Forum des Savoirs

LIÈGE université Gembloux Agro-Bio Tech

Quelle agriculture proposer face au réchauffement climatique ?

Un équilibre à trouver pour le maintien de la santé de l'homme et de son environnement

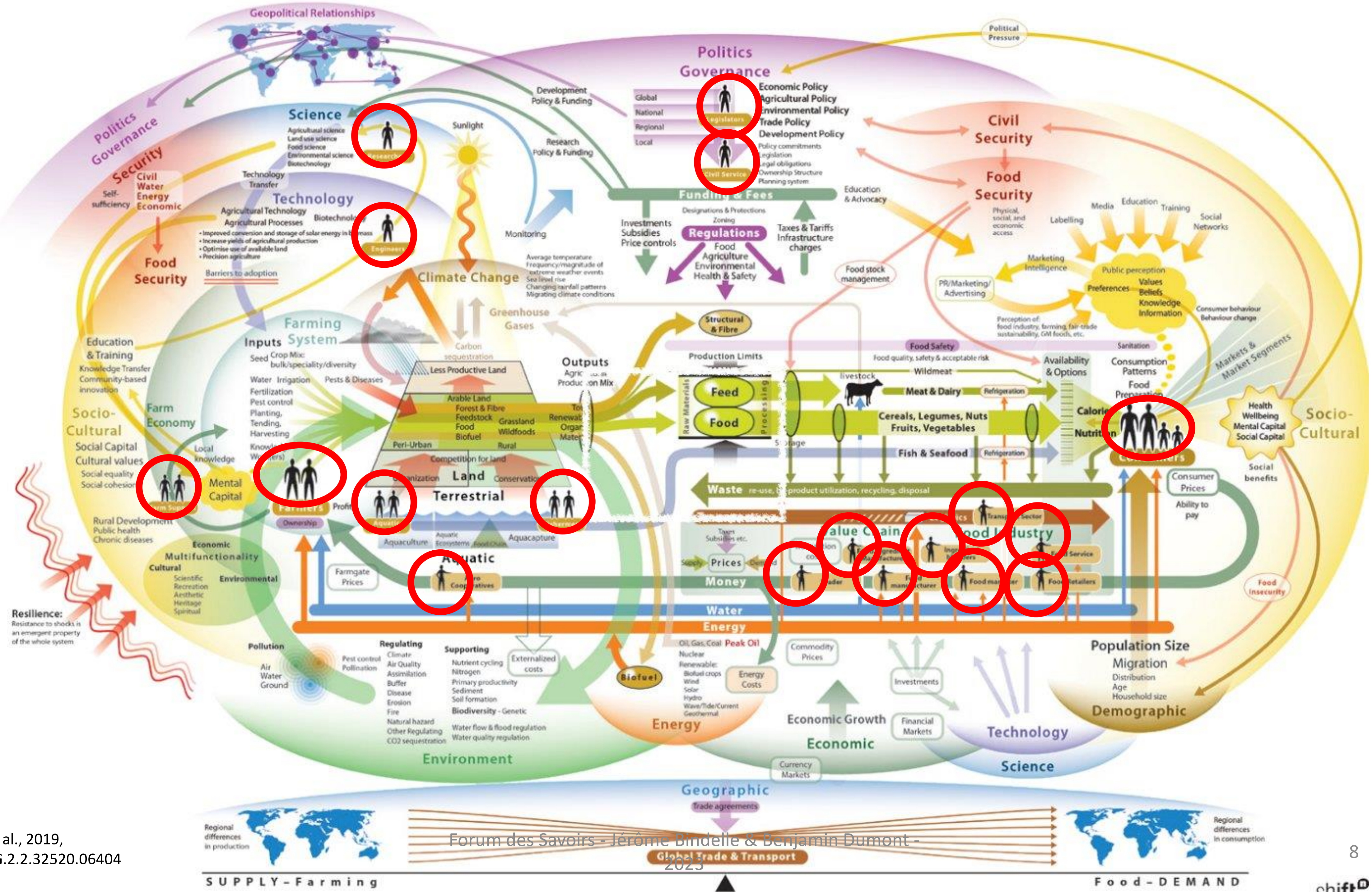
Prof. Jérôme Bindelle et Prof. Benjamin Dumont


Pression démographique sur la planète
LA BOMBE HUMAINE
MANIÈRE DE
Octobre-novembre 2019

Les écosystèmes naturels pourraient nourrir 600 millions de personnes

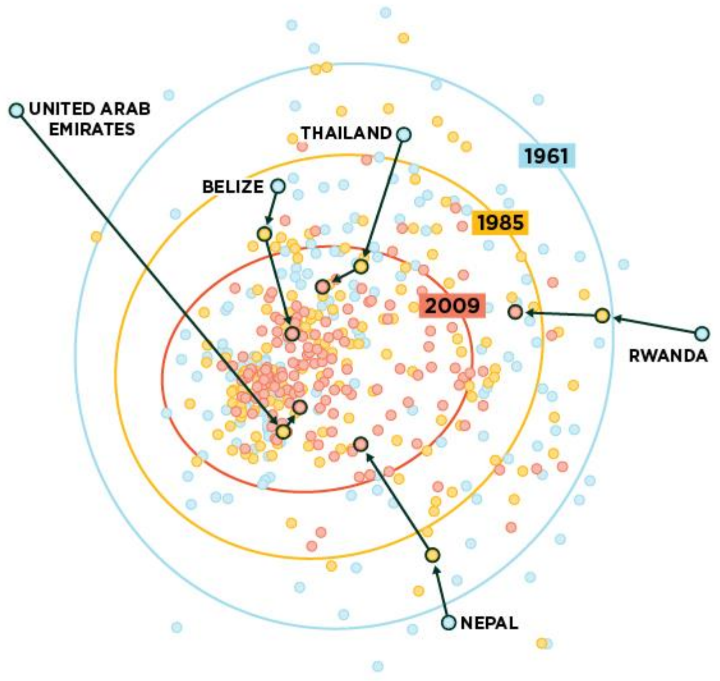
Les 7,5 milliards restant ne peuvent être nourris que par l’agriculture

A travers l'Histoire, les femmes et les hommes ont développé une grande diversité de systèmes alimentaires

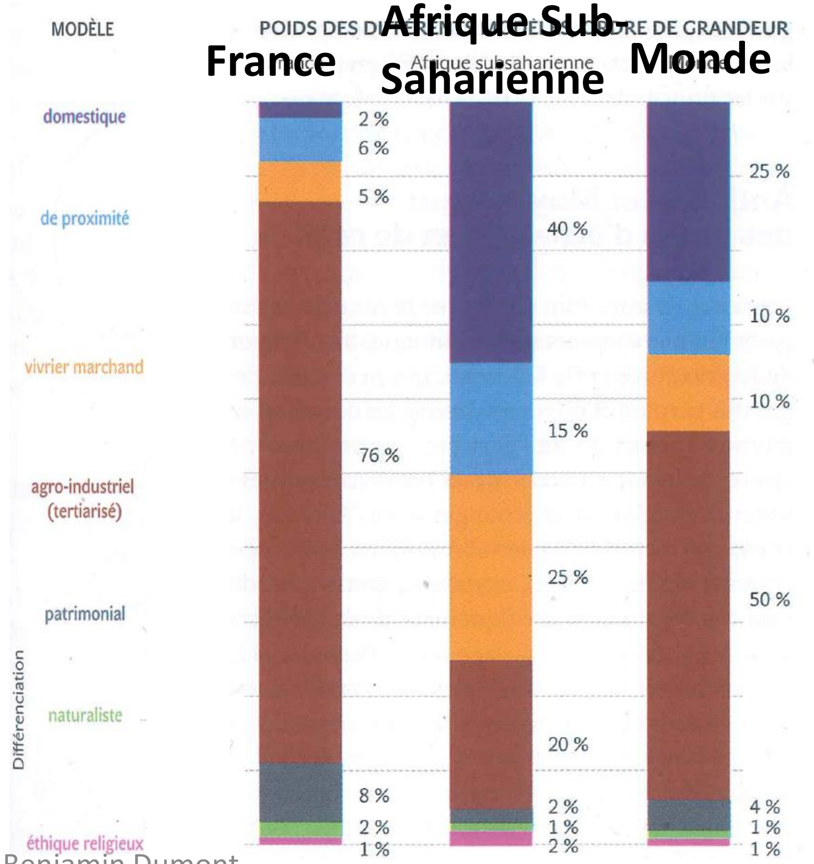


Nicholson et al., 2019,
10.13140/RG.2.2.32520.06404

Aujourd’hui, les systèmes alimentaires convergent vers le modèle agro-industriel



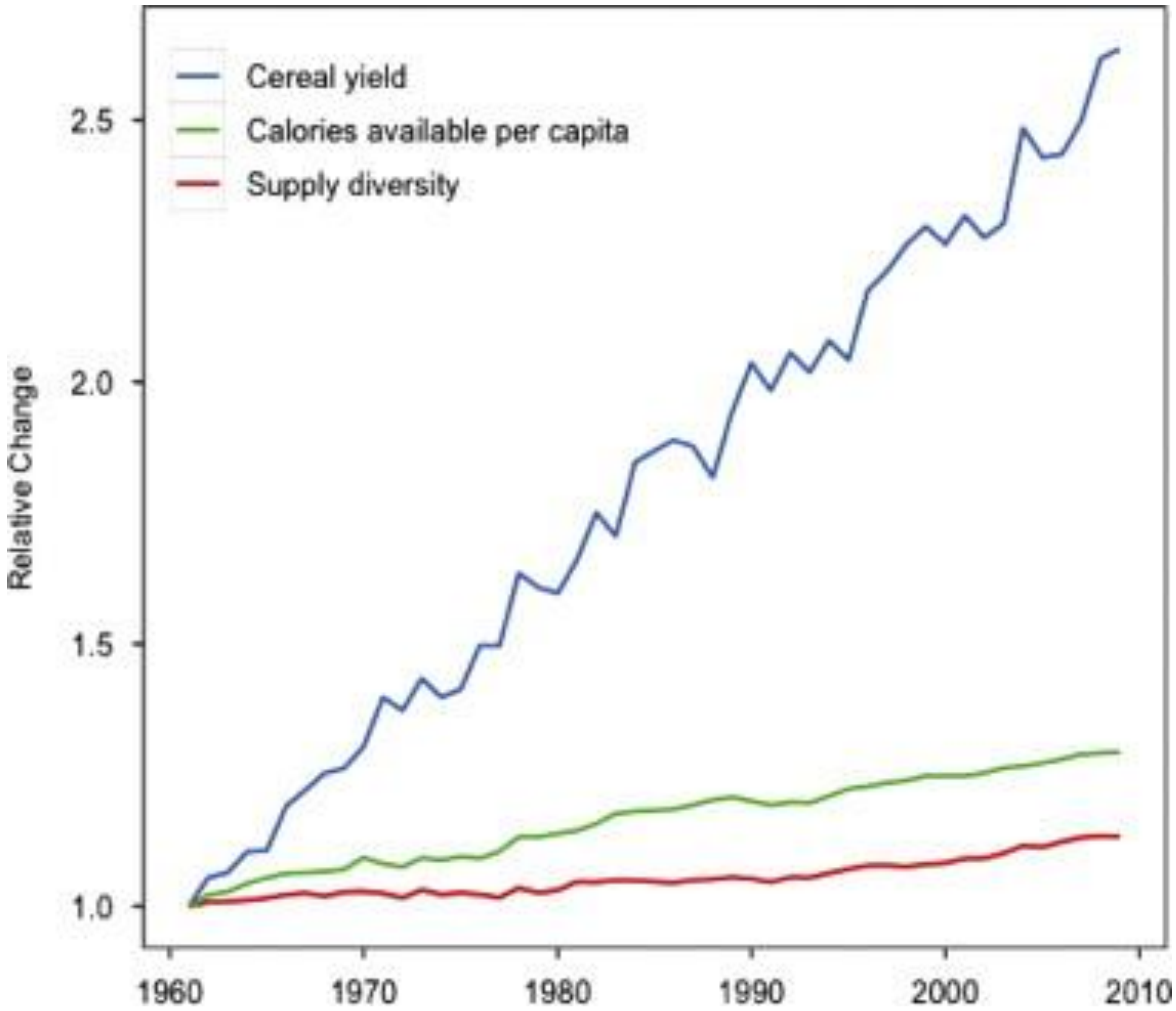
France



Modèle agro-industriel

Khoury at al., 2014. PNAS

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



Remans et al. 2014
http://dx.doi.org/10.1016/j.gfs.2014.07.001

DES ORANGES QUI METTENT LA PLANÈTE DANS LE ROUGE

COÛTS CACHÉS
(POUR 100GR)

- Destruction de la biodiversité et risques sanitaires liés aux pesticides.
- Exploitation des travailleurs et travailleuses agricoles.
- Profits concentrés dans les mains de grandes exploitations.

Lire plus

DU LAIT QUI N'EST PAS TOUT BLANC

humundi
SOS FAIM

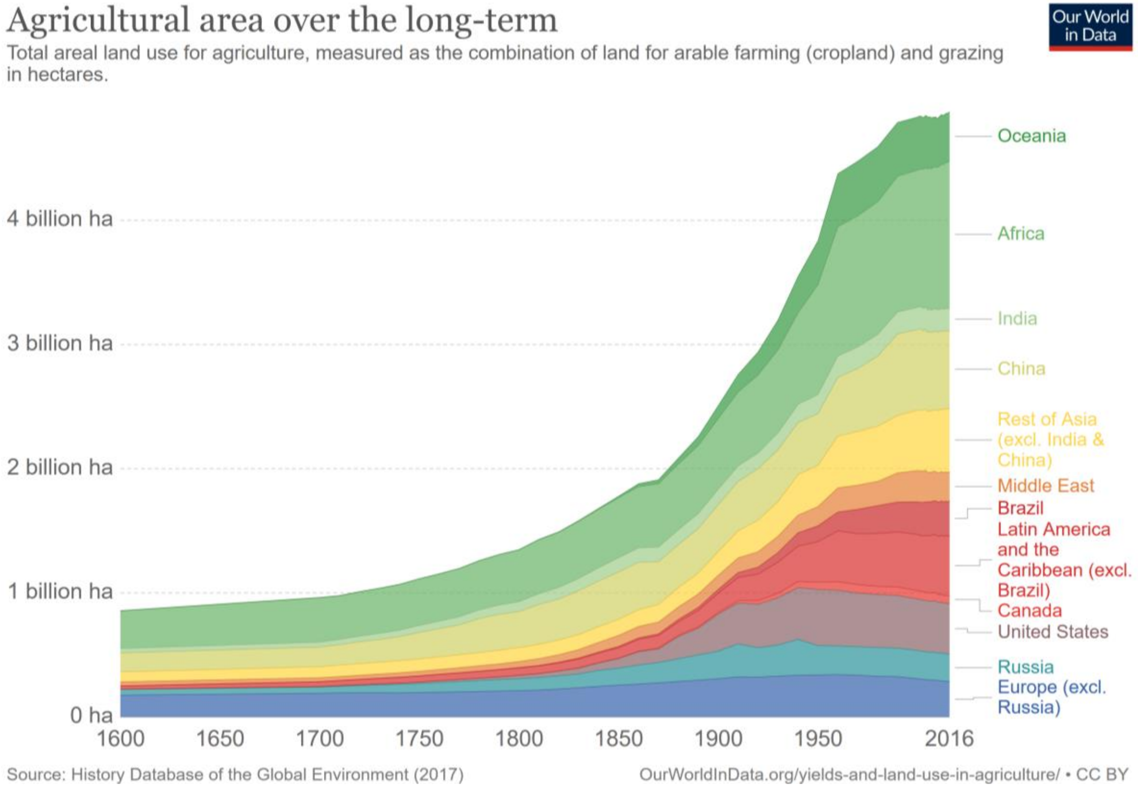
COÛTS CACHÉS
(POUR 100ML)

- Destruction des petites fermes laitières d'Europe et d'Afrique.
- Faible revenus pour les éleveurs et éleveuses.
- Déforestation et émission de gaz à effet de serre pour produire l'alimentation du bétail.

Lire plus

Nos assiettes ne sont pas neutres sur l’environnement

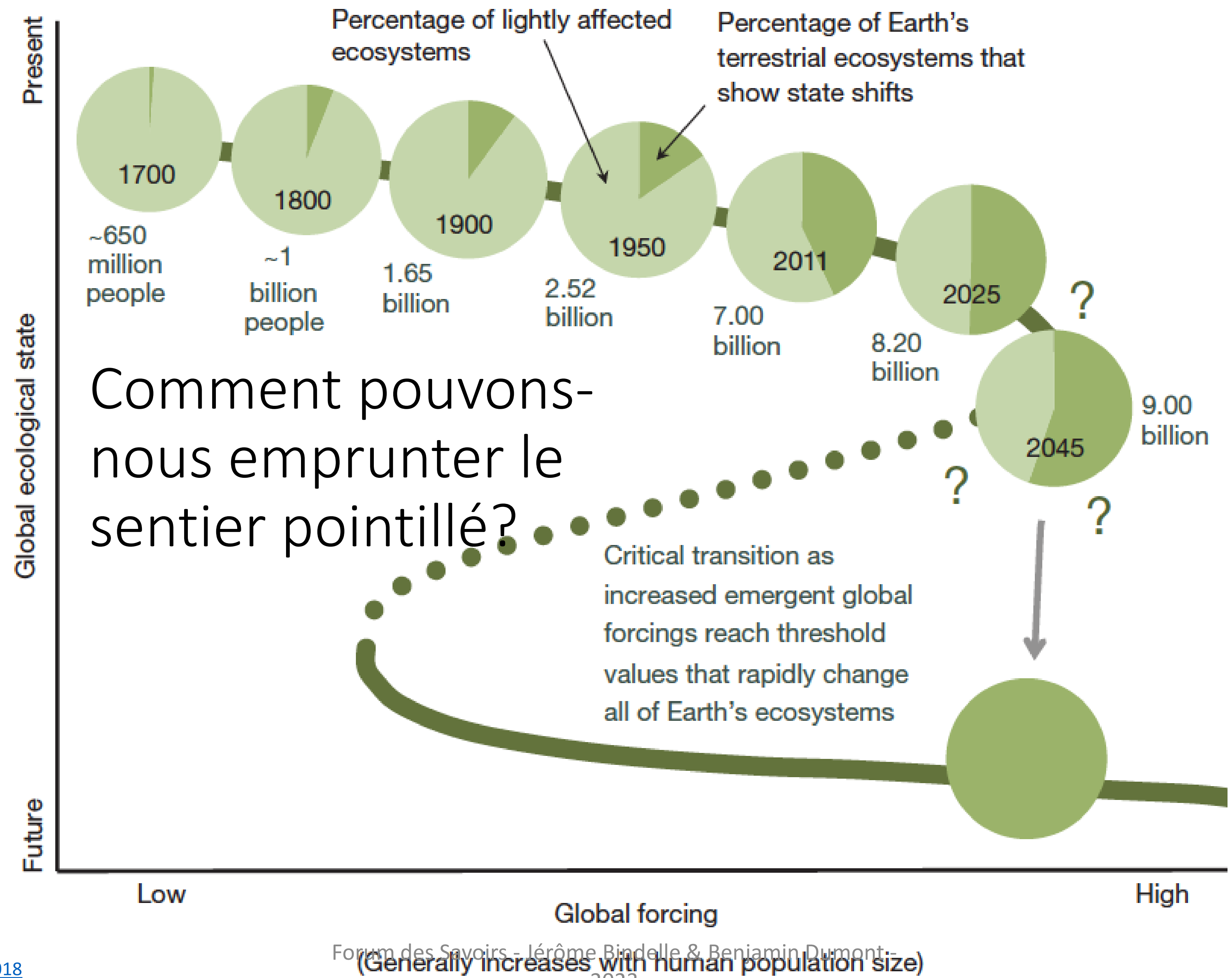
- L’agriculture utilise 40 % des terres hors-gel dont ¾ sont dédiées à l’élevage exclusivement
- L’agriculture et l’exploitation forestière produisent 23% des emissions anthropiques de GES
- L’agriculture occupe la plus grande part des émissions de methane et de protoxyde d’azote
- L’agriculture est le plus grand facteur de perte de biodiversité



Le monde ne suffit pas

L'agriculture est presqu'à son expansion maximale

Comment pouvons-nous emprunter le sentier pointillé?



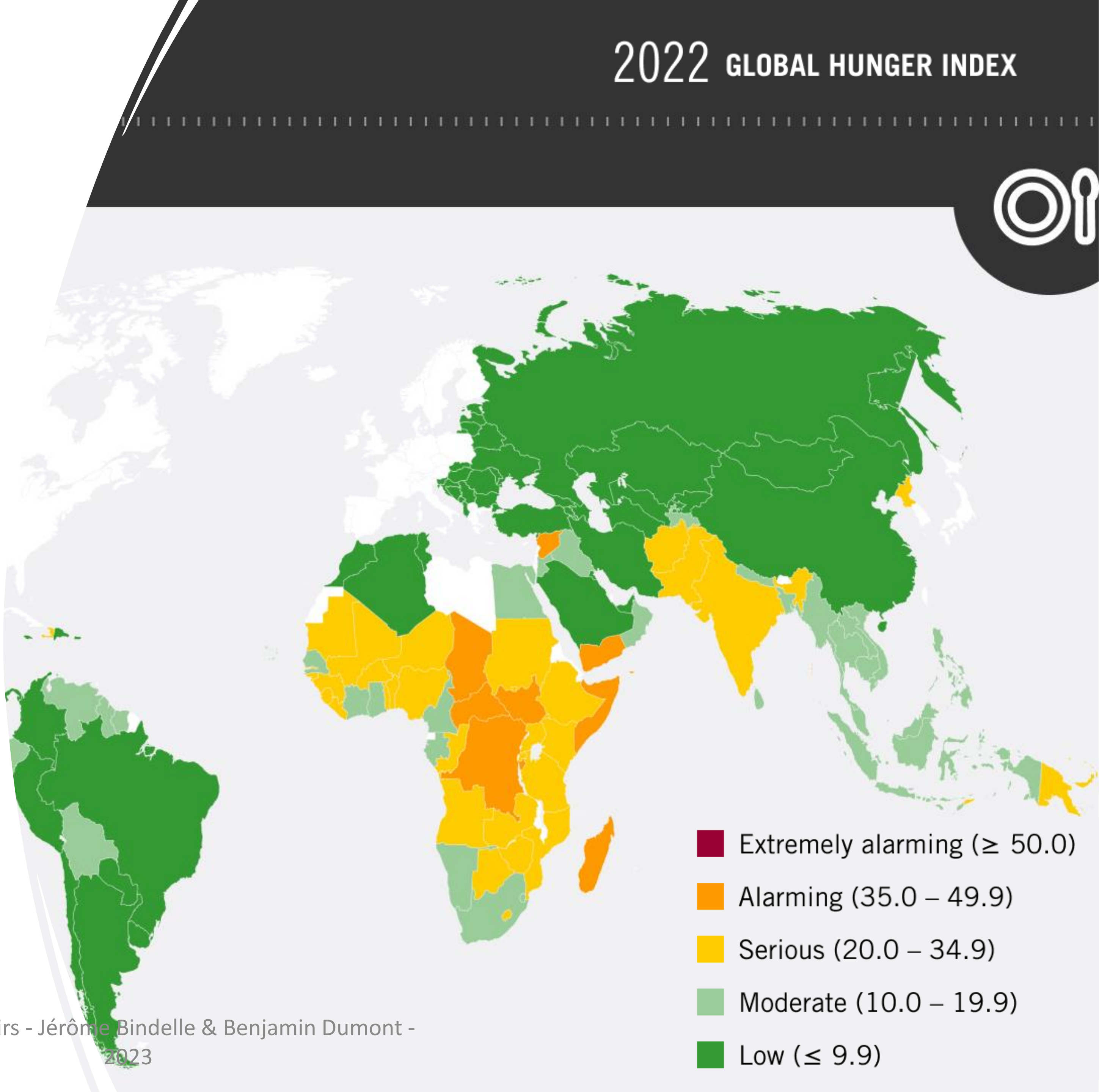
Barnovsky et al 2012
https://doi.org/10.1038/nature11018


Malnutrition Facts
30-40% of food produced is wasted in the US.
Meanwhile, more than 54 million Americans are food insecure.
#ChangeTheFacts
MalnutritionFacts.com
Dole


BAGS

Les inégalités alimentaires perdurent

- 22% des enfants ont un retard de croissance
- 15% de la population mondiale souffre d’une carence en fer
- 821 millions de personnes dans le monde ne reçoivent pas assez de calories pour éviter la faim chronique.
- 2 milliards de personnes ne consomment pas suffisamment de vitamines et de minéraux pour une croissance saine.
- Les retards de croissance et l'émaciation sont liés à 45 % de la mortalité des enfants de moins de trois ans
- 151 millions d'enfants de moins de cinq ans souffrent d'un retard de développement physique et cognitif et risquent davantage de vivre dans la pauvreté à l'âge adulte.



La Ville lutte contre la précarité alimentaire dans les écoles, une famille belge sur quatre aurait des difficultés à nourrir ses enfants

Repas complets gratuits, collations saines, fontaines à eau, la Ville de Charleroi met en place des mesures pour gommer le plus possible les inégalités dans l'assiette à l'école.

Pauline Schumacker

Par Marie Degel
Publié le 11/03/2023 à 07:00


BURGERS
PIZZA
OPEN 24 HOURS

Des aspirations sociétales à entendre

Principalement sur l'élevage et les 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

nature food

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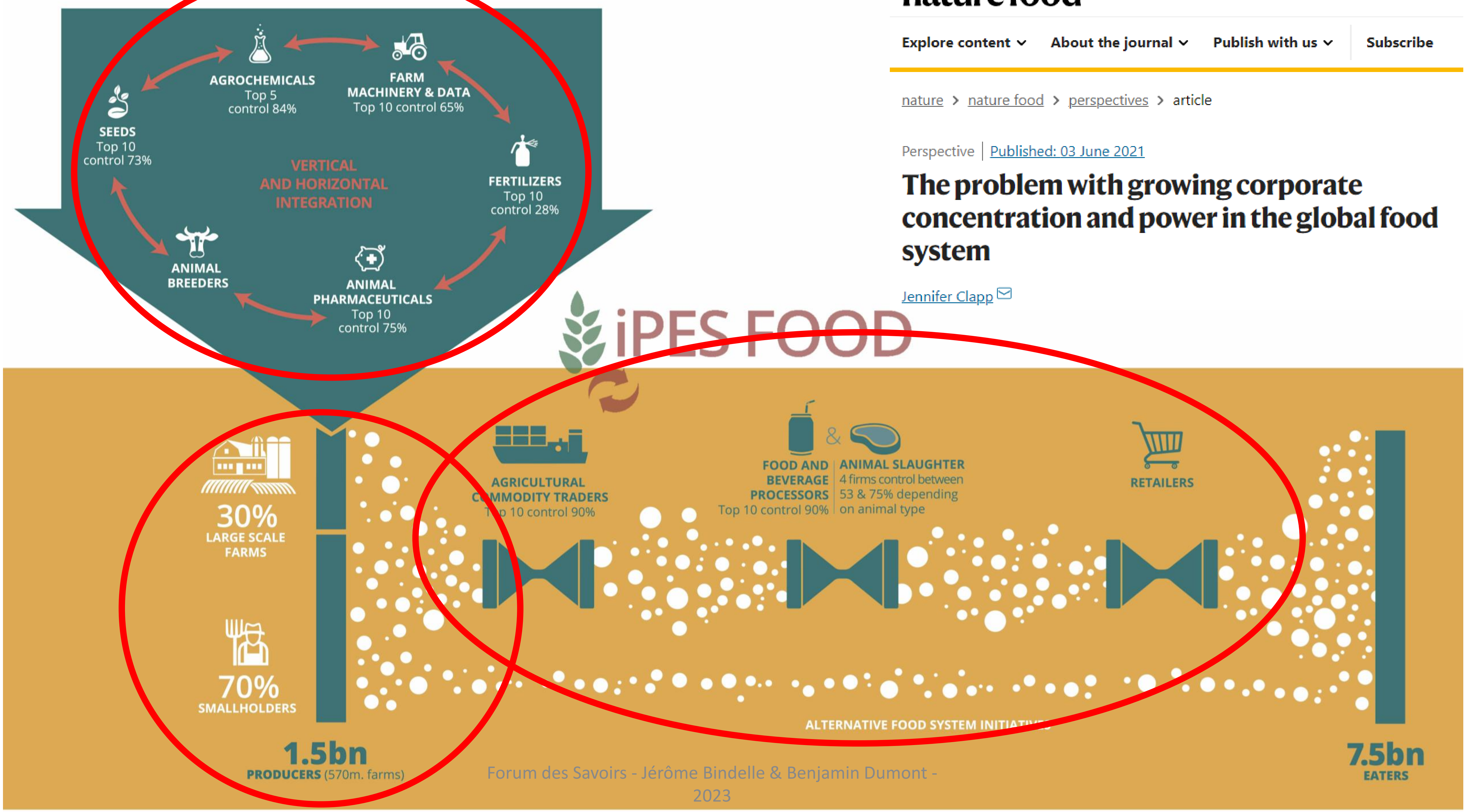
nature > nature food > perspectives > article

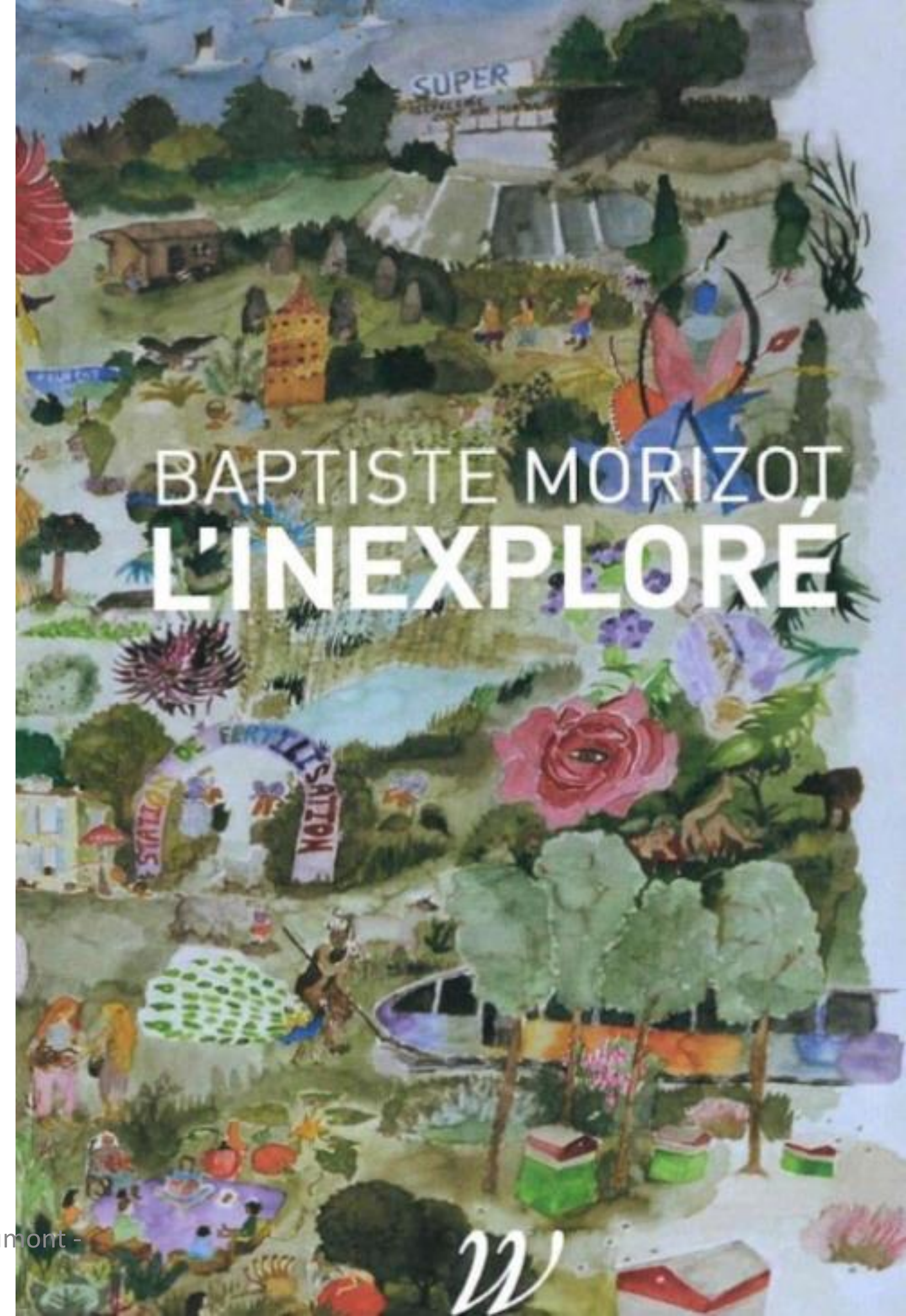
Perspective | Published: 03 June 2021

The problem with growing corporate concentration and power in the global food system

Jennifer Clapp



« La crise actuelle, plus qu’une crise des sociétés humaines d’un côté, plus qu’une crise des vivants de l’autre, est une crise de nos relations au vivant »



AGRICULTURE

100 ANS D'INNOVATIONS

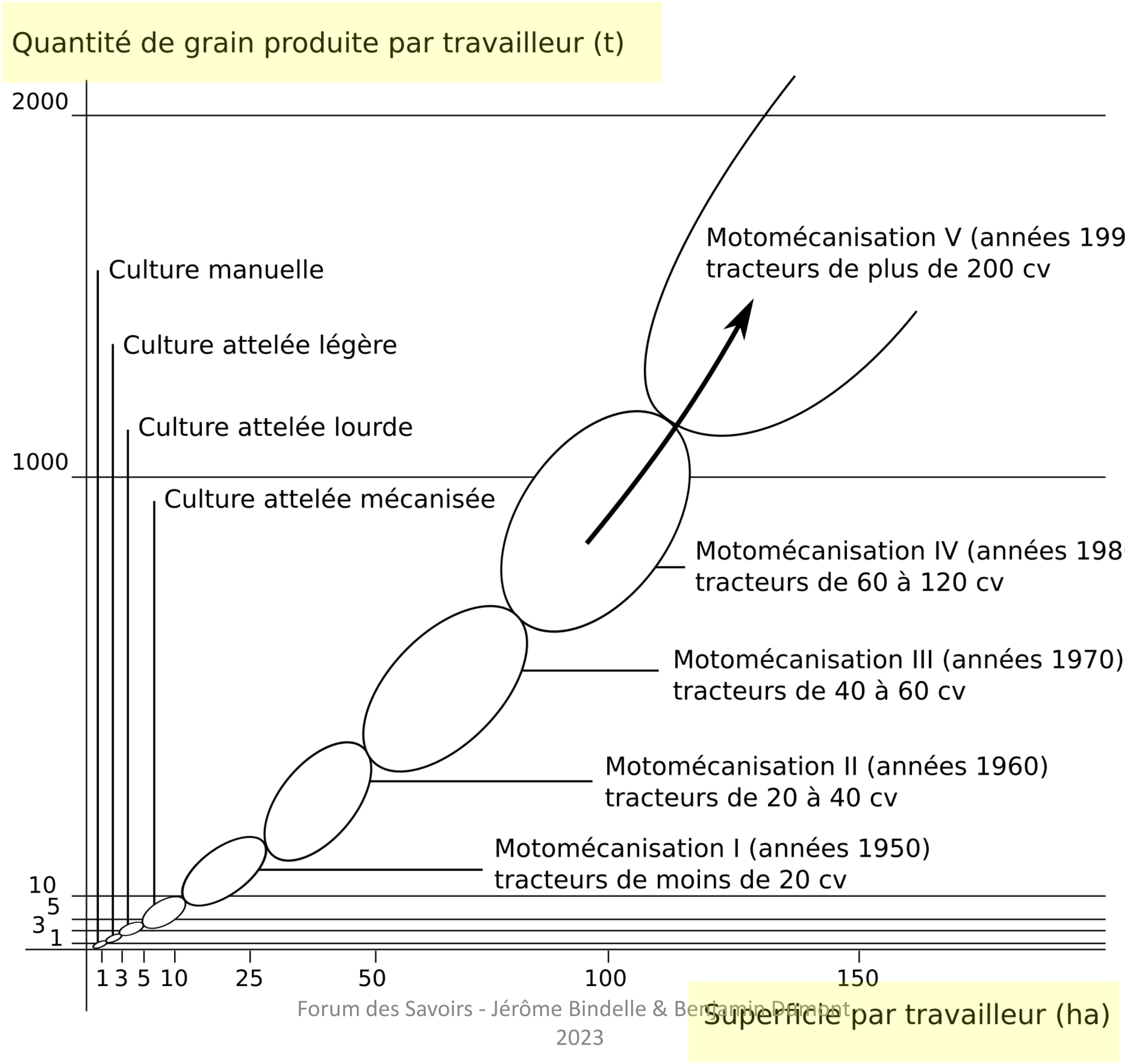
<VΛ Un siècle de progrès technologiques dans des domaines aussi variés que les machines agricoles, l'aérospatiale ou la chimie sépare l'agriculteur d'hier, avec ses chevaux de trait, de celui d'aujourd'hui.

