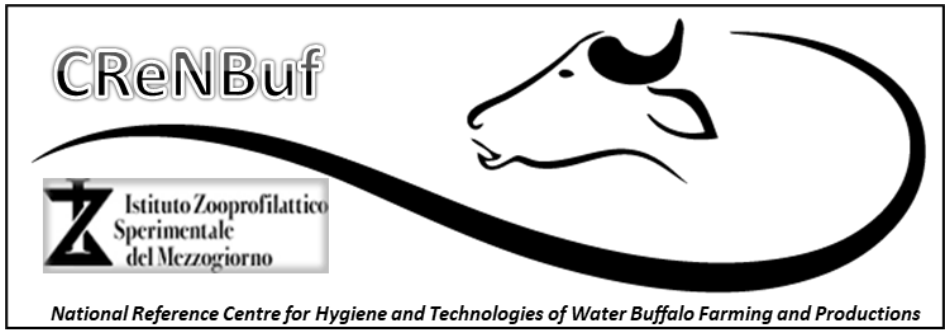
Istituto Zooprofilattico
Sperimentale del Mezzogiorno
Campania | Calabria

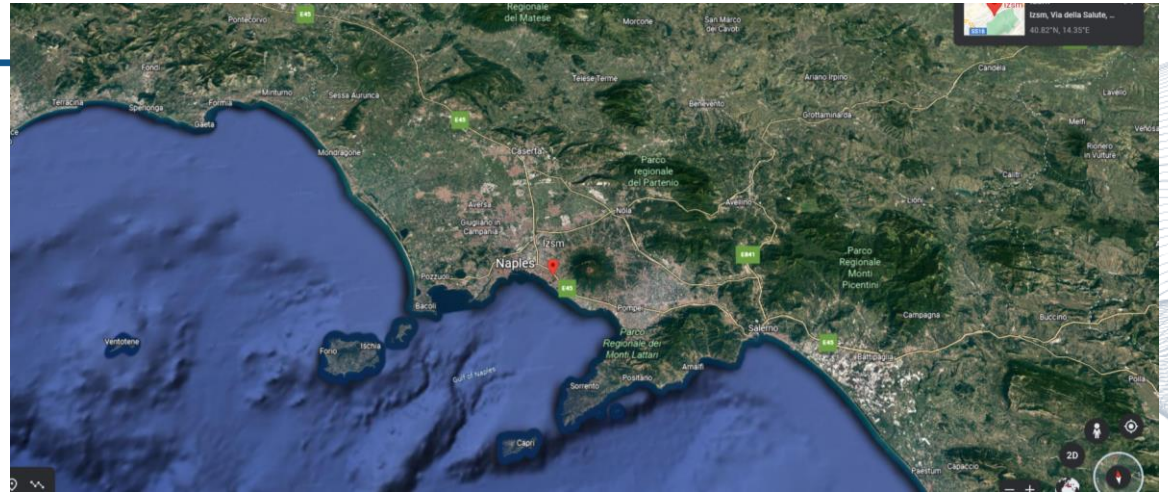
Studio del benessere animale e della sostenibilità della filiera produttiva della bufala da latte mediante approccio multidisciplinare

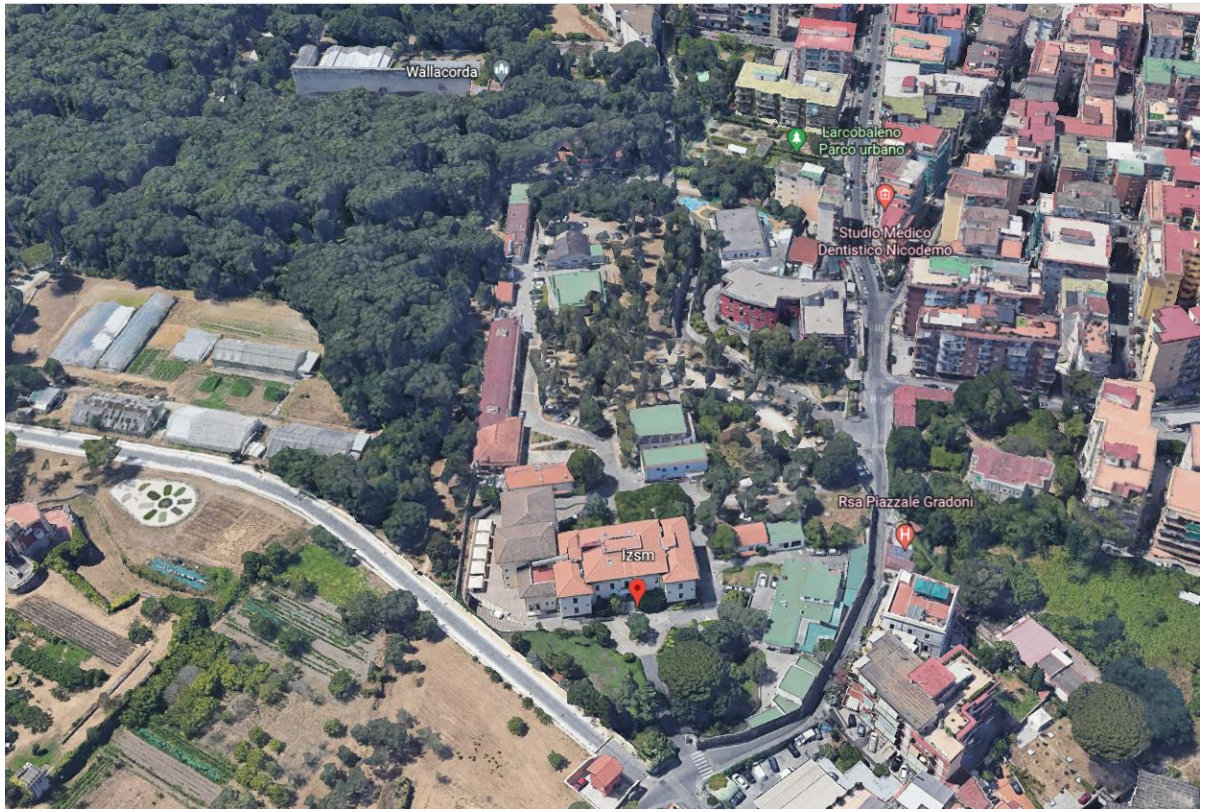


Istituto Zooprofilattico Sperimentale del Mezzogiorno
Centro di referenza Nazionale sull'igiene e le tecnologie dell'allevamento e delle produzioni Bufaline (CReNBuf)
UOSD Produzioni Zootecniche Benessere Animale e Stabulari Sperimentali.
domenico.vecchio@izsmportici.it

Domenico Vecchio

Istituto Zooprofilattico Sperimentale del Mezzogiorno





Istituto Zooprofilattico Sperimentale del Mezzogiorno

CReNBuf

Istituto Zooprofilattico Sperimentale del Mezzogiorno
Campania | Calabria

National Reference Centre for Hygiene and Technologies of Water Buffalo Farming and Productions

Il Centro di Referenza

L'Istituto Zooprofilattico Sperimentale del Mezzogiorno ospita presso la Sezione Diagnostica Provinciale di Salerno ***il Centro di Referenza Nazionale su "L'igiene e le tecnologie dell'allevamento e delle produzioni bufaline"***, istituito con provvedimento del Ministero della Salute l'08 maggio 2002 e destinato, attraverso l'erogazione di servizi di assistenza tecnico-scientifica ed attività specialistica di laboratorio, *alla promozione e valorizzazione della specie bufalina e delle sue produzioni.*

Divulgazione

Divulgazione di protocolli per la diagnostica delle malattie della bufala

Sistema informativo

Garantire un sistema informativo, di divulgazione dati e risultati

Formazione

Realizzazione di progetti di sviluppo e formazione del personale.

Sorveglianza

Attività di sorveglianza epidemiologica nell'ambito della sanità animale

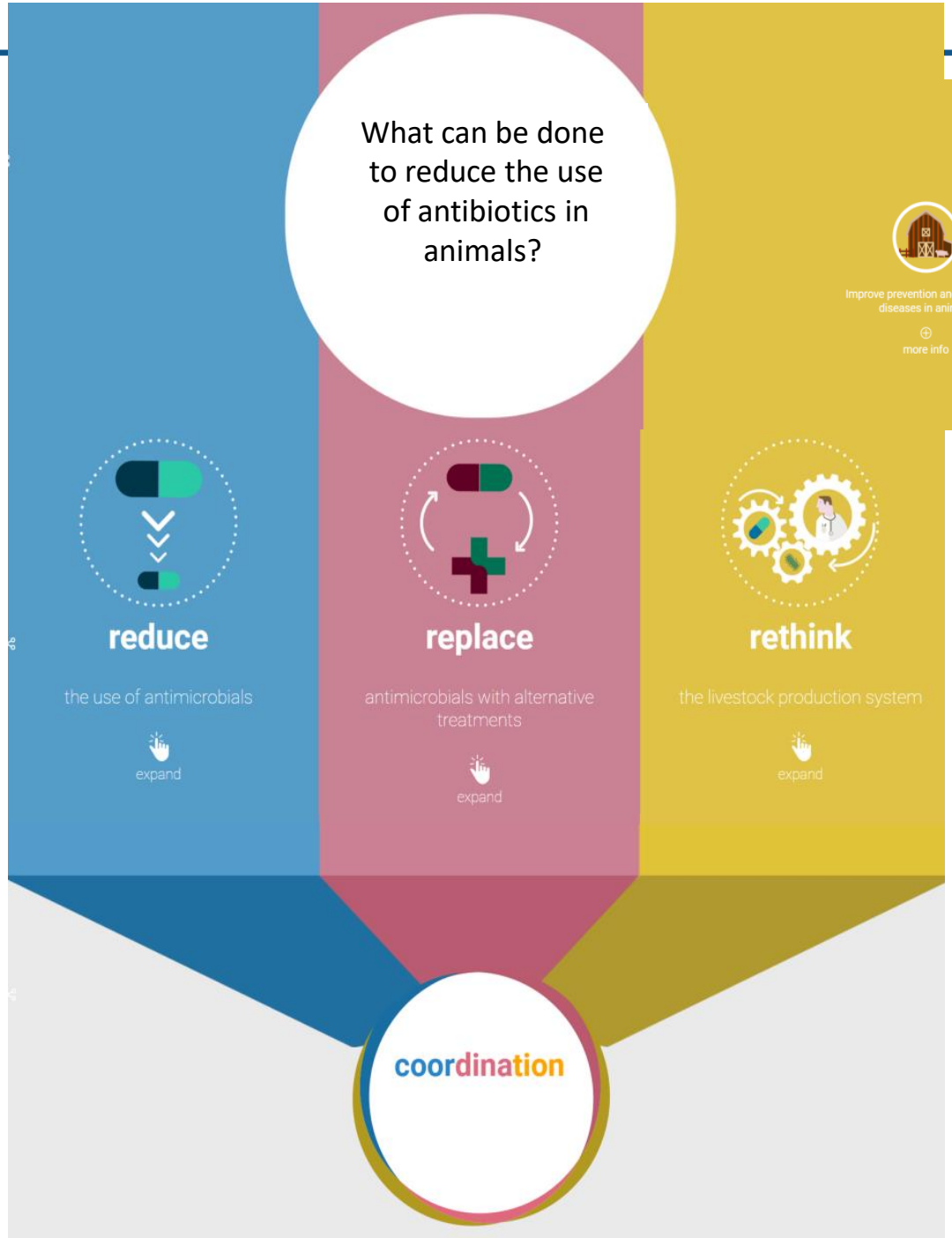
Ricerca

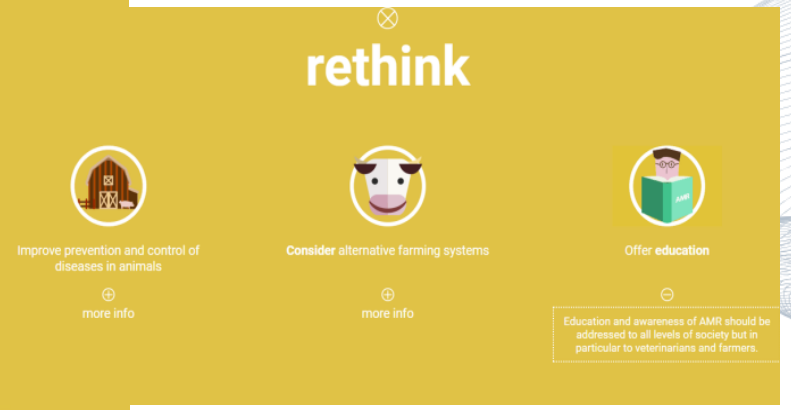
Sviluppo di nuove metodologie diagnostiche biomolecolari

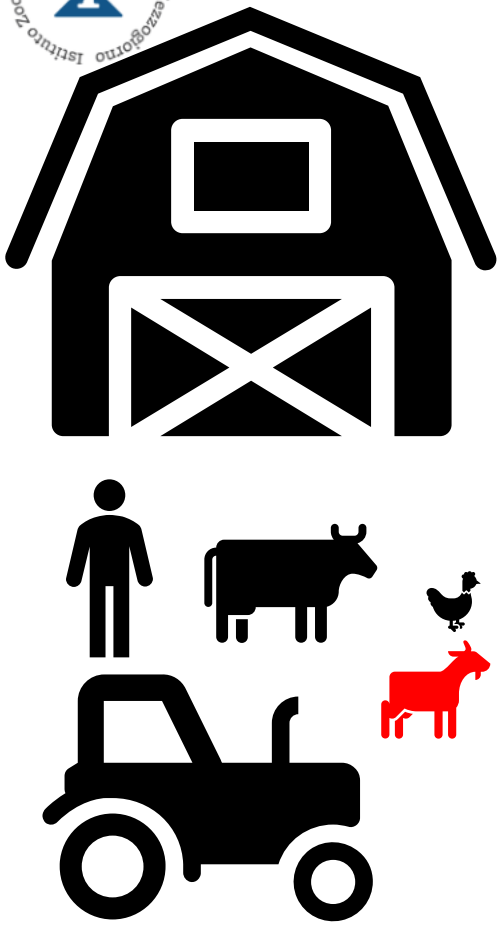
Benessere

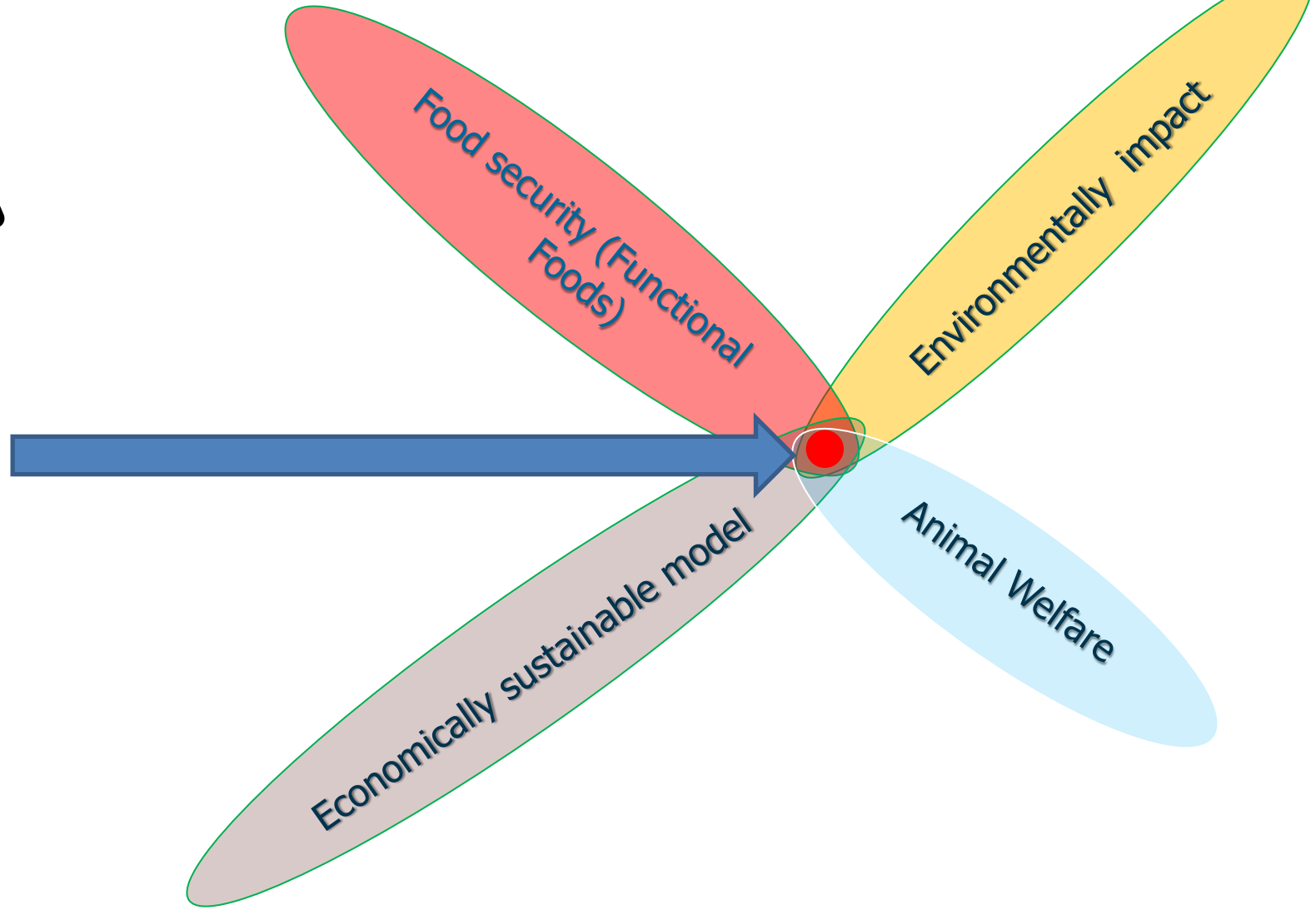
Analisi dei parametri immunitari di benessere nella specie bufalina

Present & Future








Food security (Functional Foods)
Environmentally impact
Economically sustainable model
Animal Welfare

Studio del Benessere animale e della Sostenibilità della filiera produttiva della bufala da latte mediante approccio multidisciplinare.

Ministero della Salute

N. identificativo progetto: **IZSME 08/18 RC**

U.O. 1 IMS Istituto Zooprofilattico Sperimentale del Mezzogiorno – Centro di Referenza Nazionale per l'Igiene e le Tecnologie dell'Allevamento e delle Produzioni Bufaline (CReNBuf)

U.O. 2 IMS IZSLER –Centro di Referenza Nazionale per il Benessere Animale (CReNBA)

U.O. 1 EMS Università degli Studi di Milano – Dipartimento di Medicina Veterinaria:

U.O. 2 EMS Università degli Studi di Napoli Federico II- Laboratorio di Urbanistica e Pianificazione del Territorio

U.O. 3 EMS Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria Centro di ricerca Zootecnia e Acquacoltura- CREA

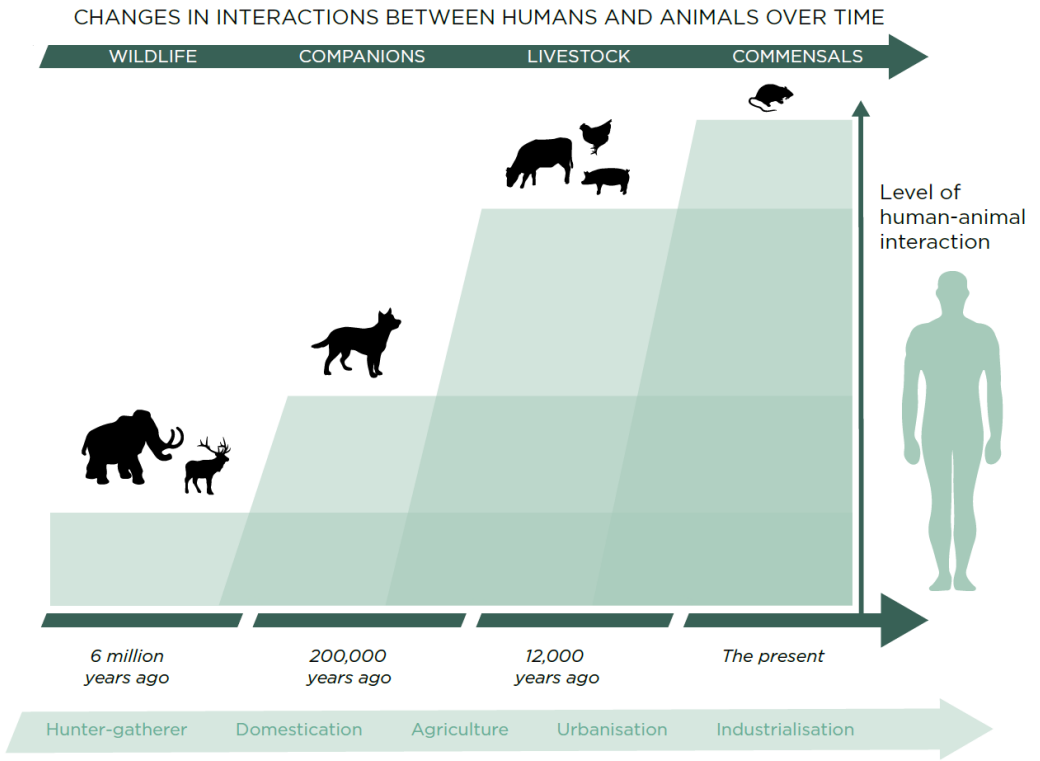


Figure 5: Schematic (non-quantitative) representation of the changes in the nature and level of human-animal interaction over time, linked to changes in the size and organisation of human societies.

Source: Redrawn based on Reperant, *et al.* (2012).

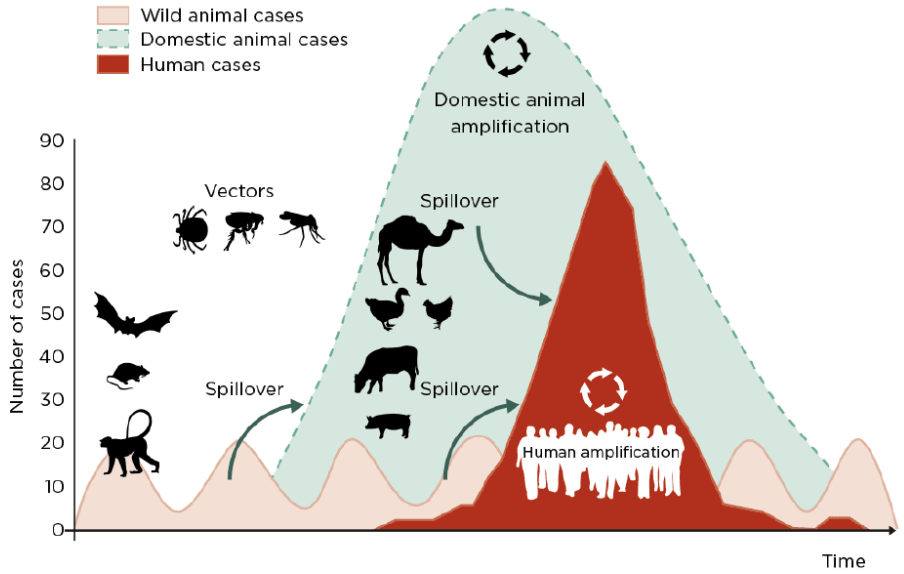
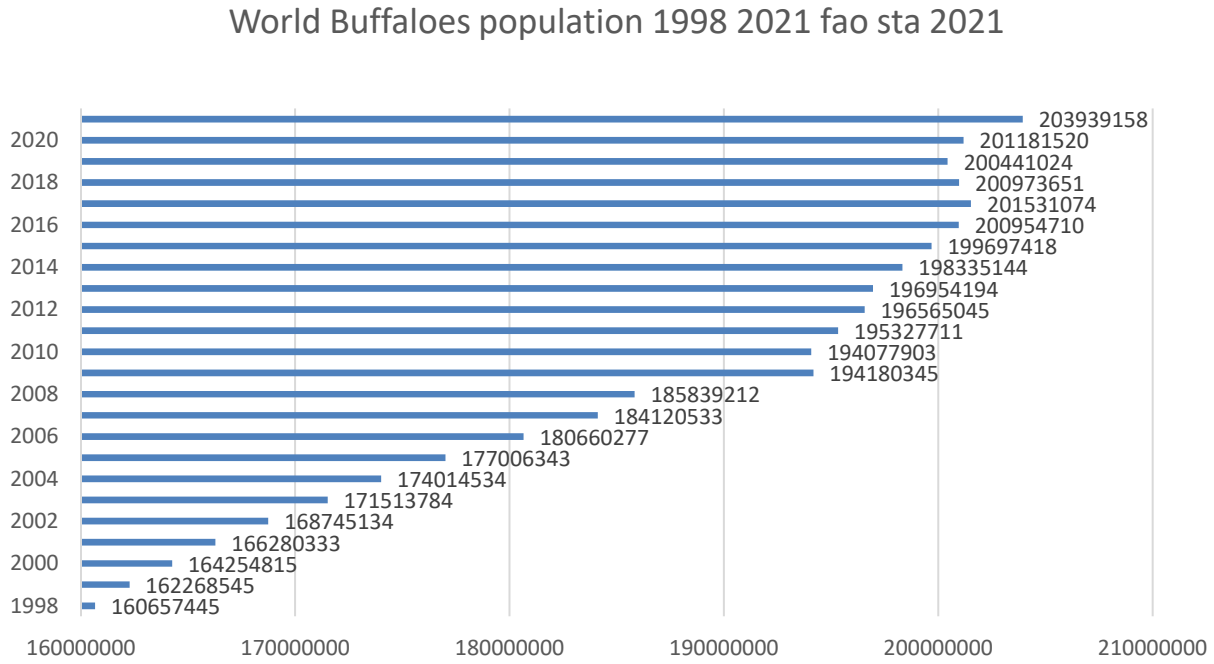


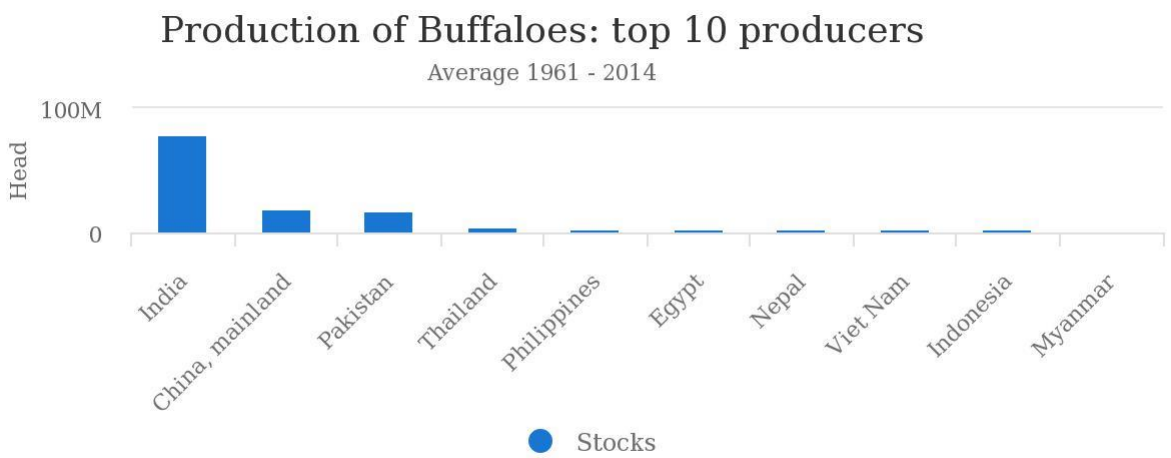
Figure 12: Transmission and amplification of zoonotic diseases. Transmission of a pathogen to people can occur directly from a wild animal or following an outbreak in livestock that amplifies the likelihood of transmissions to humans.

Source: Redrawn from Karesh, *et al.* (2012).

Why talk about Buffalo?

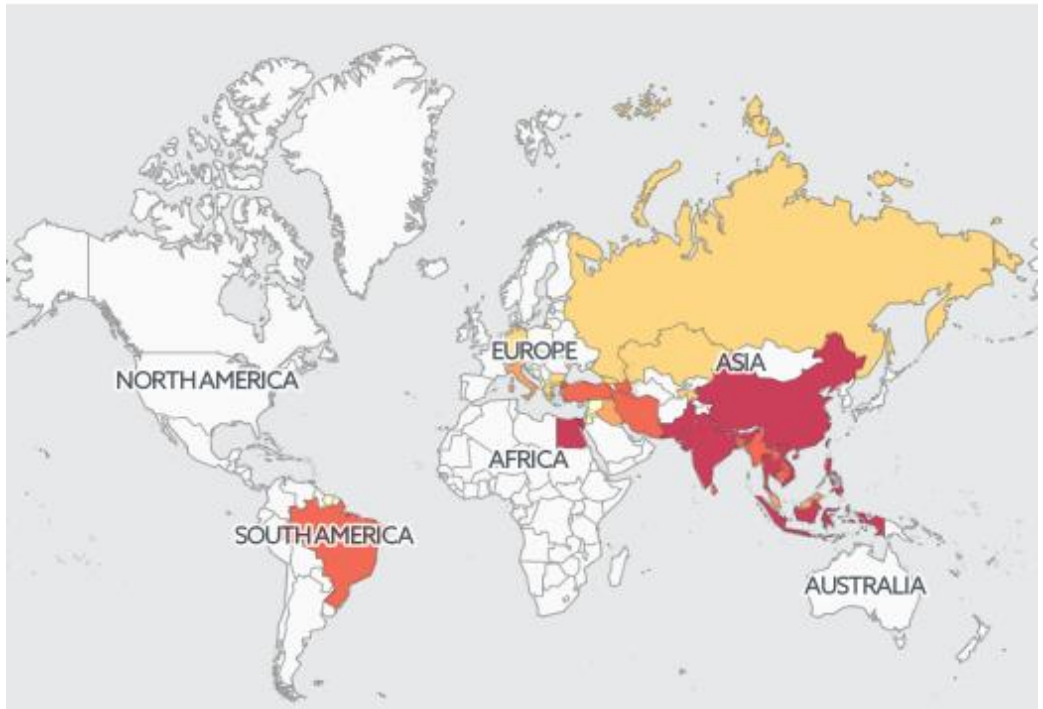
World buffaloes population





Source: FAOSTAT (Apr 04, 2017)

Production of Buffaloes
by country Average
1961 - 2014



World milk production (buffalo vs bovine)

			2011	2021	%
Production (tonnes) 5510					
World+(Total) 5000		Milk,whole fresh buffalo 951	96.056.481	137.761.642	+43,4%
		Milk,whole fresh cow 882	617.329.720	746.056.588	+20,8%

http://faostat3.fao.org/faostat

http://www.fao.org/faostat/en/#data/QL

Table 3. Buffalo, Camel, Cow, Goat, and sheep milk whole fresh produced in 2018 for each region

Milk, whole fresh†		Buffalo	Camel	Cow	Goat	Sheep	Total
World	tonns	127.658.734	3.137.071	683.217.056	18.712.088	10.631.058	843.356.007
	%	15,14%	0,37%	81,01%	2,22%	1,26%	100,00%
Asia	tonns	124.958.493	262.233	213.201.098	10.627.509	4.924.398	353.973.731
	%	35,30%	0,07%	60,23%	3,00%	1,39%	100,00%
America	tonns	189.739	NA	184.304.156	779.806	90.871	185.364.572
	%	0,10%	NA	99,43%	0,42%	0,05%	100,00%
Europe	tonns	390.137	76	220.377.066	2.722.332	3.168.166	226.657.777
	%	0,17%	0,00%	97,23%	1,20%	1,40%	100,00%
Oceania	tonns	NA	NA	30.706.258	39	NA	30.706.297
	%	.	.	100,00%	0,00%	-	100,00%
Africa	tonns	2.120.365	2.874.762	34.628.478	4.582.402	2.447.623	46.653.630
		4,54%	6,16%	74,22%	9,82%	5,25%	100,00%

†Data from 2018 (51). The percentage (%) of animal species milk was calculated according to each geographical area. NA: not available.

Minervino AHH, Zava M, Vecchio D and Borghese A (2020) Bubalus bubalis: A Short Story. Front. Vet. Sci. 7:570413. doi: 10.3389/fvets.2020.570413

Sistema Informativo Veterinario - Statistiche

CONSISTENZA ALLEVAMENTI E CAPI BOVINI E BUFALINI

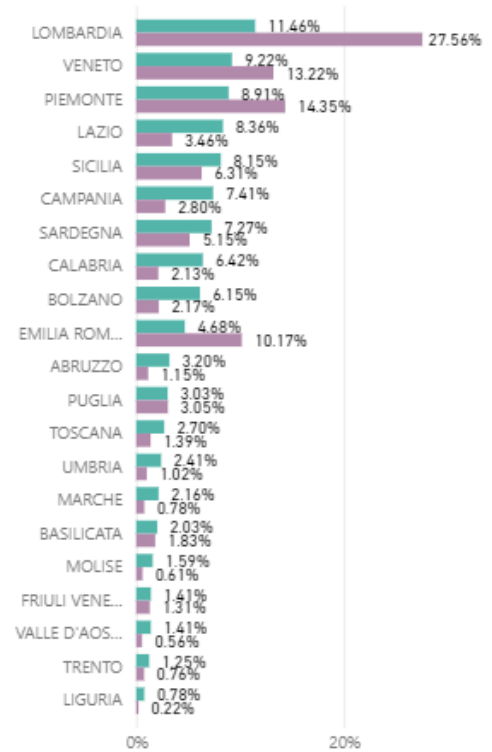
DATA RIFERIMENTO
30/06/2023

TIPO ATTIVITA	DATA RIFERIMENTO	ORIENTAMENTO PRODUTTIVO	TIPOLOGIA PRODUTTIVA
ALLEVAMENTO	30/06/2023	All	All

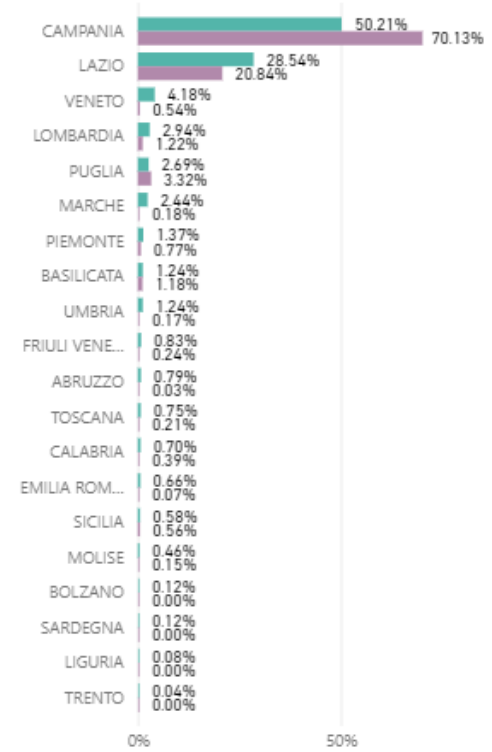
SPECIE	BOVINI		BUFALINI	
REGIONE	NUMERO ALLEVAMENTI	NUMERO CAPI	NUMERO ALLEVAMENTI	NUMERO CAPI
ABRUZZO	4,084	63,147	19	129
BASILICATA	2,594	100,395	30	5,123
BOLZANO	7,846	119,367	3	13
CALABRIA	8,192	117,063	17	1,703
CAMPANIA	9,462	153,621	1,212	305,023
EMILIA ROMAGNA	5,980	558,568	16	289
FRIULI VENEZIA GIULIA	1,806	71,703	20	1,061
LAZIO	10,673	189,738	689	90,639
LIGURIA	991	12,220	2	3
LOMBARDIA	14,630	1,513,600	71	5,291
MARCHE	2,755	42,857	59	762
MOLISE	2,026	33,524	11	664
PIEMONTE	11,370	787,911	33	3,359
PUGLIA	3,869	167,467	65	14,418
SARDEGNA	9,278	282,825	3	12
SICILIA	10,409	346,519	14	2,436
TOSCANA	3,446	76,154	18	926
TRENTO	1,597	41,693	1	2
UMBRIA	3,071	56,130	30	726
VALLE D'AOSTA	1,800	31,020		
VENETO	11,775	725,754	101	2,343
Total	**127,654**	**5,491,276**	**2,414**	**434,922**

Dati elaborati il **15/07/2023**

%ALLEVAMENTI E CAPI BOVINI ALLA DATA DI RIFERIMENTO PER REGIONE



%ALLEVAMENTI E CAPI BUFALINI ALLA DATA DI RIFERIMENTO PER REGIONE



Sistema Informativo Veterinario - Statistiche

Variazioni patrimonio nel tempo | Densità allevamenti e capi bovini e bufalini | Consistenza allevamenti e capi per orientamento produttivo | Consistenza allevamenti e capi per classe di consistenza | Consistenza a

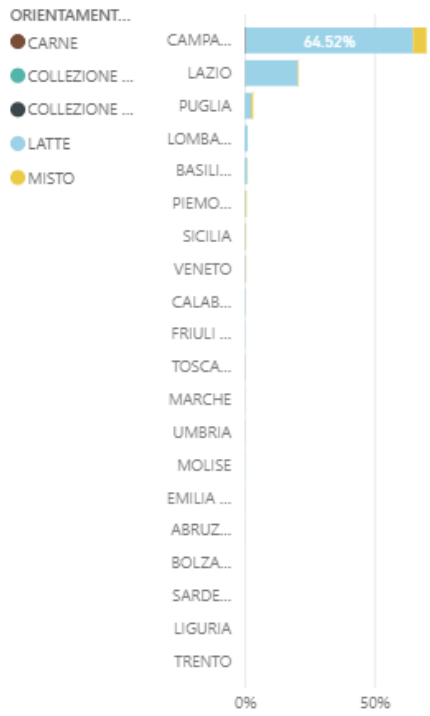
ALLEVAMENTI E CAPI BOVINI E BUFALINI PER ORIENTAMENTO PRODUTTIVO

DATA RIFERIMENTO
30/06/2023

DATA RIFERIMENTO	REGIONE	ASL	PROVINCIA	COMUNE	MODALITÀ ALLEVAMENTO	TIPOLOGIA PRODUTTIVA
30/06/2023	All	All	All	All	All	All

CONSISTENZA ALLEVAMENTI IN PERCENTUALE SUL TOTALE

CONSISTENZA CAPI IN PERCENTUALE SUL TOTALE

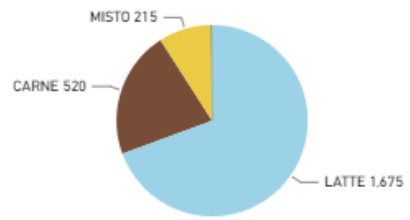


SPECIE
BUFALINI

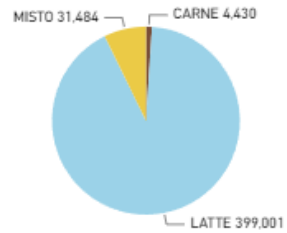
434,922
NUMERO CAPI

2,414
NUMERO ALLEVAMENTI

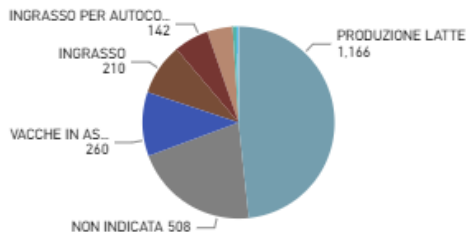
NUMERO ALLEVAMENTI



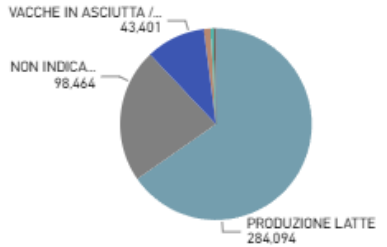
NUMERO CAPI



NUMERO ALLEVAMENTI per tipologia produttiva



NUMERO CAPI per tipologia produttiva



Dati elaborati il **15/07/2023**

CONSISTENZA ALLEVAMENTI PER CLASSE DI CONSISTENZA

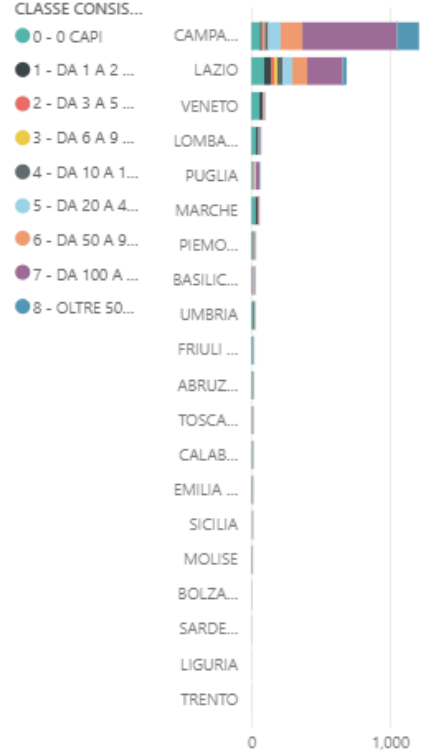
SPECIE: BUFALINI

DATA RIFERIMENTO: 30/06/2023

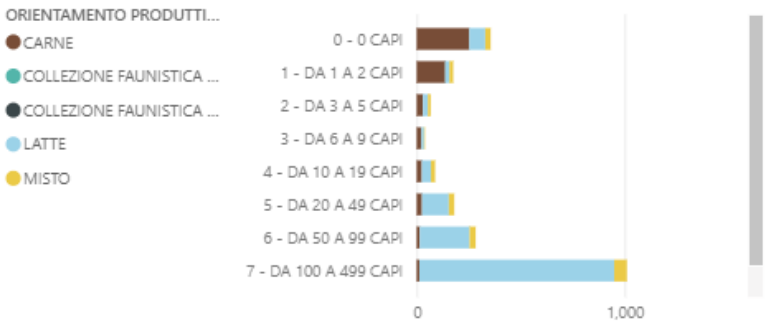
DATA RIFERIMENTO	MODALITÀ ALLEVAMENTO	TIPOLOGIA PRODUTTIVA	REGIONE	ASL	PROVINCIA	COMUNE
30/06/2023	All	All	All	All	All	All

ORIENTAMENTO	CARNE		LATTE		MISTO		COLLEZIONE FAUNISTICA - DIVERSA DA GIARDINO ZOOLOGICO		COLLEZIONE FAUNISTIC GIARDINO ZOOLOGICO	
CLASSE CONSISTENZA	NUMERO ALLEVAMENTI	NUMERO CAPI	NUMERO ALLEVAMENTI	NUMERO CAPI	NUMERO ALLEVAMENTI	NUMERO CAPI	NUMERO ALLEVAMENTI	NUMERO CAPI	NUMERO ALLEVAMENTI	NUMEF
0 - 0 CAPI	253	0	77	0	26	0				
1 - DA 1 A 2 CAPI	136	177	19	27	18	26	1	2	2	
2 - DA 3 A 5 CAPI	30	106	24	98	13	54			1	
3 - DA 6 A 9 CAPI	22	159	14	109	4	28				
4 - DA 10 A 19 CAPI	25	341	44	629	20	275				
5 - DA 20 A 49 CAPI	26	782	129	4,433	26	831				
6 - DA 50 A 99 CAPI	15	1,044	240	17,648	29	2,093				
7 - DA 100 A 499 CAPI	13	1,821	937	223,884	61	14,471				
Total	**520**	**4,430**	**1,675**	**399,001**	**215**	**31,484**	**1**	**2**	**3**	

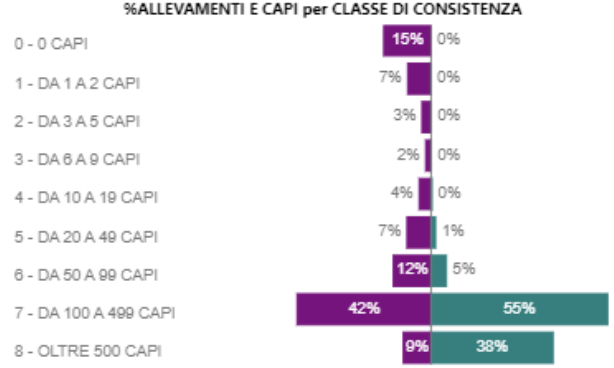
ALLEVAMENTI E CAPI per REGIONE e CLASSE DI CONSISTENZA



ALLEVAMENTI E CAPI per CLASSE DI CONSISTENZA e ORIENTAMENTO PRODUTTIVO



%ALLEVAMENTI E CAPI per CLASSE DI CONSISTENZA



Dati elaborati il **15/07/2023**

VARIAZIONE PATRIMONIO BOVINO E BUFALINO NEL TEMPO

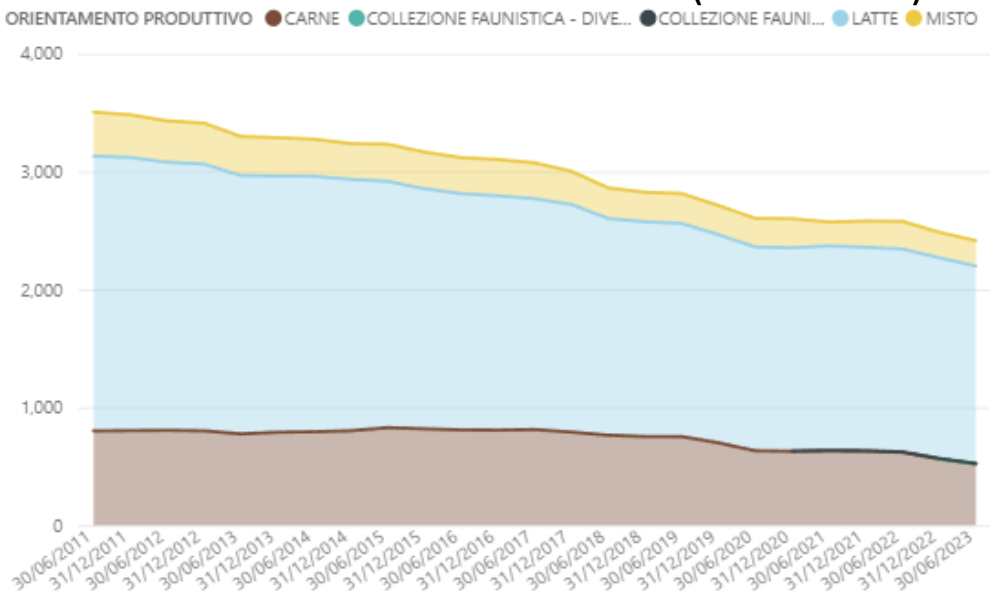
SPECIE: BUFALINI | REGIONE: All | ASL: All | PROVINCIA: All | COMUNE: All

ANNI VISUALIZZATI: 2011 – 2023

TIPOLOGIA PRODUTTIVA: All | CLASSE CONSISTENZA: All | MODALITÀ ALLEVAMENTO: All

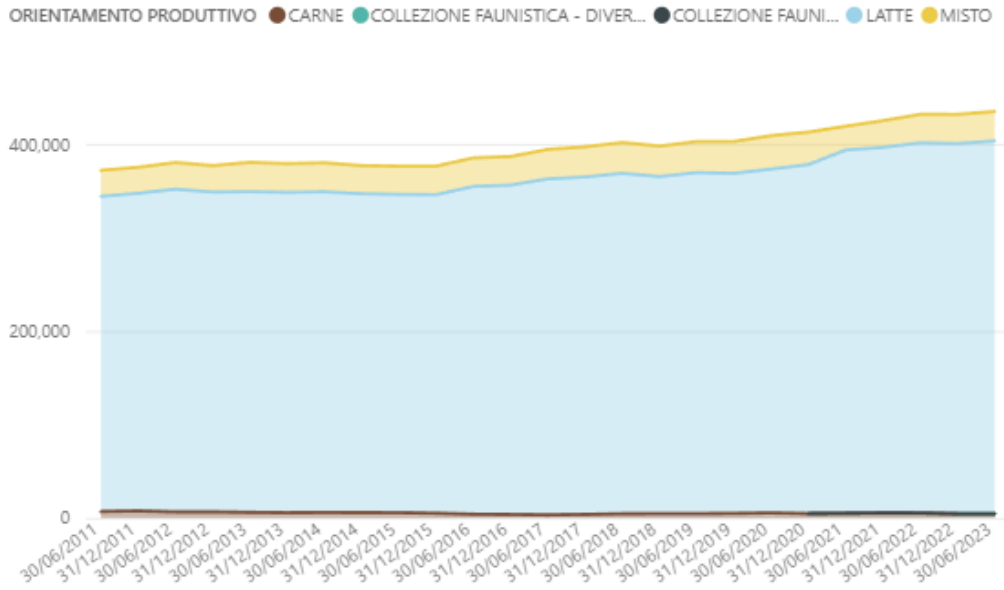
-30,10% (latte+misti)

NUMERO ALLEVAMENTI



+17,92% (latte+misti)

NUMERO CAPI



Dati elaborati il **15/07/2023**

Sistema Informativo Veterinario - Statistiche

VARIAZIONE PATRIMONIO BOVINO E BUFALINO NEL TEMPO

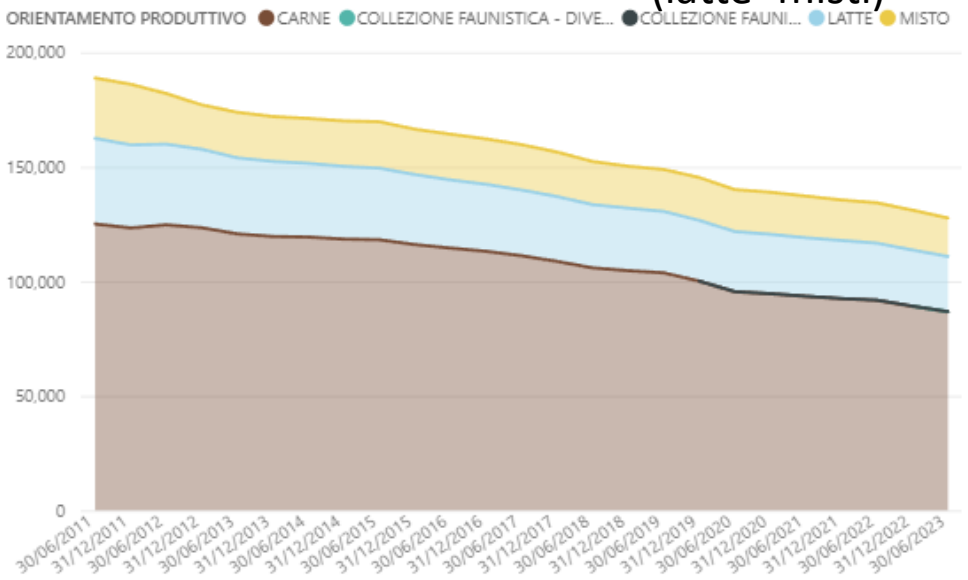
SPECIE: BOVINI | REGIONE: All | ASL: All | PROVINCIA: All | COMUNE: All

ANNI VISUALIZZATI: 2011 – 2023

TIPOLOGIA PRODUTTIVA: All | CLASSE CONSISTENZA: All | MODALITÀ ALLEVAMENTO: All

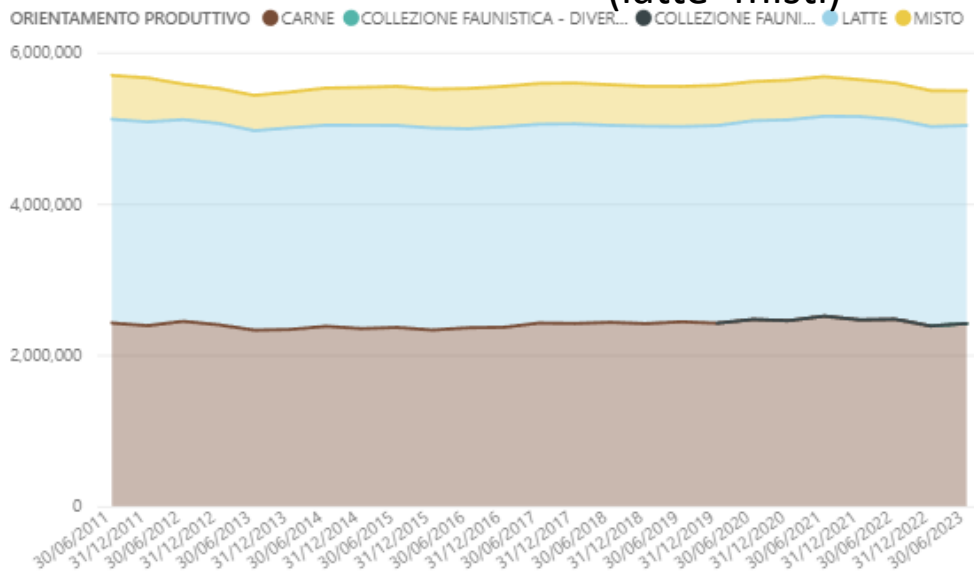
-35,91% (latte+misti)

NUMERO ALLEVAMENTI



-6,05% (latte+misti)

NUMERO CAPI



Dati elaborati il **15/07/2023**

Sistema Informativo Veterinario - Statistiche

zioni patrimonio nel tempo | Densità allevamenti e capi bovini e bufalini | Consistenza allevamenti e capi per orientamento produttivo | Consistenza allevamenti e capi per classe di consistenza | Consiste

