LIÈGE université
TERRA
Agriculture is life

Reconnecting agriculture to food systems for global sustainability

the example of long term experimental crop rotations of *AgricultureIsLife*

De Clerck C., Dumont B., Beckers Y., Bodson B., Colinet G., Cornelis J.T., Dufrêne M., Monty A., Pierreux J., Bindelle J.

25th National Symposium for Applied Biological Sciences
31/01/2020

Pression démographique sur la planète

LA BOMBE HUMAINE

MANIÈRE DE VOIR
Octobre-novembre 2019
#167

7,627,283,707

Unmanaged natural ecosystems could provide food for 600 million people

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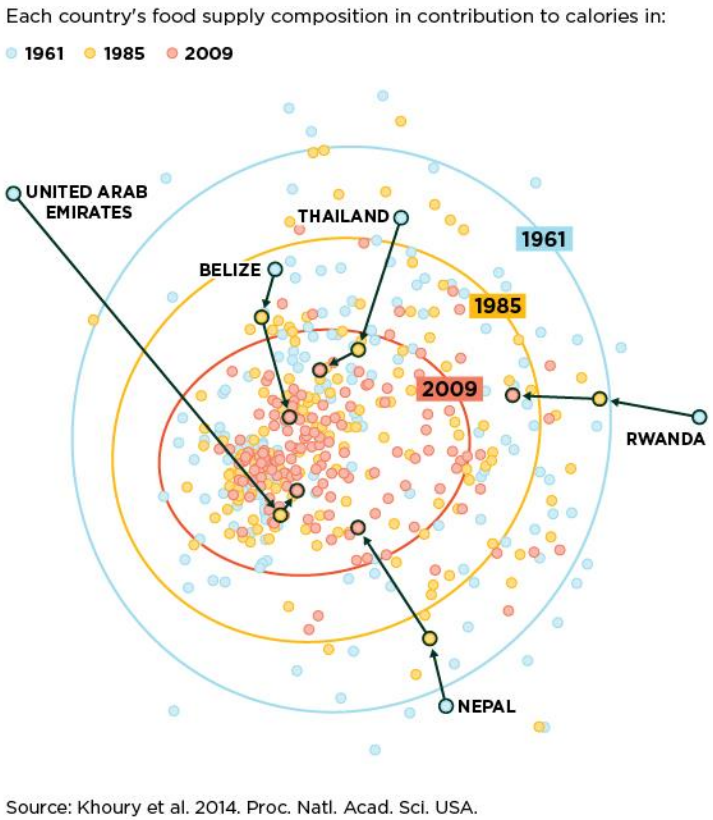
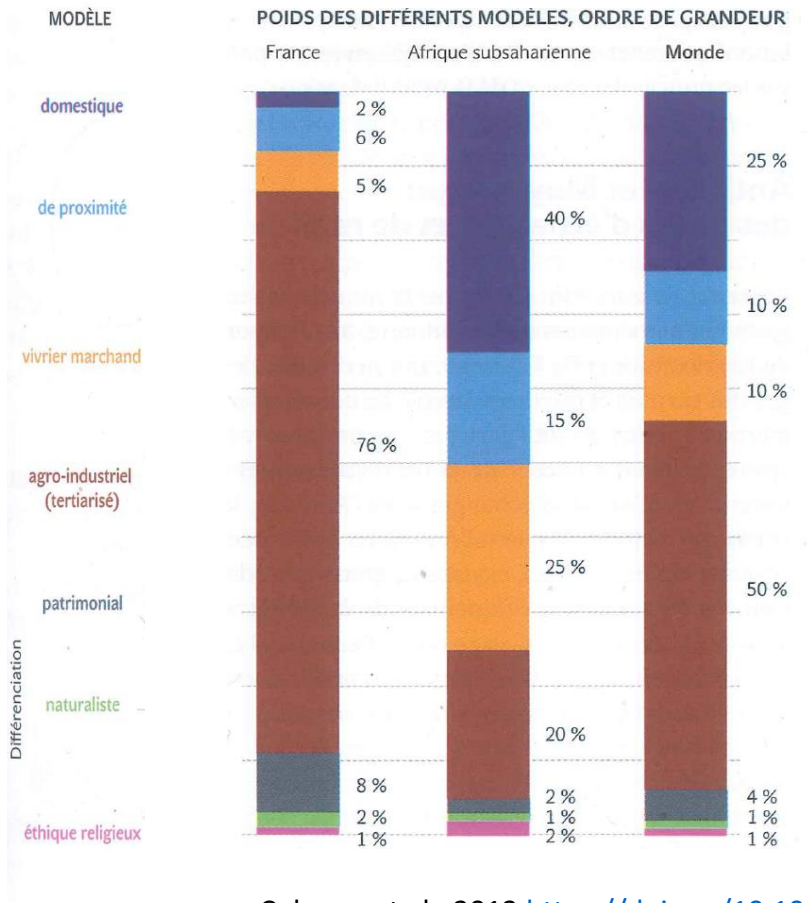
The other 7 billion CANNOT be sustained without agriculture

Through History, mankind has developed a wide variety of food systems

Nowadays, food systems are increasingly converging toward the agro-industrial model



Source: Khoury et al. 2014. Proc. Natl. Acad. Sci. USA.

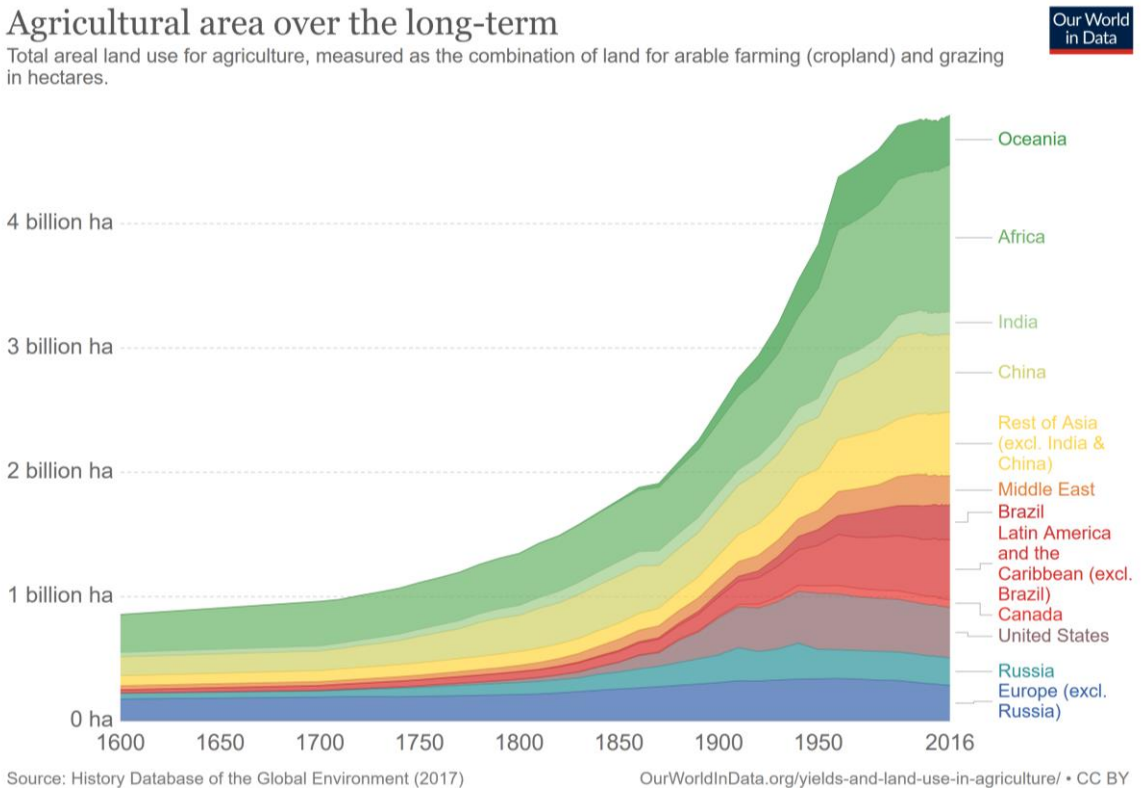


Khoury at al., 2014. PNAS

Colonna et al., 2013 https://doi.org/10.1017/CBO9781139567688

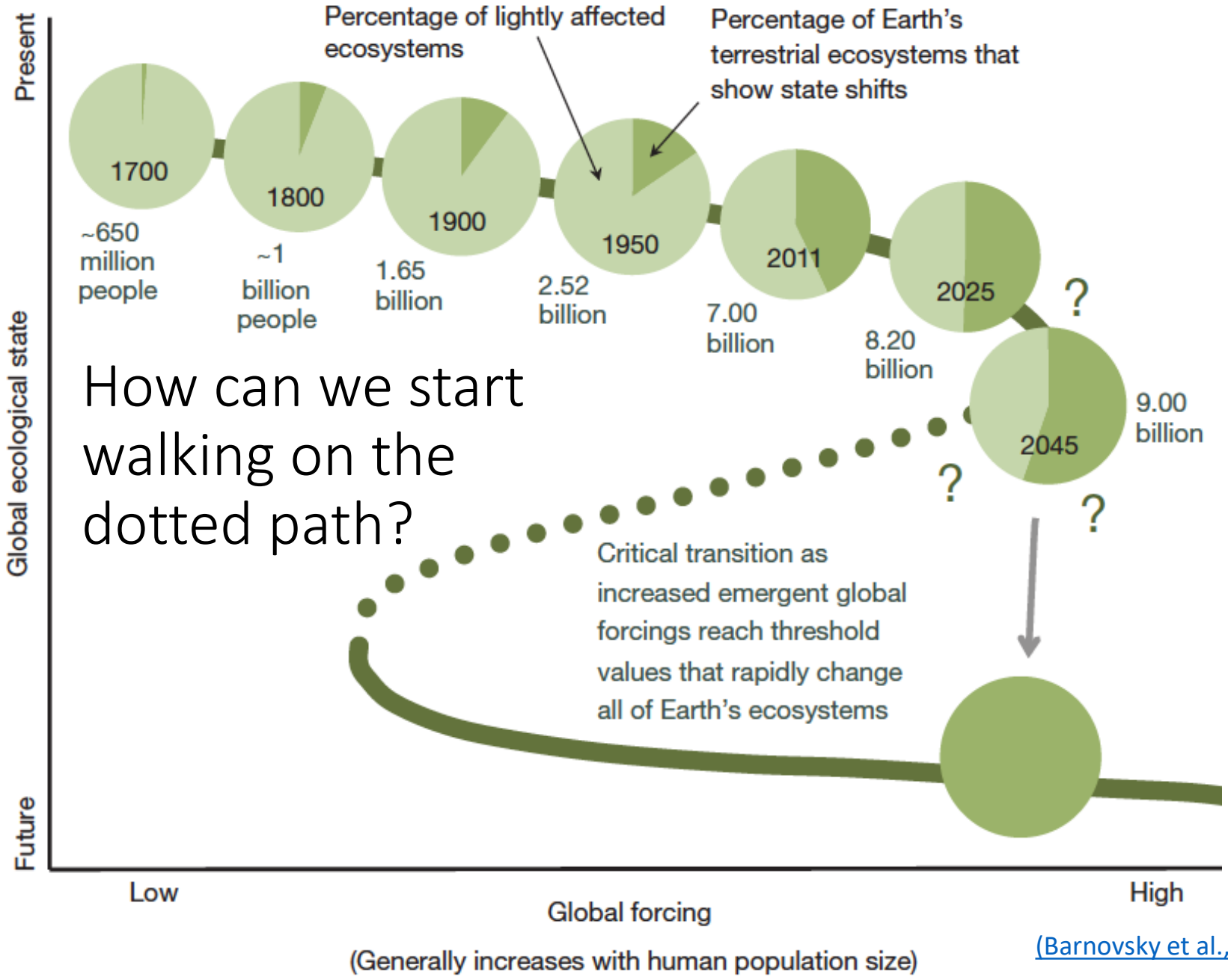
Our diets are not environment-neutral

- Agriculture uses 40 % of ice-free land, of which ¾ are used for livestock only
- Agriculture, forestry and other land use are responsible for 23% of anthropogenic GHG
- Agriculture holds the largest share of global methane and nitrous oxide emissions
- Agriculture is the largest driver of biodiversity loss



