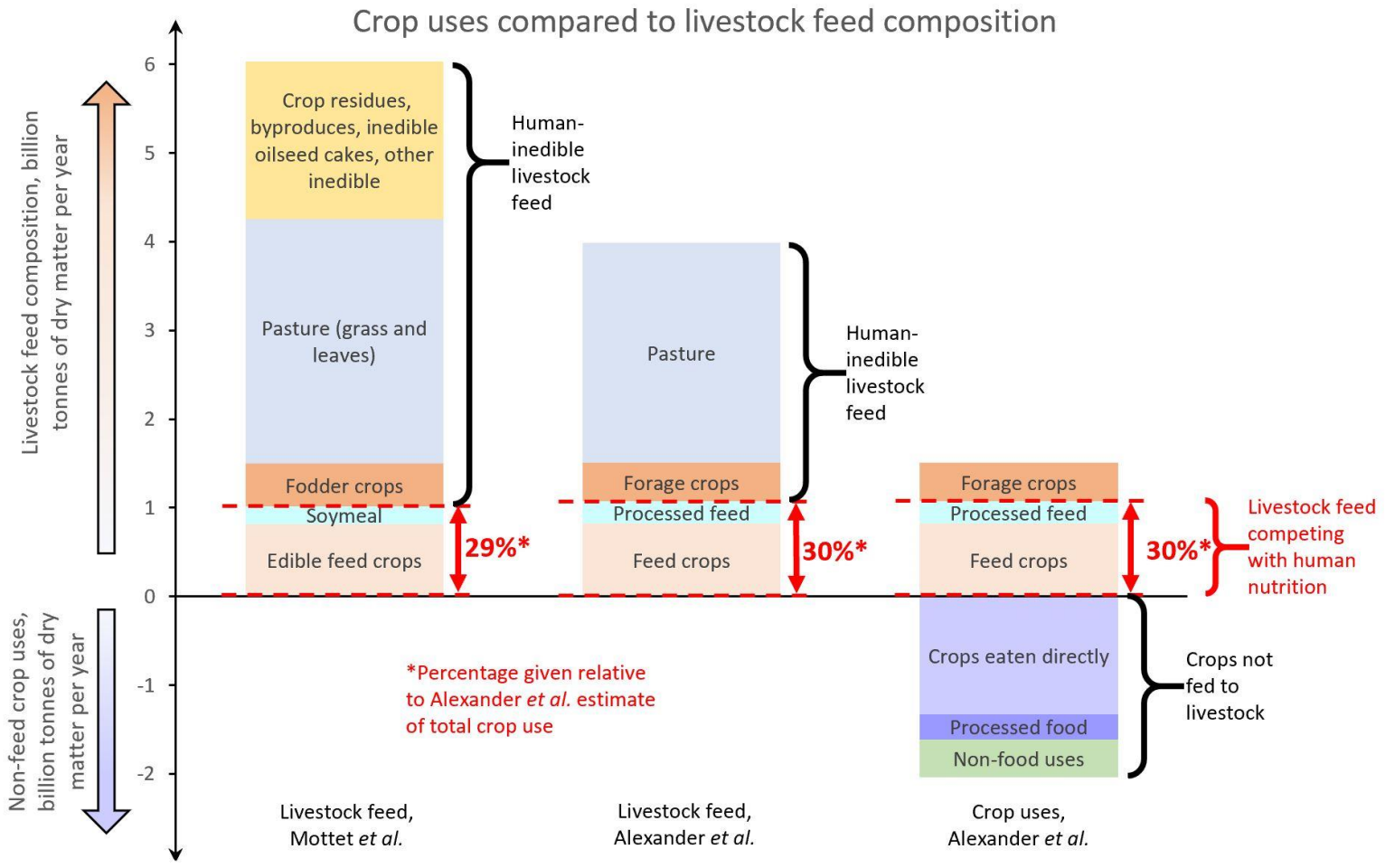

- The quantity of crops available for direct human consumption could rise by two-thirds if feed crops and processed feed were no longer fed to livestock
- Need for feed limiting this competition

A need for a nuanced perspective

Not all livestock production models are equally harmful and useful

Advanced Review

Re-framing the climate change debate in the livestock sector: mitigation and adaptation options

M.G. Rivera-Ferre,* F. López-i-Gelats, M. Howden, P. Smith, J.F. Morton and M. Herrero

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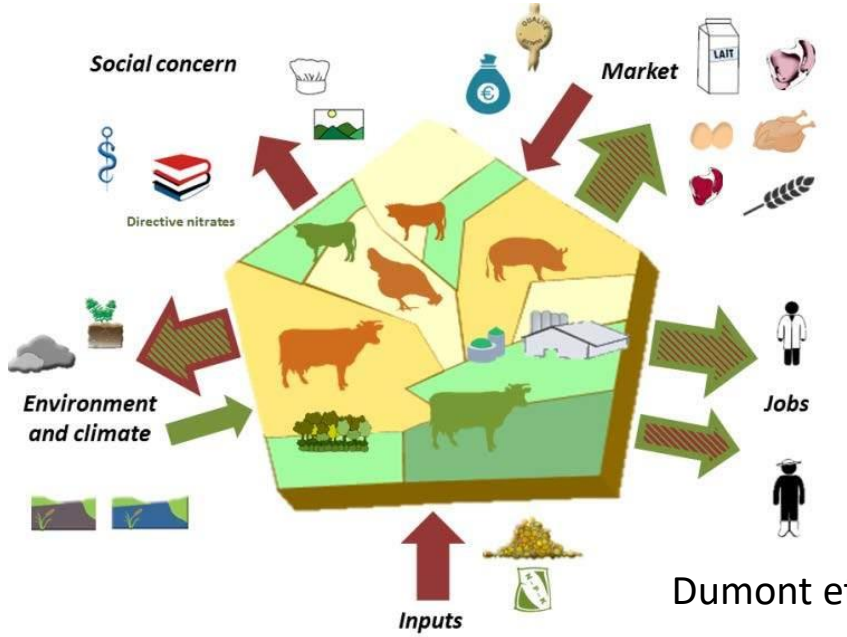
Not all livestock production models are equally harmful and useful

Livestock production can provide essential services to society



Dumont et al., 2016

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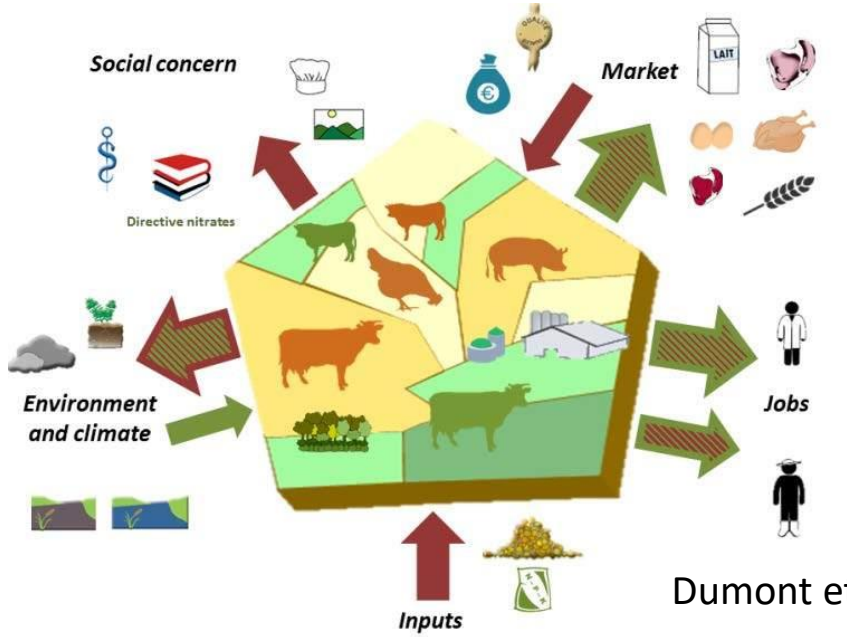
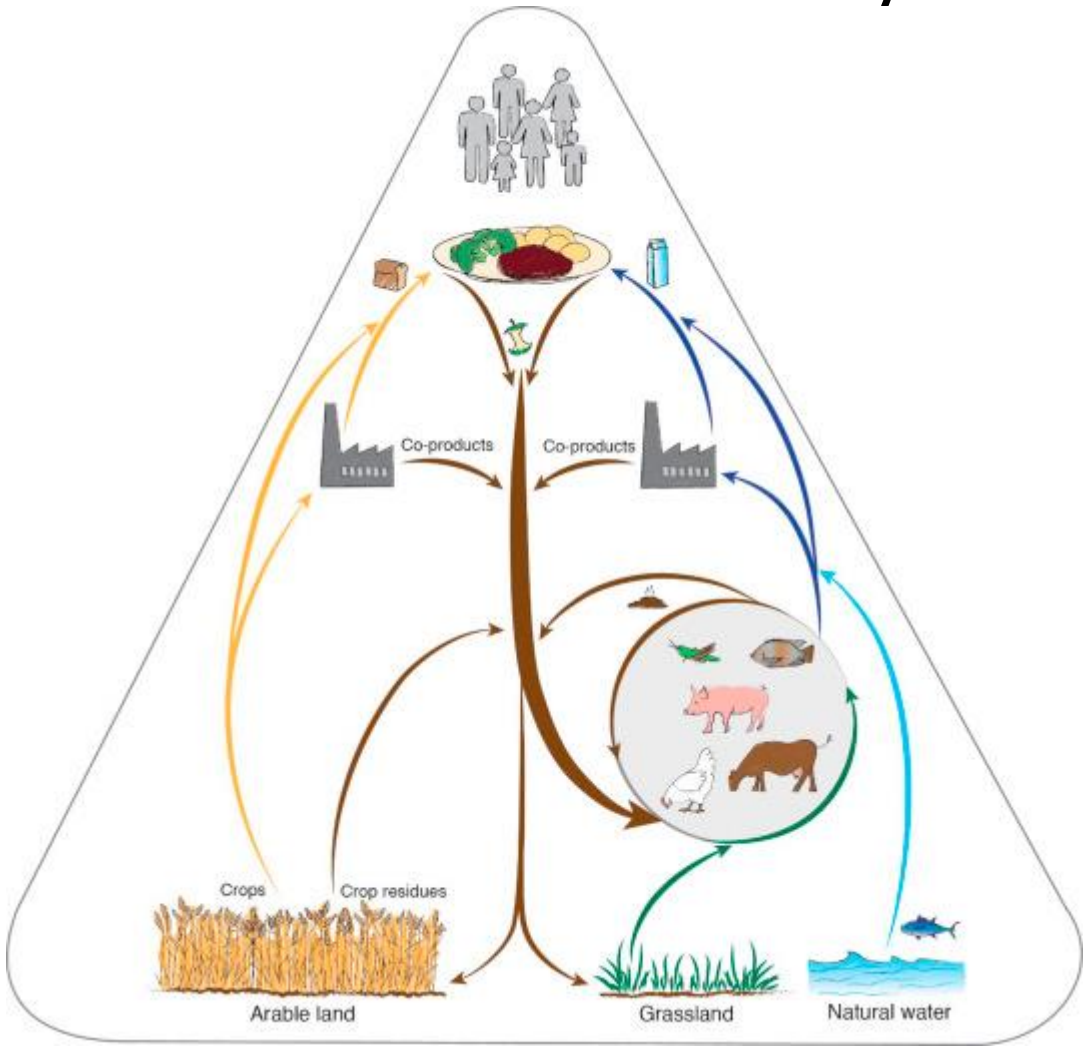


Dumont et al., 2016

By recycling by-products and biomass from grasslands into the food system, farm animals can play a crucial role in feeding humanity.
van Zanten et al., 2019