DENSITÀ ALLEVAMENTI E CAPI BOVINI E BUFALINI

DATA RIFERIMENTO
30/06/2018

DATA RIFERIMENTO: 30/06/2018 | SPECIE: Multiple selec... | ORIENTAMENTO PRODUTTIVO: All | TIPOLOGIA PRODUTTIVA: All | CLASSE DI CONSISTENZA: All | MODALITÀ ALLEVAMENTO: All

REGIONE: CAMPANIA

REGIONE	NUMERO ALLEVAMENTI	NUMERO CAPI
CAMPANIA	1,360	297,041
Total	1,360	297,041

0.1000
DENSITÀ ALLEVAMENTI (N. ALLEV. PER KMQ)

21.8484
DENSITÀ CAPI (N. CAPI PER KMQ)

ALLEVAMENTI

CAPI

Dati elaborati il **09/07/2018**

Sistema Informativo Veterinario - Statistiche

Variazioni patrimonio nel tempo | Densità allevamenti e capi bovini e bufalini | Consistenza allevamenti e capi per orientamento produttivo | Consistenza allevamenti e capi per classe di consistenza | Consiste

DENSITÀ ALLEVAMENTI E CAPI BOVINI E BUFALINI

DATA RIFERIMENTO
30/06/2023

DATA RIFERIMENTO: 30/06/2023 | SPECIE: Multiple selec... | ORIENTAMENTO PRODUTTIVO: All | TIPOLOGIA PRODUTTIVA: All | CLASSE DI CONSISTENZA: All | MODALITÀ ALLEVAMENTO: All

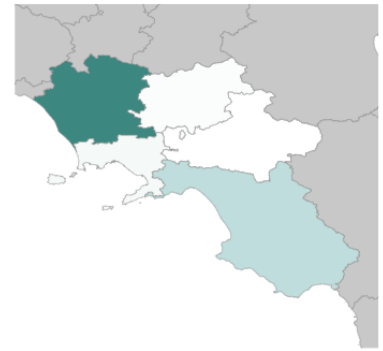
REGIONE: CAMPANIA

REGIONE	NUMERO ALLEVAMENTI	NUMERO CAPI
CAMPANIA	1,212	305,023
Total	1,212	305,023

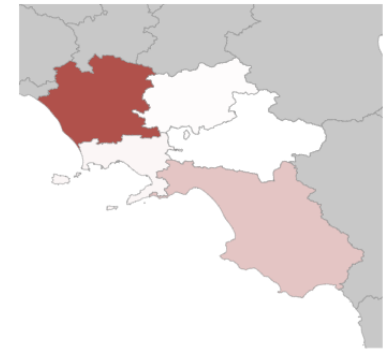
0.0891
DENSITÀ ALLEVAMENTI (N. ALLEV. PER KMQ)

22.4355
DENSITÀ CAPI (N. CAPI PER KMQ)

ALLEVAMENTI



CAPI



Dati elaborati il **15/07/2023**

TAB. 07

FORMAGGI DOP IGP STG - VALORE ECONOMICO

	PRODUZIONE CERTIFICATA (tonnellate)			VALORE ALLA PRODUZIONE (milioni di euro)			VALORE AL CONSUMO (milioni di euro)			VALORE ALL'EXPORT (milioni di euro)		
Prodotto	2019	2020	Var 20/19	2019	2020	Var 20/19	2019	2020	Var 20/19	2019	2020	Var 20/19
Grana Padano DOP	199.292	203.606	+2,2%	1.562	1.364	-12,7%	2.491	2.515	+0,9%	798	839	+5,2%
Parmigiano Reggiano DOP	144.738	146.860	+1,5%	1.556	1.285	-17,4%	2.591	2.488	-4,0%	692	682	-1,5%
Mozzarella di Bufala Campana DOP	50.176	50.707	+1,1%	426	426	-0,1%	803	761	-5,3%	147	159	+8,3%
Gorgonzola DOP	60.309	61.205	+1,5%	368	393	+6,9%	582	585	+0,5%	138	143	+3,4%
Pecorino Romano DOP	26.939	30.909	+14,7%	173	228	+32,3%	326	395	+21,3%	158	160	+1,7%
Asiago DOP	20.682	23.065	+11,5%	110	128	+16,4%	174	197	+12,8%	9,8	9,4	-4,5%
Provolone Valpadana DOP	6.700	7.340	+9,6%	38	43	+11,9%	81	89	+9,8%	2,8	5,3	+92,1%
Montasio DOP	6.104	6.663	+9,2%	40	43	+7,5%	62	69	+10,2%	2,1	4,9	+132,2%
Taleggio DOP	8.806	8.369	-5,0%	40	38	-5,0%	106	100	-5,0%	34	30	-13,9%
Pecorino Toscano DOP	3.205	3.533	+10,2%	30	34	+10,2%	58	64	+10,2%	8,5	4,5	-47,8%
Altri prodotti DOP IGP	24.121	25.427	+5,4%	184	195	+5,7%	300	321	+7,0%	22	27	+19,2%
Totale Formaggi	551.072	567.683	+3,0%	4.527	4.176	-7,8%	7.573	7.582	+0,1%	2.013	2.064	+2,5%

Indagine Ismea - Qualivita 2021

A new Animal Health Strategy for the European Union (2007-2013)

Investiment in Pevention

Direct and indirect coasts

Reactive

«CURE»

€ → €

Proactive

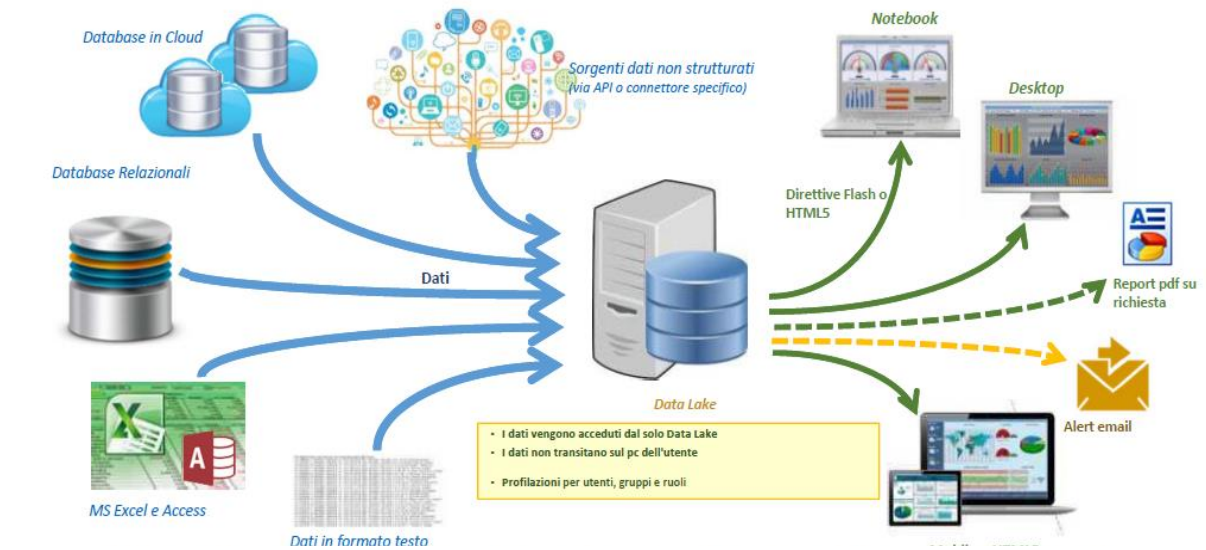
«prevention»

€ → €

G.R.Loria IZSS

CLASSYFARM

ClassyFarm architettura

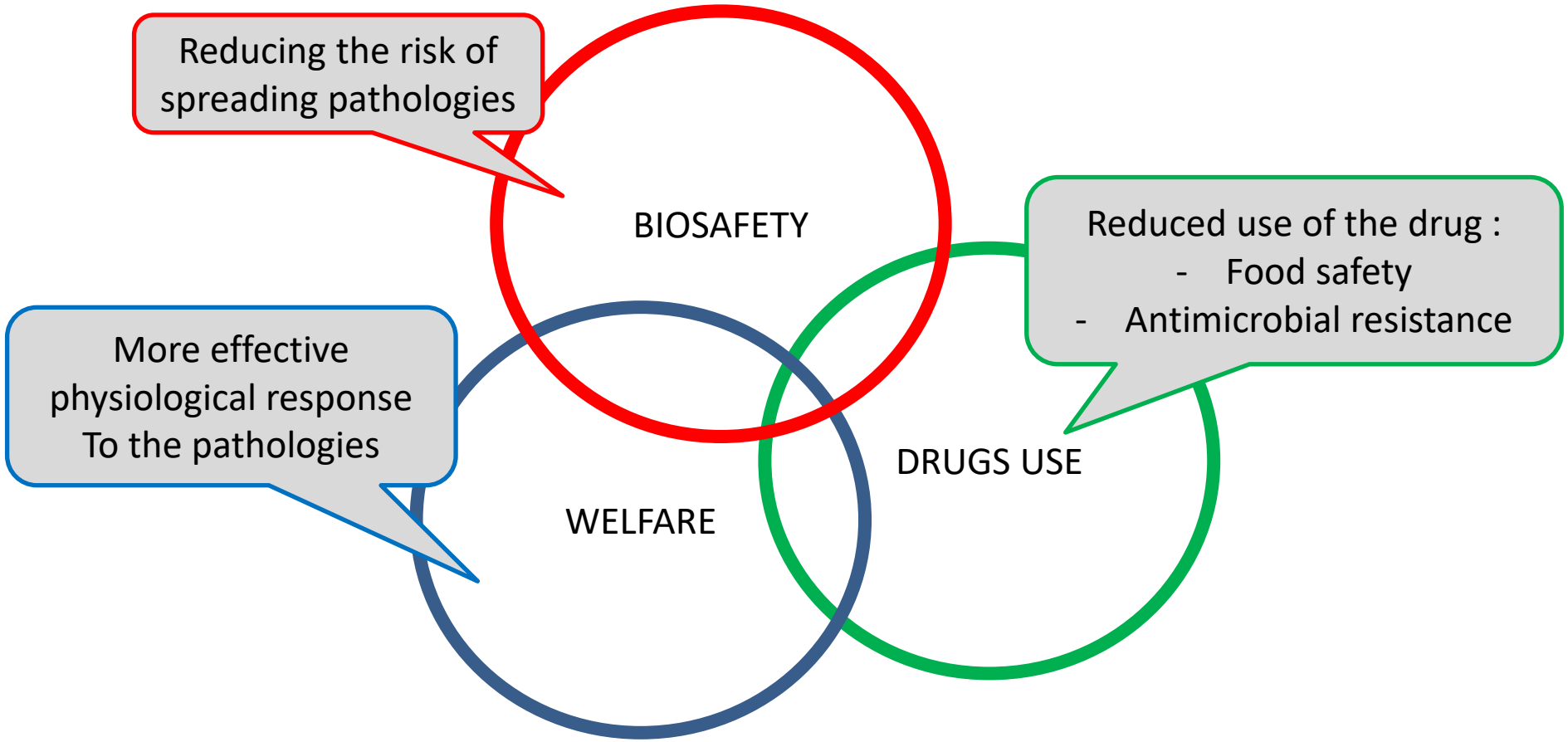


http://www.classyfarm.it/

ClassyFarm permits the collection and processing of data relating to the following evaluation areas:

- Animal Welfare
- Biosecurity
- Antimicrobial usage
- Injuries detected at slaughterhouse

Animal veterinary health, towards the future



Bertocchi 2016

Special Eurobarometer 533

Attitudes of Europeans towards animal welfare

Total EU27 | 26,376 interviews | Fieldwork: 2 March 2023 - 26 March 2023

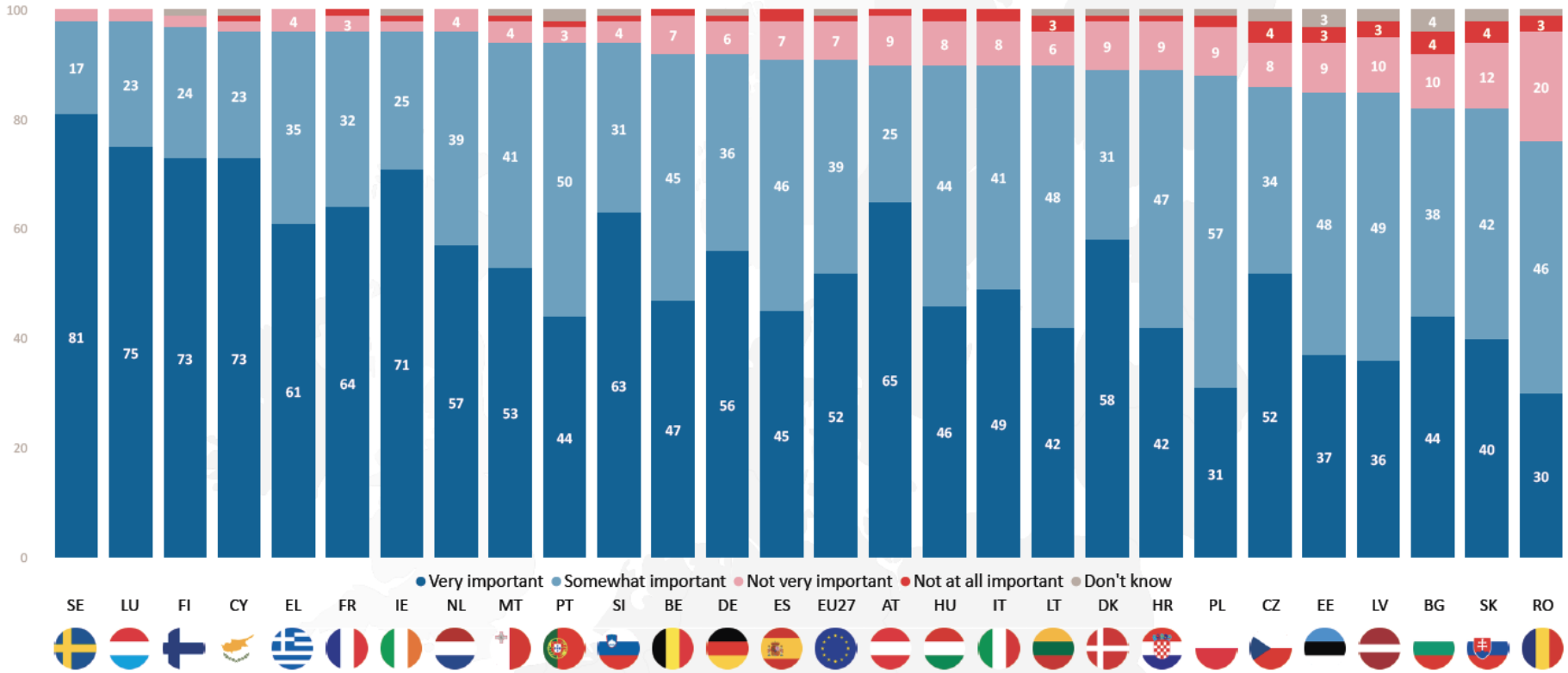
Italy | 1,027 interviews | Fieldwork: 2 March 2023 - 16 March 2023

Methodology (IT): Face-to-face

Italy

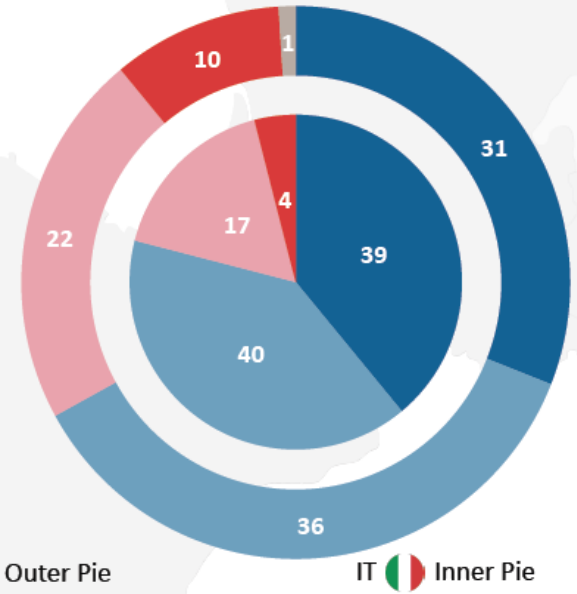
1. PROTECTION OF FARMED ANIMALS

QC2. In your opinion, how important is it to protect the welfare of farmed animals (e.g. pigs, cattle, poultry, etc.) to ensure that they have decent living conditions? (%)



2. INFORMATION AND CLOSENESS TO ANIMALS

QC1. Would you like to have more information about the conditions in which farmed animals are raised in (OUR COUNTRY)? (EU27) (%)

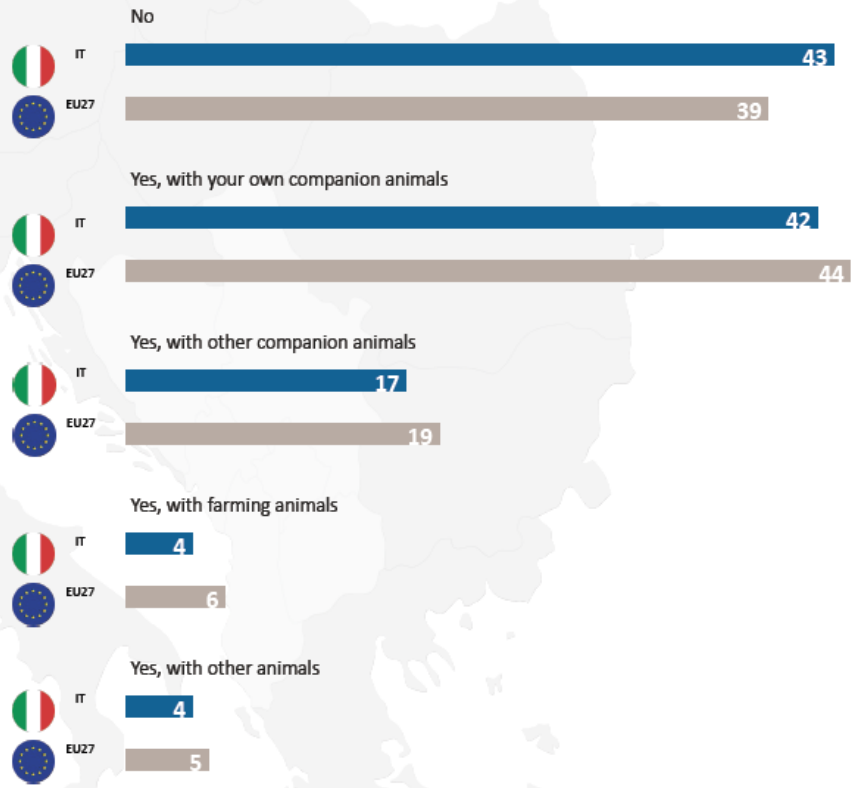


	EU27	▲▼	IT	▲▼
Yes, certainly	31	▲1	39	▲3
Yes, probably	36	▲2	40	▼4
No, probably not	22	▲2	17	▲7
No, certainly not	10	▼3	4	▼1
Don't know	1	▼2		▼5

▲▼ Mar. 2023 / Nov. - Dec. 2015

Yes, probably
Yes, certainly
No, probably not
No, certainly not
Don't know

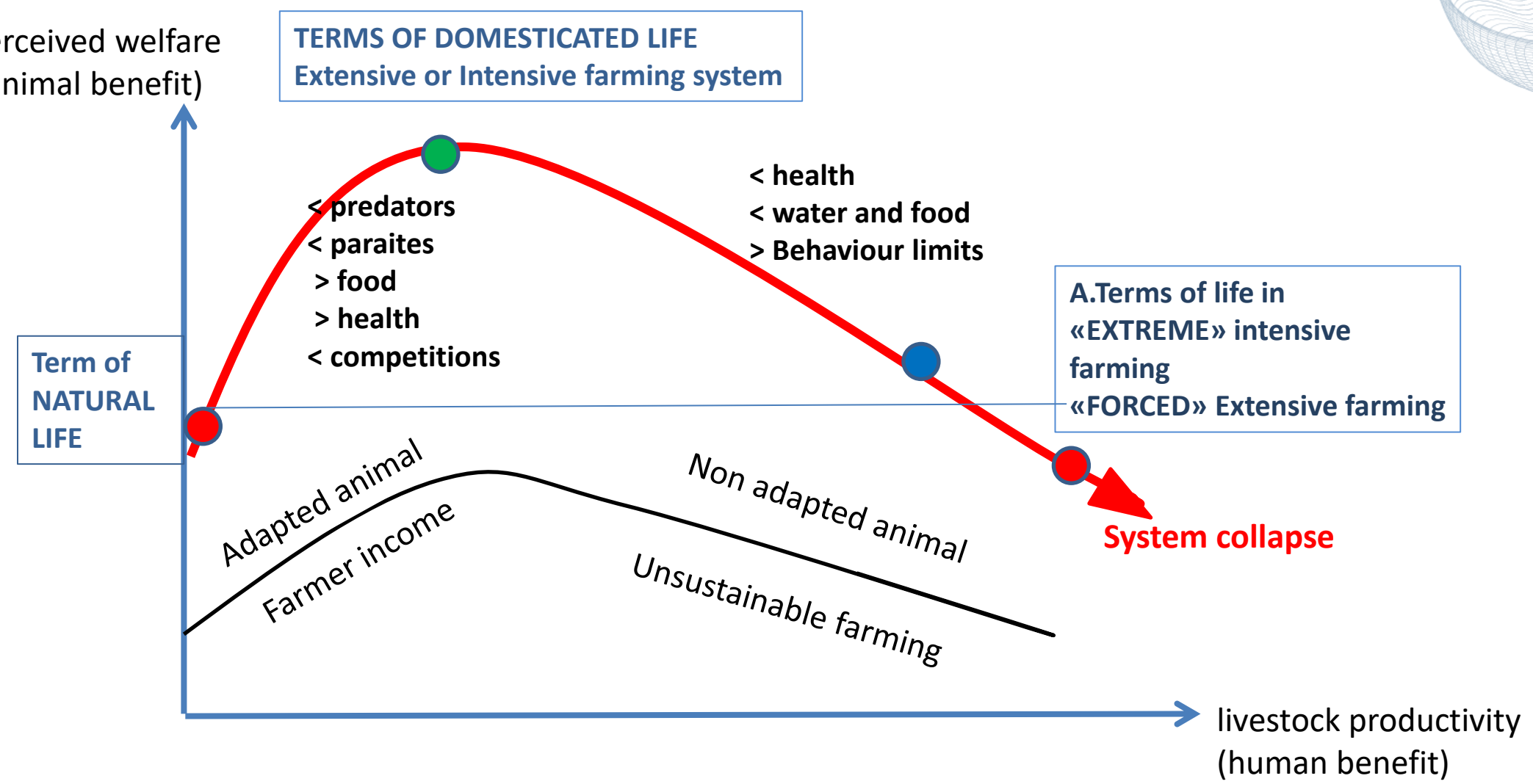
QC14. In your daily life, are you in regular contact with animals? (MULTIPLE ANSWERS POSSIBLE) (EU27) (%)



What is it the animal welfare?

"The welfare of an individual is its state as regards its attempts to cope with its environment"
(Broom 1986)

Concept of animal welfare, animal adaptation and farming sustainability



Bertocchi 2016

Welfare assessment

INPUT

management

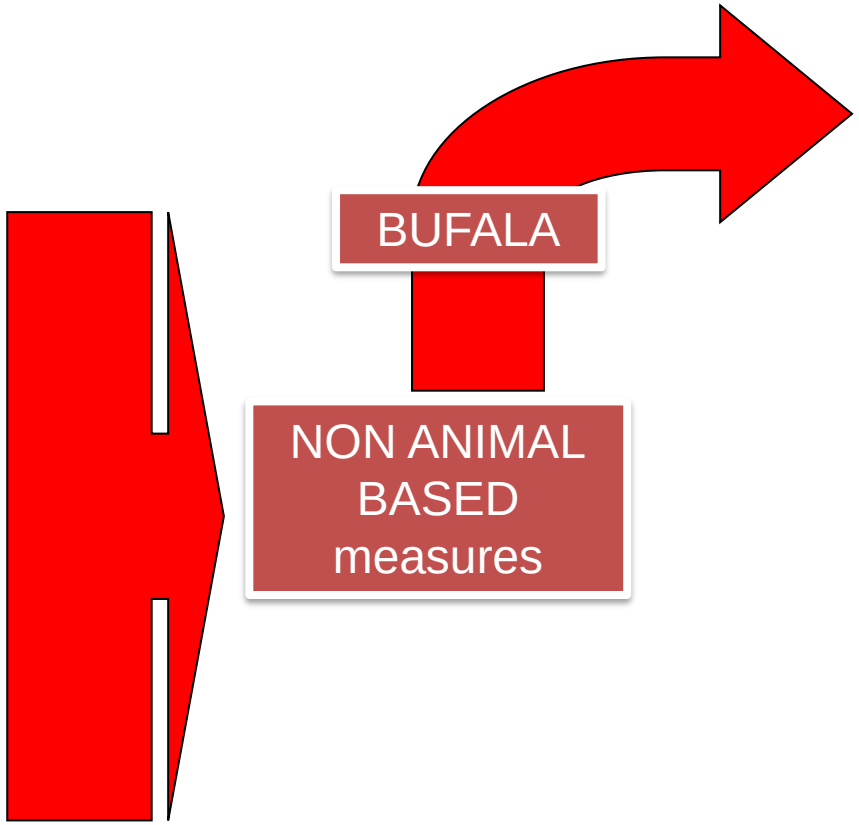
Eg.. Staff training, nutrition,

Weaning protocol etc.

Structures

e.g. Space, volume, troughs, milking machine

Climate e.g. T°, U%, gas



Hazards / Benefit

OUTPUT

- Claws
  - Overgrowing
  - Prolaps V/U
  - Calf Mortality
  - → Health conditions
- Arts
  - Neck
  - Nipples
  - ANIMAL BASED measures
  - → Skin lesions
- Towards the man.
  Toward the animals
  - → Behavior
- Nutrition status BCS
  - → Physiological state

Consequences on the animal

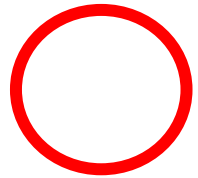
CReNBA

Bertocchi Luigi,2016

Welfare assessment

Negativ level
Distress

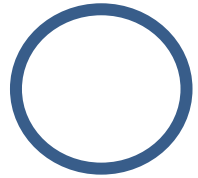
There is no guarantee the respect of 5 freedom
For all or part of the polopation
-Negative environmental condition
- Presence of Non-Physiological Adverse Effects



Threshold 1

Normal level
Nostress

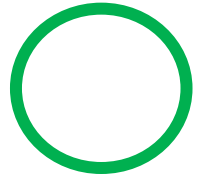
Is guaranteed the respect of the 5 freedoms for the whole population
- Normal environmental condition
- Physiological presence of adverse effects



Threshold 2

Positiv level
Eustress

Very positive living conditions better than only 5 freedoms
-Optimum environmental condition
- Absence / Minimum Evidence of Adverse Effects

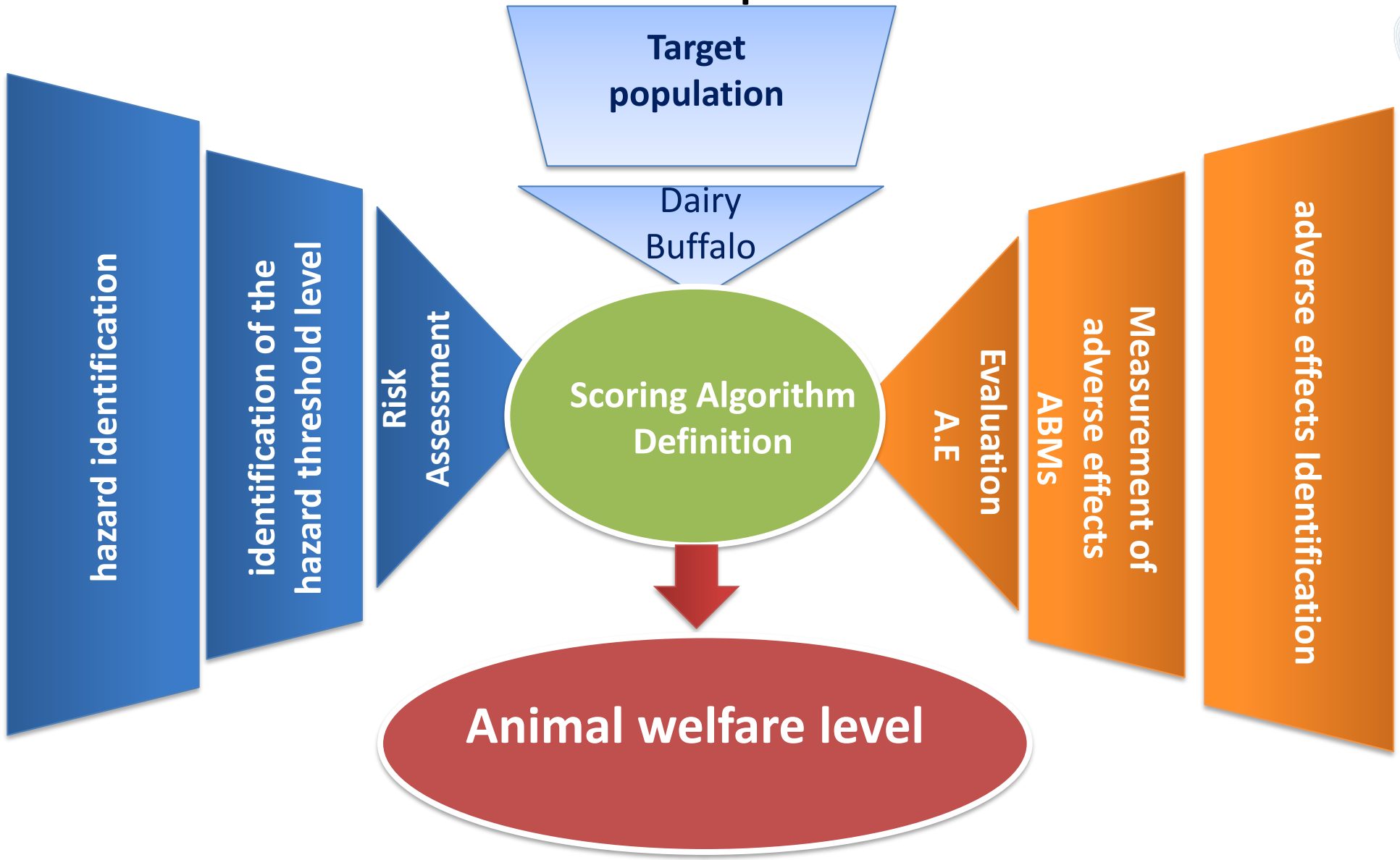


Bertocchi Luigi,2016

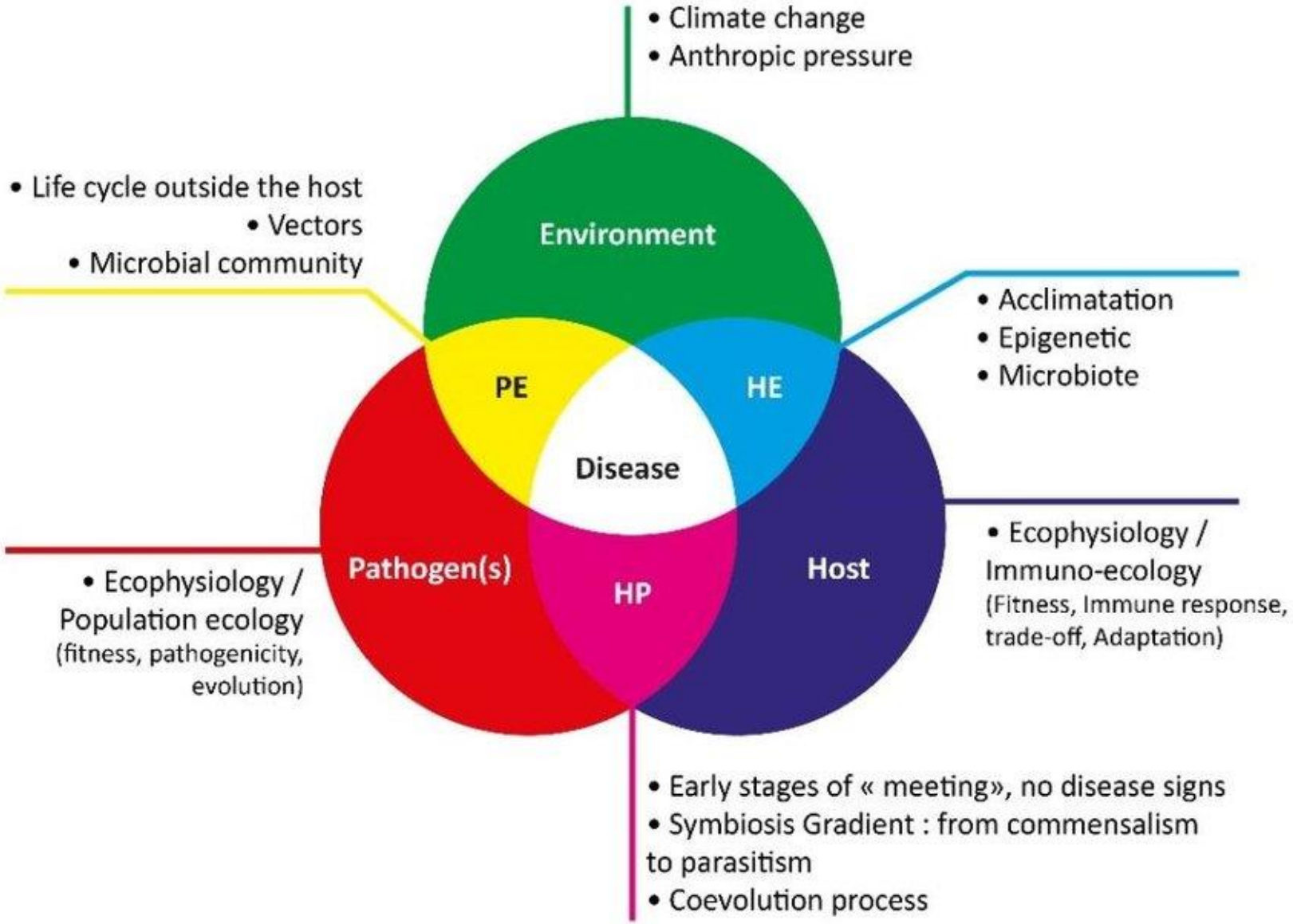
Composition of the thematic areas for the welfare assessment and Biosecurity in buffalo farm dairy free stall

Areas	Theme	N. item
Area A	Management	32
Area B	Structures and equipments	30
Area C	Animal Based measures	17
	Significant risks and alarm systems	9
Biosecurity	Ruminant Biosecurity	15
	Total Evaluation Item	103

Evaluation process



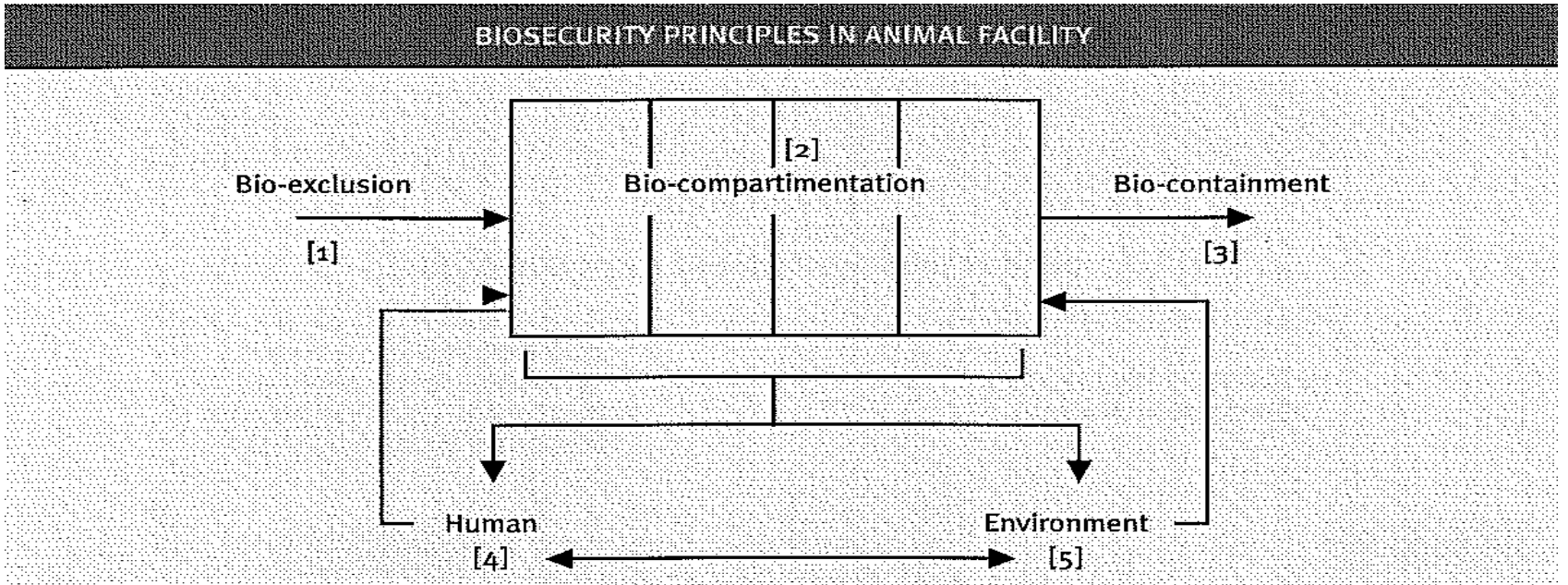
Bertocchi Luigi,2016



in book: Oysters and Clams: Cultivation, Habitat Threats and Ecological impact

The ecological approach of the Host-Pathogen-Environment System. This figure was uploaded by Christine Paillard 2016

Biosecurity



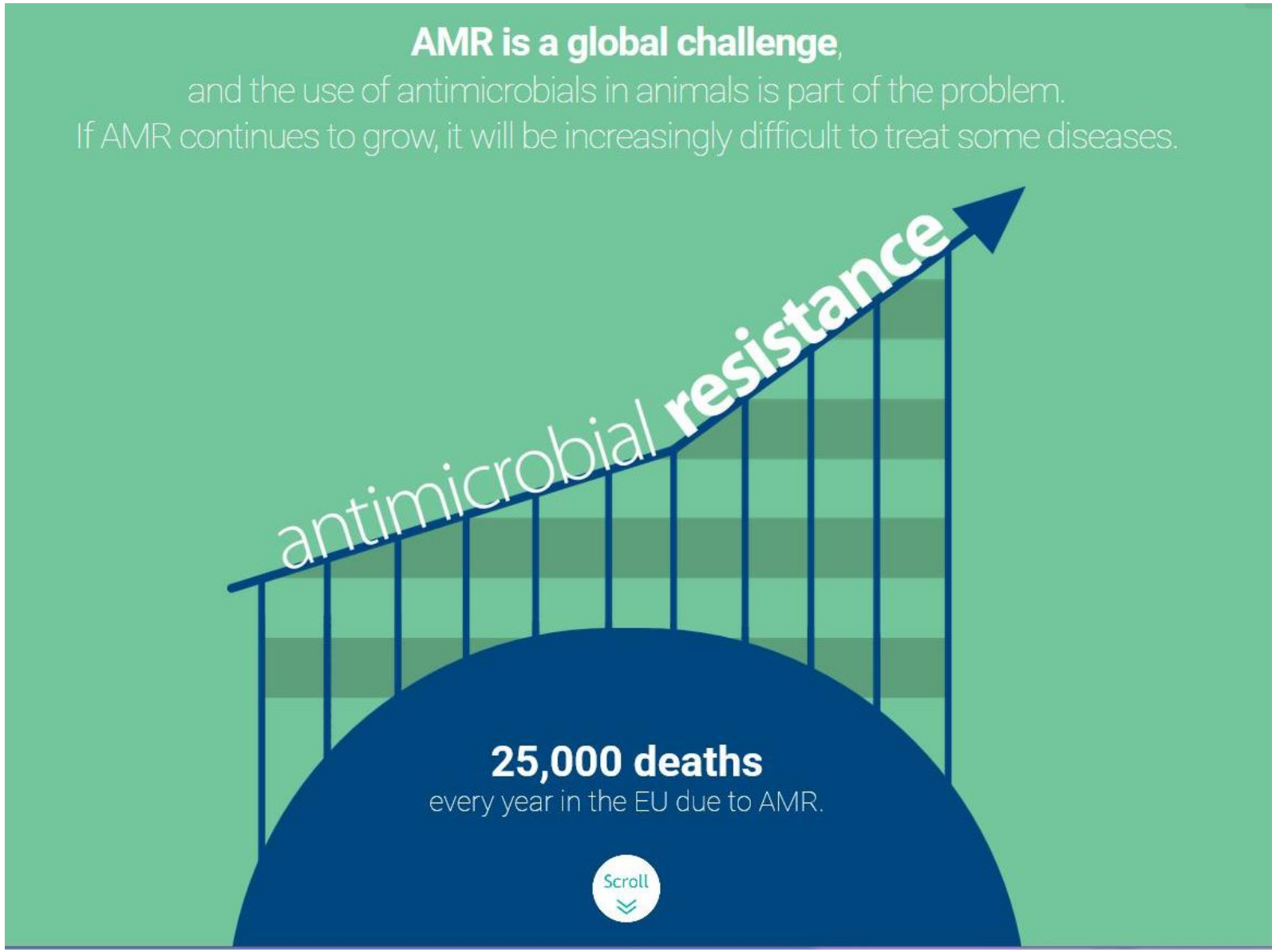
All the stages specified in the figure above are part of a biosecurity approach and contribute to the reduction of the risk of introduction and spread of infectious agents: 1) to limit the risk of introduction (bio-exclusion); 2) to limit the spread of the pathogen within the same facility, e.g. by isolating excreting animals (bio-compartimentation); 3) to limit the spread of the disease agent outside the facility (inter-herd transmission) (bio-containment); 4) to prevent the risk of human bio-contamination; 5) to prevent any environmental bio-contamination and persistence of the pathogen. Human can contaminate animals as well (e.g., *Mycobacterium bovis* (55)). Animals can be re-infected by the contaminated environment, which is especially true for pathogens presenting a long environmental persistence such as *Bacillus anthracis* (56) or *Mycobacterium bovis* (57) when

Biosecurity

- **(OIE Terrestrial Animal Health Code):**

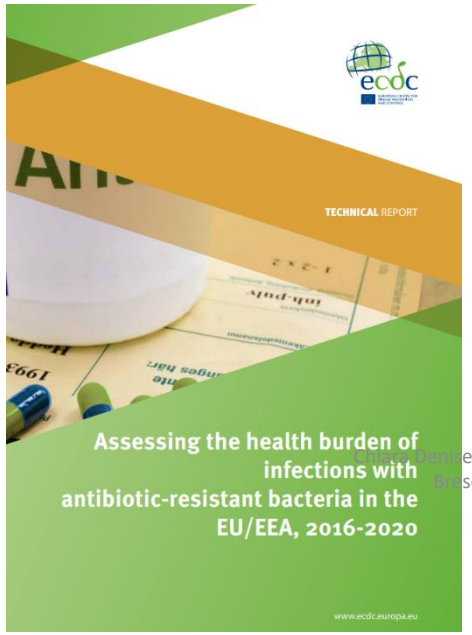
❖ A set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infection or infestations to, from and within animal population

❖ These preventive, non-medication based measures are relevant for the maintence of animal health, and by extension, of food production, food safety, and biodiversity.


AMR is a global challenge,
and the use of antimicrobials in animals is part of the problem.
If AMR continues to grow, it will be increasingly difficult to treat some diseases.
antimicrobial resistance
25,000 deaths
every year in the EU due to AMR.
Scroll

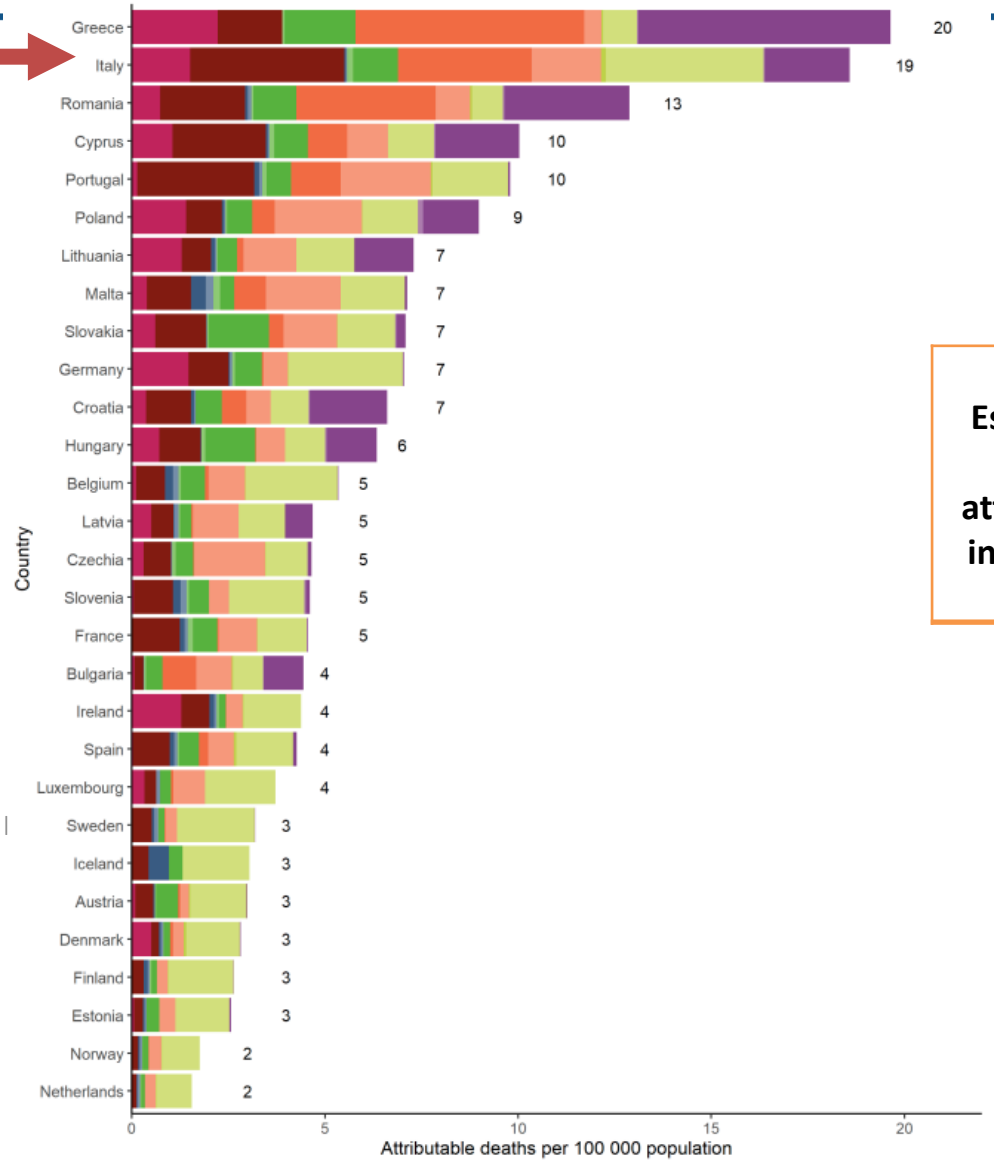
Italia

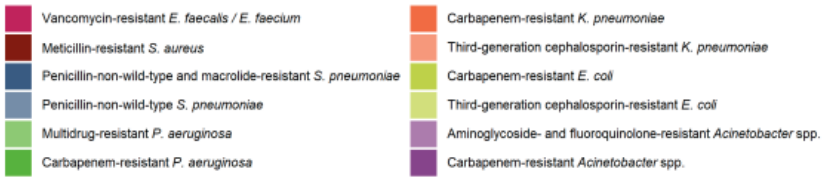
Stockholm, November 2022



ecdc
EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

Figure 5. Estimations of the burden of infections with antibiotic-resistant bacteria presented as attributable deaths per 100 000 population by country*, EU/EEA, 2020



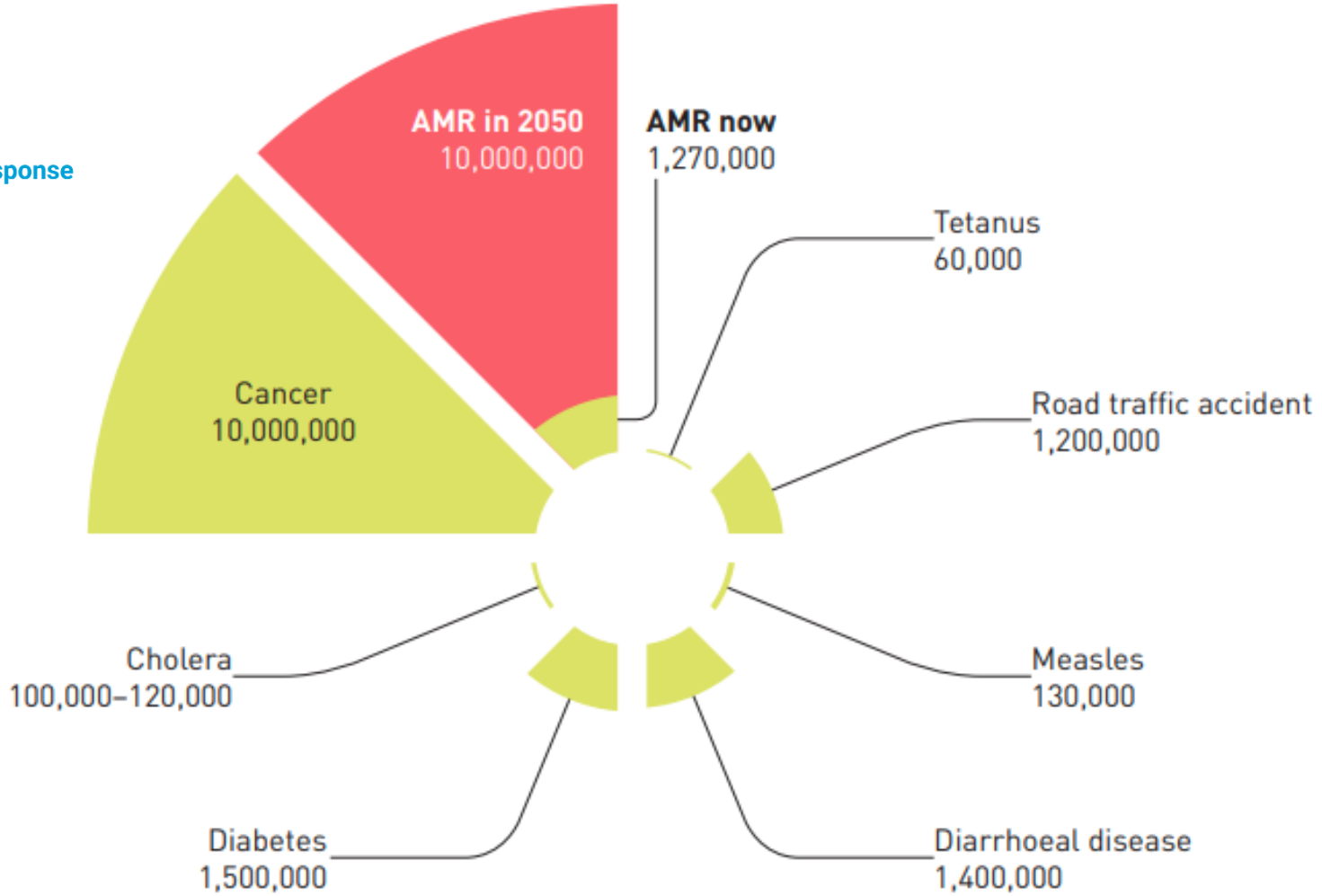


Estimated median number of attributable deaths in Europe (95% UI)	year 2020
	35 813 (31 395 - 40 584)

07 FEBRUARY 2023 | REPORT

Bracing for Superbugs: Strengthening environmental action in the One Health response to antimicrobial resistance