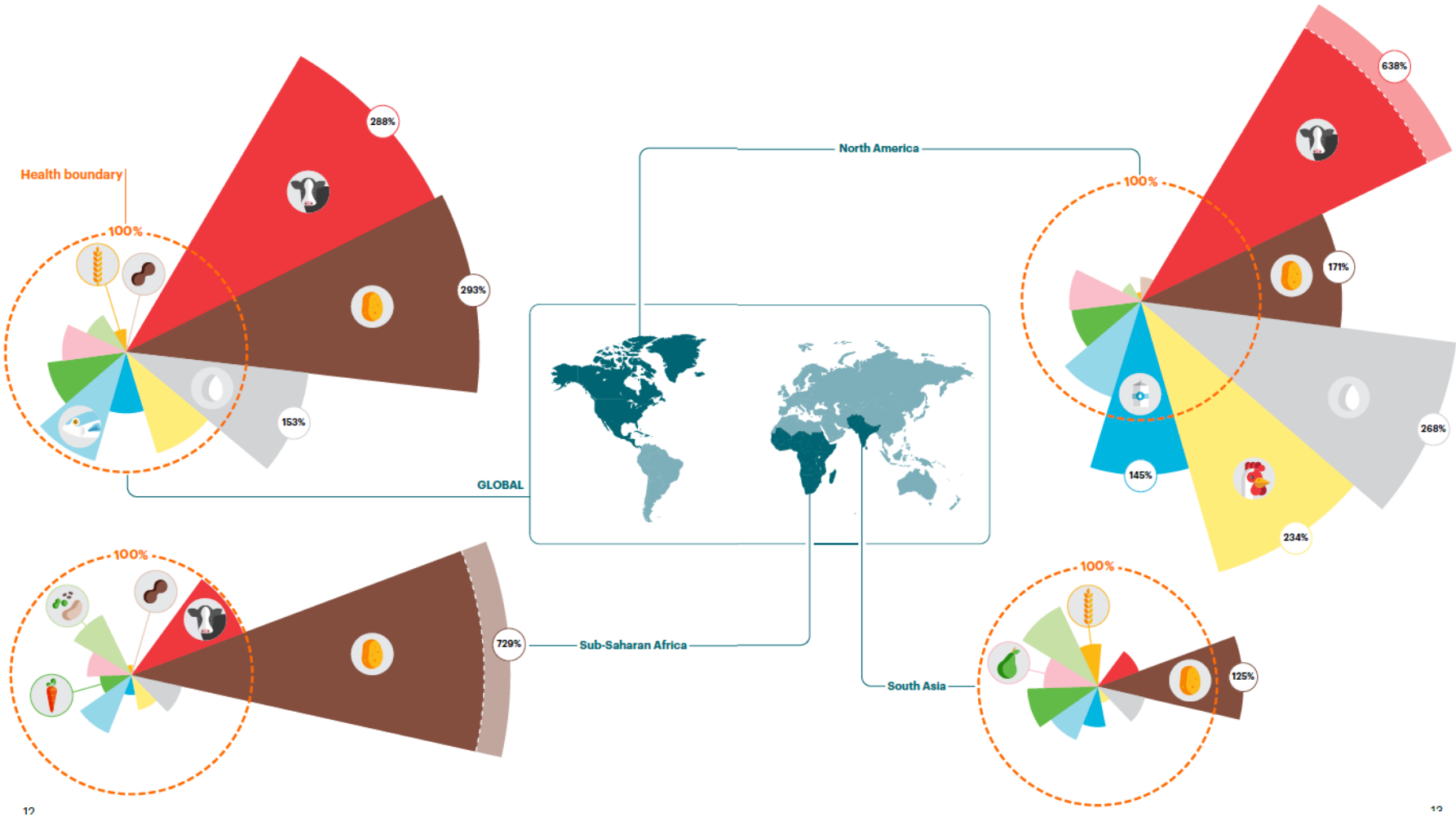
The world is not enough

Agriculture is almost already at its maximal expansion



(Barnovsky et al., 2012. Nature)

Need to reduce the gap between dietary patterns and health boundaries



Eat-Lancet Commission, 2019
https://eatforum.org/eat-lancet-commission/eat-lancet-commission-summary-report/

Urgent need to (re)-connect healthy diets with sustainable agricultural systems

Considering societal claims

Mainly on livestock and pesticides

Suicides chez les agriculteurs : des chiffres qui font froid dans le dos

Sur le plateau du 12/13, Anne-Claire Le Sann détaille les chiffres alarmants et croissants du suicide chez les agriculteurs.

France 3
France Télévisions

Mis à jour le 11/09/2019 | 17:48
publié le 11/09/2019 | 17:32

Partager

Les chiffres des suicides chez les agriculteurs sont alarmants et la réalité est encore plus sinistre pour une profession frappée par la solitude des exploitants, les conditions de vie difficiles, mais aussi les difficultés financières récurrentes. "*Ce serait plus de deux suicides par jour, selon les chiffres de la Mutualité sociale agricole parus cet été. Elle évoque 605 suicides chez agriculteurs, exploitants et salariés*", appuie en plateau Anne-Claire Le Sann.

LES AUTRES JT DE FRANCE 3

19/20 Soir/3

LES TITRES

DIRECT. Coronavirus 2019-nCoV : Air France suspend ses vols à destination et en provenance de la Chine jusqu'au 9 février

Coronavirus 2019-nCoV : comment la France a développé son propre test pour détecter le virus

Tuesday, December 6, 2016, 12:20

Study: Asia-Pacific loses steam in efforts to end hunger

By Reuters

In this March 21, 2007 photo, jobless Mel Rosete (L), watches over his three children sharing a plate of noodle in Manila's slum district of Tondo. Mel's wife Leticia, a market vendor makes 120 pesos (US$2.47) a day, not enough to ensure three meals a day for their seven children. (Romeo Gacad / AFP)

THE FOOD FOUNDATION

Menu

A healthy diet is beyond the financial reach of 3.7 million children in the UK: it's time we addressed the inequalities in our food system

September 2018 Tweet

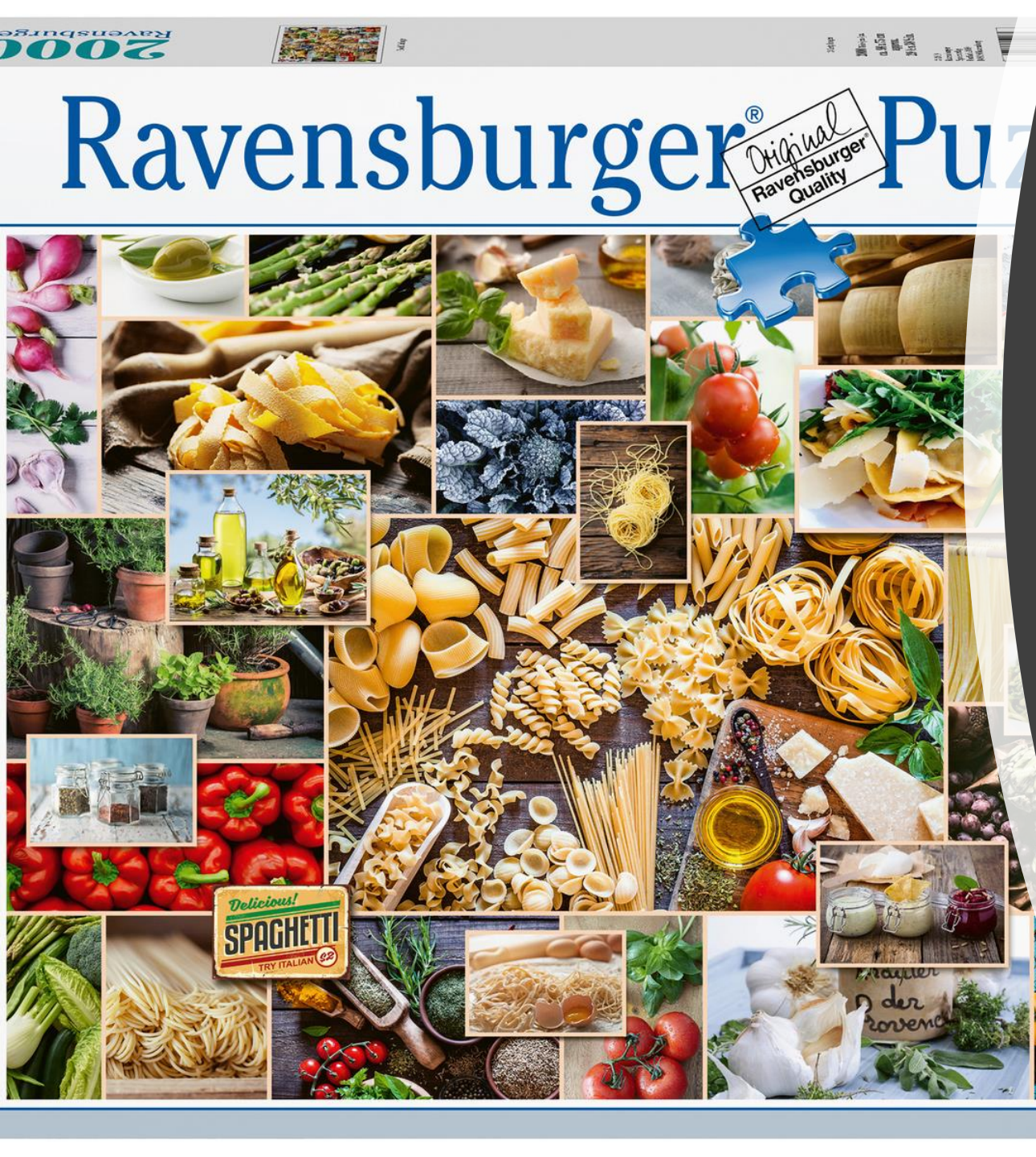
Not forgetting social justice

Questions for *AgricultureIsLife*?

Can we design cropping systems for the silty region of Hesbaye (Belgium) that

1. supply sustainable food systems
2. with and without animals
3. relocalizing agriculture ?

Can we effectively manage these systems over time while getting rid of pesticides?



What pieces do we have to start with and solve this puzzle?

- People
- Crops
- Livestock

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

Walter Willett, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett, David Tilman, Fabrice DeClerck, Amanda Wood, Malin Jonell, Michael Clark, Line J Gordon, Jessica Fanzo, Corinna Hawkes, Rami Zurayk, Juan A Rivera, Wim De Vries, Lindiwe Majele Sibanda, Ashkan Afshin, Abhishek Chaudhary, Mario Herrero, Rina Agustina, Francesco Branca, Anna Lartey, Shenggen Fan, Beatrice Crona, Elizabeth Fox, Victoria Bignet, Max Troell, Therese Lindahl, Sudhvir Singh, Sarah E Cornell, K Srinath Reddy, Sunita Narain, Sania Nishtar, Christopher J L Murray

Executive summary

Food systems have the potential to nurture human health and support environmental sustainability; however, they are currently threatening both. Providing a growing global population with healthy diets from sustainable food systems is an immediate challenge. Although global food production of calories has kept pace with population growth, more than 820 million people have insufficient food and many more consume low-quality diets that cause micronutrient deficiencies and contribute to a substantial rise in the incidence of diet-related obesity and diet-related non-communicable diseases, including coronary heart disease, stroke, and diabetes. Unhealthy diets pose a greater risk to morbidity and mortality than does unsafe sex, and alcohol, drug, and tobacco use combined. Because much of the world's population is inadequately nourished and many environmental systems and processes are pushed beyond safe boundaries by food production, a global transformation of the food system is urgently needed.

The absence of scientific targets for achieving healthy diets from sustainable food systems has been hindering large-scale and coordinated efforts to transform the global food system. This Commission brings together 19 Commissioners and 18 coauthors from 16 countries in various fields of human health, agriculture, political sciences, and environmental sustainability to develop global scientific targets based on the best evidence available for healthy diets and sustainable food production. These global targets define a safe operating space for food systems that allow us to assess which diets and food production practices will help ensure that the UN Sustainable Development Goals (SDGs) and Paris Agreement are achieved.

We quantitatively describe a universal healthy reference diet to provide a basis for estimating the health and environmental effects of adopting an alternative diet to standard current diets, many of which are high in unhealthy foods. Scientific targets for a healthy reference diet are based on extensive literature on foods, dietary patterns, and health outcomes. This healthy reference diet largely consists of vegetables, fruits, whole grains, legumes, nuts, and unsaturated oils, includes a low to moderate amount of seafood and poultry, and includes no or a low quantity of red meat, processed meat, added sugar, refined grains, and starchy vegetables. The global average intake of healthy foods is substantially lower than the reference diet intake, whereas overconsumption of unhealthy foods is increasing. Using several approaches, we found with a high level of certainty that global adoption of the reference dietary pattern would provide major health benefits, including a large reduction in total mortality.