Local and low-opportunity cost feed in more circular systems as a start



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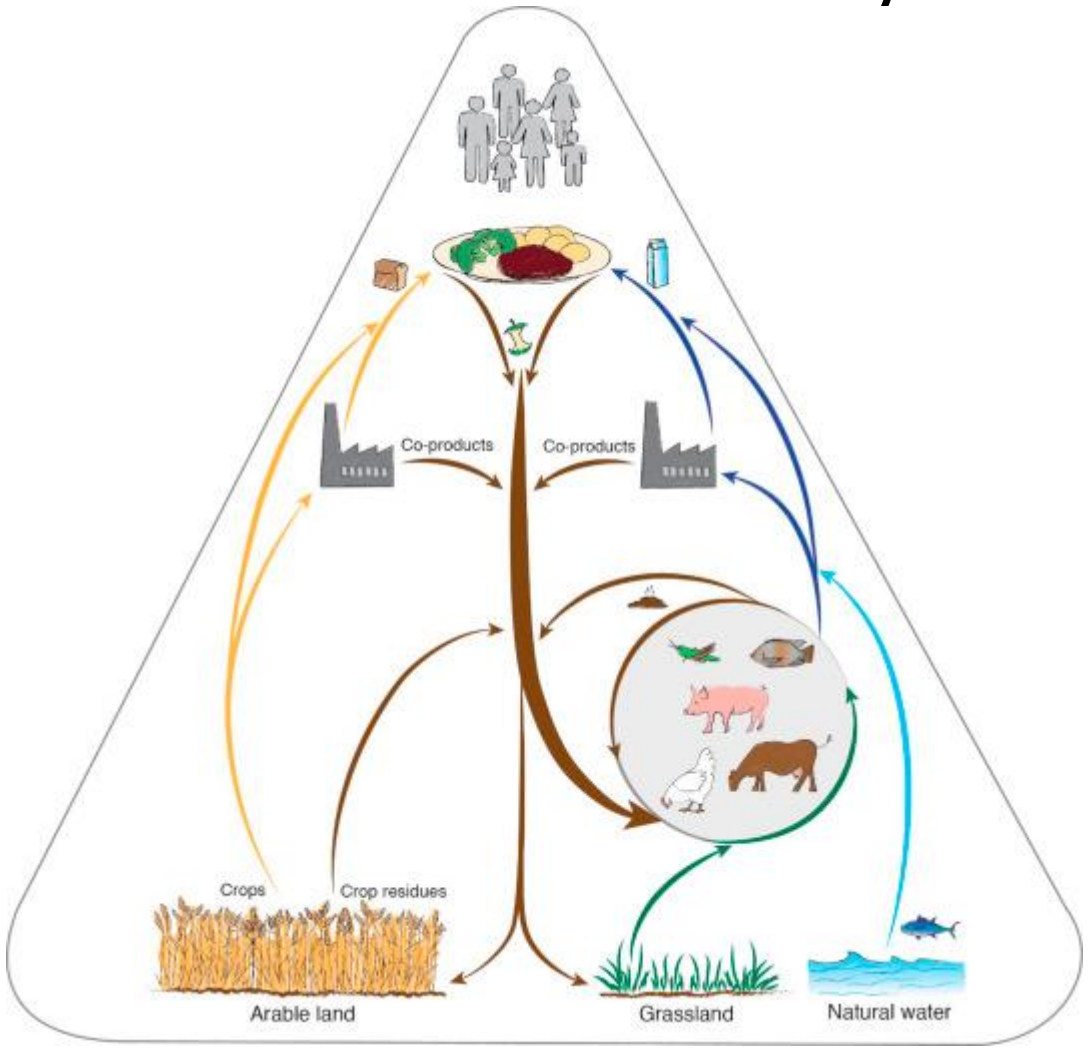

Local?

By analogy with local food systems: *"a food system in which foods are produced, processed and retailed within a defined geographical area (within a 20 to 100 km radius approximately)"*

Kneafsey et al., 2013

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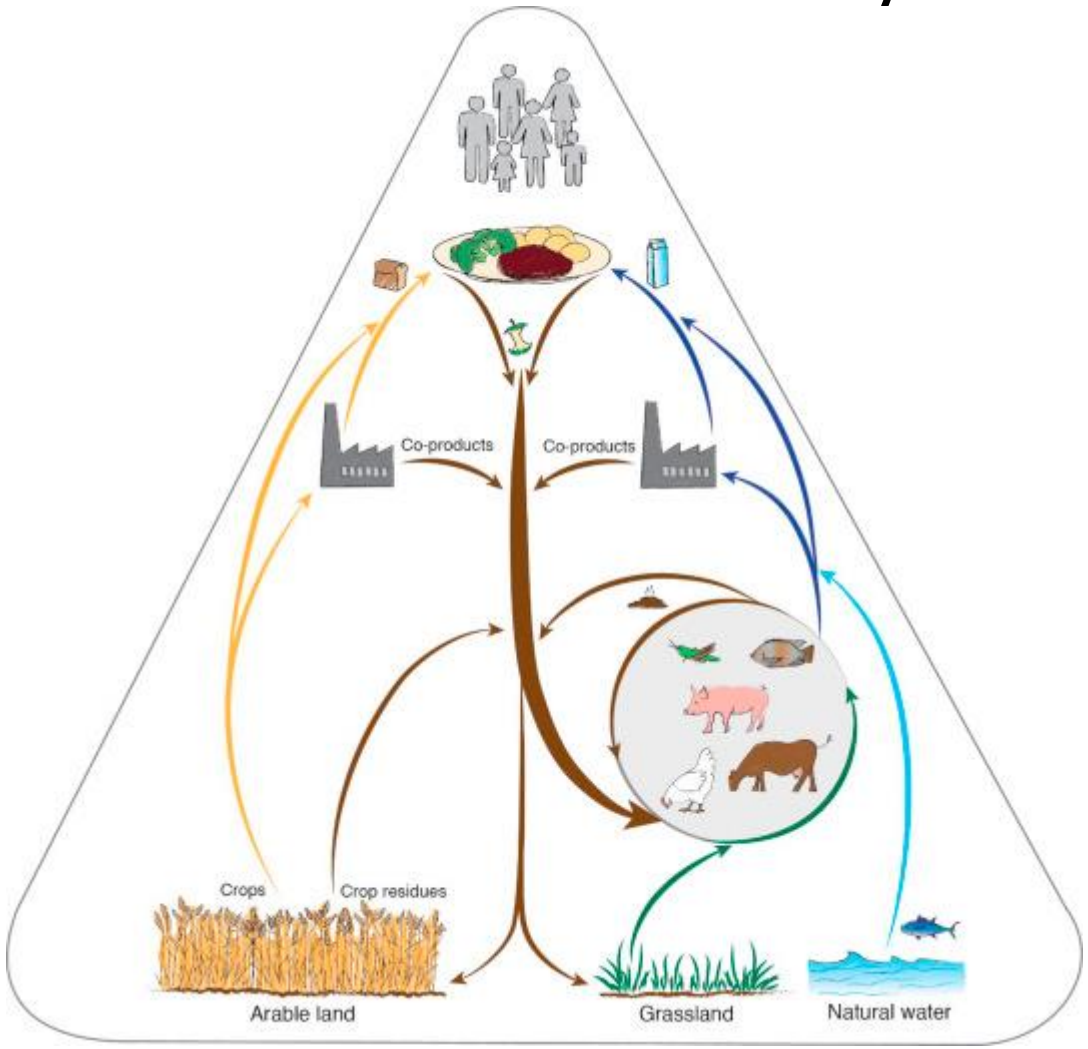

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Kneafsey et al., 2013

Low-opportunity cost?

Arable land is primarily used for food production; biomass unsuited for direct human consumption is recycled as animal feed; by-products and manure are used to maintain soil fertility.

van Zanten et al., 2019

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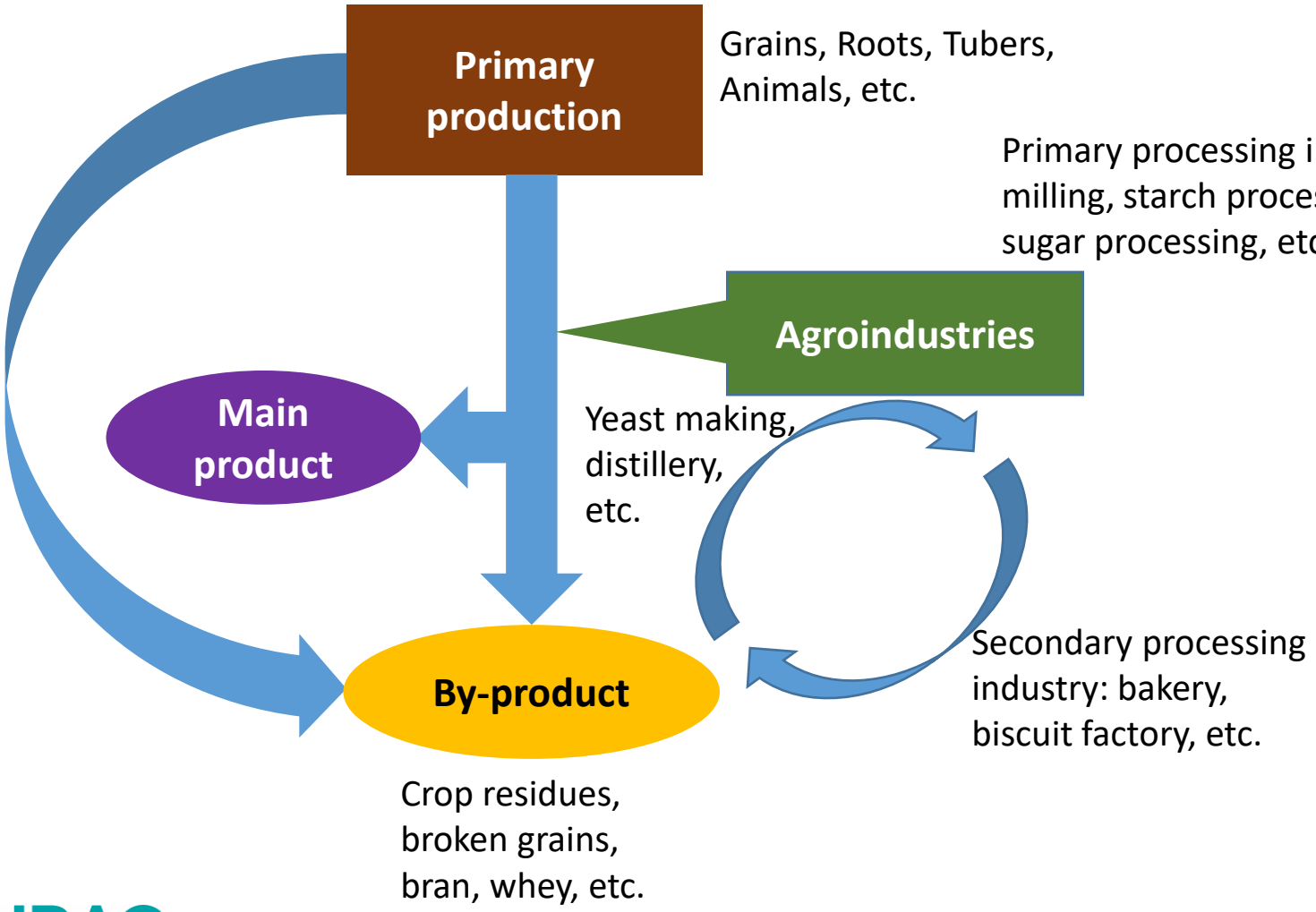
Valuing by-products (1)