UN environment programme

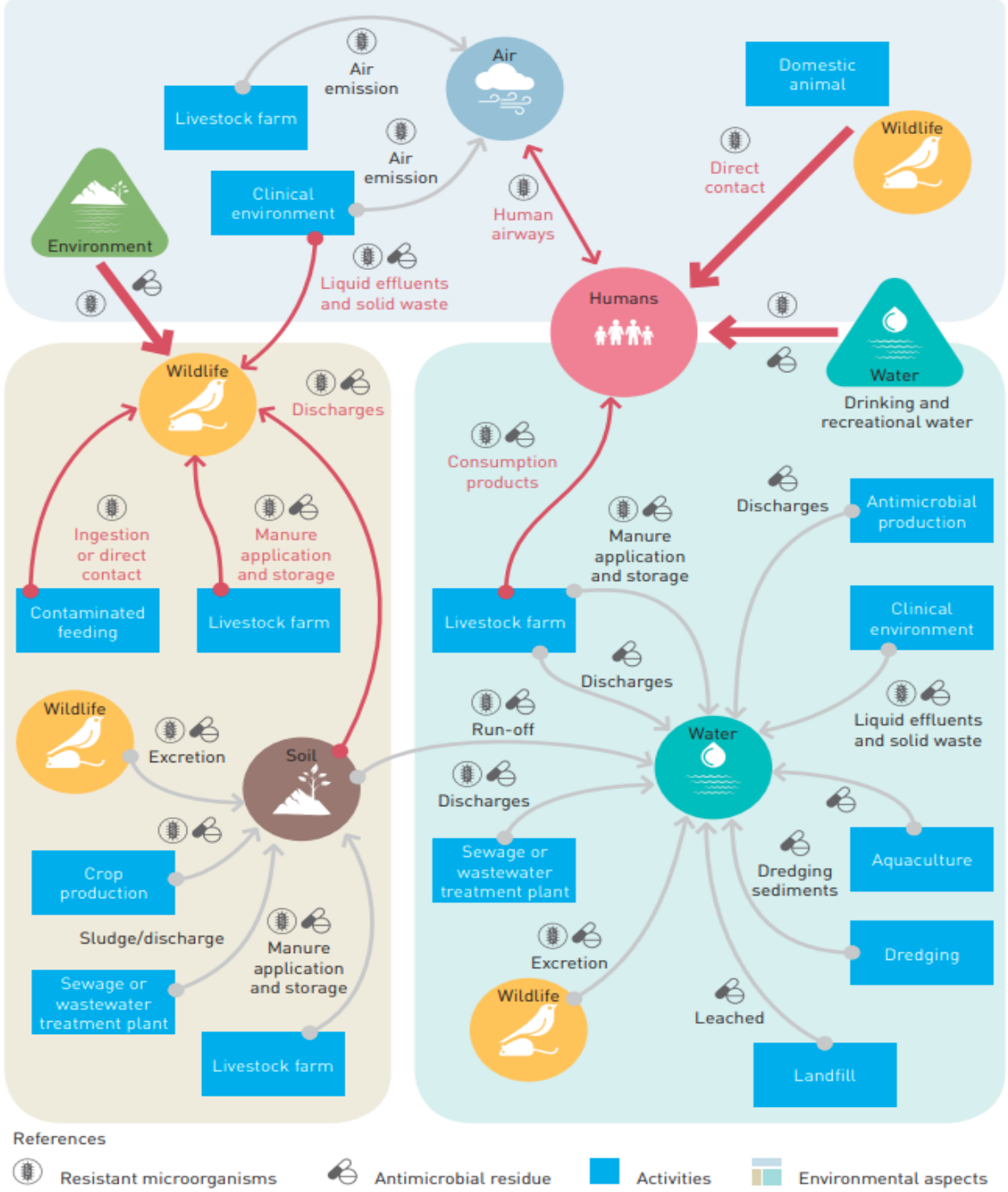


Predicted mortality from AMR compared to common causes of death today (adapted from O'Neill 2016; Murray et al. 2022)

07 FEBRUARY 2023 | REPORT

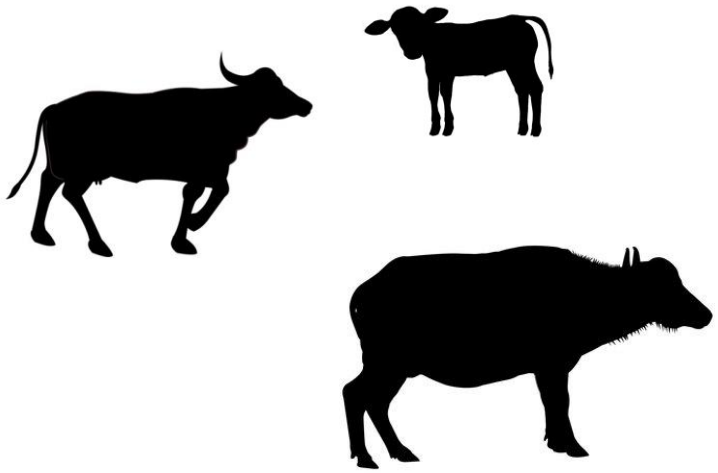
Bracing for Superbugs: Strengthening environmental action in the One Health response to antimicrobial resistance

UN environment programme



Data Standardization (animal biomass)

- ✓ **Animal category**
  - Cause
  - Active molecules
  - Administration
  - Posology



Animal Category	Standard Live Weight (kg)	age
Adult Buffalo (BU)	600	From first birth
Heifers (MA)	300	6 months to first birth
Calves (VI)	100	0-6 months

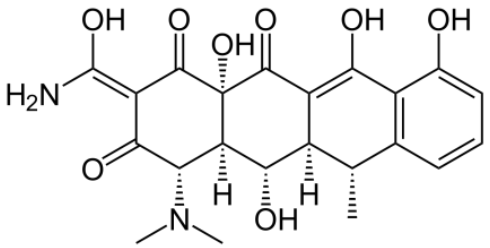
Data Standardization

- ✓ Animal category
- ✓ **Cause of treatment**
  - ✓ - Active molecules
  - ✓ - Administration
  - ✓ Posology

Causes of treatment	Gastrointestinal	Osteoarticular
Urogenital	Respiratory	Cutaneous
Locomotor	dry therapy	Mastitis
Nervous	Septicaemia	unknown

Data Standardization

- ✓ Animal category
- ✓ - Cause
- ✓ **Active molecules (PA)**
- ✓ - Administration
- ✓ Posology

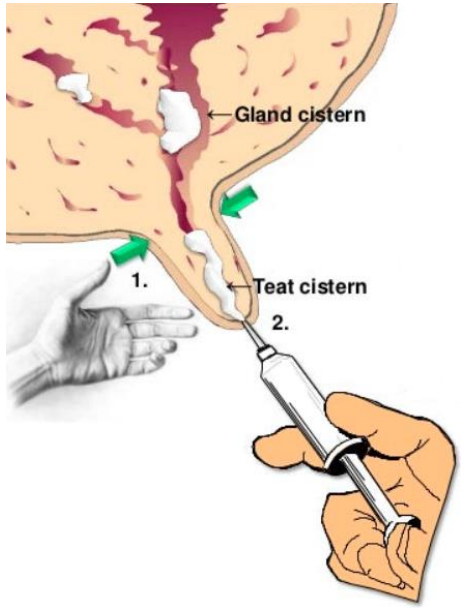


Category of antimicrobial*	PA
Critical (C)	Cefalosporine III-IV Gen Fluorochinoloni
Potentially Critical (PC)	Macrolidi
Non Critical(NC)	Aminopenicilline Aminoglicosidi Cefalosporine I-II Gen Lincosamidi Penicilline Penicilline BLR Sulfamidici Tetracicline

*Ministero della salute – DG della Sanità Animale e dei Farmaci Veterinari

Data Standardization

- ✓ Animal category
- ✓ - Cause
- ✓ - Active molecules
- ✓ **Administration**
- ✓ Posology



VdS
Injectable (INJ)
Intramammary dry (IM dry)
Intramammary lactation (IM LAT)
Intrauterin (IU)

Data Standardization

- ✓ Animal category
- ✓ - Cause
- ✓ - Active molecules
- ✓ - Administration
- ✓ **Posology**

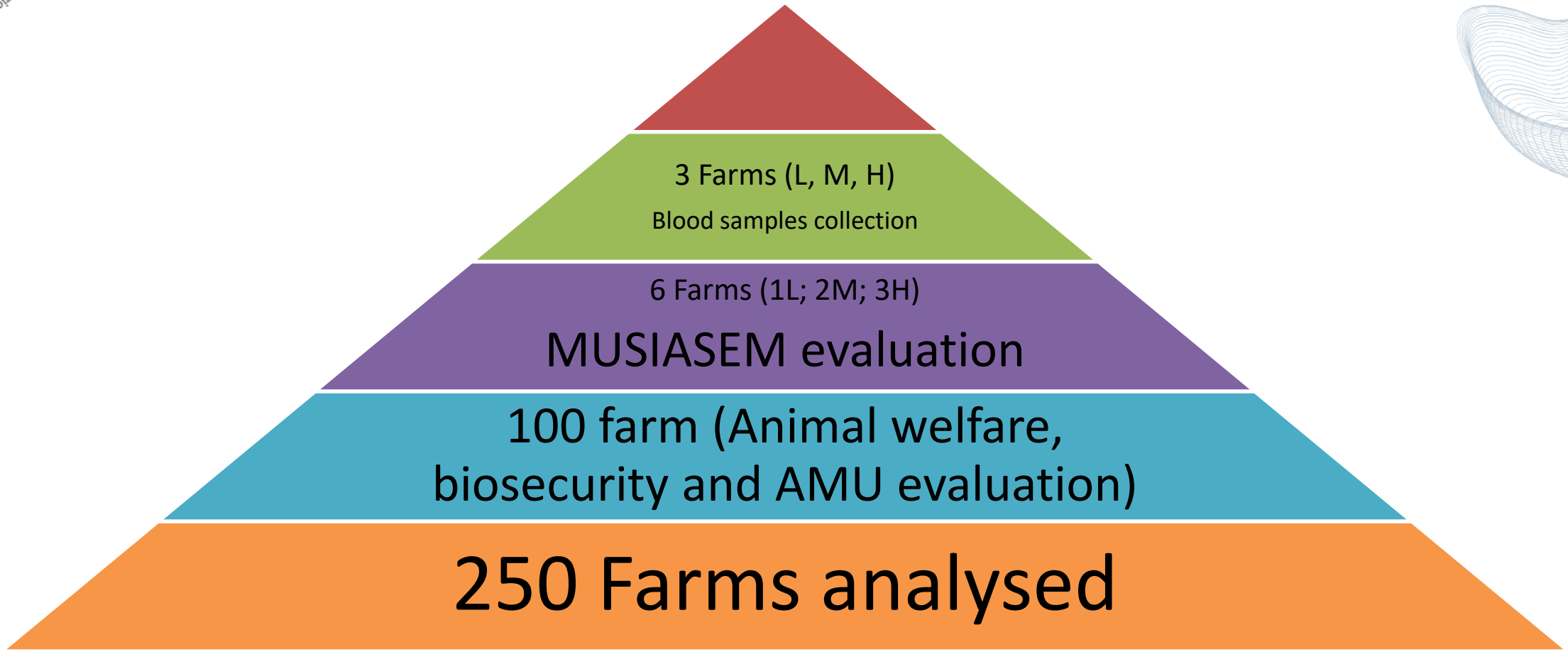
Antimicrobial Use

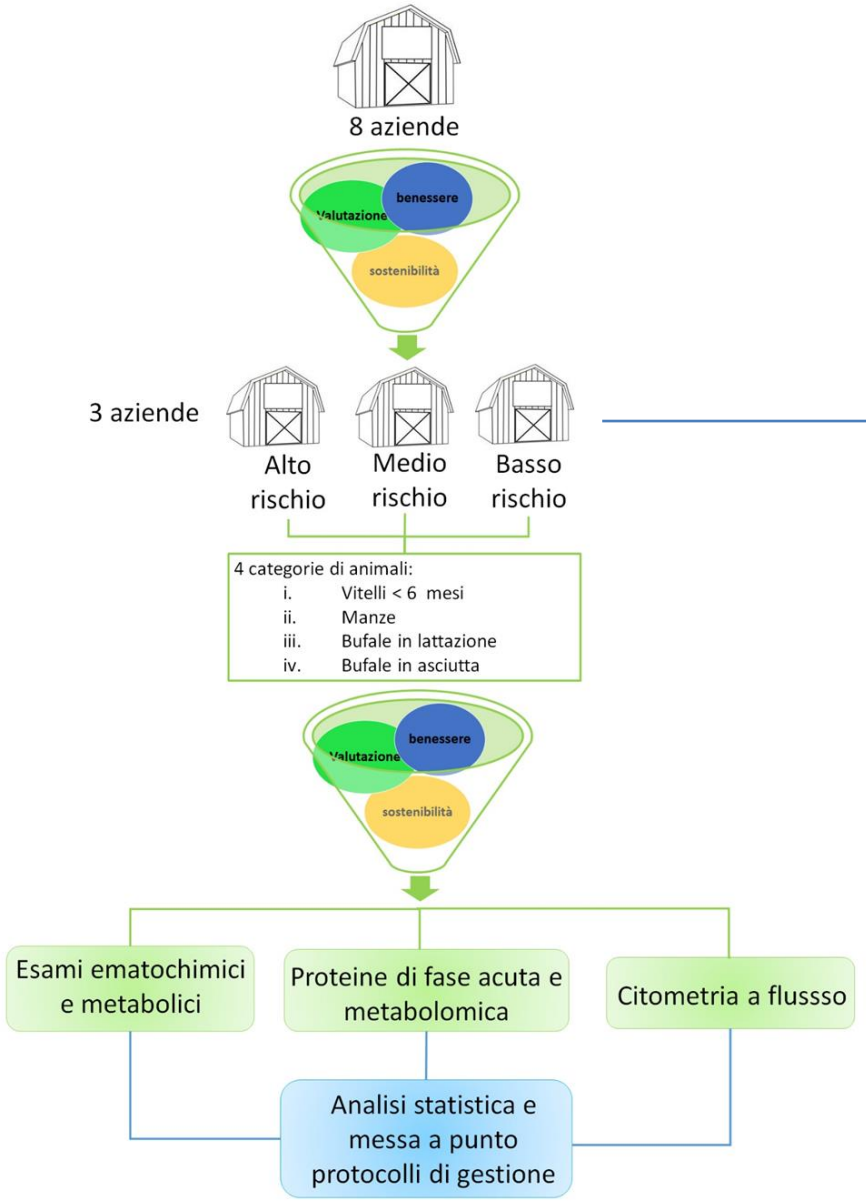
Defined Daily Dose (DDDAit)*

$$\sum_{i=1}^{n} \frac{PA_i \text{ active ingredient used (mg)}}{DDDAit_i \text{ (mg) x animals (n)} \times \text{wightat risk (kg)}}$$

*Mazza, F. et al.; Animals 2021

*Scherpenzeel C.G. M. et al.; Journal of Dairy Science, Volume 97, Issue 6, 2014


3 Farms (L, M, H)
Blood samples collection
6 Farms (1L; 2M; 3H)
MUSIASEM evaluation
100 farm (Animal welfare, biosecurity and AMU evaluation)
250 Farms analysed



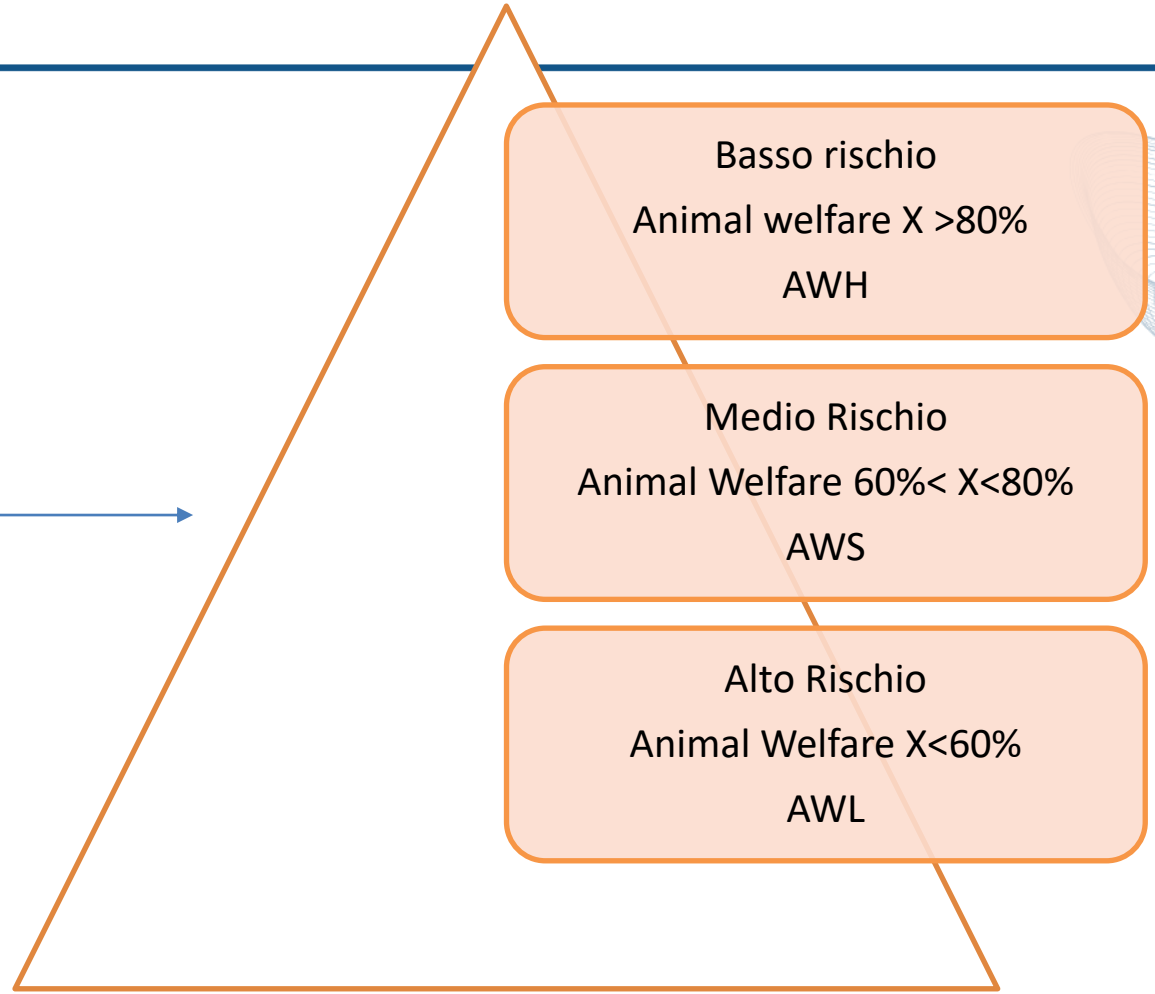


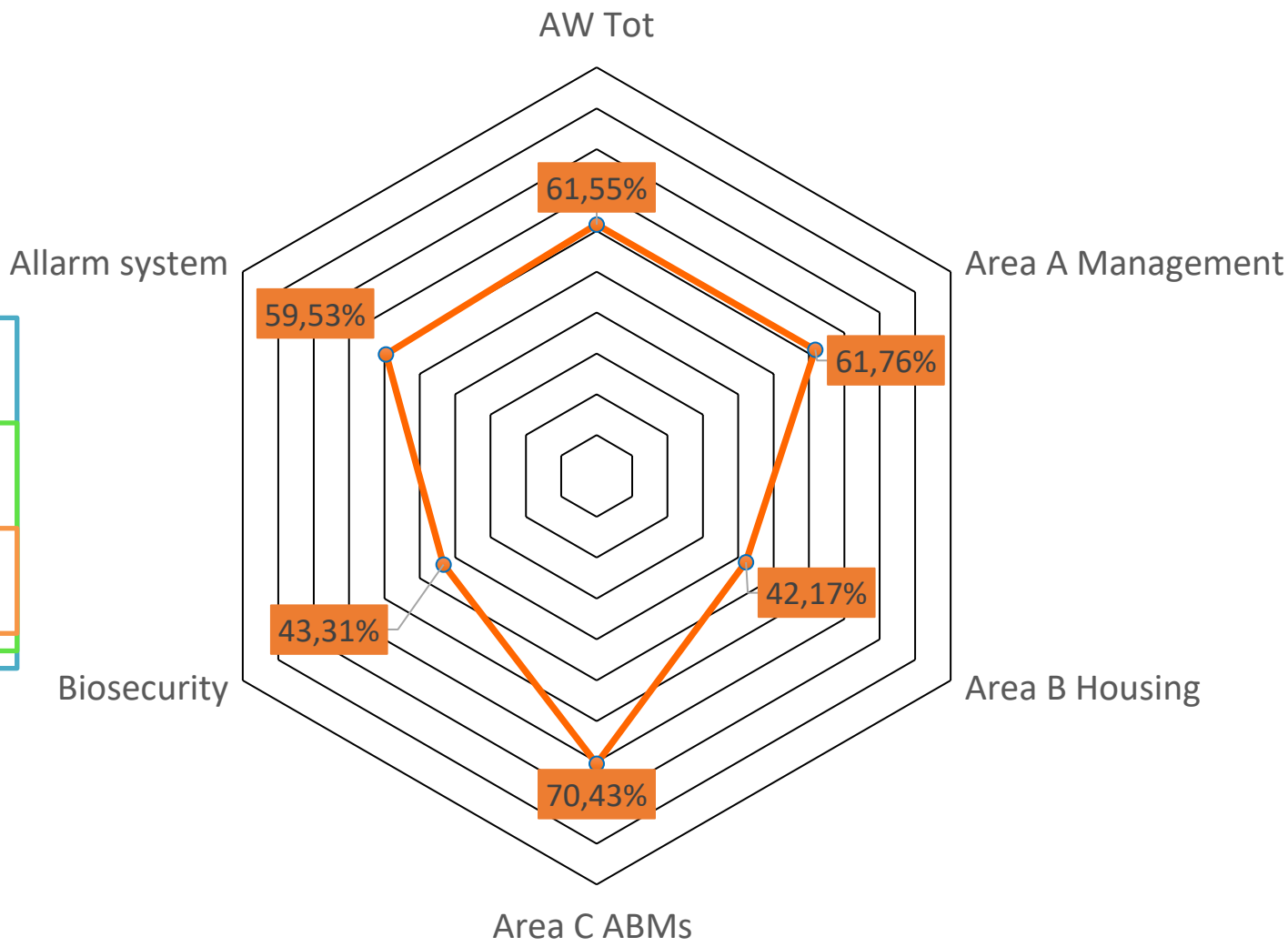
Figura 2 diagramma di flusso delle fasi del progetto di ricerca

100 farms

Average size: 412 heads (min. 81 max 2240)

Total heads: 41.200

Animal Welfare

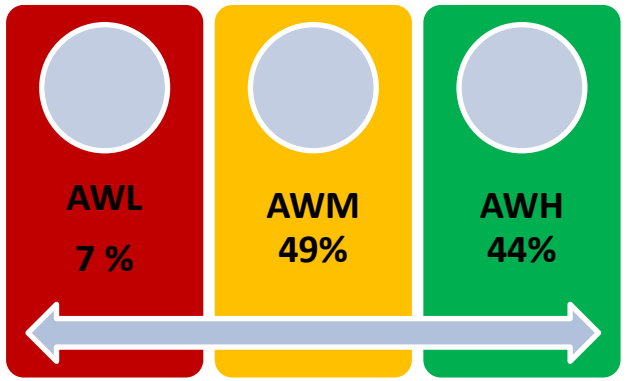


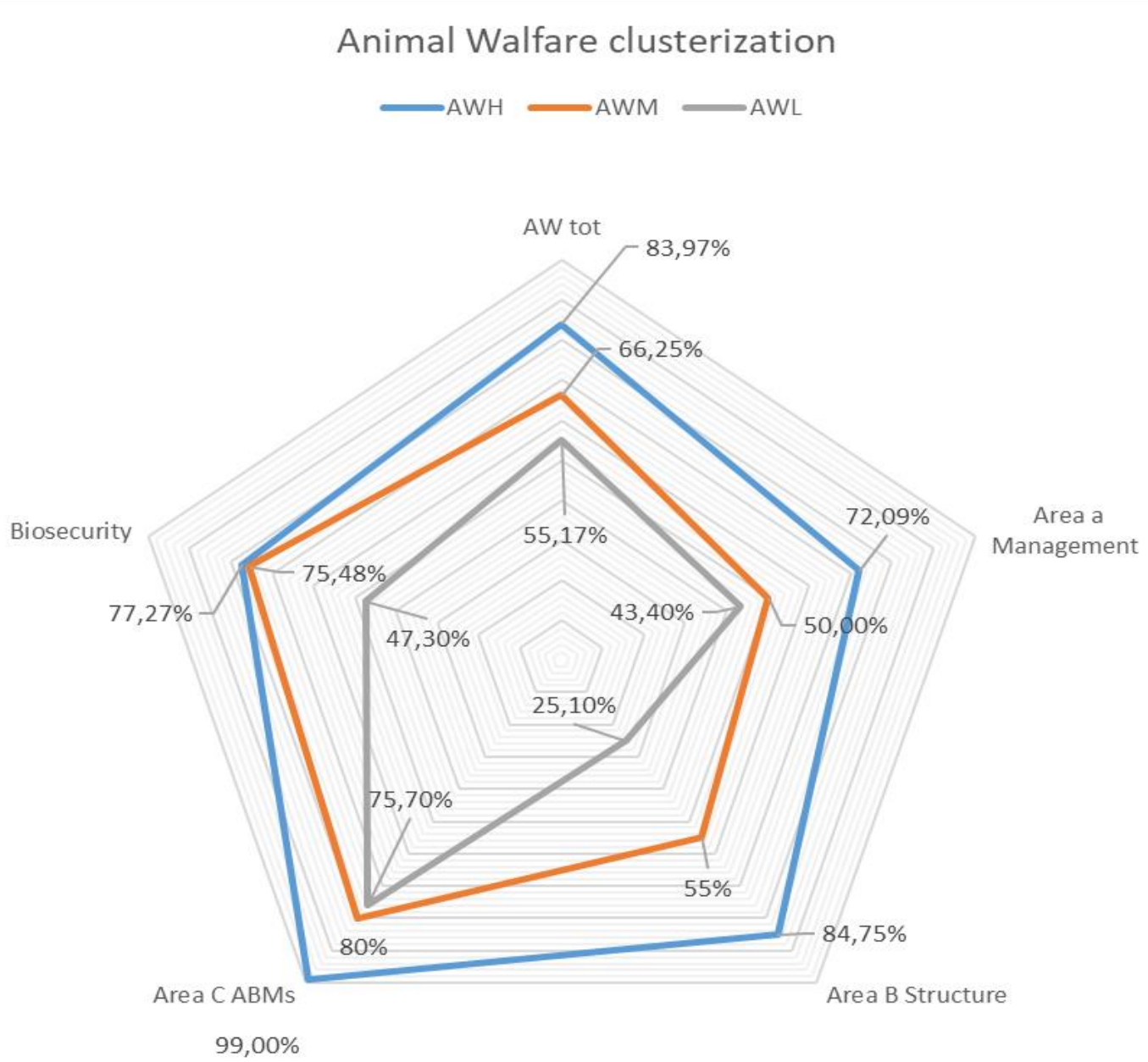
Value AW totale, Area A Management, Area B Structure, Area C ABMs e Biosecurity for 3 classes of animal welfare risk (AWH; AWM; AWL)

AWL = X≤ 59%

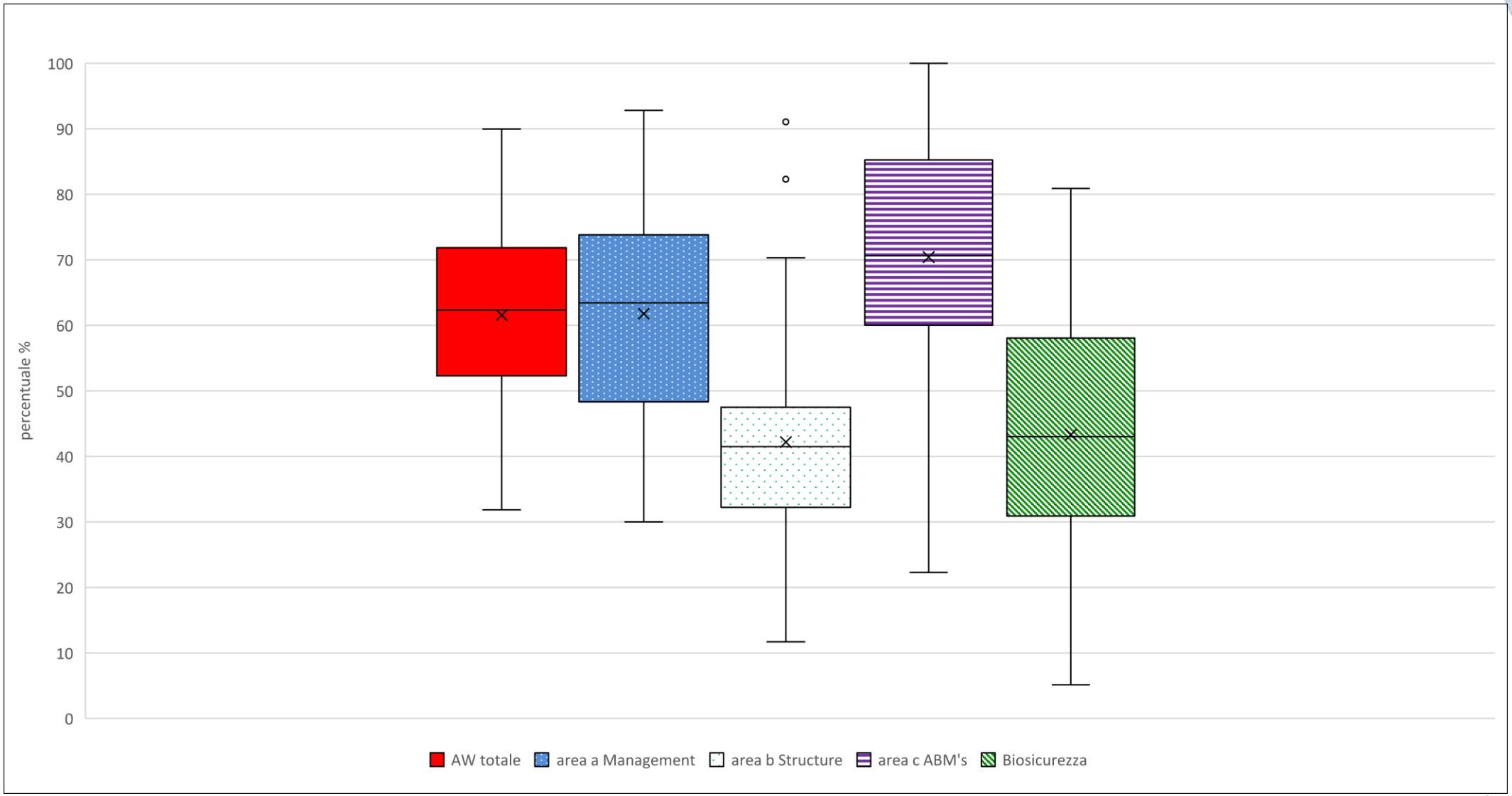
AWM= 79% ≥ X ≥ 60%

AWH= X ≥80%



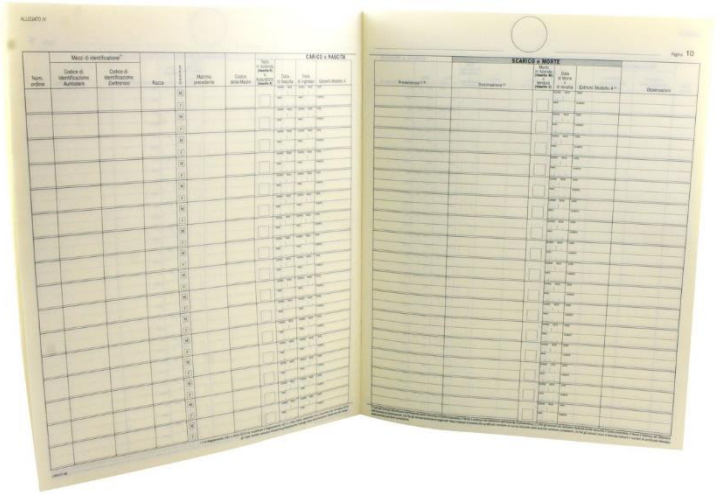


Baseline distribution delle aree tematiche rilevate: Benessere animale totale (AW Totale), Area a Management, Area b Structure, Area c ABMs, Biosicurezza.



Antimicrobial use evaluation

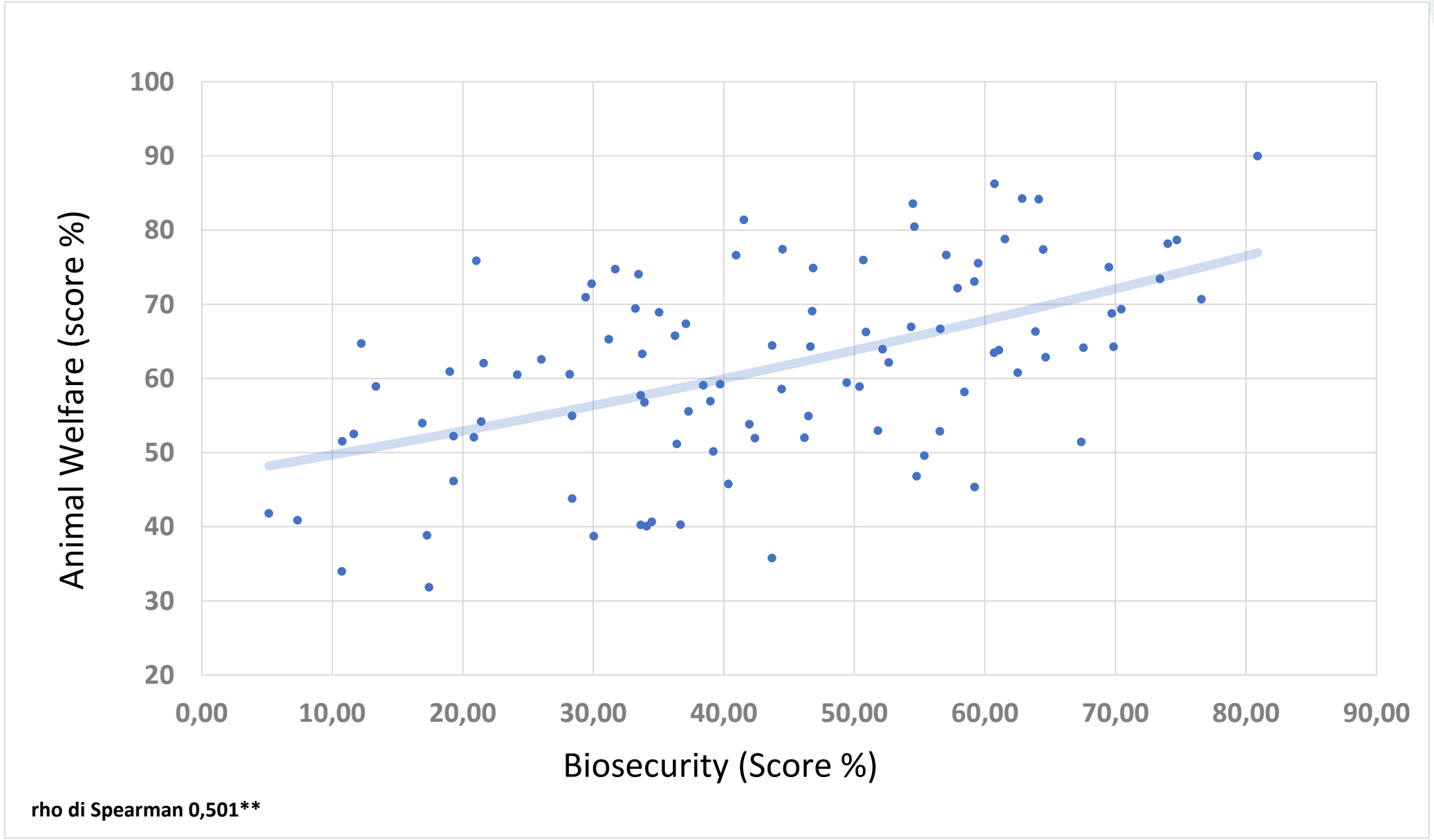
N° 100 Buffalo's farms (Total heads: 41.200)



	A	B	C	D	E	F	G	H	I	J	K
1	azienda	periodo	farmaco	n flaconi	volume flacone/dosi	un mis	soggetto	n.trattati	causa	dose sogg ml	gg trattamento
2		04/02/2017	ALAMYCIN	1	250	ml	BUF	2	EN	45	3
3		15/09/2017	ALAMYCIN	1	250	ml	BUF	1	RE	45	6
4		04/03/2017	AMMINOFARMA	1	250	ml	VIT	10	EN	5	4
5		24/03/2017	AMMINOFARMA	2	250	ml	VIT	20	EN	5	4
6		09/05/2017	BAYCOX	1	250	ml	BUF	13	TZ	20	1
7		13/11/2017	BAYMER	1	1000	ml	VIT	60	AP		1
8		05/01/2017	BETAMOX	1	250	ml	BUF	2	RE	50	4
9		24/03/2017	BETAMOX	1	250	ml	BUF	2	CU	50	2
10		18/04/2017	BETAMOX	1	250	ml	BUF	2	EN	50	2
11		28/04/2017	BETAMOX	1	250	ml	BUF	2	RE	50	2
12		07/08/2017	BETAMOX	1	250	ml	BUF	5	RE	50	4
13		15/09/2017	BETAMOX	1	250	ml	BUF	2	RE	50	4
14		05/01/2017	BRAVOXIN	1	100	ml	VIT	50	TZ	2	1
15		14/03/2017	BRAVOXIN	1	100	ml	VIT	50	TZ	2	1
16		04/07/2017	BRAVOXIN	1	100	ml	VIT	25	TZ	2	1
17		07/08/2017	BRAVOXIN	1	100	ml	VIT	25	TZ	2	1
18		04/02/2017	CEFTIOCYL	1	250	ml	BUF	4	UG	40	2
19		07/08/2017	CEFTIOCYL	1	250	ml	BUF	4	UG	40	2

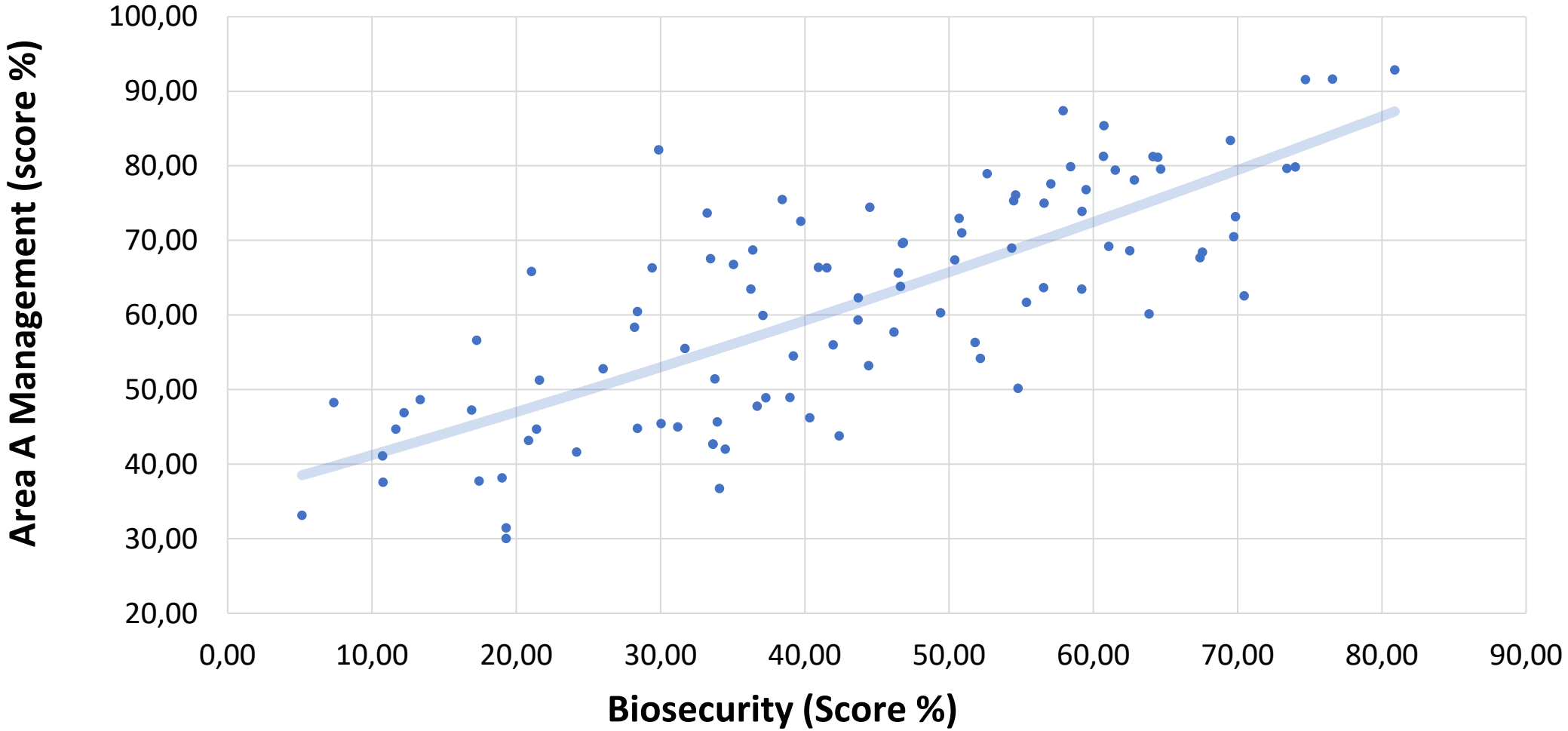
2015 2016 2017

Correlation between Animal Welfare score and Biosecurity score



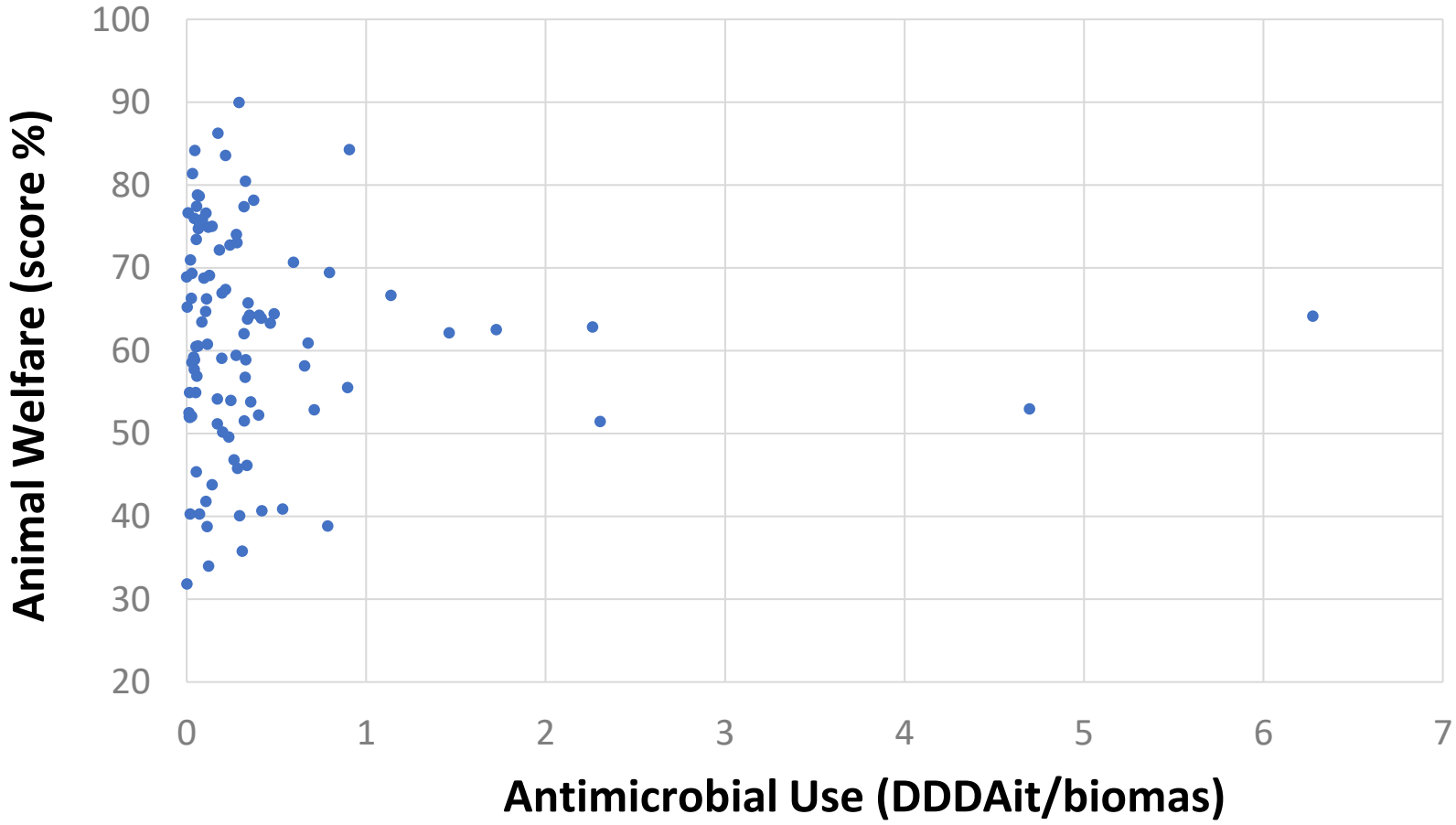
rho di Spearman 0,501**

Correlation between Area A score and Biosecurity score



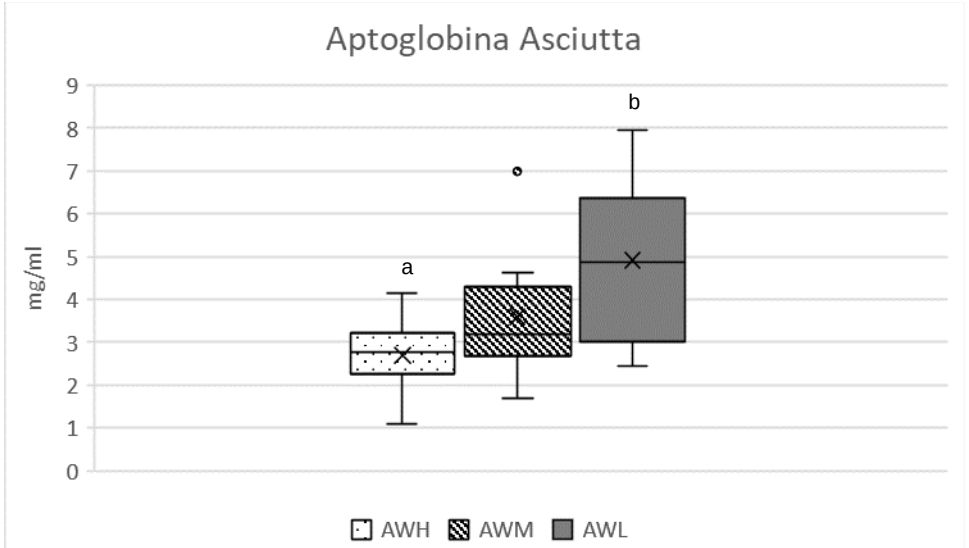
rho di Spearman 0,759**

Correlation between animal welfare score and Antimicrobial use (DDDAit)



rho di Spearman -0,011

Figura 20 Baseline distribution dei valori di Aptoglobina per i soggetti in asciutta per le diverse classi di rischio Benessere (AWH, AWM, AWL) a≠b; P<0.05



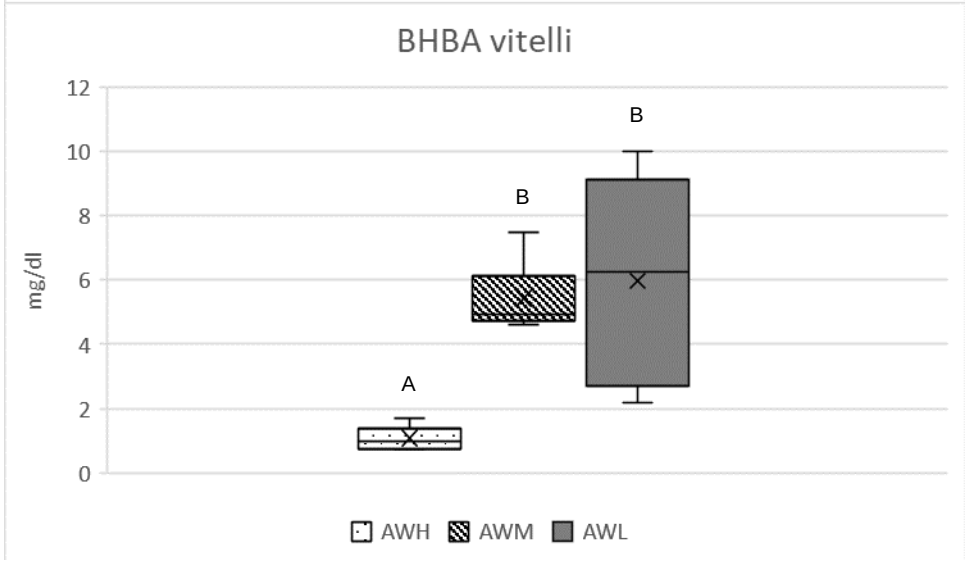
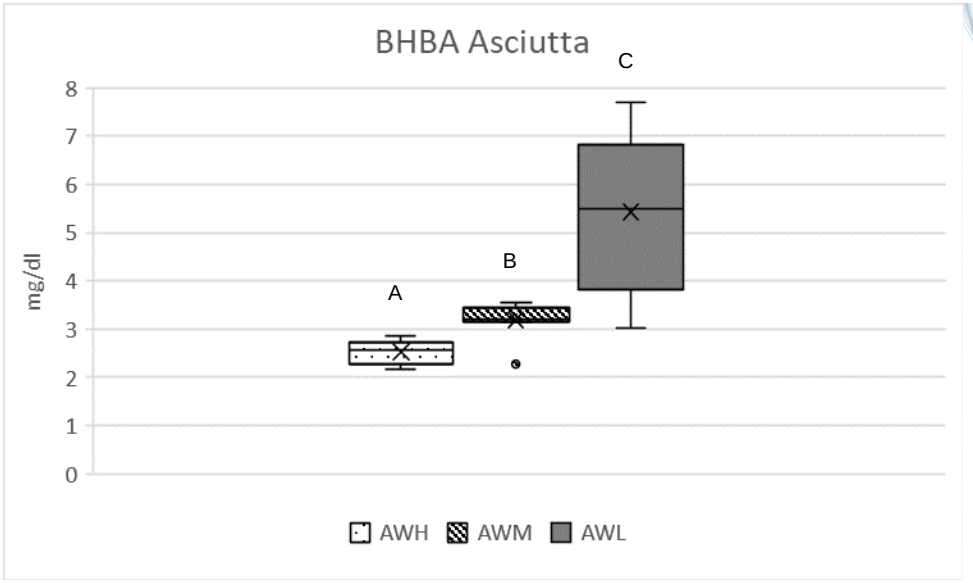


Figura 22 Baseline distribution dei valori di Betaidrossibutirrato (BHBA mg/dl) per i vitelli per le diverse classi di rischio Benessere (AWH, AWM, AWL). A≠B; P<0.001

Figura 21 Baseline distribution dei valori di Betaidrossibutirrato (BHBA mg/dl) per i soggetti in asciutta per le diverse classi di rischio Benessere (AWH, AWM, AWL) A≠B≠C; P<0.001