Depuis le début du XX[e] siècle, l'agriculture a connu plusieurs révolutions techniques. Des bouleversements qui ont libéré les agriculteurs de certaines tâches, mais les ont rendus dépendants d'autres acteurs… PAR ROMÁN IKONICOFF

LIBRARY OF CONGRESS - ATG MEDIALAB/ESA - FOTOLIA


July of 1941 in Walla Wall County, Washington State.


CLAAS
CLAAS
8900
LEXION

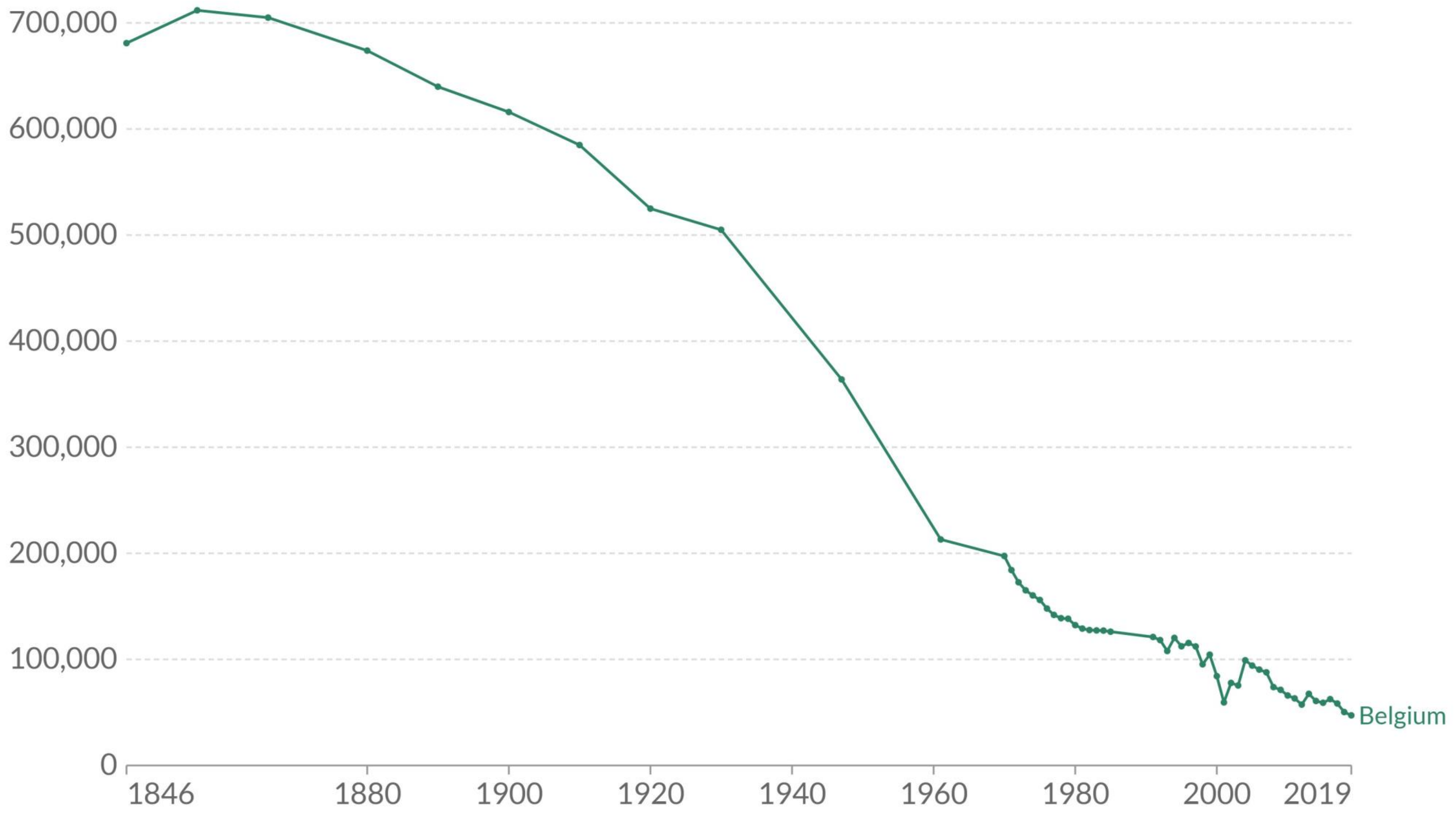


Mazoyer & Roudart, 2002

Number of people employed in agriculture, 1846 to 2019

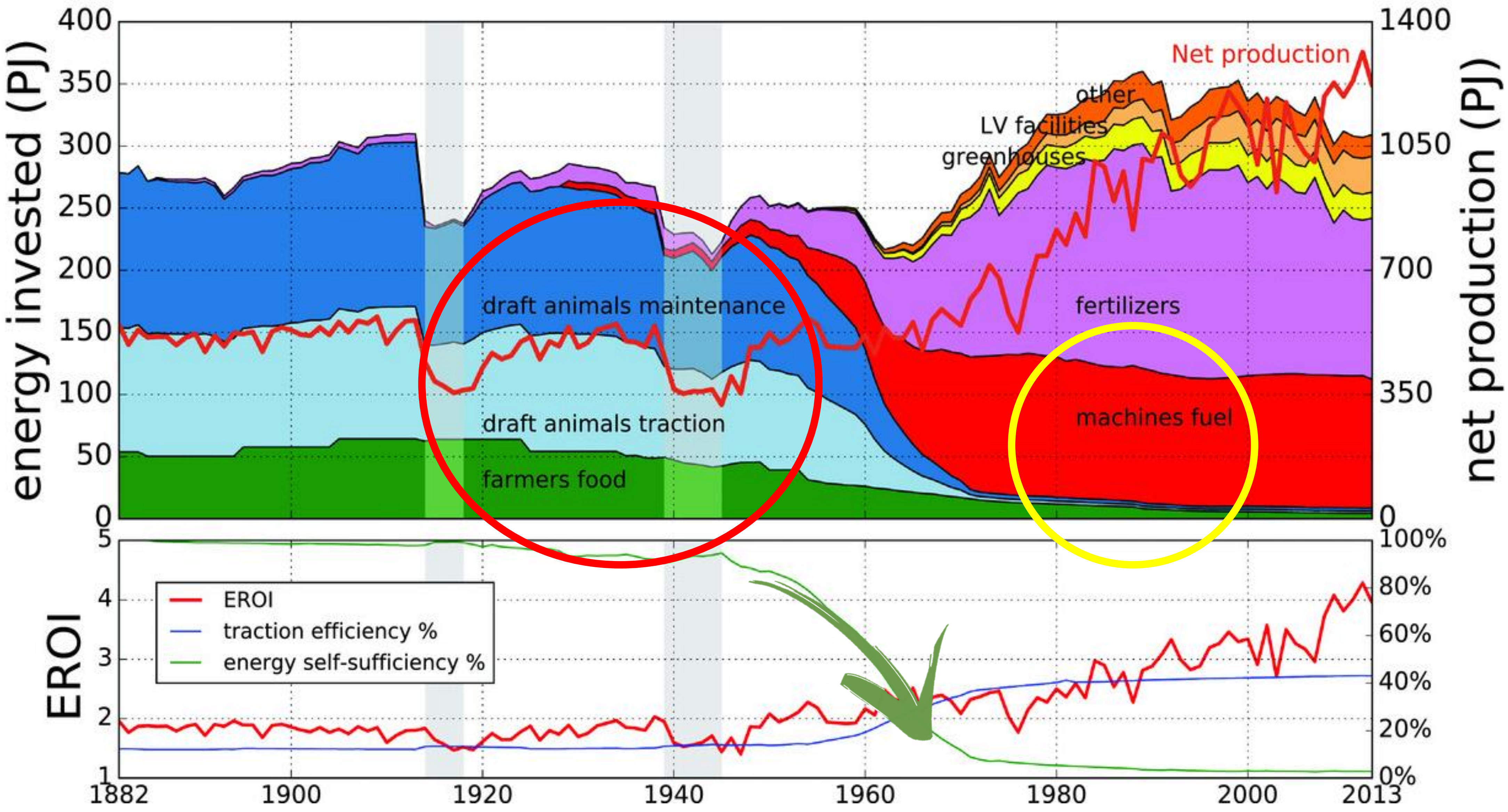
Our World in Data

Agriculture includes the cultivation of crops and livestock production, as well as forestry, hunting, and fishing. Employment includes anyone engaged in any activity to produce goods or services for pay or profit.



Source: Our World in Data based on International Labor Organization (via the World Bank) and historical sources

Changement du métabolisme de l'agriculture française

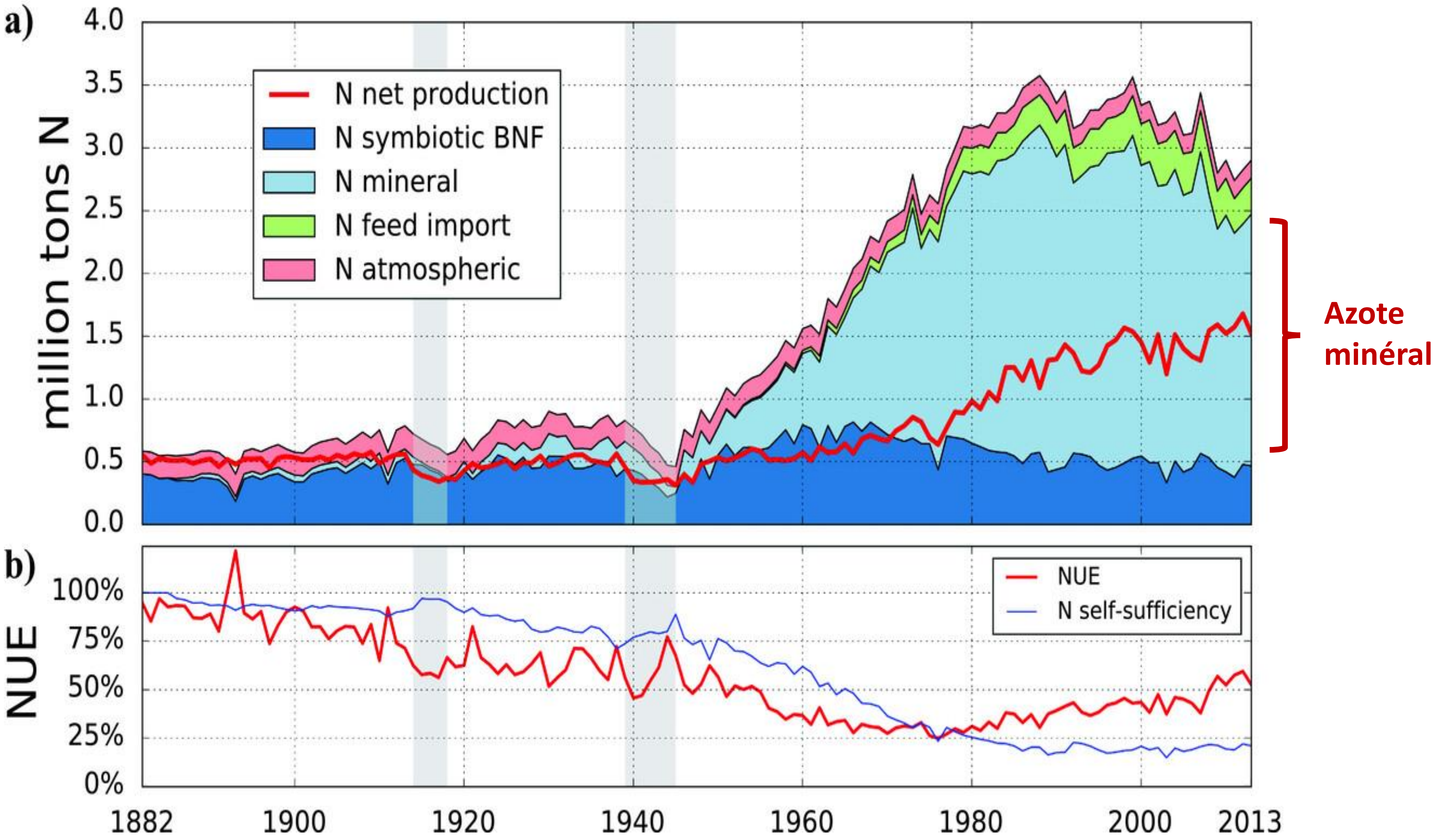


Harchaoui et Chatzimpiros, 2018
https://doi.org/10.1111/jiec.12760

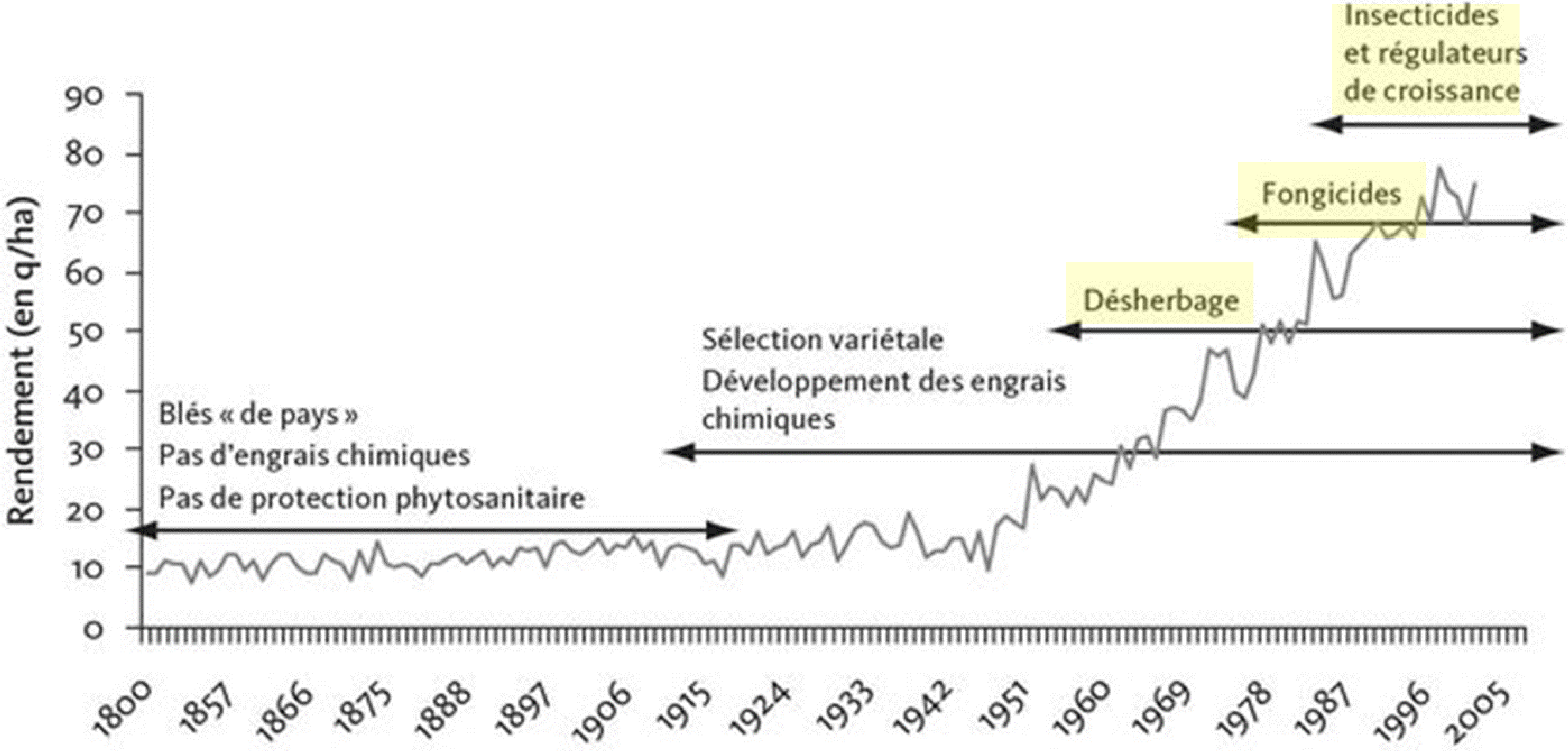
La sieste

Vincent van Gogh

Changement du métabolisme de l'agriculture française



La moitié de l’azote contenu dans votre corps est passé par une usine comme celle-ci


Insecticides et régulateurs de croissance
Fongicides
Désherbage
Sélection variétale
Développement des engrais chimiques
Blés « de pays »
Pas d'engrais chimiques
Pas de protection phytosanitaire
Rendement (en q/ha)
90
80
70
60
50
40
30
20
10
0
1800
1857
1866
1875
1888
1897
1906
1915
1924
1933
1942
1951
1960
1969
1978
1987
1996
2005

70% des antibiotiques sont utilisés en élevage

Clinical Microbiology and Infection
Volume 18, Issue 8, August 2012, Pages 745-755

Review

Novel and uncommon antimicrobial resistance genes in livestock-associated methicillin-resistant *Staphylococcus aureus*

K. Kadlec [a], A.T. Feßler [a], T. Hauschild [a], S. Schwarz [a]

Show more

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https://doi.org/10.1111/j.1469-0691.2012.03842.x Get rights and content

Food Microbiology
Volume 51, October 2015, Pages 51-56

Methicillin-resistant *Staphylococcus aureus* (MRSA) in slaughtered pigs and abattoir workers in Italy

Giovanni Normanno [a], Angela Dambrosio [b], Vanessa Lorusso [c], Georgios Samoilis [d], Pietro Di Taranto [a], Antonio Parisi [e]

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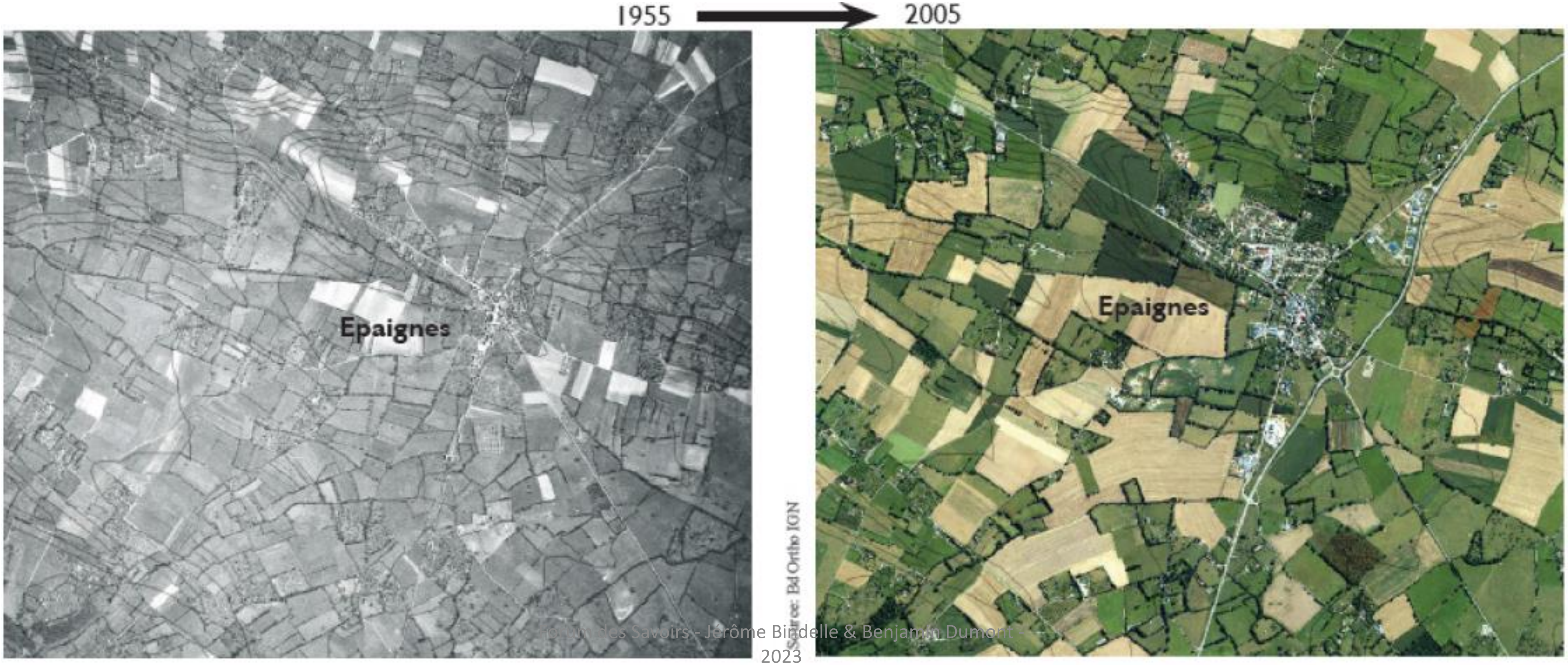
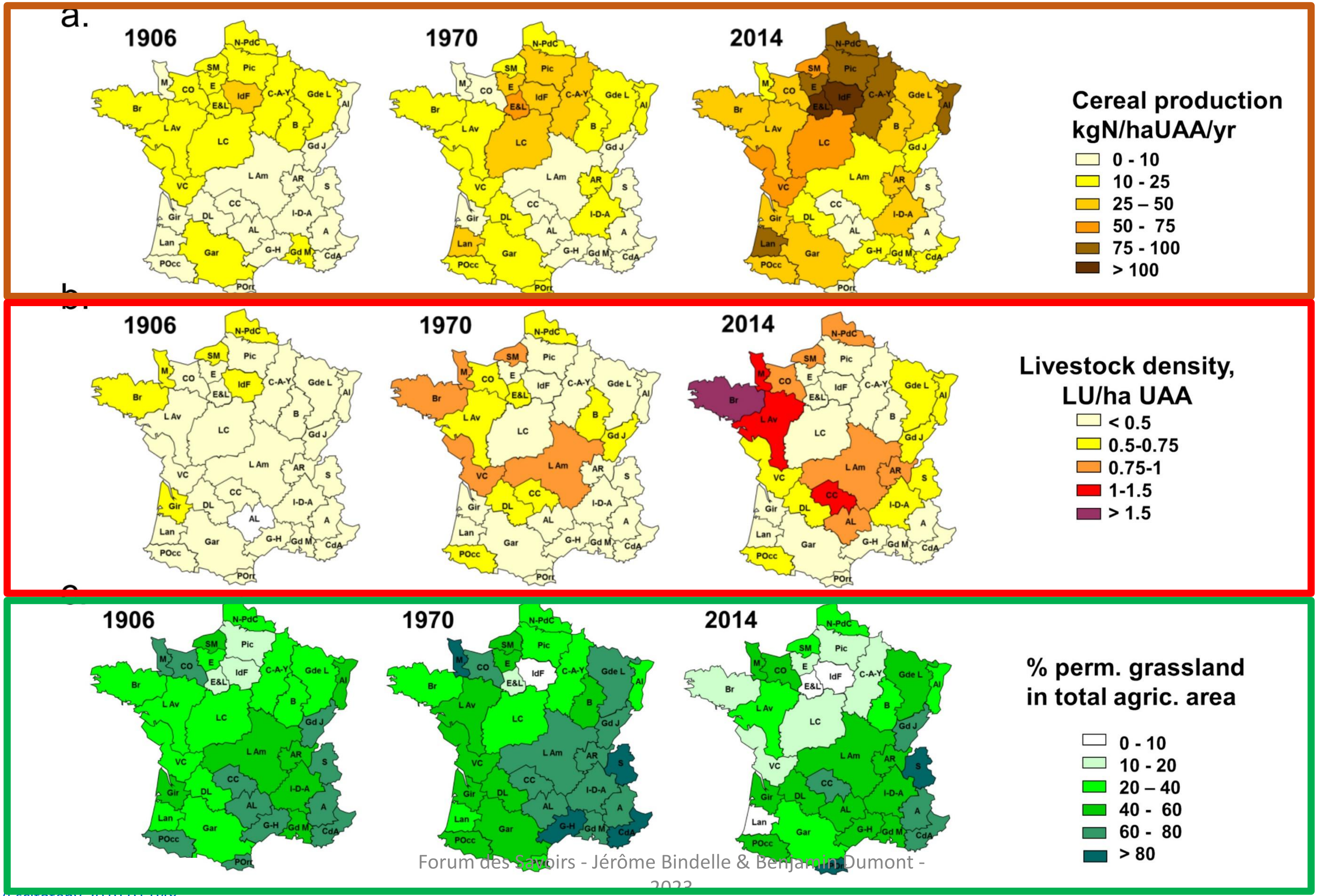
https://doi.org/10.1016/j.fm.2015.04.007 Get rights and content

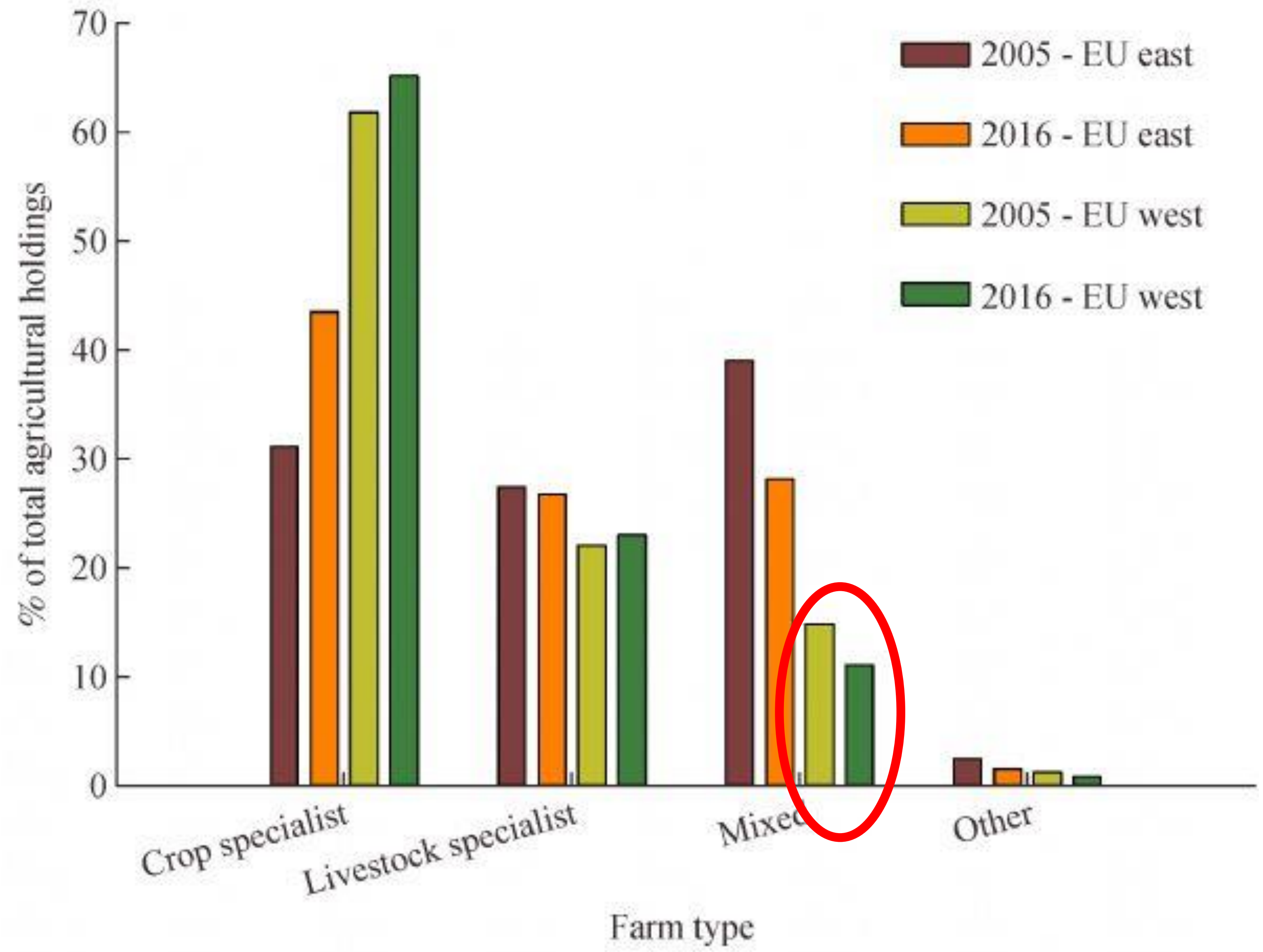
Simplification paysagère au XX^{ème} siècle