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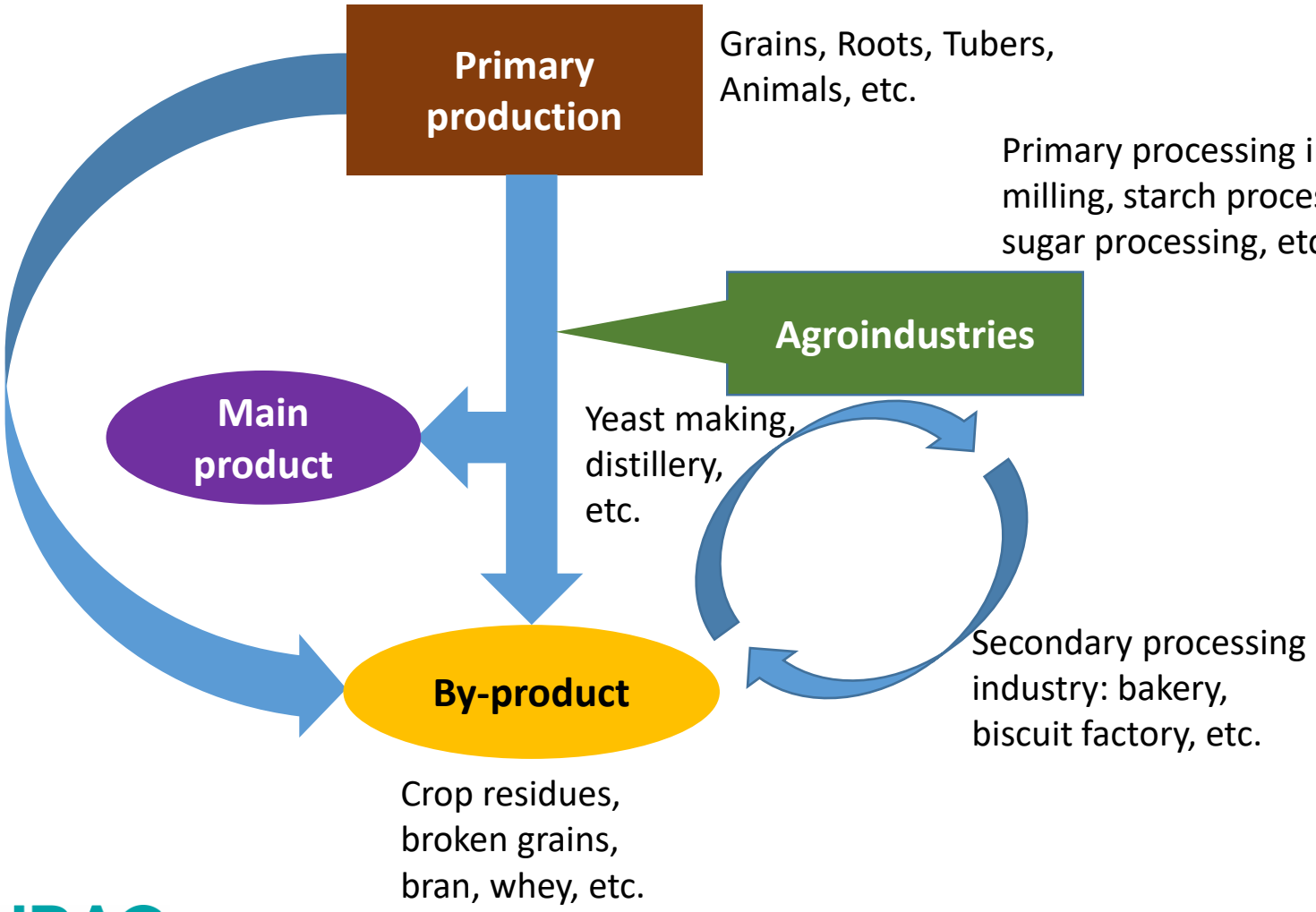

Industry	Amount of by-products used for animal feeding (1000 t DM) 2007	2016
Oil	1844	3474
Starch	1100	1582
Sugar	1349	1097
Flour	1109	1030
Alcohol	5	770
Meat / Fish	366	563
Dairy	341	359
Semolina	146	265
Beer	50	88
Malt	67	56
Total	**6378**	**9284**

GIS Avenir élevage, 2020

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Valuing by-products (2)

Table 1. Composition of diets and the range (minimum to maximum) of potentially human-edible fractions of various dietary ingredients

Item, % of DM	Diet[1]		Human-edible fraction,[2] %	
	CON	WBBP	Minimum	Maximum
Grass silage, first-cut	44.8	44.8	0	0
Hay, second and third-cut	30.0	30.0	0	0
Barley grain	6.50	—	40	80
Triticale	4.95	—	60	100
Corn	4.25	—	70	90
Rye	3.75	—	60	100
Field beans	3.75	—	70	90
Molasses	0.75	—	0	0
Limestone	0.68	—	0	0
Sodium bicarbonate	0.25	—	0	0
Mineral and vitamin premix[3]	0.32	0.20	0	0
Wheat bran	—	14.0	0	20
Sugar beet pulp	—	11.0	0	0

[1]CON = control diet; WBBP = wheat bran and dried sugar beet pulp diet.

J. Dairy Sci. 99:1228–1236
http://dx.doi.org/10.3168/jds.2015-10285

Feeding of wheat bran and sugar beet pulp as sole supplements in high-forage diets emphasizes the potential of dairy cattle for human food supply

P. Ertl,*[1] Q. Zebeli,† W. Zollitsch,* and W. Knaus*

INRAE

Valuing by-products (2)

Wheat bran and sugar beet pulp could replace common cereal-based concentrates in the diet of lactating dairy cows without compromising their performance, while improving human-edible feed conversion efficiency.

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Table 5. Milk production data, live weight change, and efficiency indicators of cows fed diets differing in concentrate type

Item	Diet[1] CON	Diet[1] WBBP	SEM	*P*-value
Milk parameters				
ECM yield, kg/d	22.5	22.7	0.7	0.796
Protein, %	3.23	3.21	0.07	0.925
Fat, %	4.29	4.23	0.12	0.741
Urea, mg/100 mL	13.3	13.7	0.7	0.611
SCC, n × 10^3/mL	125	80	30	0.286
Live weight change, kg/d	−0.16	0.03	0.11	0.253
Efficiency parameters				
Feed conversion efficiency, kg of ECM per kg of DMI	1.27	1.25	0.01	0.102
N efficiency, milk N in % of N intake	29.7	28.3	0.7	0.169

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				0
				20
				0

agriculture

MDPI

Review

By-Product Feeds: Current Understanding and Future Perspectives

Kaili Yang [1,2], Yiqing Qing [1,2], Qifang Yu [1,2], Xiaopeng Tang [3], Gang Chen [1,2], Rejun Fang [1,2,*] and Hu Liu [1,2]

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Valuing abandoned land

- Projected to reach the equivalent of 3% of today's total agricultural land (Perpiña Castillo et al., 2021)

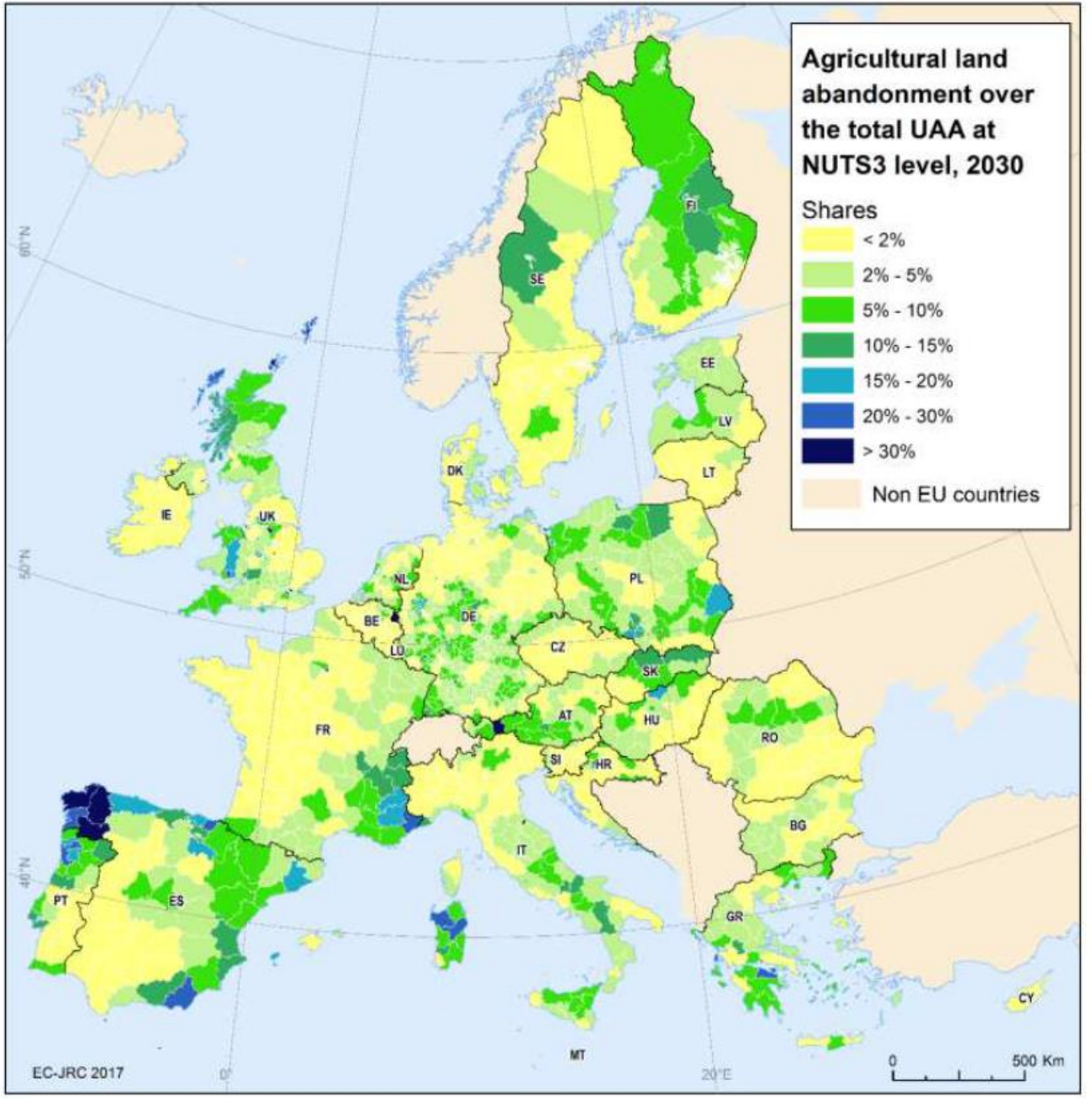
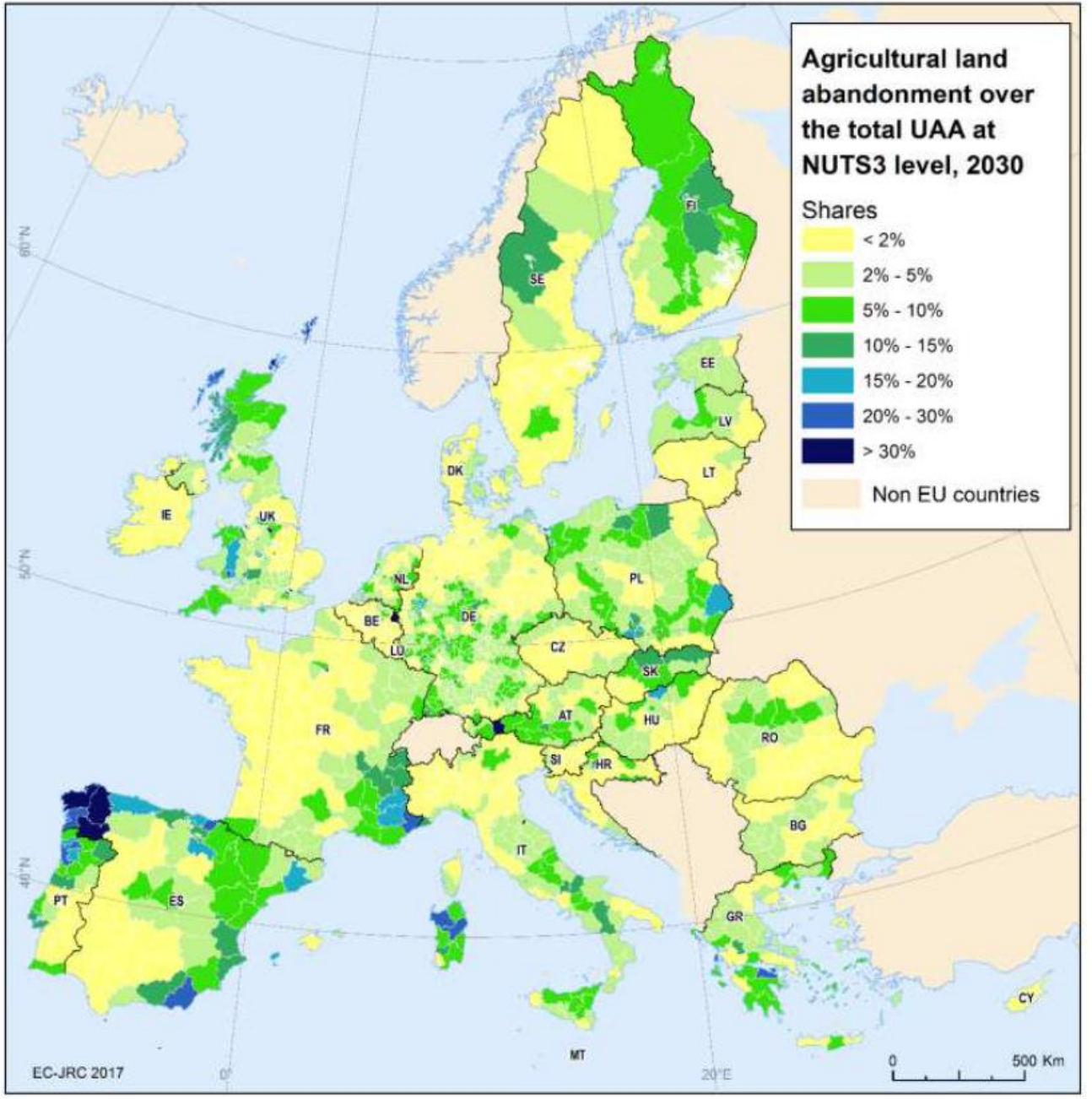