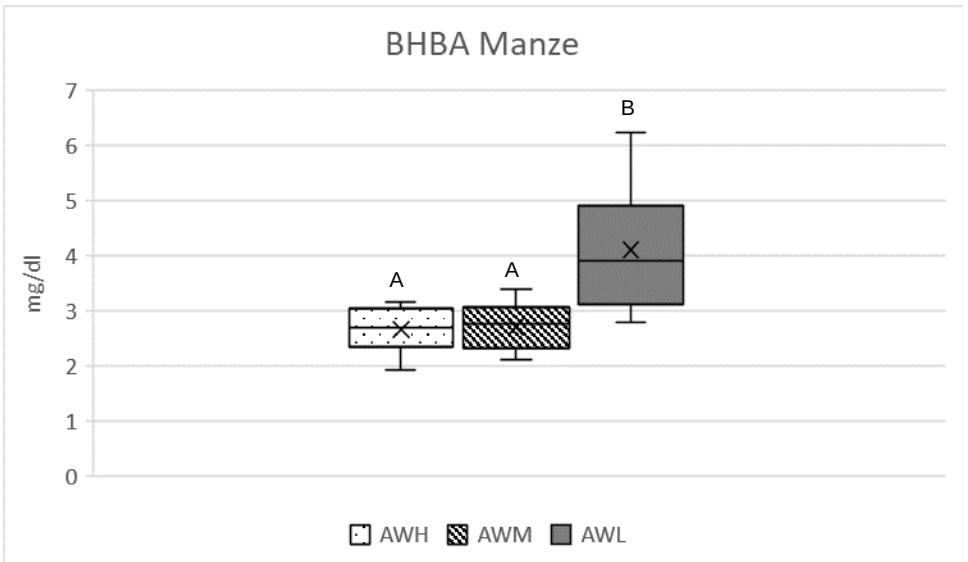
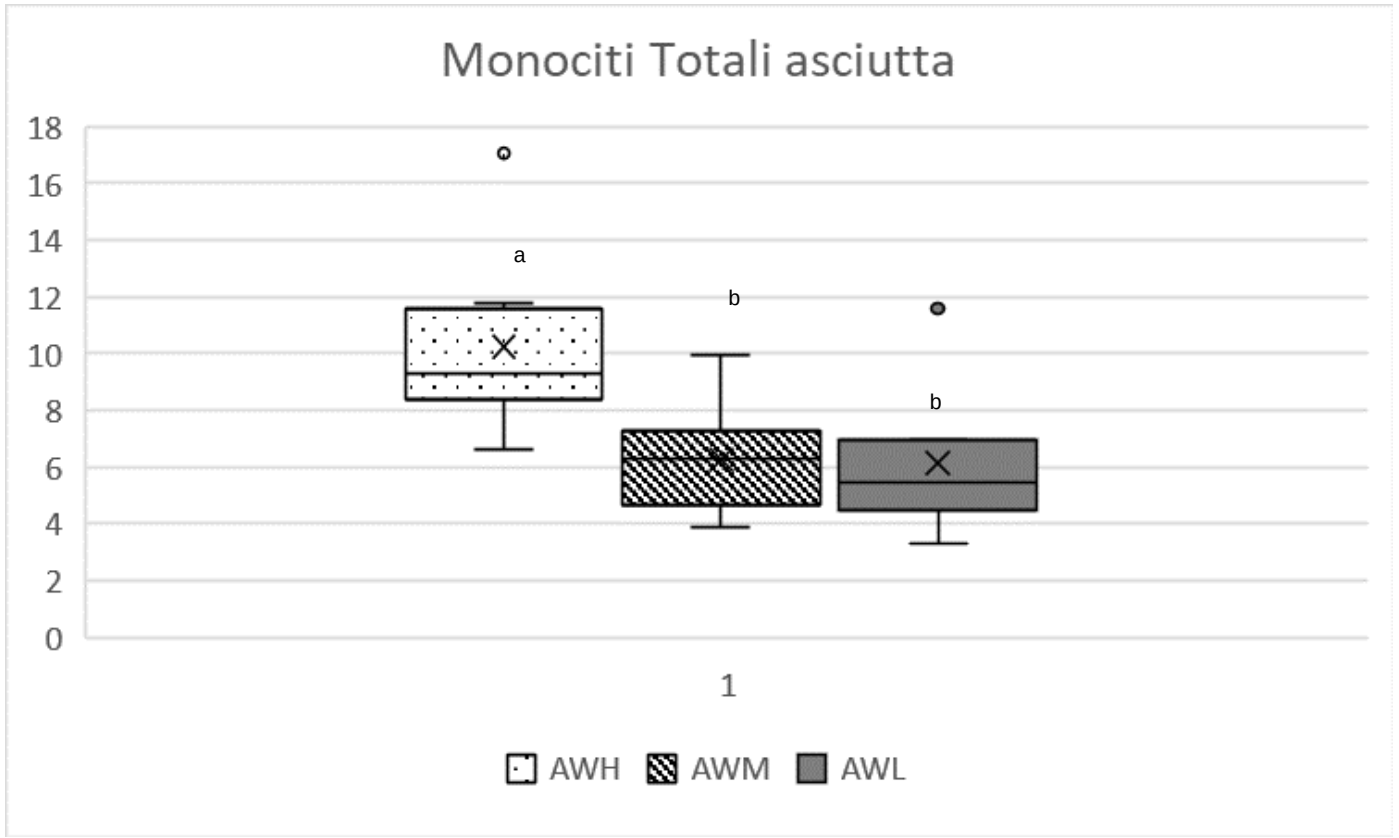


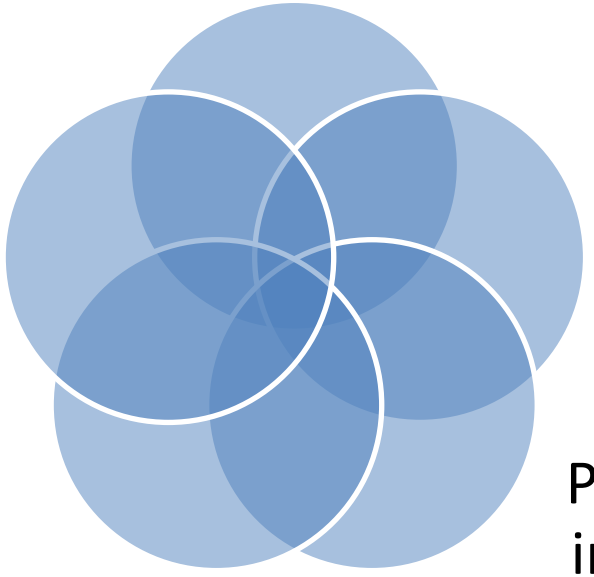
Figura 23 Baseline distribution dei valori di Betaidrossibutirrato (BHBA mg/dl) per le manze per le diverse classi di rischio Benessere (AWH, AWM, AWL). A≠B; P<0.001


Monociti Totali asciutta
18
16
14
12
10
8
6
4
2
0
a
b
b
1
AWH
AWM
AWL

Vulnerability of the system

REACTIVITY AND READINESS

Monitoring the critical point

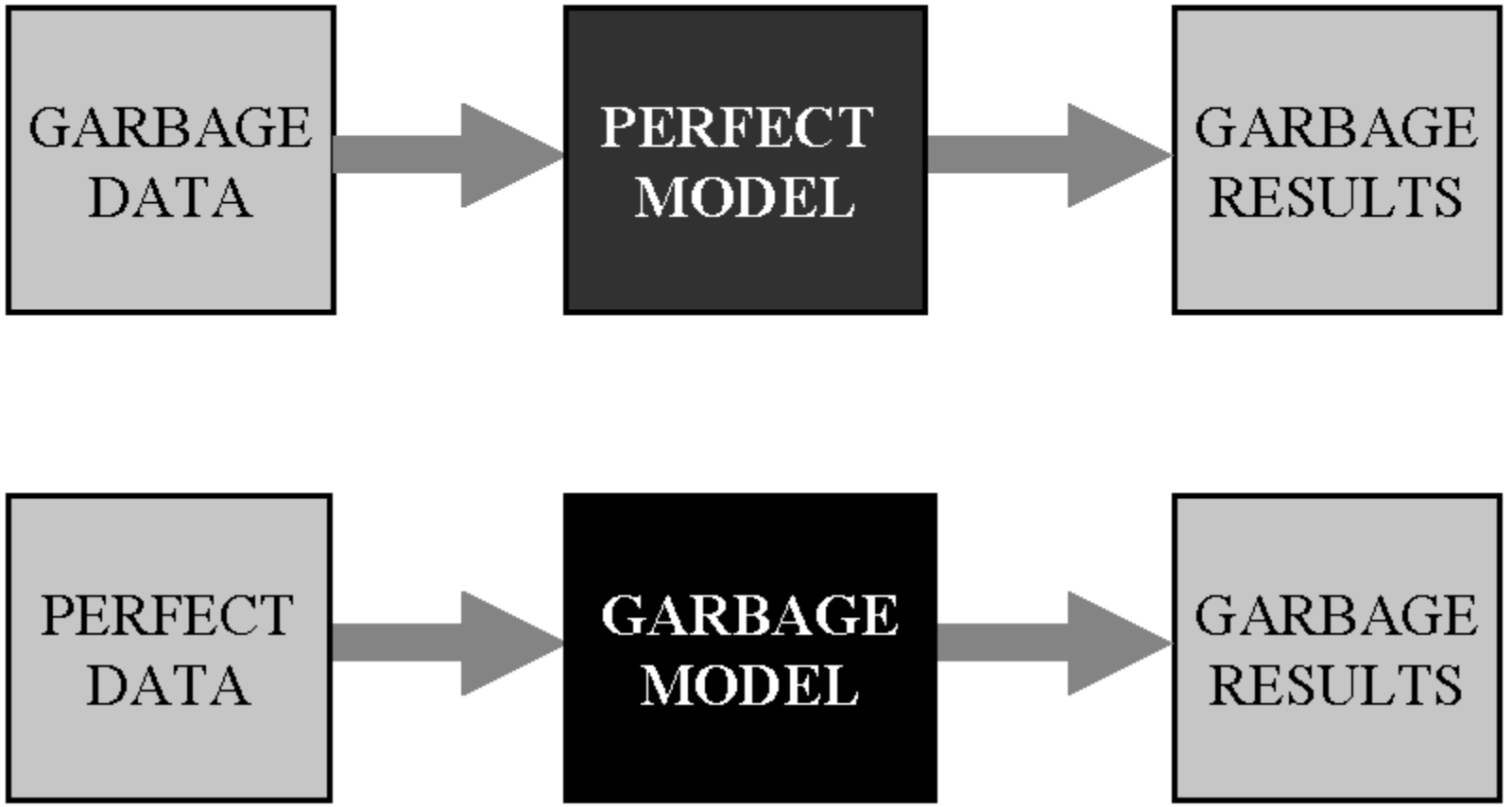


Mitigating the risks

Preparing an intervention plan

MODEL CALCULATIONS

"Garbage In-garbage Out" Paradigm



Present & Future

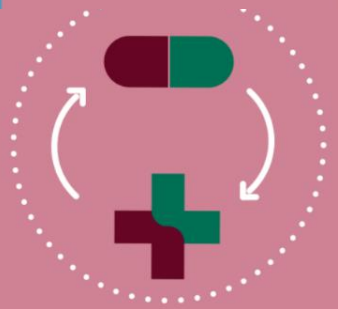
Cosa fare per evitare l'uso di antibiotici negli animali?

coordinazione

Queste misure vanno attuate nel quadro di una **strategia integrata**.

ridurre

l'uso di antimicrobici



rimpiazzare

gli antimicrobici con soluzioni alternative

ripensare

il sistema di produzione degli animali

monitoraggio

Monitorare l'uso di antimicrobici negli animali e nell'uomo e il livello di resistenza agli antimicrobici è essenziale per valutare l'efficacia delle misure adottate

Migliorare la prevenzione e il controllo delle malattie negli animali

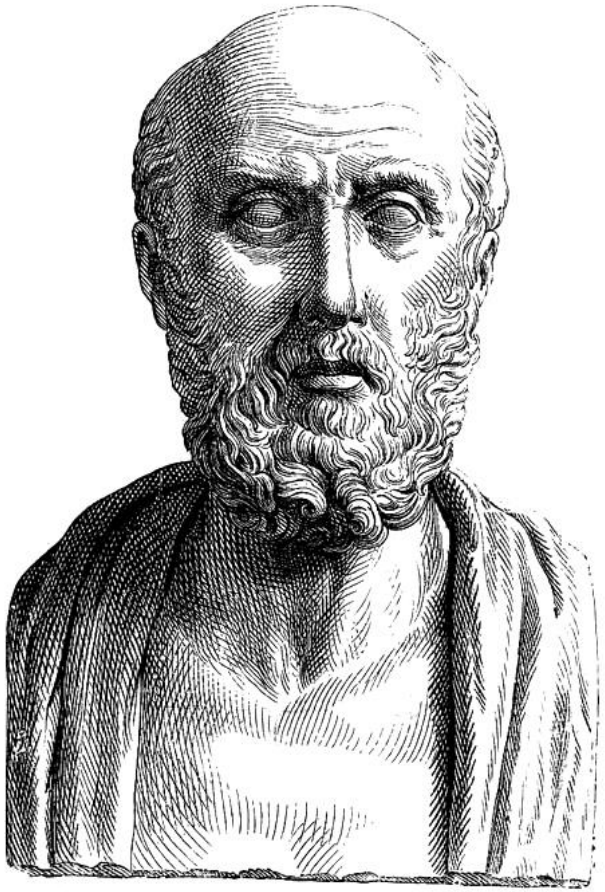
Valutare sistemi di allevamento alternativi

Formare

The Most Complex job is to remove

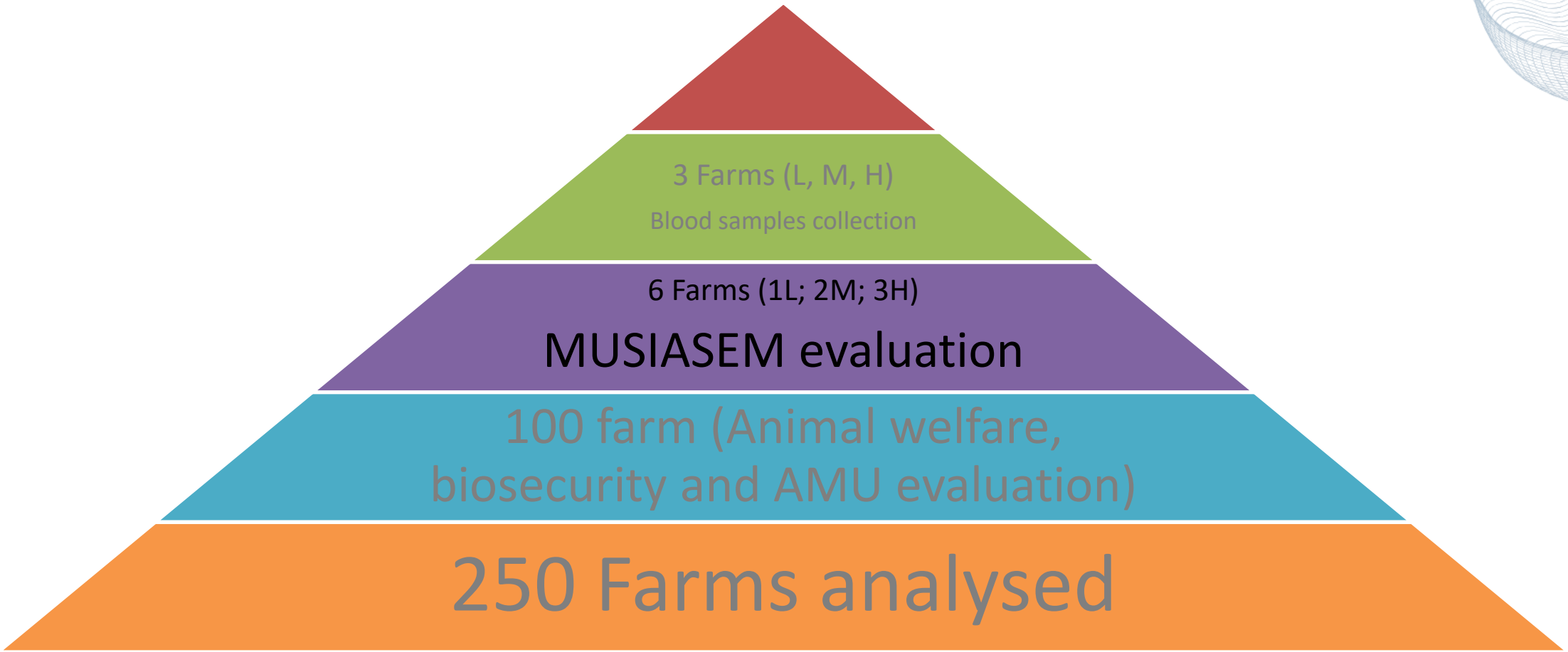
Very often when faced with a company problem, before trying to «remove» the cause, one is tempeted to «add» a solution to a system that is not in balace

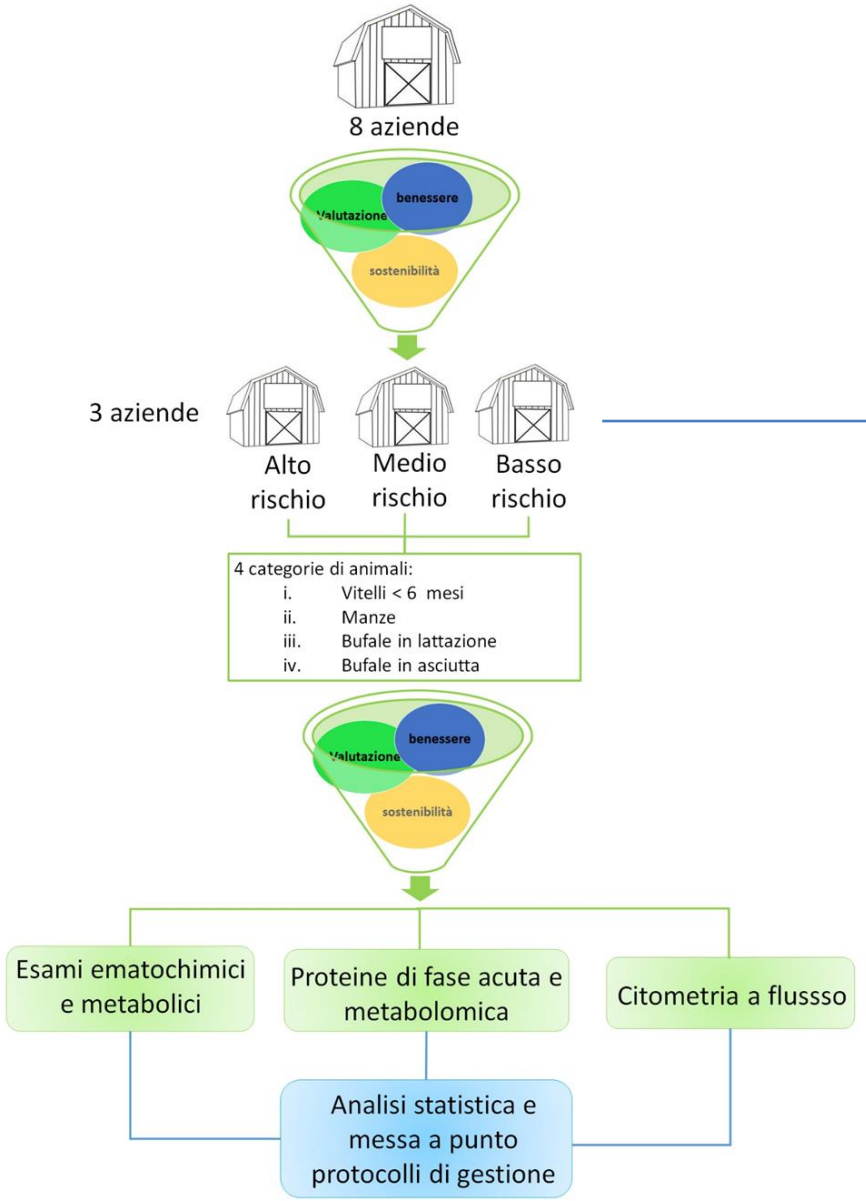
Pillars of health status in humans



«When a patient asks you for a cure, ask him if he is willing to abandon the causes»

(Ippocrate 460-377 a.C.)


3 Farms (L, M, H)
Blood samples collection
6 Farms (1L; 2M; 3H)
MUSIASEM evaluation
100 farm (Animal welfare, biosecurity and AMU evaluation)
250 Farms analysed



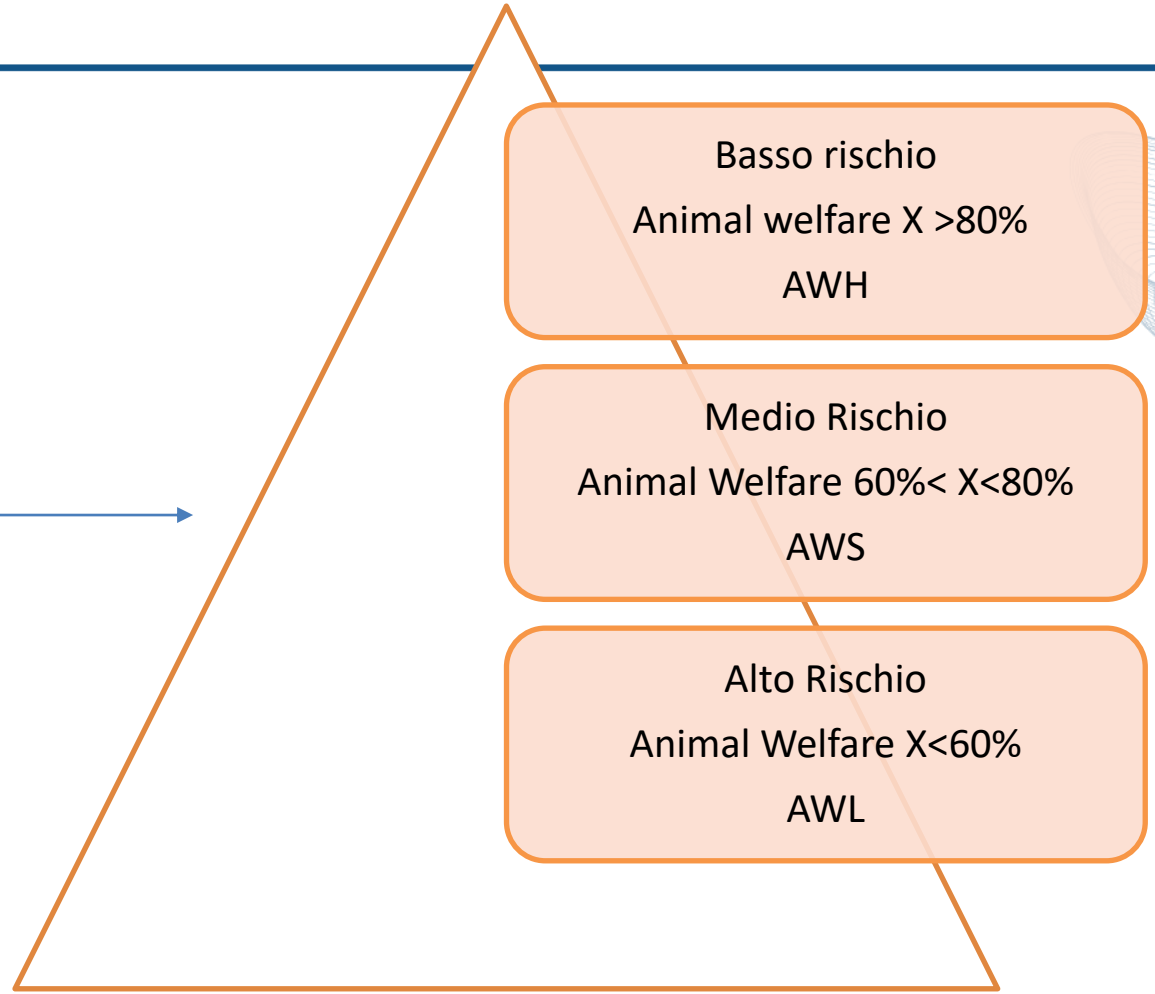
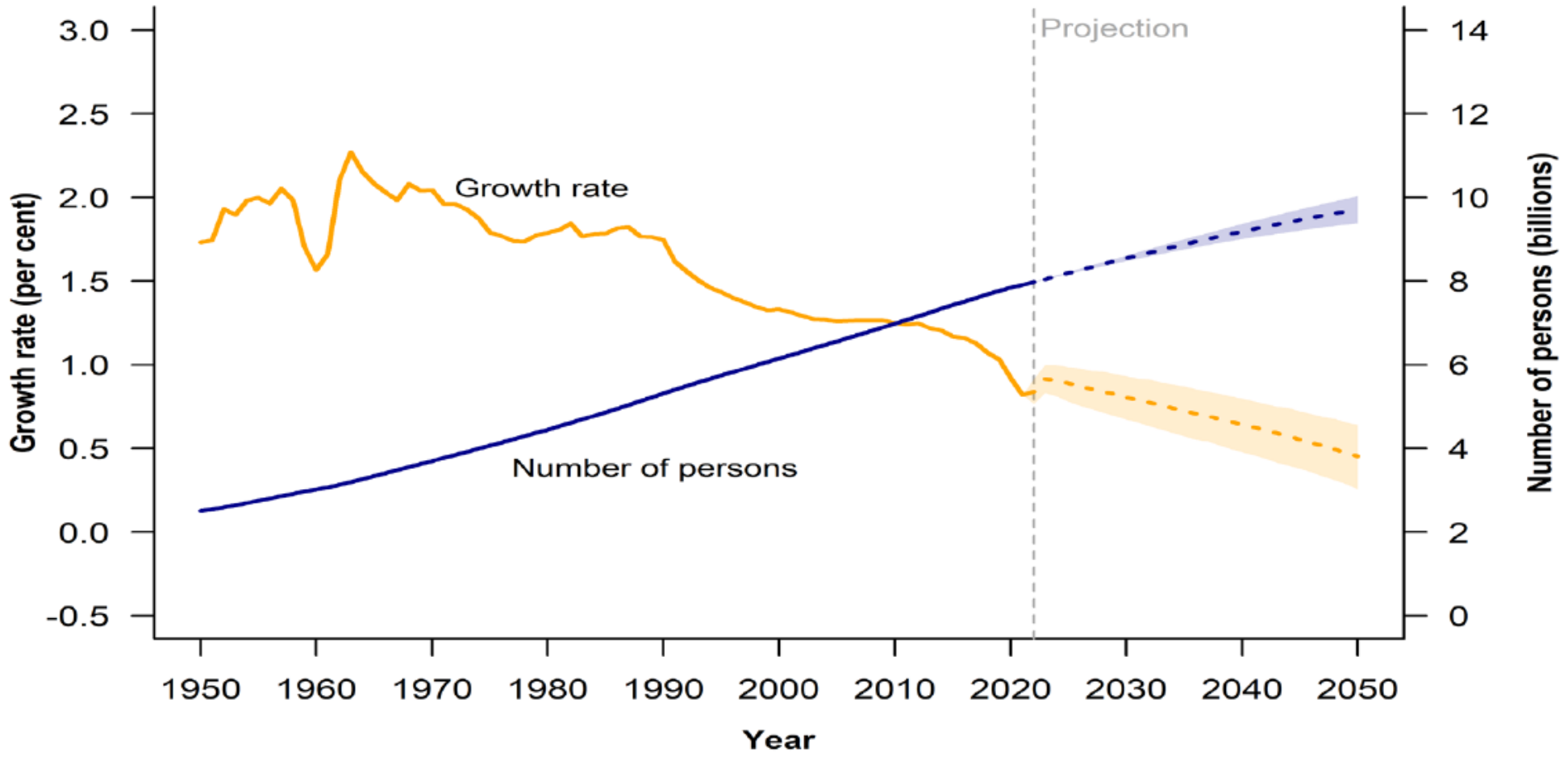


Figura 2 diagramma di flusso delle fasi del progetto di ricerca

Global population size and annual growth rate: estimates, 1950-2022, and medium scenario with 95 per cent prediction intervals, 2022-2050



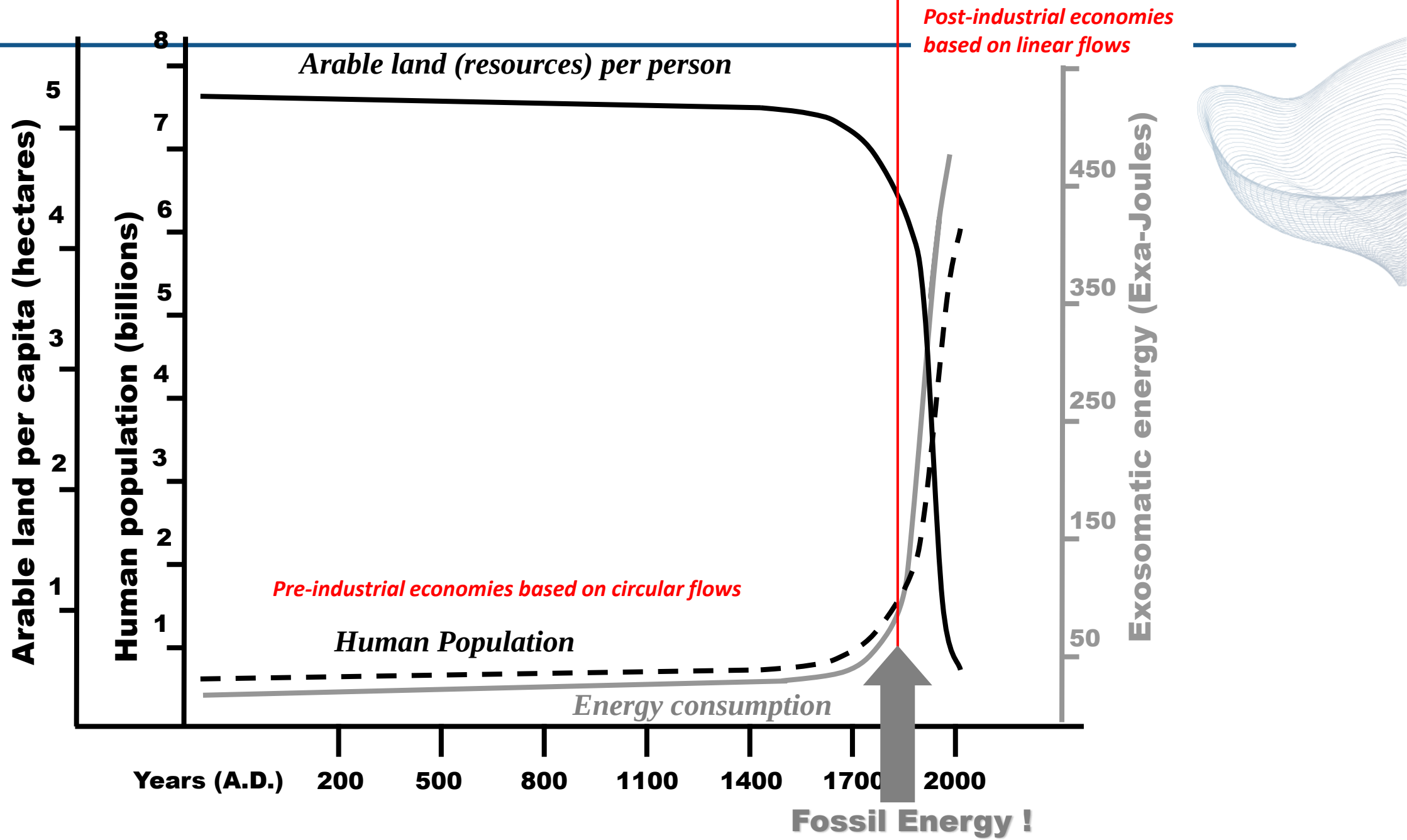
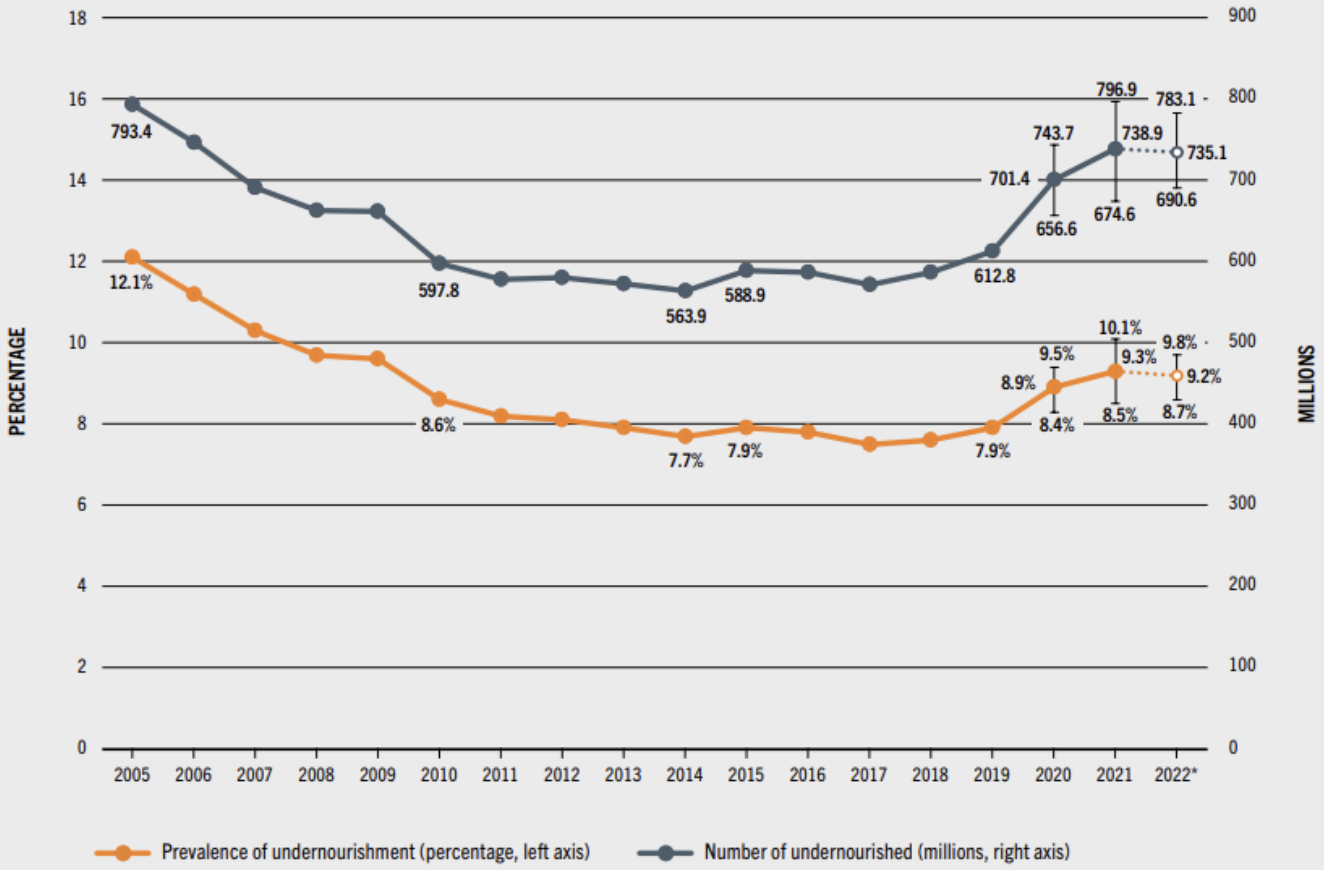

Post-industrial economies based on linear flows
Arable land (resources) per person
Arable land per capita (hectares)
Human population (billions)
Exosomatic energy (Exa-Joules)
Pre-industrial economies based on circular flows
Human Population
Energy consumption
Years (A.D.)
200
500
800
1100
1400
1700
2000
Fossil Energy !

FIGURE 1 GLOBAL HUNGER REMAINED VIRTUALLY UNCHANGED FROM 2021 TO 2022 BUT IS STILL FAR ABOVE PRE-COVID-19-PANDEMIC LEVELS



NOTES: * Projections based on nowcasts for 2022 are illustrated by dotted lines. Bars show lower and upper bounds of the estimated range.
SOURCE: FAO. 2023. FAOSTAT: Suite of Food Security Indicators. In: *FAO*. [Cited 12 July 2023]. www.fao.org/faostat/en/#data/FS

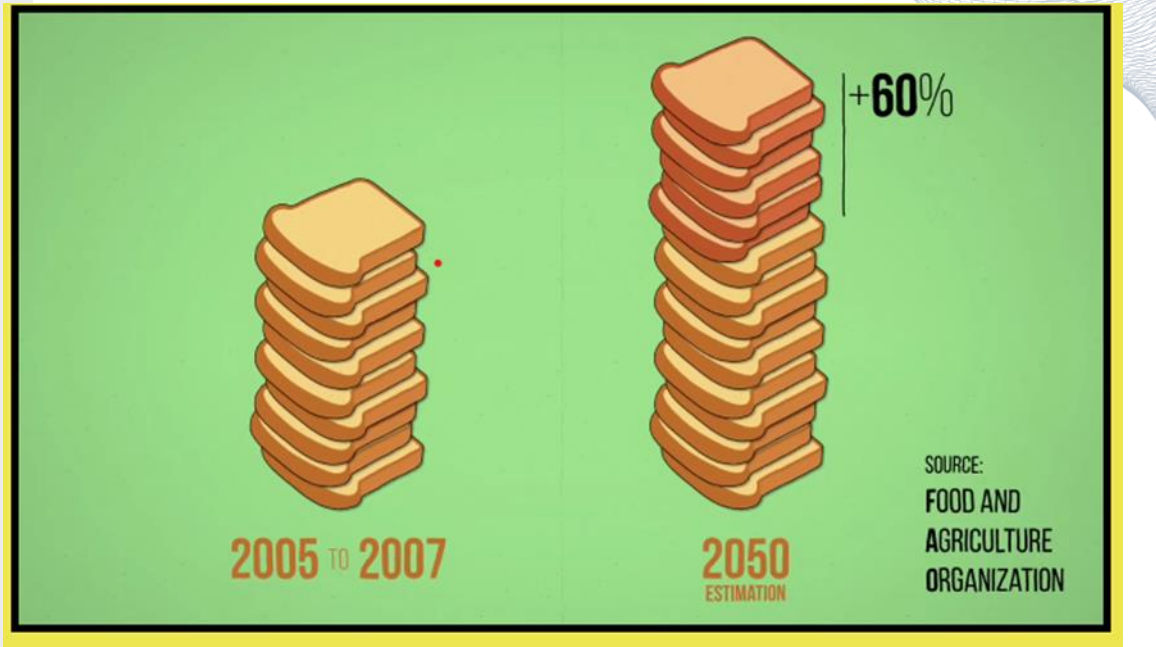
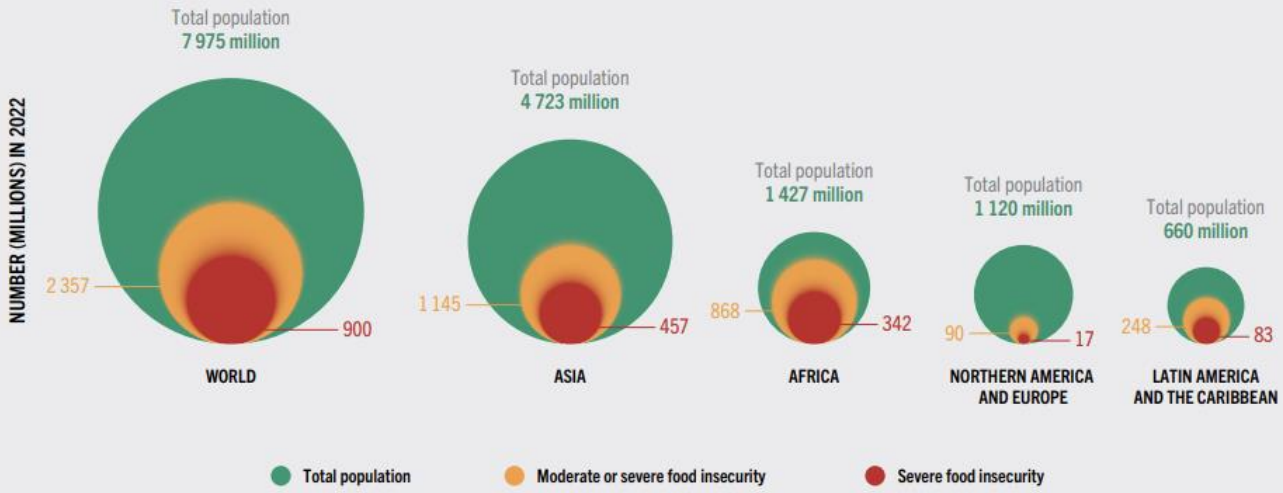
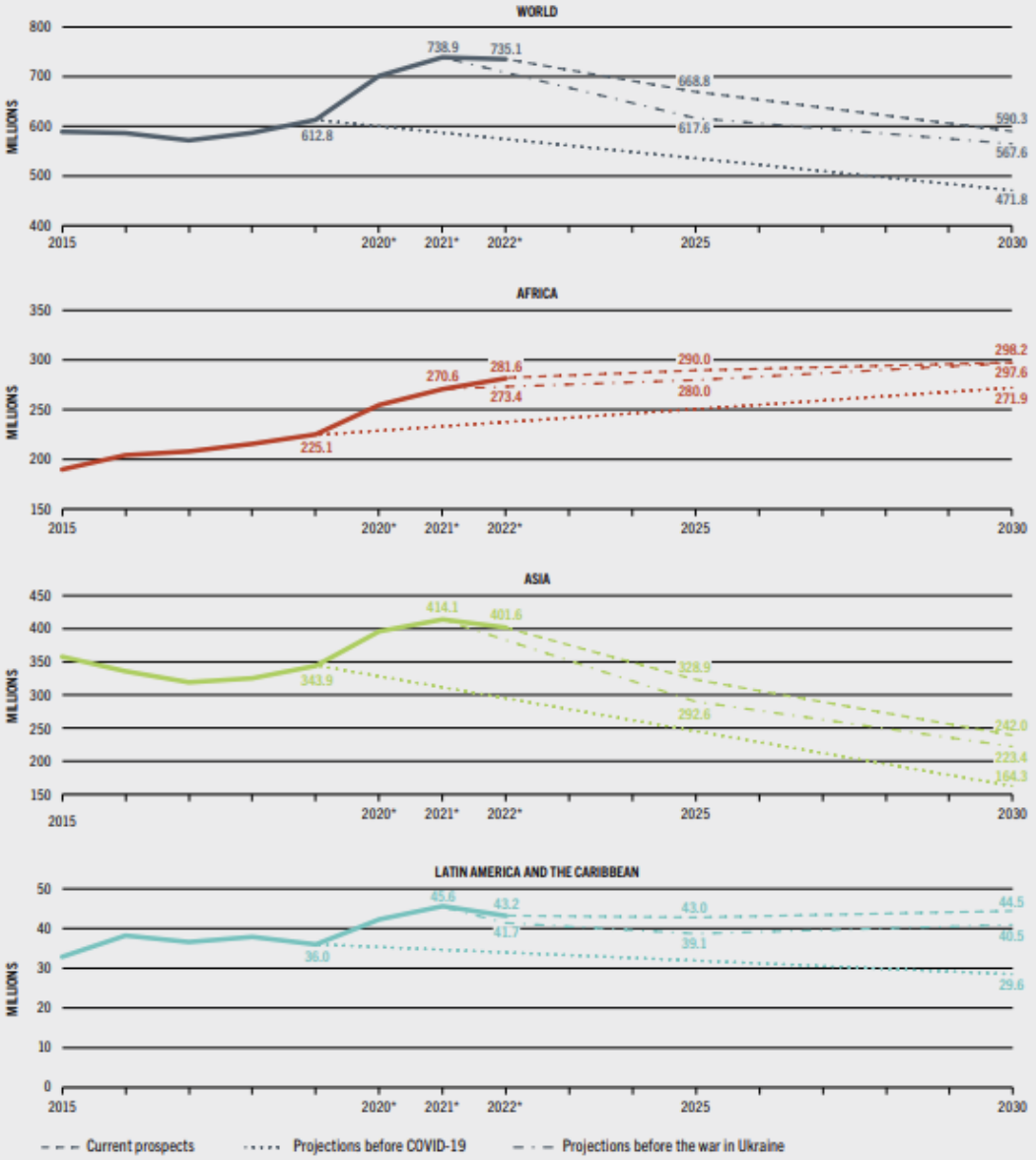


FIGURE 7 THE CONCENTRATION AND DISTRIBUTION OF FOOD INSECURITY BY SEVERITY DIFFER GREATLY ACROSS THE REGIONS OF THE WORLD

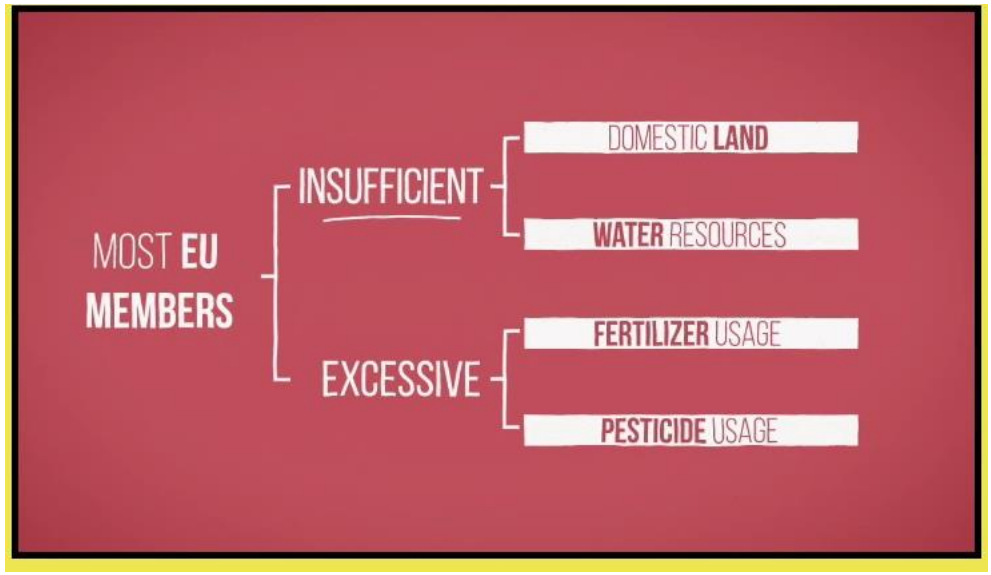


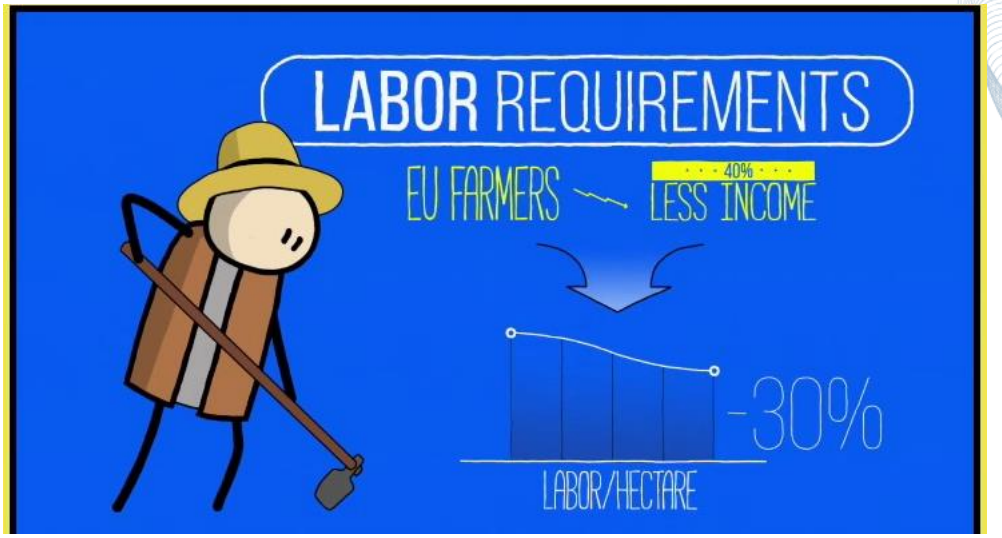
SOURCE: FAO. 2023. FAOSTAT: Suite of Food Security Indicators. In: *FAO*. [Cited 12 July 2023]. www.fao.org/faostat/en/#data/FS

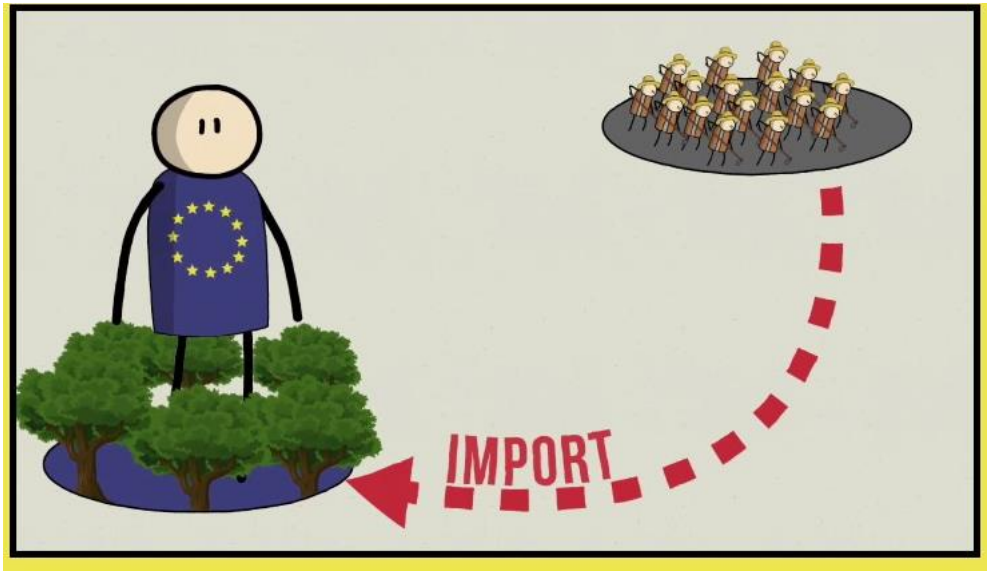
FIGURE 5 PROJECTED NUMBERS OF UNDERNOURISHED INDICATE THAT THE WORLD IS FAR OFF TRACK TO ACHIEVE ZERO HUNGER BY 2030



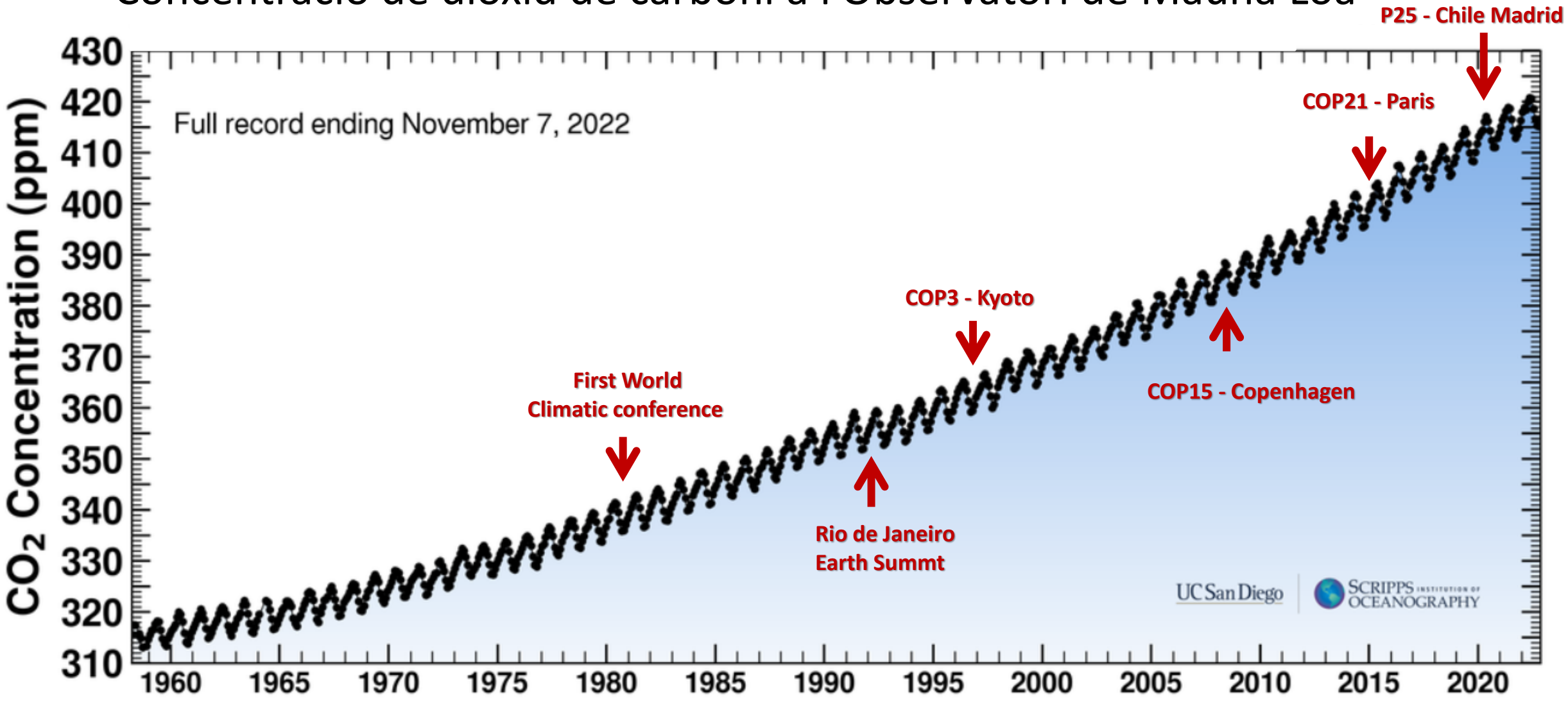
NOTE: * The 2020, 2021 and 2022 values are based on the projected midranges which can be found in **Annex 2**.
SOURCE: Authors' (FAO) own elaboration.