AAC Entice
BW968
HY2021



Le Noë et al, 2019
https://doi.org/10.1016/j.scitotenv.2019.01.048



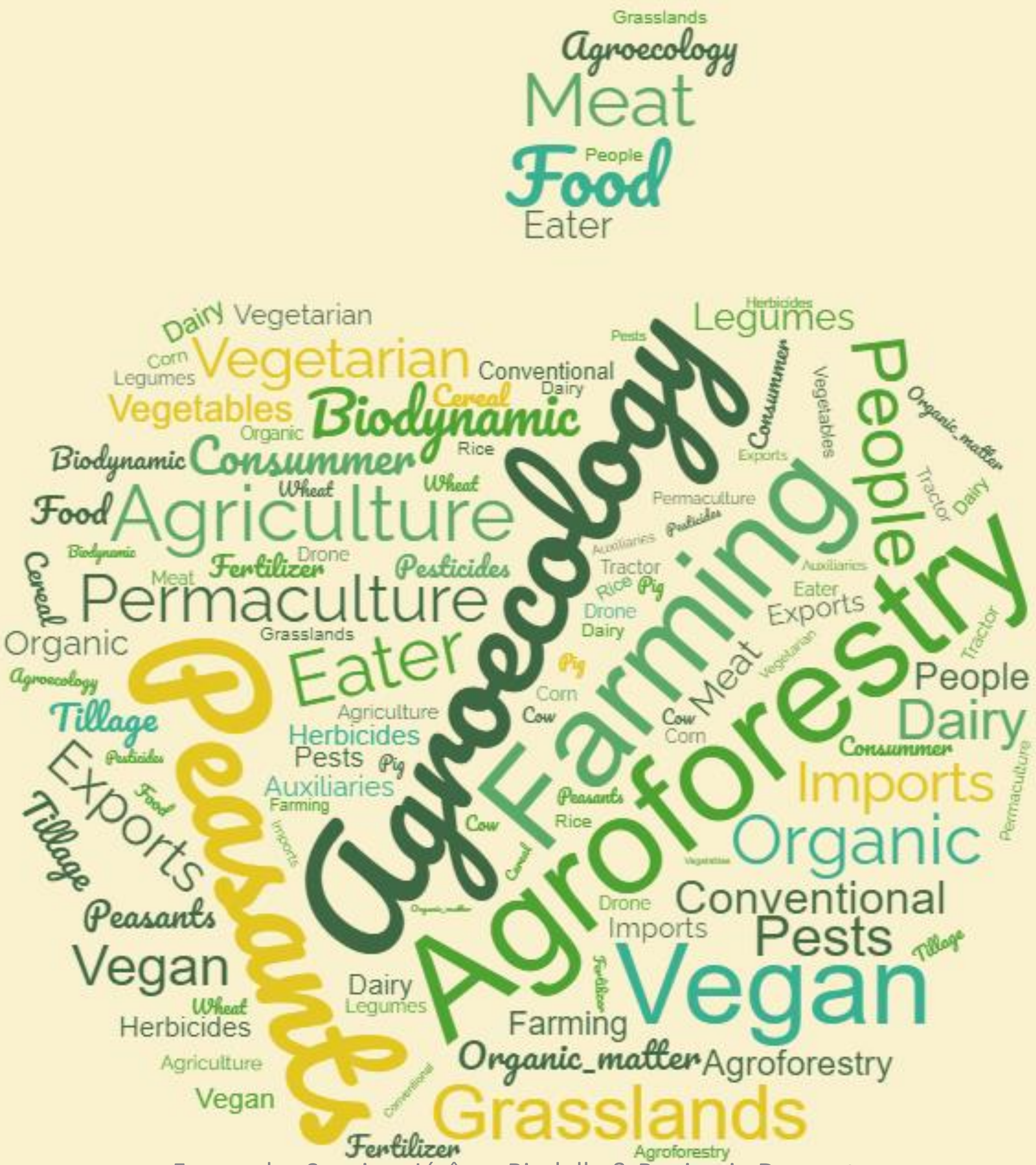
Schut et al. 2021
https://doi.org/10.15302/J-FASE-2020373

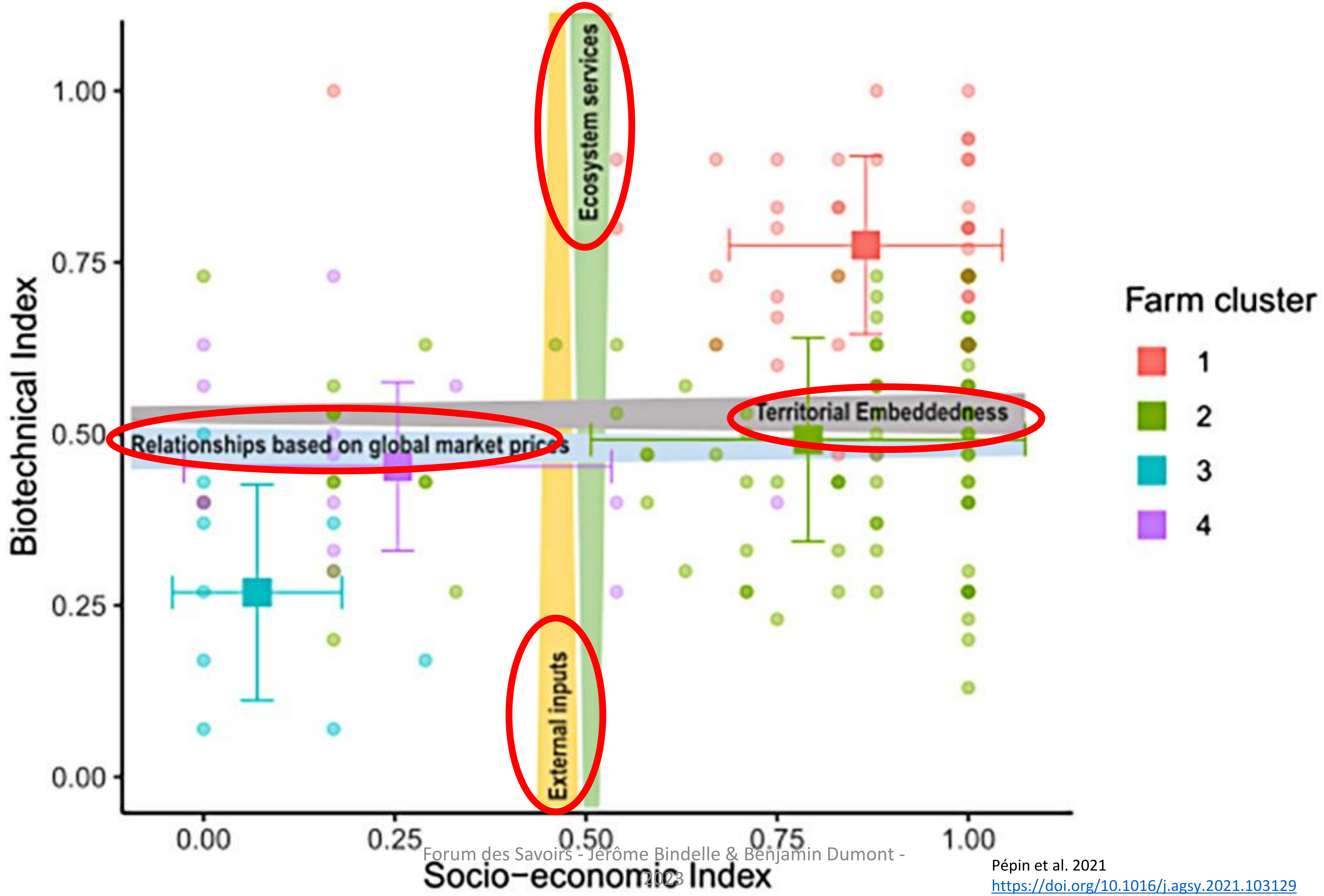
L’INRAE reste optimiste, mais…

« Malgré ce constat, des solutions sont encore possibles pour garantir la vie de la planète, avec une bonne qualité de vie pour les générations futures. Les systèmes alimentaires (…) sont des pivots pour le développement durable. (…)

Toutefois, pour cela, ils doivent se transformer de façon profonde dans les 10 à 30 prochaines années, grâce à des actions immédiates et à la mise en oeuvre de solutions progressives et de trajectoires adaptatives. »


Sometimes You Need
To Make a U-Turn


Grasslands
Agroecology
Meat
People
Food
Eater
Dairy
Vegetarian
Herbicides
Legumes
Pests
Corn
Legumes
Vegetarian
Conventional
Dairy
Cereal
Vegetables
Biodynamic
Organic
Rice
Consummer
Vegetables
Organic_matter
Biodynamic
Consummer
Exports
People
Wheat
Wheat
Tractor
Dairy
Permaculture
Food
Agriculture
Pesticides
Agroecology
Auxiliaries
Biodynamic
Drone
Fertilizer
Pesticides
Tractor
Auxiliaries
Cereal
Meat
Farming
Rice
Pig
Eater
Permaculture
Drone
Exports
Agroforestry
Dairy
Organic
Grasslands
Pig
Meat
Tractor
Agroecology
Eater
Corn
People
Agriculture
Cow
Cow
Dairy
Tillage
Corn
Consummer
Herbicides
Peasants
Pests
Pig
Imports
Pesticides
Exports
Auxiliaries
Peasants
Food
Farming
Rice
Organic
Tillage
Cow
Drone
Conventional
Peasants
Imports
Pests
Tillage
Vegan
Vegan
Dairy
Wheat
Legumes
Herbicides
Farming
Organic_matter
Agroforestry
Agriculture
Vegan
Grasslands
Fertilizer
Agroforestry



Pépin et al. 2021
https://doi.org/10.1016/j.agsy.2021.103129

Agroécologie?

Appliquer concepts et principes de l'écologie à la conception et la gestion d'agroécosystèmes qui maximisent les services écosystémiques et de systèmes alimentaires durables

Des pratiques

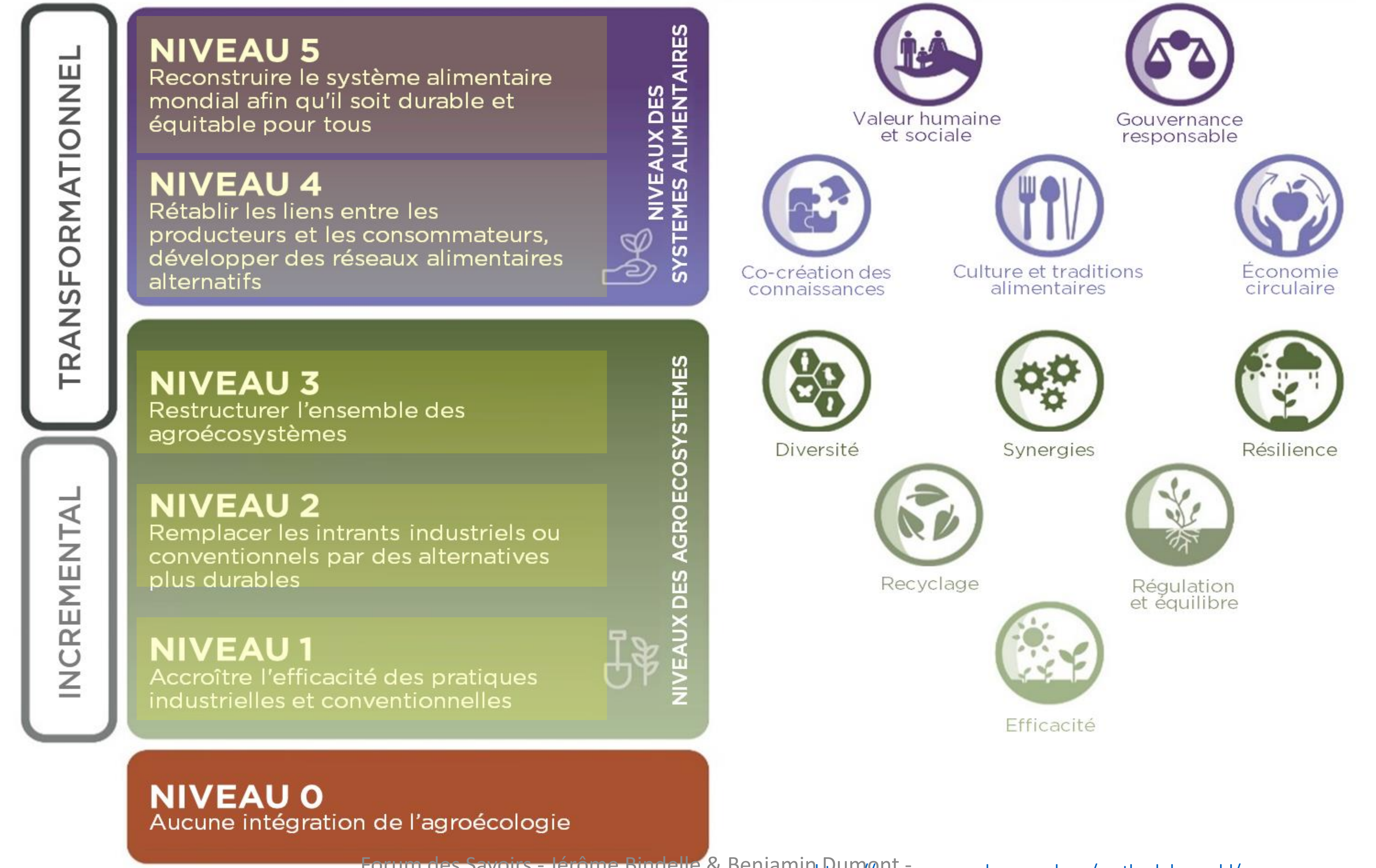
Restaurer la diversité agricole, dans le temps et l'espace, par la mise en œuvre de « pratiques agricoles » (au sens large), i.a. par les rotations culturales, les inter-cultures ou encore l'association entre culture et élevage, etc.

Un mouvement social

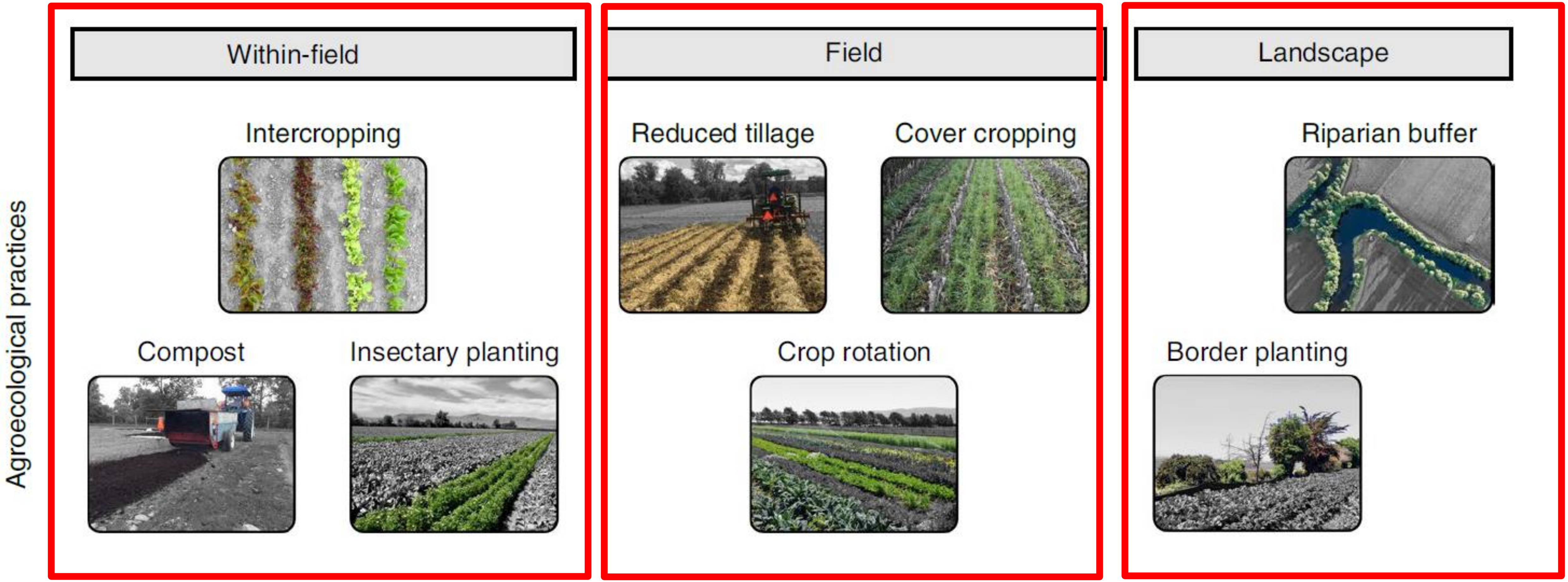
prônant une nouvelle manière de considérer les fonctions de l’agriculture et ses relations avec la société.

Atteindre une plus grande souveraineté alimentaire dans une perspective d’équité et de justice sociale.

5 NIVEAUX DE CHANGEMENT DES SYSTEMES ALIMENTERES ET 10+ ELEMENTS DE L'AGROECOLOGIE



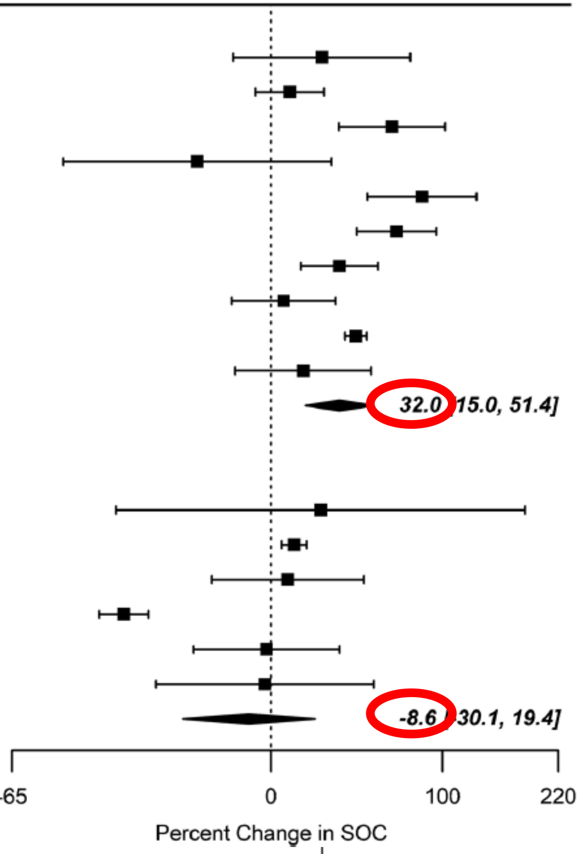
https://www.agroecology-pool.org/methodology-old/



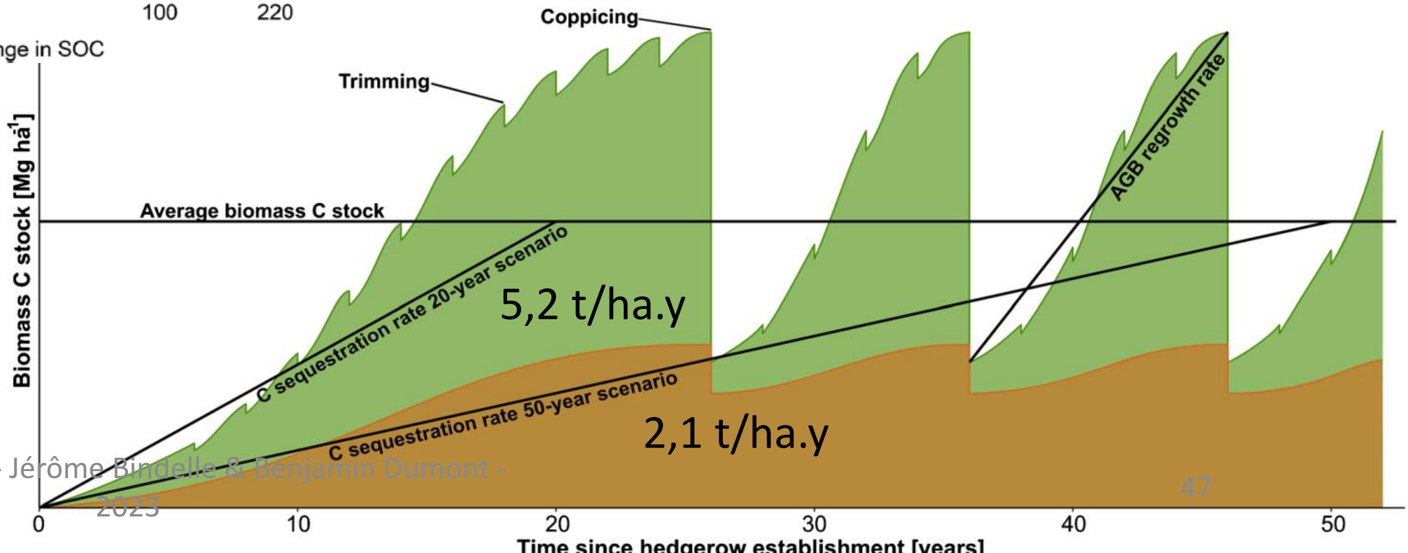
Liebert et al. 2022
https://doi.org/10.1038/s41477-022-01191-1

Haies et bandes boisées

Reference	SOC Control	SOC Hedgerow	SOC unit	Sampling depth [cm]	n (sites)
Cropland Control					
Baah-Acheamfour et al. 2014	53.1	65.2	g kg^{-1}	10	12
Dhillon & Van Rees 2017	73.7	79.5	Mg ha^{-1}	50	10
Holden et al. 2019_a	19.0	31.0	g kg^{-1}	7	3
Monokrousos et al. 2006_a	12.9	9.6	g kg^{-1}	10	1
Monokrousos et al. 2006_b	15.2	28.0	g kg^{-1}	10	1
Paulsen & Bauer 2008_a	98.0	163.0	Mg ha^{-1}	60	1
Thiel et al. 2015_a	80.8	106.5	Mg ha^{-1}	40	4
Thiel et al. 2015_b	72.9	76.7	Mg ha^{-1}	40	4
Van Vooren et al. 2018_c	32.3	45.5	Mg ha^{-1}	20	1
Van Vooren et al. 2018_d	40.5	46.1	Mg ha^{-1}	20	1
Overall Percent Change [95% CI]					
Grassland Control					
Follain et al. 2007	36.0	44.0	g kg^{-1}	5	1
Ford et al. 2019	62.1	68.2	Mg ha^{-1}	15	38
Holden et al. 2019_b	29.0	31.0	g kg^{-1}	7	3
Paulsen & Bauer 2008_b	296.0	163.0	Mg ha^{-1}	60	1
Van Vooren et al. 2018_a	40.6	39.8	Mg ha^{-1}	20	1
Van Vooren et al. 2018_b	39.2	38.3	Mg ha^{-1}	20	1
Overall Percent Change [95% CI]					

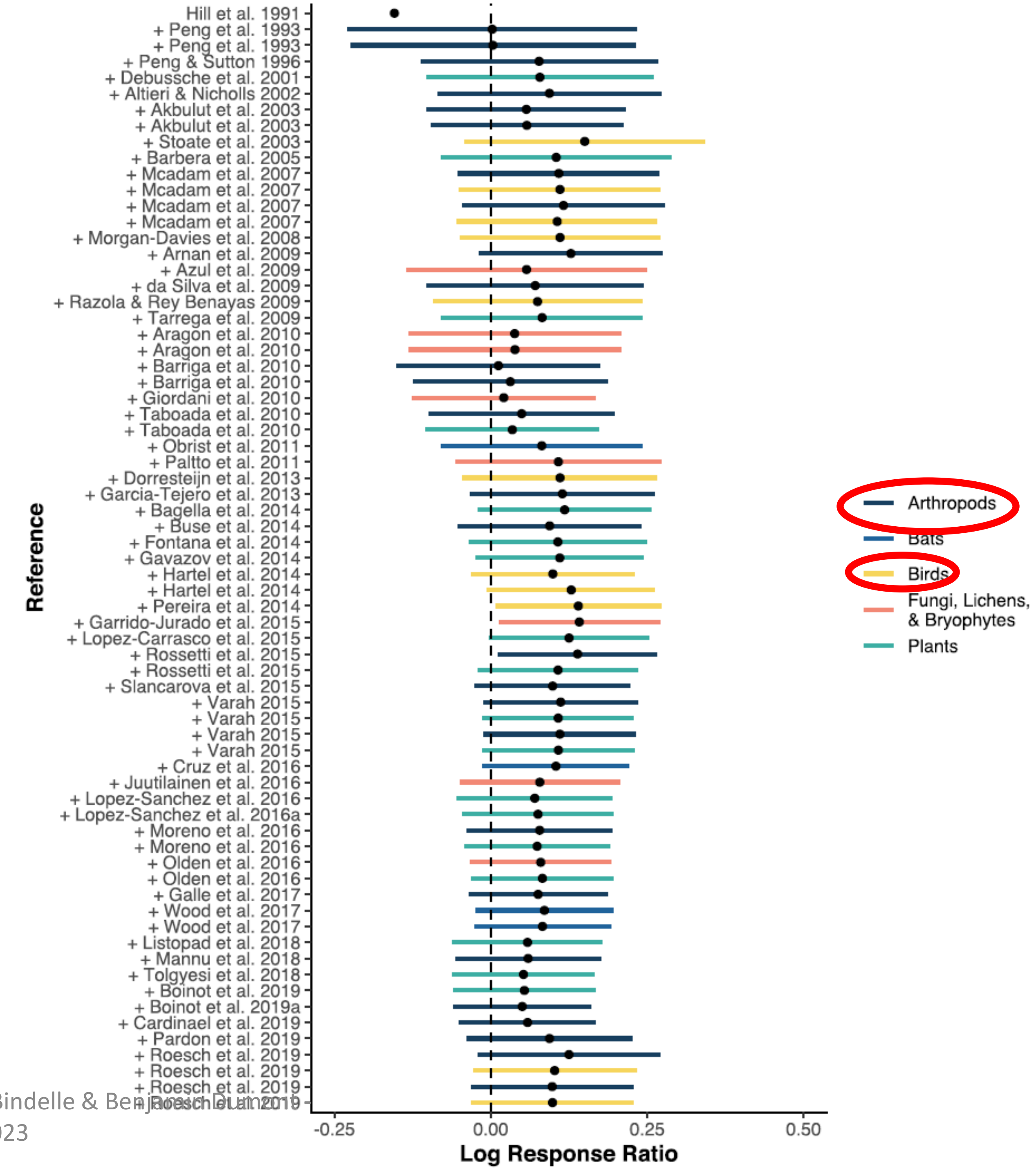


Drexler et al. 2021
https://doi.org/10.1007/s10113-021-01798-8

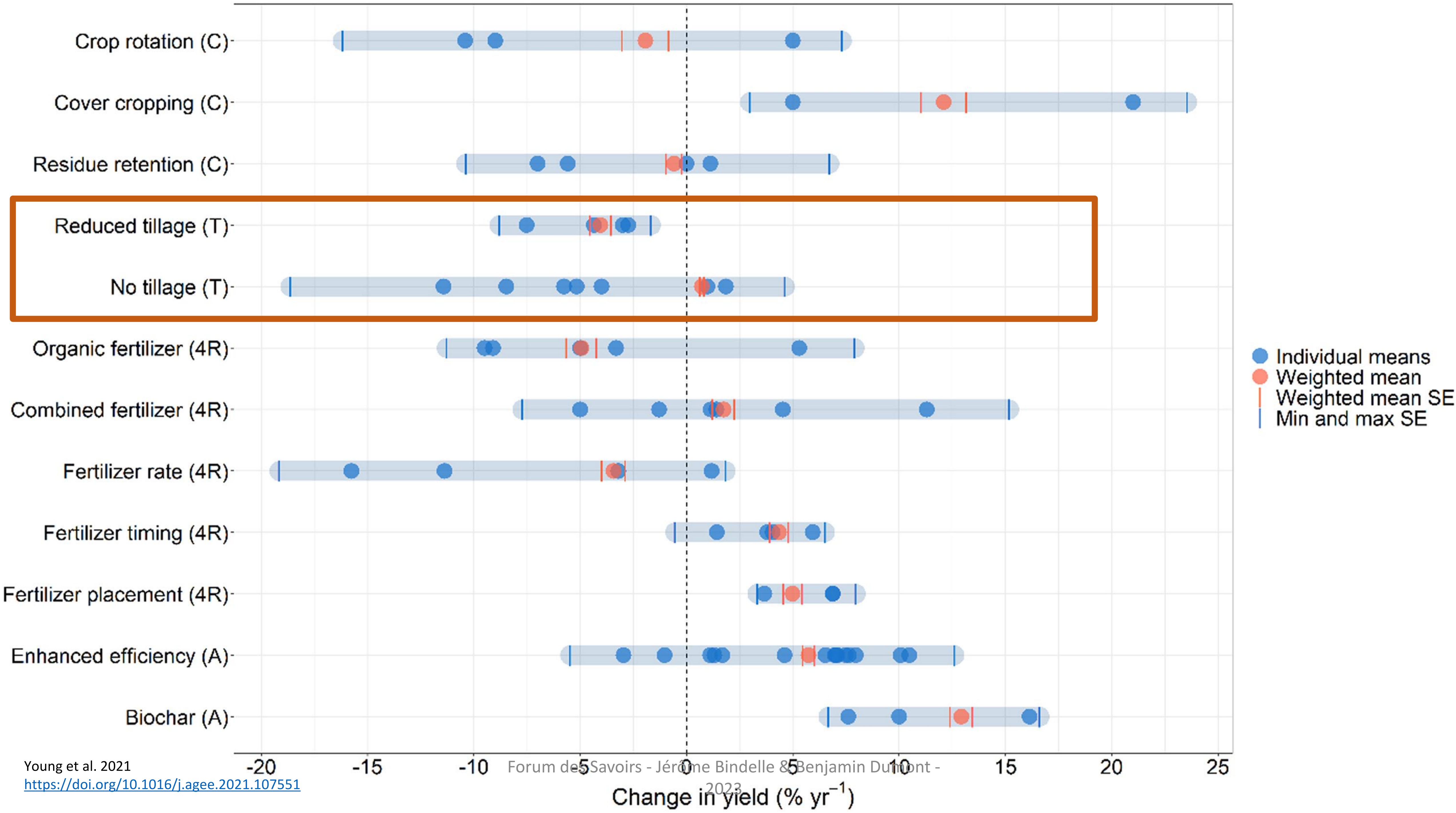


YES WE PLANT

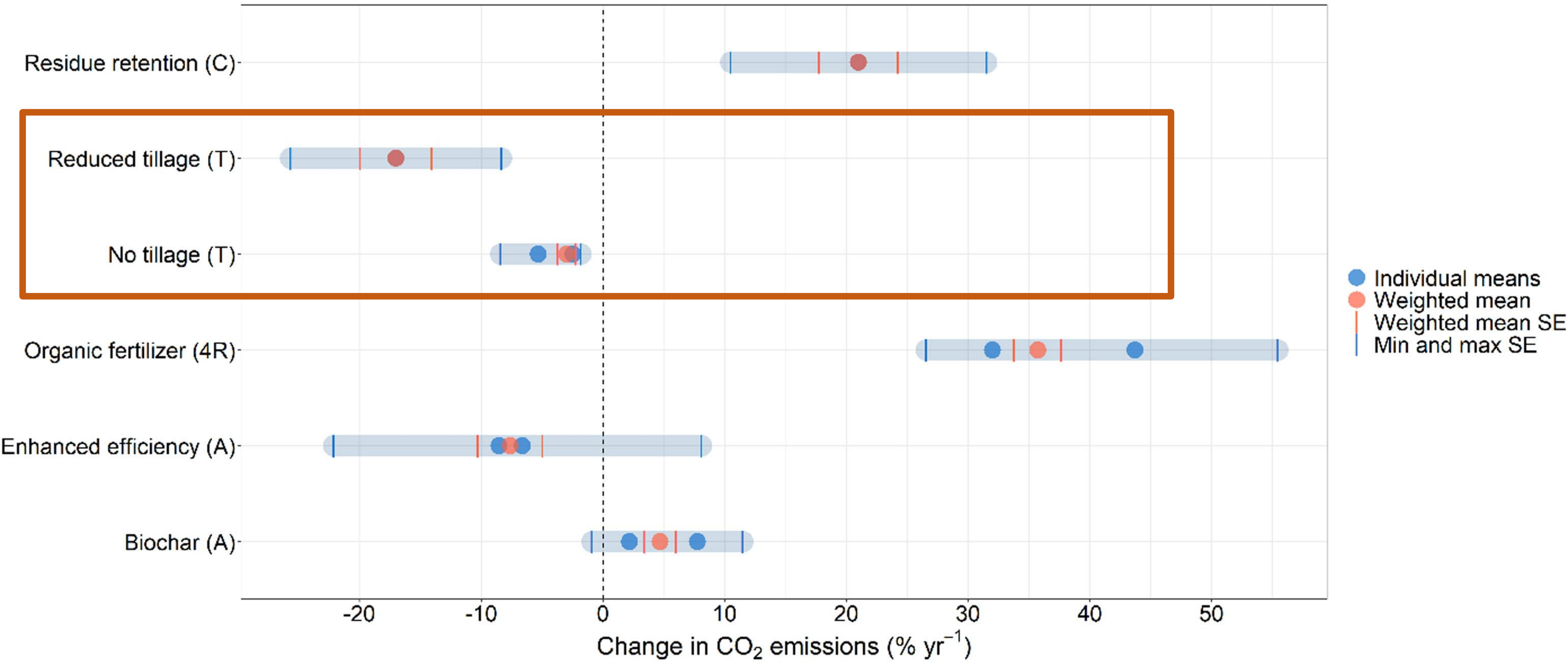
Les systèmes agroforestiers augmentent la biodiversité de 60 % par rapport aux terres cultivées sans plantes ligneuses