Figure 6: Shares of agricultural land abandonment with regard to the total agricultural land aggregated at NUTS 3 level in 2030

Valuing abandoned land

- Projected to reach the equivalent of 3% of today's total agricultural land (Perpiña Castillo et al., 2021)
- This land has a considerable potential for livestock feed production
- In Norway turning to grazing these pastures led to an increase in annual biomass production by 72% (5.27 vs. 3.06 t DM/ha) (Steinshamn et al., 2018)



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Valuing rangelands

- 16.9 million ha in Europe ➔ 10% UAA

INRAE

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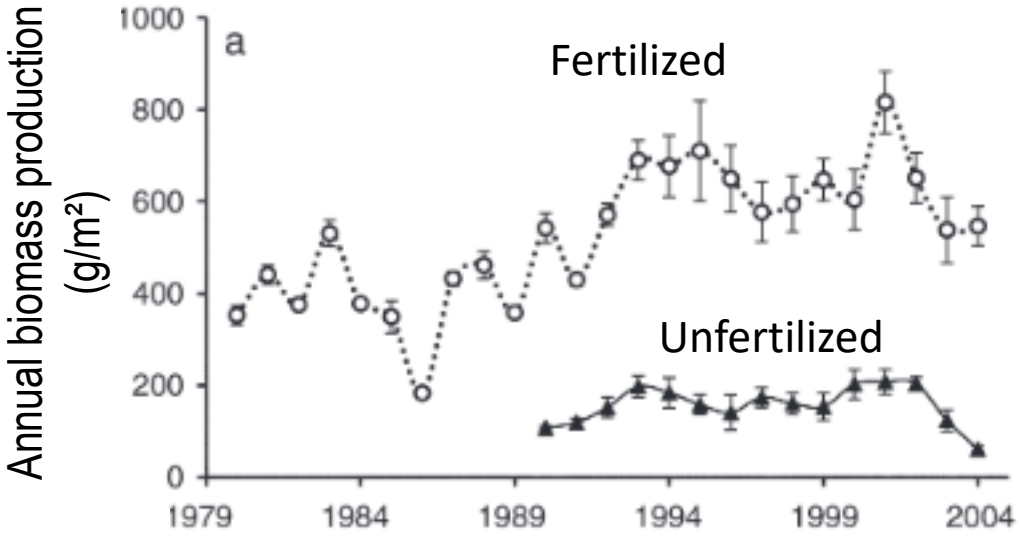

Ecology, 95(3), 2014, pp. 737–748

Combined effects of climate, resource availability, and plant traits on biomass produced in a Mediterranean rangeland

Simon Chollet,[1] Serge Rambal,[1] Adeline Fayolle,[1] Daniel Hubert,[2] Didier Foulquié,[3] and Eric Garnier[1,4]

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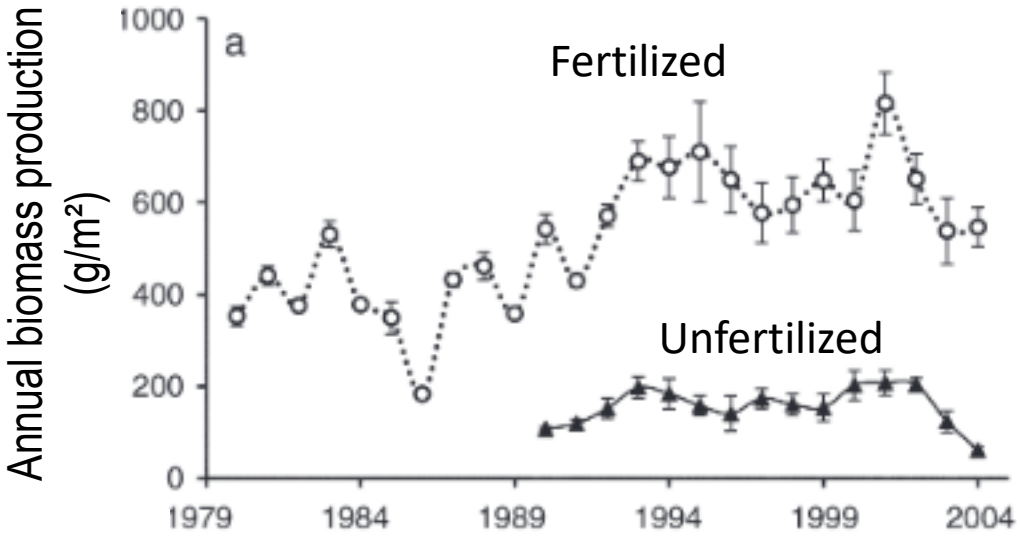

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- Rangeland biomass: a low-opportunity cost feed with non-negligible potential
- Rangeland grazing ➔ intake of plants containing secondary compounds favorable for parasite control
- A provision of multiple services to society (landscape conservation, fire prevention…)


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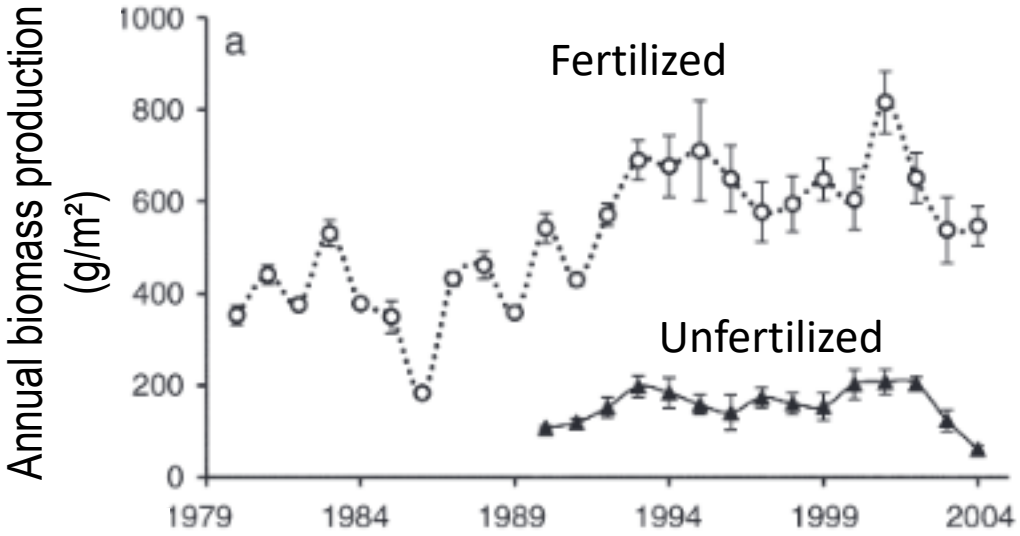

forests
MDPI
Article

Payment for Targeted Grazing: Integrating Local Shepherds into Wildfire Prevention

Elsa Varela [1,*], Elena Górriz-Mifsud [2], Jabier Ruiz-Mirazo [3] and Feliu López-i-Gelats [1,4]

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Challenges linked to valuing all sources of biomass for feed

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- **How to best support this use of all biomass sources for feed?**

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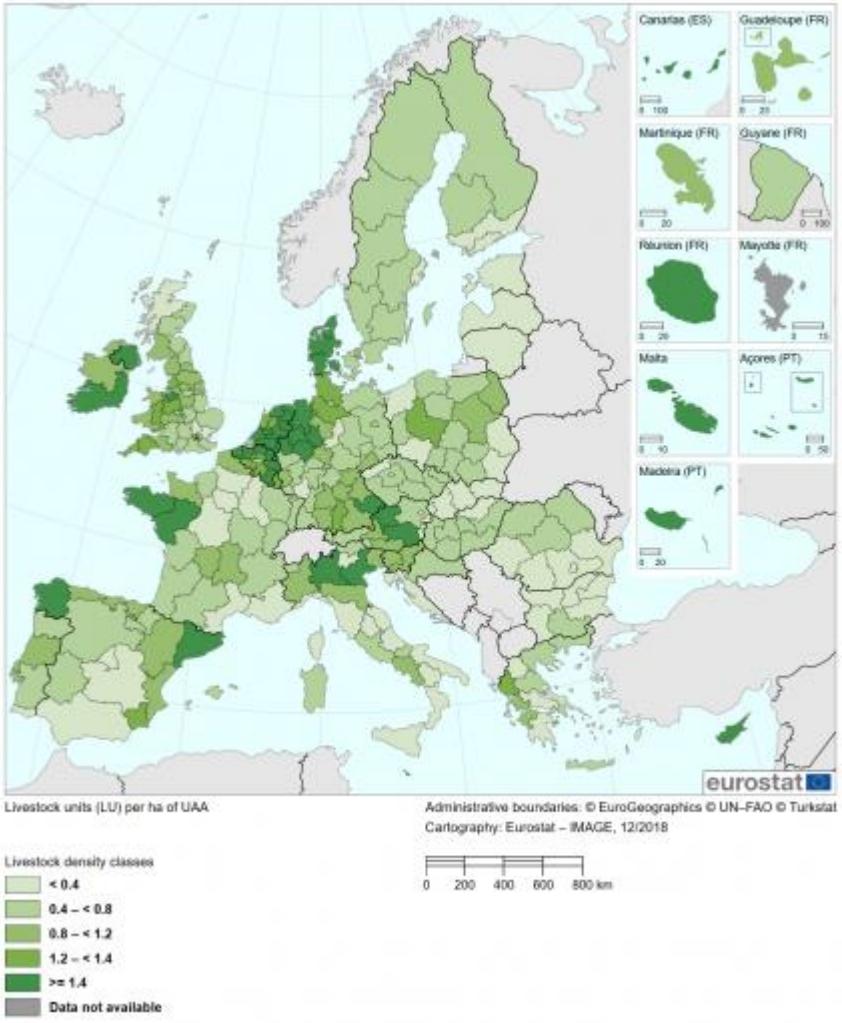
Mixed farming: swimming against the tide…

Map 1: Livestock density by NUTS 2 regions, EU-28, 2016
(Livestock units per hectare of utilised agricultural area)



A concentration of livestock in a few regions

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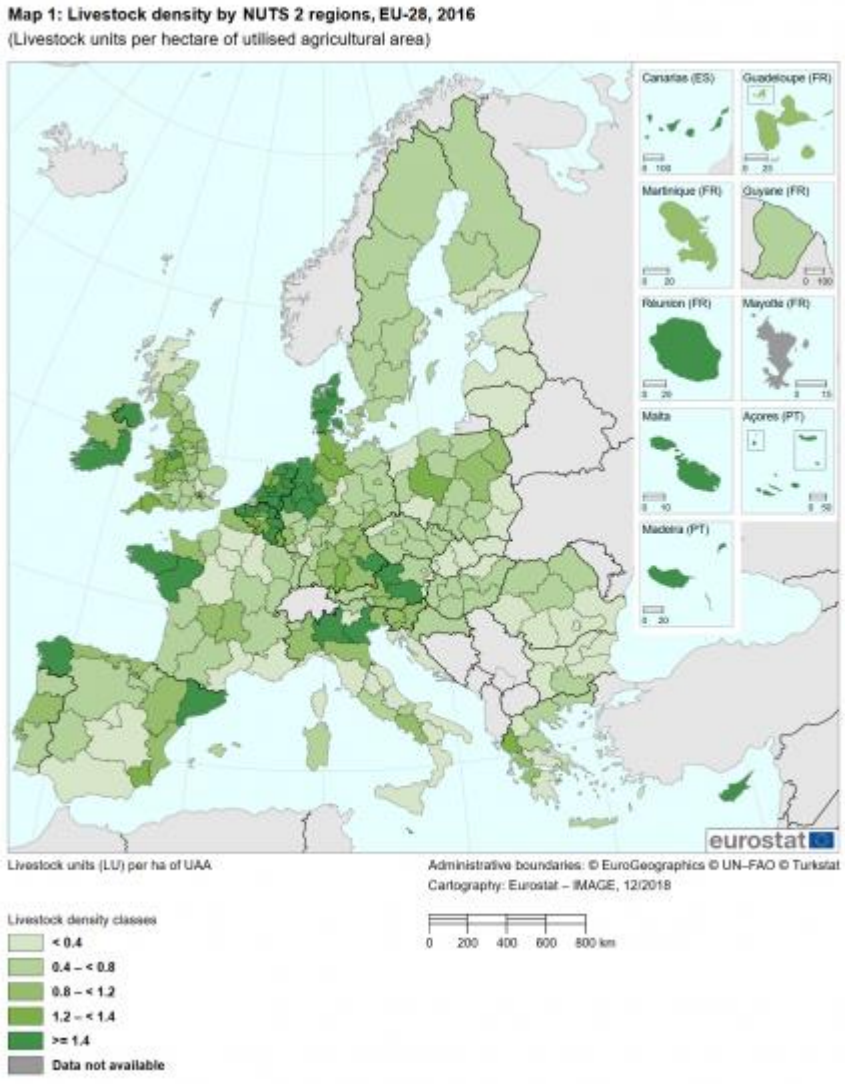