MOST EU MEMBERS
INSUFFICIENT
DOMESTIC LAND
WATER RESOURCES
EXCESSIVE
FERTILIZER USAGE
PESTICIDE USAGE


LABOR REQUIREMENTS
EU FARMERS
40%
LESS INCOME
-30%
LABOR/HECTARE


IMPORT

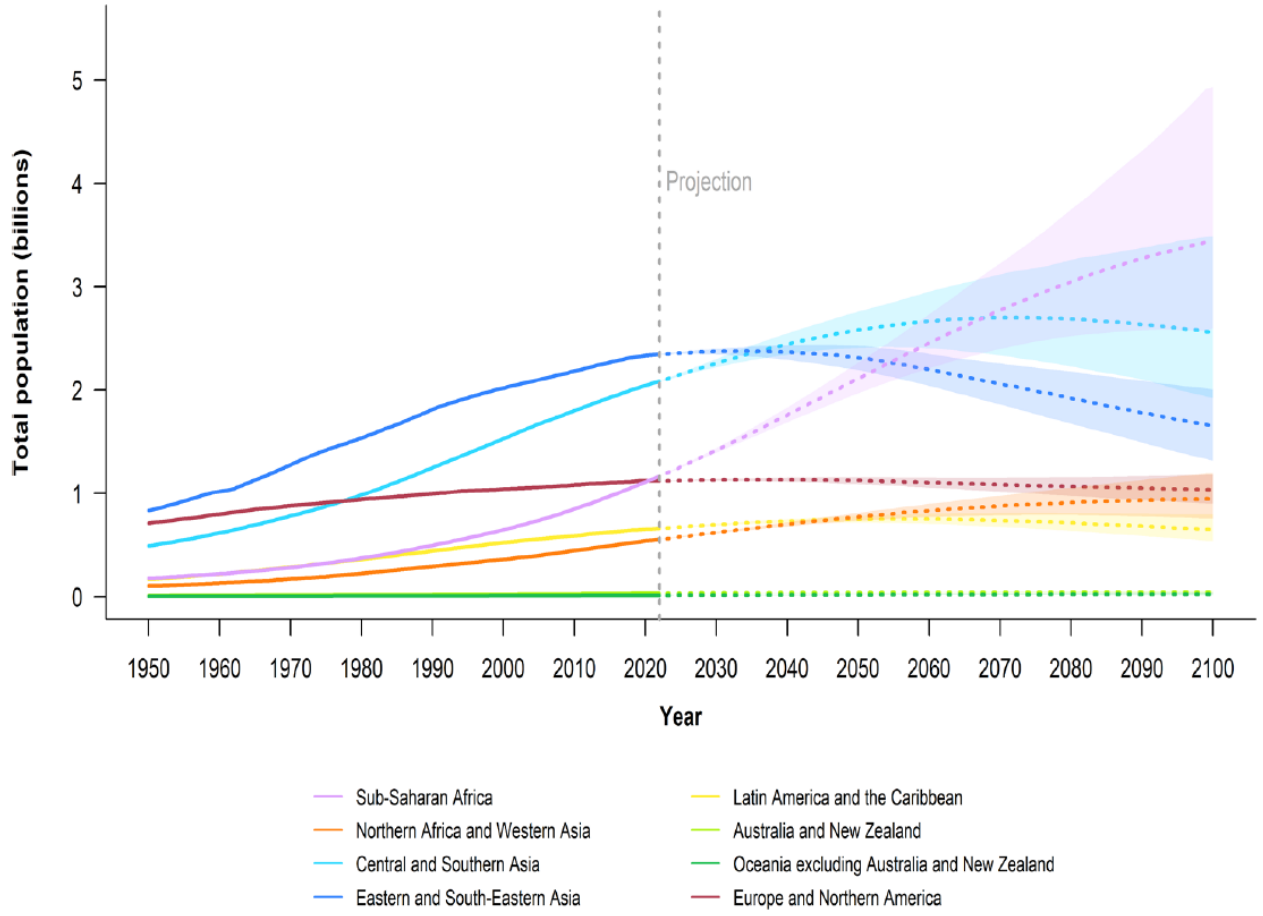
- Concentració de diòxid de carboni a l'Observatori de Mauna Loa



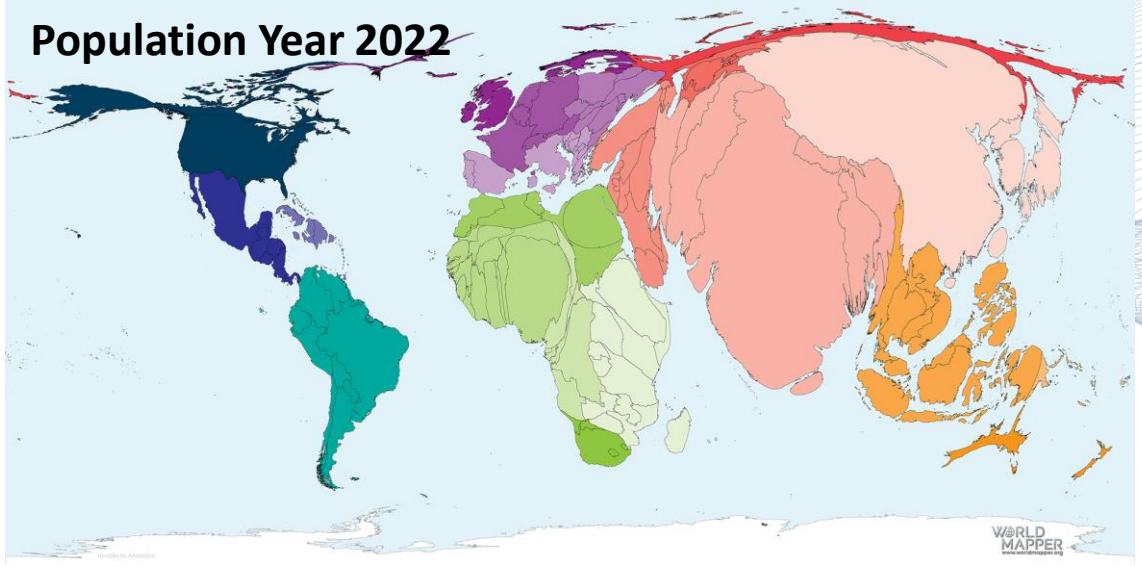
https://keelingcurve.ucsd.edu/ full record – 1960-2022

United Nations

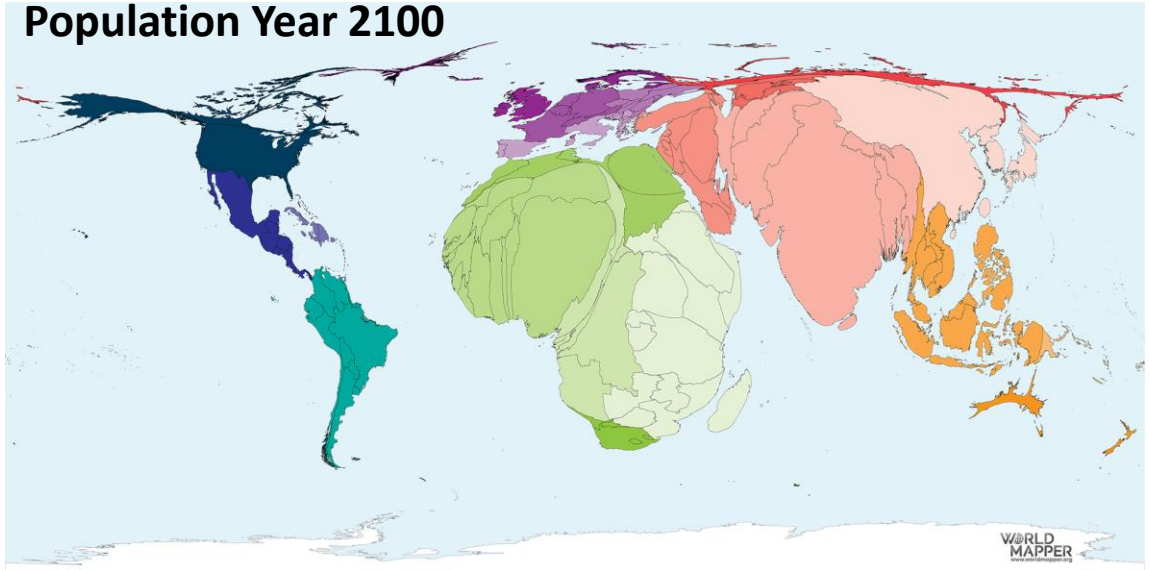
Population by SDG region: estimates, 1950-2022, and medium scenario with 95 per cent prediction intervals, 2022-2100



Population Year 2022



Population Year 2100



World Population Prospects 2022: Summary of Results

Contributions to total population change of the balance of births over deaths and of immigration over emigration, by income group, from 1950-1960 to 2040-2050

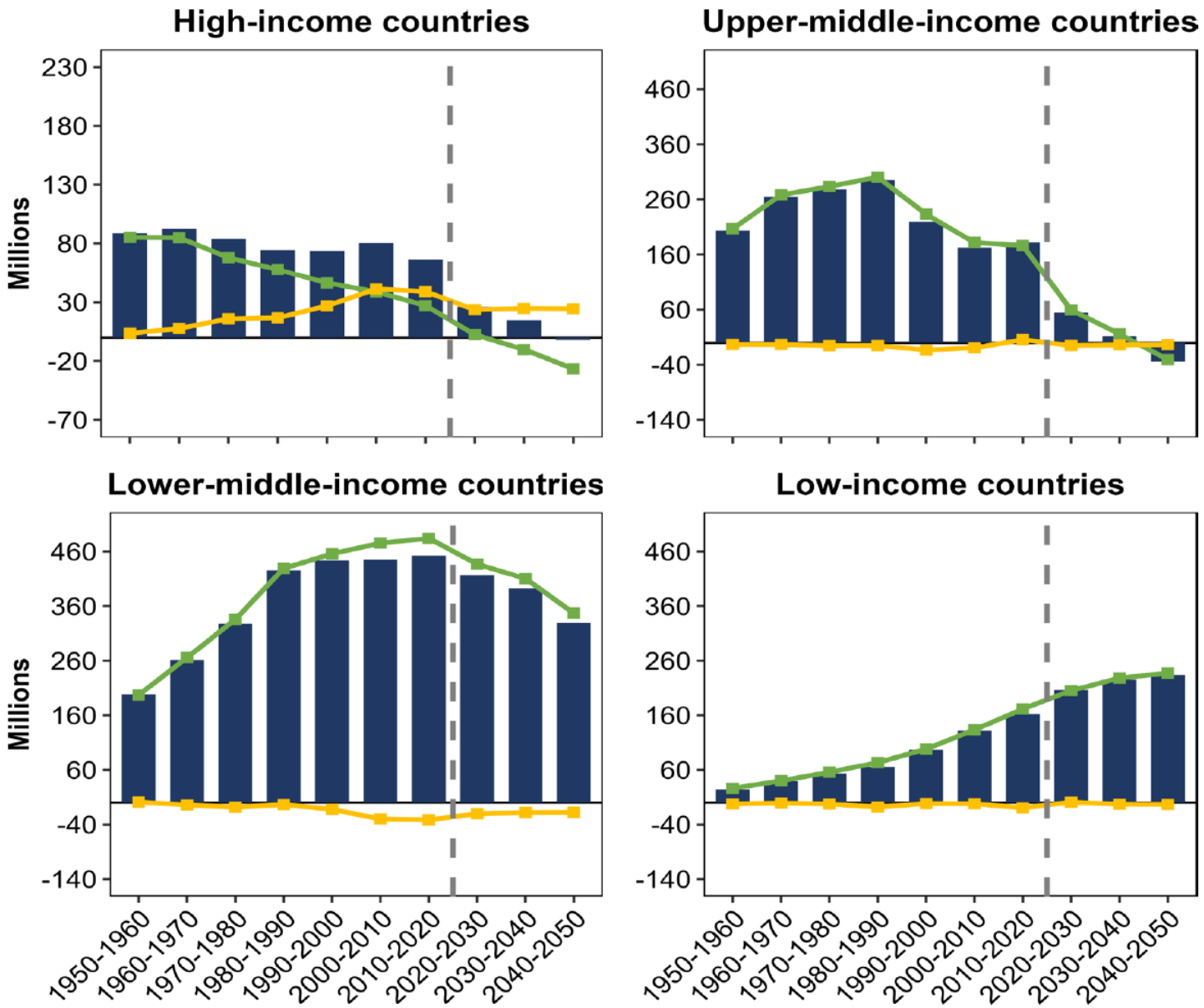


Figure 9.1a Per capita calorie intake by source, 1961–2050

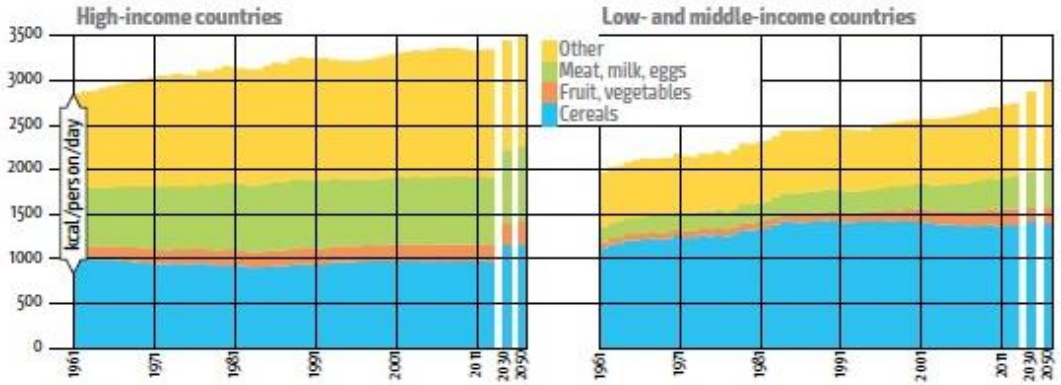
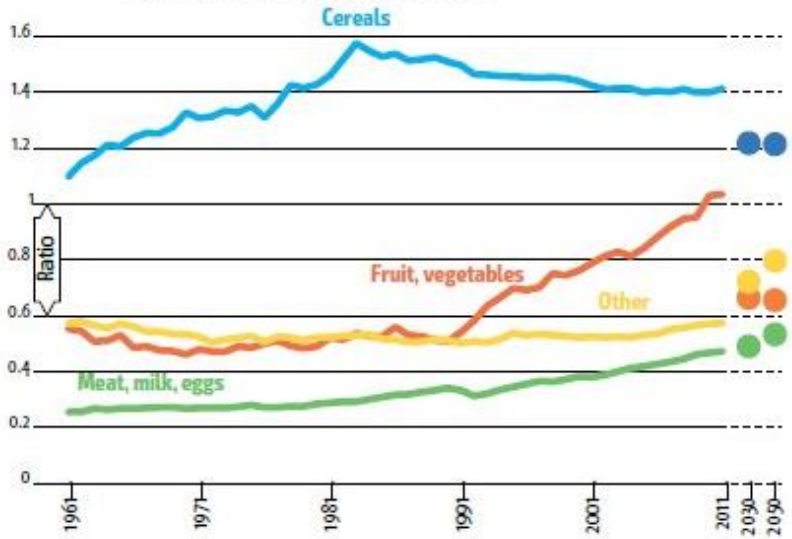


Figure 9.1b Per capita calorie intake in low- and middle-income countries compared to high-income countries



Sources: FAO Global Perspectives Studies. Data for 1961–2011 from FAO, 2016a; data for 2030 and 2050 from Alexandratos and Bruinsma, 2012.

Figure 9.2a Per capita protein intake by source, 1961–2050

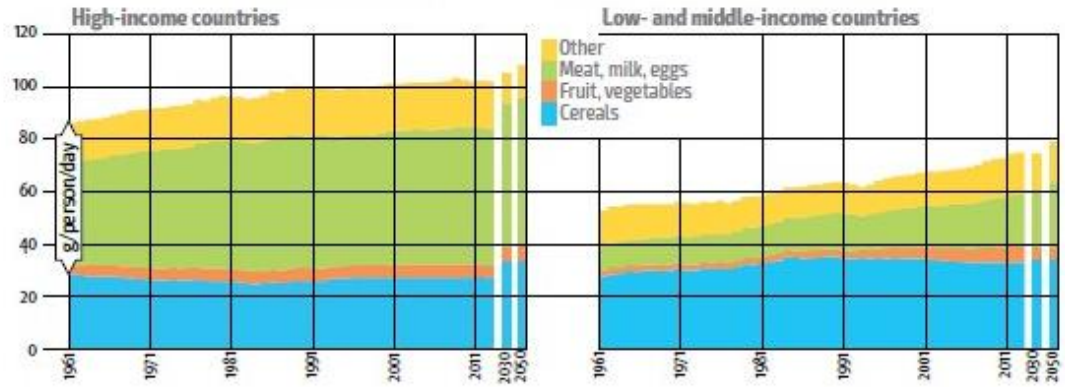
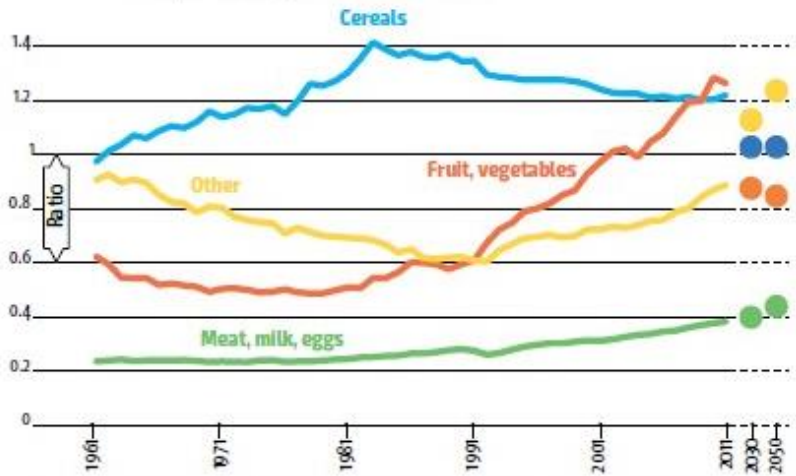


Figure 9.2b Per capita protein intake in low- and middle-income countries compared to high-income countries



Sources: FAO Global Perspectives Studies. Data for 1961–2011 from FAO, 2016a; data for 2030 and 2050 from Alexandratos and Bruinsma, 2012.

The future of food and agriculture: Trends and challenges FAO 2017

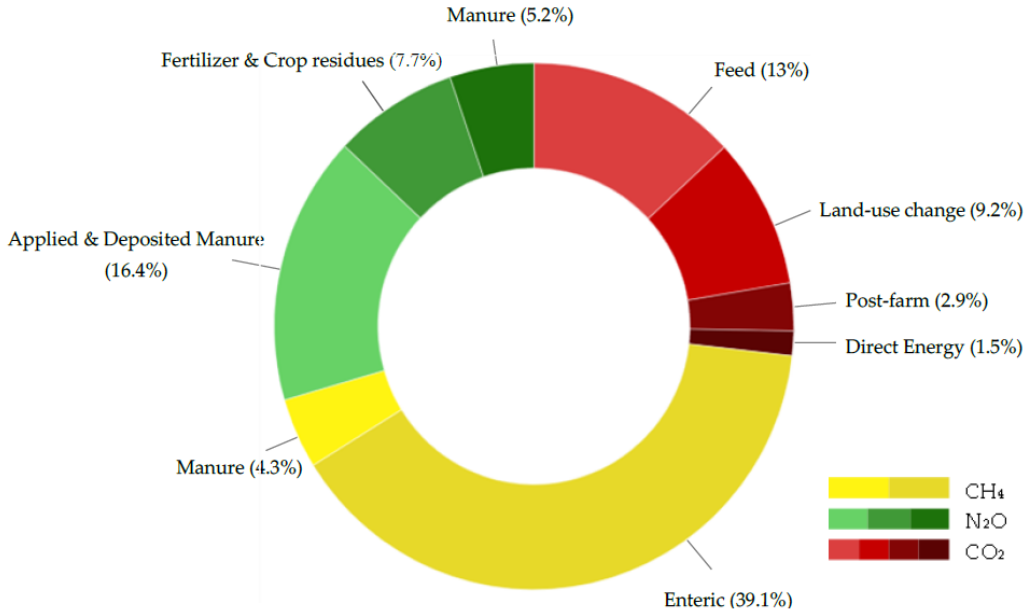


Figure 1. Emissions from livestock (by category), where methane (CH_4) emissions are portrayed in yellow, nitrous oxide (N_2O) in green, and carbon dioxide (CO_2) in red. Figure drawn by authors with data source from [7].

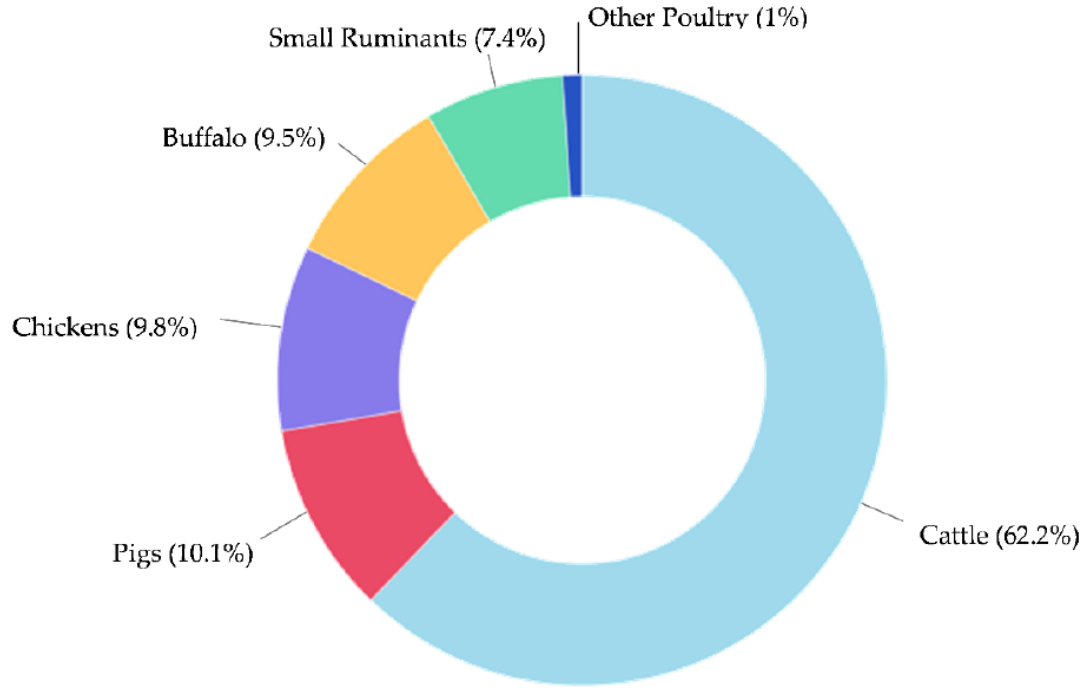


Figure 2. Emissions from livestock (by species). Figure drawn by authors with data source from [102].

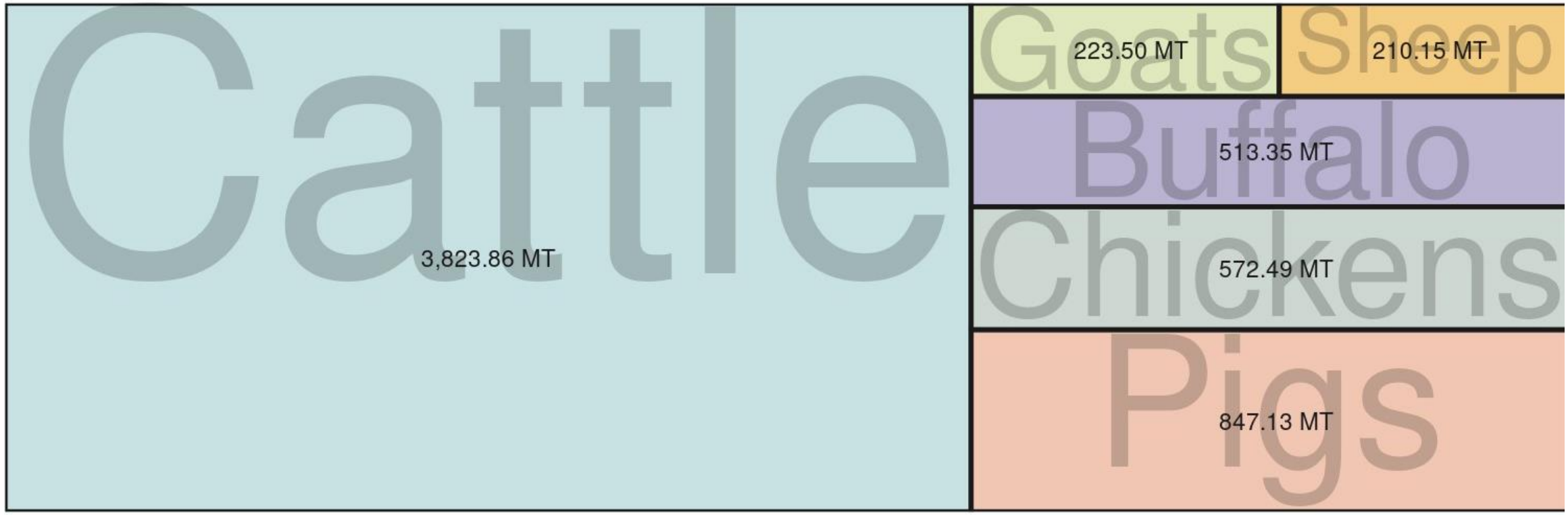
Cheng et al 2022

GLEAM 3.0 Global Emissions Assessment (2015) FAO

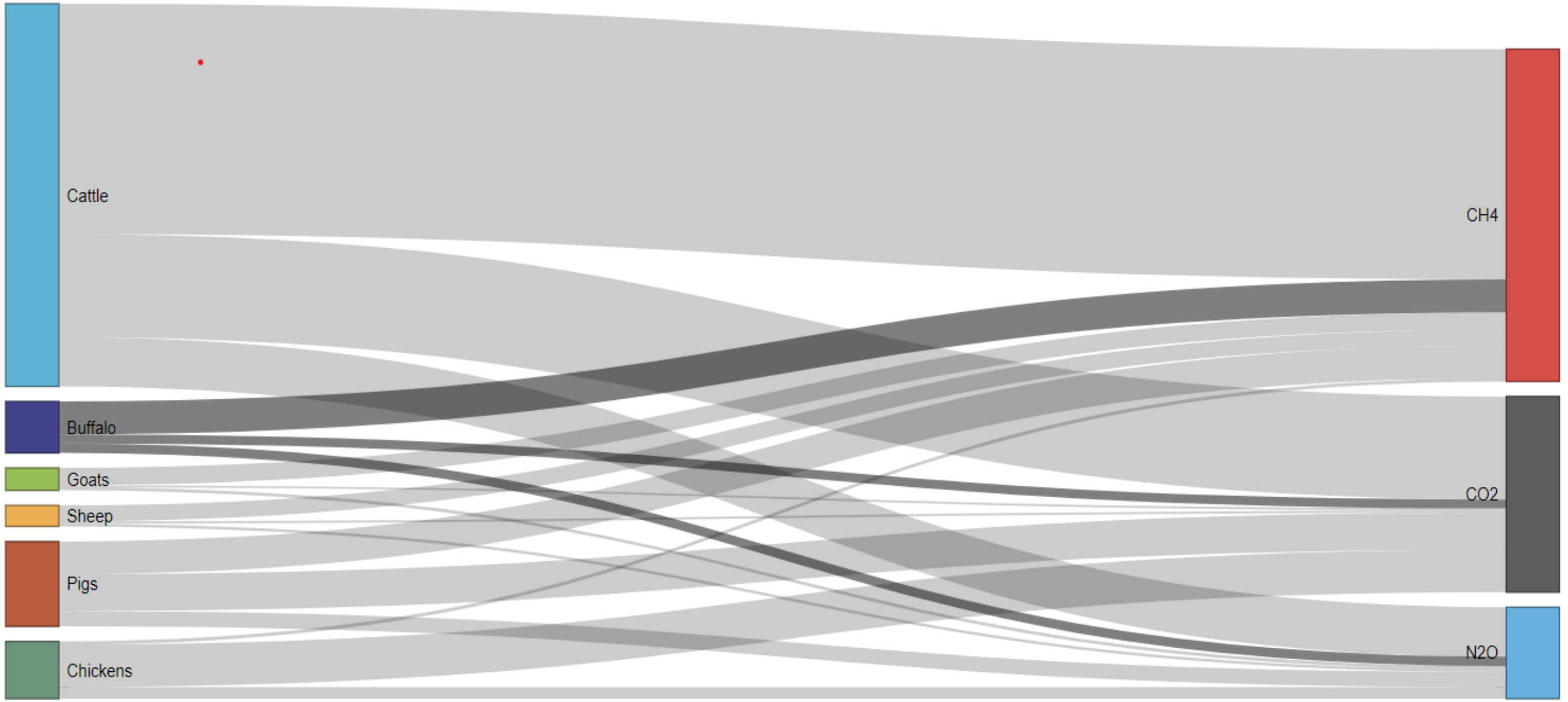
Global emissions from livestock in 2015

Emissions

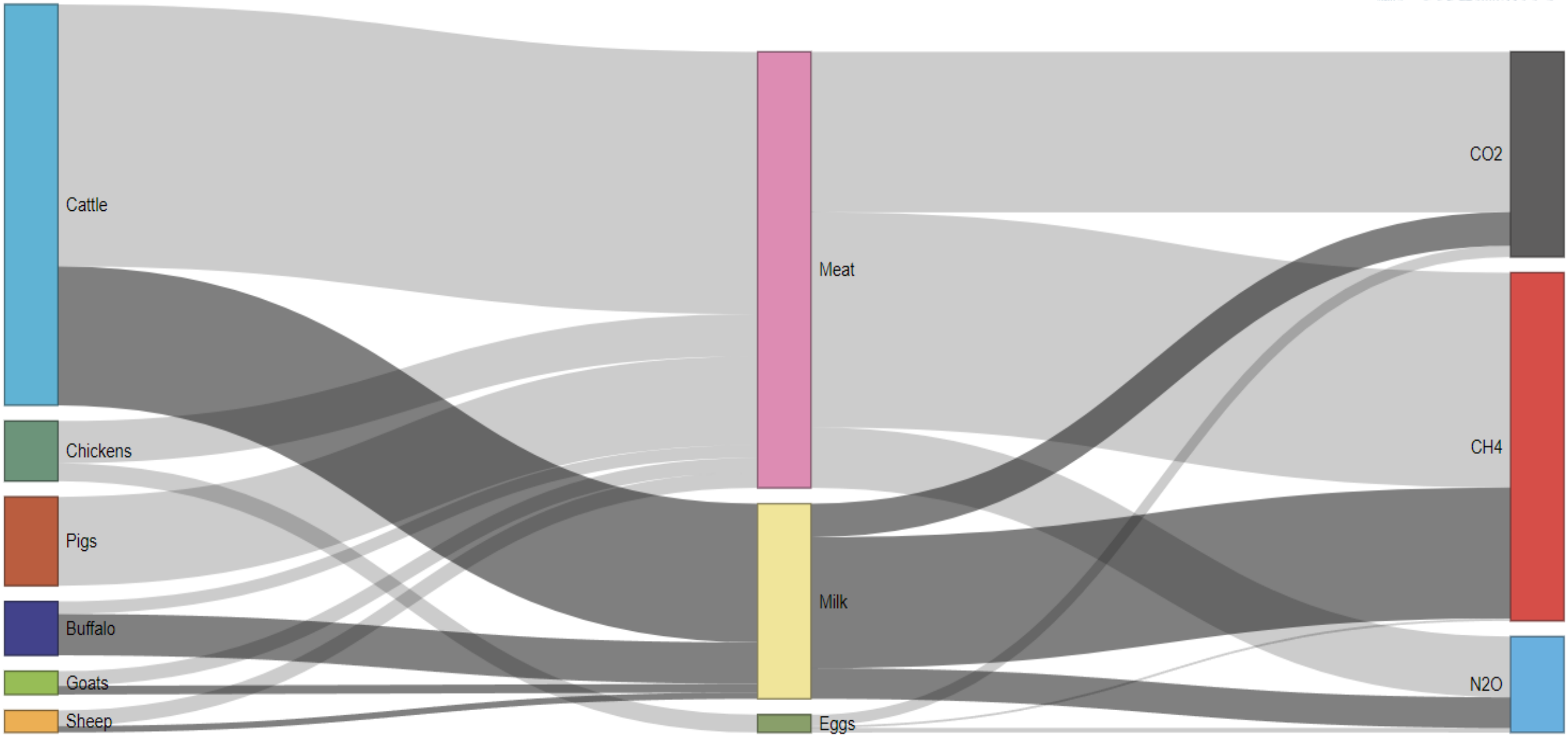
6.2B	12	3.6B
Total emissions [tonnes CO_2eq]	Percent of total global GHG emissions	Direct emissions [tonnes CO_2eq]



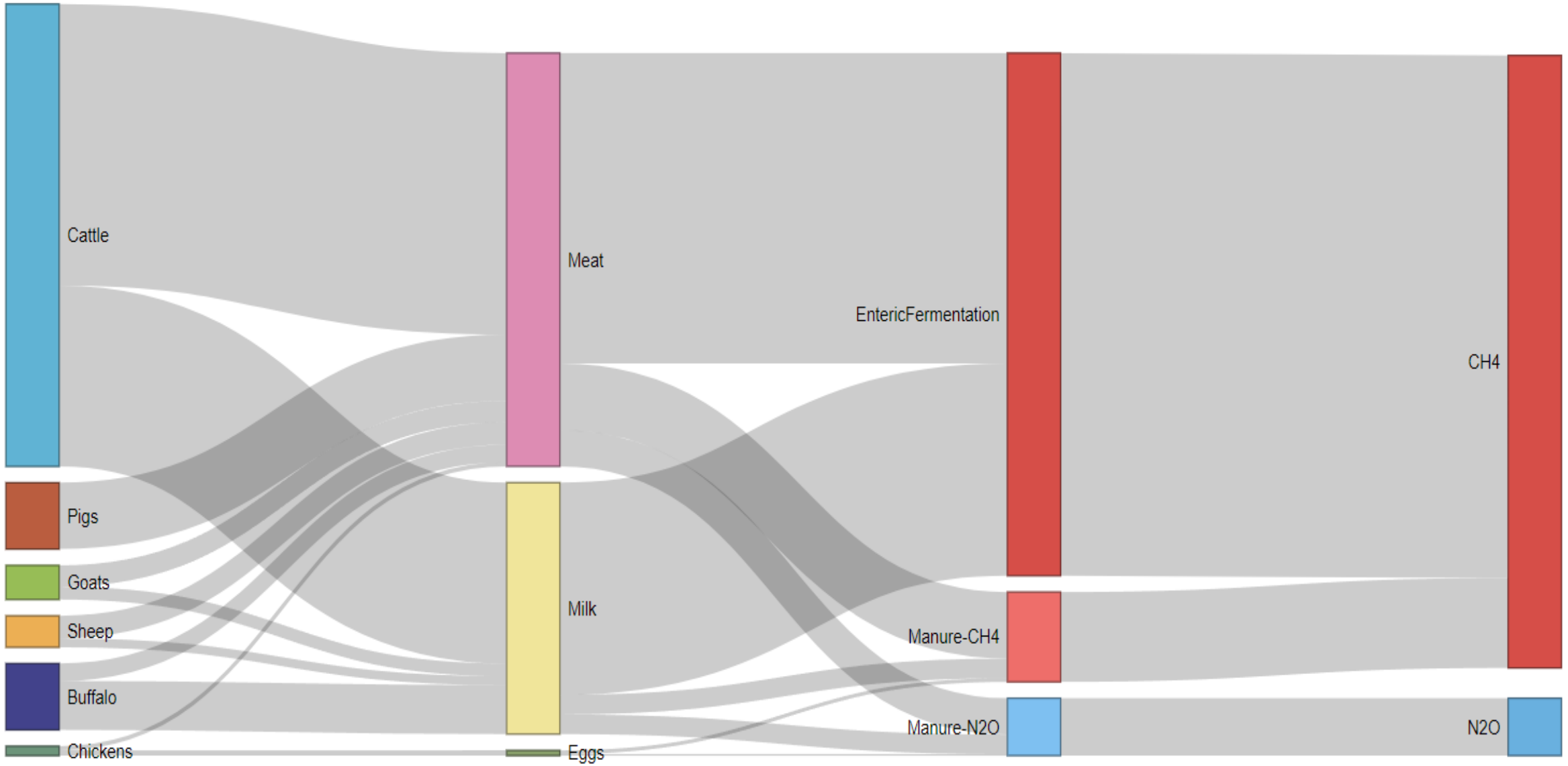
GLEAM 3.0 Global Emissions Assessment (2015) FAO



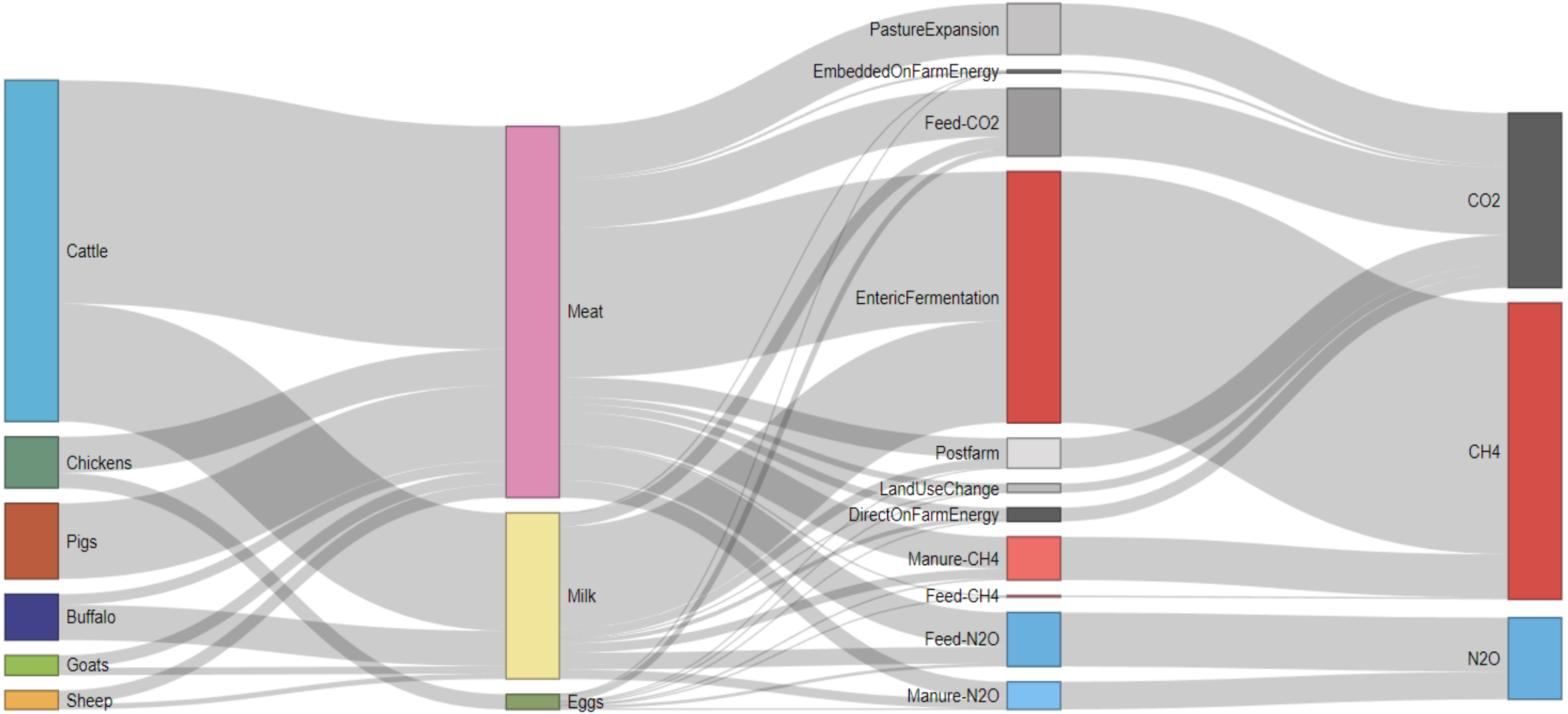
GLEAM 3.0 Global Emissions Assessment (2015) FAO



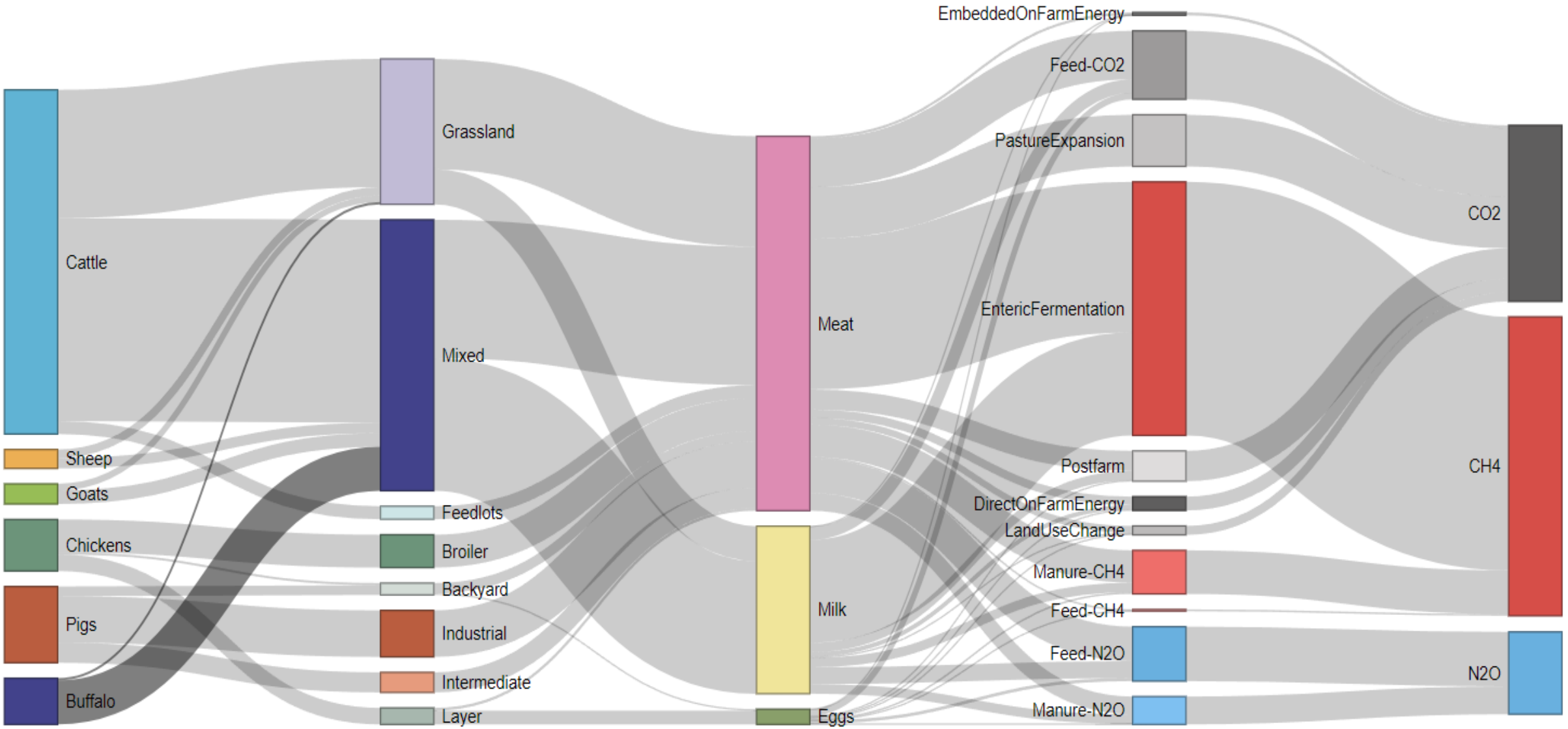
GLEAM 3.0 Global Emissions Assessment (2015) FAO



GLEAM 3.0 Global Emissions Assessment (2015) FAO



GLEAM 3.0 Global Emissions Assessment (2015) FAO



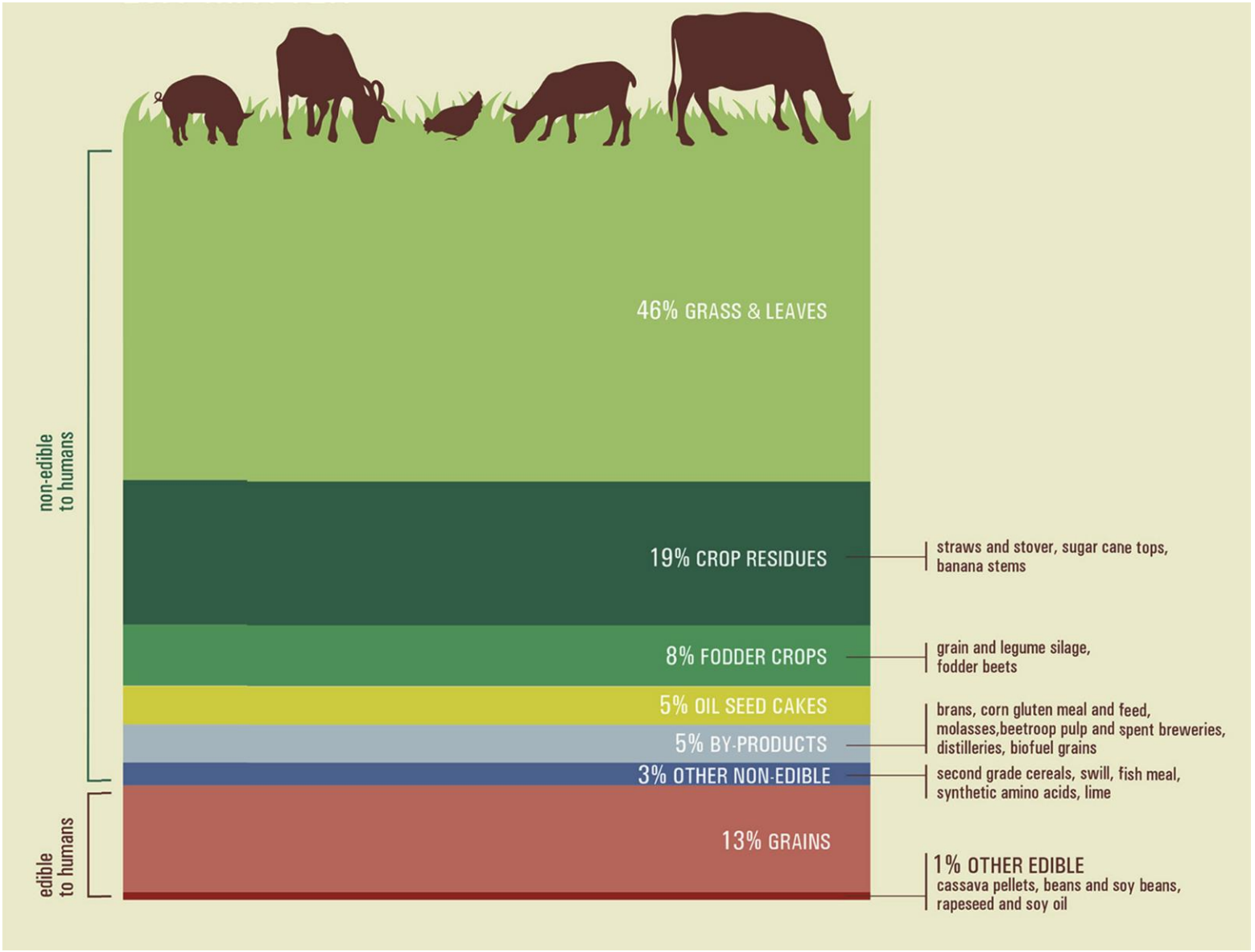
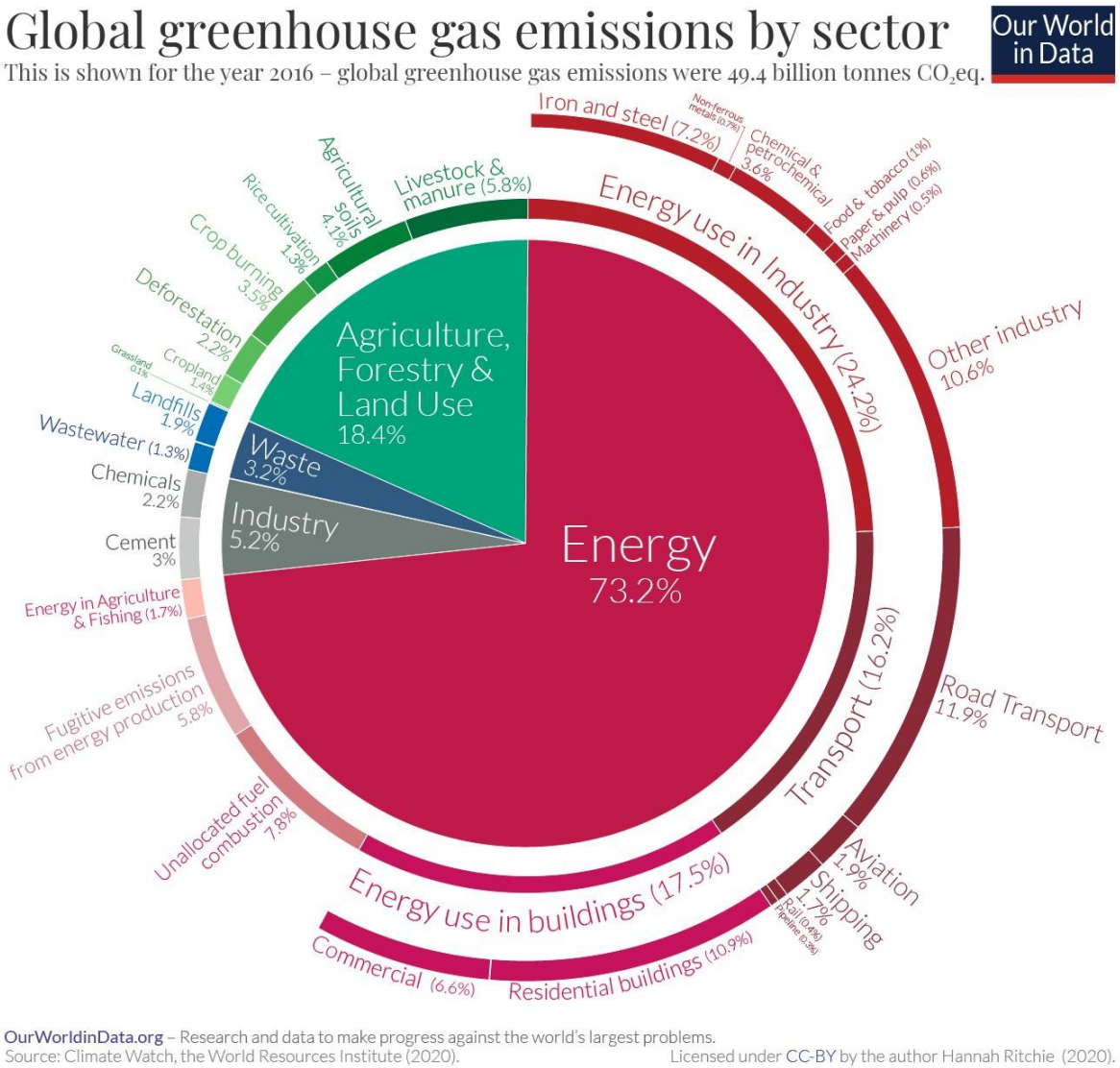


Fig. 2. Global livestock feed ration composition (source: GLEAM 2.0). Mottet el al 2017

Significance of livestock emissions globally

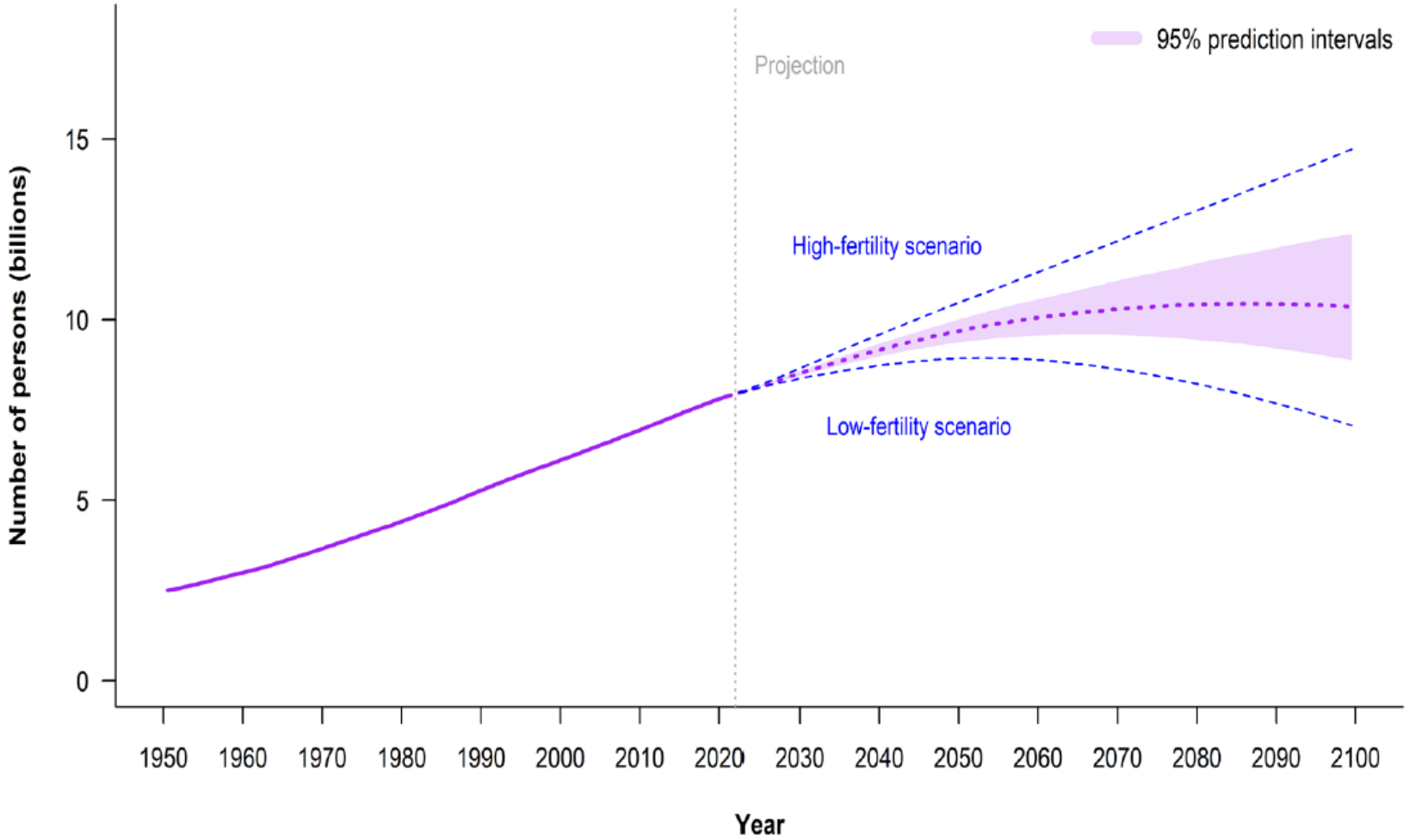


NGHGI Sector		Activity	GHG Emitted CH_4	GHG Emitted N_2O	GHG Emitted CO_2	FAO	
AFOLU	LULUCF	Forest Conversion to Other Land Uses and Burning Biomass	x	x	x	LAND USE CHANGE	AGRICULTURAL LAND
		Peat Fires	x		x		
		Drained Organic Soils	x		x		
	AGRICULTURE	Burning - Crop residues	x	x		FARM GATE	
		Burning - Savanna	x	x			
		Crop Residues		x			
		Drained Organic Soils		x			
		Enteric Fermentation	x				
		Manure Management	x	x			
		Manure Applied to Soils		x			
		Manure Left on Pasture		x			
		Rice Cultivation	x				
		Synthetic Fertilizers		x			
ENERGY AND IPPU		On-farm Energy Use	x	x	x	PRE AND POST PRODUCTION	FOOD SYSTEM
		Food Transport	x	x	x		
		Processing	x	x	x		
		Packaging	x	x	x		
		Refrigeration	x	x	x		
		Retail	x	x	x		
		Cooking	x	x	x		
		Fertilizer manufacturing and other pre-production	x	x	x		
WASTE		Solid Food Waste	x				
		Incineration			x		
		Industrial Wastewater	x	x			
		Domestic Wastewater	x	x			

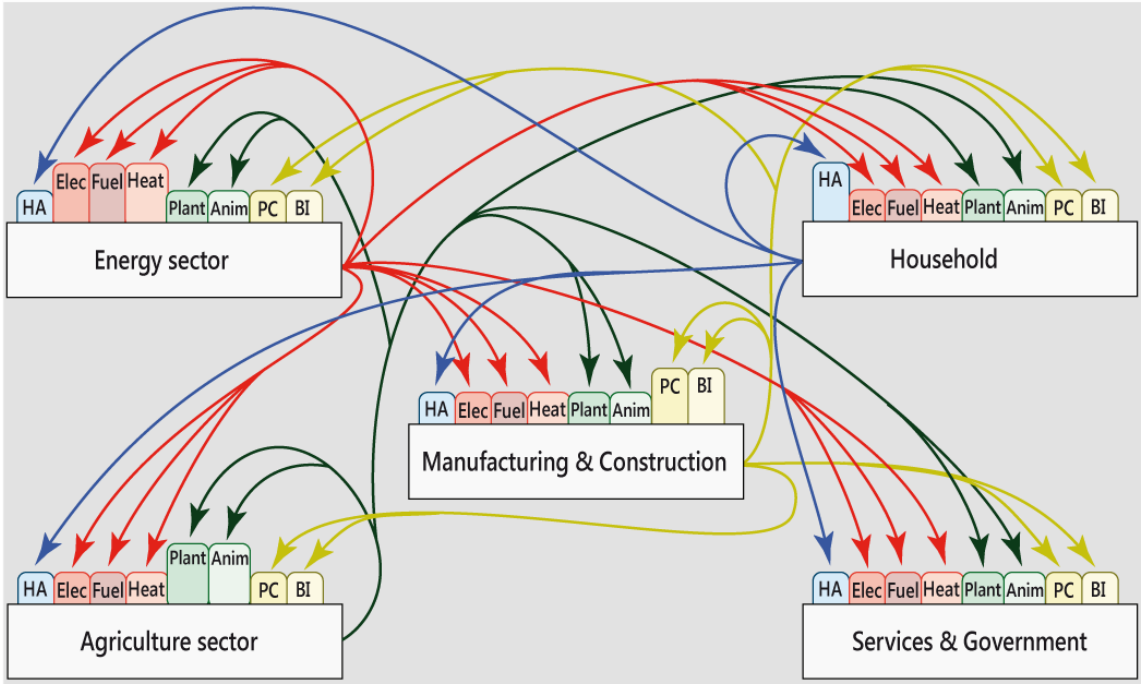
Tubiello et al 2021

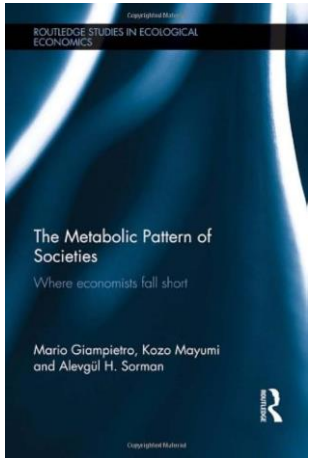
United Nations

Global population size: estimates, 1950-2022, and medium scenario with 95 per cent prediction intervals and high- and low-fertility scenarios, 2022-2100



MuSIASEM (Multi-Scale Integrated Accounting of Societal and Ecosystem Metabolism)





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HORIZON 2020

Moving Towards Adaptive Governance in Complexity: Informing Nexus Security

Fact Sheet | Reporting | Results

Objective

MAGIC is a proposal coordinated by the Institute of Environmental Science and Technology (ICTA) of the Autonomous University of Barcelona (UAB) in collaboration with partners which have a proven and track record in their respective fields of competence.