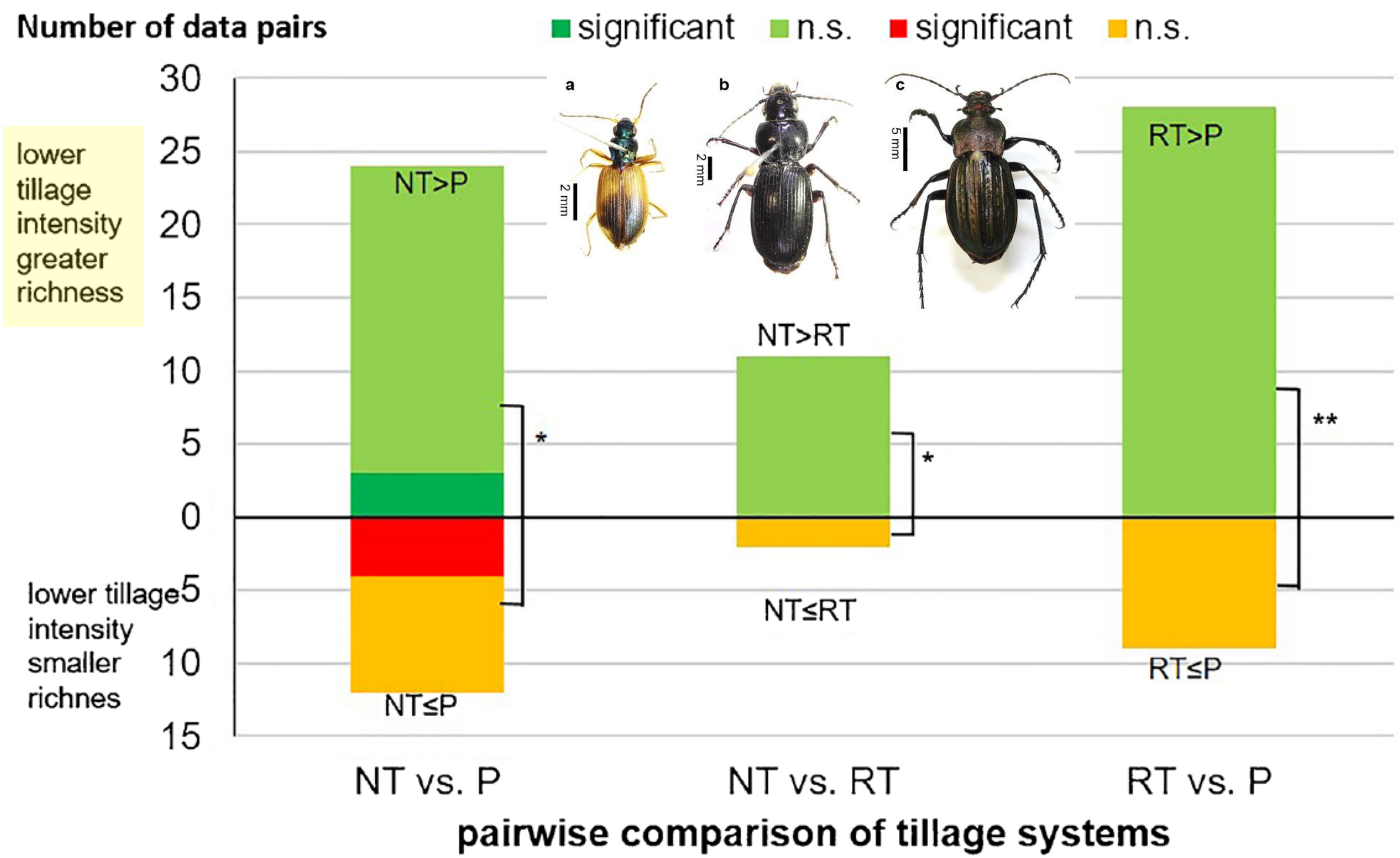
Mupepele et al 2021
https://doi.org/10.1186/s12862-021-01911-9



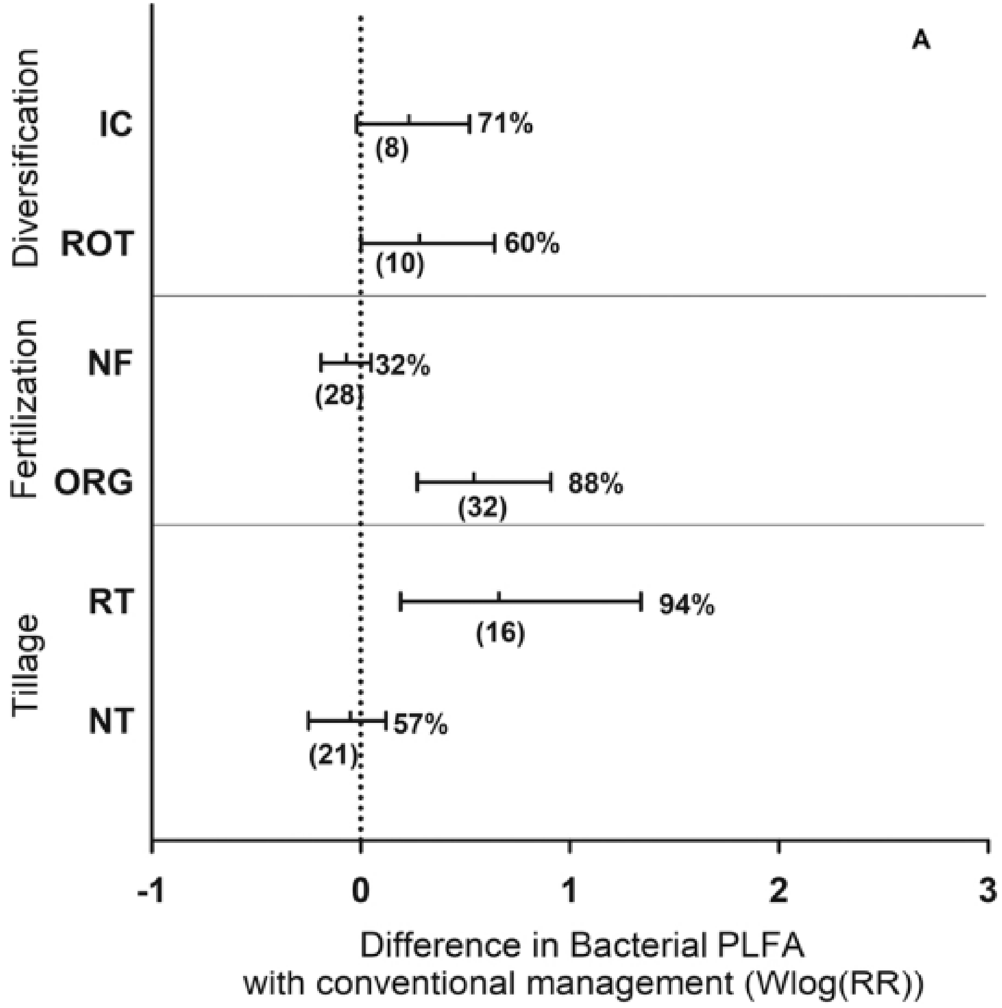
Young et al. 2021
https://doi.org/10.1016/j.agee.2021.107551



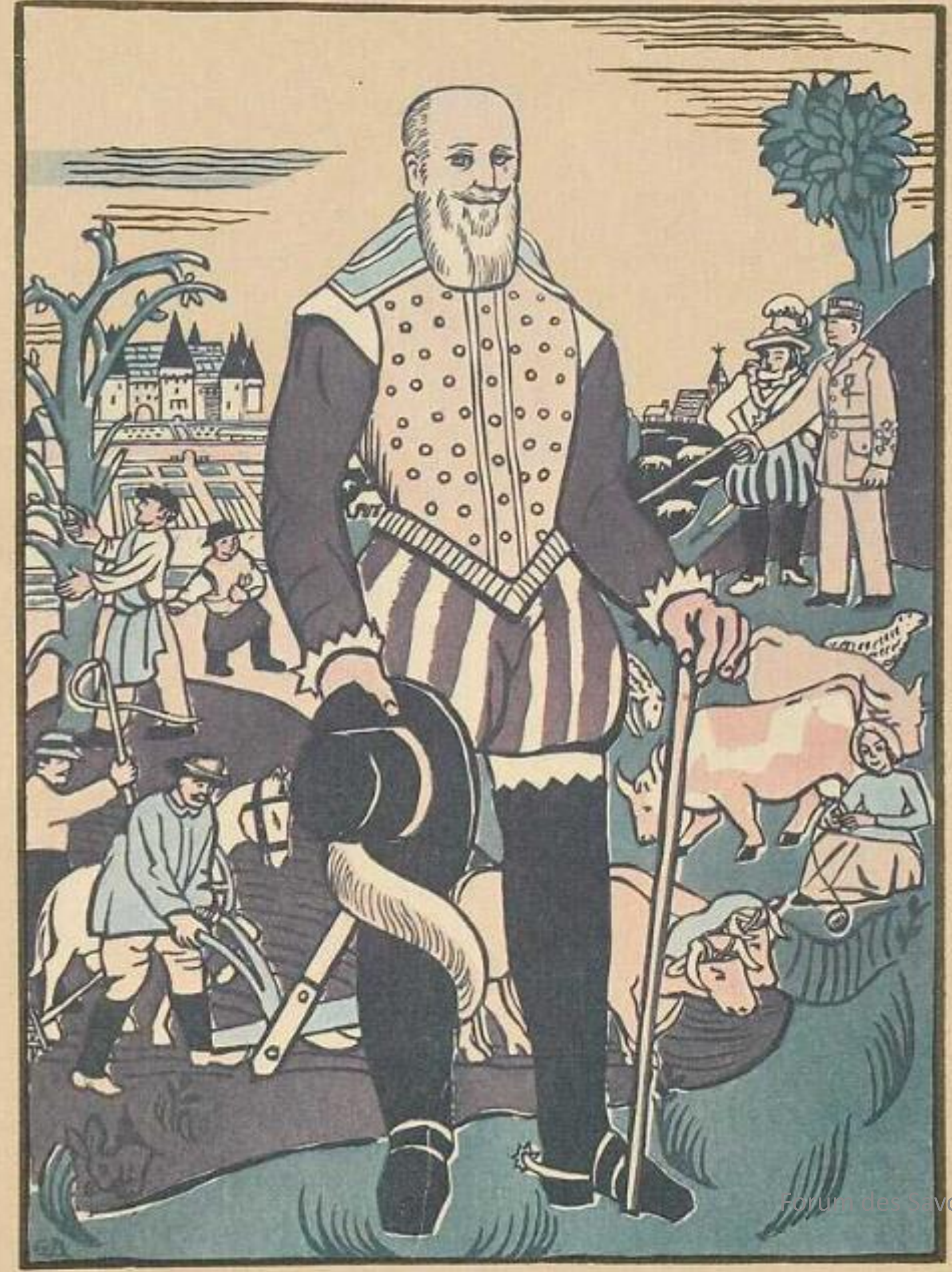
Young et al. 2021
https://doi.org/10.1016/j.agee.2021.107551



Müller et al 2022
https://doi.org/10.1007/s13593-022-00803-6



Morugan-Coronado et al, 2022
https://doi.org/10.1016/j.agee.2022.107867

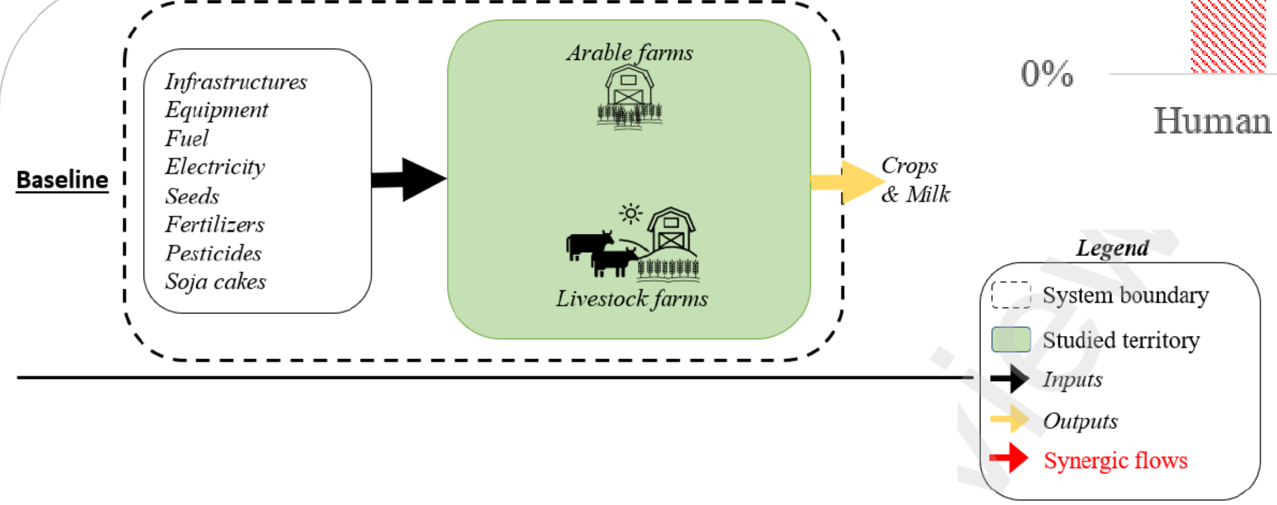


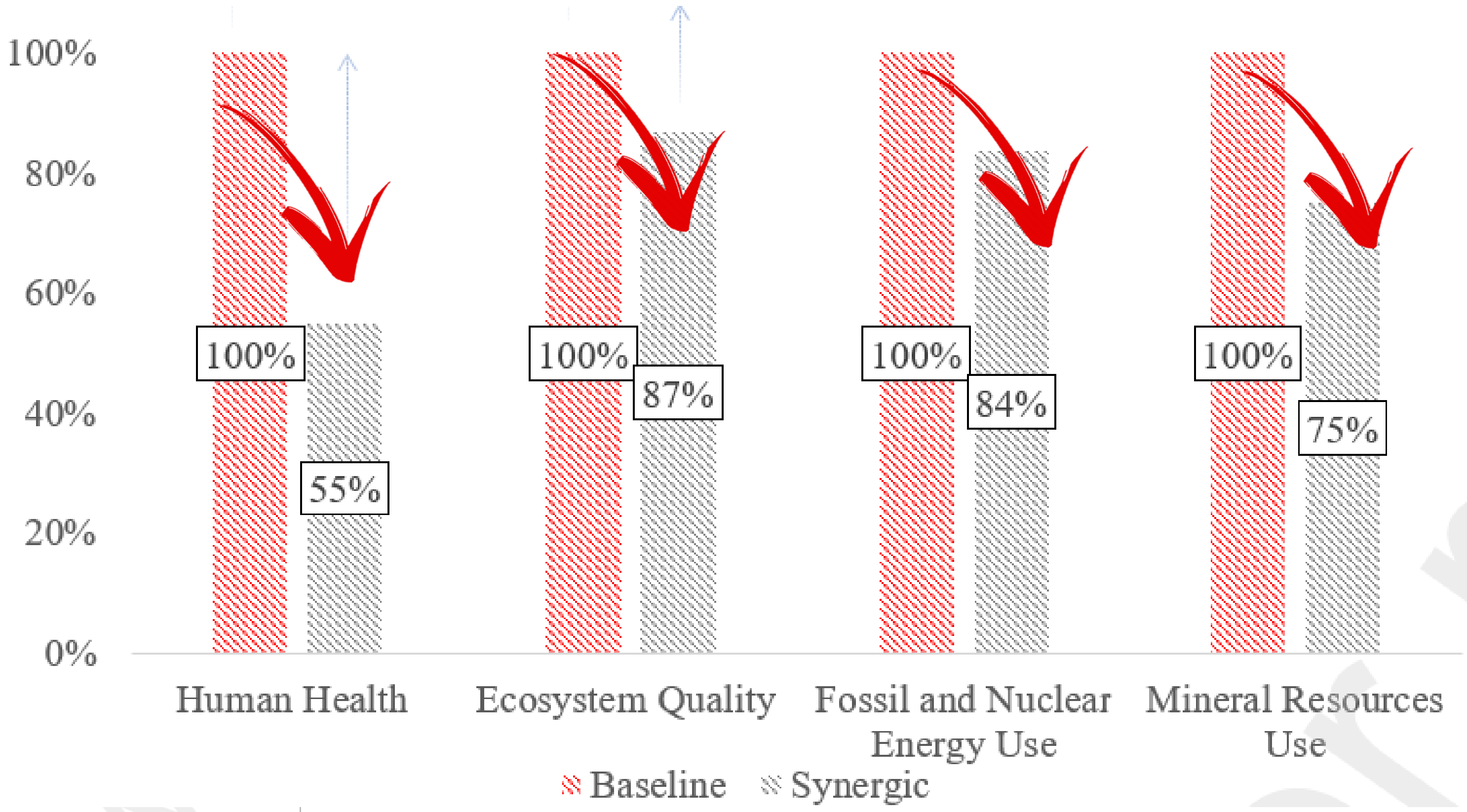
"LABOURAGE ET PATURAGE SONT LES MAMELLES DE LA FRANCE"

SULLY

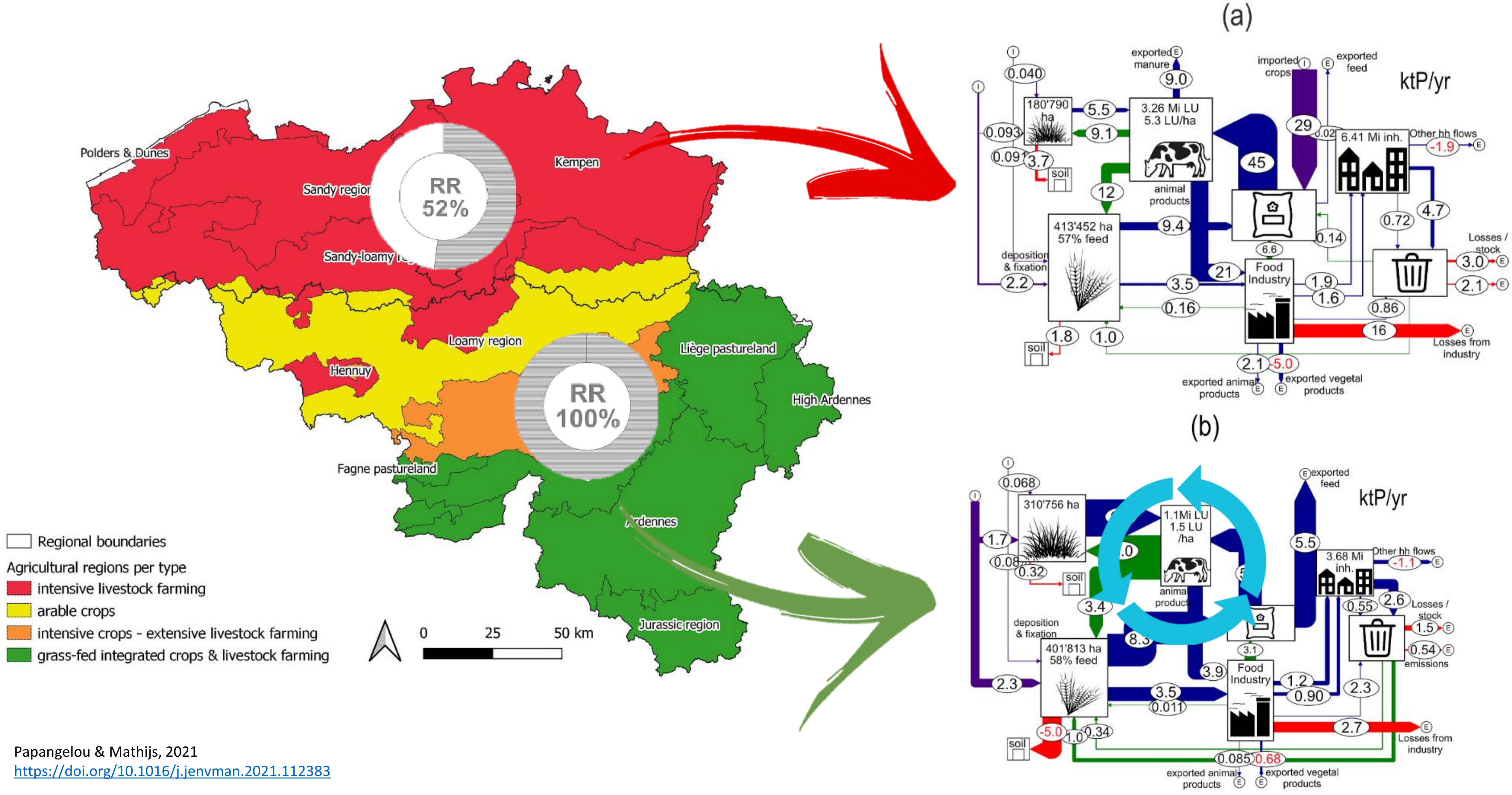
A cornfield of moderate fertility produces a much greater quantity of food for man than the best pasture of equal extent.

Adam Smith



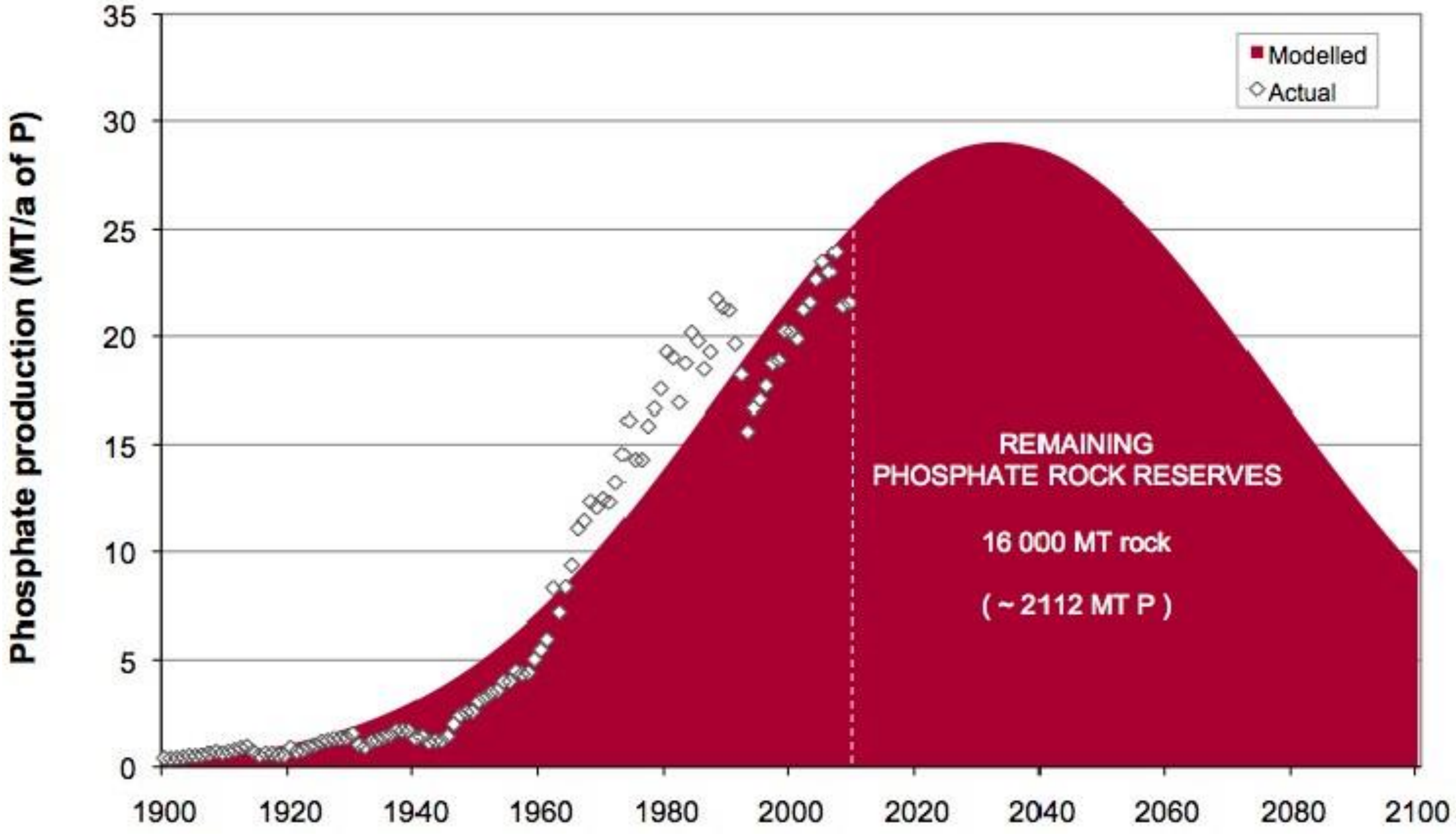


Cirone et al 2023
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4364074
Preprint!

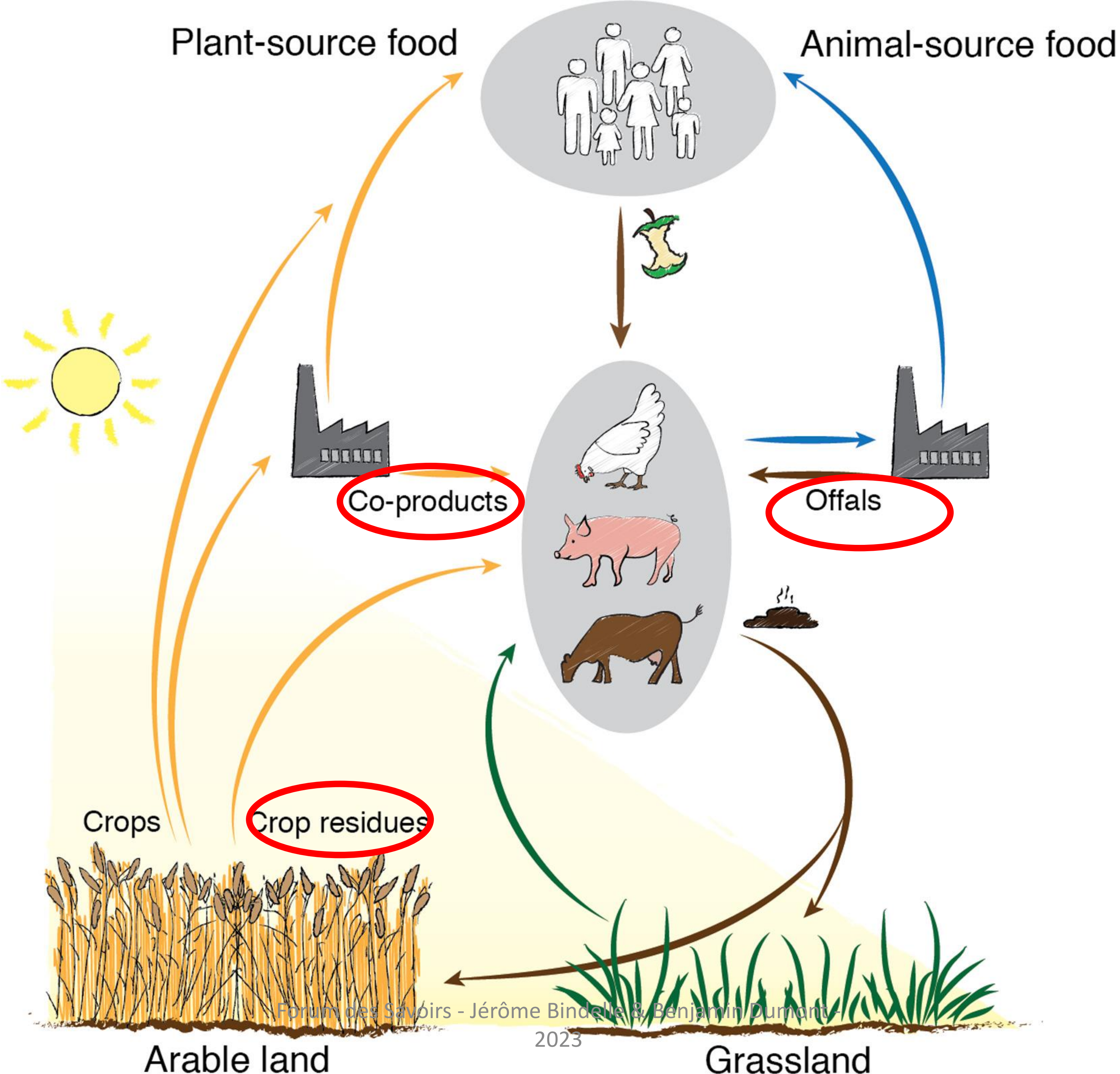


Papangelou & Mathijs, 2021

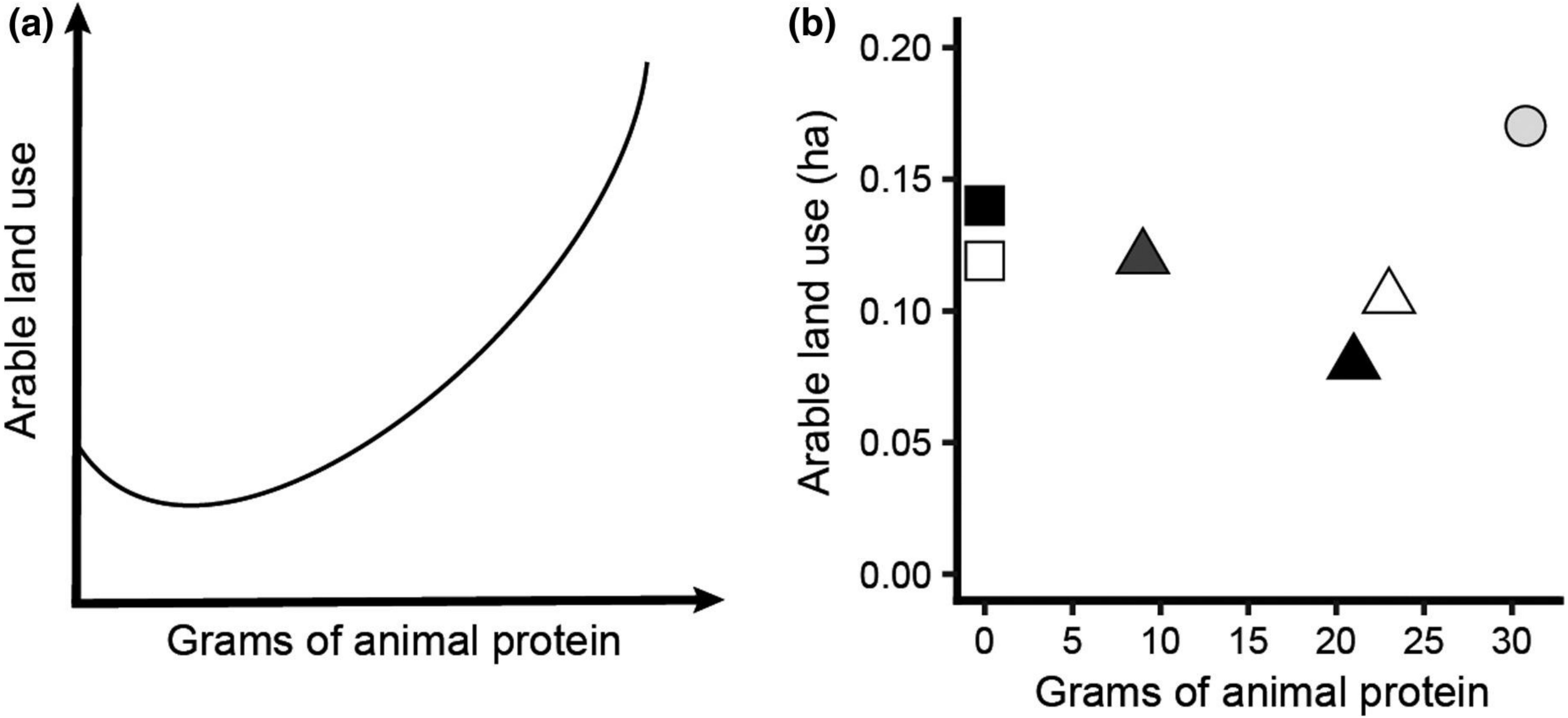
https://doi.org/10.1016/j.jenvman.2021.112383