The Commission integrates, with quantification of universal healthy diets, global scientific targets for sustainable food systems, and aims to provide scientific boundaries to reduce environmental degradation caused by food production at all scales. Scientific targets for the safe operating space of food systems were established for six key Earth system processes. Strong evidence indicates that food production is among the largest drivers of global environmental change by contributing to climate change, biodiversity loss, freshwater use, interference with the global nitrogen and phosphorus cycles, and land-system change (and chemical pollution, which is not assessed in this Commission). Food production depends on continued functioning of biophysical systems and processes to regulate and maintain a stable Earth system; therefore, these systems and processes provide a set of globally systemic indicators of sustainable food production. The Commission concludes that quantitative scientific targets constitute universal and scalable planetary boundaries for the food system. However, the uncertainty range for these food boundaries remains high because of the inherent complexity in Earth system dynamics.

Diets inextricably link human health and environmental sustainability. The scientific targets for healthy diets and sustainable food systems are integrated into a common framework, the safe operating space for food systems, so that win-win diets (ie, healthy and environmentally sustainable) can be identified. We propose that this framework is universal for all food cultures and production systems in the world, with a high potential of local adaptation and scalability.

Application of this framework to future projections of world development indicates that food systems can provide healthy diets (ie, reference diet) for an estimated global population of about 10 billion people by 2050 and remain within a safe operating space. However, even small increases in consumption of red meat or dairy foods would make this goal difficult or impossible to achieve. Within boundaries of food production, the reference diet can be adapted to make meals that are consistent with food cultures and cuisines of all regions of the world.

Because food systems are a major driver of poor health and environmental degradation, global efforts are urgently needed to collectively transform diets and food production. An integrative framework combined with scientific targets

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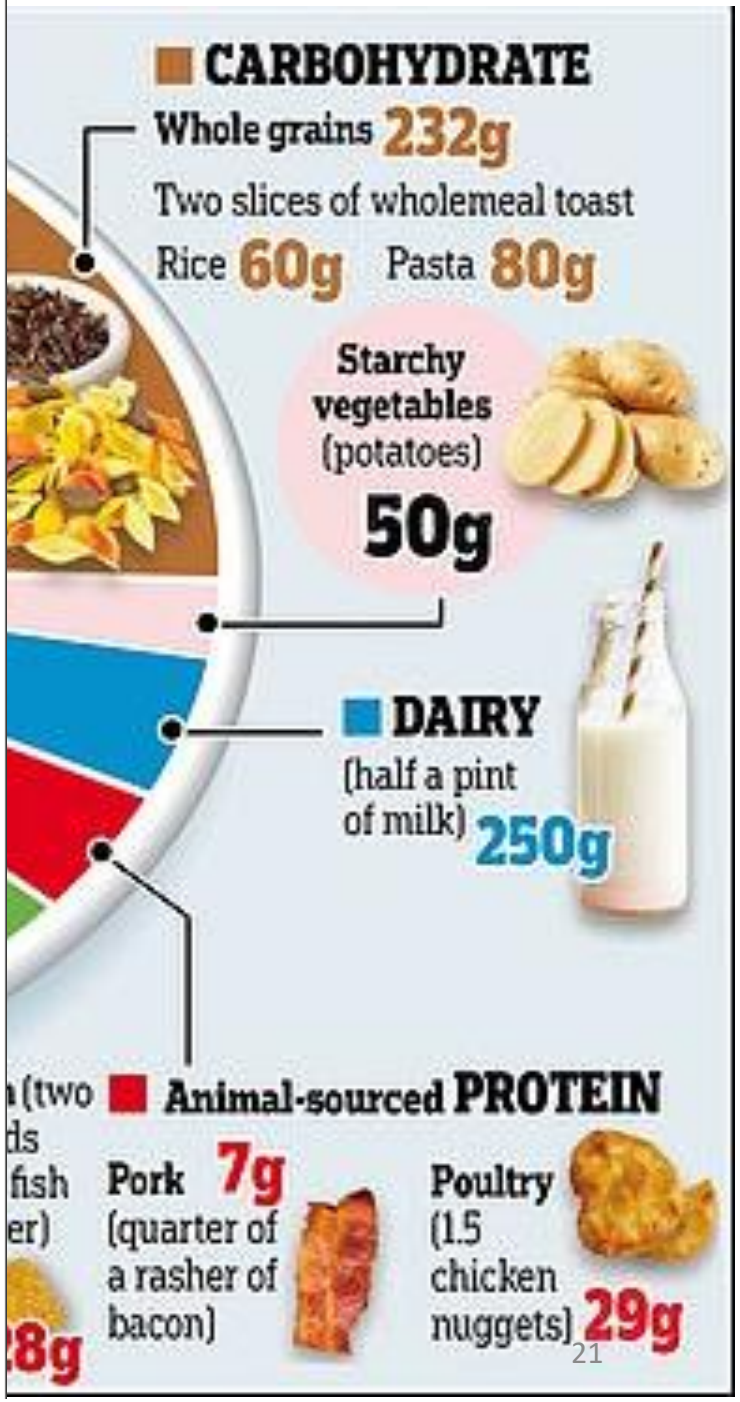
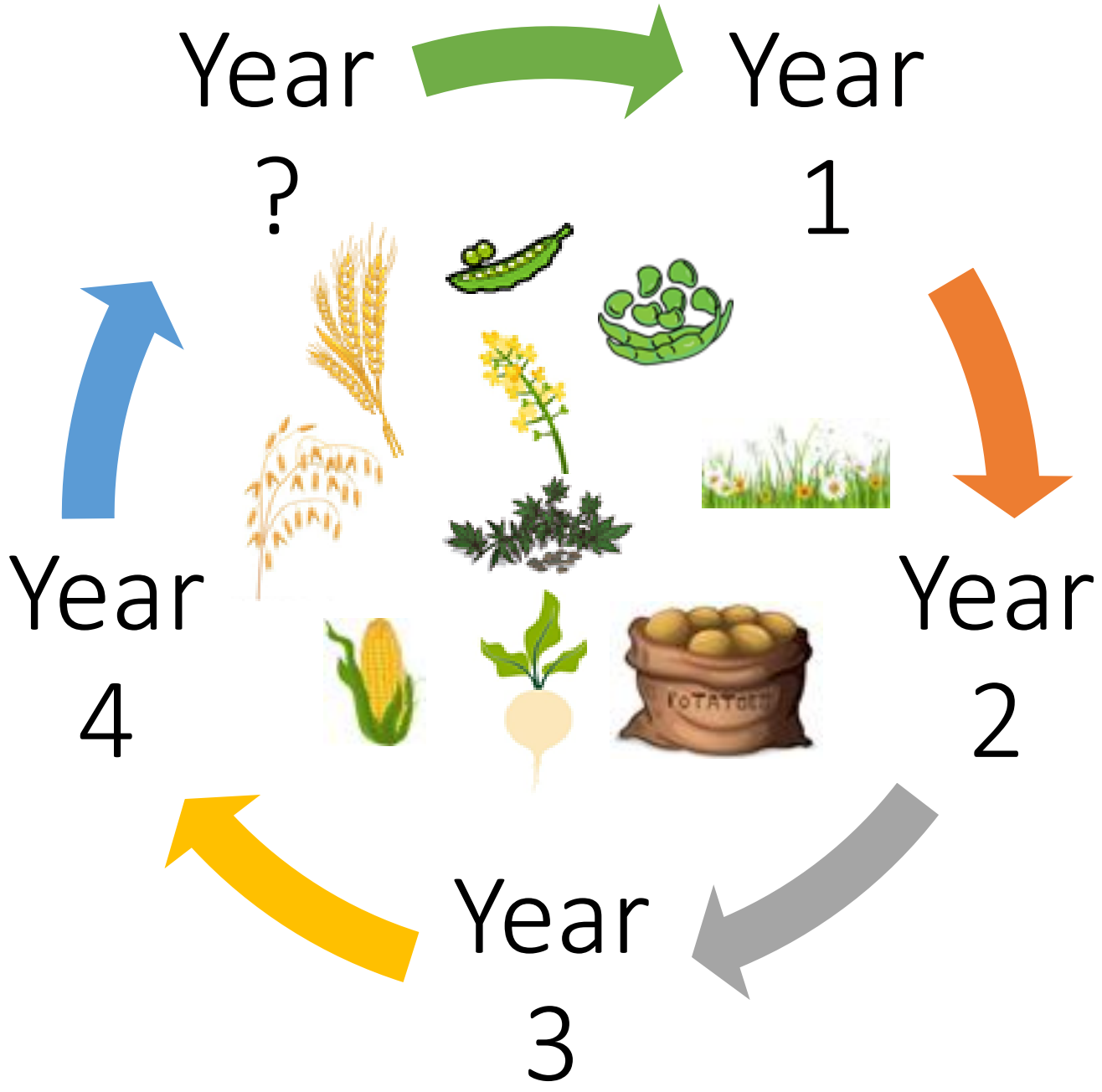
This online publication has been corrected. The corrected version first appeared at thelancet.com on February 7, 2019
See Comment page 386

Harvard T H Chan School of Public Health, Harvard Medical School, Channing Division of Network Medicine, Brigham and Women's Hospital, Boston, MA, USA (Prof W Willett MD); Potsdam Institute for Climate Impact Research, Potsdam, Germany (Prof J Rockström PhD); Stockholm Resilience Centre, Stockholm, Sweden (Prof J Rockström, B Loken PhD, F DeClerck PhD, A Wood PhD, M Jonell PhD, L J Gordon PhD, B Crona PhD, V Bignet MSc, M Troell PhD, T Lindahl PhD, S E Cornell PhD); EAT, Oslo, Norway (B Loken, F DeClerck, A Wood, S Singh MBChB); University of Auckland, Auckland, New Zealand (S Singh); Oxford Martin Programme on the Future of Food and Centre on Population Approaches for Non-Communicable Disease Prevention, Nuffield Department of Population Health (M Springmann PhD), Food Climate Research Network, Environmental Change Institute and Oxford Martin School (T Garnett PhD), University of Oxford, Oxford, UK; Centre for Food Policy, City, University of London, London, UK (Prof T Lang PhD, Prof C Hawkes PhD); World Wide Fund for Nature International, Gland, Switzerland (S Vermeulen PhD); Hoffmann Centre for Sustainable Resource Economy, Chatham House, London, UK (S Vermeulen); Department of Ecology, Evolution and Behavior (D Tilman PhD), Natural




Year ?
Year 1
Year 2
Year 3
Year 4

Agronomical constraints

- 3 to 8 years
- Maximization of intercrops
- Intercrops possible only before crops that are sowed in spring
- Periodicity of legumes >= 3 years
- Alternance of botanical families:
  - Solanaceae/Brassicaceae/Amaranthaceae,/Cannabaceae, Fabaceae
  - except for Poaceae
- No constraints on fertility

Year 1	Silage corn	Cereal corn	Sugarbeet	Sugarbeet	Sugarbeet	Potatoe	Rapeseed	Sugarbeet	Sugarbeet	Potatoe	Potatoe	Sugarbeet	Sugarbeet	Potatoe	Sugarbeet	Potatoe	Rapeseed	Sugarbeet	Sugarbeet	Potatoe
Year 2	Winter wheat	Winter wheat	Silage corn	Cereal corn	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 3	Winter Barley	Winter Barley	Winter wheat	Winter wheat	Winter Barley	Winter Barley	Winter Barley	Silage corn	Cereal corn	Silage corn	Cereal corn	Spring potatoes	Rapeseed	Rapeseed	Spring Pea	Spring Pea	Spring Pea	Rapeseed	Rapeseed	Rapeseed
Year 4	-	-	-	-	-	-	-	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Winter barley	Winter barley	Winter barley	Silage corn	Cereal corn	Silage corn
Year 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Winter barley	Winter barley	Winter barley
Year 7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 1	Potatoe	Sugarbeet	Sugarbeet	Potatoe	Spring potatoes	Spring potatoes	Spring potatoes	Spring potatoes	Sugarbeet	Sugarbeet	Sugarbeet	Sugarbeet	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Hemp	Hemp	Sugarbeet
Year 2	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea	Winter wheat	Winter wheat	Winter wheat	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Winter wheat	Winter wheat	Winter wheat
Year 3	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Silage corn	Cereal corn	Silage corn	Cereal corn	Cereal corn	Faba beans	Faba beans	Spring potatoes
Year 4	Winter wheat	Spring potatoes	Winter wheat	Winter wheat	Winter pea	Winter pea	W.wheat + W.pea	W.wheat + W.pea	Spring potatoe	W.wheat + W.pea	W.wheat + W.pea	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 5	Cereal corn	Winter wheat	SB/SP	SB/SP	Silage corn	Cereal corn	Silage corn	Cereal corn	Winter wheat	Sugarbeet	Potatoe	Pea/(Faba)bean	Sugarbeet	Sugarbeet	Potatoe	Potatoe	Faba beans	Rapeseed	Rapeseed	Rapeseed
Year 6	Winter barley	Winter barley	Winter wheat	Winter wheat	Winter barley	Winter barley	Winter barley	Winter barley	Winter barley	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea
Year 7	-	-	Winter barley	Winter barley	-	-	-	-	-	Winter barley	Winter barley	Winter barley	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Spring Pea	Spring Pea	Silage corn
Year 8	-	-	-	-	-	-	-	-	-	-	-	-	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea	Oats	Oats	Winter wheat