Our objective is to open the path towards a new way of managing the Nexus in which researchers and decision makers work together in the search for development strategies that can contribute to the smart, sustainable and inclusive economic growth required by the EU 2020 Strategy, while maintaining a leading and informed participation in international discussions about global issues, like climate change or food security.

In order to do so, MAGIC deploys a set of novel, cutting-edge and system-oriented approaches that originates from system ecology, bio-economics and Science and Technology Studies. Their combination allows MAGIC to highlights if a certain mix of EU policies results in undesirable or unforeseen outcomes. Climate, water, land energy, and food modeling are integrated into a socio- and bio-economics framework using an iterative and participatory method. Significant care is taken to embed these ideas and approaches within the advisory and decision making functions of the European Commission.

Impacts are twofold.

First, MAGIC contributes a methodological framework where the needs for advice of different DG in the design of development strategies for the EU are covered using a method that can embrace the complexity of the nexus, for a better understanding of the interactions it holds.

Second, the project provides 'on the flight' advice to the EC about the timeliness and soundness for the EU 2020 Strategy and the EU position in international agreements of EU policies -like the Water Framework Directive, the Common Agricultural Policy, or the Low-Carbon Economy Strategy- and targets of implementing technologies -such as fracking, desalination, biofuels and GMOs.

Project Information

MAGIC
Grant agreement ID: 689669

DOI
10.3030/689669

Closed project

EC signature date
22 April 2016

Start date
1 June 2016

End date
30 September 2020

Funded under
SOCIETAL CHALLENGES - Climate action, Environment, Resource Efficiency and Raw Materials

Total cost
€ 7 457 761,25

EU contribution
€ 7 457 761,25

Coordinated by
UNIVERSITAT AUTONOMA DE BARCELONA
Spain

European Commission | Funding & tender opportunities

Single Electronic Data Interchange Area (SEDIA)

HOME | SEARCH FUNDING & TENDERS | HOW TO PARTICIPATE | PROJECTS & RESULTS | WORK AS AN EXPERT | SUPPORT

MuSIASEM: an accounting framework for Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism

ID: 26521 - Last published on Nov 18, 2020

Internal navigation

- General information
- Who we are
- Our result
- Addressing target audiences and expressin…

Our result has been made possible through

Horizon 2020
European Union Funding
for Research & Innovation

Project(s) info:

- **MAGIC - Moving Towards Adaptive Governance in Complexity: Informing Nexus Security (689669)**

MuSIASEM (Multi-Scale Integrated Accounting of Societal and Ecosystem Metabolism)

Mario Giampietro

External metabolic systems

External pressures (environmental and social)

Externalization

Funds and flows externalized

Impredicative relationships

Holarchy
A network of interactions

Social-Ecological System (complex and adaptive)

Incentives

€

HH

SG

MC

AG

EM

Growing added value

Viability

Ecosphere

Stock

Fund

Techno-flows Funds

Technosphere

Socio Economic System

Wastes

Eco-flows

Desirability

Feasibility

...1
...2
...3
...4
...5
...n

Livestock sector

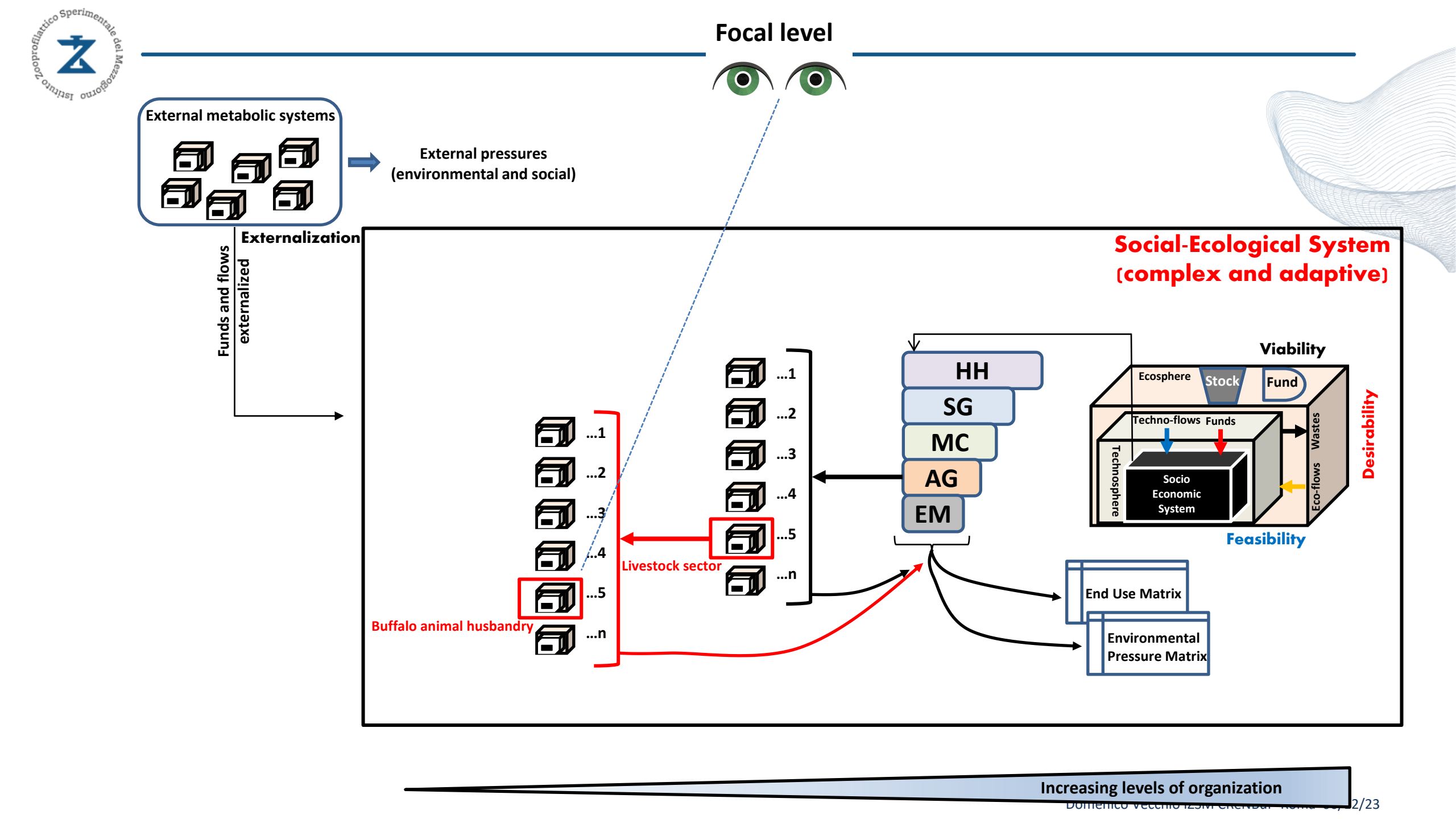
Buffalo animal husbandry

End Use Matrix

Environmental Pressure Matrix

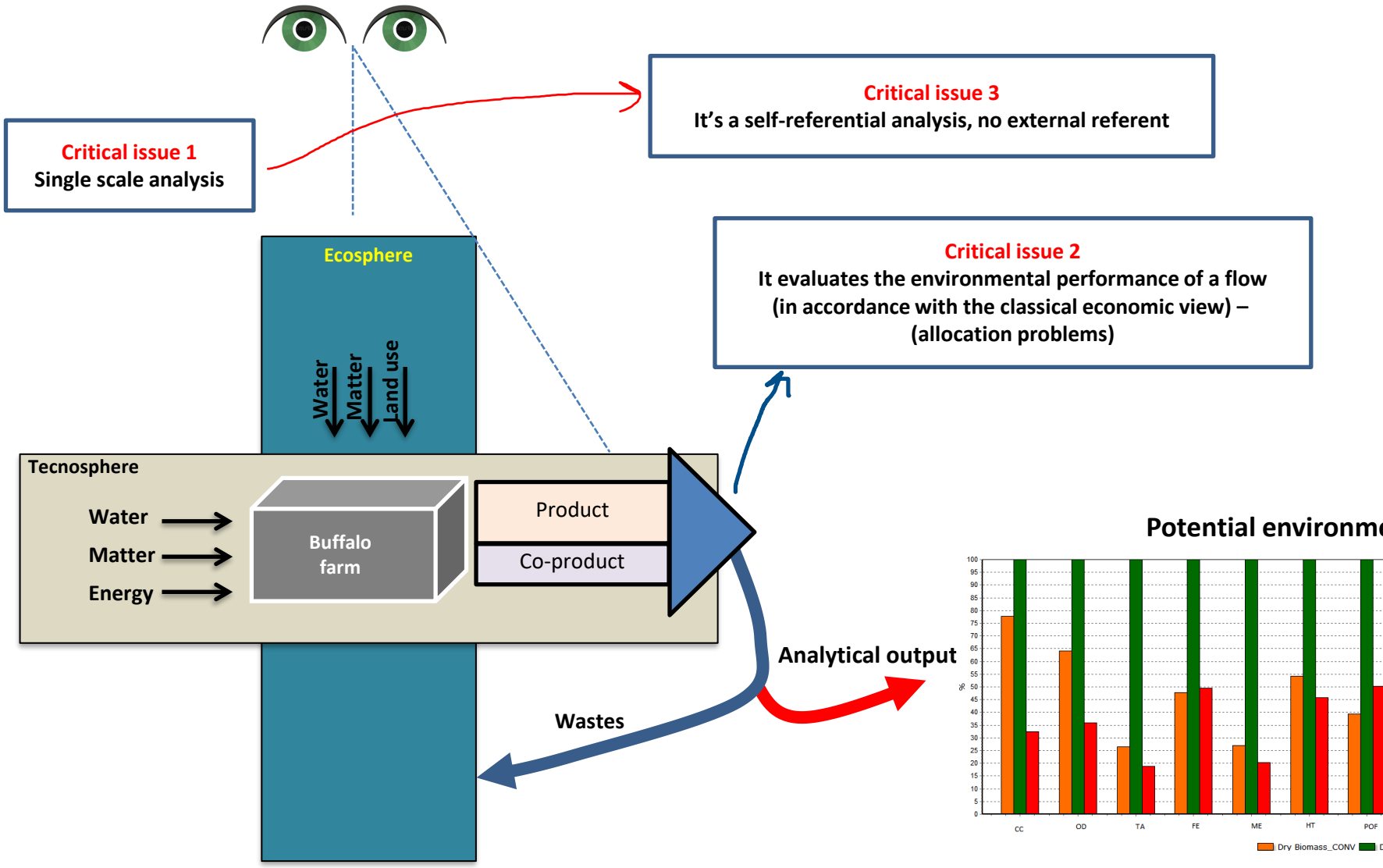
Does the Jevons paradox compromise efficiency efforts?

Increasing levels of organization


Focal level
External metabolic systems
External pressures
(environmental and social)
Externalization
Funds and flows
externalized
Social-Ecological System
(complex and adaptive)
...1
...2
...3
...4
...5
...n
Livestock sector
Buffalo animal husbandry
HH
SG
MC
AG
EM
Viability
Ecosphere
Stock
Fund
Techno-flows
Funds
Technosphere
Socio
Economic
System
Wastes
Eco-flows
Desirability
Feasibility
End Use Matrix
Environmental
Pressure Matrix
Increasing levels of organization

~~LCA (Life Cycle Assessment)~~

It's not a robust analytical tool able to evaluate sustainability. Instead it is a powerful tool for evaluating some features of metabolism.



Potential environmental impact

LCA is part of this perception, it's no coincidence that the method was developed by companies that have the focal level in the product. Therefore their perception, on a single scale, is typical of those who aspire to the myth of efficiency

Nicholas Georgescu-Roegen

The purpose of the economy?

1. **IS NOT *producing goods and services*.**
2. **IS *reproducing the processes associated with the production and consumption of goods and services*.**

Such a processes are fundamental for maintaining the socio-economic fabric.

Instead, we look at the metabolic system which, to guarantee the specific functions for which it is structured, works in a specific way according to specific system. This also makes us understand why the comparison approach, typical of LCA, does not always work. The risk is comparing bananas with broccoli, the fact that they are both vegetables with the samefirst letter does not mean that they are the same thing.

System identity

Formal identity

VIABILITY
Internal techno-economic performance
Established by the relationships between funds and flows

Buffalo farm
output milk

Defined by means of the metabolic characterization ← What the system does How the system works

FEASIBILITY
Internal performance
Established by the relationships with ecosphere

EXTERNALIZATION
Internal performance
Established by the relationships with external funds and flows

Semantic identity

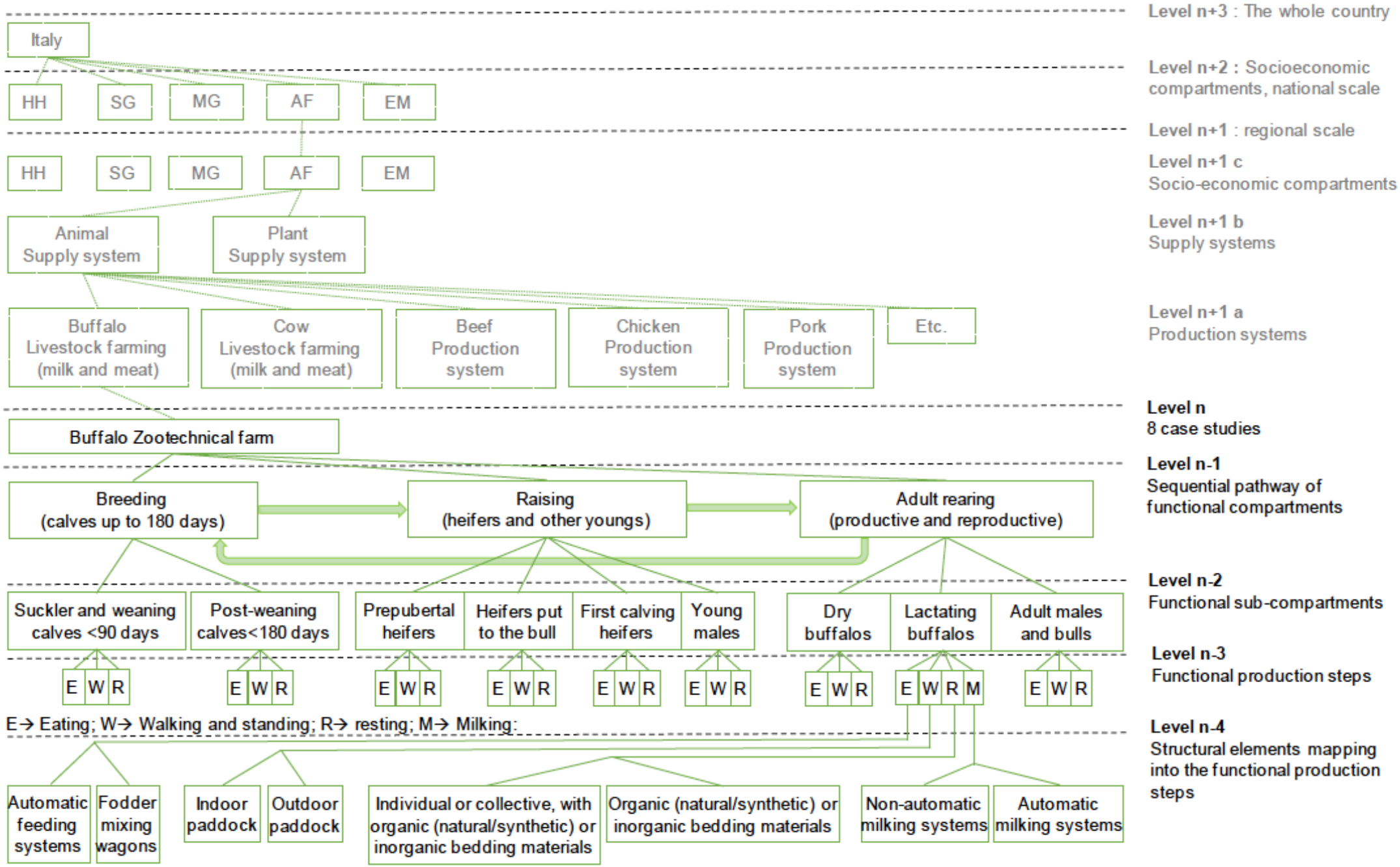
DESIRABILITY
Normative and institutional features
Established by end use of the product and system's environmental pressure

Why the system exists and works

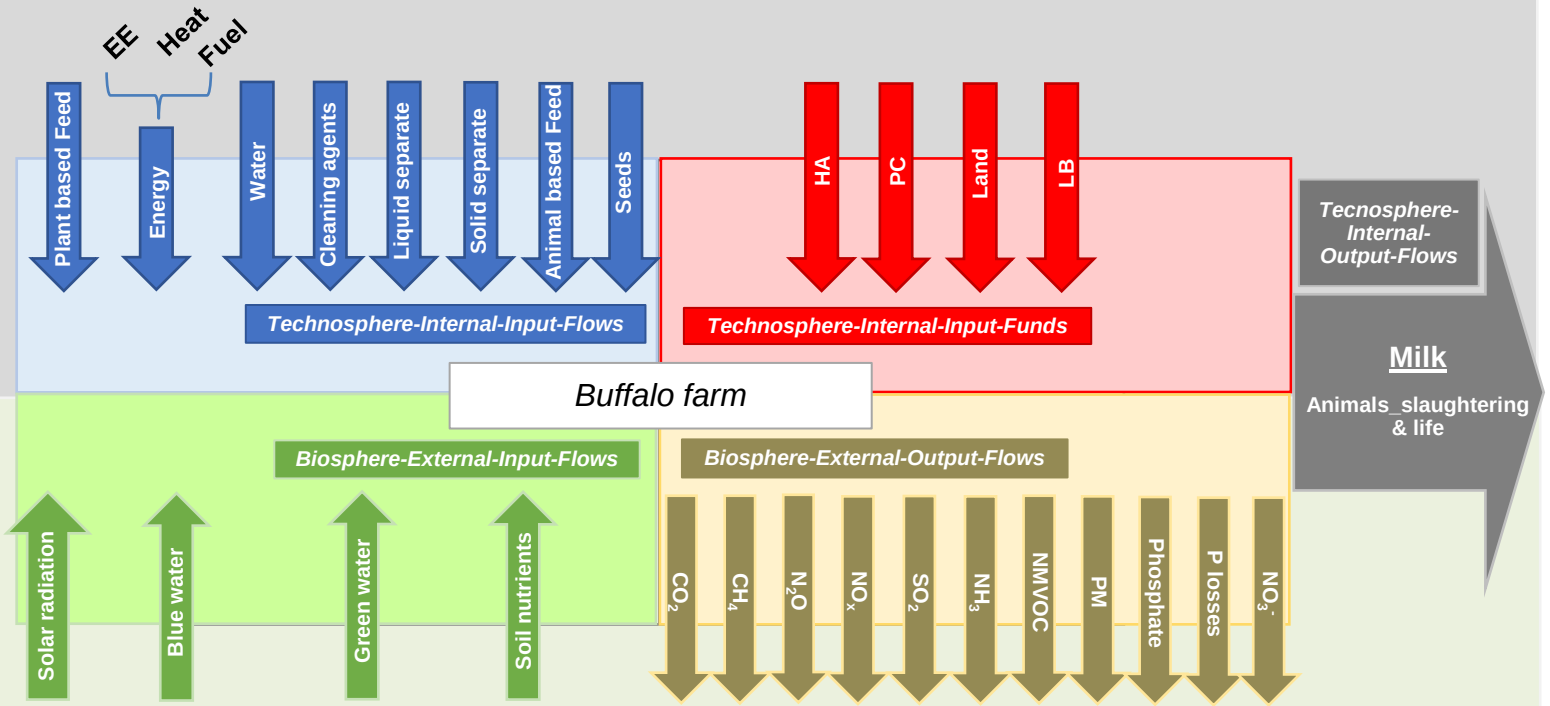
External identity
(milk to be transformed in a popular product and profit of transformers)

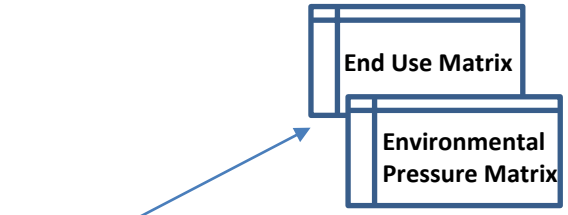
Internal identity
(profit by means of a traditional product)

Upward causation ⇄ Downward causation


Level n+3 : The whole country
Italy
Level n+2 : Socioeconomic compartments, national scale
HH
SG
MG
AF
EM
Level n+1 : regional scale
Level n+1 c
Socio-economic compartments
Level n+1 b
Supply systems
Animal Supply system
Plant Supply system
Level n+1 a
Production systems
Buffalo Livestock farming (milk and meat)
Cow Livestock farming (milk and meat)
Beef Production system
Chicken Production system
Pork Production system
Etc.
Level n
8 case studies
Buffalo Zootechnical farm
Level n-1
Sequential pathway of functional compartments
Breeding (calves up to 180 days)
Raising (heifers and other youngs)
Adult rearing (productive and reproductive)
Level n-2
Functional sub-compartments
Suckler and weaning calves <90 days
Post-weaning calves<180 days
Prepubertal heifers
Heifers put to the bull
First calving heifers
Young males
Dry buffalos
Lactating buffalos
Adult males and bulls
Level n-3
Functional production steps
E W R
E W R M
E→ Eating; W→ Walking and standing; R→ resting; M→ Milking:
Level n-4
Structural elements mapping into the functional production steps
Automatic feeding systems
Fodder mixing wagons
Indoor paddock
Outdoor paddock
Individual or collective, with organic (natural/synthetic) or inorganic bedding materials
Organic (natural/synthetic) or inorganic bedding materials
Non-automatic milking systems
Automatic milking systems

Internal view: Internal metabolic pattern of secondary inputs (techno-carriers) by techno-funds





Numerical outputs

Quantitative Story-Telling (QST)

External view: Stability of boundary conditions

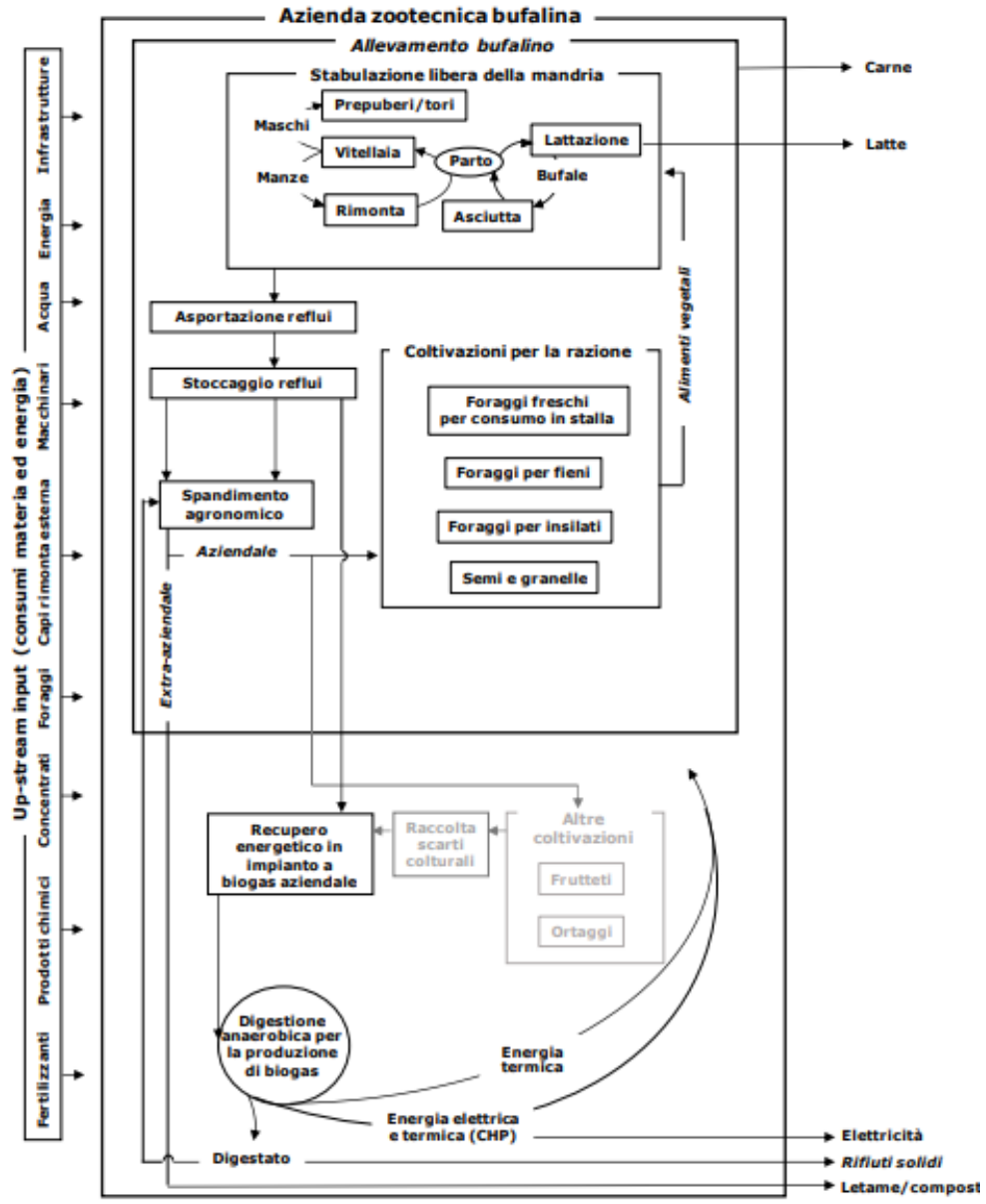


Figura 1: Flowchart generale di processo per l'allevamento bufalino.

Figura 1: Flowchart generale di processo per l'allevamento bufalino.

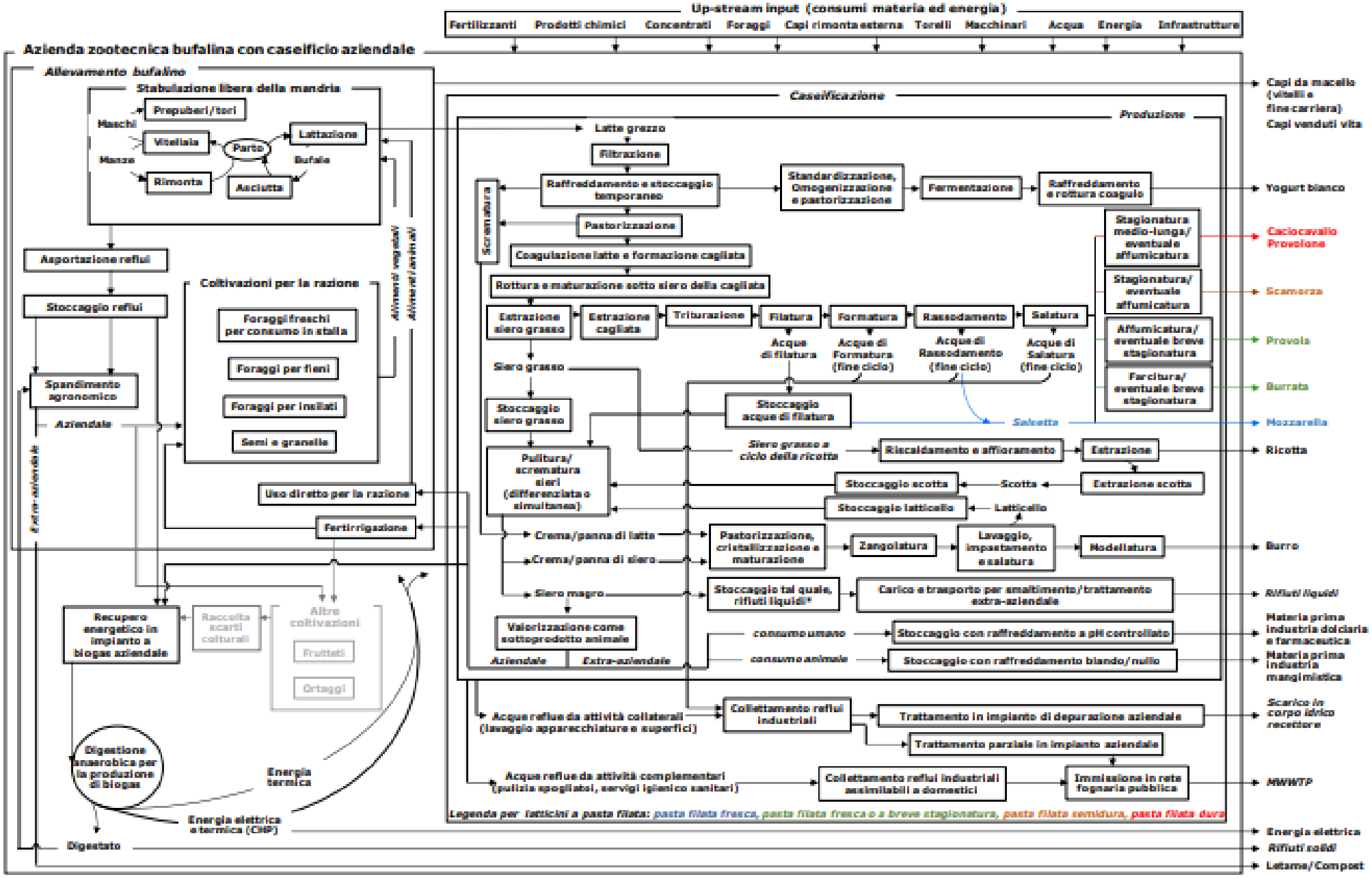
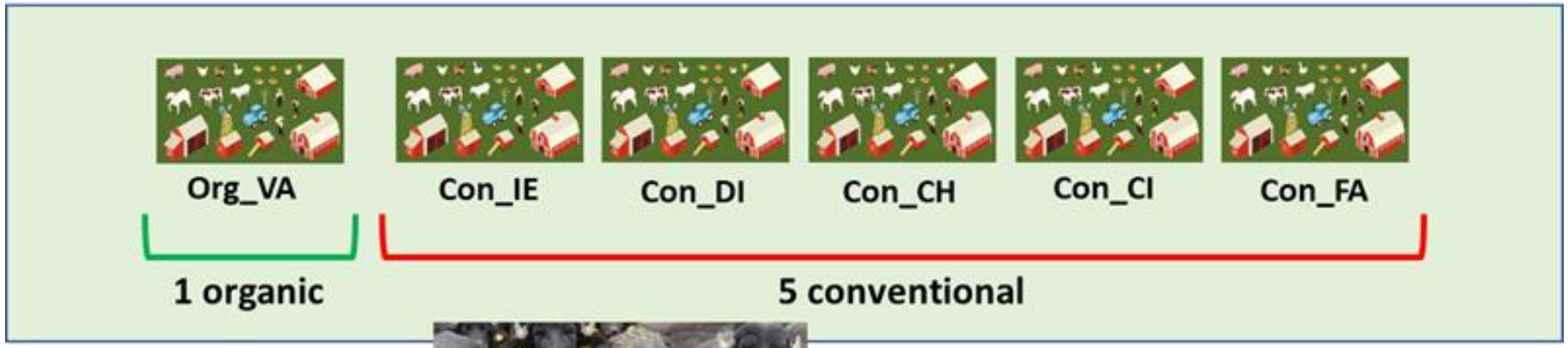


Figura 2: Flowchart generale di processo per le aziende zootecniche bufaline con caseificio aziendale.

6 buffalo farms

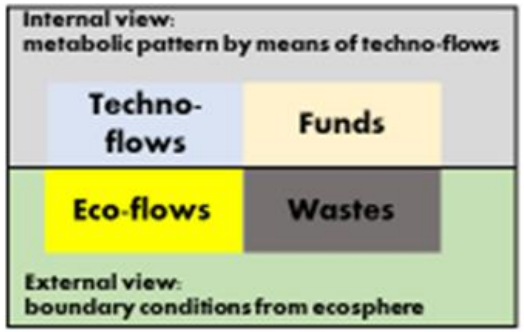


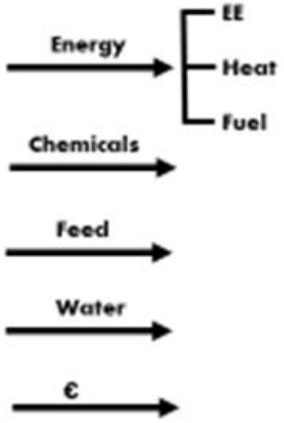
Milk production

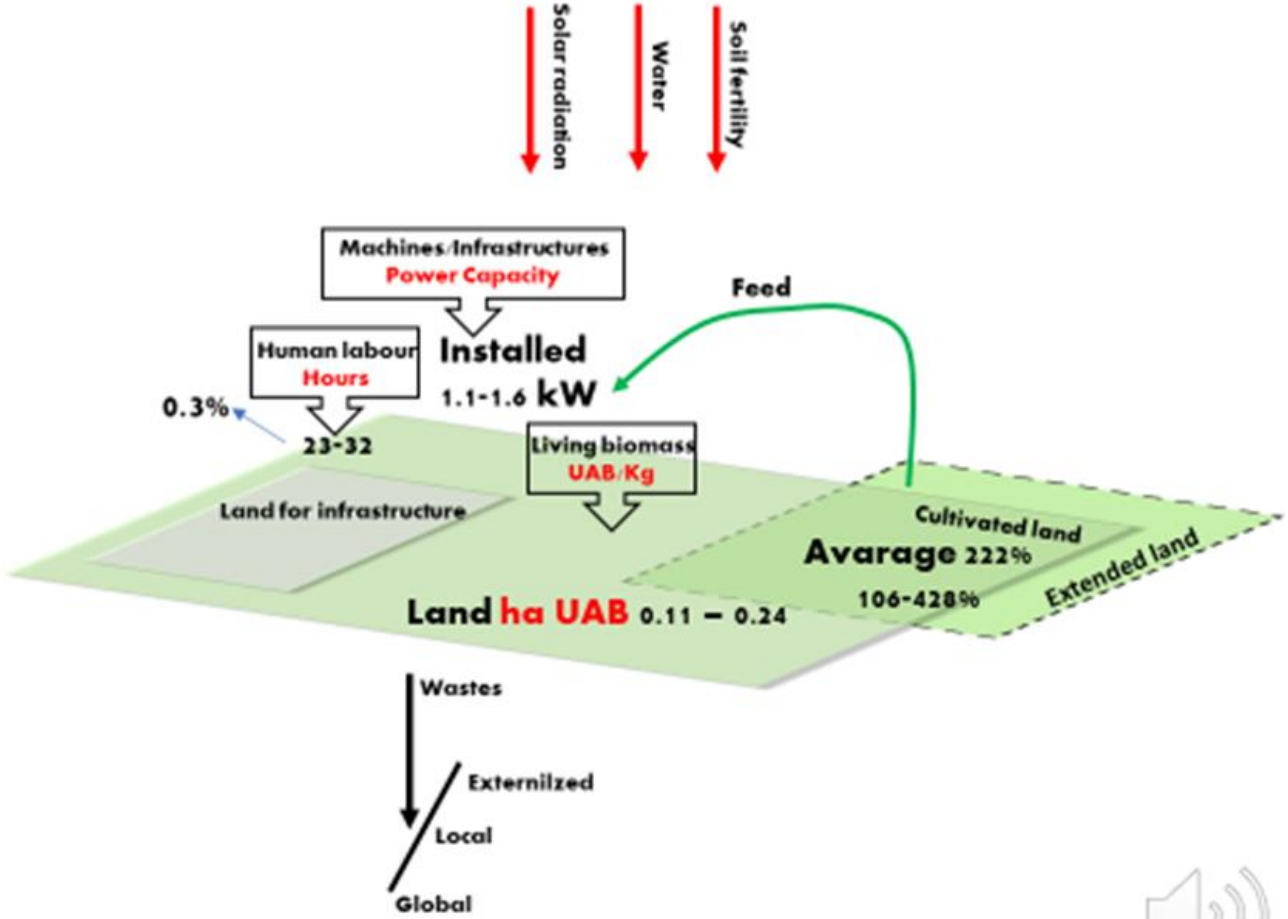
Analytical formalization

Time window_ 1 year

Processor

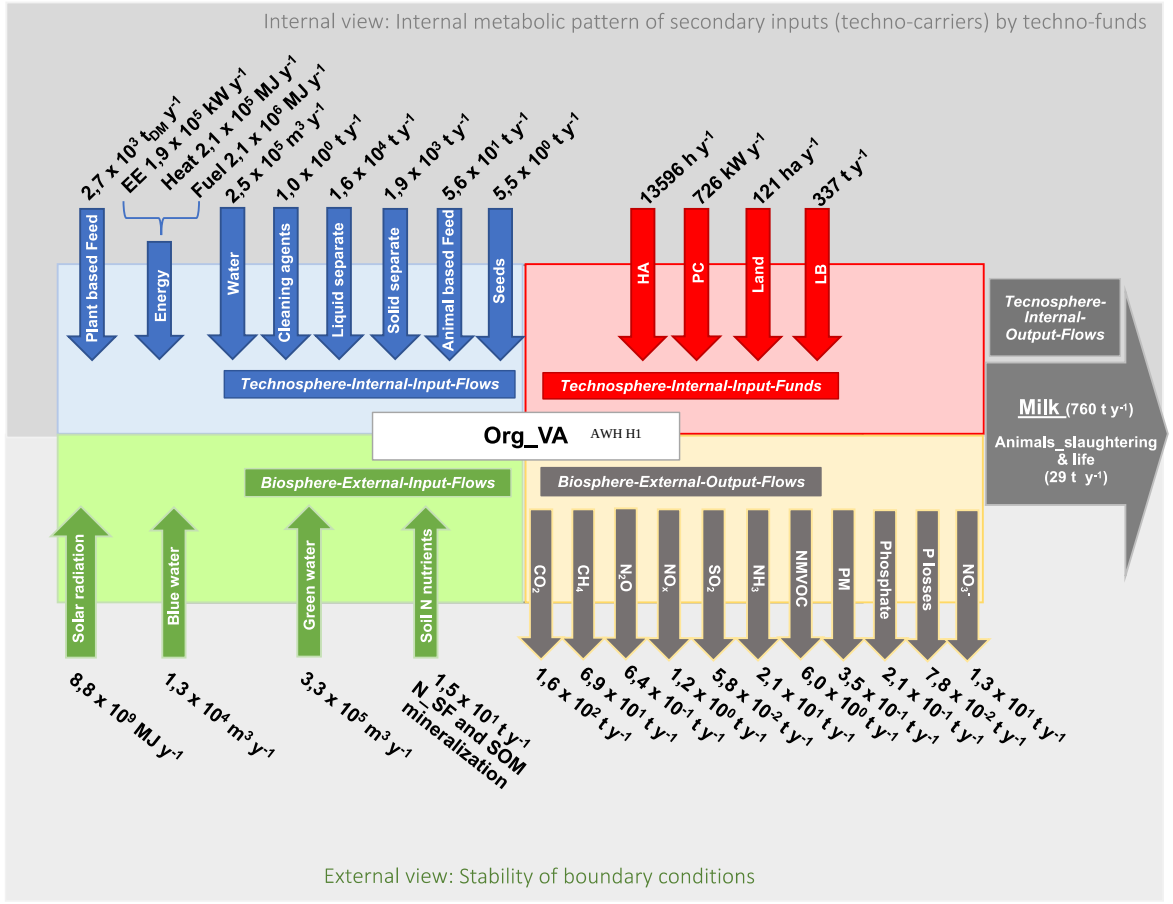


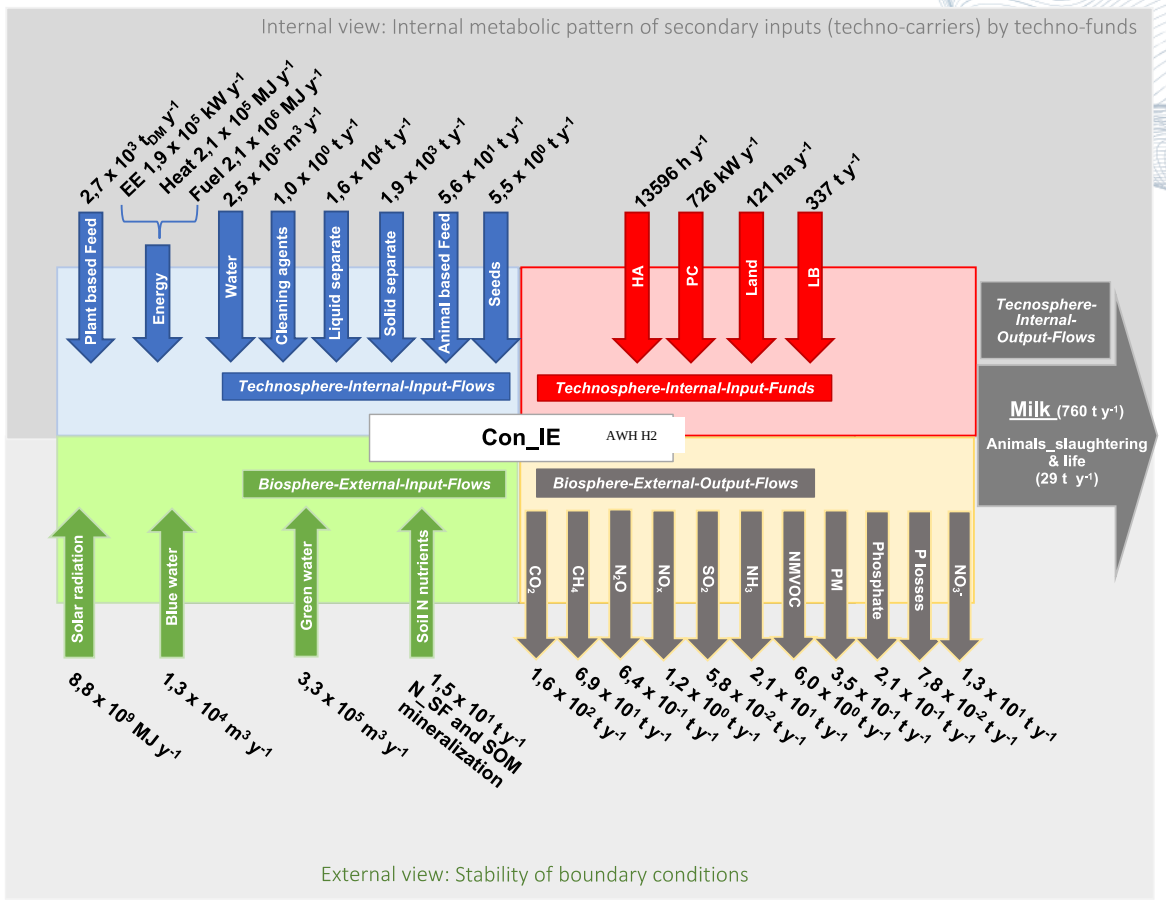




Efficiency – Flow/Fund

Extensive variables – products flows to consumption


Internal view: Internal metabolic pattern of secondary inputs (techno-carriers) by techno-funds
2,7 x 10³ t_DM y⁻¹
EE 1,9 x 10⁵ kW y⁻¹
Heat 2,1 x 10⁵ MJ y⁻¹
Fuel 2,1 x 10⁶ MJ y⁻¹
2,5 x 10⁵ m³ y⁻¹
1,0 x 10⁰ t y⁻¹
1,6 x 10⁴ t y⁻¹
1,9 x 10³ t y⁻¹
5,6 x 10¹ t y⁻¹
5,5 x 10⁰ t y⁻¹
13596 h y⁻¹
726 kW y⁻¹
121 ha y⁻¹
337 t y⁻¹
Plant based Feed
Energy
Water
Cleaning agents
Liquid separate
Solid separate
Animal based Feed
Seeds
HA
PC
Land
LB
Technosphere-Internal-Input-Flows
Technosphere-Internal-Input-Funds
Tecnosphere-Internal-Output-Flows
Org_VA
AWH H1
Milk (760 t y⁻¹)
Animals_slaughtering & life (29 t y⁻¹)
Biosphere-External-Input-Flows
Biosphere-External-Output-Flows
Solar radiation
Blue water
Green water
Soil N nutrients
CO₂
CH₄
N₂O
NOₓ
SO₂
NH₃
NMVOC
PM
Phosphate
P losses
NO₃⁻
8,8 x 10⁹ MJ y⁻¹
1,3 x 10⁴ m³ y⁻¹
3,3 x 10⁵ m³ y⁻¹
1,5 x 10¹ t y⁻¹ N_SF and SOM mineralization
1,6 x 10² t y⁻¹
6,9 x 10¹ t y⁻¹
6,4 x 10⁻¹ t y⁻¹
1,2 x 10⁰ t y⁻¹
5,8 x 10⁻² t y⁻¹
2,1 x 10¹ t y⁻¹
6,0 x 10⁰ t y⁻¹
3,5 x 10⁻¹ t y⁻¹
2,1 x 10⁻¹ t y⁻¹
7,8 x 10⁻² t y⁻¹
1,3 x 10¹ t y⁻¹
External view: Stability of boundary conditions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1,0 x 10⁰ t y⁻¹
1,6 x 10⁴ t y⁻¹
1,9 x 10³ t y⁻¹
5,6 x 10¹ t y⁻¹
5,5 x 10⁰ t y⁻¹
13596 h y⁻¹
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Plant based Feed
Energy
Water
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Technosphere-Internal-Input-Flows
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Con_IE
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Biosphere-External-Input-Flows
Biosphere-External-Output-Flows
Solar radiation
Blue water
Green water
Soil N nutrients
CO₂
CH₄
N₂O
NOₓ
SO₂
NH₃
NMVOC
PM
Phosphate
P losses
NO₃⁻
8,8 x 10⁹ MJ y⁻¹
1,3 x 10⁴ m³ y⁻¹
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1,6 x 10² t y⁻¹
6,9 x 10¹ t y⁻¹
6,4 x 10⁻¹ t y⁻¹
1,2 x 10⁰ t y⁻¹
5,8 x 10⁻² t y⁻¹
2,1 x 10¹ t y⁻¹
6,0 x 10⁰ t y⁻¹
3,5 x 10⁻¹ t y⁻¹
2,1 x 10⁻¹ t y⁻¹
7,8 x 10⁻² t y⁻¹
1,3 x 10¹ t y⁻¹
External view: Stability of boundary conditions

Outflows (wastes) *per* UBA

Animal Welfare H level (conventional farm) metabolic system - data referring to 1 year

CO_2	CH_4 Fossil	CH_4 Biogenic	N_2O	NOx	SO_2	NH_3	NMVOC	Particulates < 2.5 μm	PO_4^{--}	P	NO_3^-
2570 kg	2.7 kg	98 kg	3 kg	6.7 kg	2.9 kg	56 kg	12.8 kg	1.1 kg	1 kg	0.54 kg	103 kg

Outflows (wastes) *per* UBA

Animal Welfare Sufficient Medium Level (conventional farm) metabolic system - data referring to 1 year

CO_2	CH_4 Fossil	CH_4 Biogenic	N_2O	NOx	SO_2	NH_3	NMVOC	Particulates < 2.5 μm	PO_4^{--}	NO_3^-
2102 kg	2.3 kg	168 kg	3.7 kg	5.2 kg	2.5 kg	62 kg	12 kg	0.8 kg	0.7 kg	185 kg

Outflows (wastes) *per* UBA

Animal Welfare LOW level (conventional farm) metabolic system - data referring to 1 year

CO_2	CH_4 Fossil	CH_4 Biogenic	N_2O	NOx	SO_2	NH_3	NMVOC	Particulates < 2.5 μm	PO_4^{--}	P	NO_3^-
2198 kg	2.6 kg	139 kg	2.6 kg	5.3 kg	2.6 kg	44 kg	12 kg	0.9 kg	0.7 kg	0.4 kg	85 kg

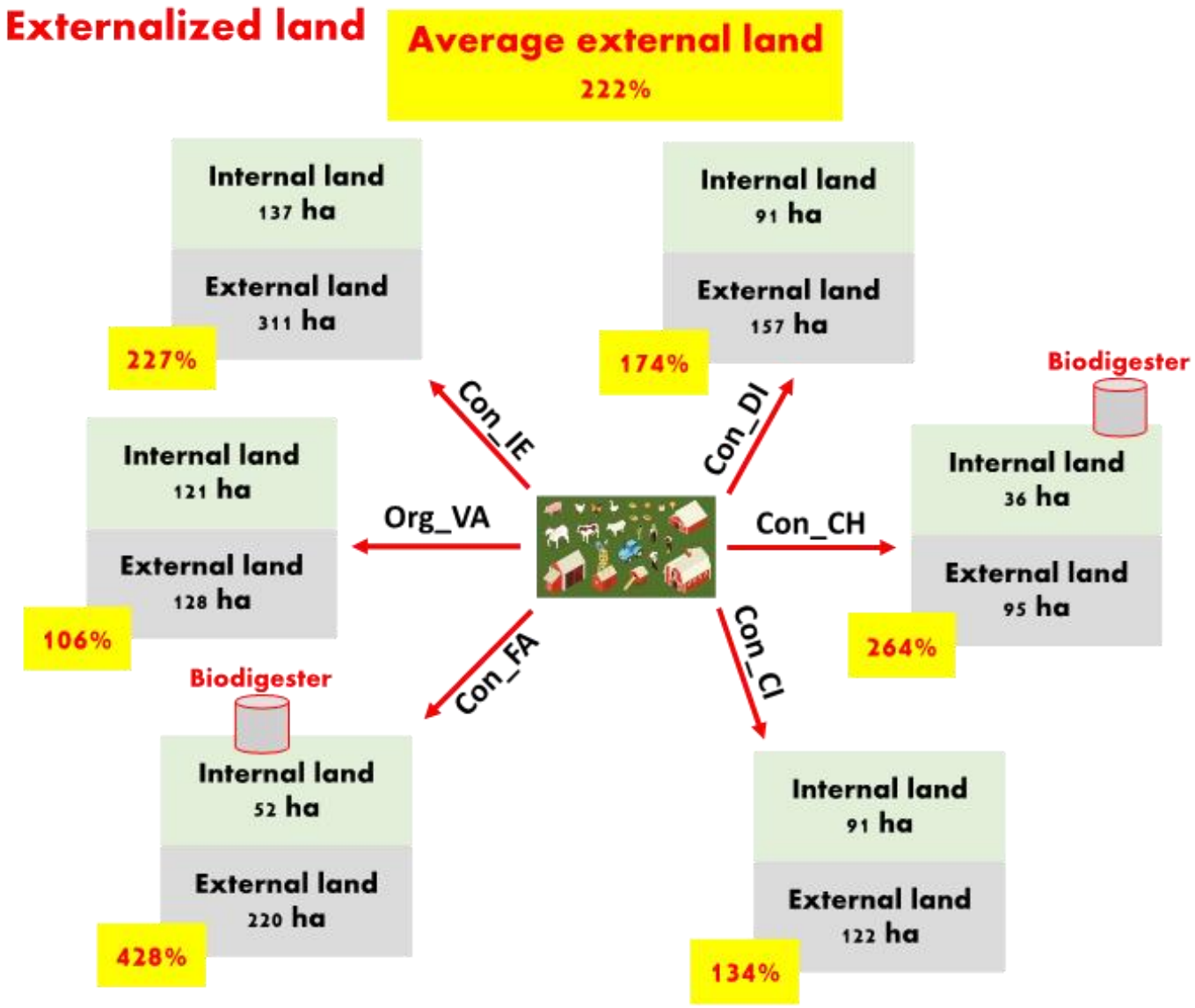


Figura 37 Contributo di utilizzo di terre intra-aziendali ed extra-aziendali per garantire il flusso di alimenti (foraggi e concentrati) alla mandria.