Cordell & White 2011
http://dx.doi.org/10.3390/su3102027

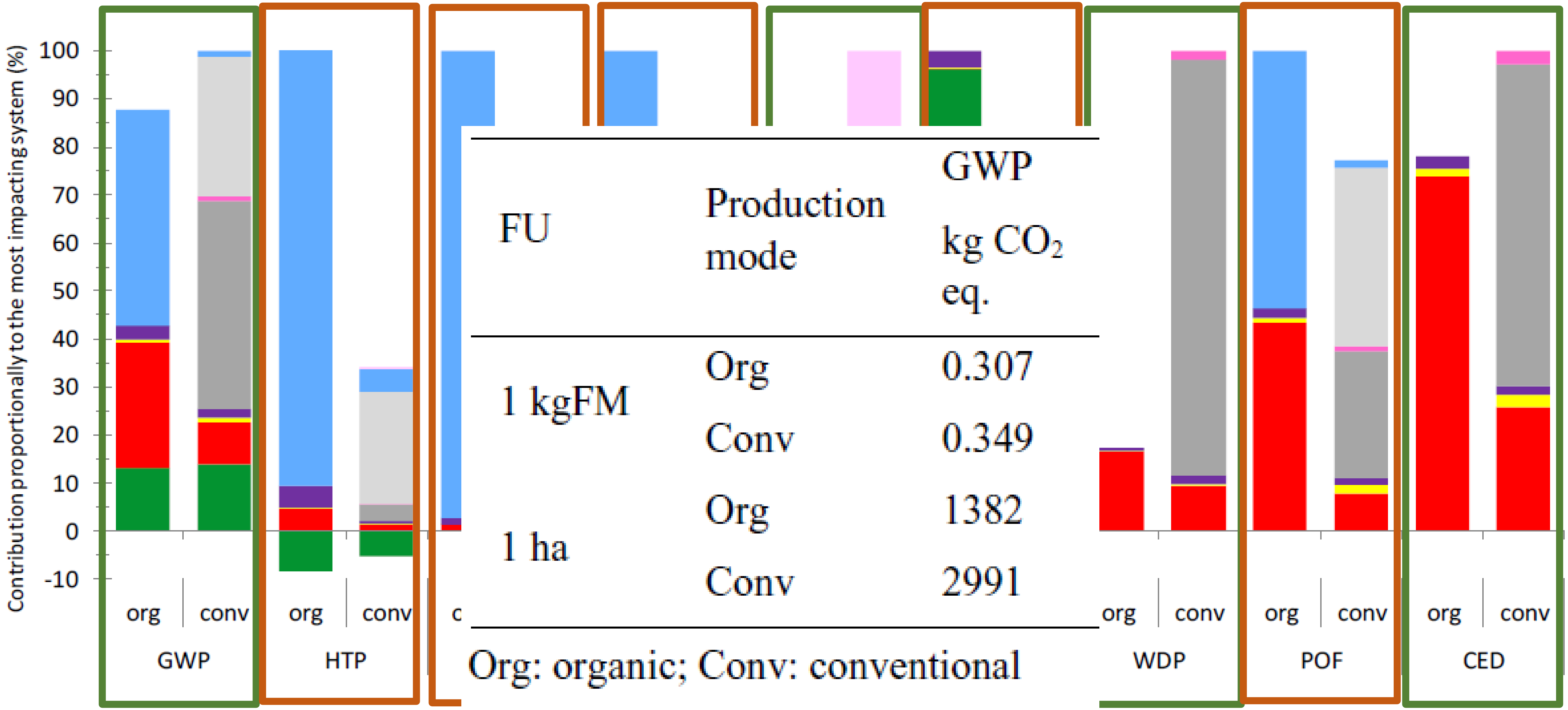


Van Zanten et al., 2018
https://doi.org/10.1111/gcb.14321



Van Zanten et al., 2018
https://doi.org/10.1111/gcb.14321

TRADITIONAL Organic VS. CONVENTIONAL -AGRICULTURE-

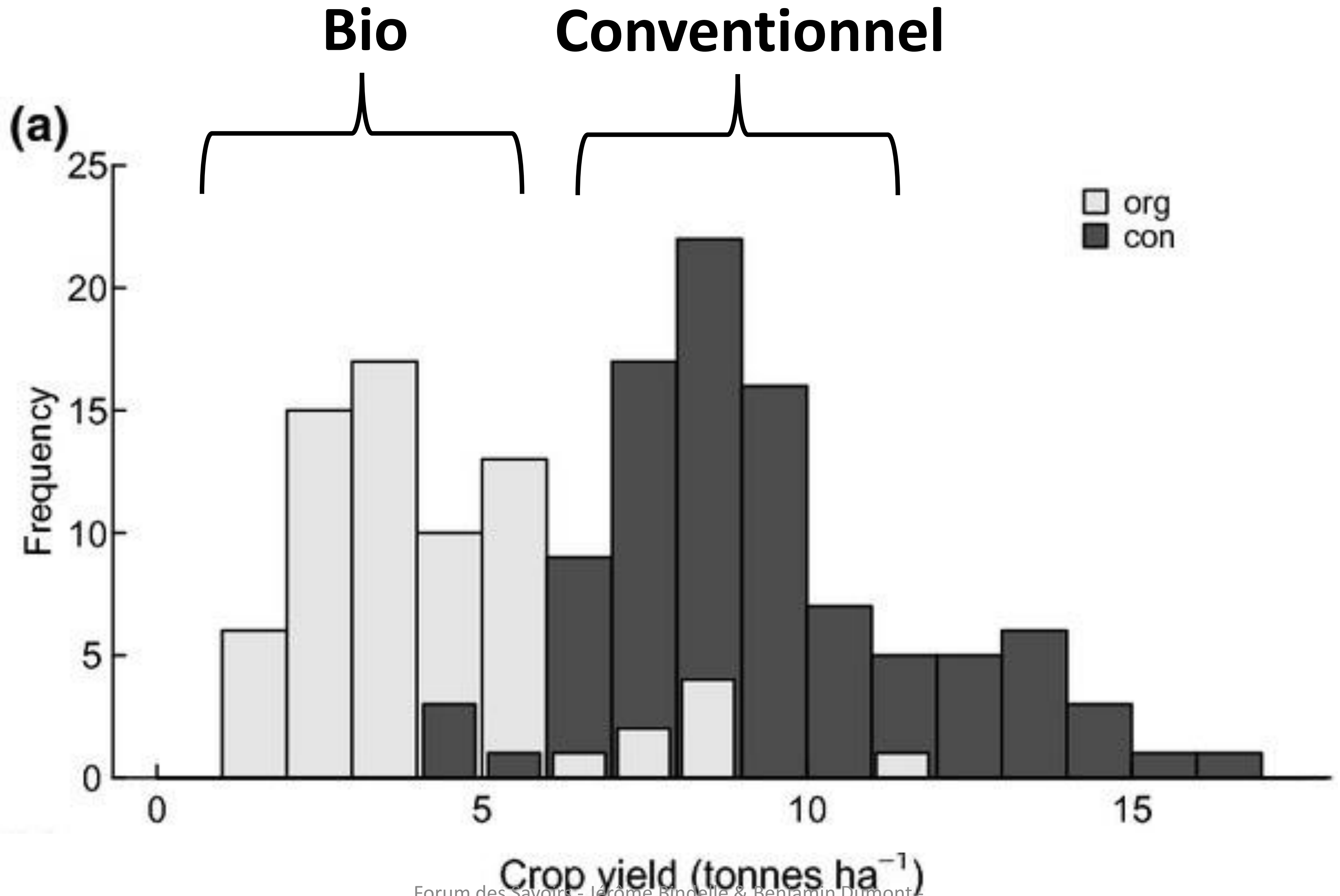


FU	Production mode	GWP kg CO_2 eq.
1 kgFM	Org	0.307
	Conv	0.349
1 ha	Org	1382
	Conv	2991

Org: organic; Conv: conventional

Fig. 1. LCIA results by impact category for the production of 1 kgFM of organic (org) and conventional (conv) wheat. ● Crop effect (emissions tied to land occupation), ● Mechanization, ● Transport, ● Seeds, ● Mineral fertilizers production, ● Pesticides production, ● Emissions due to mineral fertilizers use, ● Emissions due to organic fertilizers use, ● Pesticides emissions.

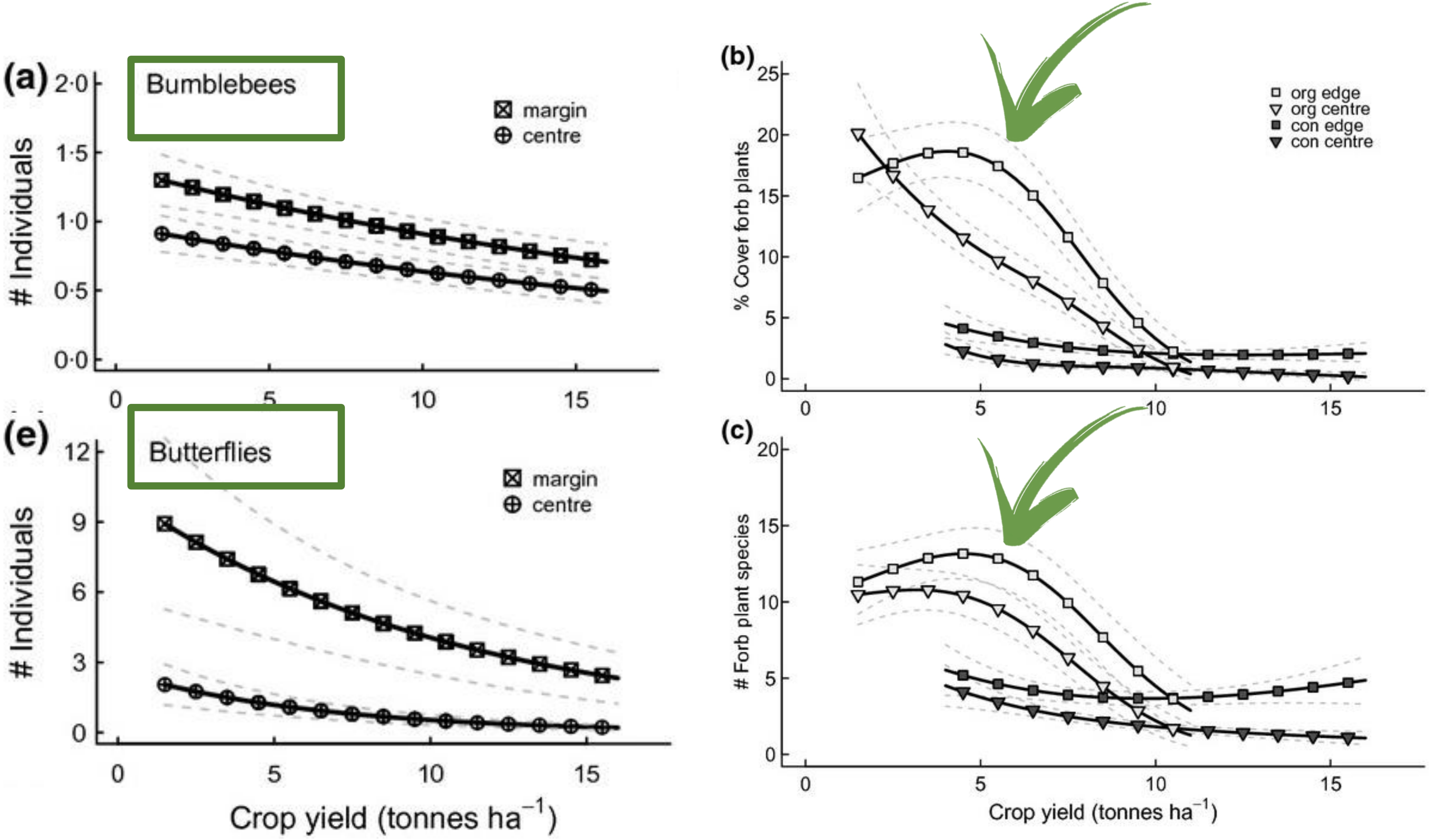
Van Stappen et al. 2015
https://doi.org/10.1016/j.aaspro.2015.12.047



Gabriel et al. 2010
https://doi.org/10.1111/j.1461-0248.2010.01481.x

	Conventional		Organic	
	Mean ± SEM	Median (range)	Mean ± SEM	Median (range)
Field measures				
Crop field size (ha)	11.8 ± 1.40	9.3 (2.6–51.6)	6.3 ± 0.63	5.1 (1.6–27.6)
Grass field size (ha)	5.7 ± 0.58	4.7 (0.7–17.6)	4.0 ± 0.27	3.5 (1.2–10.1)
Crop field margin width (m)	3.7 ± 0.39	2.5 (1.0–12)	2.3 ± 0.28	1.8 (0.2–11)
Length of crop rotation (years)	4.6 ± 0.52	5 (1–6)	5.6 ± 0.29	6 (4–7)
Number of herbicide applications	2.3 ± 0.27	2 (1–7)	0	0
Number of insecticide applications	0.56 ± 0.08	1 (0–1)	0	0
Synthetic nitrogen fertilizer (kg N ha^{-1})*	164 ± 9.0	160 (43–268)	0	0
Organic nitrogen fertilizer (kg N ha^{-1}) *	10 ± 5.2	0 (0–170)	27 ± 6.7	0 (0–188)
Grain yield winter cereal (t ha^{-1})	9.3 ± 0.33	9.0 (4.2–14.9)	4.2 ± 0.39	3.6 (2.0–11.1)

Gabriel et al. 2010
https://doi.org/10.1111/j.1461-0248.2010.01481.x


(a)
Bumblebees
margin
centre
Individuals
2·0
1·5
1·0
0·5
0·0
0
5
10
15
(e)
Butterflies
margin
centre
Individuals
12
9
6
3
0
0
5
10
15
Crop yield (tonnes ha^{-1})
(b)
org edge
org centre
con edge
con centre
% Cover forb plants
25
20
15
10
5
0
0
5
10
15
(c)
Forb plant species
20
15
10
5
0
0
5
10
15
Crop yield (tonnes ha^{-1})

	Conventional		Organic	
	Mean ± SEM	Median (range)	Mean ± SEM	Median (range)
Field measures				
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Gabriel et al. 2010
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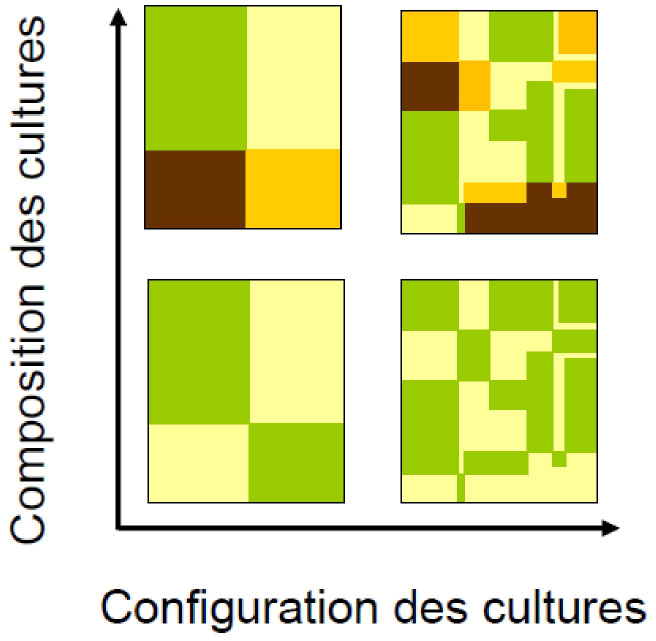
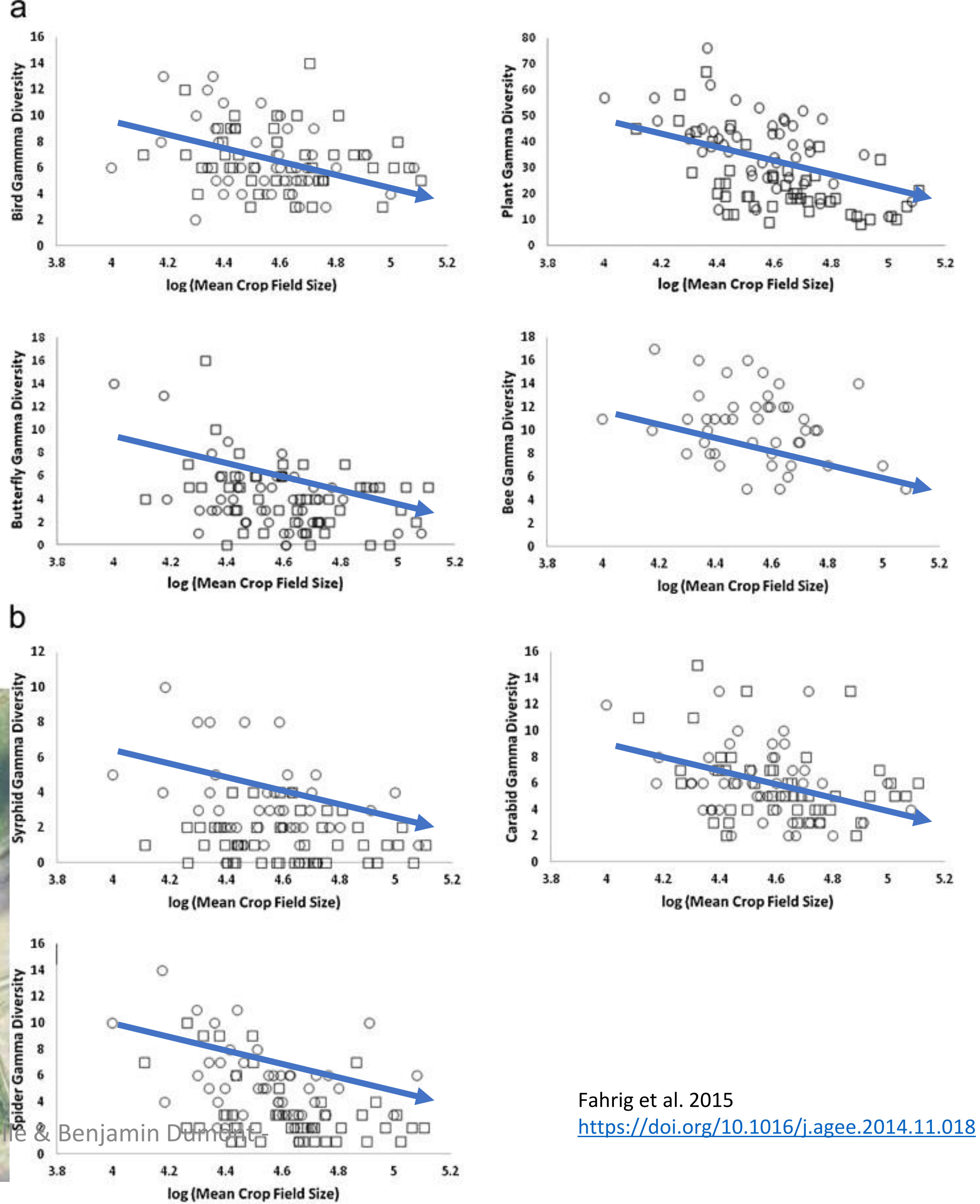




Fahrig et al. 2015
https://doi.org/10.1016/j.agee.2014.11.018

Les itinéraires techniques “conventionnels” vs. “bio” n’ont pas d’impact sur la teneur des céréales en nutriments: protéines, minéraux, antioxydants, etc.

Nutritional quality of organic and conventional wheat*

G. Langenkämper[1], C. Zörb[1], M. Seifert[1], P. Mäder[2], B. Fretzdorff[1], T. Betsche[1]

(Received June 26, 2006)

Functional and Nutritional Characteristics of Wheat Grown in Organic and Conventional Cropping Systems

Eun Young Park,[1] Byung-Kee Baik,[2] Perry R. Miller,[3] Ian C. Burke,[4] Eric A. Wegner,[5] Nicole E. Tautges,[4] Craig F. Morris,[5] and E. Patrick Fuerst[6,†]

Wheat quality in organic and conventional farming: results of a 21 year field experiment

Paul Mäder,[1*] Diana Hahn,[1,2] David Dubois,[3] Lucie Gunst,[3] Thomas Alföldi,[1] Hans Bergmann,[2] Michael Oehme,[4] Renato Amadò,[5] Hanna Schneider,[5] Ursula Graf,[6†] Alberta Velimirov,[7‡] Andreas Fließbach[1] and Urs Niggli[1]

https://www.sillonbelge.be/9259/article/2022-05-31/pression-maladies-en-froment-les-plantes-devraient-etre-protegees-jusquen-fin-de

https://wallpapercave.com/picanha-wallpapers

Les produits animaux "bio" ont un profil nutritionnel plus intéressant pour la santé:
PUFA, ω3/ω6
(vit A, vitE)

Comparison of nutritional quality between conventional and organic dairy products: a meta-analysis

Eny Palupi,[a] Anuraga Jayanegara,[b†] Angelika Ploeger[a] and Johannes Kahl[a*]

Nutritional properties of organic and conventional beef meat at retail

Albert Ribas-Agustí,[*] Isabel Díaz, Carmen Sárraga, Jose A García-Regueiro and Massimo Castellari

Composition differences between organic and conventional meat: a systematic literature review and meta-analysis

Dominika Średnicka-Tober[1,7], Marcin Barański[1], Chris Seal[2], Roy Sanderson[3], Charles Benbrook[4], Håvard Steinshamn[5], Joanna Gromadzka-Ostrowska[6], Ewa Rembiałkowska[7], Krystyna Skwarło-Sońta[8], Mick Eyre[1], Giulio Cozzi[9], Mette Krogh Larsen[10], Teresa Jordon[1], Urs Niggli[11], Tomasz Sakowski[12], Philip C. Calder[13], Graham C. Burdge[13], Smaragda Sotiraki[14], Alexandros Stefanakis[14], Halil Yolcu[1,15], Sokratis Stergiadis[1,16], Eleni Chatzidimitriou[1], Gillian Butler[1], Gavin Stewart[1] and Carlo Leifert[1*]

Les legumes et les fruits “bio” ont des teneurs supérieures en flavonoïdes, antioxydants, polyphenols, vit C., carotéonoïdes etc.

Does Organic Production Enhance Phytochemical Content of Fruit and Vegetables? Current Knowledge and Prospects for Research

Xin Zhao[1], Edward E. Carey[2], Weiqun Wang[3], and C.B. Rajashekar[1]

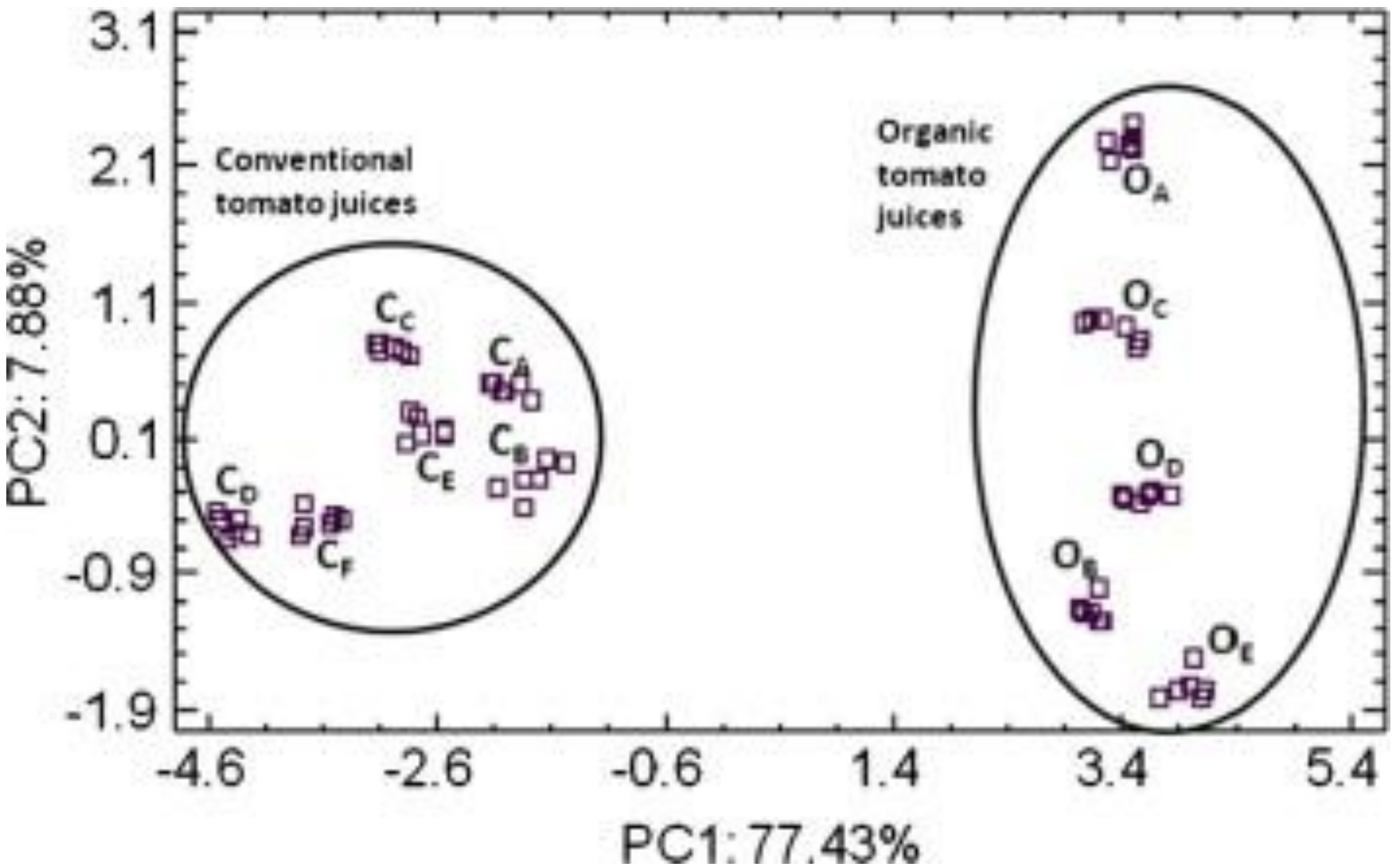
Organic Foods Contain Higher Levels of Certain Nutrients, Lower Levels of Pesticides, and May Provide Health Benefits for the Consumer

Walter J. Crinnion, ND

Review

Organic foods contribution to nutritional quality and value

Mona Elena Popa, Amalia Carmen Mitelut, Elisabeta Elena Popa, Andreea Stan, Vlad Ioan Popa



Vallverdu-Queralt et al., 2016
https://doi.org/10.1016/j.foodchem.2011.07.017

Et les pesticides?

Effect of wheat species (Triticum aestivum vs T. spelta), farming system (organic vs conventional) and flour type (wholegrain vs white) on composition of wheat flour – Results of a retail survey in the UK and Germany – 3. Pesticide residue content

Juan Wang[a,b,*], Gultakin Hasanalieva[b,c], Liza Wood[b], Christos Anagnostopoulos[d], Georgios Ampadogiannis[d], Eleftheria Bempelou[d], Maroula Kiousi[d], Emilia Markellou[d], Per Ole Iversen[e,f], Chris Seal[a], Marcin Baranski[b,g], Vanessa Vigar[h], Carlo Leifert[e,h,*], Leonidas Rempelos[b,*]

Factor	chlormequat	Piperonyl butoxide#	2-phenyl-phenol##	glyphosate##	cypermethrin##	at least 1 CPP	multiple (> 2) CPP residues
Country							
Germany (n = 16)	23 ± 11	27 ± 9	13 ± 13	4 ± 3	15 ± 10	54 ± 11	15 ± 6
UK (n = 15)	45 ± 12	20 ± 6	0	16 ± 12	21 ± 9	57 ± 11	24 ± 9
Species							
Spelt wheat (n = 15)	33 ± 12	31 ± 9	0	4 ± 3	25 ± 10	64 ± 10	13 ± 6
Common wheat (n = 16)	35 ± 11	17 ± 5	13 ± 13	16 ± 12	11 ± 8	47 ± 11	24 ± 9
Farming system							
Conventional (n = 15)	68 ± 11	36 ± 9	13 ± 13	21 ± 11	9 ± 9	87 ± 6	36 ± 9
Organic (n = 16)	3 ± 2	12 ± 5	0	0	25 ± 9	25 ± 8	4 ± 2
Flour type							
White (n = 15)	31 ± 11	20 ± 8	13 ± 13	7 ± 5	7 ± 7	49 ± 11	14 ± 7
Whole-grain (n = 16)	37 ± 12	27 ± 7	0	14 ± 11	26 ± 10	61 ± 10	24 ± 8
ANOVA 1 (p-values)*							
Main Effects							
Species (SP)	NS	NS	–	–	–	NS	NS
Farming System (FS)	0.003	0.0438	–	–	–	0.0020	0.0116
Flour type (FT)	NS	NS	–	–	–	NS	NS
Interactions	NS	NS	–	–	–	NS	NS

Is organic farming safer to farmers' health? A comparison between organic and traditional farming

Carla Costa [a,*], Julia García-Lestón [b], Solange Costa [a], Patrícia Coelho [a], Susana Silva [a], Marta Pingarilho [c], Vanessa Valdiglesias [b,d], Francesca Mattei [d], Valentina Dall'Armi [d], Stefano Bonassi [d], Blanca Laffon [b], John Snawder [e], João Paulo Teixeira [a]

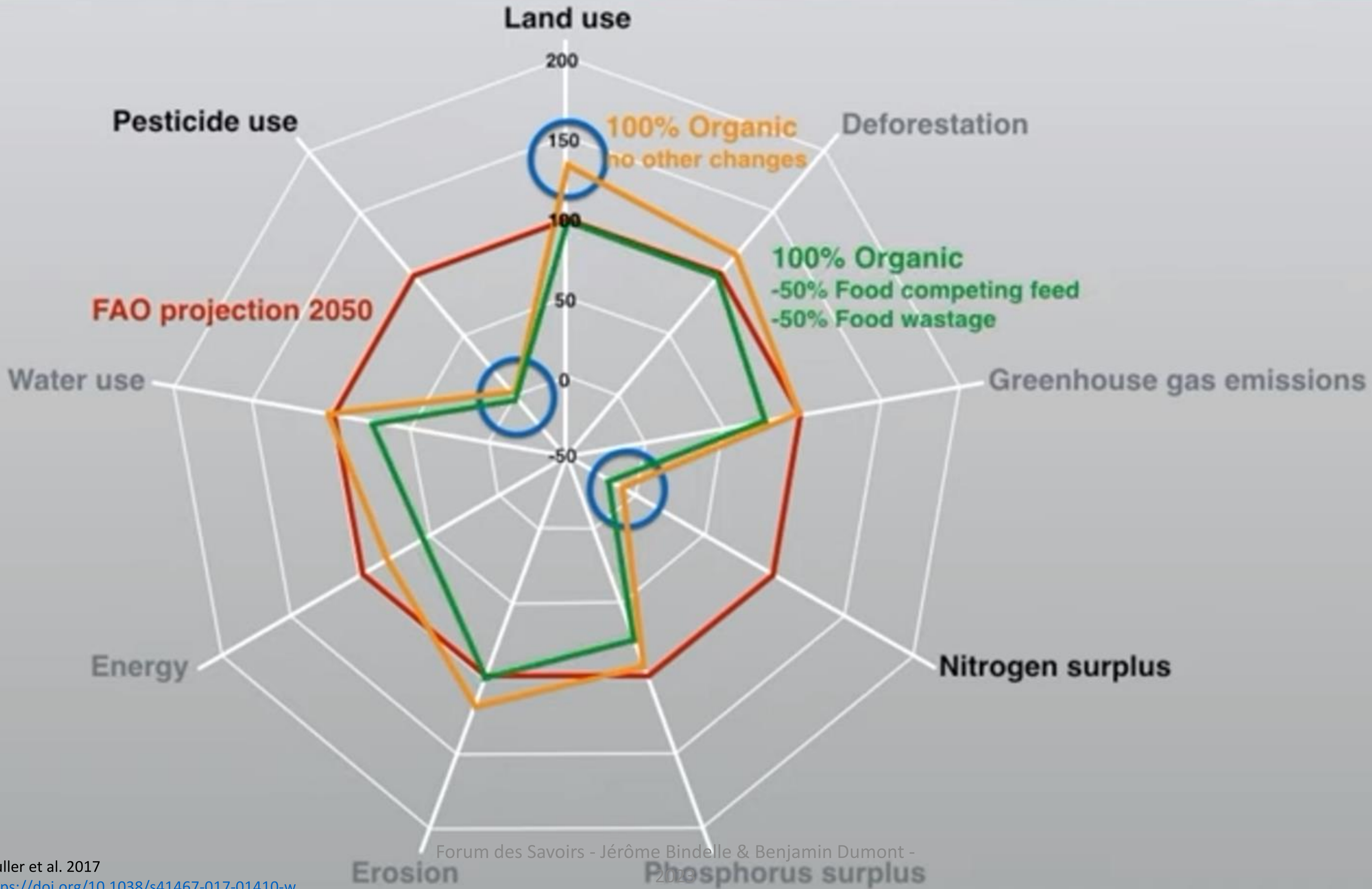
H I G H L I G H T S

- There are no previous studies on the impact of organic farming on workers' health.
- Genetic damage and immunological alterations of workers were studied.
- Results confirm increased DNA damage levels in farmers exposed to pesticides.