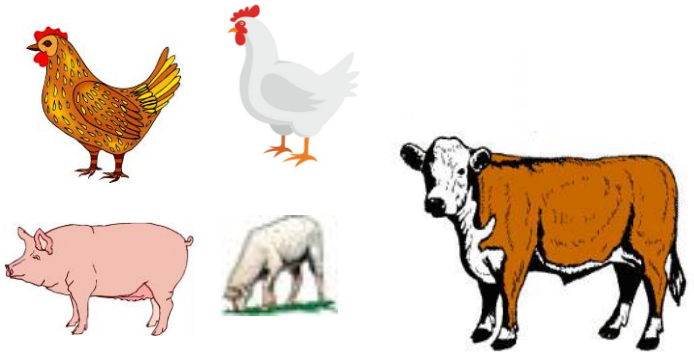
Year 1

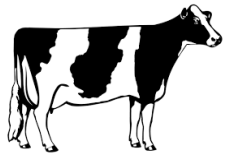
Year 2

Year 3

Year 4

Year 5





Connecting diets to cropping system

Table 4 *Composition (g/kg DM) of some example concentrate feeds*

	Dairy cows	Beef cattle and sheep	Pigs	Broiler chickens	Laying hens
	A. Bell, personal communication and author's estimate (2009)	A. Bell, personal communication and author's estimate (2009)	A. Bell, personal communication (2009); Hazzeldine, (2009)	C. Rymer, personal communication (2009)	C. Rymer, personal communication (2009)
Cereal grain	200	450	600	700	640
Cereal by-products	150	300	180	0	20
Soyabean meal	70	0	120	150	150
Rapeseed meal	350	[illegible]	[illegible]	[illegible]	0
Other oilseed meals	50	40	0	0	60
Pulses	0	0	0	50	0
Other by-products	170	100	10	90	30
Minerals + vitamins	10	10	10	10	100
ME (MJ/kg DM)	12.5	12.8	13.0	13.4	12.0
CP (g/kg DM)	255	172	198	205	164
Human-edible proportion	0.36	0.47	0.64	0.75	0.65

DM = dry matter; ME = metabolisable energy.

Livestock concentrate diets composition

Table 5 *Example systems of UK livestock production: output per head and inputs of concentrates and forage crops (based on Williams et al., 2006)*

System	Description	Unit	Time (weeks)	Output (kg)[1]	Concentrates (kg DM/head)	Forage crops (kg DM/head)	
						Grazing	Silage/hay
Milk	Housed 190 days per year, grazed 175 days per year	1 cow + 0.25 heifer	44 (cow lactation) + 8 (cow dry period) + 104 (heifer)	6500	1787	2229	3149
Upland suckler beef	Spring-calving, grass-finishing of weaned calves, 530 kg live weight and 20 months at slaughter	1 calf + 1.087 cow	80 (calf), 52 (cow)	292	674	4851	2506
Lowland suckler beef	Autumn-calving, w[illegible]ter-finishing of weaned calves, [illegible] 18 months at sl[illegible]	1 calf + 1.[illegible]7 cow	72 (calf), 52 (cow)	308	1557	4261	1811
18 to 20 month beef	Spring-born dairy-bred calves, grass finishing, 515 kg live weig[illegible] and 19 months at slaughter	1 calf	76	288	1150	1680	1660
Cereal beef	Continental × dairy-bred bul[illegible] weight and 12.5 months at slaughter	[illegible]	[illegible]	[illegible]	[illegible]	0	90.0
Upland lamb	Half-bred flocks, 0.35 of lambs finished off grazed pasture. Store lambs finished indoors. 30 kg live weight an[illegible] at slaughter	1 lamb + 0.714 ewe	28 (lamb), 52 (ewe)	15.0	54.0	425	34.0
Lowland lamb	Pure-bred flocks, 0.6 of lambs finished off grazed pasture. Store lambs finished indoors. 37.5 kg live weight and 7 months at slaughter	1 lamb + 0.667 ewe	28 (lamb), 52 (ewe)	18.8	47.0	375	127
Pig meat	Housed indoors, heavy bacon, 109 kg live weight at slaughter	1 piglet + 0.045 sow	25 (piglet), 52 (sow)	78.1	283	0	0
Poultry meat	Housed 42 days, 2.54 kg at slaughter	1 chicken	6	2.0	4.0	0	0
Eggs	Housed 385 days, 295 eggs/layer, 60 g/egg	1 hen	55	17.7	38.6	0	0

DM = dry matter.
[1]Whole milk, bone-in carcase or whole egg + shell.

Livestock production cycle, forage and concentrate requirements & yields

Wilkinson, 2011
https://doi.org/10.1017/S175173111100005X

Cultures	Nature de la récolte	Superficie ha	Rendement 100 kg à l'ha	Production en tonnes	Production en tonnes
1. Céréales pour le grain					
Froment d'hiver	grain	129.919	94,3	1.224.528	1.213.985
Froment de printemps	grain	1.756	53,7	9.422	9.211
Epeautre	grain	18.458	73,2	135.092	96.718
Seigle *(y c. méteil)*	grain	293	49,0	1.437	872
Orge de brasserie	grain	258	63,6	1.642	1.642
Orge d'hiver	grain	30.166	91,9	277.187	274.294
Orge de printemps	grain	2.466	53,5	13.202	12.154
Avoine *(y c. mélanges de céréales d'été)*	grain	3.244	54,5	17.680	14.576
Triticale	grain	3.024	71,2	21.528	21.488
Maïs grain	grain	5.972	119,2	71.159	60.346
Autres céréales	grain	2.928	44,1	12.898	13.402
2. Cultures industrielles					
Plants de pommes de terre	tubercules	831	275,5	22.893	29.069
Pommes de terre hâtives	tubercules	141	383,8	[illegible]	2.732
Pommes de terre de conservation	tubercules	[illegible]	[illegible]	[illegible]	1.761.718
Betteraves sucrières	racines	34.535	863,[illegible]	2.980.645	3.421.986
Lin	paille	9.205	59,1	54.444	25.142
Colza et navette	grain	10.646	42,7	45.441	50.582
3. Cultures fourragères					
Betteraves fourragères	racines	947	1.038,3	98.326	86.168
Maïs fourrager	masse verte	53.306	464,4	2.475.317	2.721.486
Pois fourragers	grains secs	625	46,3	2.895	
Fèves et féveroles	grains secs	515	31,2	1.608	
Autres légumineuses	grains secs	977	1.038,3	3.544	
Légumineuses	grains secs				7.222

Crop rotation & yields

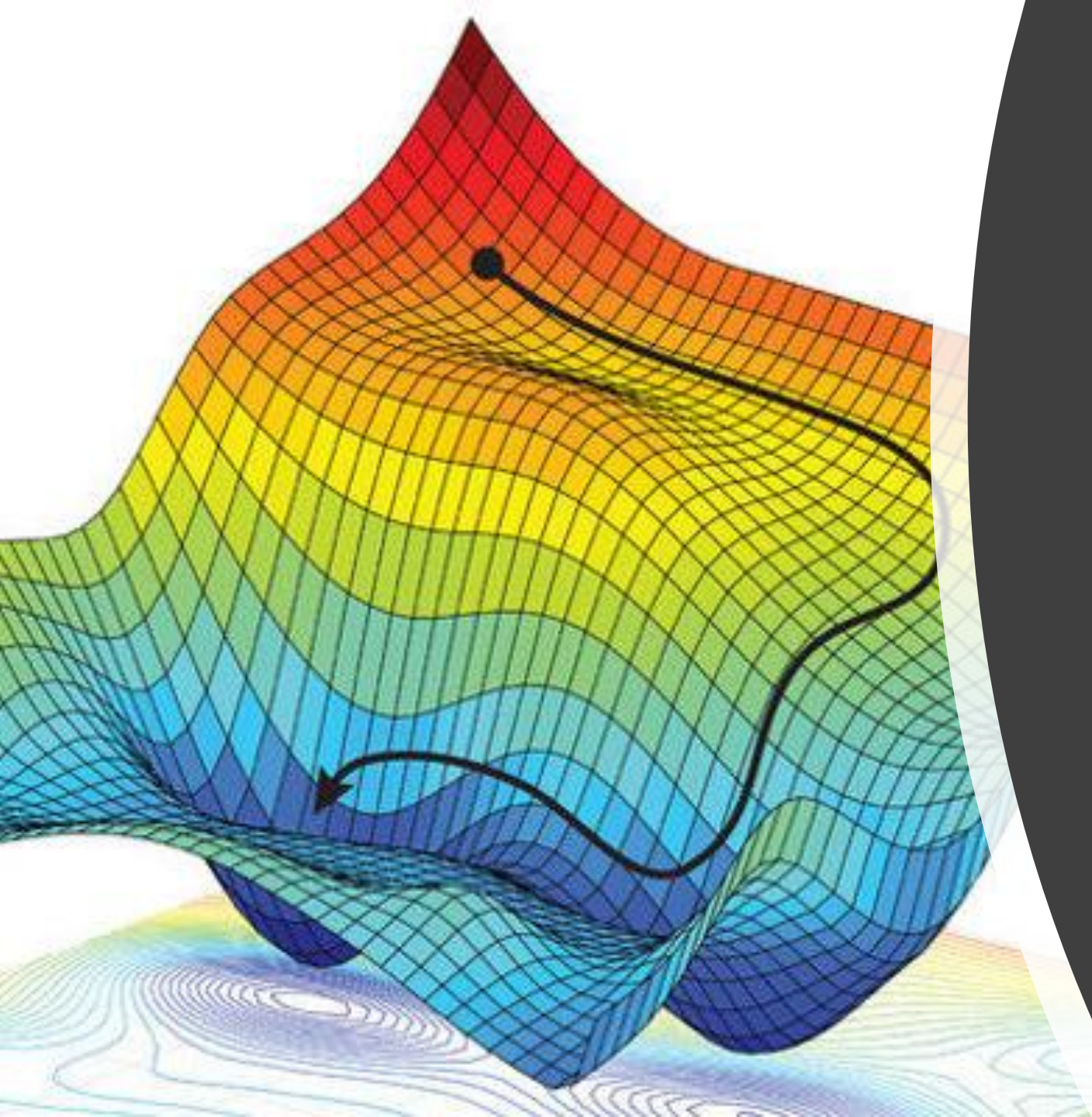
Statbel, 2018
https://statbel.fgov.be/sites/default/files/files/documents/landbouw/8.1%20Land-%20en%20tuinbouwbedrijven/L06-2018-PROV-WEB-BE-FR.xlsx

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

	Macronutrient intake (possible range), g/day	Caloric intake, kcal/day
Whole grains*		
Rice, wheat, corn, and other†	232 (total gains 0–60% of energy)	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	..
Dark green vegetables	100	23
Red and orange vegetables	100	30
Other vegetables	100	25
Fruits		
All fruit	[illegible]	126
Dairy foods		
Whole milk or derivative equivalents (eg, cheese)	250 (0–500)	153
Protein sources‡		
Beef and lamb	7 (0–14)	15
Pork	7 (0–14)	15
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish§	28 (0–100)	40
Legumes		
Dry beans, lentils, and peas*	50 (0–100)	172
Soy foods	25 (0–50)	112
Peanuts	25 (0–75)	142
Tree nuts	25	149
Added fats		
Palm oil	6·8 (0–6·8)	60
Unsaturated oils¶	40 (20–80)	354
Dairy fats (included in milk)	0	0
Lard or tallow‖	5 (0–5)	36
Added sugars		
All sweeteners	31 (0–31)	120