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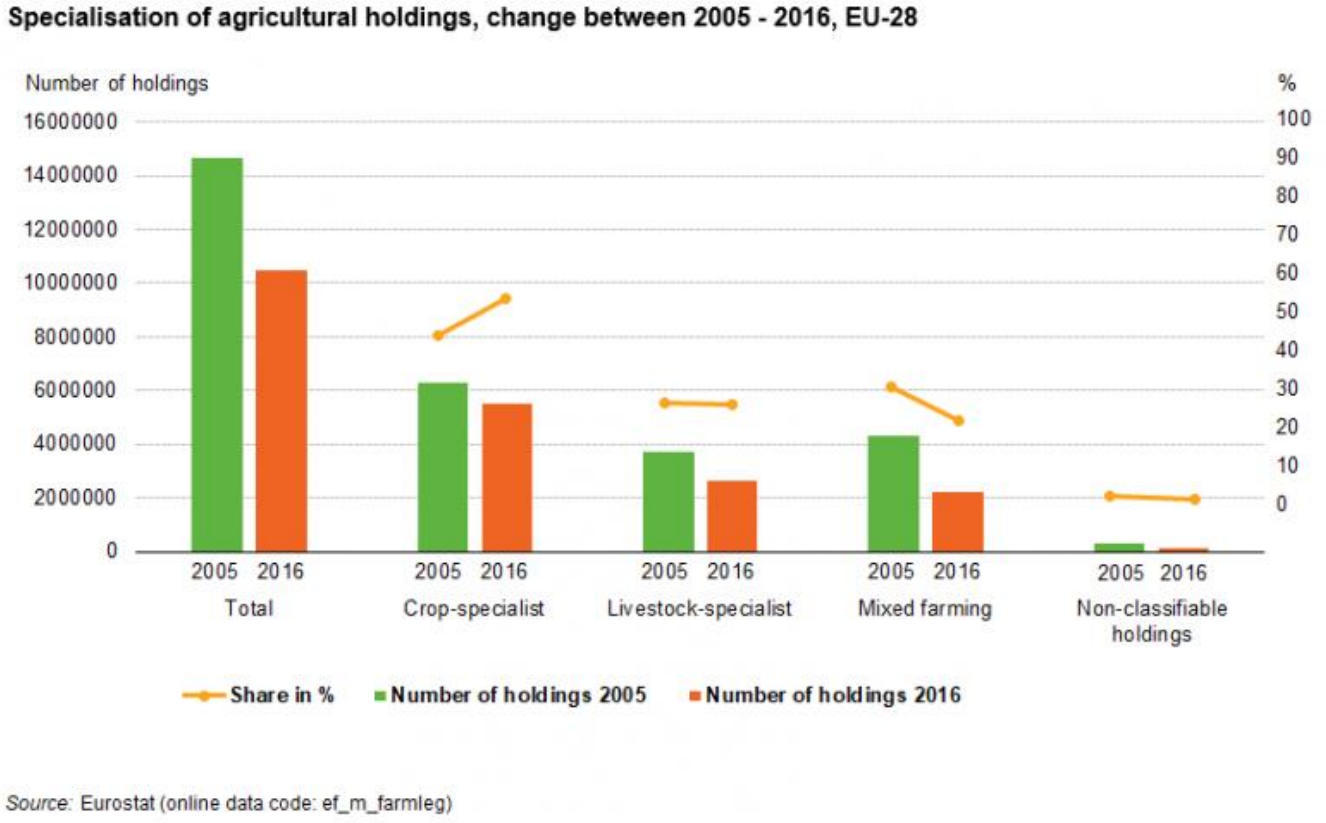

A specialization of farms

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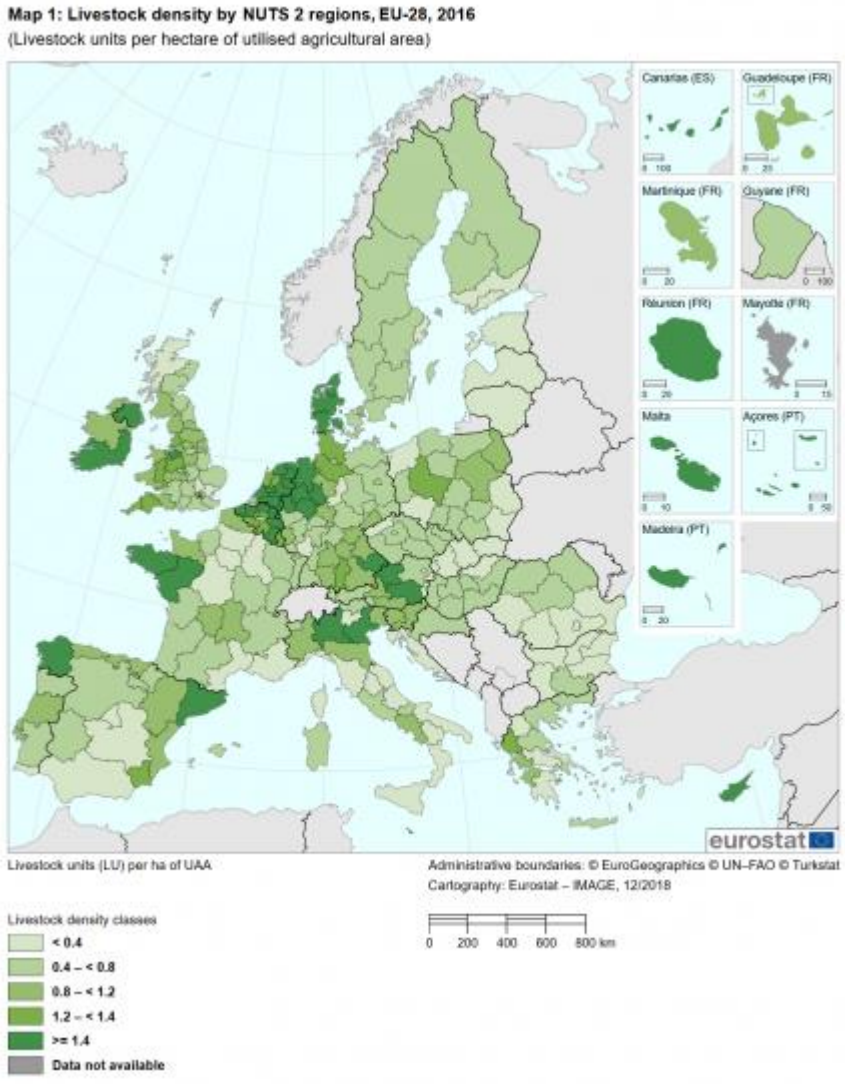

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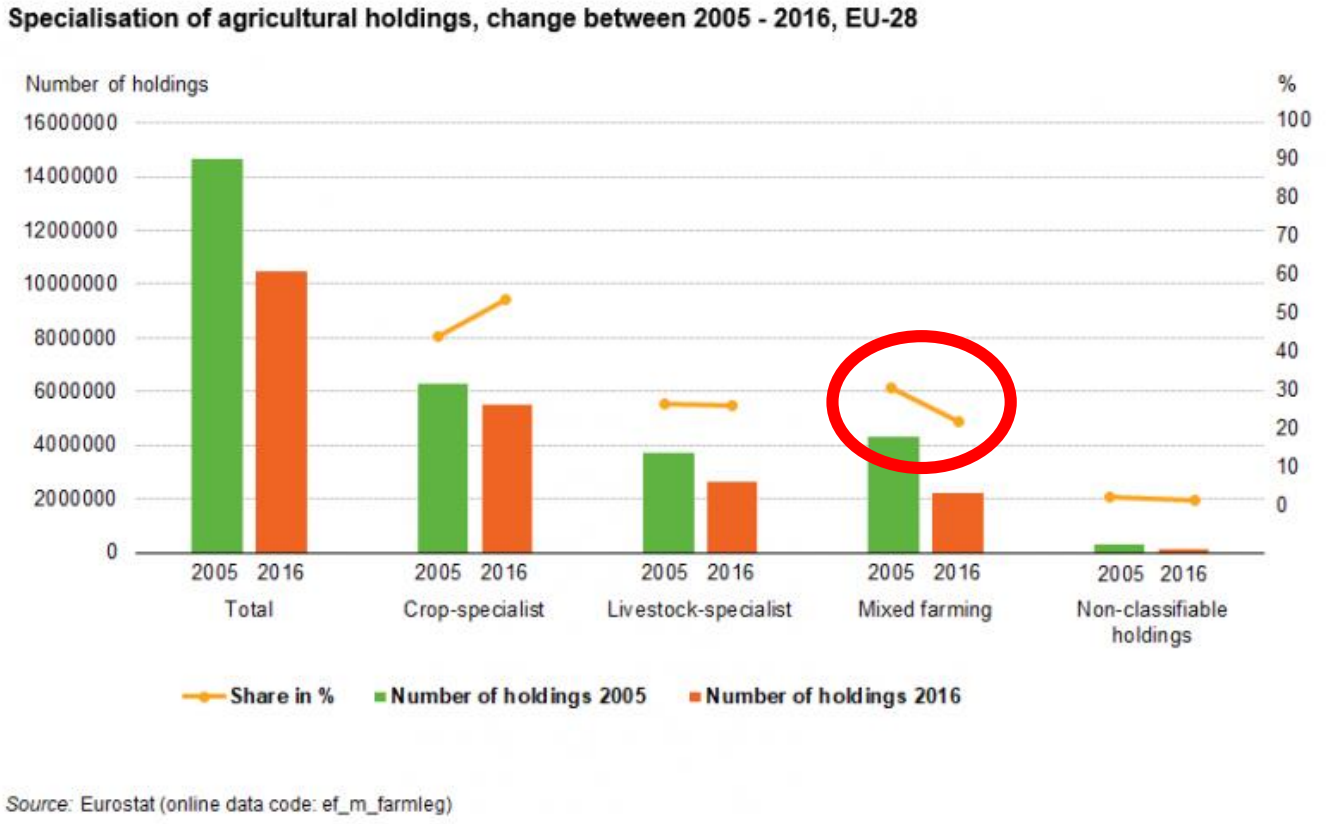
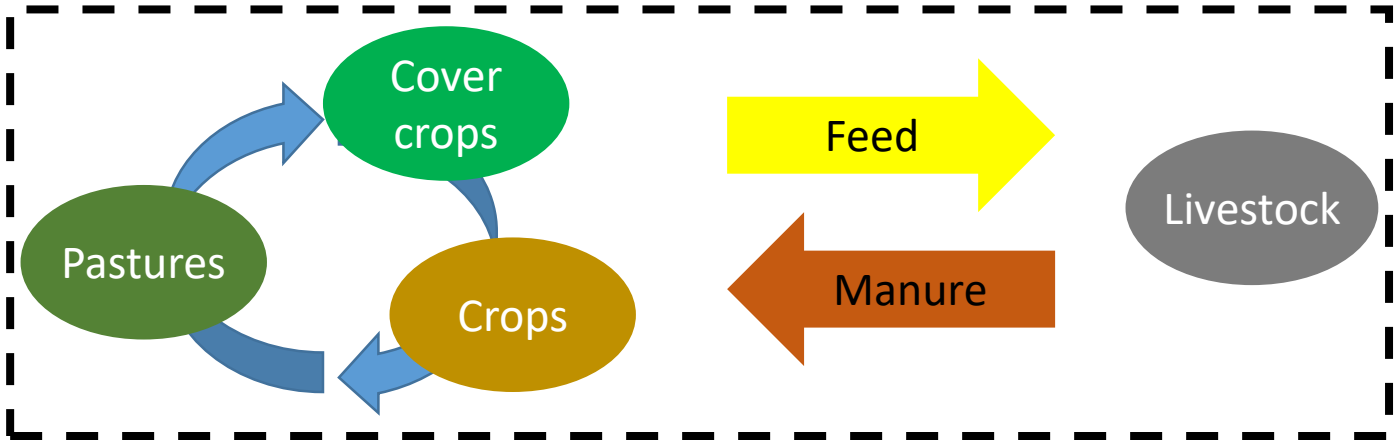