Prostate cancer risk among French farmers in the AGRICAN cohort

by Clémentine Lemarchand, PhD,[1, 2, 3] Séverine Tual, PhD,[1, 2, 3] Mathilde Boulanger MD, MSc,[1, 2, 4] Noémie Levêque-Morlais, MSc,[1, 2, 3] Stéphanie Perrier, MSc,[1, 2, 3] Bénédicte Clin, MD, PhD,[1, 2, 4] Anne-Valérie Guizard, MD, PhD,[1, 5] Michel Velten, MD, PhD,[6] Emma Rigaud, MSc,[7] Isabelle Baldi, MD, PhD,[8, 9, 10] Pierre Lebailly, PhD [1, 2, 3]

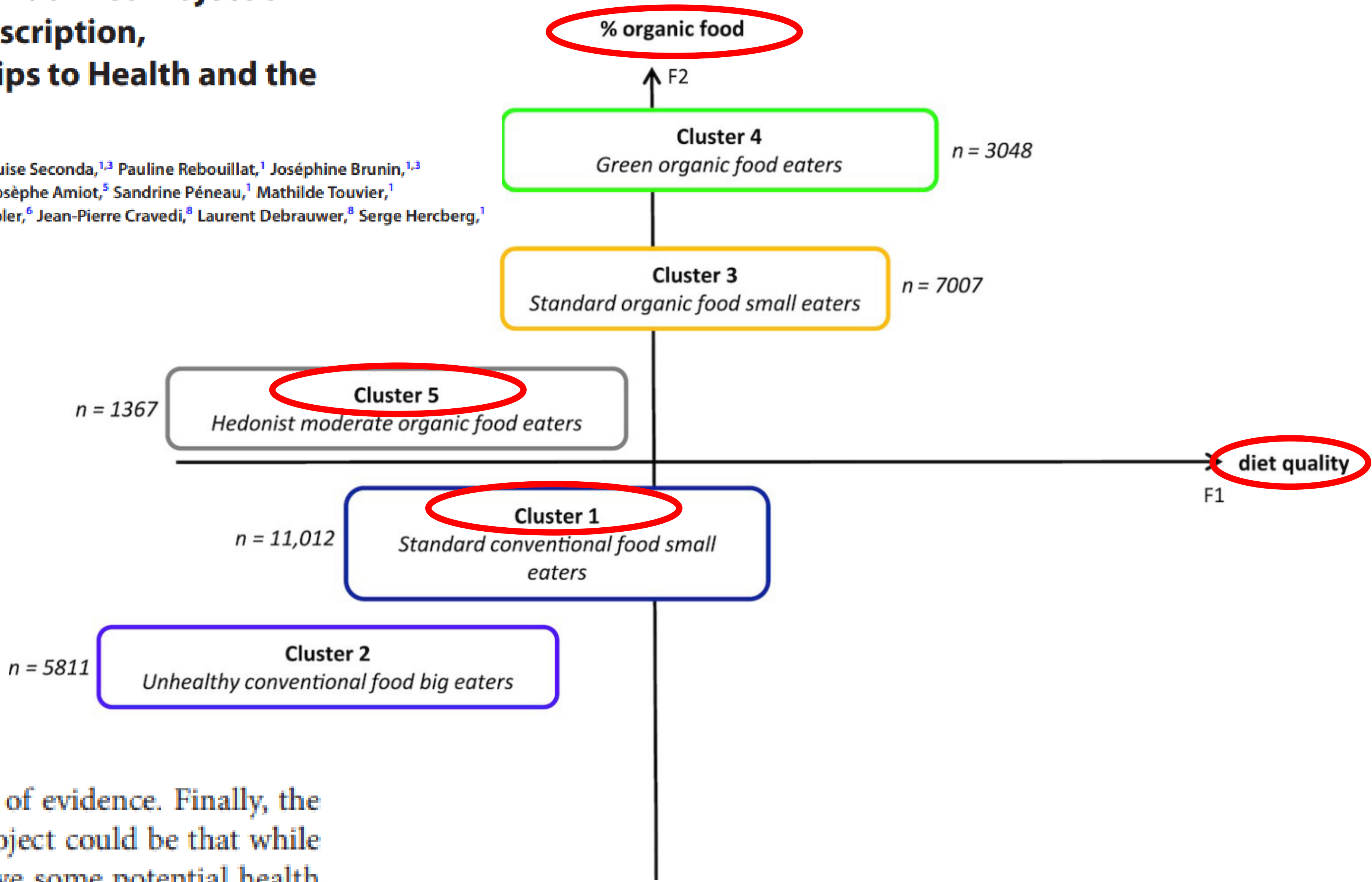
Fruit growing				
Pruning				
Ever	146	1.05	0.88–1.26	
≥40 years [a]	20	1.15	0.74–1.80	0.14
≥25 hectares [f]	6	1.62	0.72–3.61	0.12
Pesticide use				
Ever	112	1.19	0.97–1.45	
≥40 years [a]	11	1.20	0.66–2.17	0.13
≥25 hectares [f]	7	**2.28**	**1.08–4.80**	**0.02**
Harvesting				
Ever	209	1.13	0.97–1.32	
≥40 years [a]	35	1.31	0.93–1.84	**0.04**
≥25 hectares [f]	7	1.97	0.94–4.16	0.05



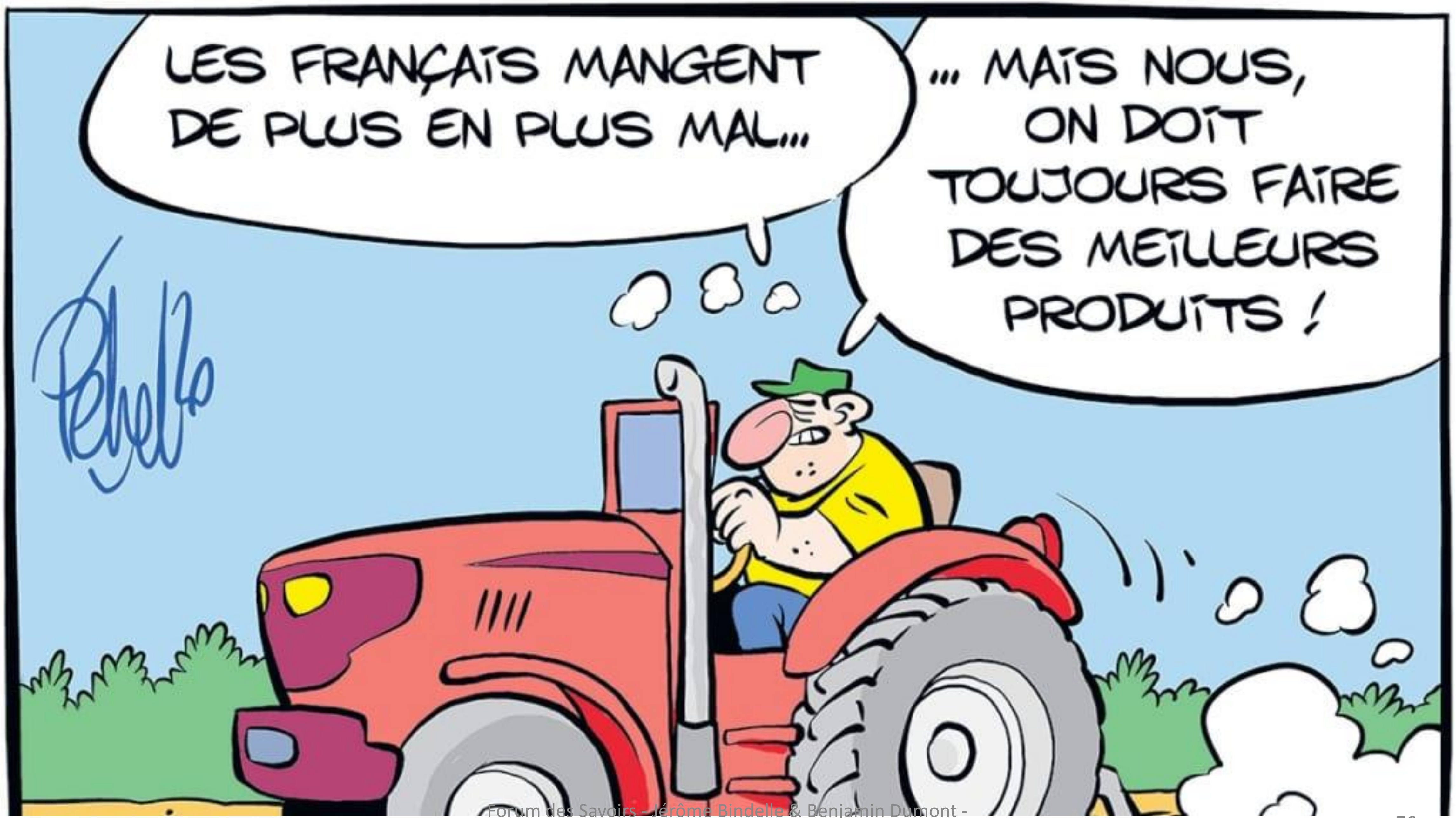
Muller et al. 2017
https://doi.org/10.1038/s41467-017-01410-w

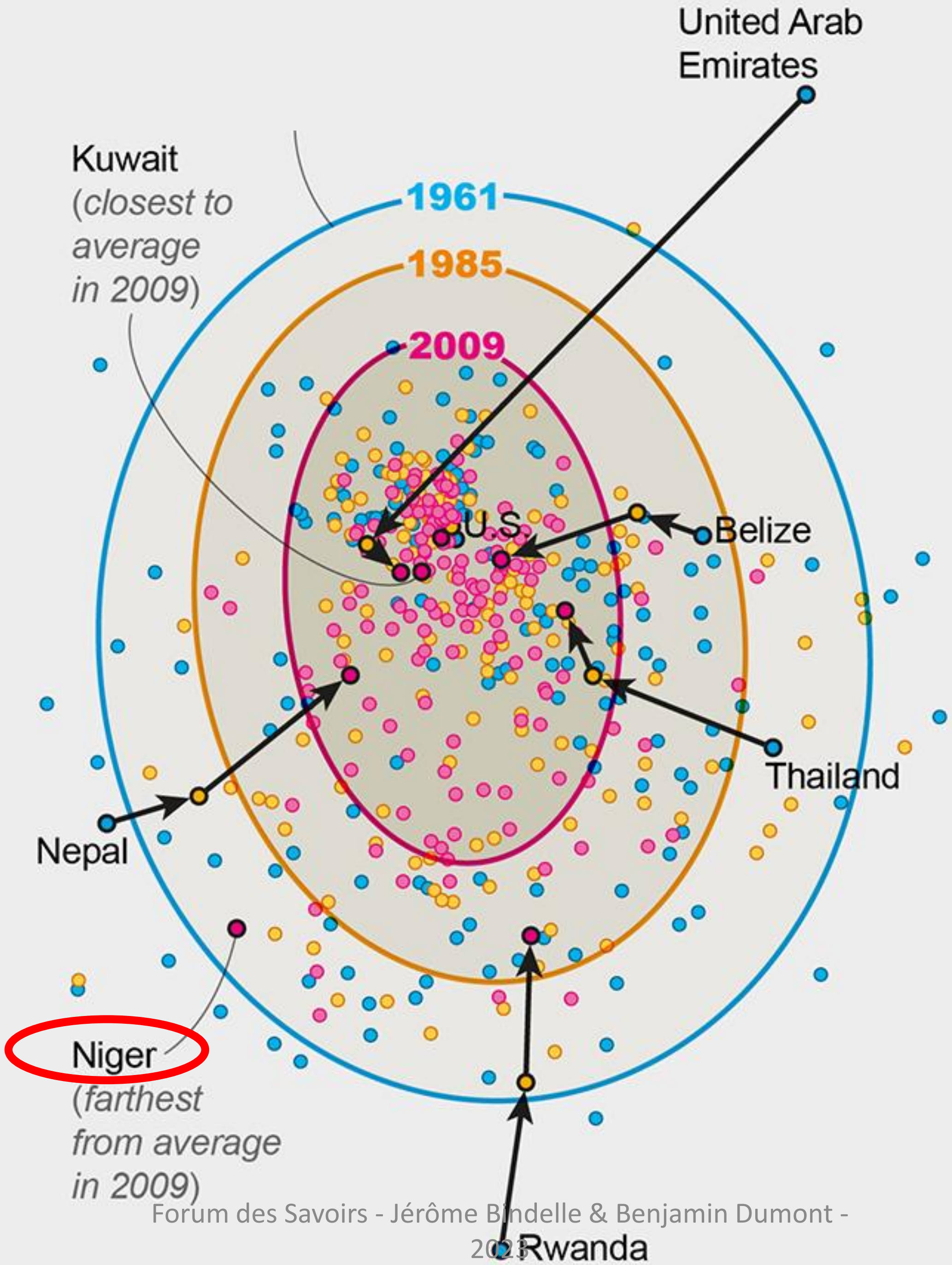
Key Findings of the French BioNutriNet Project on Organic Food–Based Diets: Description, Determinants, and Relationships to Health and the Environment

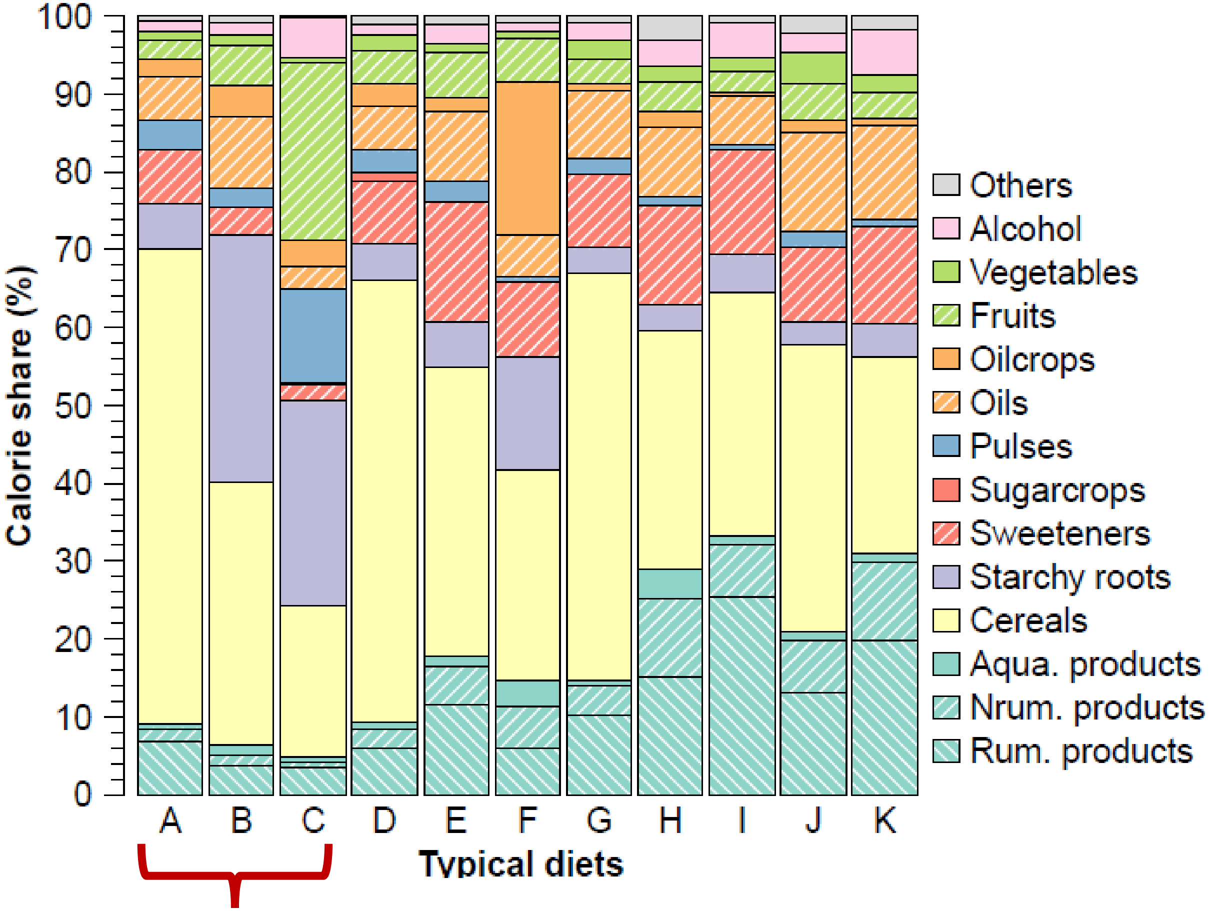
Emmanuelle Kesse-Guyot,[1] Denis Lairon,[2] Benjamin Allès,[1] Louise Seconda,[1,3] Pauline Rebouillat,[1] Joséphine Brunin,[1,3] Rodolphe Vidal,[4] Bruno Taupier-Letage,[4] Pilar Galan,[1] Marie-Josèphe Amiot,[5] Sandrine Péneau,[1] Mathilde Touvier,[1] Christine Boizot-Santai,[6] Véronique Ducros,[7] Louis-Georges Soler,[6] Jean-Pierre Cravedi,[8] Laurent Debrauwer,[8] Serge Hercberg,[1] Brigitte Langevin,[9] Philippe Pointereau,[9] and Julia Baudry[1]



meta-analyses to increase the level of evidence. Finally, the main lesson of the BioNutriNet project could be that while organic food consumption may have some potential health and environmental benefits, it should be accompanied by dietary shifts toward more plant-based dietary patterns. In


LES FRANÇAIS MANGENT DE PLUS EN PLUS MAL…
… MAIS NOUS, ON DOIT TOUJOURS FAIRE DES MEILLEURS PRODUITS !


United Arab
Emirates
Kuwait
(*closest to
average
in 2009*)
1961
1985
2009
U.S.
Belize
Thailand
Nepal
Niger
(*farthest
from average
in 2009*)
Rwanda

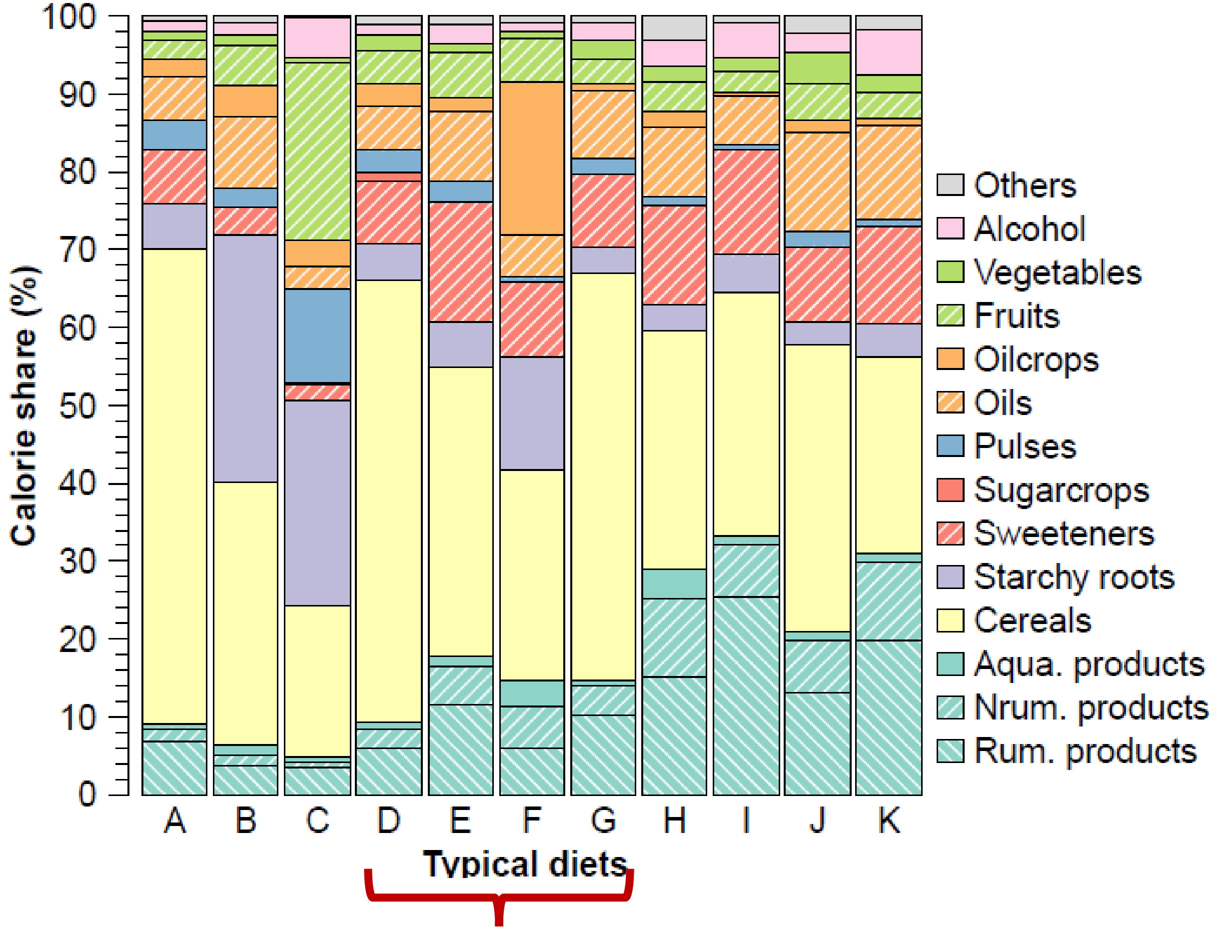


Low-calorie diets (<2400 kcal/j)
Afrique + Asie (jusqu'aux années 1990)

The Aboubakar family of Darfur province, Sudan

https://www.menzelphoto.com/portfolio/G0000s3jj73.5TSs

Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878

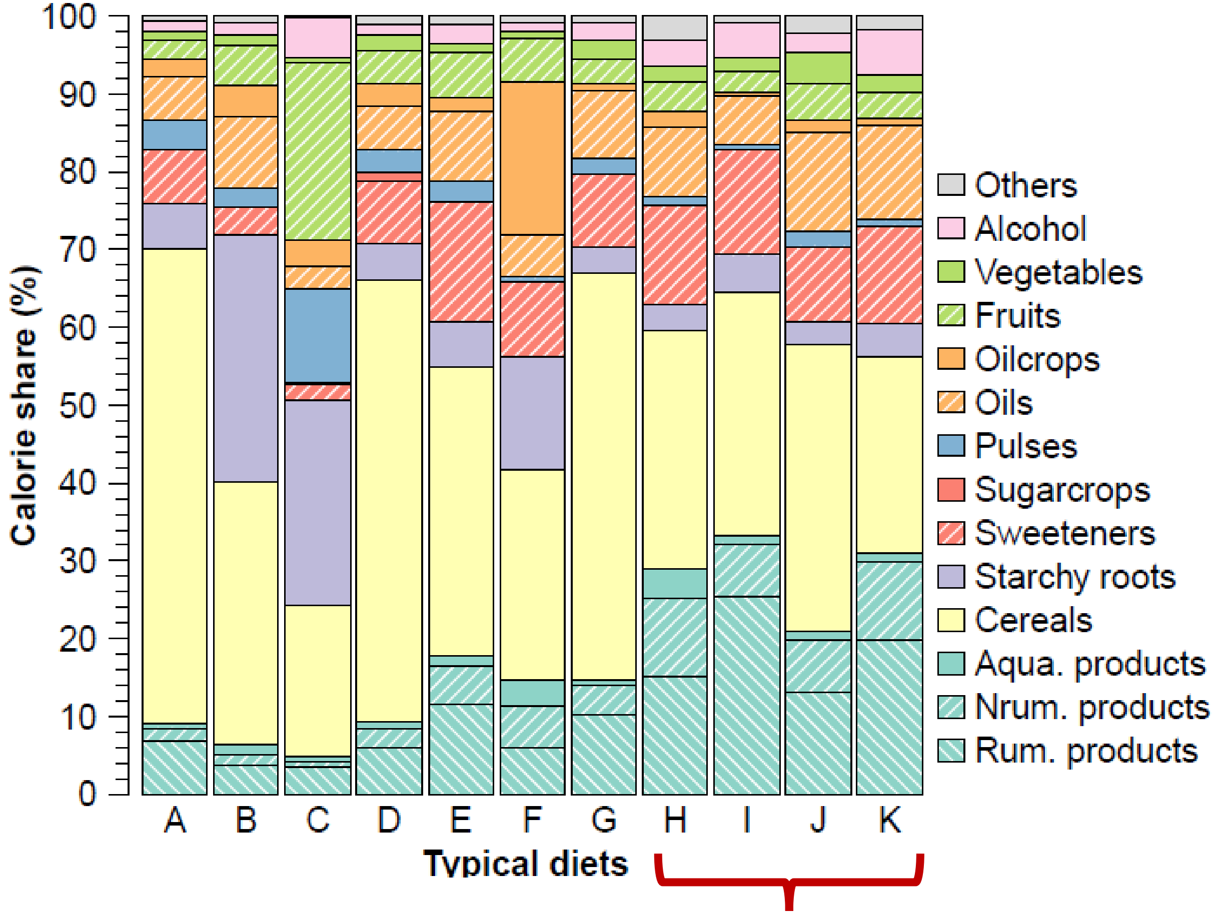


Régimes plus denses énergétiquement grâce aux produits animaux mais apports protéiques animaux encore faibles (entre 2400 et 2800 kcal/j)
Amérique du Sud

The Costa Family in La Havana Cuba

https://www.menzelphoto.com/portfolio/G0000s3jj73.5TSs

Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878



Régimes denses énergétiquement avec beaucoup de produits animaux et apports protéiques élevés (> 2800 kcal/j)

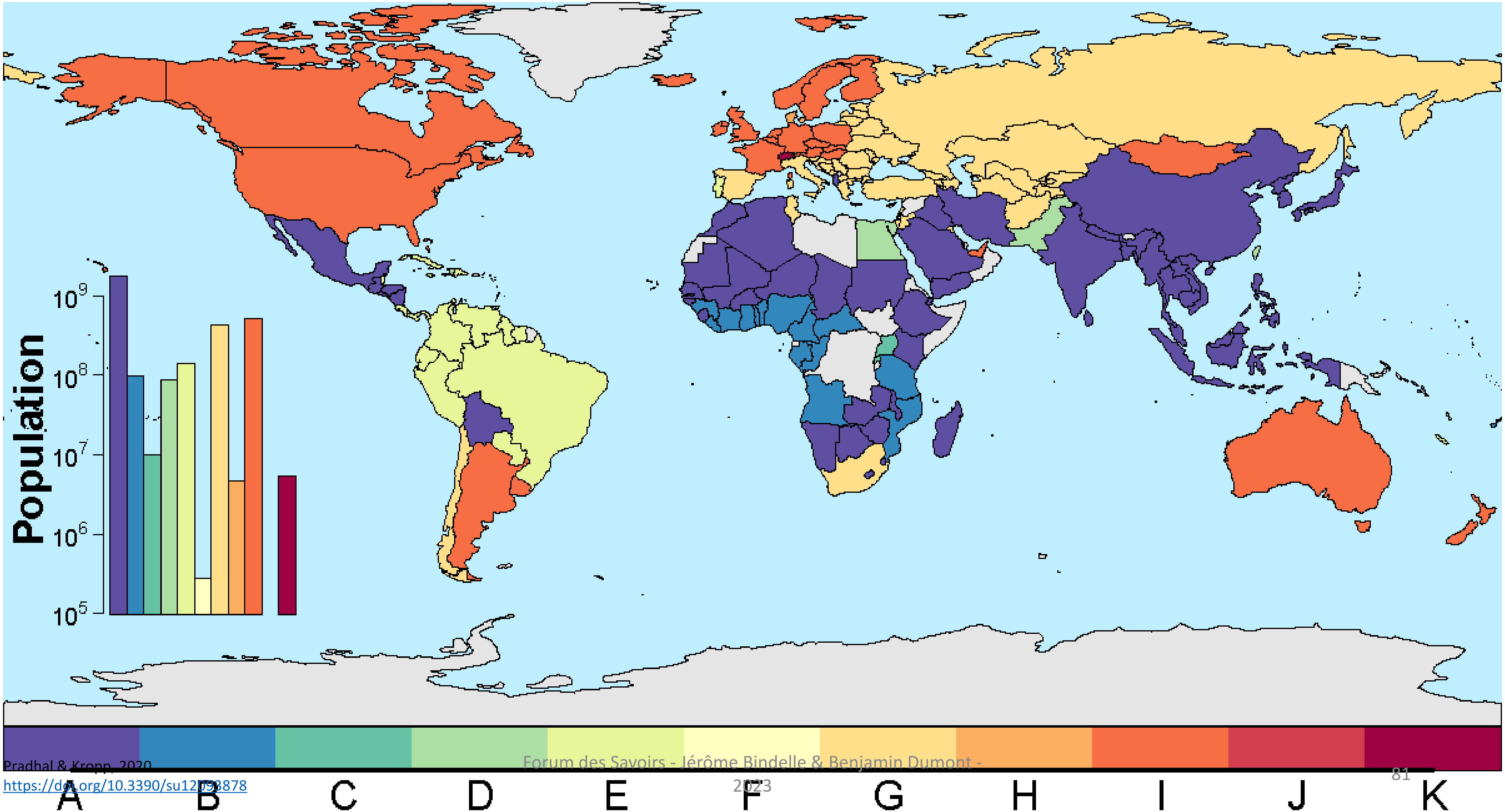
Monde occidental, mais sur tous les continents les pays transitent vers ces régimes