EAT Lancet diet

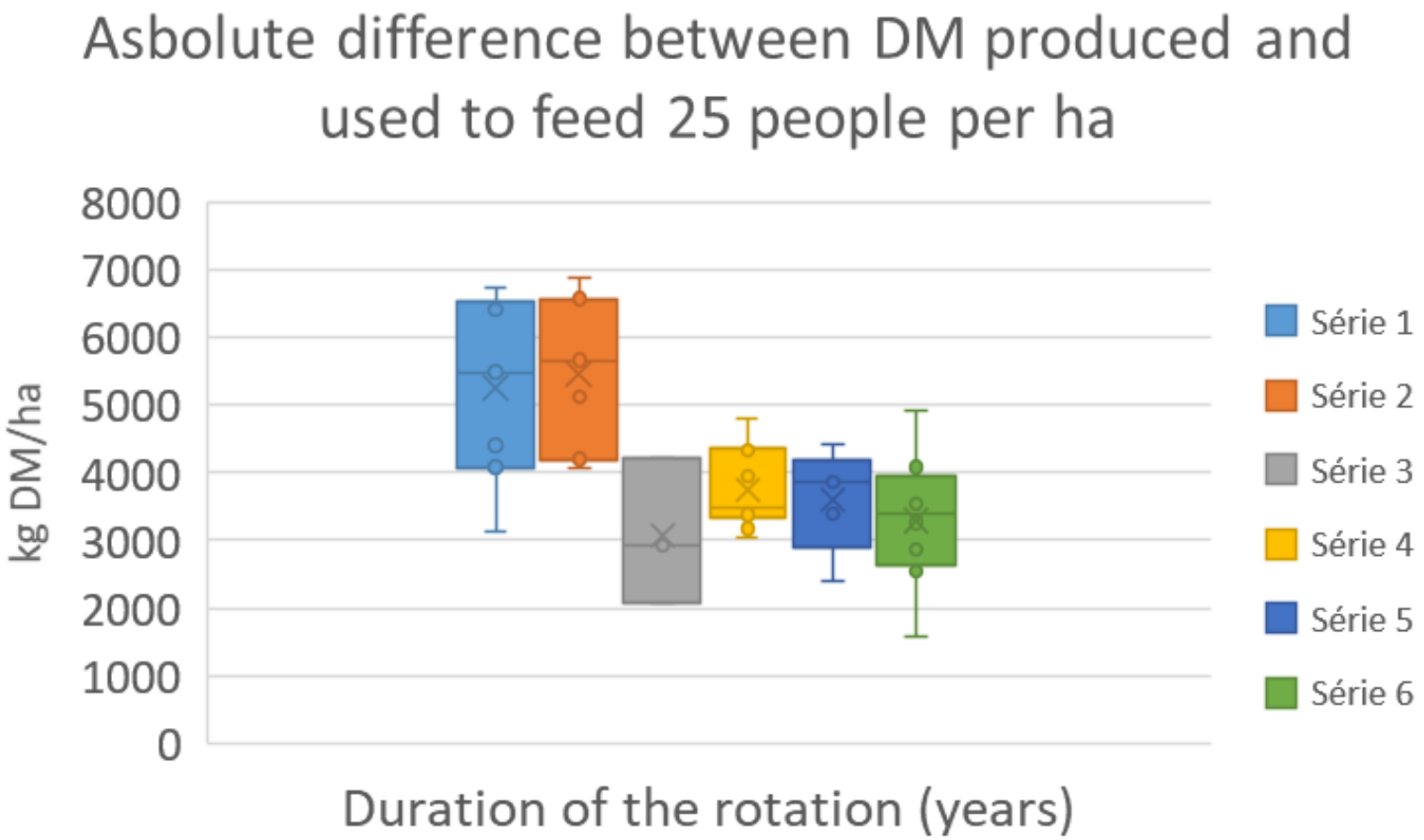
Willet et al., 2019
https://doi.org/10.1016/S0140-6736(18)31788-4



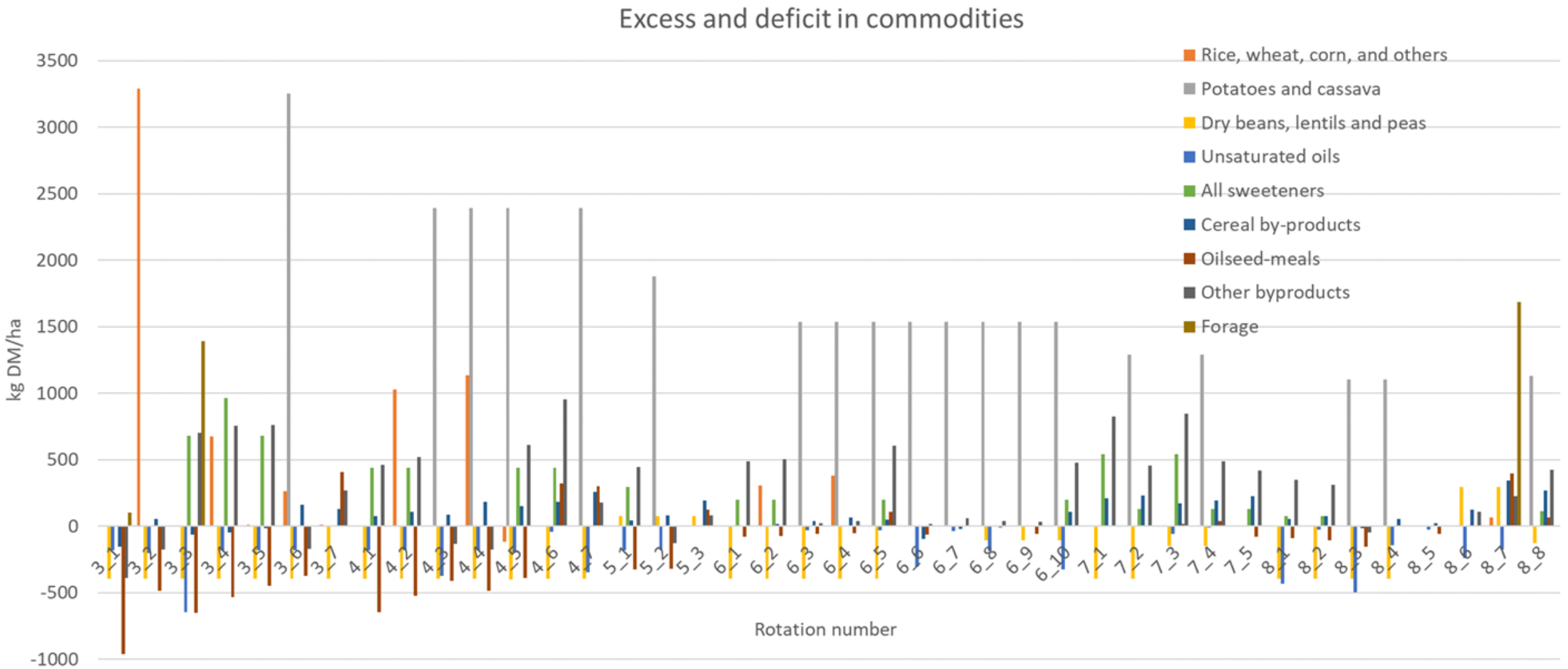
Optimization of the total biomass use efficiency of each rotation

- To feed 25 people per ha eating the diet suggested by the EAT-Lancet commission
- Objective
  - Minimization of the excess (possible exports) and deficits (required imports) of food and feed commodities

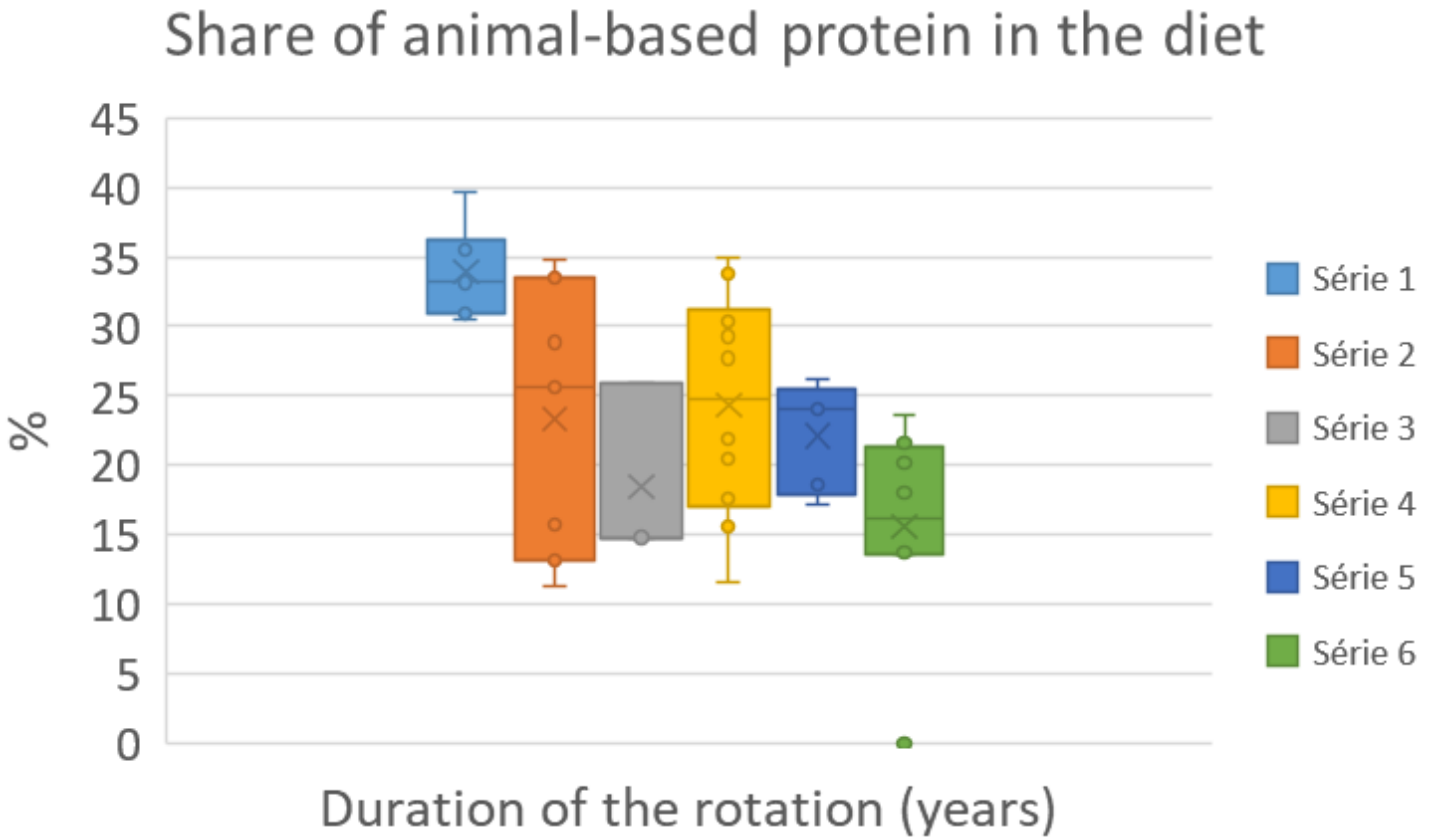
Some first observations



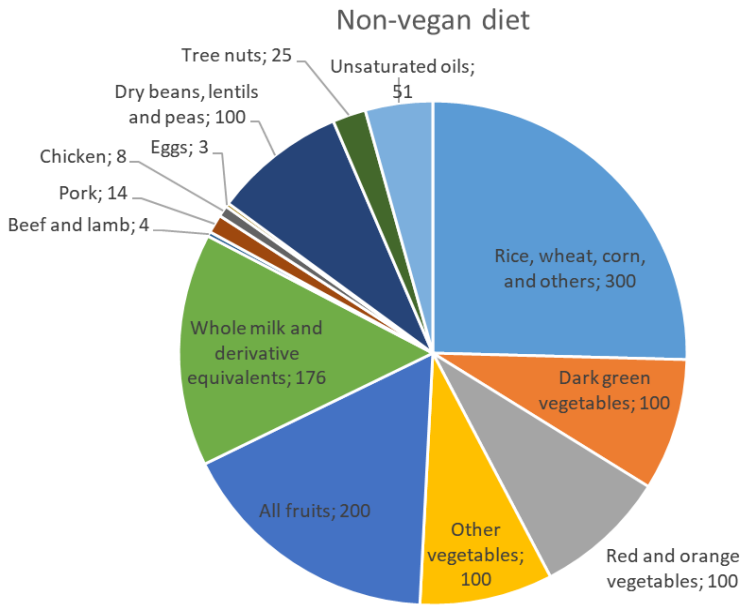
- Shorter rotations are “wasting” more biomass
- But huge diversity for a same duration