A specialization of farms

Crop-pasture-livestock reconnection

Introduction of pastures and cover crops in crop rotations

Coupling between plant and livestock



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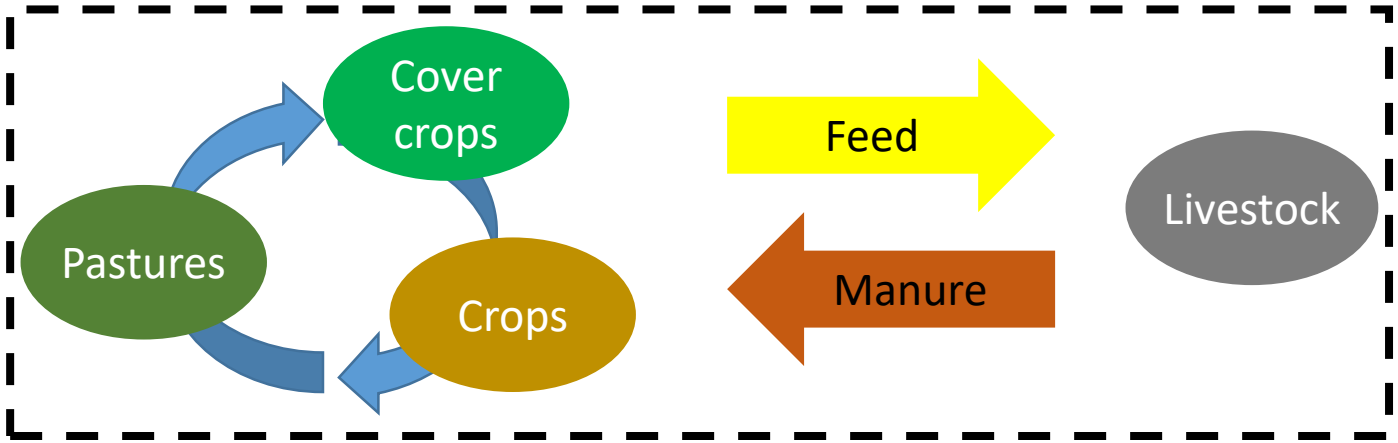

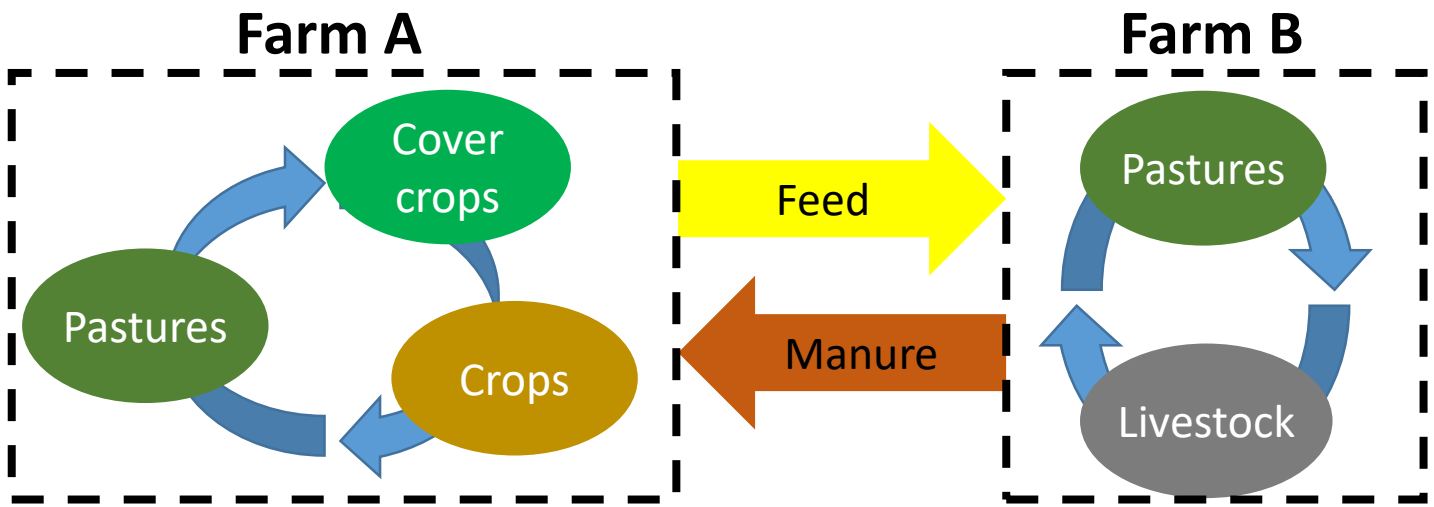

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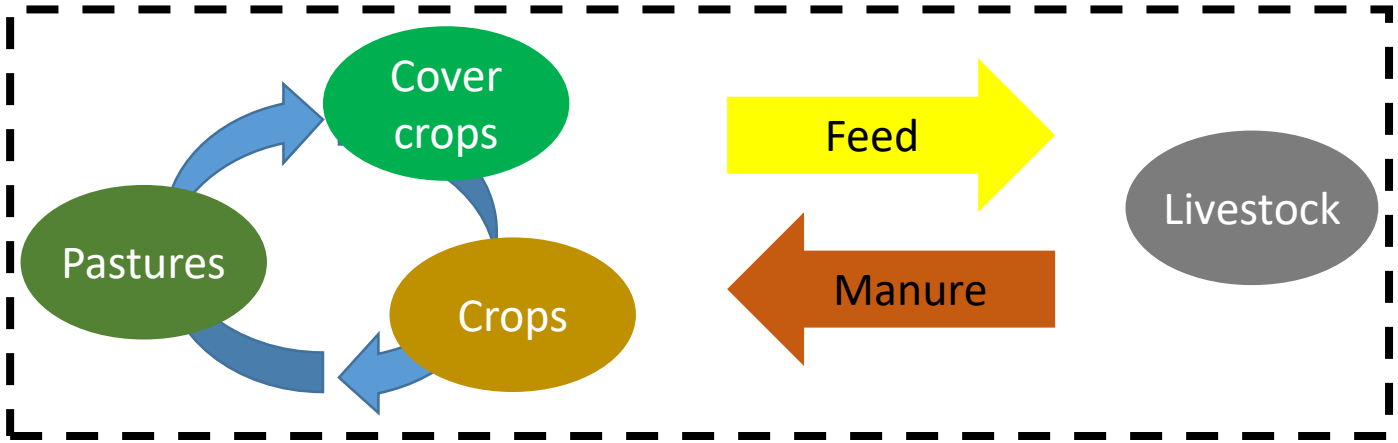

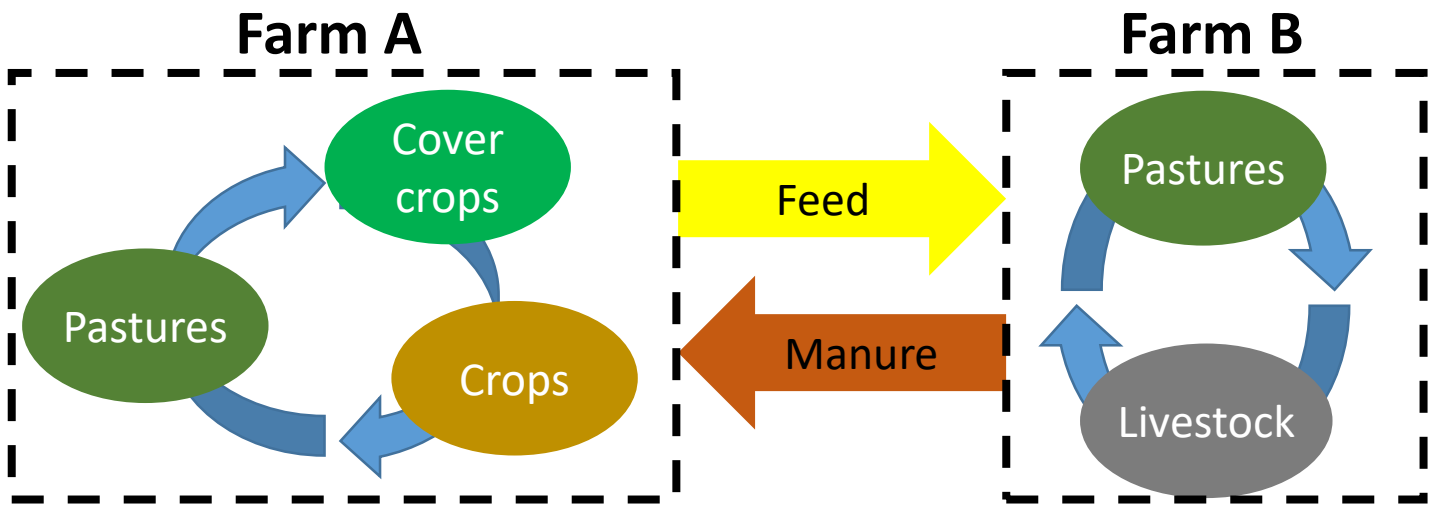

Agron. Sustain. Dev. (2016) 36:53
DOI 10.1007/s13593-016-0390-x

REVIEW ARTICLE

Crop–livestock integration beyond the farm level: a review

Guillaume Martin[1] · Marc Moraine[1] · Julie Ryschawy[1] · Marie-Angélina Magne[1] · Masayasu Asai[2] · Jean-Pierre Sarthou[1] · Michel Duru[1] · Olivier Therond[1,3]

- Provision of multiple ecosystem services
- Creation of low-opportunity cost feed

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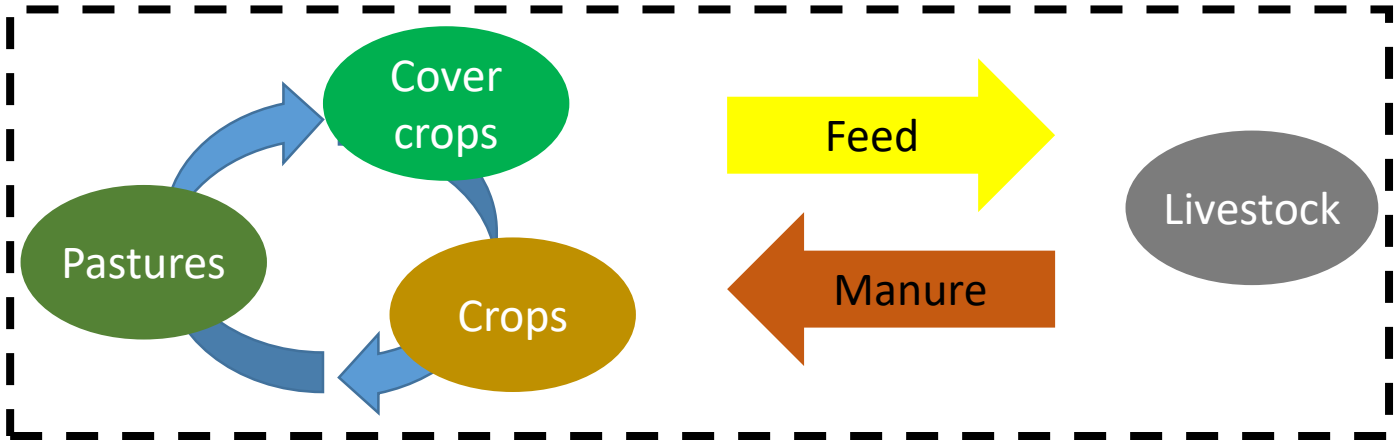