The Lopez-Furtado Family in Luxembourg

https://www.menzelphoto.com/portfolio/G0000s3jj73.5TSs

Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878

Typical diets 1961

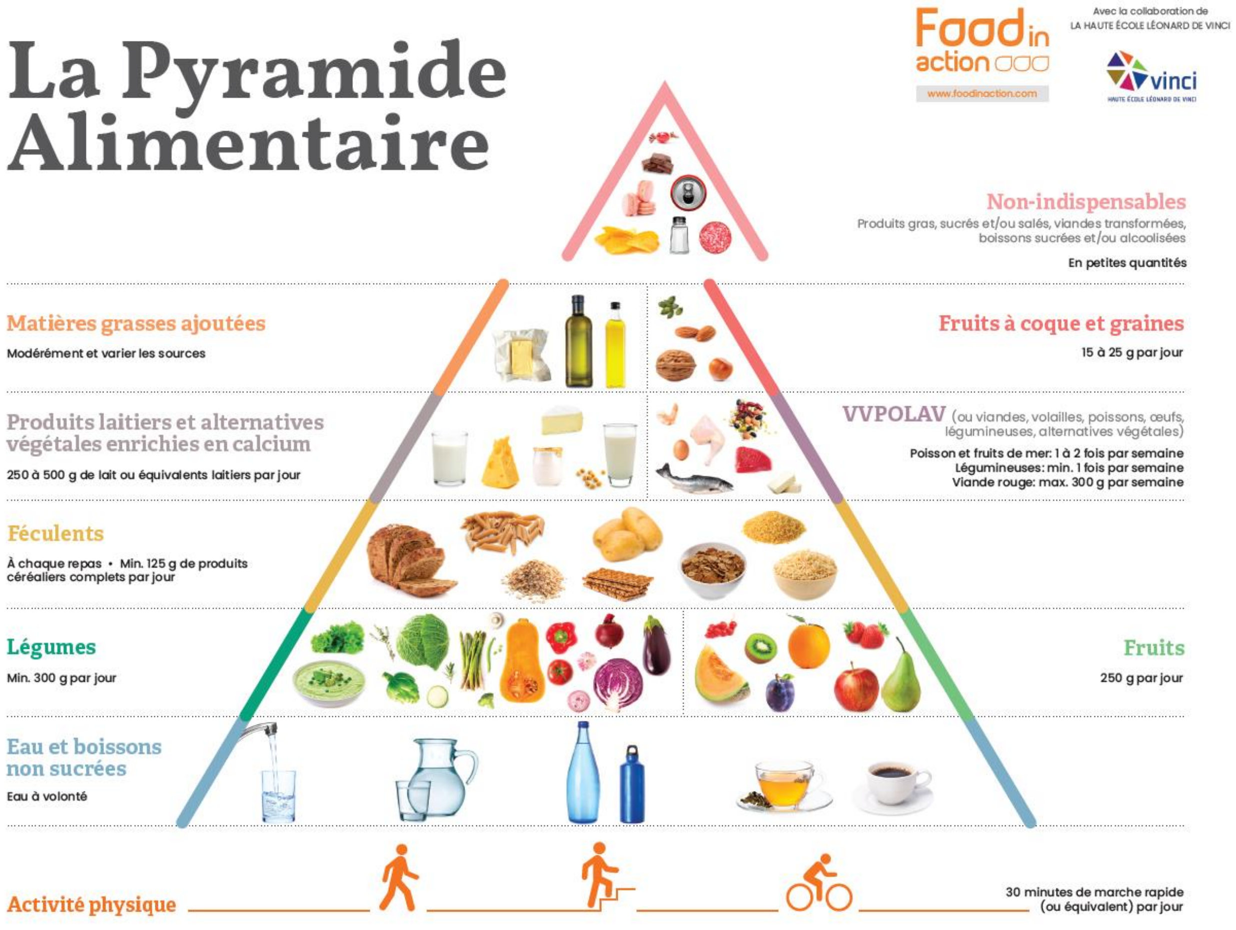


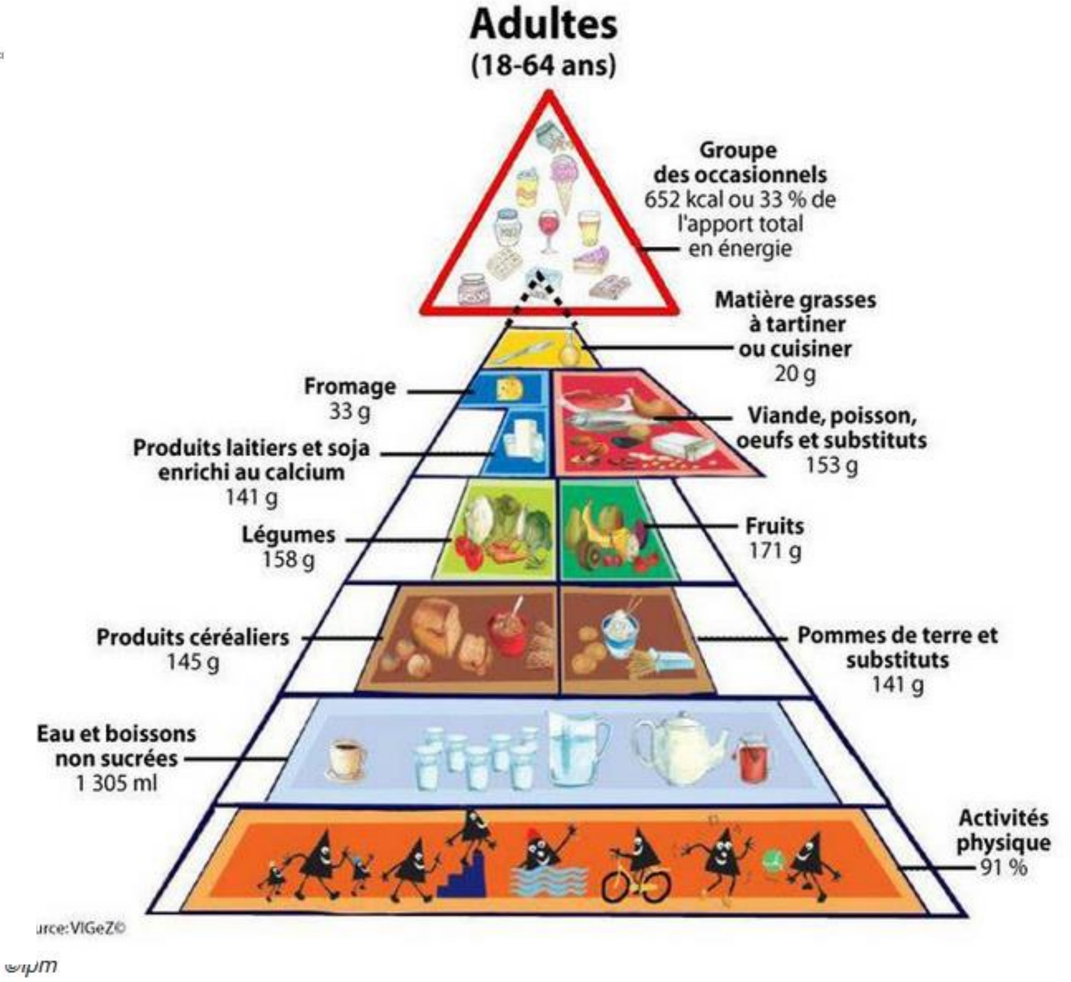
Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878

https://www.menzelphoto.com/portfolio/G0000bKlicjjOIpY/I0000XmCzmFqNwD0

Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878

Pyramide alimentaire vs. consommation réelle





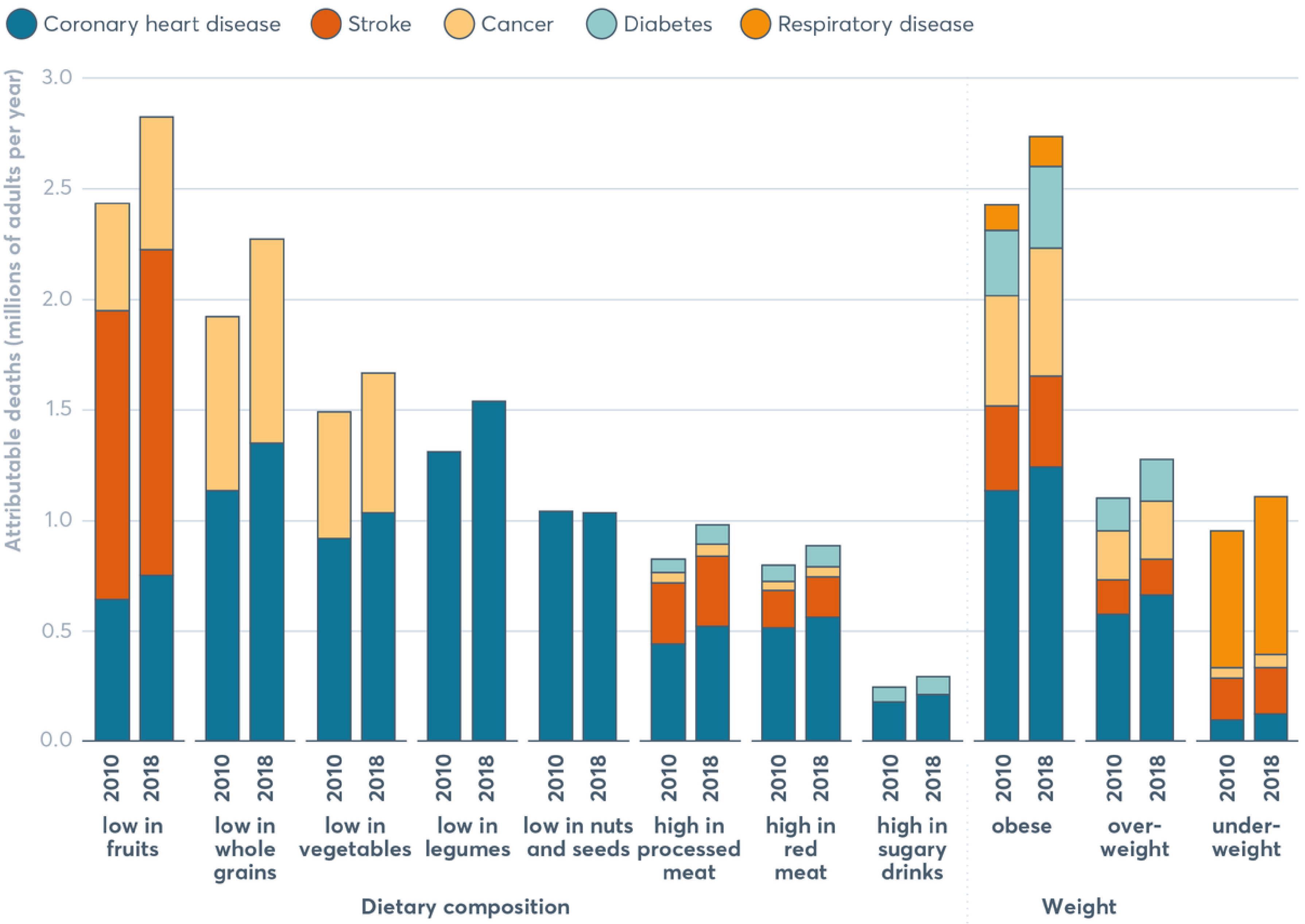
https://www.lalibre.be/planete/sciences-espace/2016/09/30/dans-lassiette-jusqua-5-ans-ca-va-apres-bonjour-les-degats-FZYYAMDFHJGSPNDRBSKGNHGR34/

le vif. Belgique Monde Mon argent Opinions Santé Sciences et environnement

A quelques exceptions près, la carte mondiale de l'obésité correspond à celle de la prospérité. © getty images

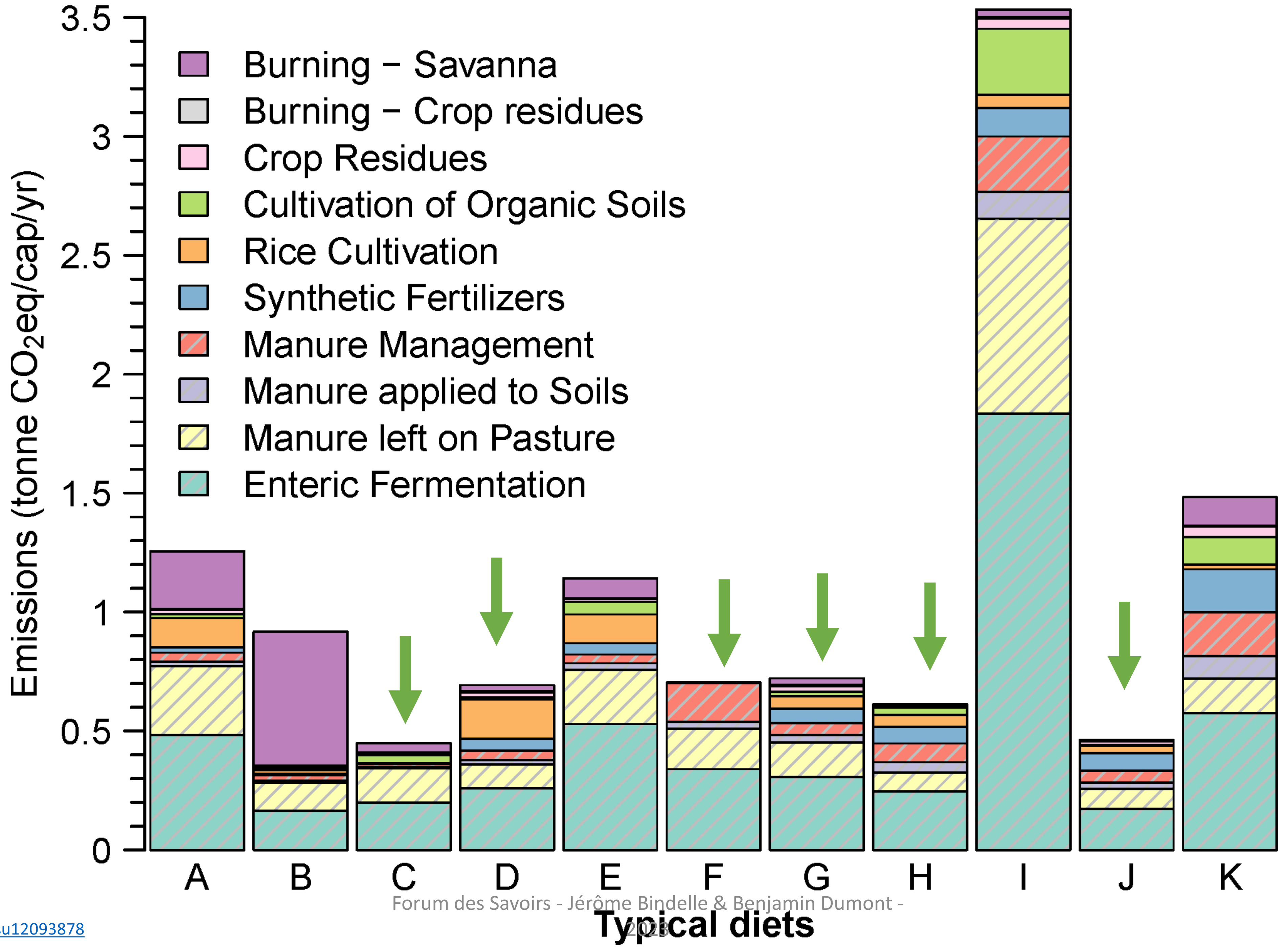
Politique de santé

Epidémie d'obésité: pourquoi on est de plus en plus gros (analyse)



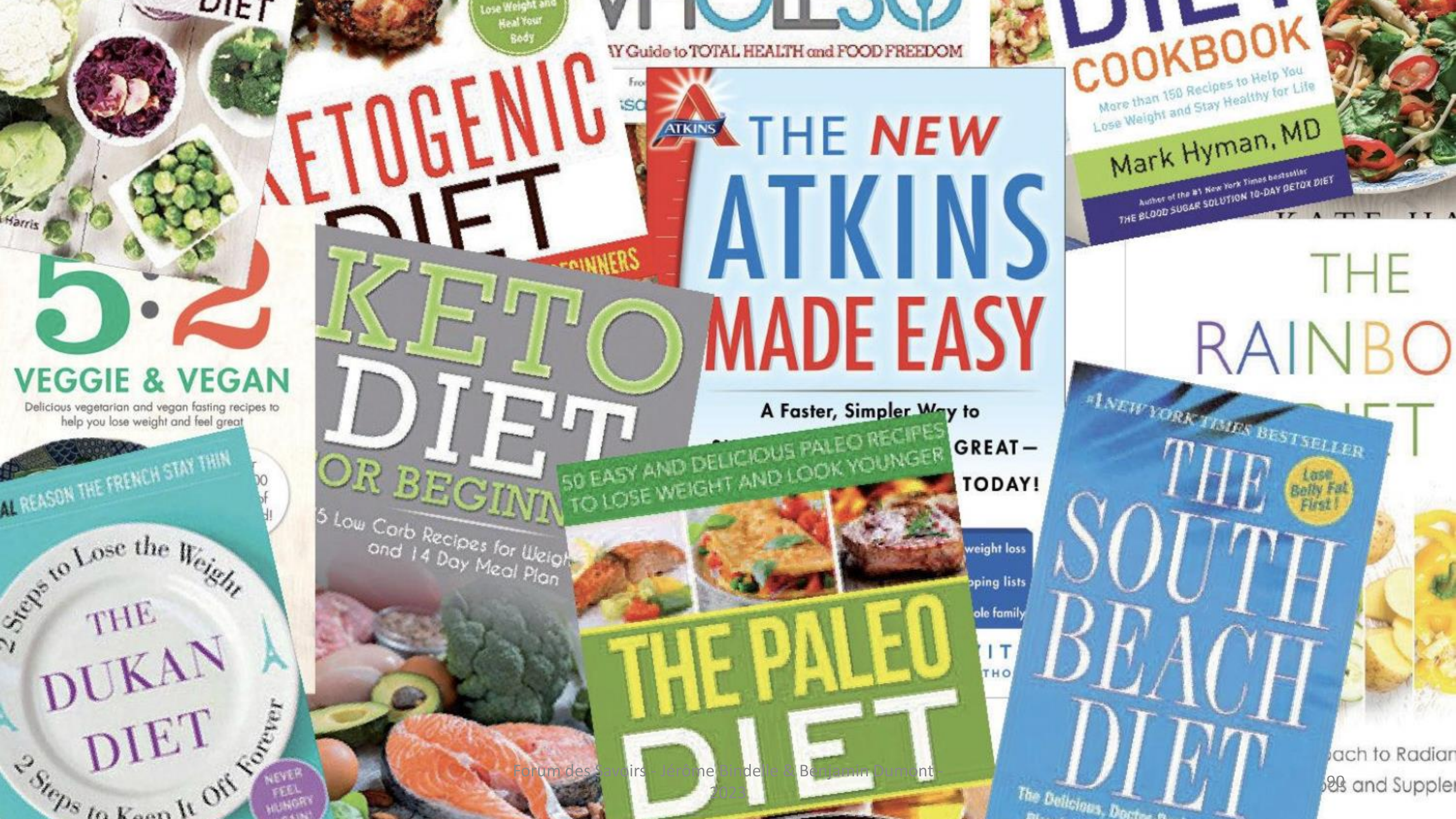
https://globalnutritionreport.org/reports/2021-global-nutrition-report/health-and-environmental-impacts-of-diets-worldwide/

L’urgence est de (re)-connecter des régimes sains avec des systèmes alimentaires durables



Pradhal & Kropp, 2020
https://doi.org/10.3390/su12093878

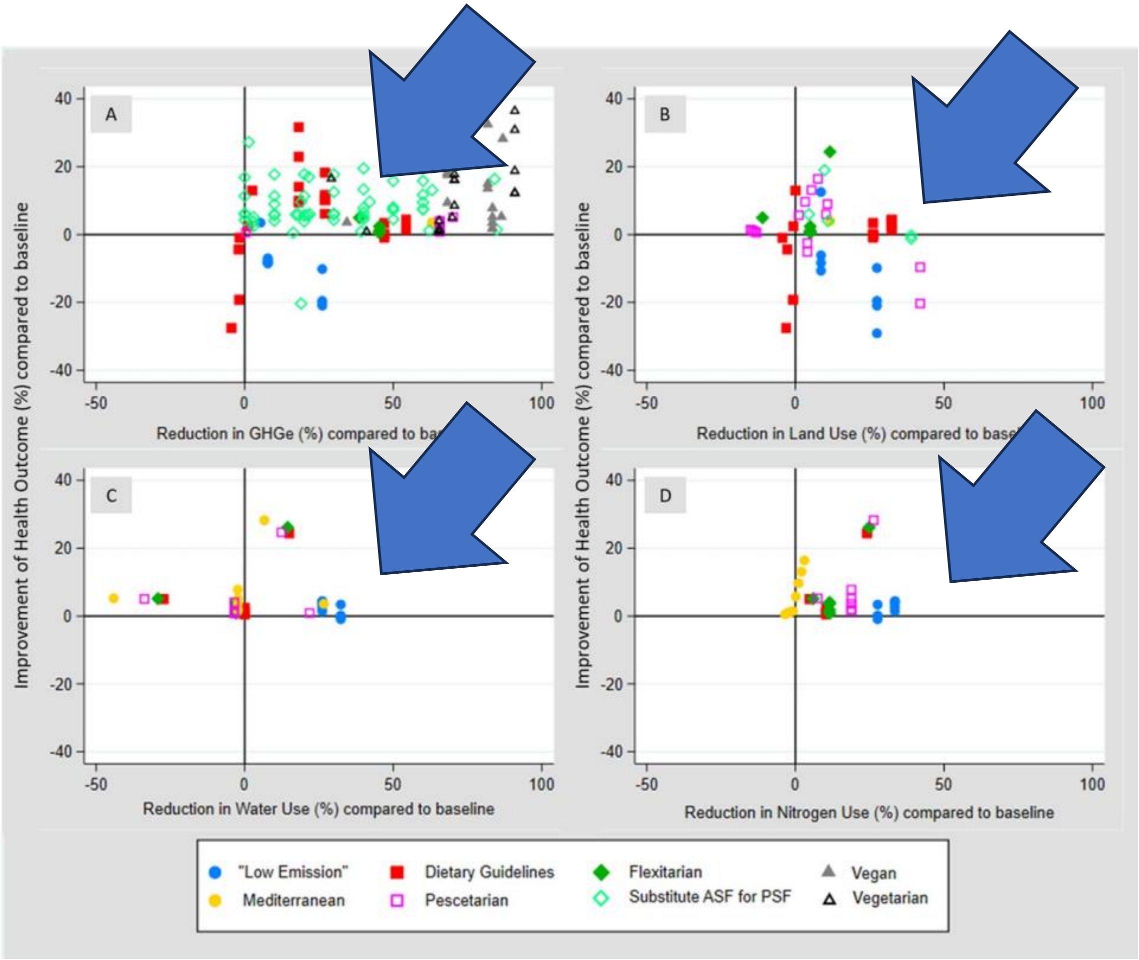
Comment assembler les pieces du casse-tête?


DIET
Lose Weight and Heal Your Body
KETOGENIC DIET
Guide to TOTAL HEALTH and FOOD FREEDOM
COOKBOOK
More than 150 Recipes to Help You Lose Weight and Stay Healthy for Life
Mark Hyman, MD
Author of the #1 New York Times bestseller THE BLOOD SUGAR SOLUTION 10-DAY DETOX DIET
ATKINS
THE NEW ATKINS MADE EASY
A Faster, Simpler Way to
GREAT—
TODAY!
weight loss
ping lists
ole family
5:2
VEGGIE & VEGAN
Delicious vegetarian and vegan fasting recipes to help you lose weight and feel great
THE RAINBO
KETO DIET FOR BEGINN
Low Carb Recipes for Weigh and 14 Day Meal Plan
50 EASY AND DELICIOUS PALEO RECIPES TO LOSE WEIGHT AND LOOK YOUNGER
THE PALEO DIET
#1 NEW YORK TIMES BESTSELLER
THE SOUTH BEACH DIET
Lose Belly Fat First!
REASON THE FRENCH STAY THIN
2 Steps to Lose the Weight
THE DUKAN DIET
2 Steps to Keep It Off Forever
NEVER FEEL HUNGRY

Author definition of diet	Dietary label in this review
'Sustainable Diet'	Low GHG Emission
Adherence to dietary guidelines: DHD, RSN, GDG, HDI, DASH and GBD	Dietary Guidelines
'Flexitarian'	Flexitarian
Increased consumption of PSF	Increase PSF
'Mediterranean diet'	Mediterranean
Pescatarian OR increase in fish consumption	Pescatarian/increase fish
Reduction of meat or other ASF, no substitution	Reduce ASF no substitute
Reduction of ASF with substitution with PSF	Substitute ASF with PSF
Reduction of ASF with substitution with SS	Substitute ASF with SS
Reduction of meat with substitution with other ASF	Substitute meat with ASF
'Vegan'	Vegan
'Vegetarian'	Vegetarian

Jarmul et al 2020
https://iopscience.iop.org/article/10.1088/1748-9326/abc2f7#er

Régimes alimentaires et leur impact environnemental



Jarmul et al 2020
https://iopscience.iop.org/article/10.1088/1748-9326/abc2f7#er

Dietary Strategies to Reduce Environmental Impact: A Critical Review of the Evidence Base

Bradley G Ridoutt,[1,2] Gilly A Hendrie,[3] and Manny Noakes[3]

Achieving Healthy and Sustainable Diets: A Review of the Results of Recent Mathematical Optimization Studies

Nick Wilson, Christine L Cleghorn, Linda J Cobiac, Anja Mizdrak, and Nhung Nghiem

Defining nutritionally and environmentally healthy dietary choices of omega-3 fatty acids

María Belén Salazar T [a], Hua Cai [b, c], Regan Bailey [d], Jen-Yi Huang [a, c, *]

Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail

Marco Springmann, Keith Wiebe, Daniel Mason-D'Croz, Timothy B Sulser, Mike Rayner, Peter Scarborough

How much animal-source food can we produce while avoiding feed-food competition?

O. van Hal, I.J.M. de Boer, and H.H.E. van Zanten

Country-Specific Sustainable Diets Using Optimization Algorithm

Abhishek Chaudhary[*,†] and Vaibhav Krishna[‡]

ORIGINAL ARTICLE

Modelling the health impact of environmentally sustainable dietary scenarios in the UK

P Scarborough[1], S Allender[1,2], D Clarke[1], K Wickramasinghe[1] and M Rayner[1]

Options for keeping the food system within environmental limits

Marco Springmann[1,2*], Michael Clark[3], Daniel Mason-D'Croz[4,5], Keith Wiebe[4], Benjamin Leon Bodirsky[6], Luis Lassaletta[7], Wim de Vries[8], Sonja J. Vermeulen[9,10], Mario Herrero[5], Kimberly M. Carlson[11], Malin Jonell[12], Max Troell[12,13], Fabrice DeClerck[14,15], Line J. Gordon[12], Rami Zurayk[16], Peter Scarborough[2], Mike Rayner[2], Brent Loken[12,14], Jess Fanzo[17,18], H. Charles J. Godfray[1,19], David Tilman[20,21], Johan Rockström[6,12] & Walter Willett[22]

Climate change mitigation and health effects of varied dietary patterns in real-life settings throughout North America[1–4]

Samuel Soret, Alfredo Mejia, Michael Batech, Karen Jaceldo-Siegl, Helen Harwatt, and Joan Sabaté

Meat consumption reduction in Italian regions: Health co-benefits and decreases in GHG emissions

Sara Farchi*, Manuela De Sario, Enrica Lapucci, Marina Davoli, Paola Michelozzi

Welfare and sustainability effects of dietary recommendations

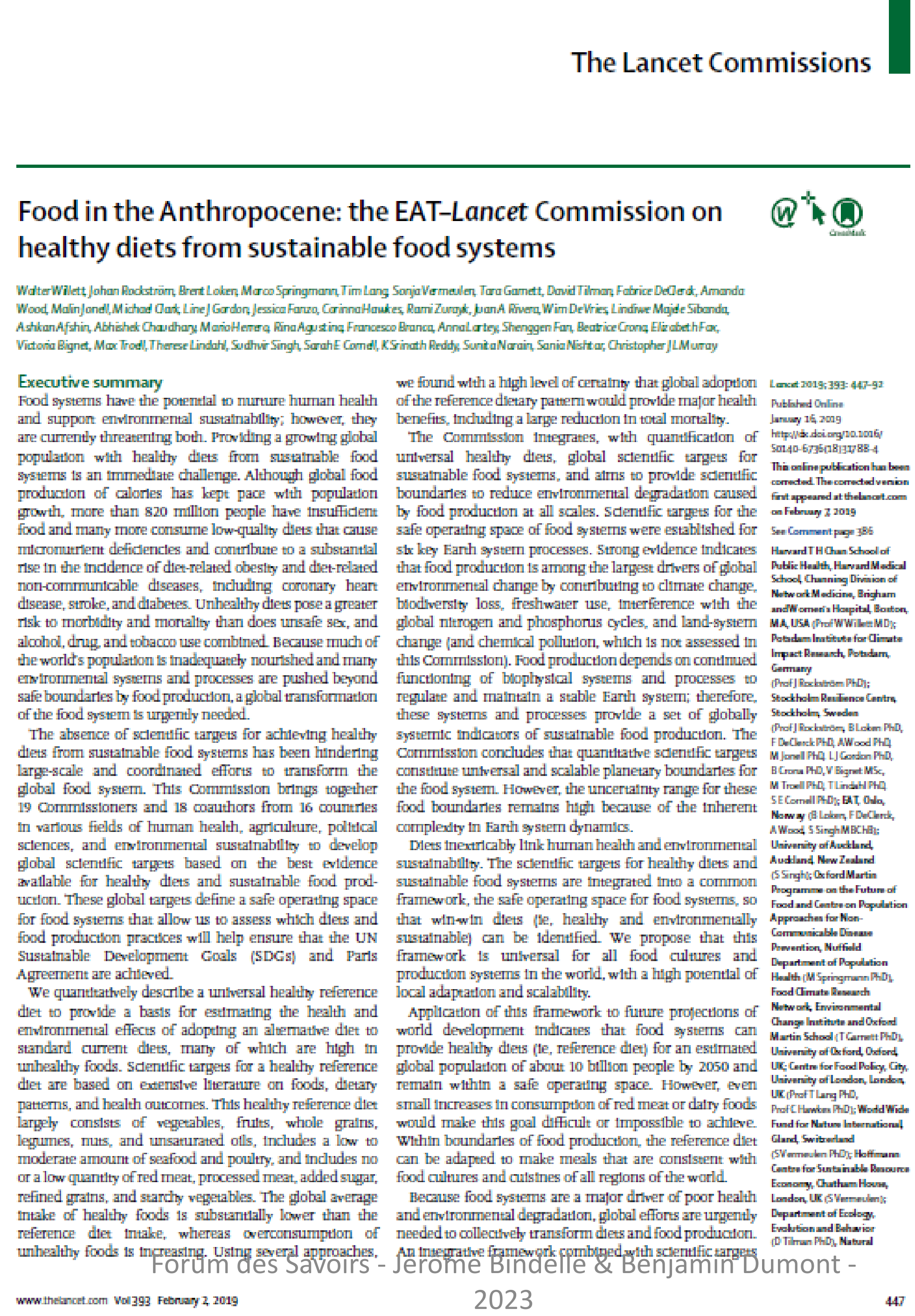
Xavier Irz [a], Pascal Leroy [b], Vincent Réquillart [c], Louis-Georges Soler [b,*]

Dietary Change and Global Sustainable Development Goals

Canxi Chen[1], Abhishek Chaudhary[2] and Alexander Mathys[1]*

PROSPECTIVE ANALYSIS OF THE EVOLUTION OF AGRONOMIC, ENVIRONMENTAL AND NUTRITIONAL PERFORMANCES OF CONTRASTING CROP ROTATIONS WHEN FACING CLIMATE CHANGE

MATHIEU DELANDMETER[1$], JÉRÔME BINDELLE[2], CAROLINE DE CLERCK[3], BENJAMIN DUMONT[1]