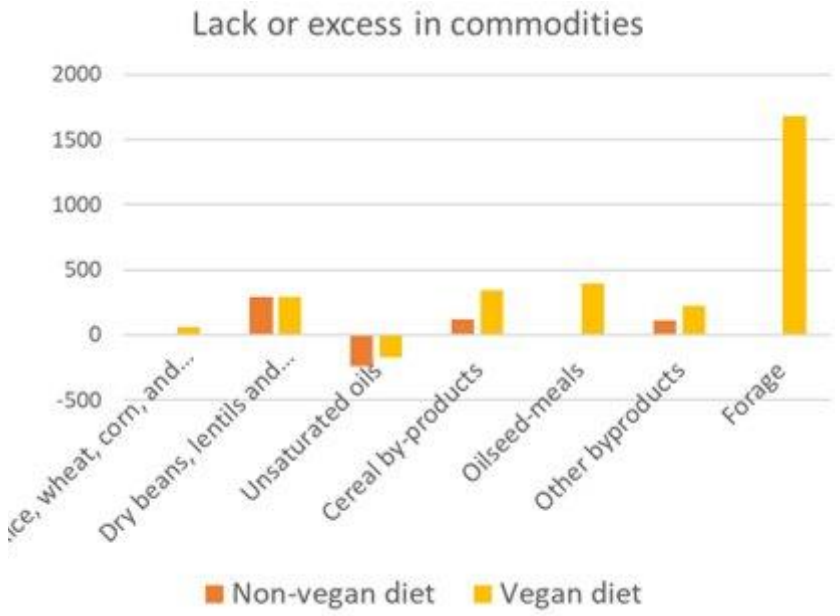

Excess and deficit in commodities
Rice, wheat, corn, and others
Potatoes and cassava
Dry beans, lentils and peas
Unsaturated oils
All sweeteners
Cereal by-products
Oilseed-meals
Other byproducts
Forage
kg DM/ha
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
Rotation number

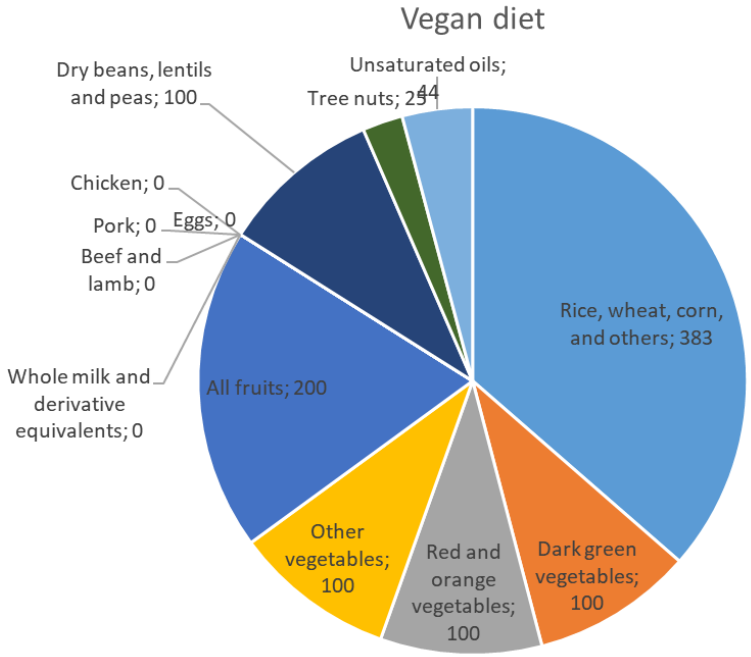
Longer rotations address the recommendations to reduce animal-based foods better

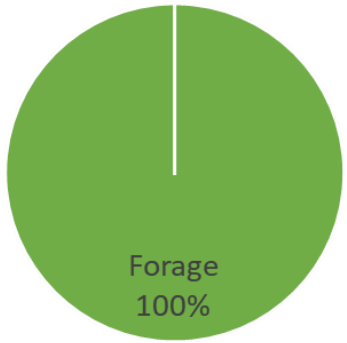


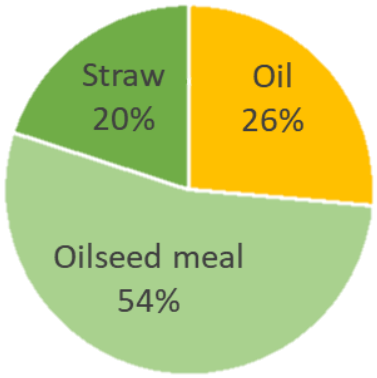
Going vegan?

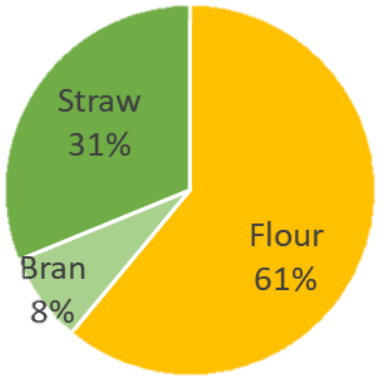

Non-vegan diet
Tree nuts; 25
Unsaturated oils; 51
Dry beans, lentils and peas; 100
Chicken; 8
Eggs; 3
Pork; 14
Beef and lamb; 4
Rice, wheat, corn, and others; 300
Whole milk and derivative equivalents; 176
Dark green vegetables; 100
All fruits; 200
Other vegetables; 100
Red and orange vegetables; 100


Lack or excess in commodities
2000
1500
1000
500
0
-500
Dry beans, lentils and...
Unsaturated oils
Cereal by-products
Oilseed-meals
Other byproducts
Forage
Non-vegan diet
Vegan diet


Vegan diet
Dry beans, lentils and peas; 100
Unsaturated oils; 44
Tree nuts; 25
Chicken; 0
Pork; 0
Eggs; 0
Beef and lamb; 0
Whole milk and derivative equivalents; 0
Rice, wheat, corn, and others; 383
All fruits; 200
Other vegetables; 100
Red and orange vegetables; 100
Dark green vegetables; 100





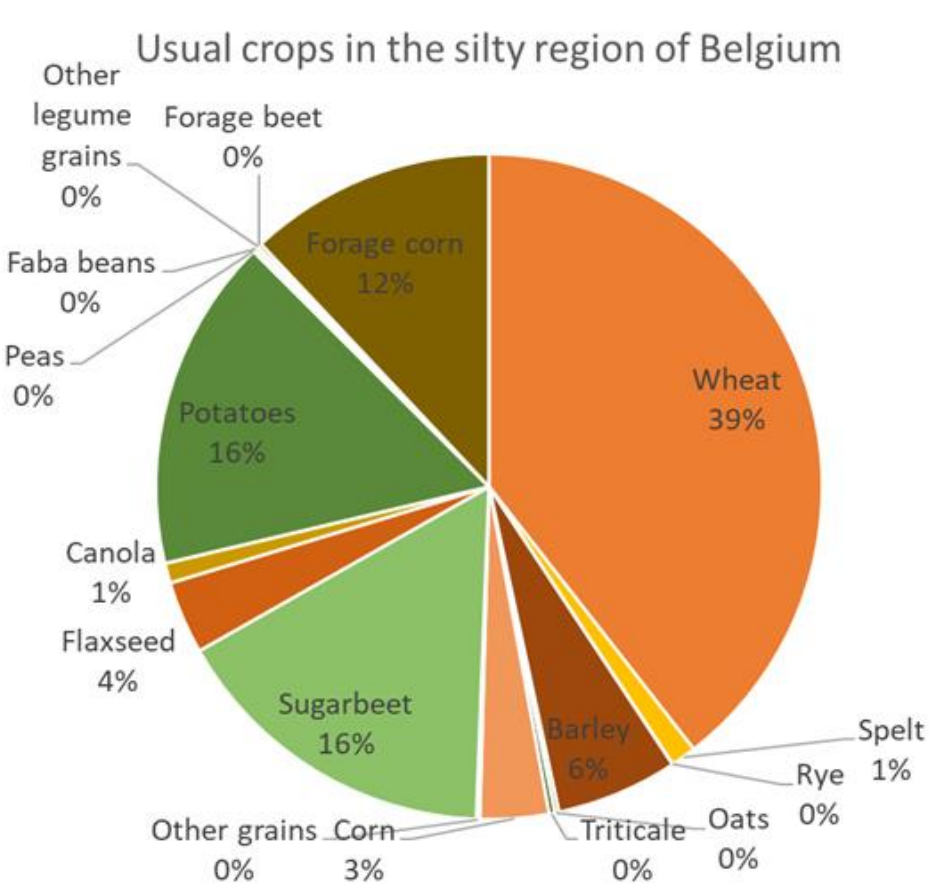


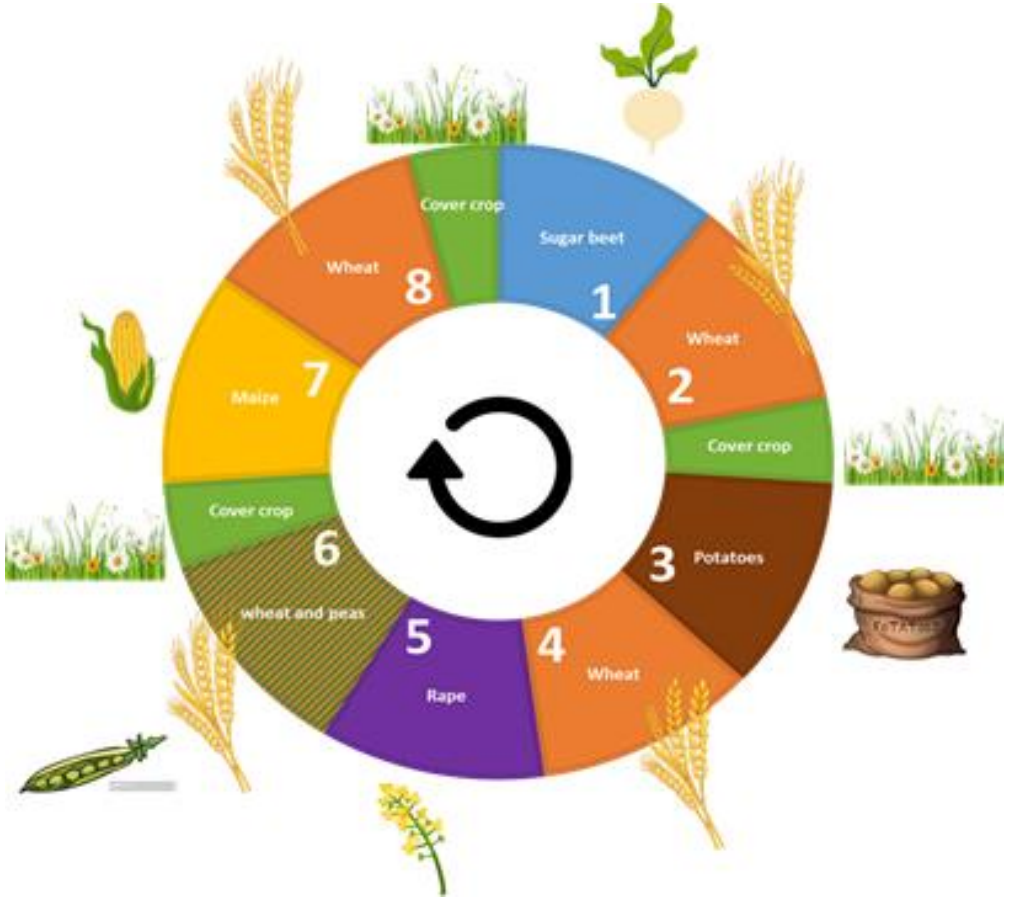
Not all crop products are edible

Year 1	Silage corn	Cereal corn	Sugarbeet	Sugarbeet	Sugarbeet	Potatoe	Rapeseed	Sugarbeet	Sugarbeet	Potatoe	Potatoe	Sugarbeet	Sugarbeet	Potatoe	Sugarbeet	Potatoe	Rapeseed	Sugarbeet	Sugarbeet	Potatoe
Year 2	Winter wheat	Winter wheat	Silage corn	Cereal corn	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 3	Winter Barley	Winter Barley	Winter wheat	Winter wheat	Winter Barley	Winter Barley	Winter Barley	Silage corn	Cereal corn	Silage corn	Cereal corn	Spring potatoes	Rapeseed	Rapeseed	Spring Pea	Spring Pea	Spring Pea	Rapeseed	Rapeseed	Rapeseed
Year 4	-	-	-	-	-	-	-	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Winter barley	Winter barley	Winter barley	Silage corn	Cereal corn	Silage corn
Year 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Winter barley	Winter barley	Winter barley
Year 7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 1	Potatoe	Sugarbeet	Sugarbeet	Potatoe	Spring potatoes	Spring potatoes	Spring potatoes	Spring potatoes	Sugarbeet	Sugarbeet	Sugarbeet	Sugarbeet	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Hemp	Hemp	Sugarbeet
Year 2	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea	Winter wheat	Winter wheat	Winter wheat	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Grassland Temp.	Winter wheat	Winter wheat	Winter wheat
Year 3	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Silage corn	Cereal corn	Silage corn	Cereal corn	Cereal corn	Faba beans	Faba beans	Spring potatoes
Year 4	Winter wheat	Spring potatoes	Winter wheat	Winter wheat	Winter pea	Winter pea	W.wheat + W.pea	W.wheat + W.pea	Spring potatoe	W.wheat + W.pea	W.wheat + W.pea	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat
Year 5	Cereal corn	Winter wheat	SB/SP	SB/SP	Silage corn	Cereal corn	Silage corn	Cereal corn	Winter wheat	Sugarbeet	Potatoe	Pea/(Faba)bean	Sugarbeet	Sugarbeet	Potatoe	Potatoe	Faba beans	Rapeseed	Rapeseed	Rapeseed
Year 6	Winter barley	Winter barley	Winter wheat	Winter wheat	Winter barley	Winter barley	Winter barley	Winter barley	Winter barley	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea
Year 7	-	-	Winter barley	Winter barley	-	-	-	-	-	Winter barley	Winter barley	Winter barley	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Spring Pea	Spring Pea	Silage corn
Year 8	-	-	-	-	-	-	-	-	-	-	-	-	Winter wheat	Winter wheat	Winter wheat	Winter wheat	W.wheat + W.pea	Oats	Oats	Winter wheat