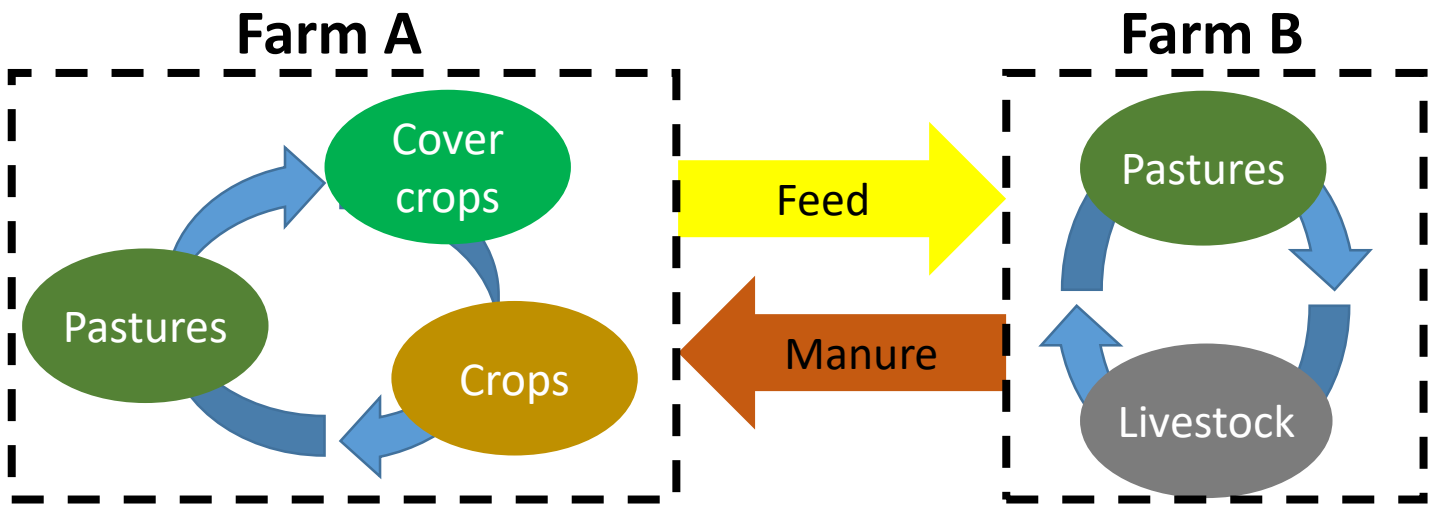

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- Provision of multiple ecosystem services
- Creation of low-opportunity cost feed
- To make best use of local feed, depending on the initial situation, crop, pasture or livestock diversity should be increased e.g. with an additional livestock species able to consume undesirable feed for other species

An old recipe with new technologies

Pietro Di Crescenzi (1233-1321)

Opus ruralium commodorum

An old recipe with new technologies

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Availability of seeds for a large diversity of crops, pastures and cover crops

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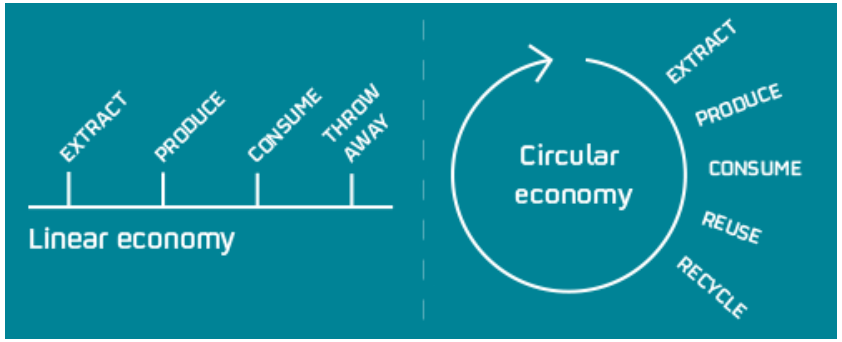
Novel equipment to allow e.g. mobile fencing for cover crop grazing

Promoting autonomy, circularity and resilience at local level

- Recycling of nutrients and currencies at the local level



Promoting autonomy, circularity and resilience at local level

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- Development of more stable internalized markets
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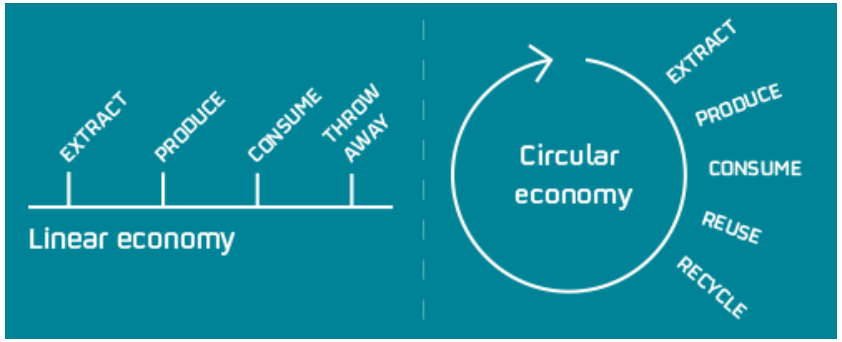

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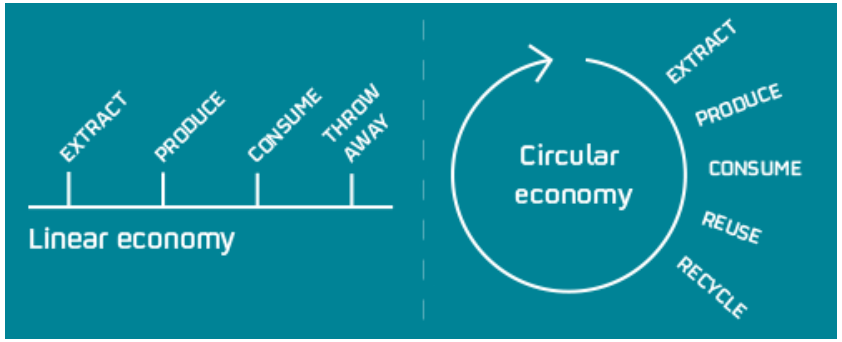

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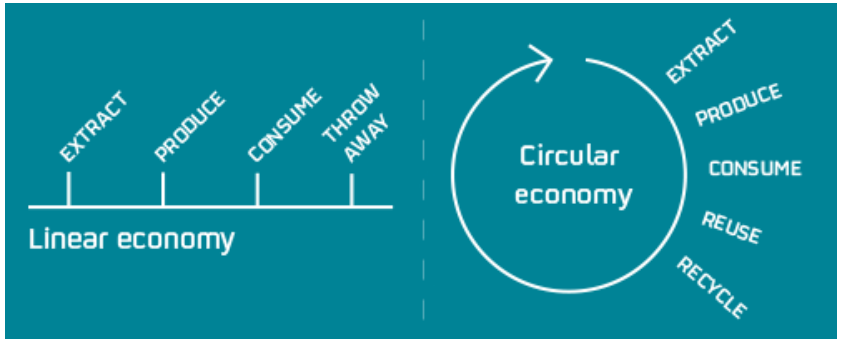

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- **How to best support this reconnection?**

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Sociotechnical lock-ins to using local feed resources

Lack and cost of infrastructures

Lack of knowledge and skills

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Sociotechnical lock-ins to using local feed resources

Lack and cost of infrastructures

Lack of knowledge and skills

© Z'lex

- Multiple types of transaction costs for information gathering, collective decision-making, implementation and monitoring
- Reducing these costs remains a challenge
- A first set of factors identified e.g.
  - Coordination by third-party entities
  - Presence of social networks
  - Spatial proximity of farms

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Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Critical factors for crop-livestock integration beyond the farm level: A cross-analysis of worldwide case studies

Masayasu Asai[a,*], Marc Moraine[b], Julie Ryschawy[c], Jan de Wit[d], Aaron K. Hoshide[e], Guillaume Martin[c]

Sociotechnical innovations to use local feed resources

- **Minervois (South Western France)**
  - Mediterranean climate
  - A plain area / a rangeland area

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Grazing in vines and crop fields : arrangements between shepherds, wine-makers and arable farmers

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Hay-making in crops fields: arrangements between breeders and arable farmers

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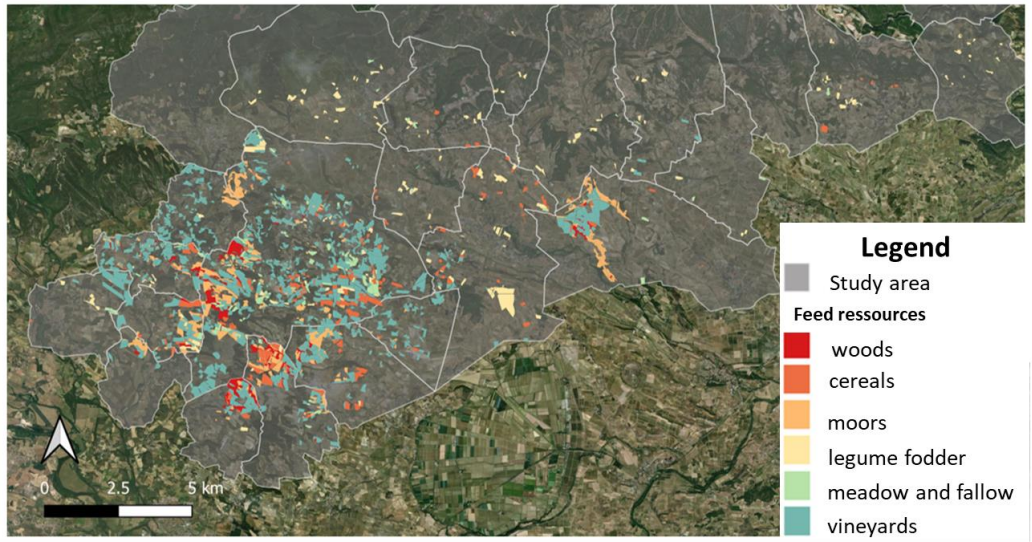
An underestimated potential



- 3000 ha (20 % of the local agricultural area)
- A flock of 1000 ewes

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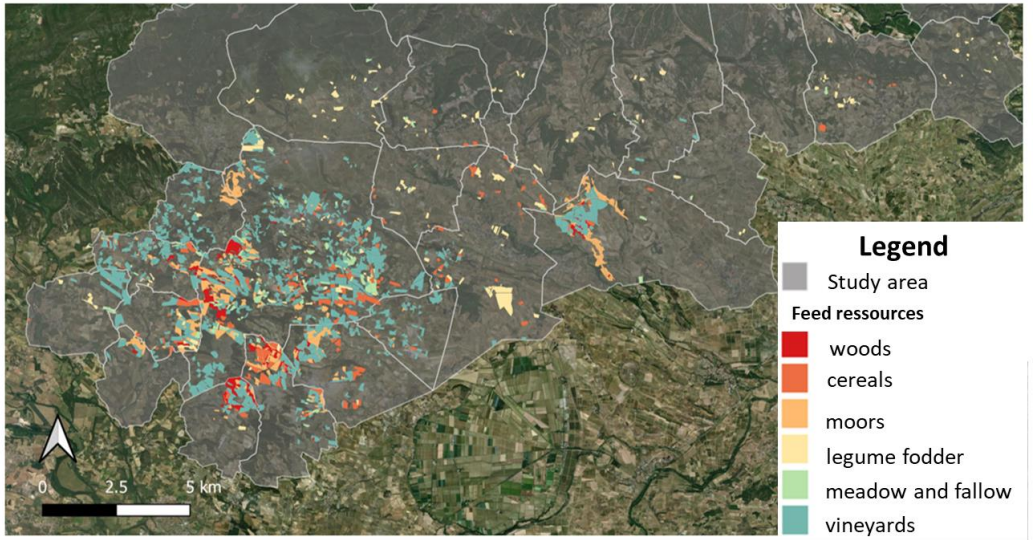