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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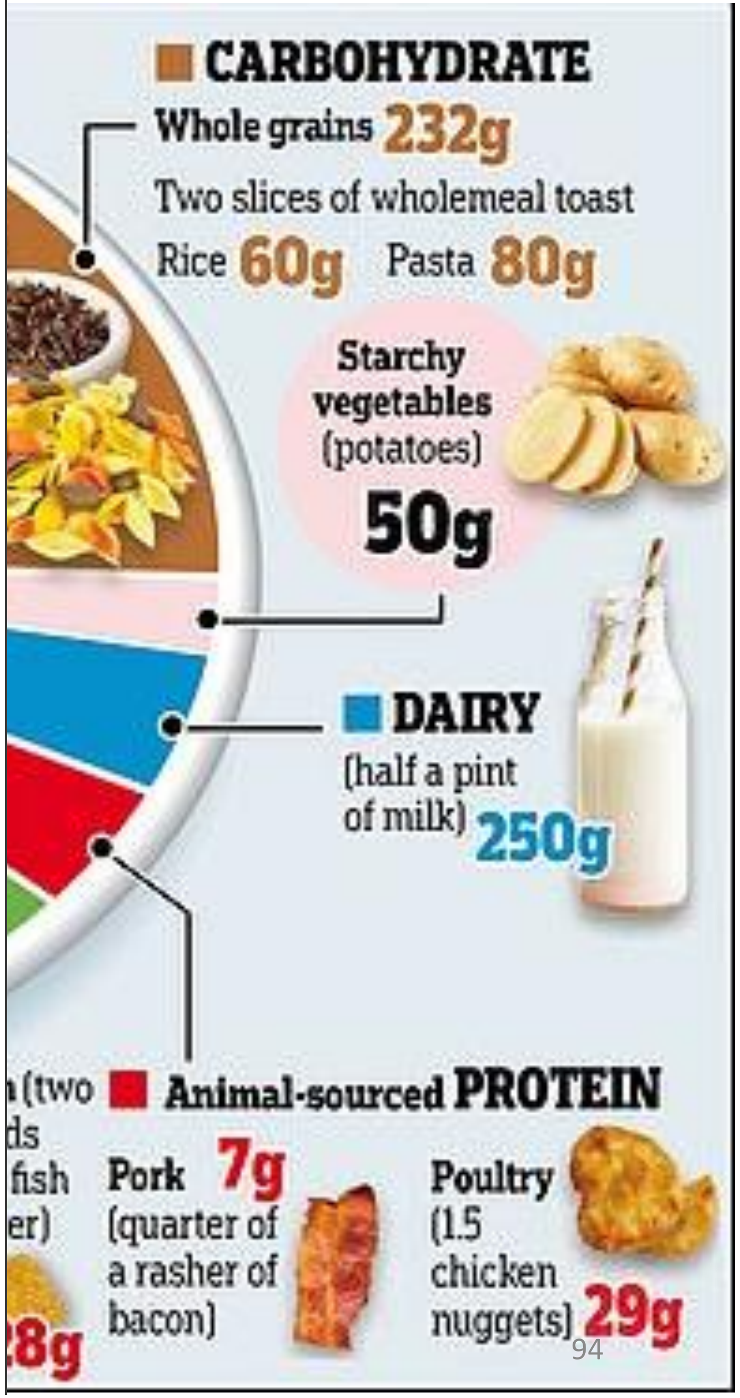
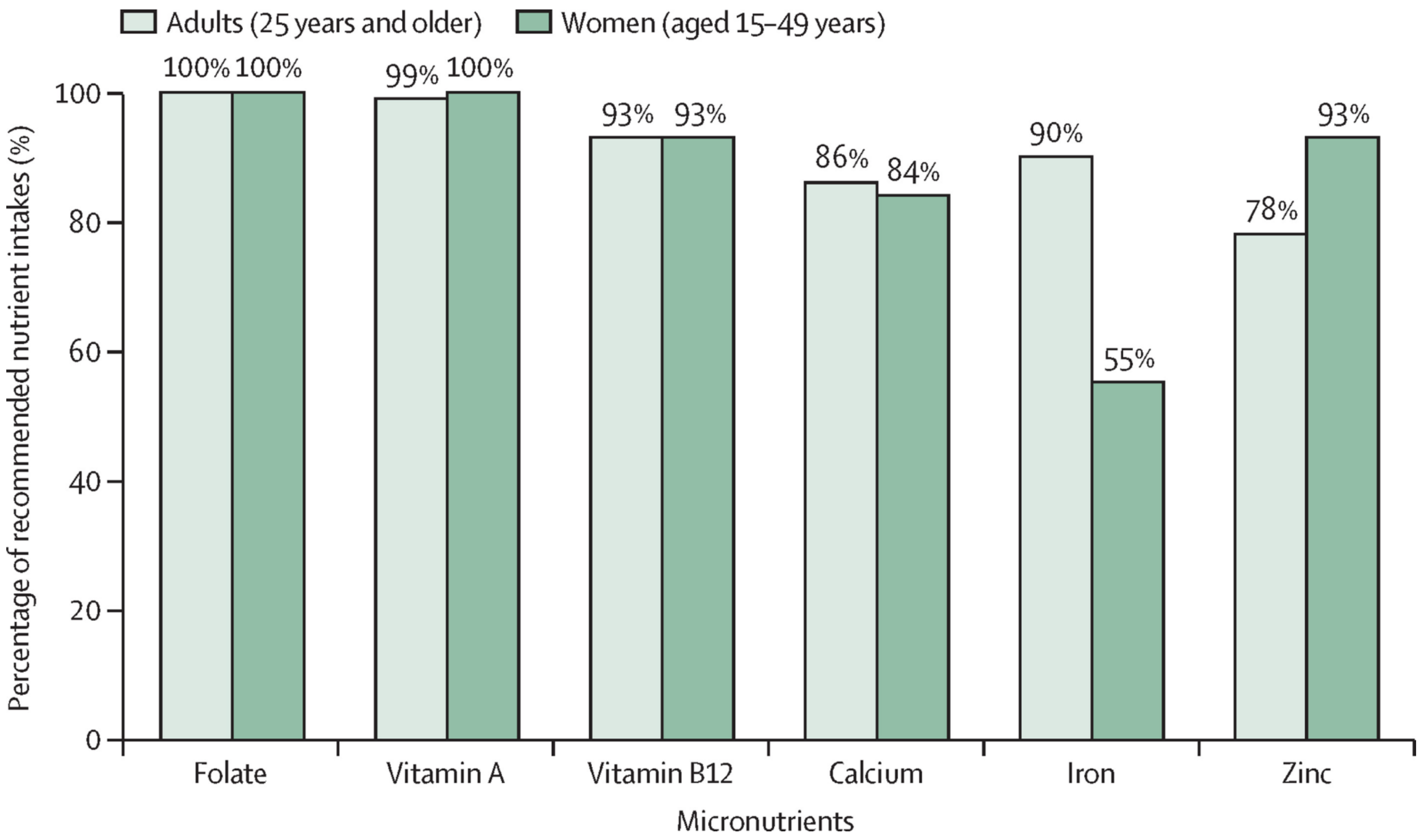
See Comment page 386

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



Déficits en micronutriments du régime EAT–*Lancet*

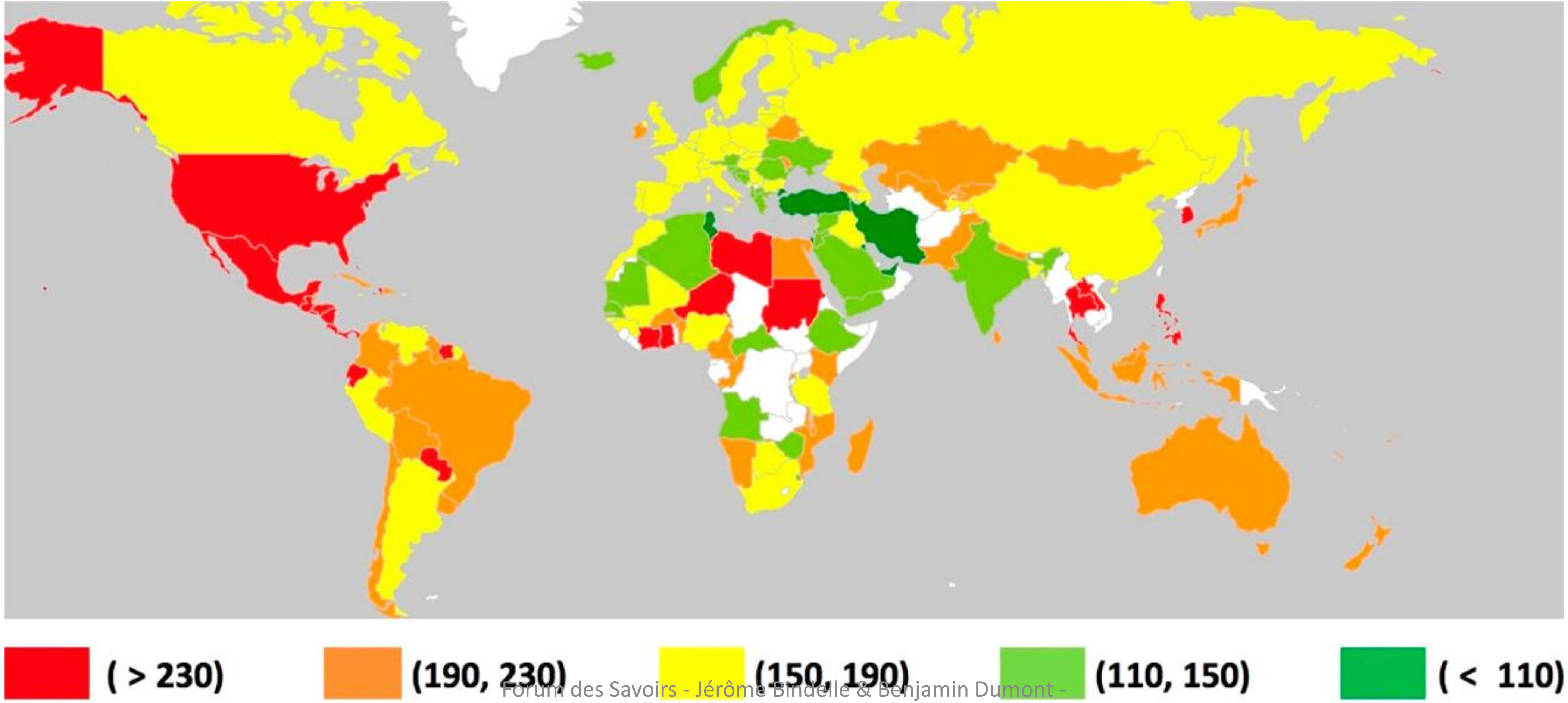


Beal et al., 2023
https://doi.org/10.1016/S2542-5196(23)00006-2

	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	200 (100–300)	126
Dairy foods		
Whole milk or derivative equivalents (eg, cheese)	250 (0–500)	153

	Macronutrient intake (possible range), g/day	Caloric intake, kcal/day
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

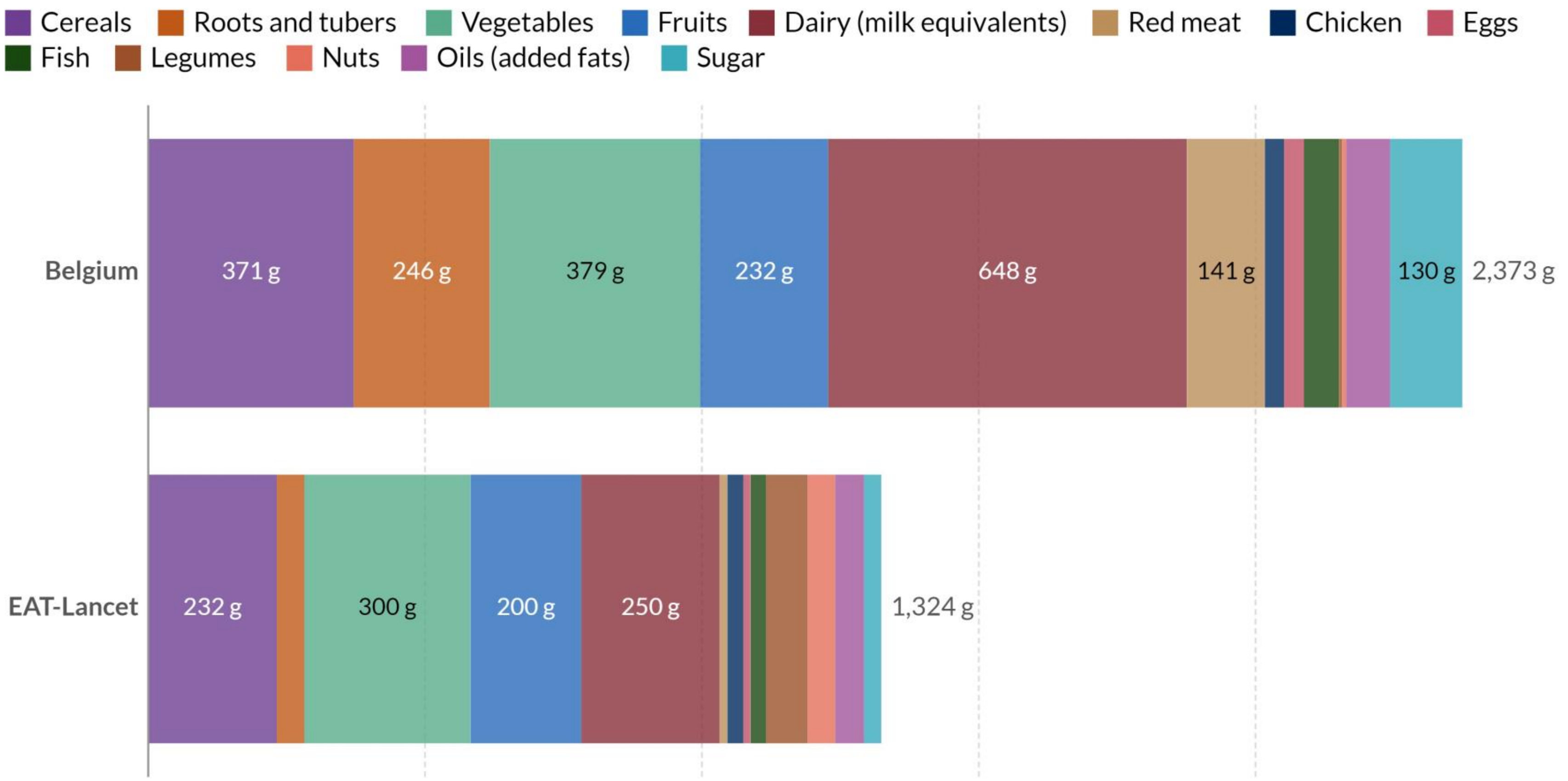
Qui doit changer le plus?



EAT-Lancet in grams per capita per day		Belgium in grams per capita per day
Cereals	232 g	371 g
Roots and tubers	50 g	246 g
Vegetables	300 g	379 g
Fruits	200 g	232 g
Dairy (milk equivalents)	250 g	648 g
Red meat	14 g	141 g
Chicken	29 g	35 g
Eggs	13 g	36 g
Fish	28 g	63 g
Legumes	75 g	6 g
Nuts	50 g	7 g
Oils (added fats)	52 g	79 g
Sugar	31 g	130 g
Total	1,324 g	2,373 g

How do actual diets compare to the EAT-Lancet diet?

Diets are shown as average daily per capita supply of different food groups, compared to the EAT-Lancet diet. The EAT-Lancet diet is a diet recommended to balance the goals of healthy nutrition and environmental sustainability for a global population.



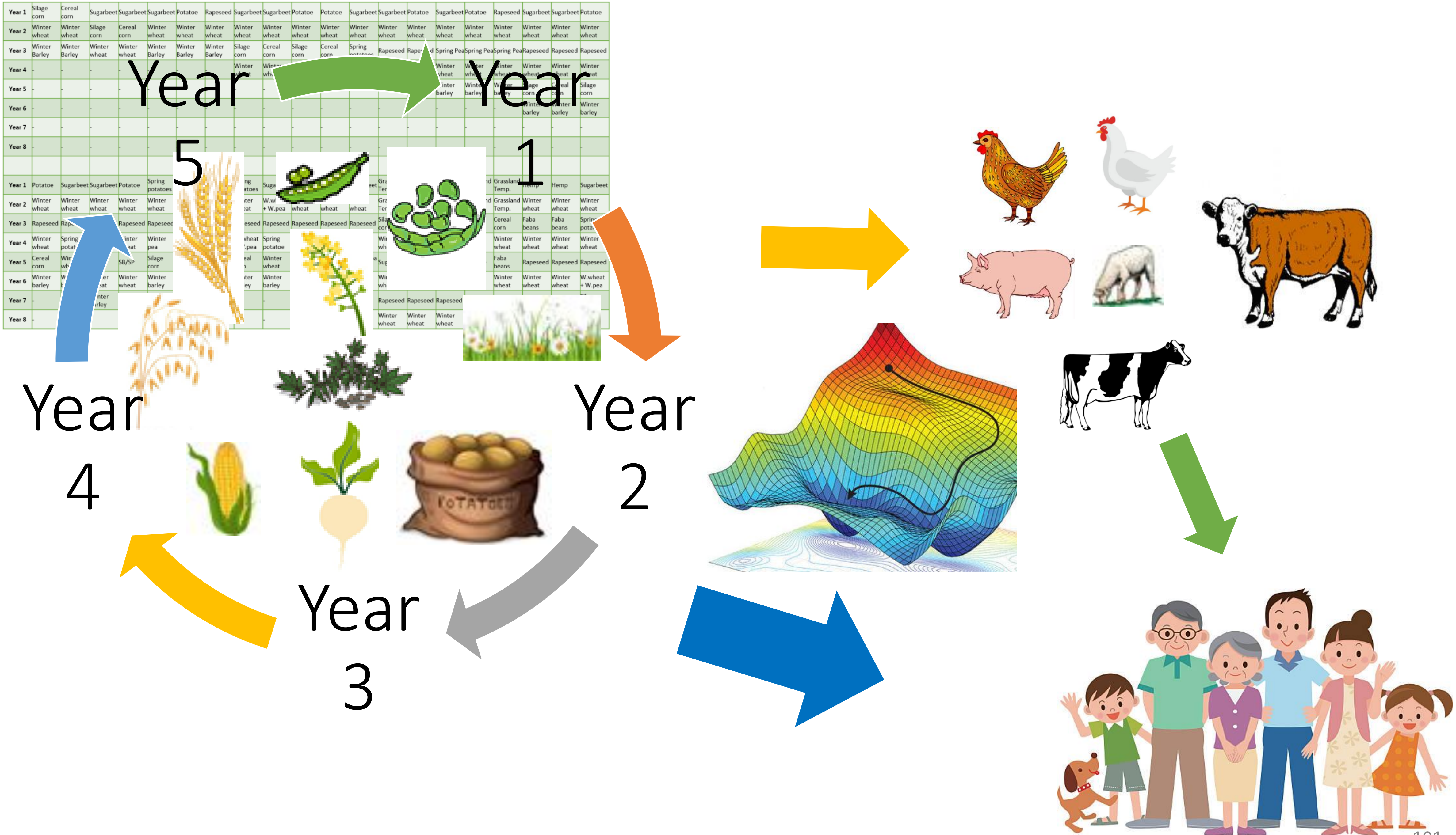
Source: Food and Agriculture Organization of the United Nations; EAT-Lancet Commission
Note: Diets by country are given as food supply – this is higher than actual intakes because it does not correct for consumer waste.
OurWorldInData.org/diet-compositions • CC BY

Ecart consommation vs. EAT-Lancet pour la Belgique

Category	Item	Actual	Optimized	Gap
Energy	Energy (kcal/cap/day)	4044,8	2444,0	65
Energy	Sugar (g/capita/day)	200,08	112,8	77
Fat	Cholesterol (mg/capita/day)	691,85	301,1	130
Fat	Polyunsaturated fatty acids (g/cap/day)	32,0	13,1	144
Fat	Saturated fats (g/capita/day)	72,38	23,1	214
Fat	Total fat (g/capita/day)	173,79	65,0	167
Fiber	Fiber (g/cap/day)	16,3	31,2	-48
Mineral	Calcium (mg/cap/day)	1245,4	639,4	95
Mineral	Copper (mg/cap/day)	1,7	2,3	-24
Mineral	Iron (mg/cap/day)	21,3	22,2	-4
Mineral	Magnesium (mg/cap/day)	493,0	558,3	-12
Mineral	Manganese (mg/cap/day)	4,7	5,9	-21
Mineral	Phosphorus (mg/cap/day)	1945,1	1506,0	29
Mineral	Potassium (mg/cap/day)	4595,6	4984,5	-8
Mineral	Selenium (µg/cap/day)	303,5	128,6	136
Mineral	Thiamin (mg/cap/day)	1,8	1,7	6
Mineral	Zinc (mg/cap/day)	13,7	10,3	33
Protain	Protein (g/cap/day)	110,9	68,5	62
Vit	Choline (mg/cap/day)	638,5	593,6	8
Vit	Folate (µg/cap/day)	399,0	558,8	-29
Vit	Niacin (mg/cap/day)	23,6	19,5	21
Vit	Pantothenic acid (mg/cap/day)	12,0	8,5	40
Vit	Riboflavin (mg/cap/day)	1,9	1,5	24
Vit	Vitamin A (RAE/cap/day)	2377,4	1146,9	107
Vit	Vitamin B12 (µg/cap/day)	8,0	2,2	261
Vit	Vitamin B6 (mg/cap/day)	2,9	3,0	-5
Vit	Vitamin C (mg/cap/day)	146,3	250,9	-42
Vit	Vitamin E (mg/cap/day)	17,6	9,7	80
Vit	Vitamin K (µg/cap/day)	213,0	218,8	-3

Chaudhary & Krishna 2019
https://doi.org/10.1021/acs.est.8b06923

Redessiner le modèle agricole en adequation avec des régimes durables


Year 1
Year 2
Year 3
Year 4
Year 5
POTATOES

Reconnecter les régimes aux systèmes de culture

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	35[illegible]	[illegible]	[illegible]	0	0
Other oilseed meals	50	40	0	0	60
Pulses	0	0	0	50	0
Other by-products	170	[illegible]	[illegible]	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.

Composition des aliments concentrés pour le bétail

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, winter-finishing of weaned calves, 560 kg live weight [illegible] 18 months at slaughter	1 calf + 1.0[illegible] cow	72 (calf), 52 (cow)	[illegible]308	15[illegible]	4261	1811
18 to 20 month beef	Spring-born dairy-bred calves, grass finishing, 515 kg live weight and 19 months at slaughter	1 calf	76	288	1150	1680	1660
Cereal beef	Continental × dairy-bred bulls, [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 a[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.

Cycle de production du bétail, producitons et besoins en fourrage et concentrés

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 h[illegible]ves	tubercules	14[illegible]	383,8	5.411	2.732
Pommes de terre d[illegible]	[illegible]	33.[illegible]	4[illegible]	[illegible]	[illegible]1.718
Betteraves sucrières	racines	34.535	863,1	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

Rendements des cultures

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

The Lancet Commissions

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

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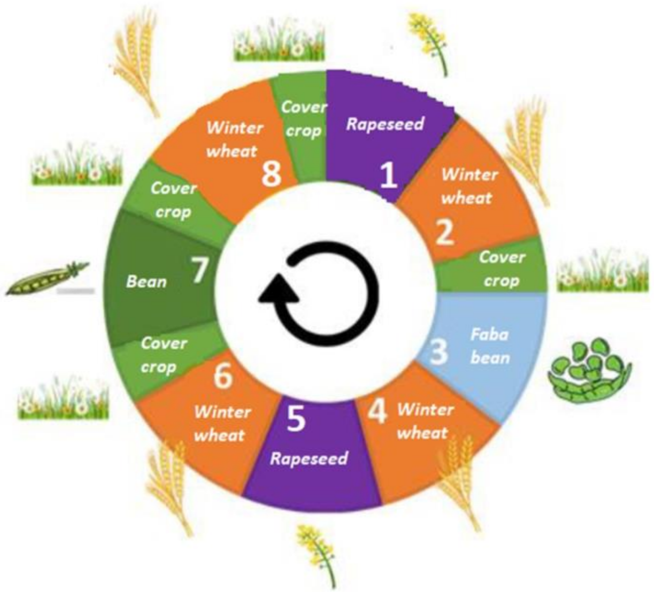
Lard or tallow‖	5 (0–5)	36
Added sugars		
All sweeteners	31 (0–31)	120

EAT Lancet diet

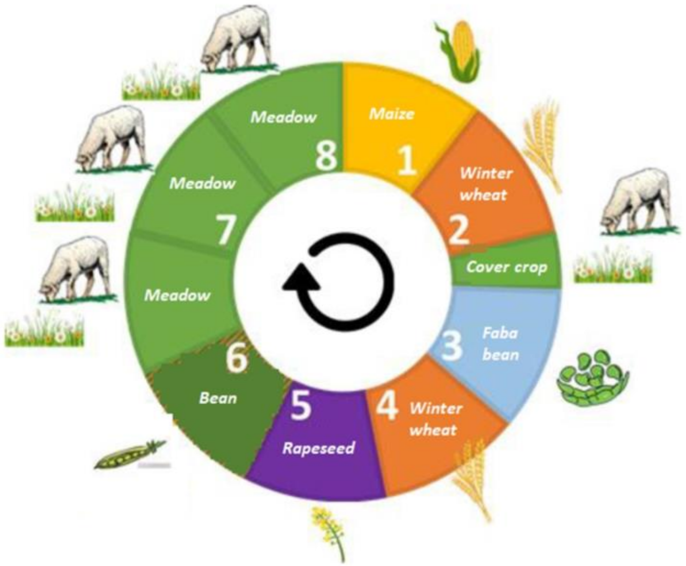
Willet et al., 2019
https://doi.org/10.1016/S0140-6736(18)31788-4

ROTATIONS INNOVANTES

Business-as-usual (BAU)



Vegan

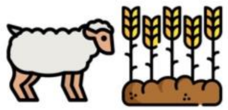


Integrated Crop-Livestock (ICLS)

Animal-crop flow:

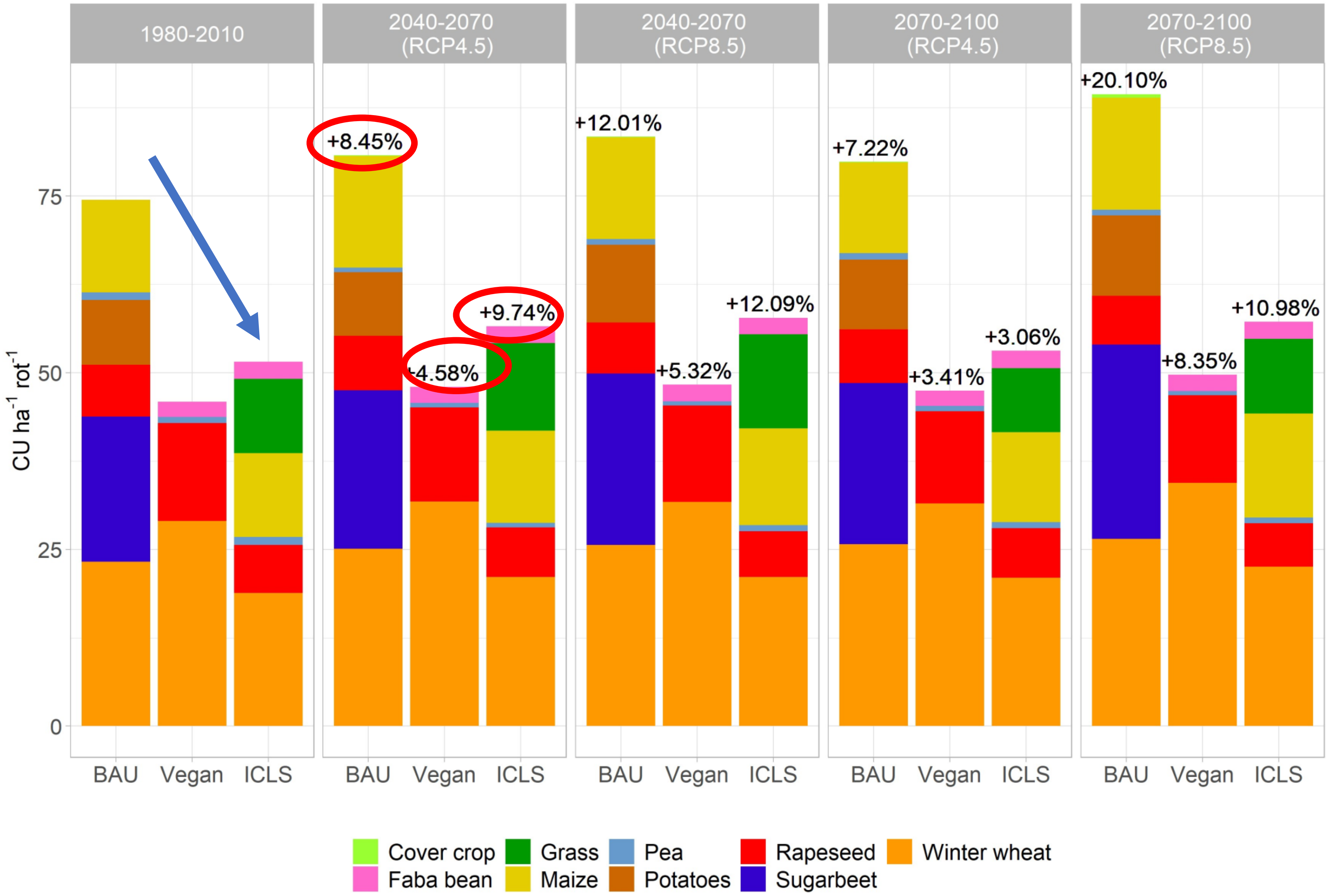
External connexion

No connexion (no animals)

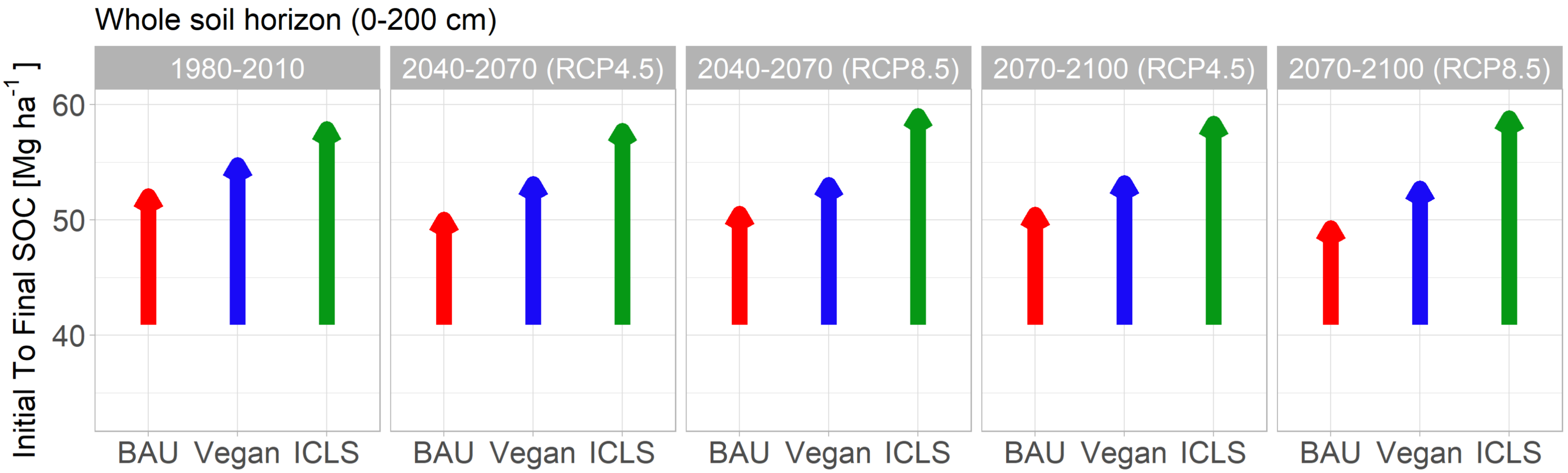


Internal connexion

Potentiel d'adaptation



Potentiel de mitigation



Remerciements

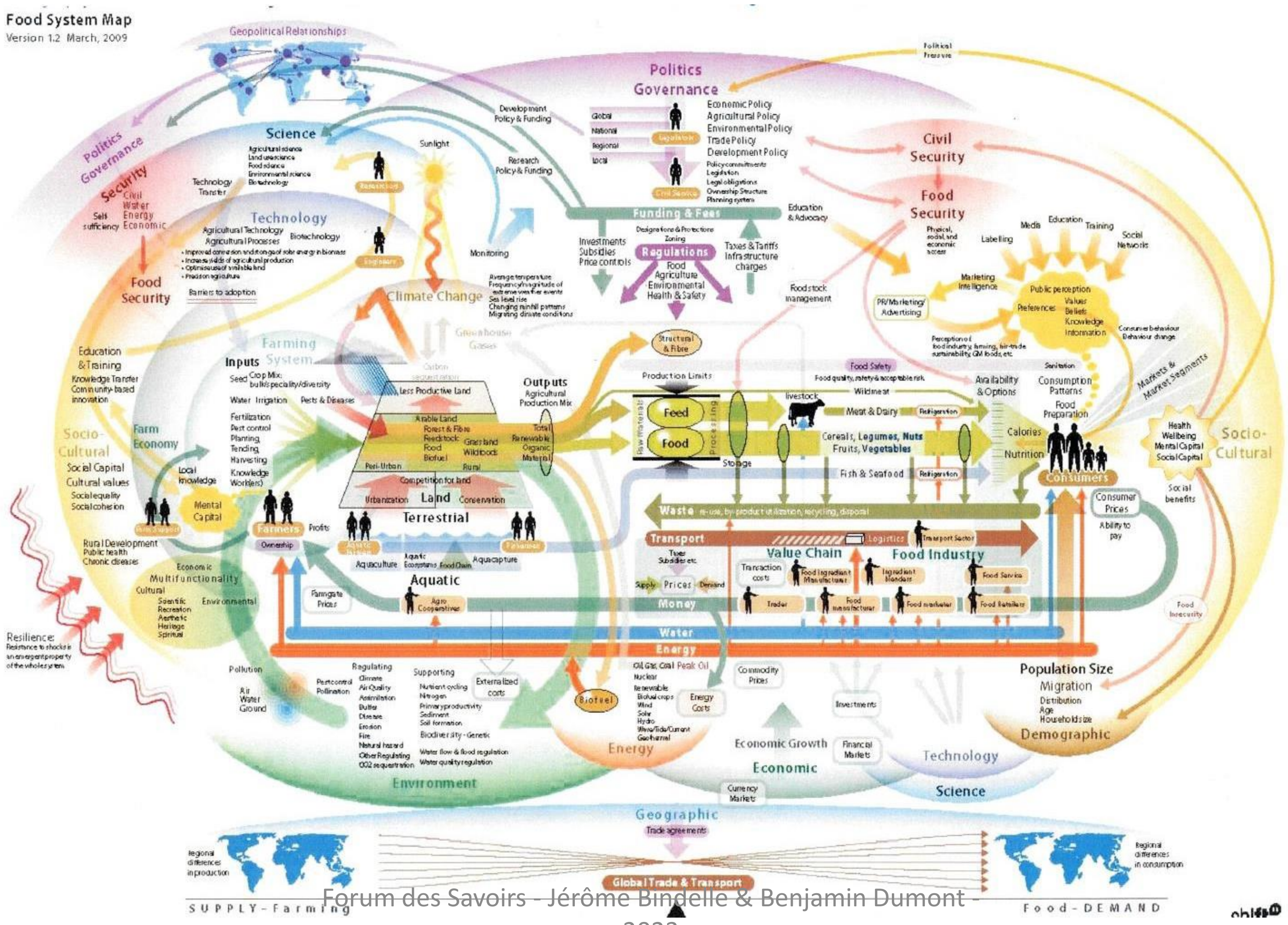
Les Amis de l'Université de Liège

Dr. Caroline De Clerck

M. Mathieu Delandmeter

Les membres du COMAC d'ECOFOODSYSTEM

We are all part of a food system



(Nicholson et al., 2019,
10.13140/RG.2.2.32520.06404)