BAU- open agricultural system for an open feed and food system

Sugarbeet
Winter wheat
Spring potatoe
Winter wheat
Rapeseed
W.wheat + W.pea
Silage corn
Winter wheat



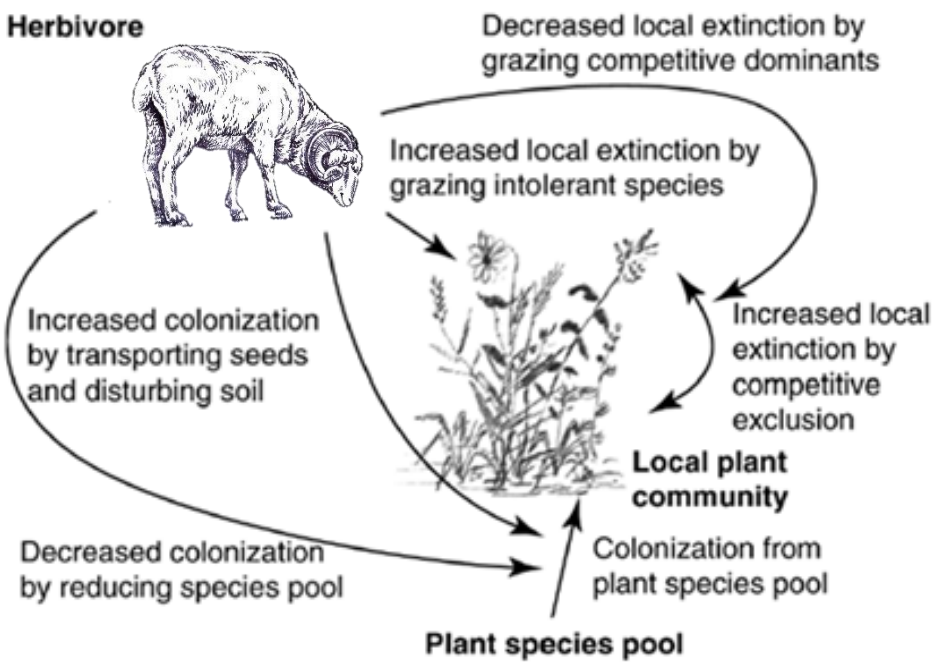


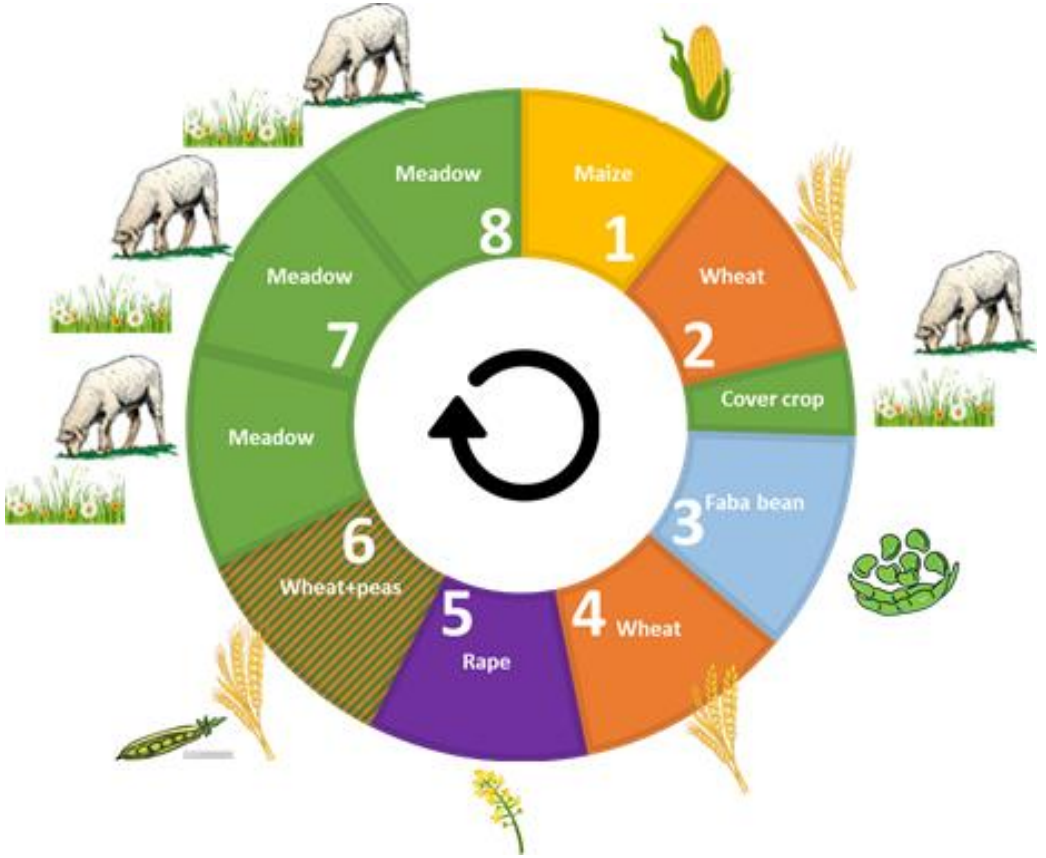
Livestock-banning food system re-localizing agriculture

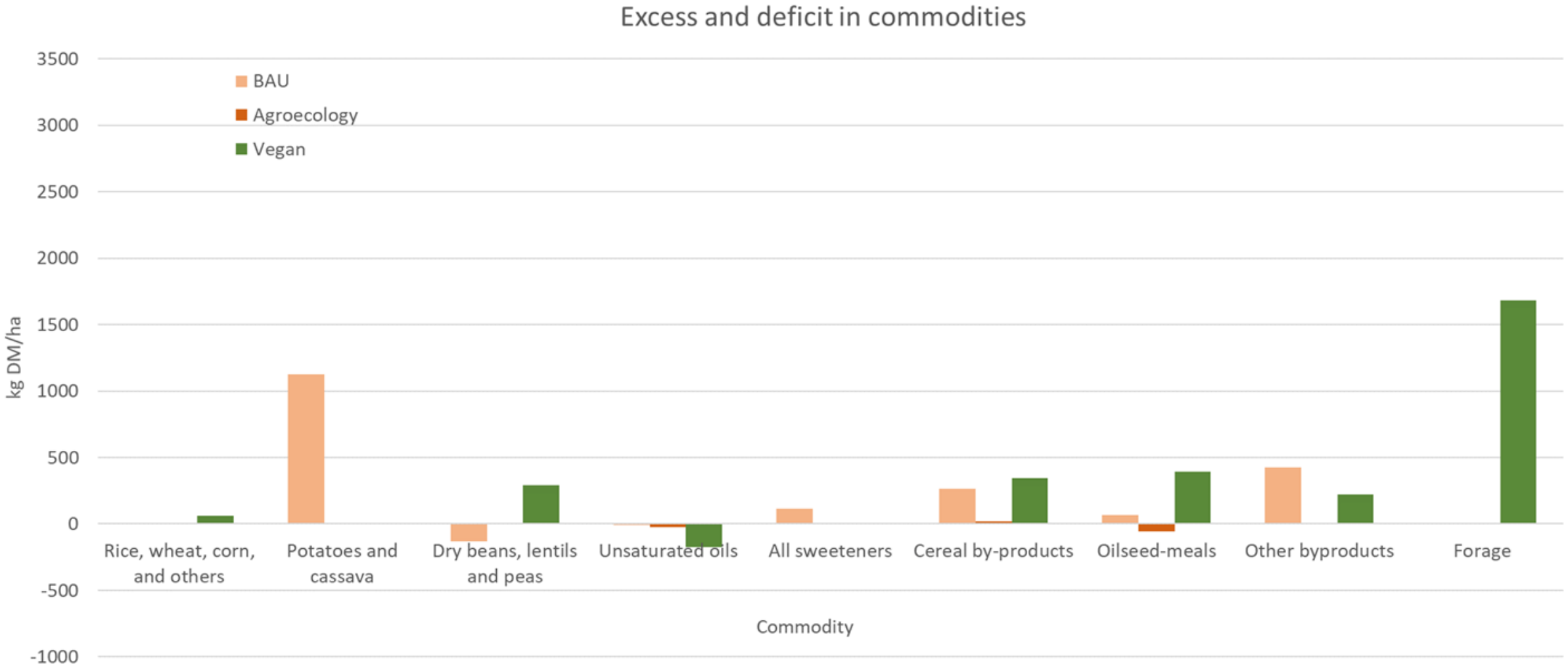
Hemp
Winter wheat
Faba beans
Winter wheat
Rapeseed
Winter wheat
Spring Pea
Oats

Food system re-localizing agriculture, using livestock as agroecological lever in the rotation

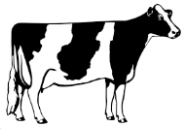
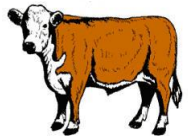
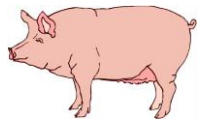
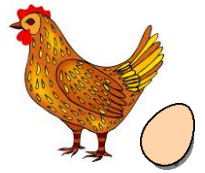
Grassland Temp.
Grassland Temp.
Cereal corn
Winter wheat
Faba beans
Winter wheat
Rapeseed
W.wheat + W.pea



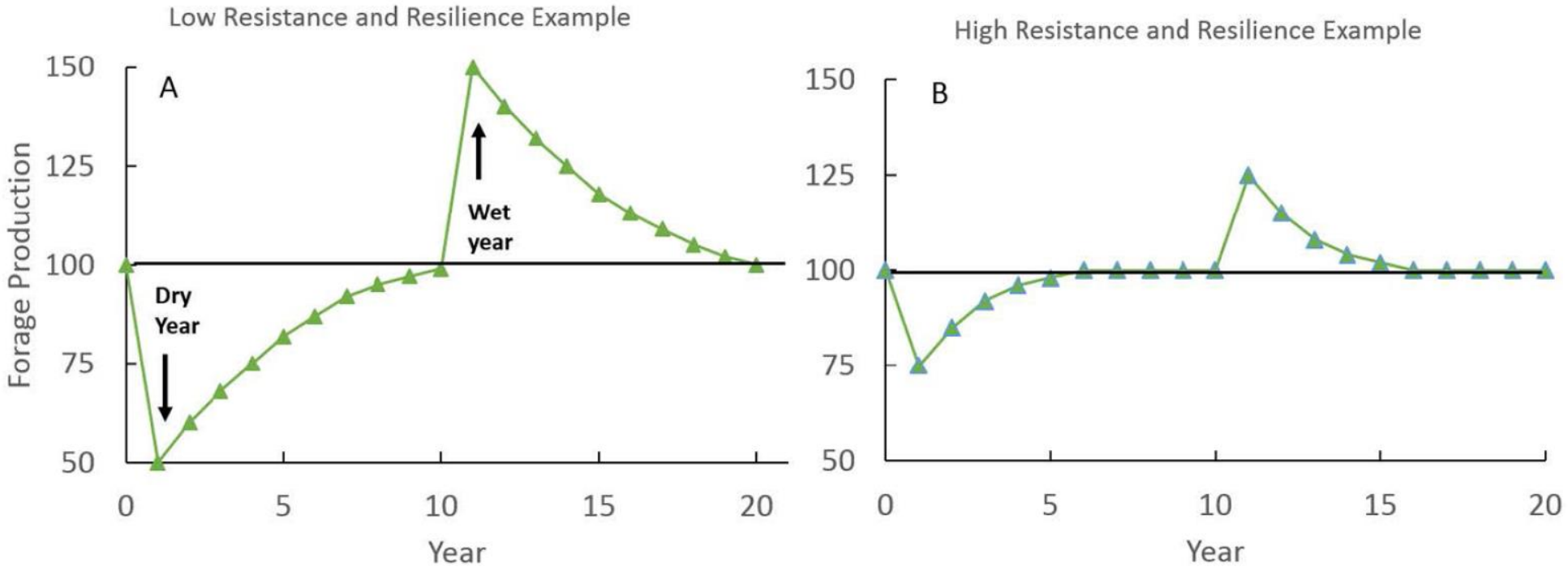




Supported flocks

BAU		0.2 + calf		0.0		0.0		0.0		19.8		0.0
Agroecology		0.3 + calf		0.2		0.2		0.1		5.5	1.7

Are all these systems managable and stable without pesticides?