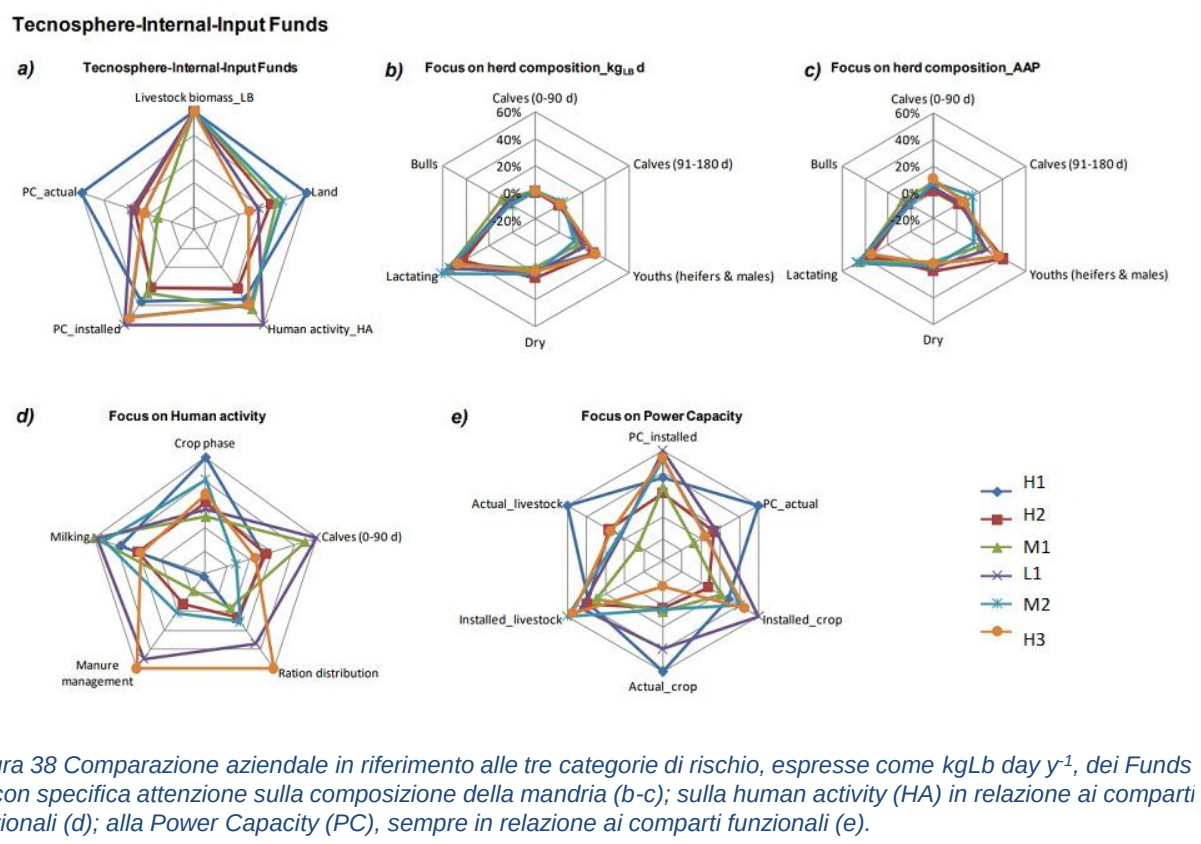


Figura 38 Comparazione aziendale in riferimento alle tre categorie di rischio, espresse come kgLb day y^{-1}, dei Funds (a) con specifica attenzione sulla composizione della mandria (b-c); sulla human activity (HA) in relazione ai comparti funzionali (d); alla Power Capacity (PC), sempre in relazione ai comparti funzionali (e).

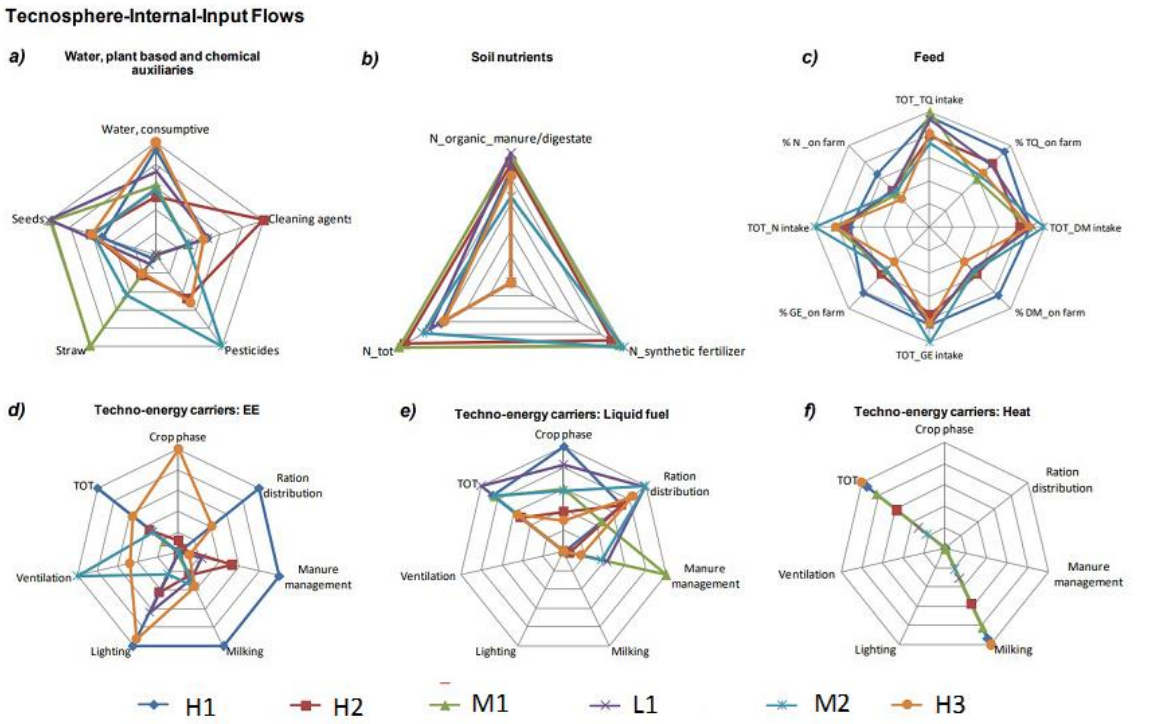


Figura 39 Comparazione aziendale, in riferimento alle tre categorie di rischio, dei diversi flussi in entrata.

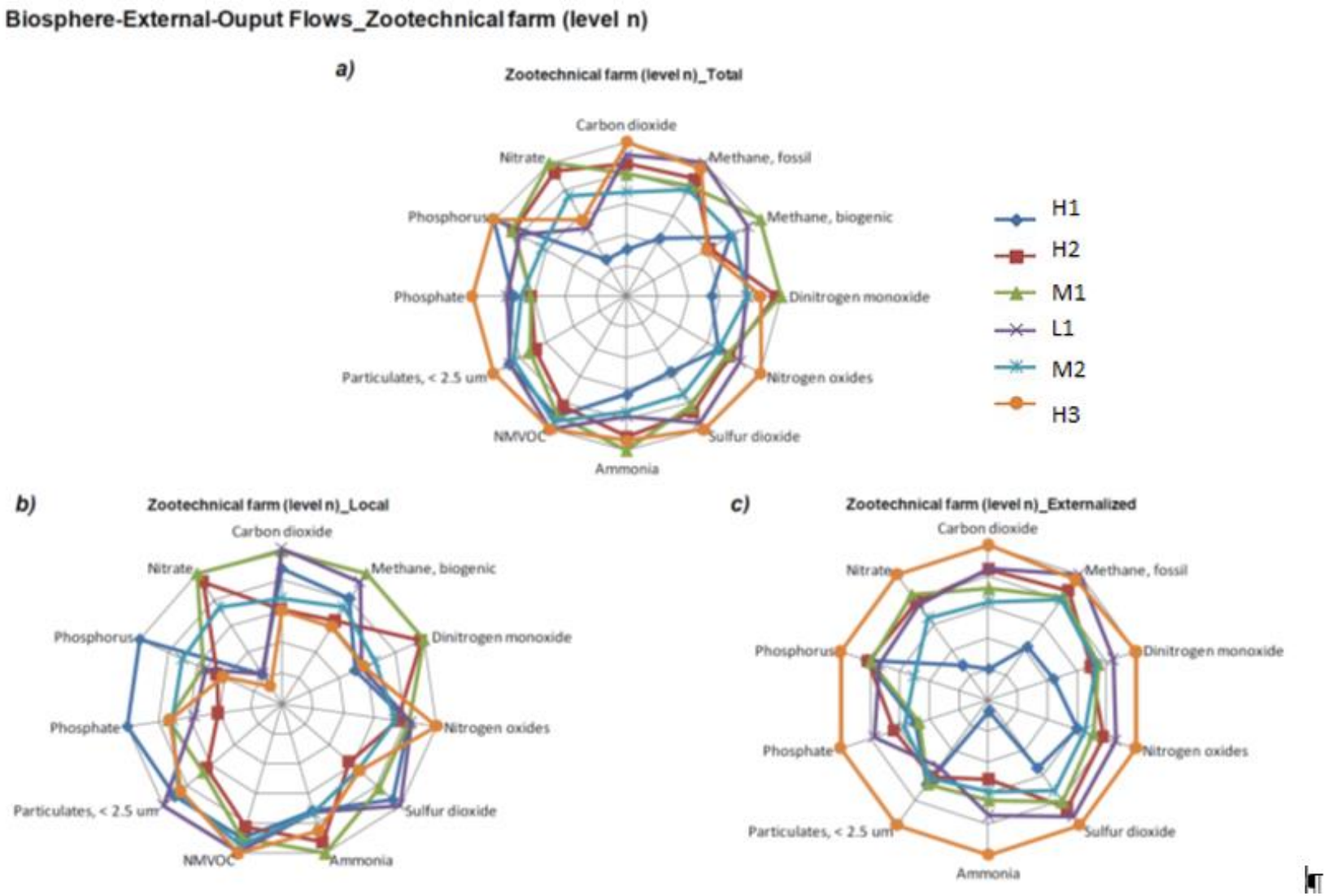
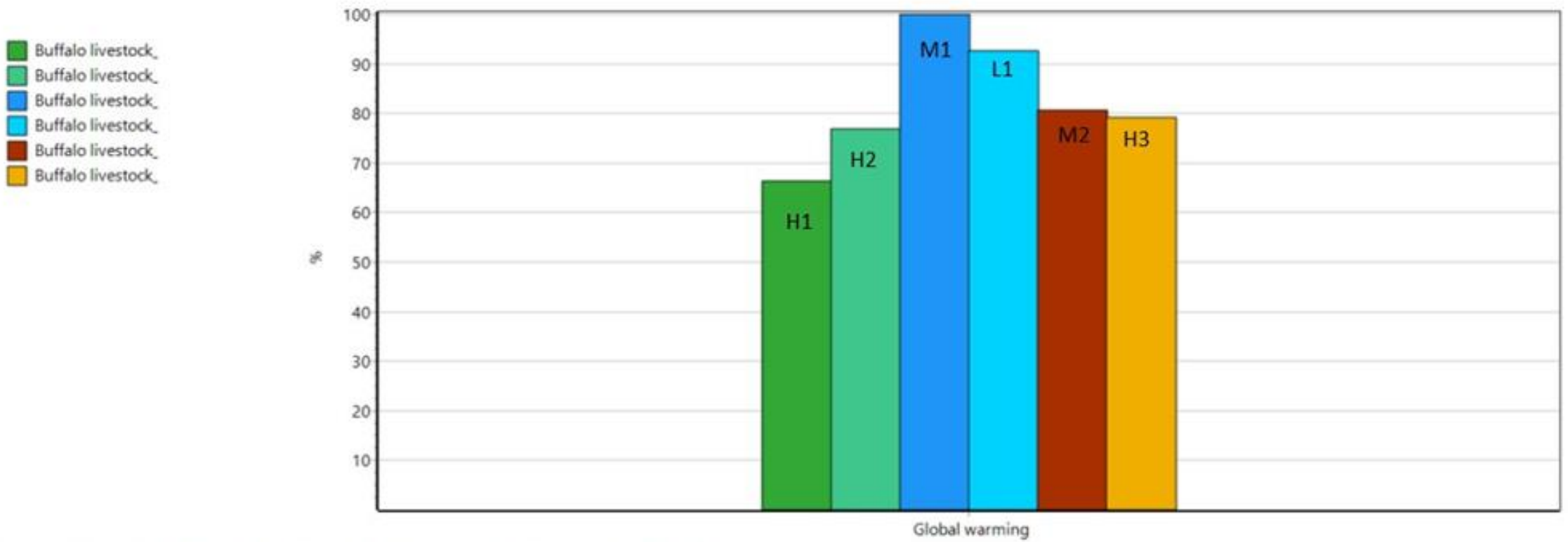


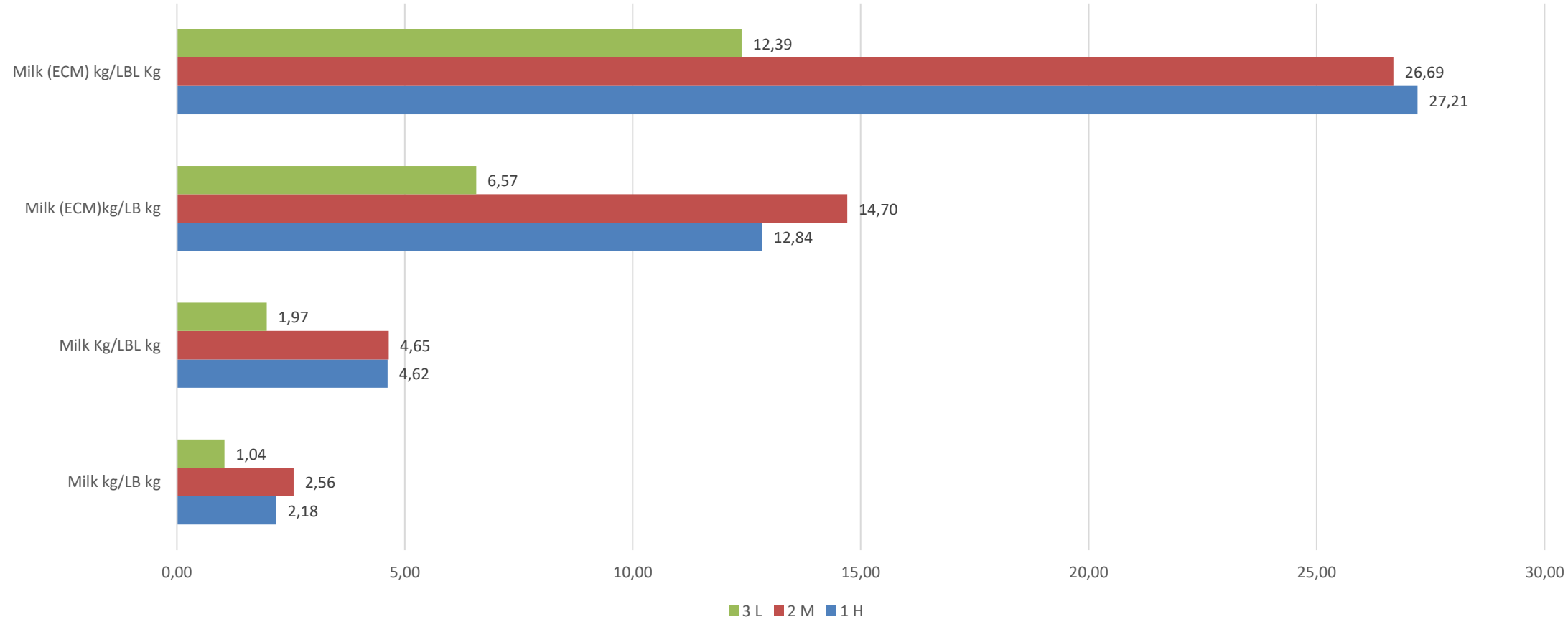
Figura 41 Analisi comparativa per kgLB d y-1 dei Biosphere-External-Output Flows dei sistemi metabolici nel loro complesso (level n), in relazione ai flussi: a) totali; b) localmente prodotti; c) esternalizzati. La scala è da 0 a 100%.

Biosphere-External-Ouput Flows_ Zootechnical farm (level n)_Focus on Climate change



Confronto di processi; Metodo: ReCiPe 2016 Midpoint (H) V1.03 / World (2010) H / Caratterizzazione

Milk efficency for different level of welfare



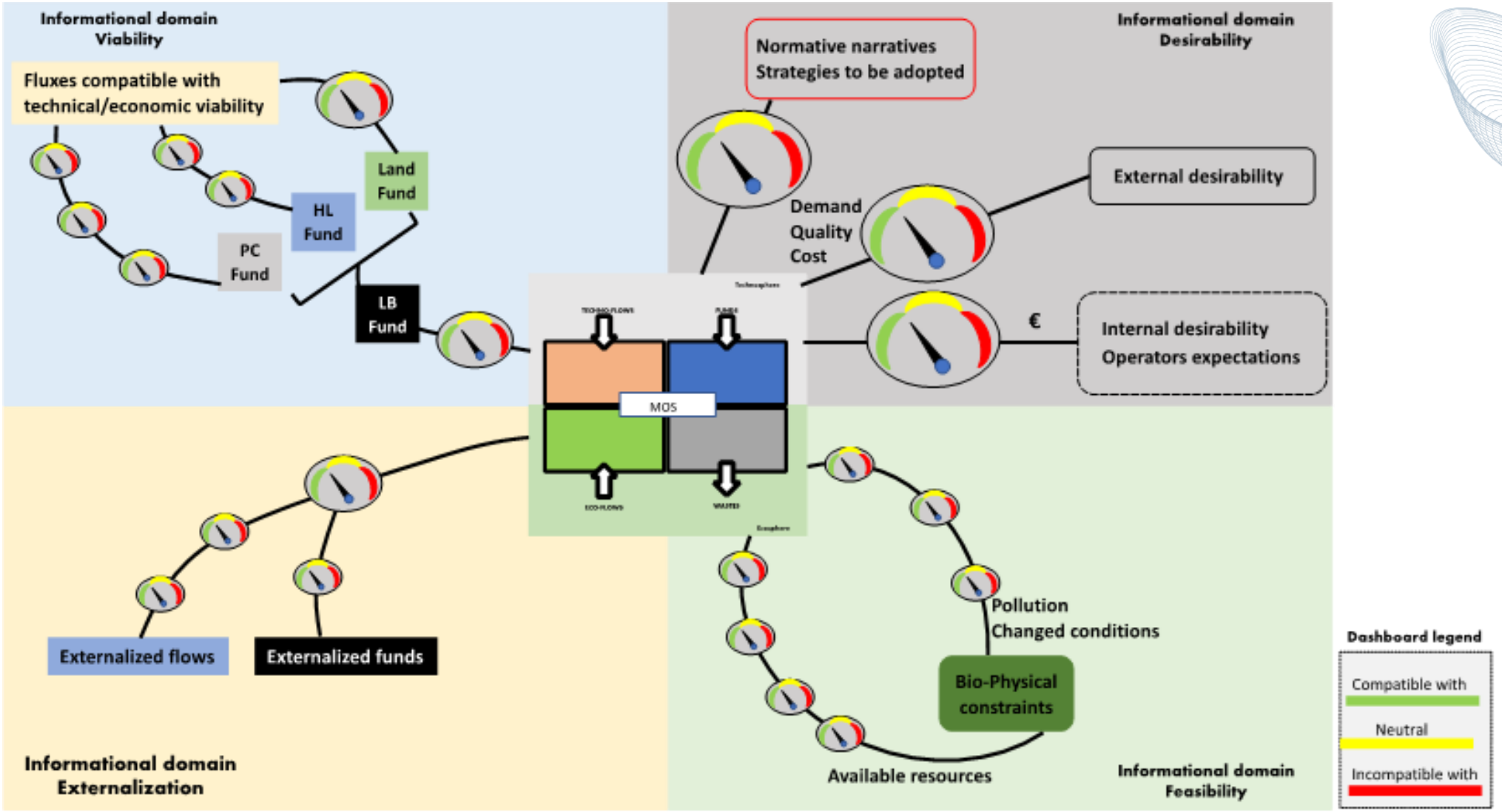
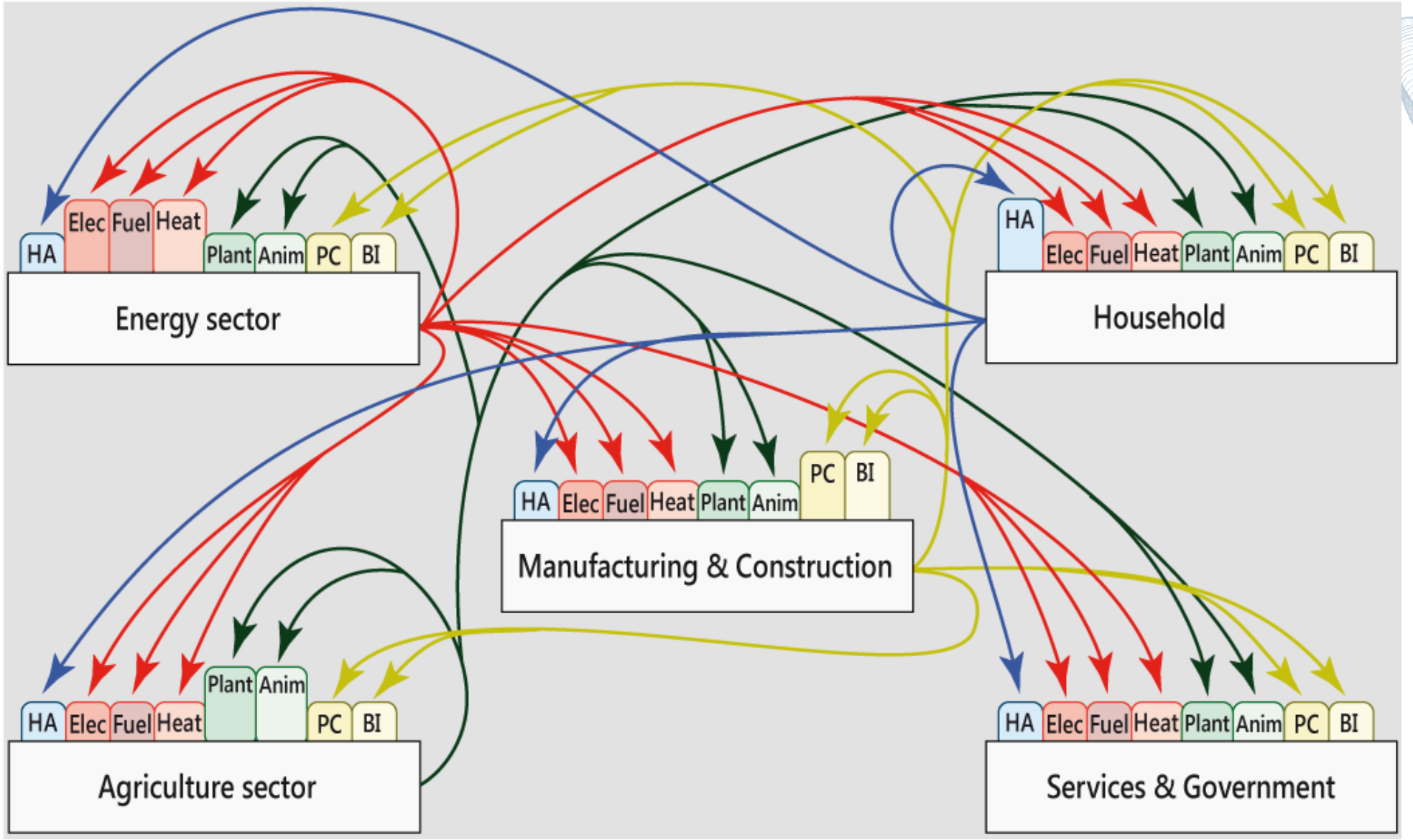
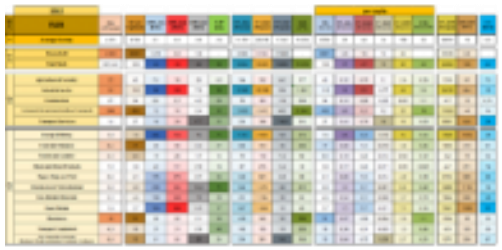


Figura 45Rappresentazione sintetica di una "grammar multi-level" che consente di generare una coerenza funzionale, in riferimento ai flows e funds del sistema metabolico sotto osservazione

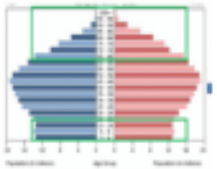

HA
Elec
Fuel
Heat
Plant
Anim
PC
BI
Energy sector
Household
Manufacturing & Construction
Agriculture sector
Services & Government

MACROSCOPE

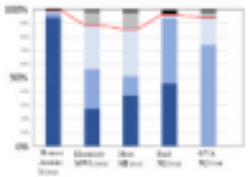
Constituent Components



End-Use Matrix



Population/Demography



Bio-Economic Pressure

DESIRABILITY

Metric #1 ←→ Metric #2

Use of Nutrient Carriers

- Animal kcal In the diet
- Plant kcal In the diet

Supply Food Commodities

- Bovine+Milk
- Poultry+Eggs
- Pork
- Others
- Animal Feed
- Grains
- Veg&Fruits
- Others

Use of Energy Carriers

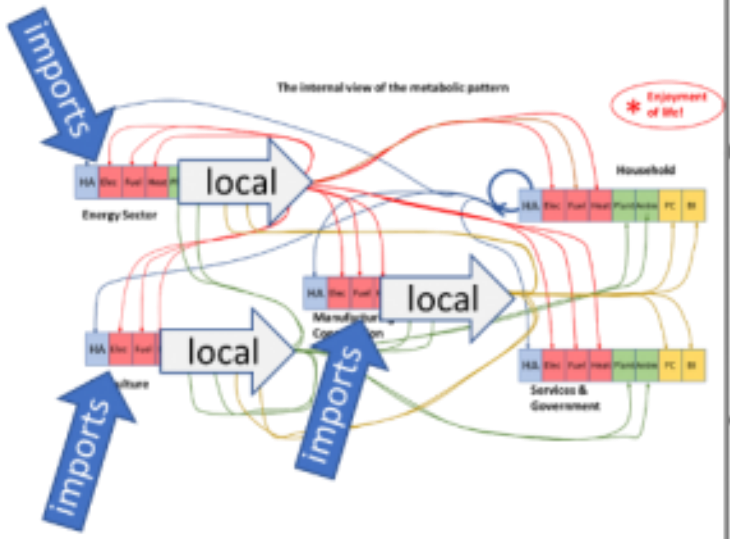
- Electricity
- Fuels
- Heat

Supply Energy Commodities

- Peakers
- Baseloaders
- Intermittent
- Crude Oil
- Liquid Fuels
- Natural Gas
- Coal
- Biomass

MESOSCOPE

Local Production + Imports



Total Consumption of Commodities

VIRTUALSCOPE

Local production

LOCAL SUPPLY SYSTEMS

local

OBSERVED

NOTIONAL

imports

VIRTUAL SUPPLY SYSTEMS

EXTERNALIZATION

Imported production

REQUIRED SUPPLY

Metric #2

Supply Food Commodities

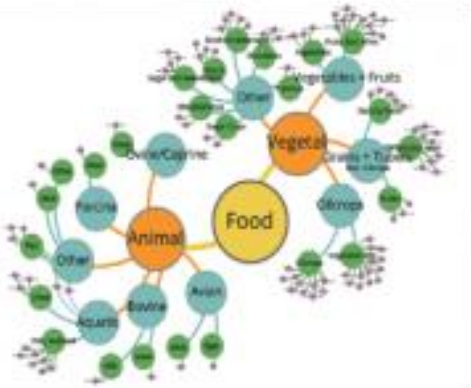
- Bovine+Milk
- Poultry+Eggs
- Pork
- Others
- Animal Feed
- Grains
- Veg&Fruits
- Others

Supply Energy Commodities

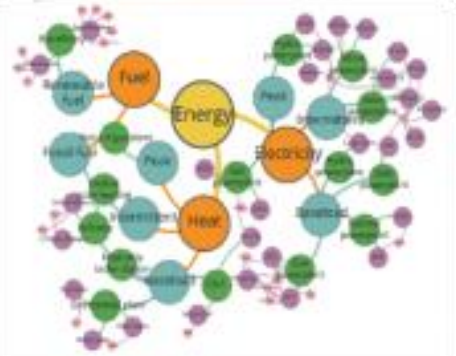
- Peakers
- Baseloaders
- Intermittent
- Crude Oil
- Liquid Fuels
- Natural Gas
- Coal
- Biomass

From requirement of commodities to requirement of production processes

Mapping production processes onto supply systems



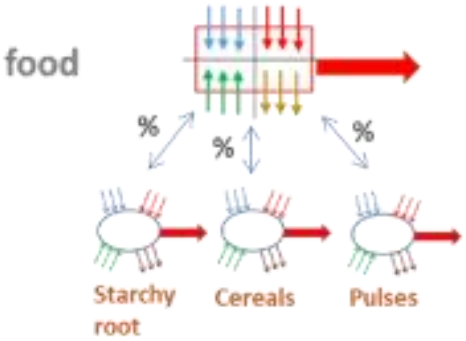
Mapping production processes onto supply systems



MICROSCOPE

Metric #3 – profiles of metabolic processors

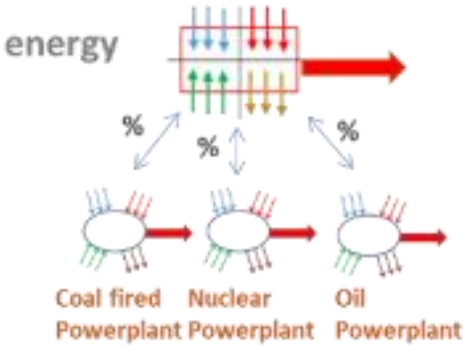
Supply System (Grains&Tubers)

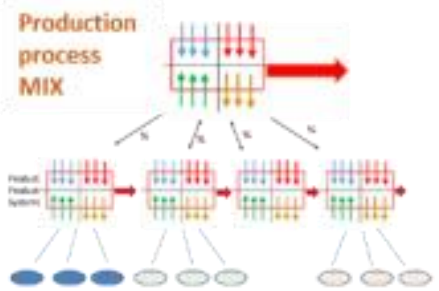


Assessing End Uses

Assessing Environmental Pressure

Supply System (Baseload kWh)

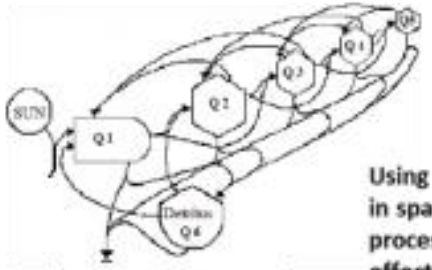




Primary Sources

Primary Sinks

FEASIBILITY



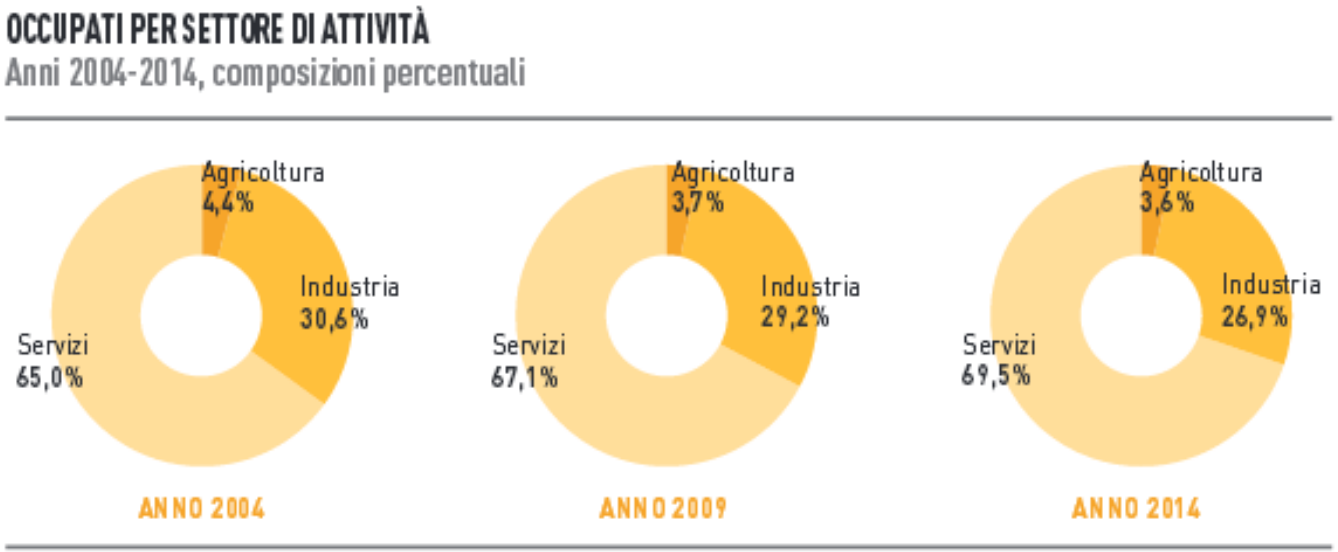
Metabolic Pattern of Ecosystems

Using GIS we can locate in space production processes and check the effect of the pressure against the characteristics of affected ecosystems

Consumers farther away from agricultural reality ...

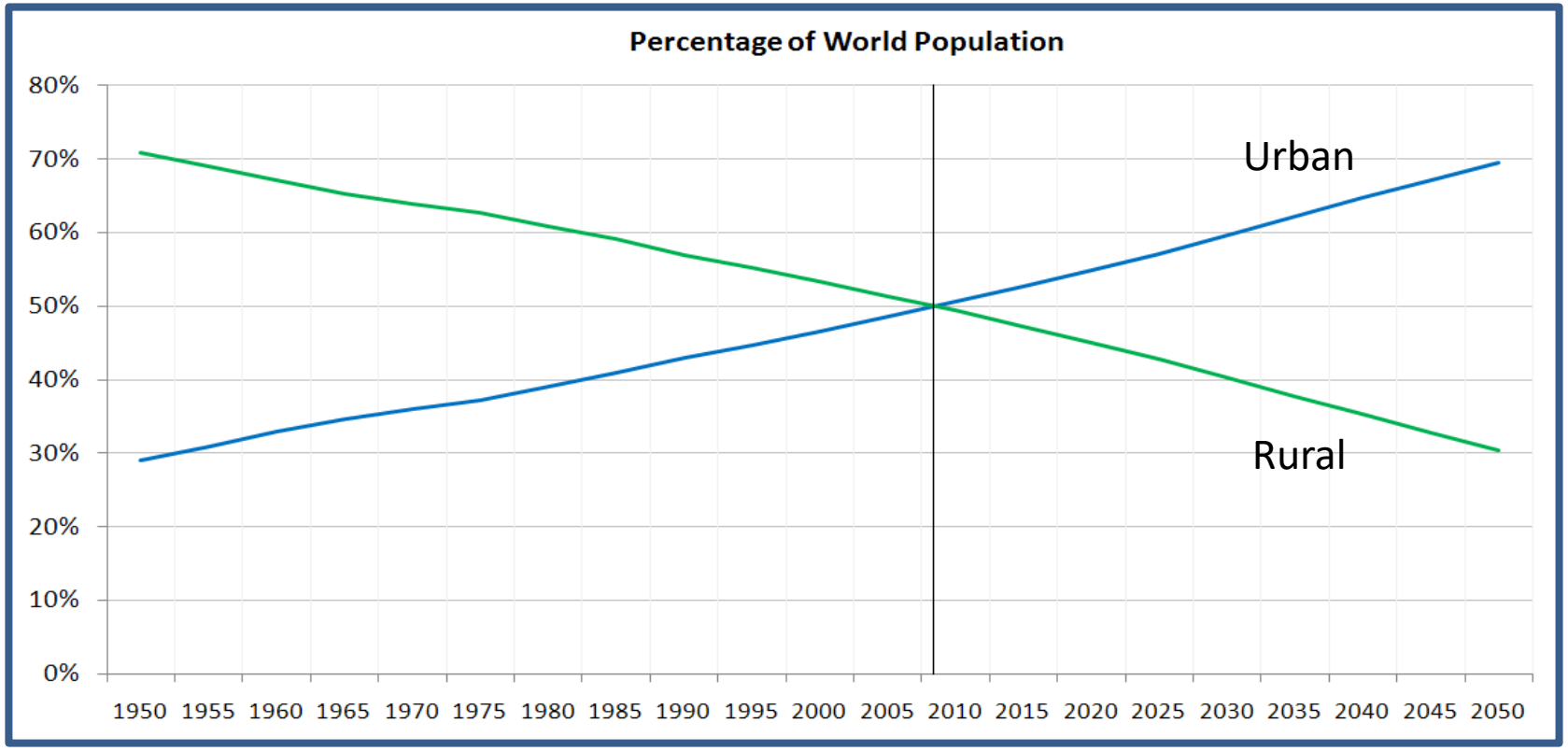
ACTIVE POPULATION IN THE AGRICULTURAL SECTOR

- 1861 → 70%
- 1911 → 52%
- ‘50 → 42%
- ‘60 → 30%
- 1981 → 11%



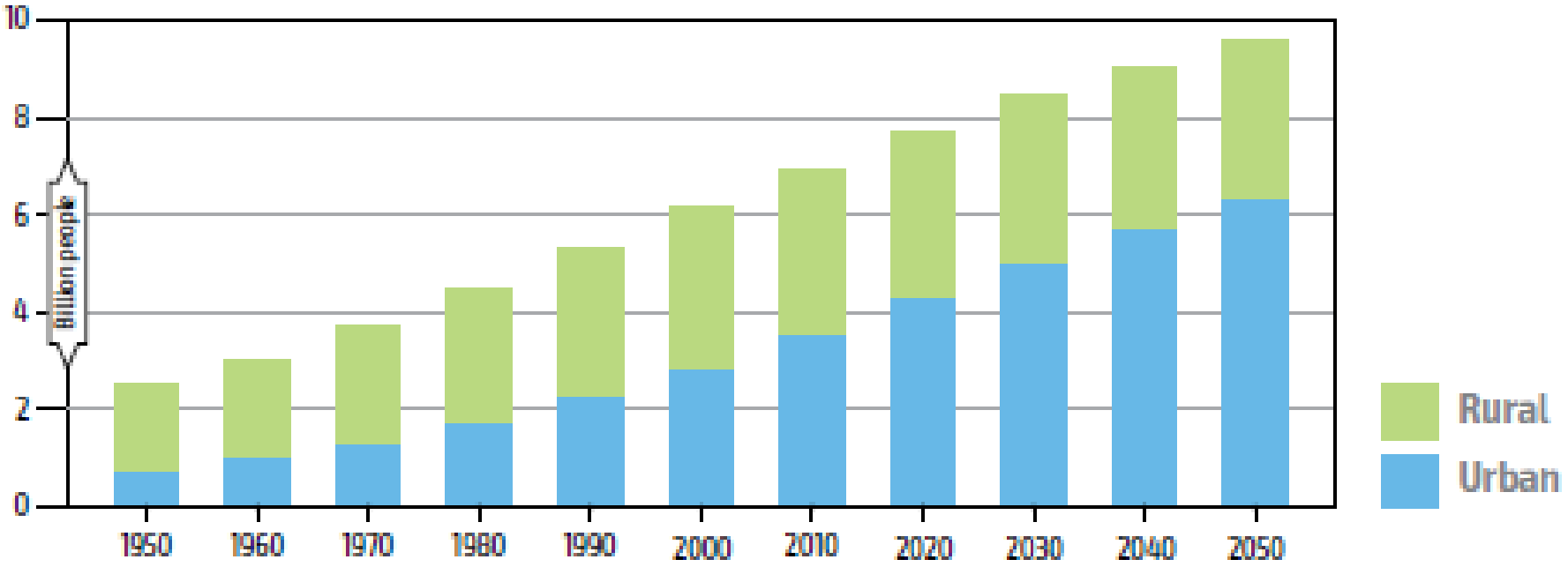
Lorenzi V. ,2016

Urban settlements are taking over the planet
and replacing the rural world!



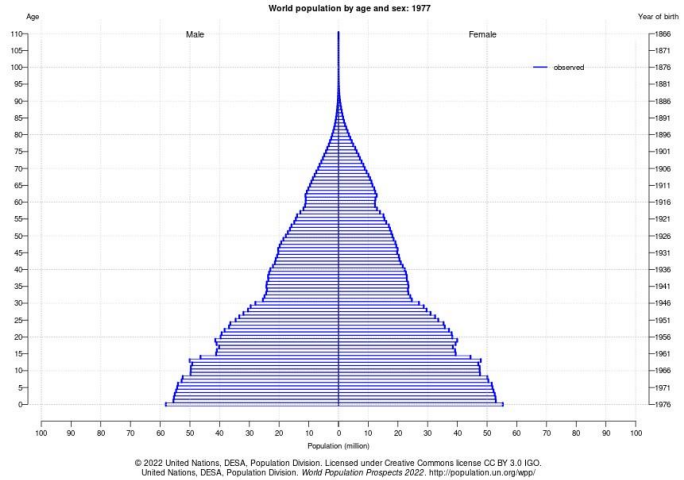
http://esa.un.org/unup/p2k0data.asp

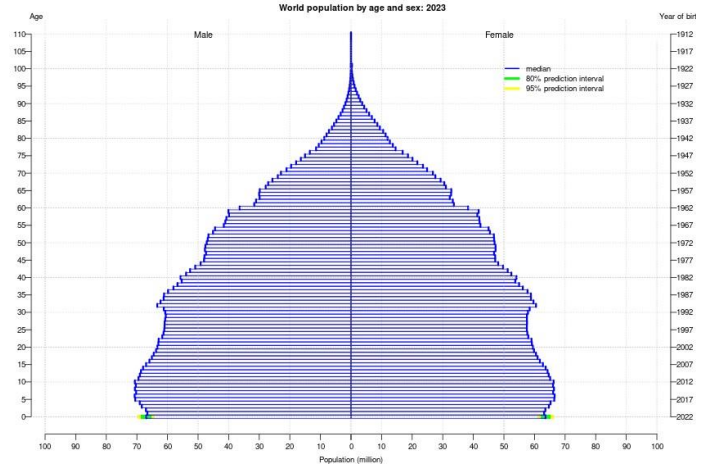
Figure 1.3 Global urban and rural populations: historical and projected

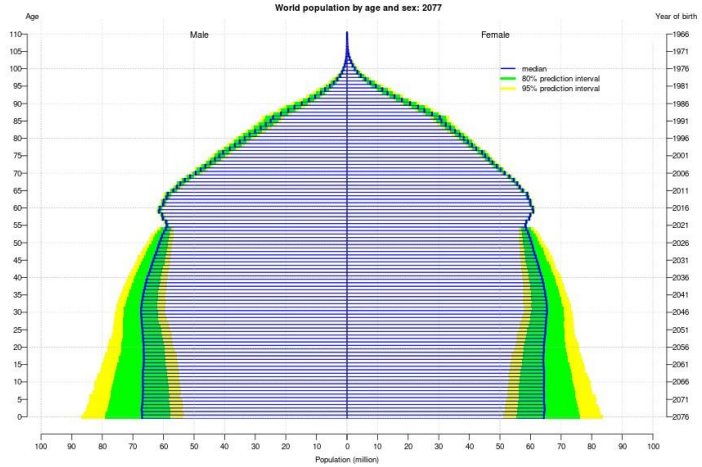


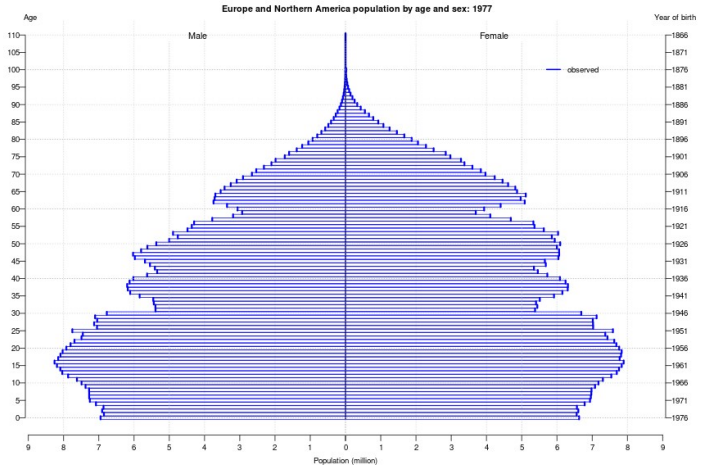
Note: Projected figures from 2015 onward refer to the medium variant scenario.

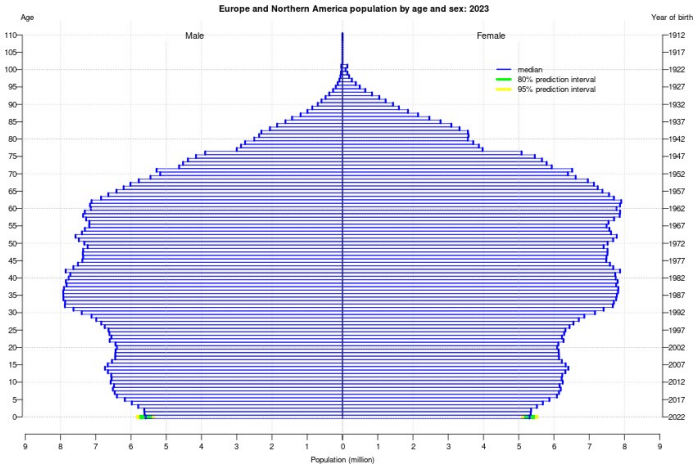
Source: UN, 2015.