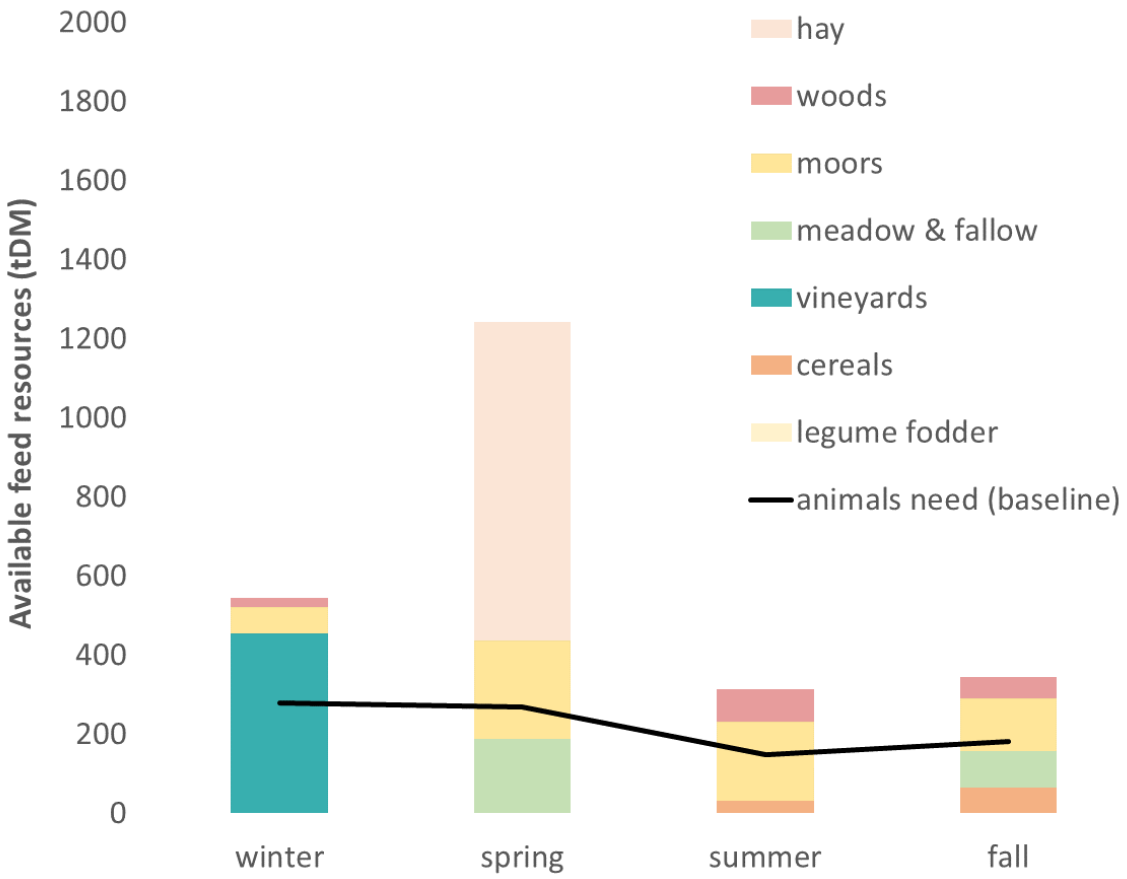

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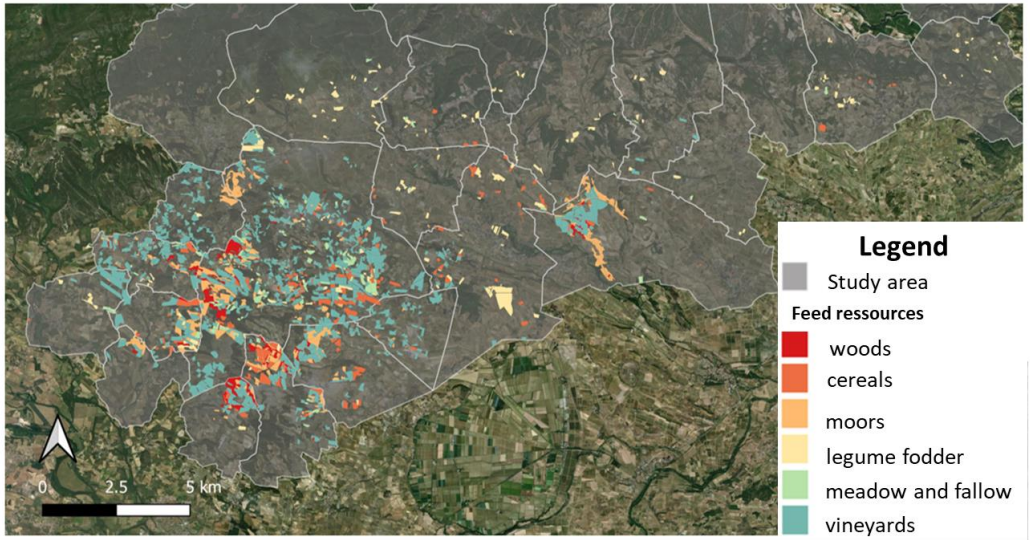

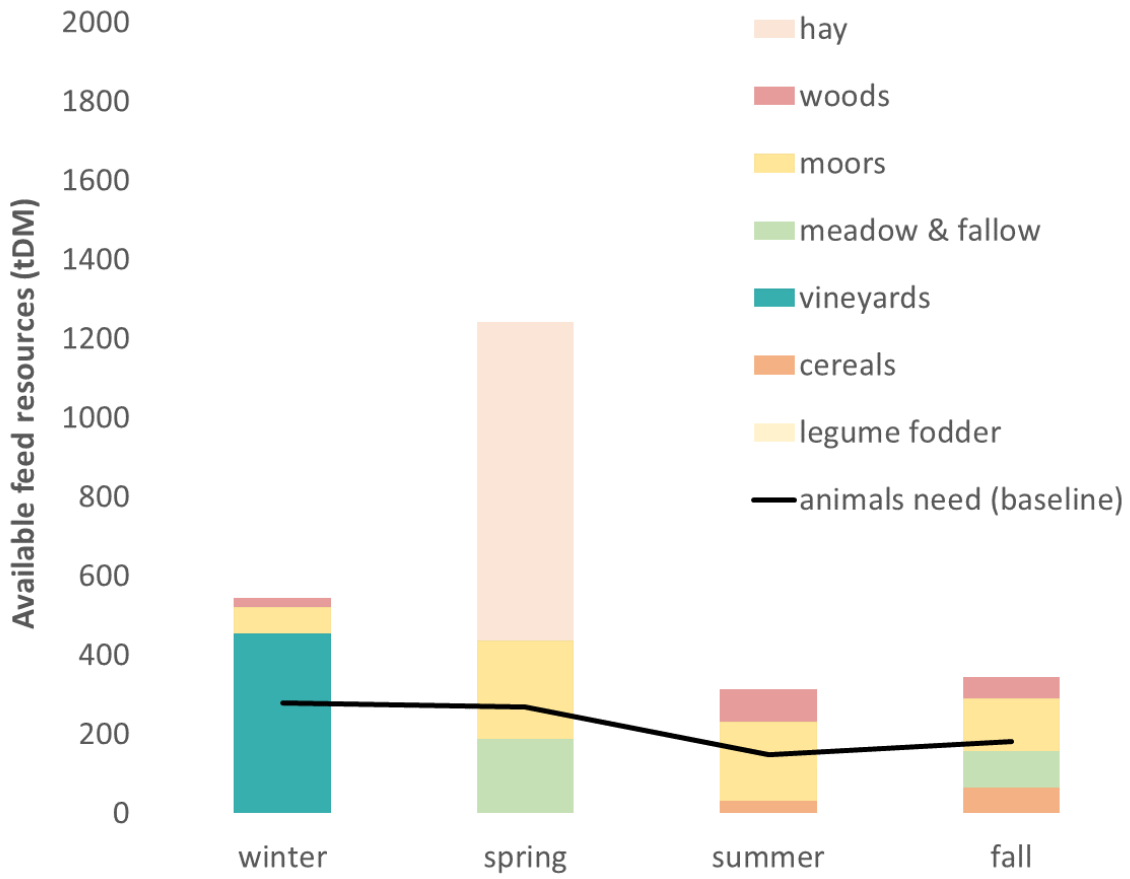

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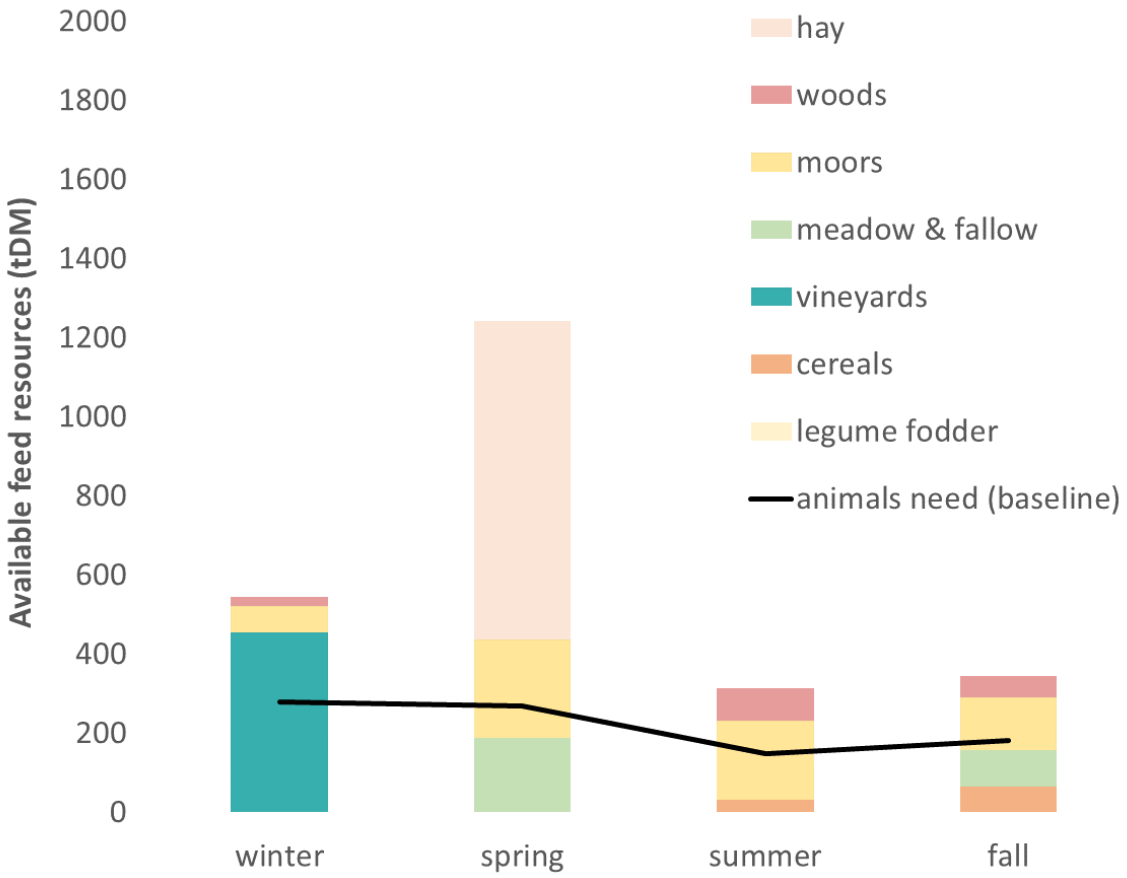

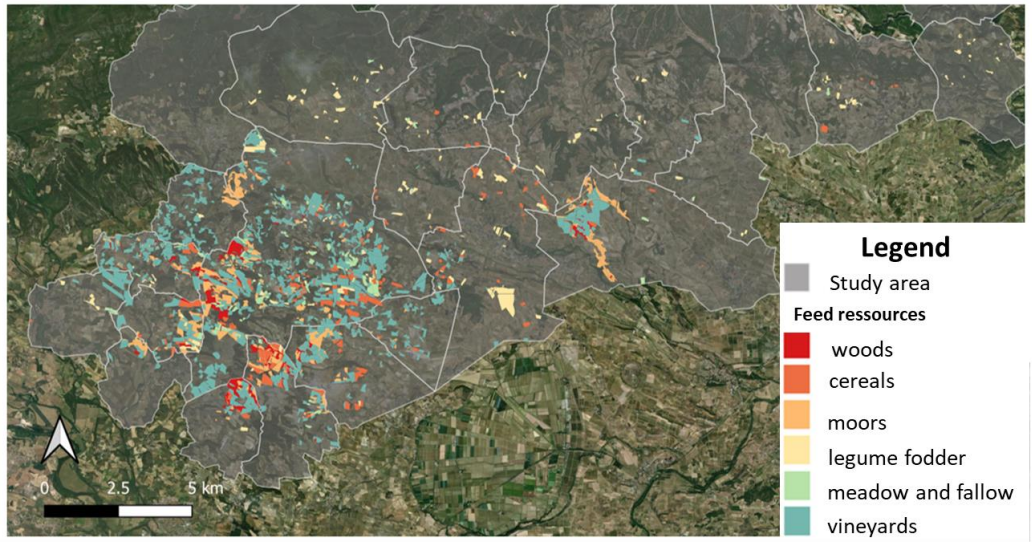

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- Successful implementation requires communication among farmers throughout the year and with other land users (hunters, open-air sport practitioners).

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Research avenues to using local feed resources

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- Interdisciplinary, participatory and multi-level research is needed to integrate the different sources and types of knowledge
- Policy measures are urgently needed to set the ground for these more circular systems

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Thank you for your attention

This work was supported by the SagiTerres project (2123-039) funded through Labex AGRO 2011-LABX-002 (under I-Site Muse framework) and through Daniel & Nina Carasso Foundation under the CO3 program.