Tracy et al., 2018 10.2135/cropsci2017.05.0317

Implementation on a 30-ha zone with a bunch of agroecological practices to support production

Within the design of the rotations

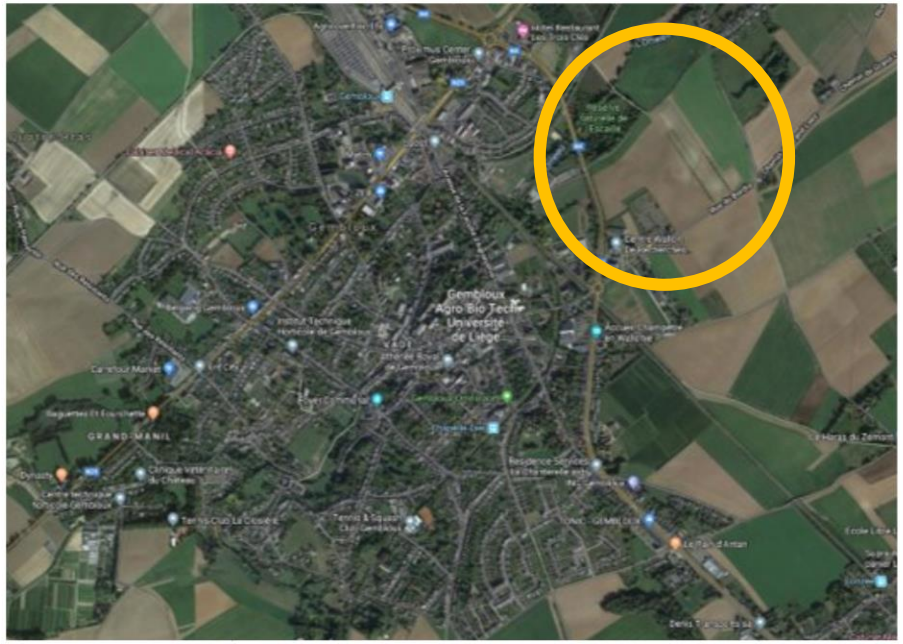
- Long term crop rotations
- Intercropping
- Mixed crops
- Temporary (grazed) pastures

Applying specific practices

- Reduced tillage
- Green manure
- Nutrients cycling trough crops and animal components

Implementing specific infrastructures

- Agroforestry
- Flower strips



Conclusions

- Designing crop rotations for Wallonia based on the EAT Lancet dietary requirements, it seems feasible (on paper) to sustain the whole population with locally produced food
- But…
  - Crop rotations should be refined and diversified to include potatoes and more oilseeds
  - Only long term monitoring will determine whether agroecological levers can efficiently manage weeds, pests and fertility
  - Stability of such systems need to be demonstrated
  - Other food commodities must be produced elsewhere, e.g. fruits, vegetables & fish
  - The health claims of the EAT-Lancet commissions are debatable

Experimental farms
4 views

All changes saved in Drive

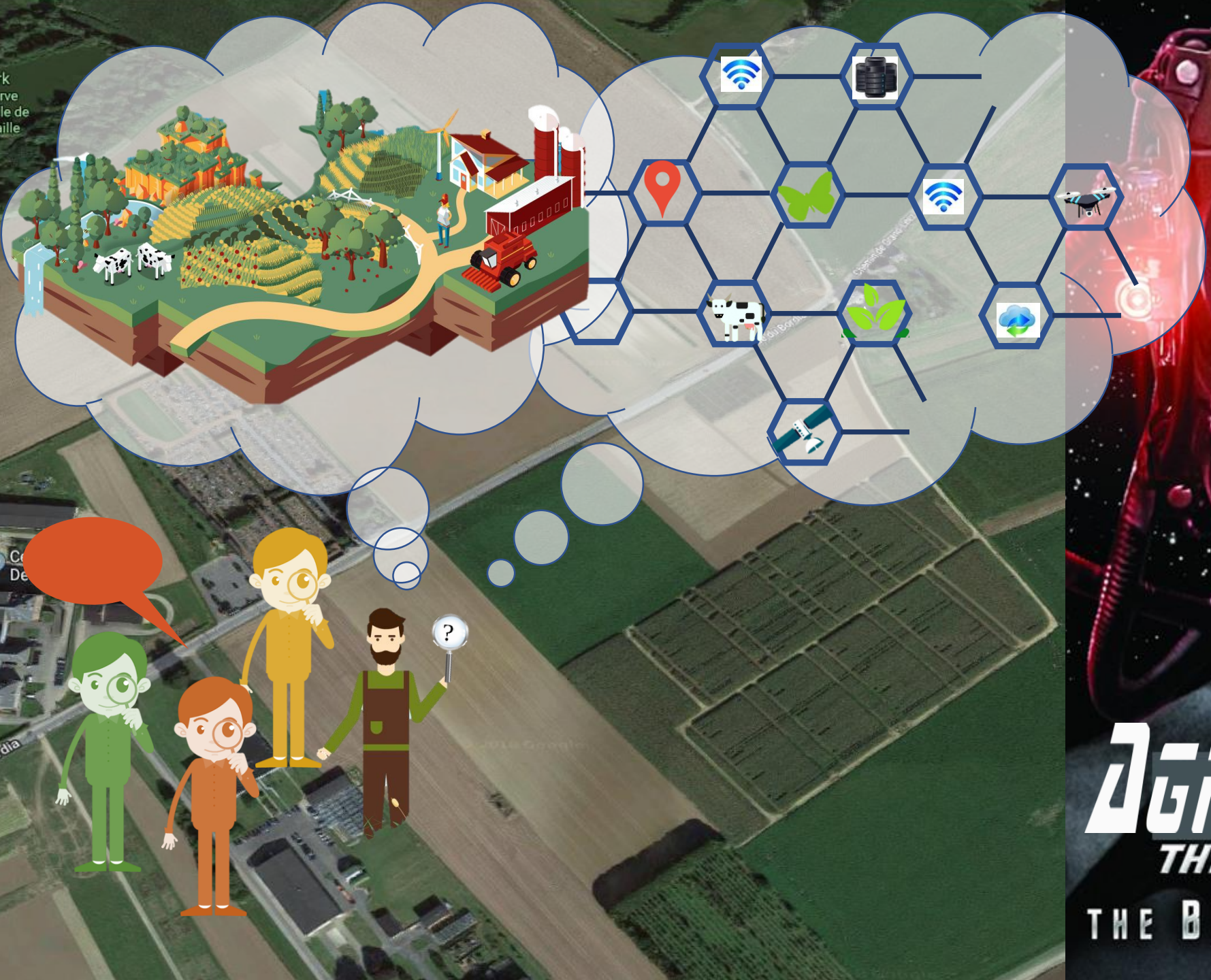
Add layer | Share | Preview

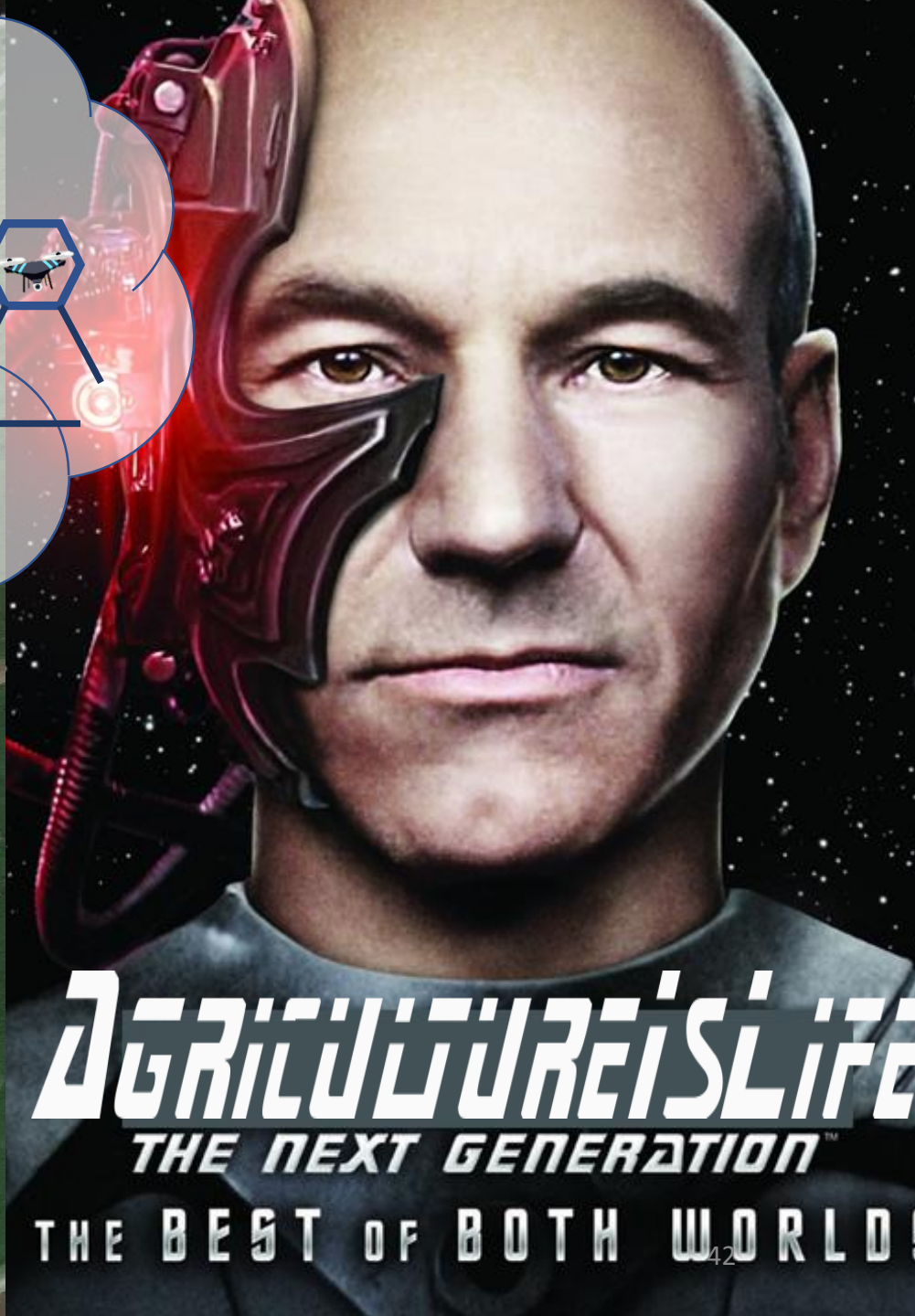
Farms

Individual styles

- UCLouvain - Ferme de Lauzelle
- ULiège - AIL - Wasabi
- ULiège - AIL - long term rotati...
- CRA-W - SYCI
- CRA-W - Organic
- CRA-W - Vegetable farming
- Uclouvain Centre Alphonse D...

Base map




AGRICULTURE IS LIFE
THE NEXT GENERATION
THE BEST OF BOTH WORLDS


L'agriculture, c'est la base de la culture
Maurice Béjart