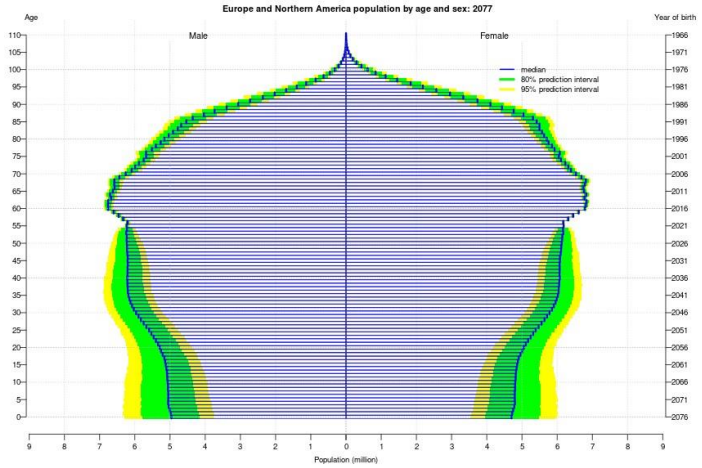


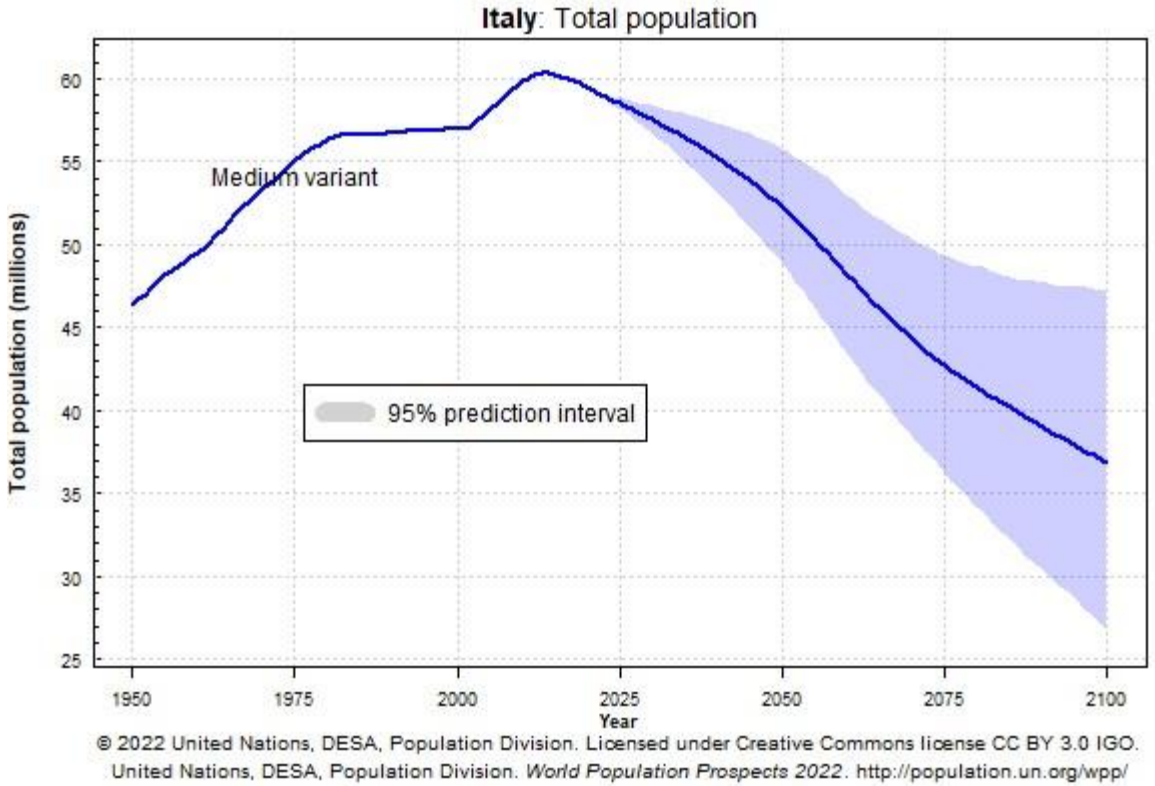






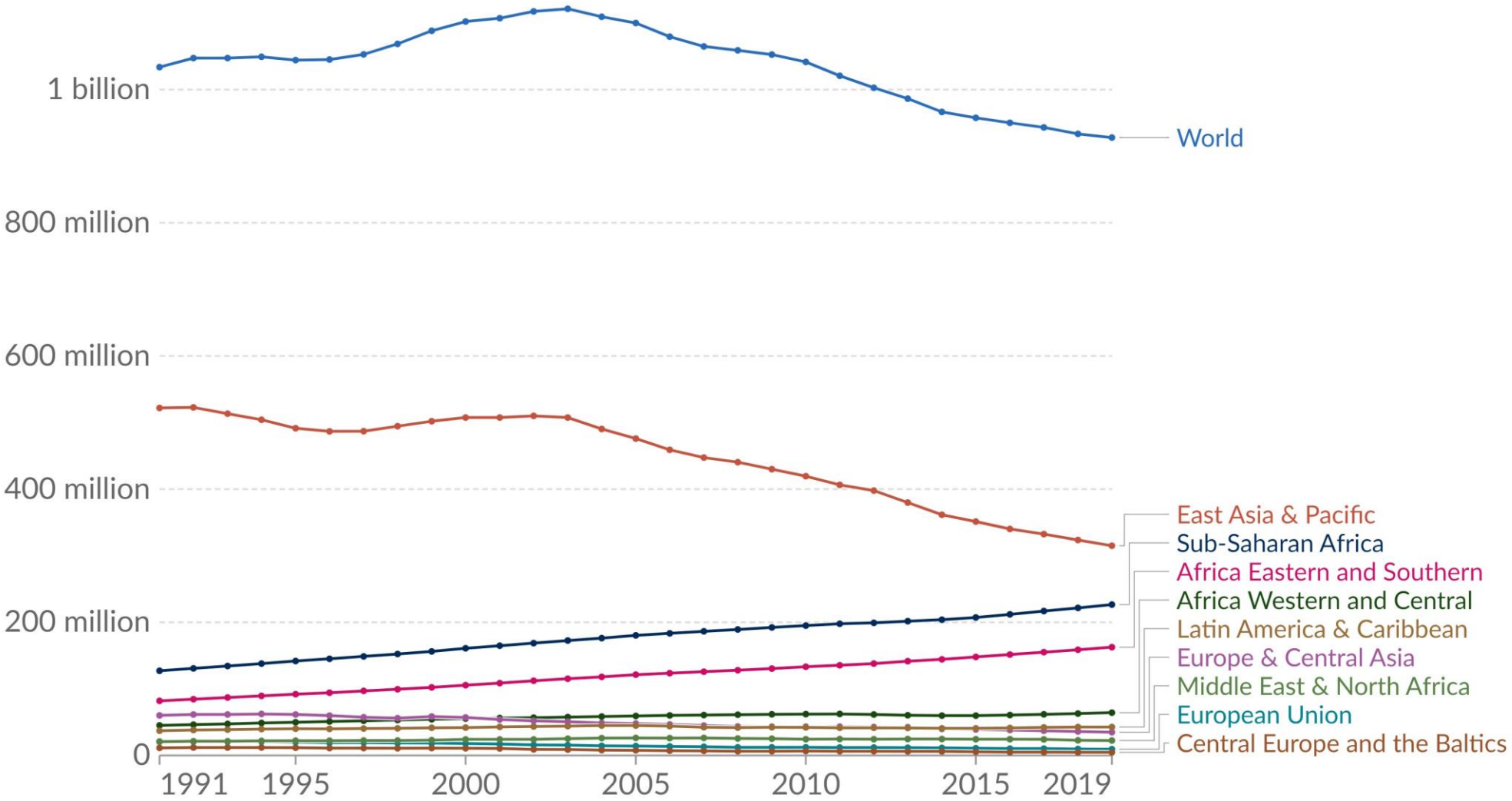





Italy: Total population
Medium variant
95% prediction interval
Total population (millions)
60
55
50
45
40
35
30
25
1950
1975
2000
2025
2050
2075
2100
Year
© 2022 United Nations, DESA, Population Division. Licensed under Creative Commons license CC BY 3.0 IGO.
United Nations, DESA, Population Division. World Population Prospects 2022. http://population.un.org/wpp/

Number of people employed in agriculture, 1991 to 2019

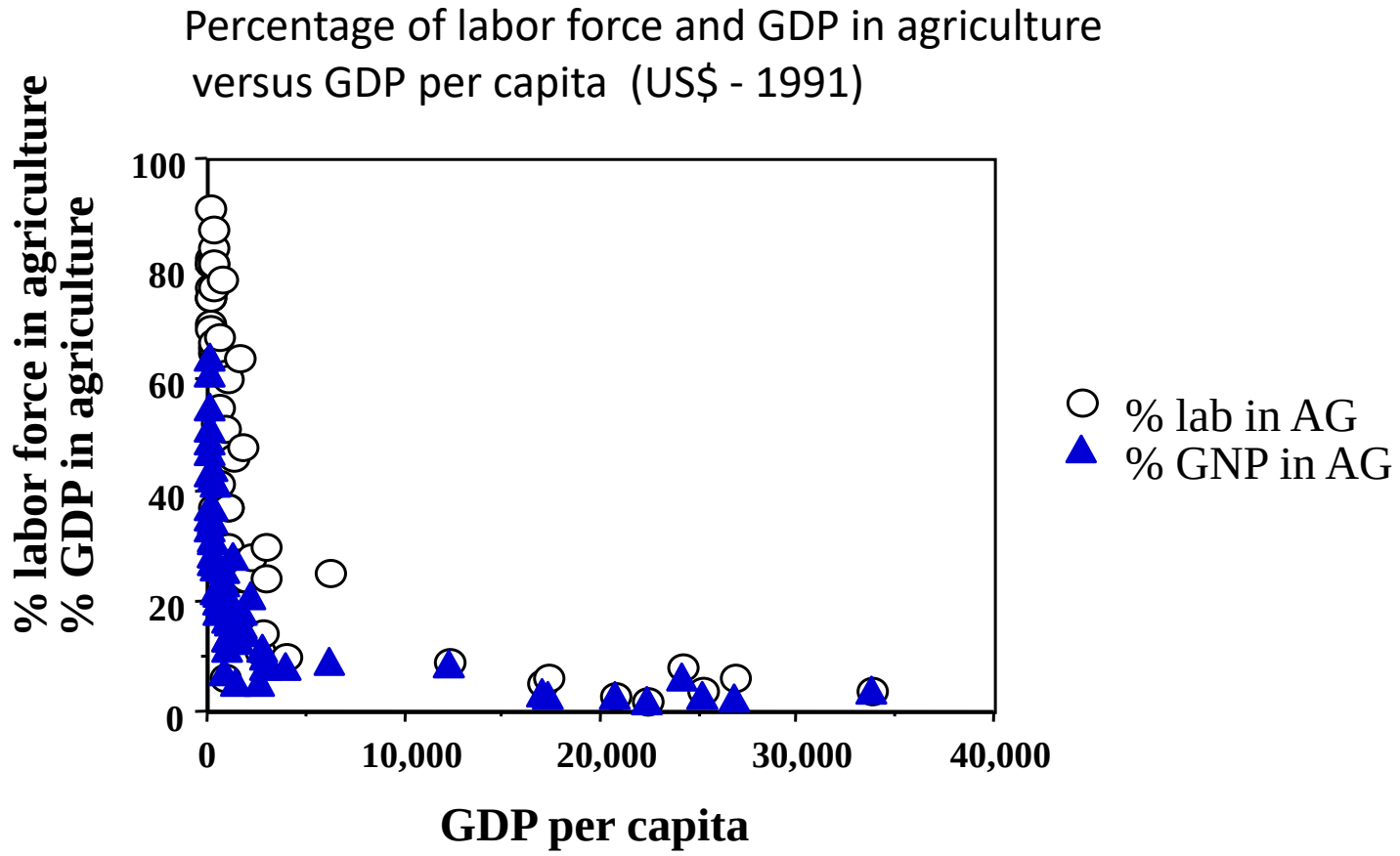
Agriculture includes the cultivation of crops and livestock production, as well as forestry, hunting, and fishing.
Employment includes anyone engaged in any activity to produce goods or services for pay or profit.



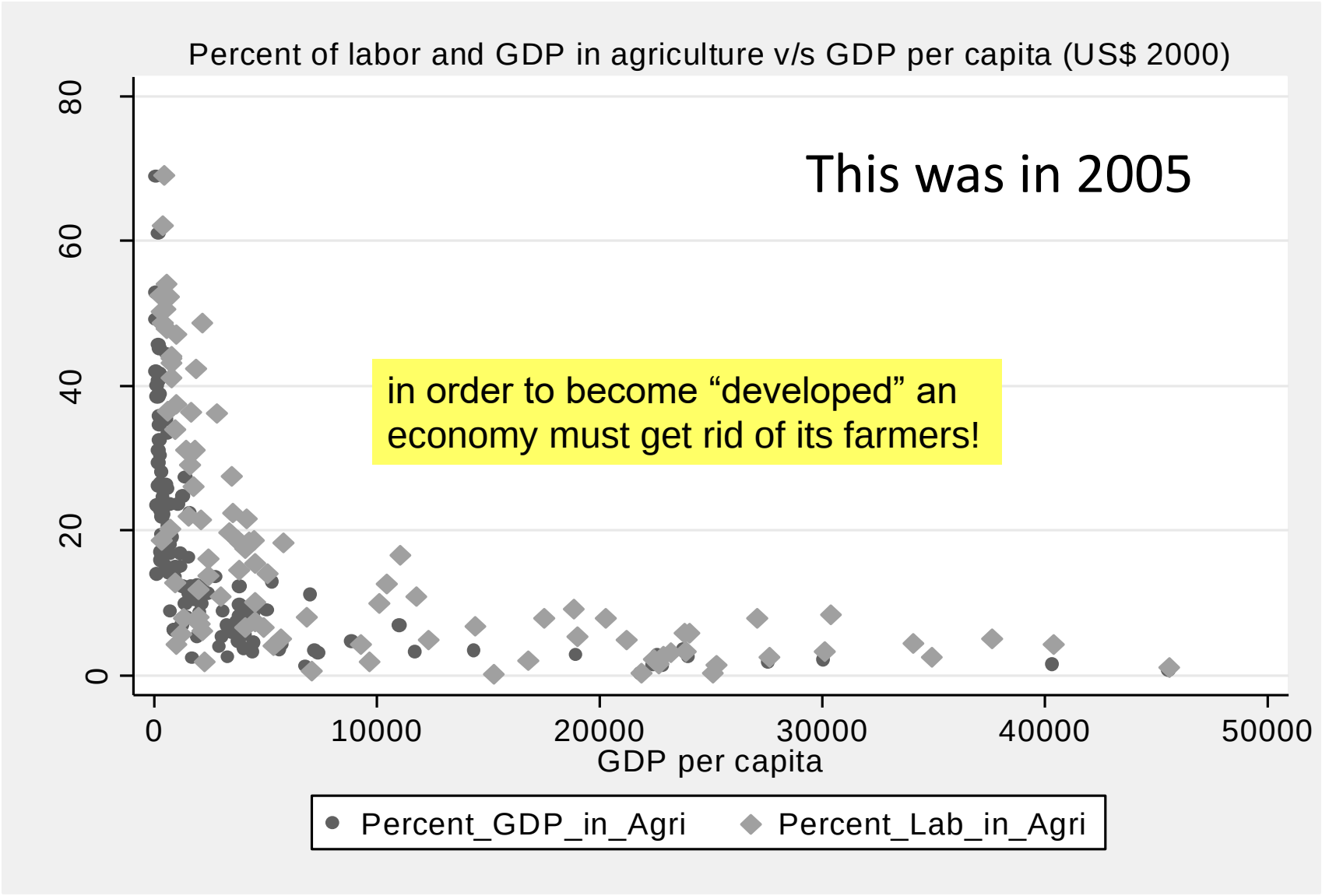
Data source: Our World in Data based on International Labor Organization (via the World Bank) and historical sources
OurWorldInData.org/employment-in-agriculture | CC BY

If the *work force* of a society is just producing its own food that society will never become rich . . .

This was in 1997



All developed countries have less than 5% of their work force in agriculture

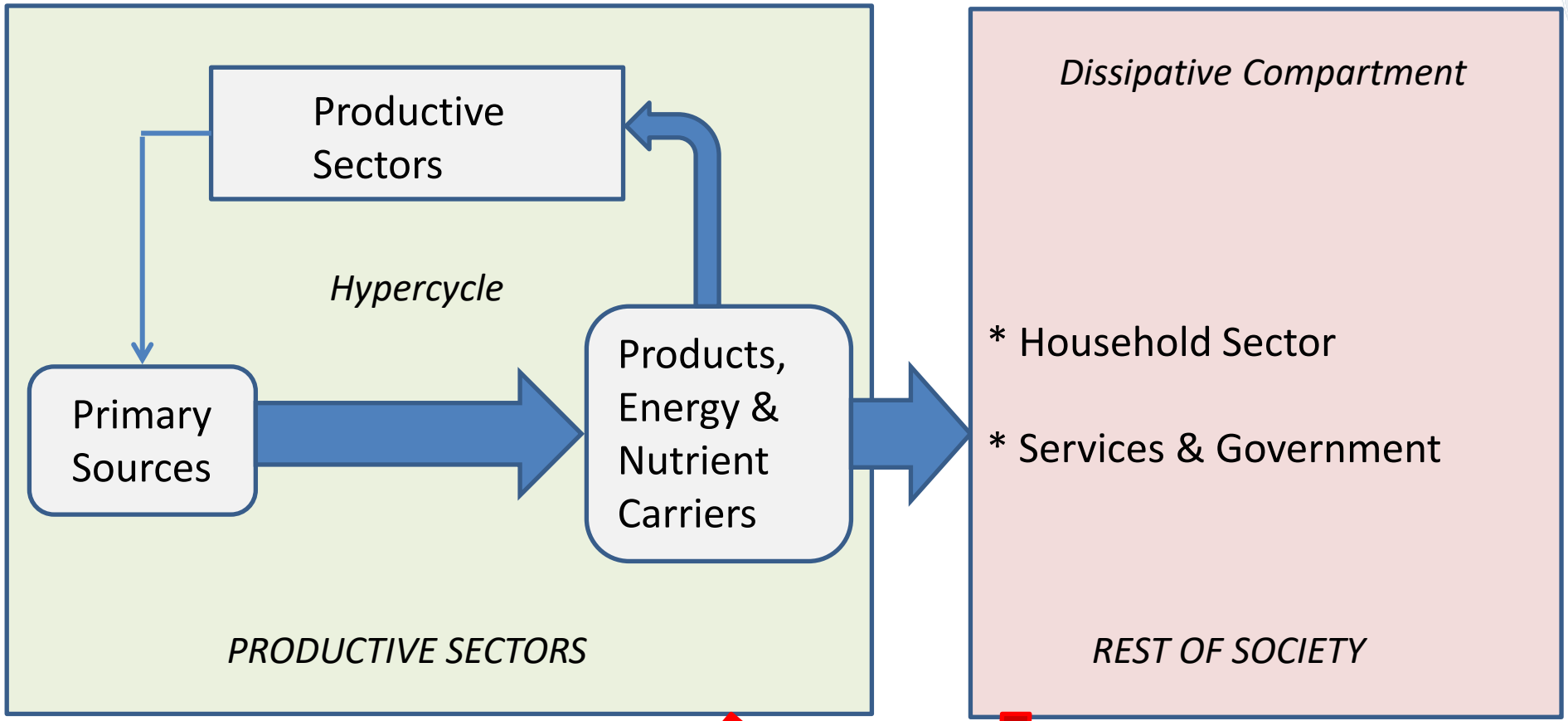


Source: WDI (2005).

Spain	% HA	% Electricity	% Heat	% Fuels	% GVA
Total Society	100%	100%	100%	100%	100%
Rest of Society	99%	78%	90%	95%	87%
Primary Sectors	1%	22%	10%	5%	13%

The level of economic development of the society reduces the fraction of the funds and flows invested in the primary sectors in the economy. The lower the percentage in the Primary Sectors the more developed is the economy

The dynamic metabolic budget: “primary sectors” vs “rest of society”



Catabolic part

Supplying:
Energy, Food, Minerals, Products, Infrastructures

Anabolic part

Supplying:
Humans, Institutions, Control

In conclusion, there are two pressures driving the use of technical inputs in agriculture

#1 Demographic pressure
strategy → boosting the productivity per hectare
the goal → reducing the demand of agricultural land

#2 Socio-economic pressure
strategy → boosting the productivity per hour of labor
the goal → reducing people from the work force

EXTERNALIZATION

Using fossil energy for trading in a global food commodity market

Current discussions over the sustainability of agriculture in EU miss the presence of an elephant in the room

→ ***today agriculture is heavily (and dangerously) depending on externalization***

The MAGIC tool-kit

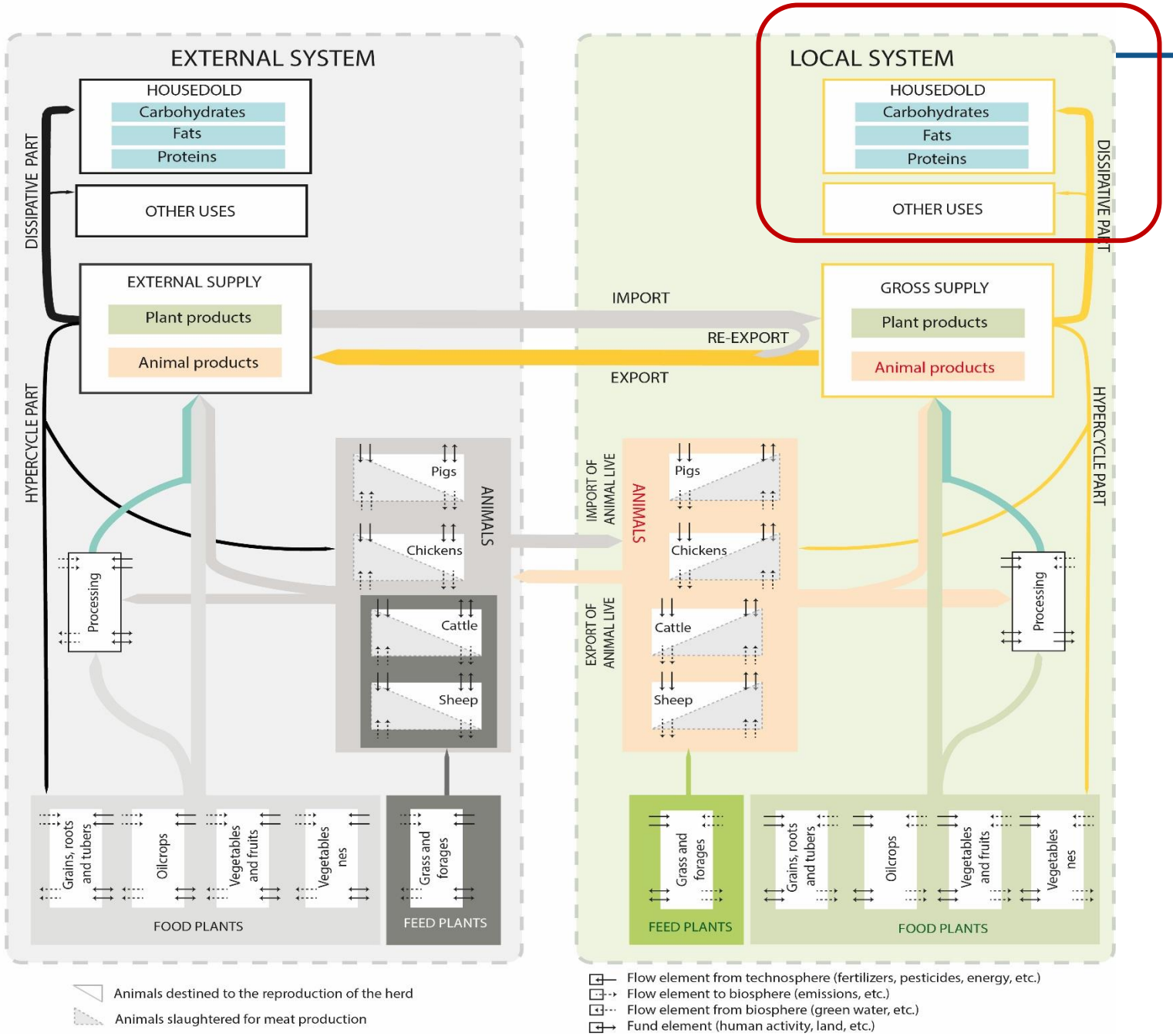
Required supply in the diet

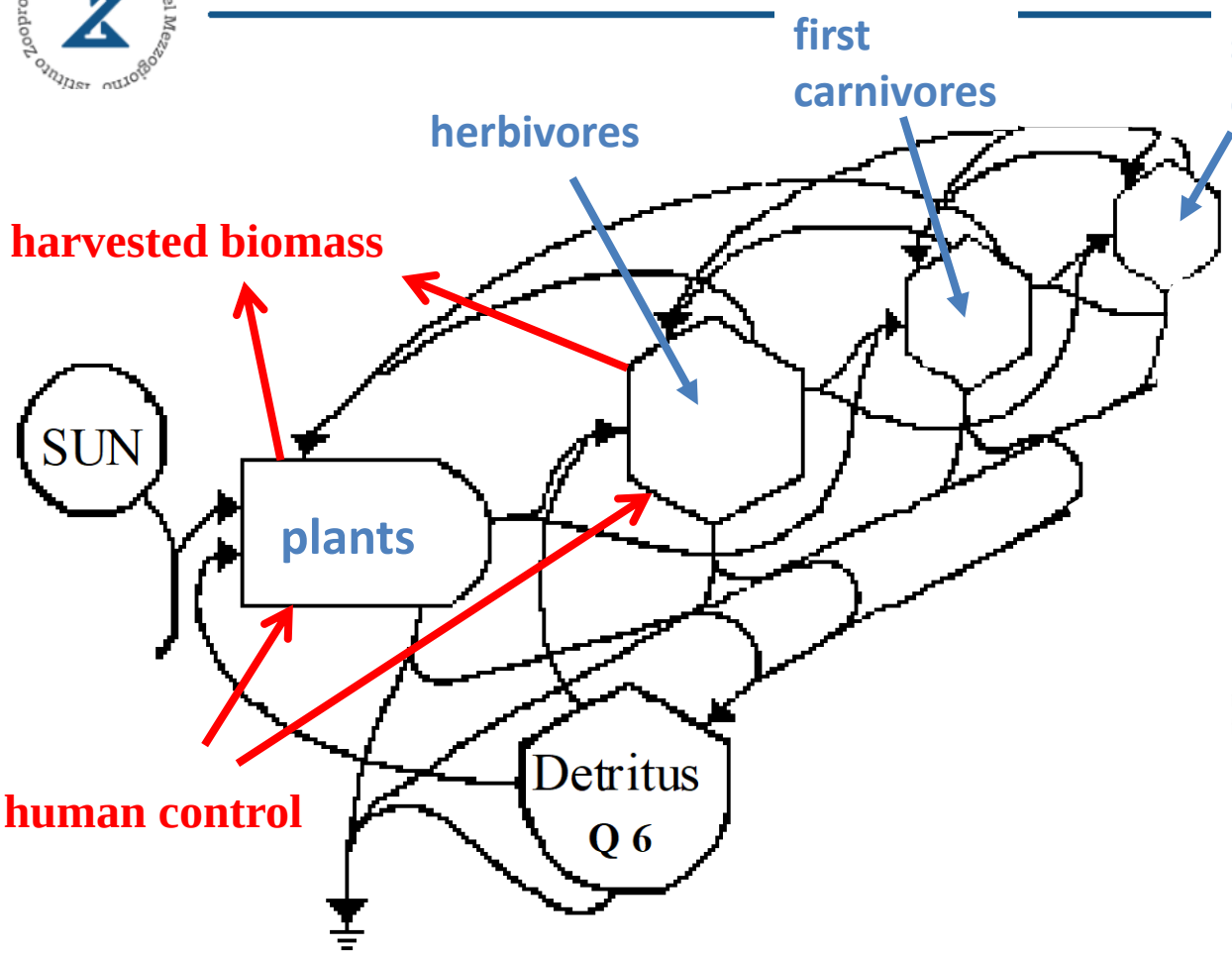
Virtual supply systems

Externalized socio-economic and environmental pressures

Actual supply systems

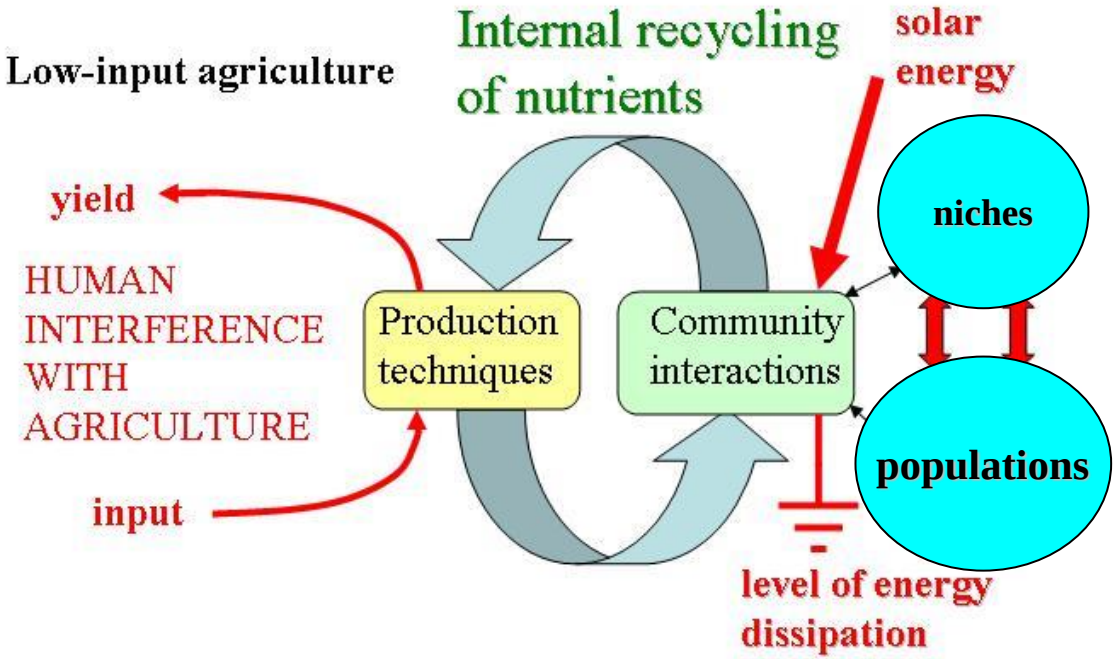
Local socio-economic and environmental pressures

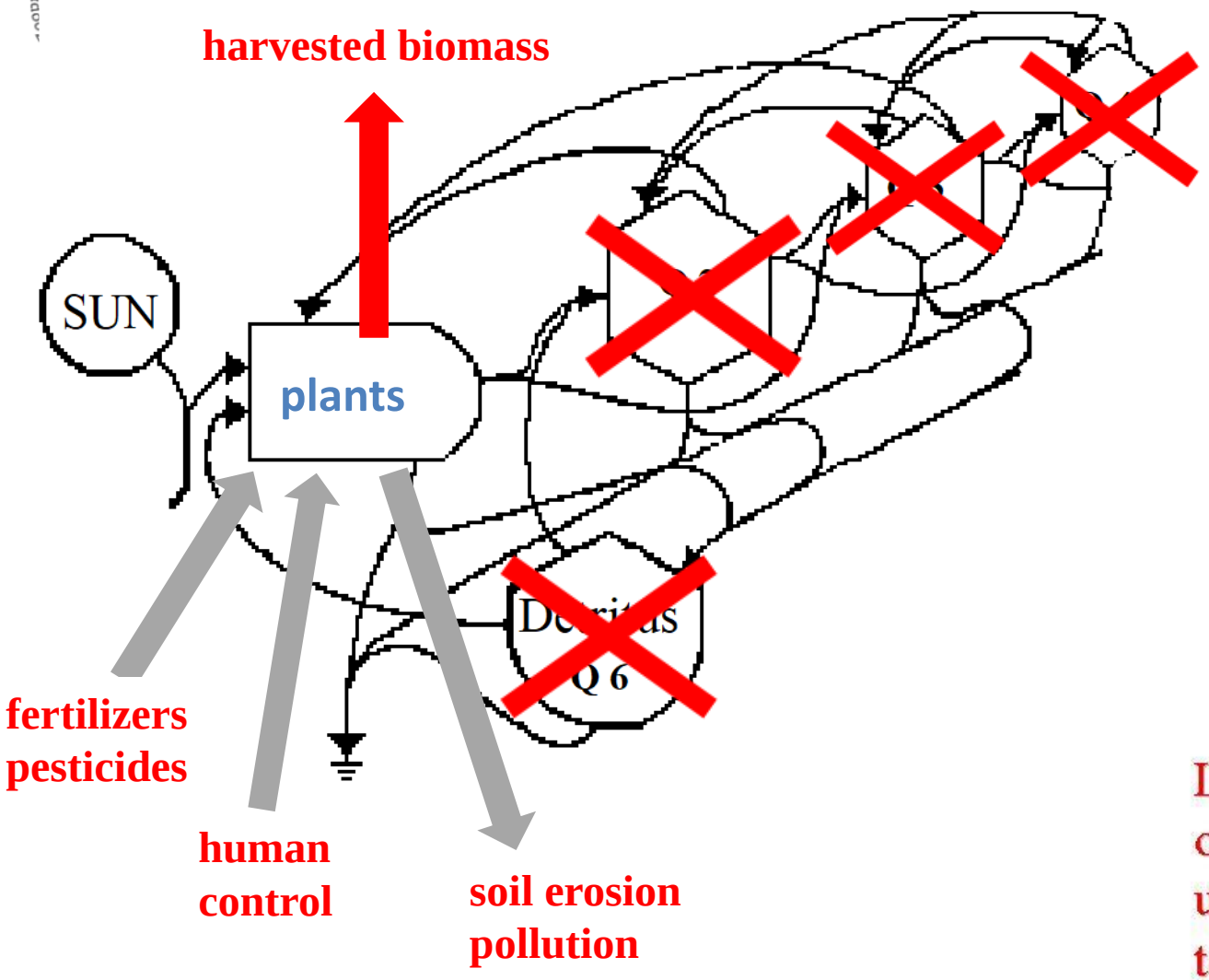




La agricultura prima della rivoluzione industriale

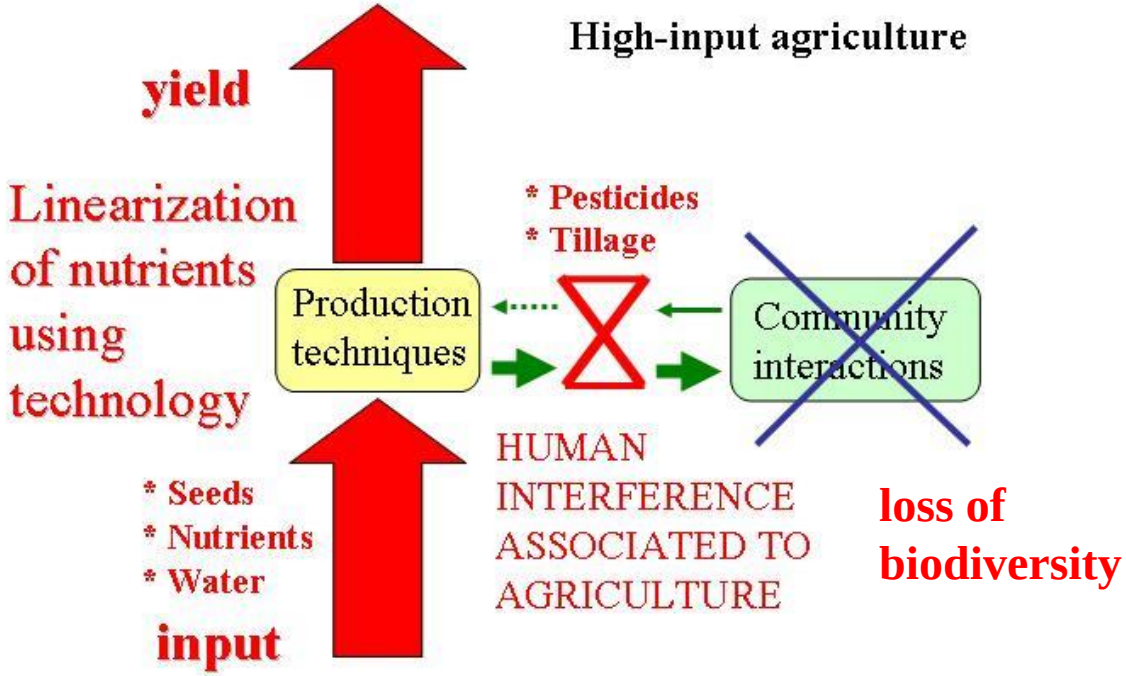
Low External Input Agriculture

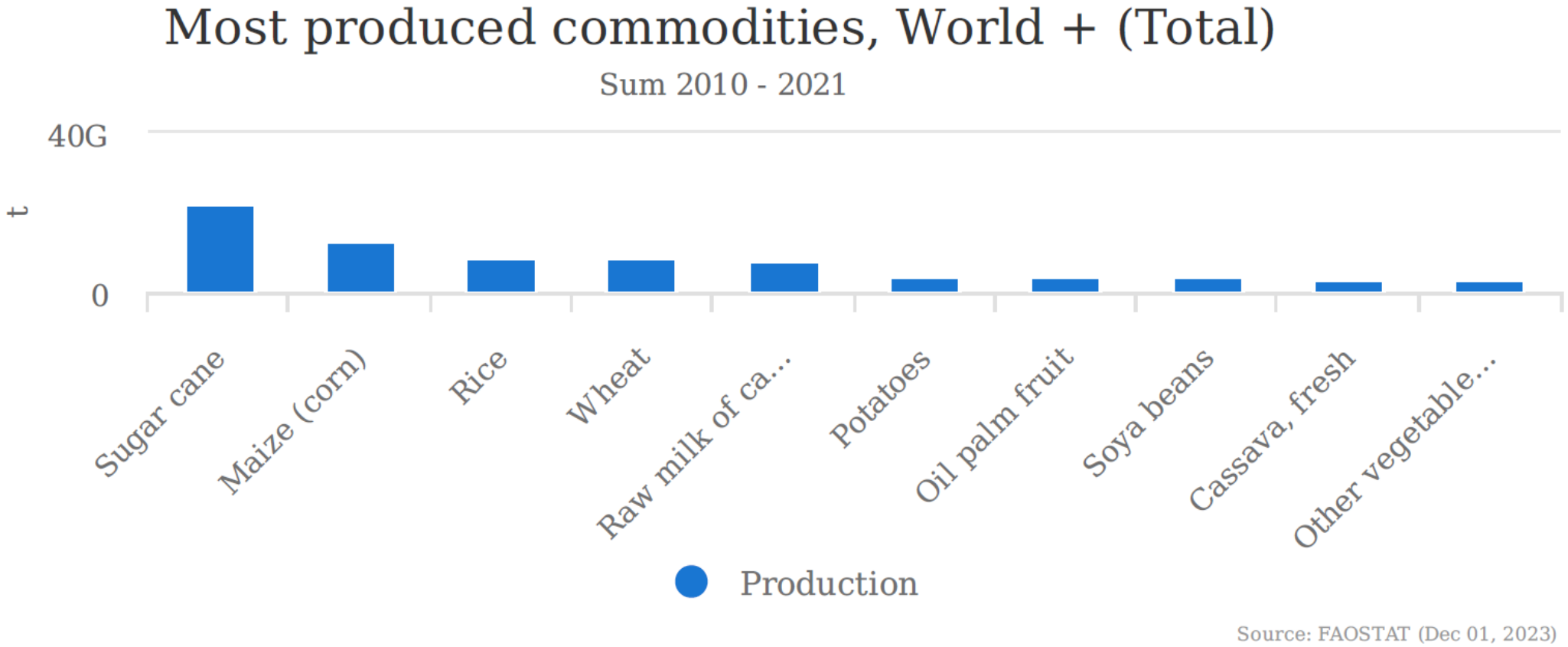


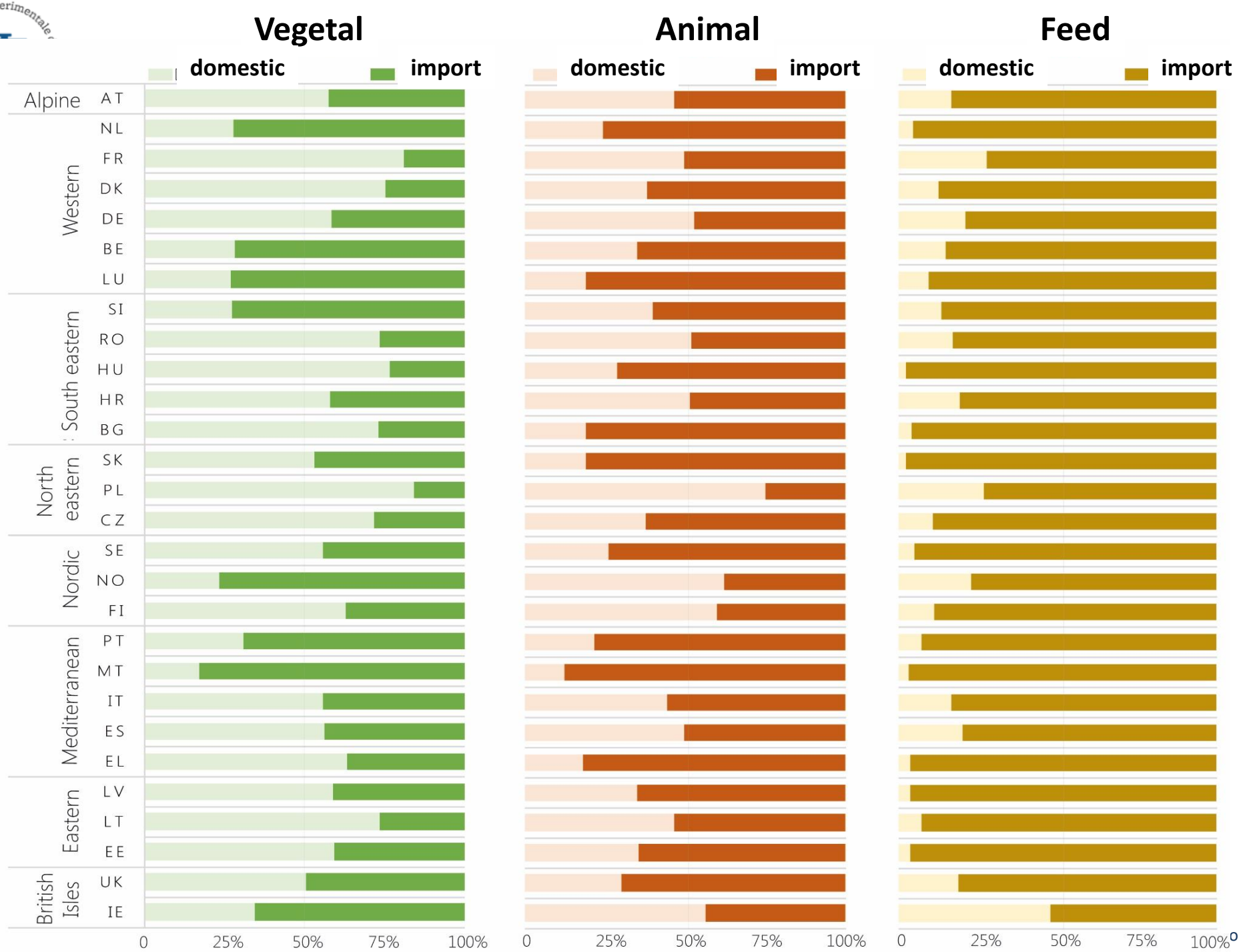


In 2030 urban population will be 60% of total population

High External Input Agriculture



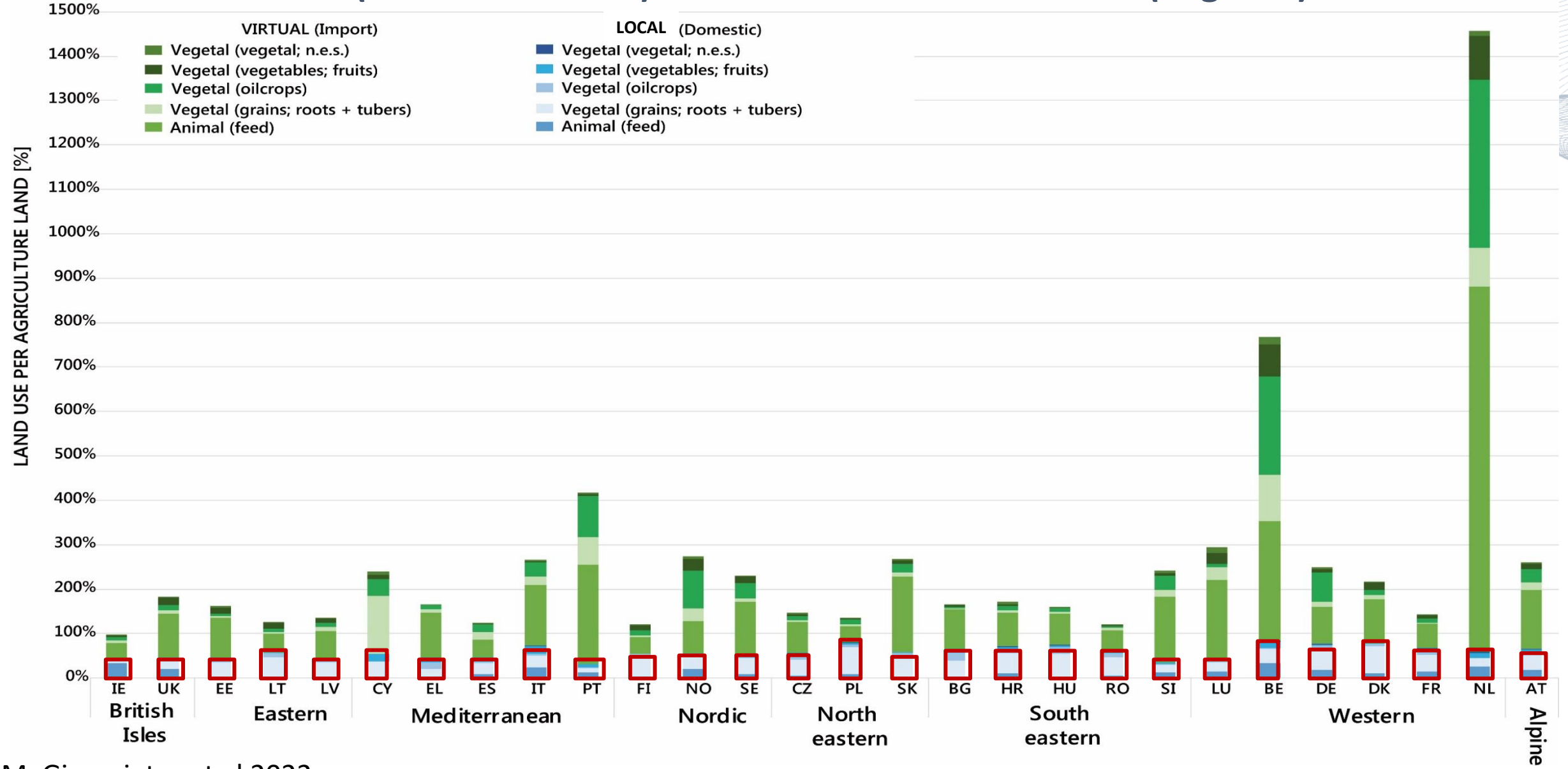

Most produced commodities, World + (Total)
Sum 2010 - 2021
40G
t
0
Sugar cane
Maize (corn)
Rice
Wheat
Raw milk of ca...
Potatoes
Oil palm fruit
Soya beans
Cassava, fresh
Other vegetable...
Production
Source: FAOSTAT (Dec 01, 2023)



Externalization of production in EU agriculture by country

M. Giampietro et al 2022

Local land use (in blue - red box) and externalized use of land (in green) in EU countries



M. Giampietro et al 2022

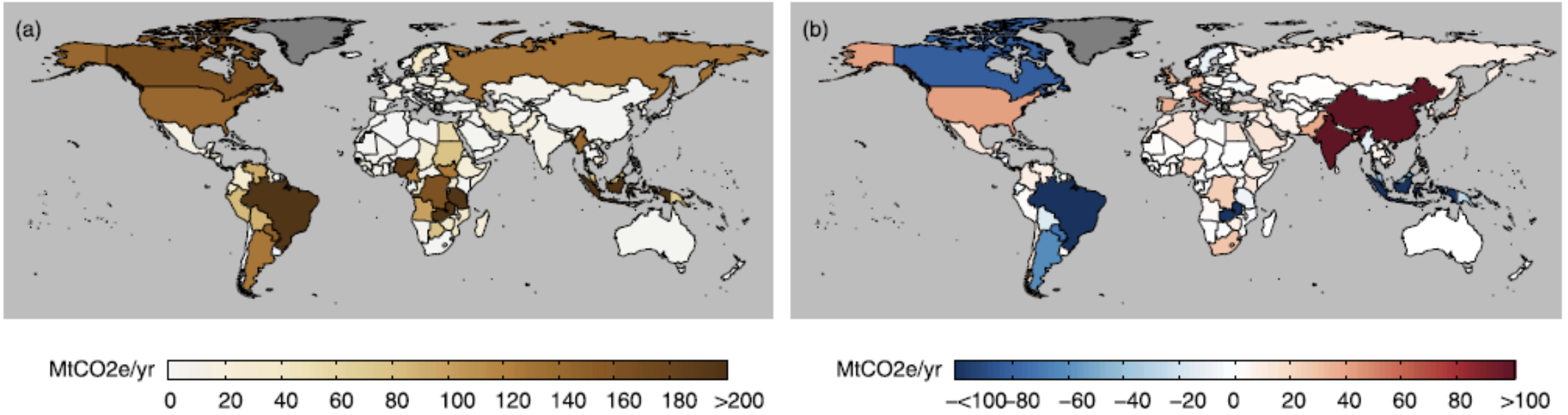


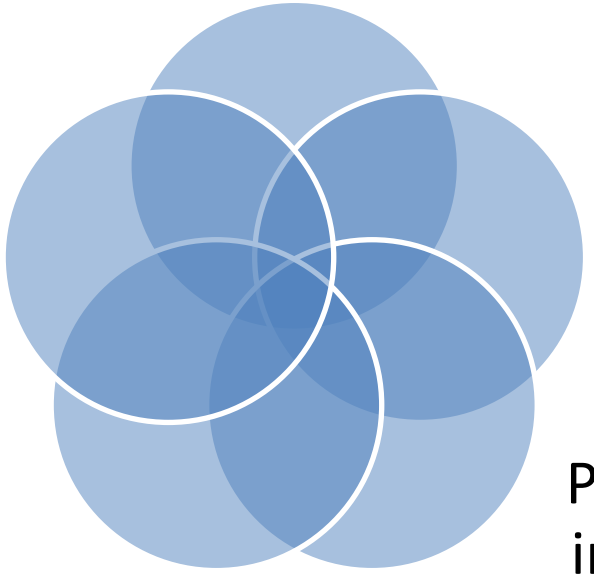
Fig. 5 Agricultural land-use emissions for 2015. Left panel (**a**) shows agricultural land use emissions without trade adjustments. Right panel (**b**) shows the differences between trade-adjusted agricultural land-use emissions and agricultural land-use emissions. Differences are calculated such that the larger the positive difference (darker red), the higher is a country's trade-adjusted agricultural land use emissions (i.e., net importers of land-use emissions). Likewise, the larger the negative difference (darker blue), the lower is a country's trade-adjusted agricultural land use emissions (i.e., net exporters of land-use emissions). Dark grey colours indicate countries with no available data (e.g., Greenland). Per capita emissions and differences are shown in Supplementary Fig. 11.

Foong et al 2022 NATURE COMMUNICATIONS | (2022) 13:3024 | https://doi.org/10.1038/s41467-022-30607-x | www.nature.com/naturecommunications

Vulnerability of the system

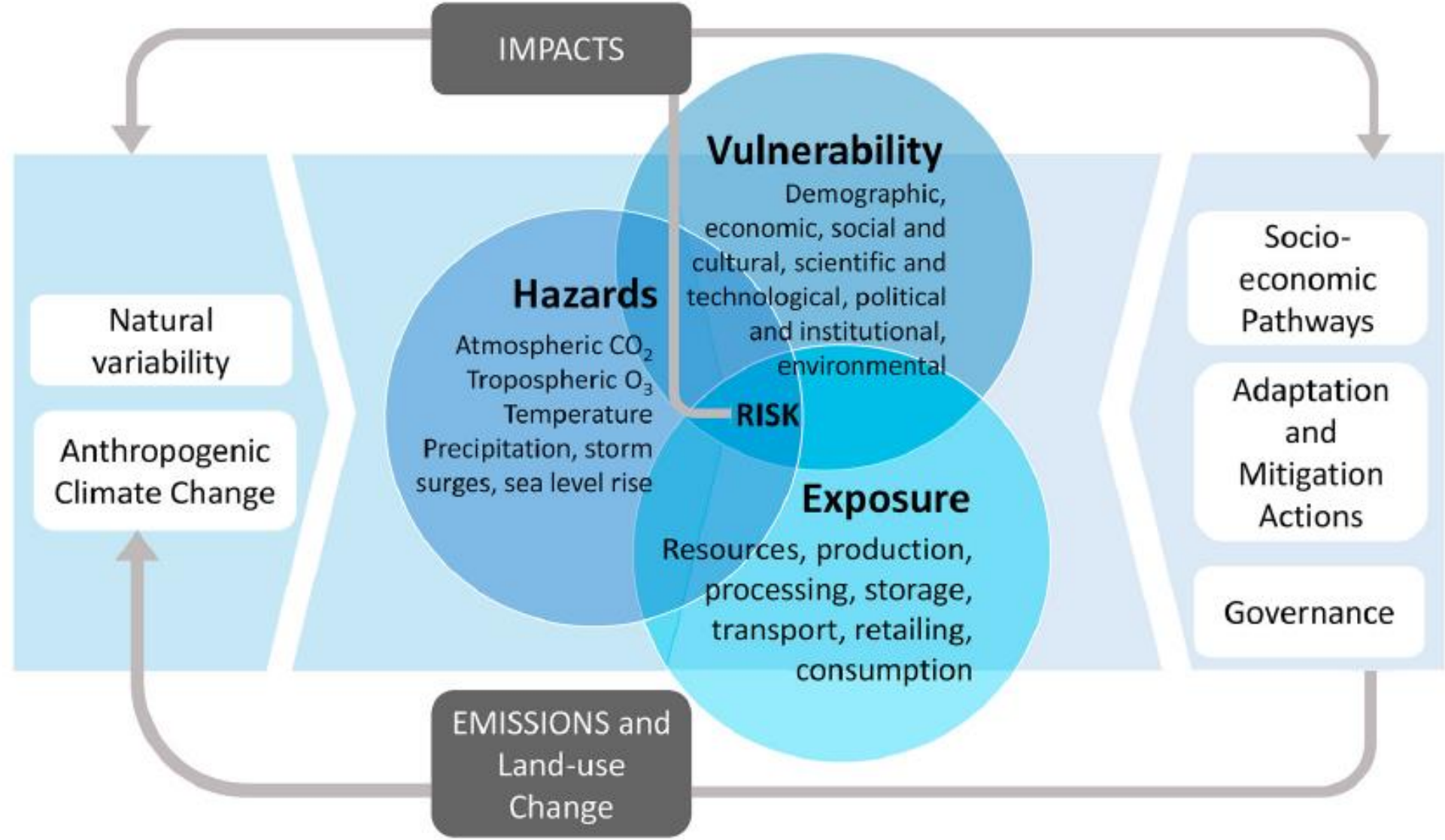
REACTIVITY AND READINESS

Monitoring the critical point



Mitigating the risks

Preparing an intervention plan



Godde et al 2021

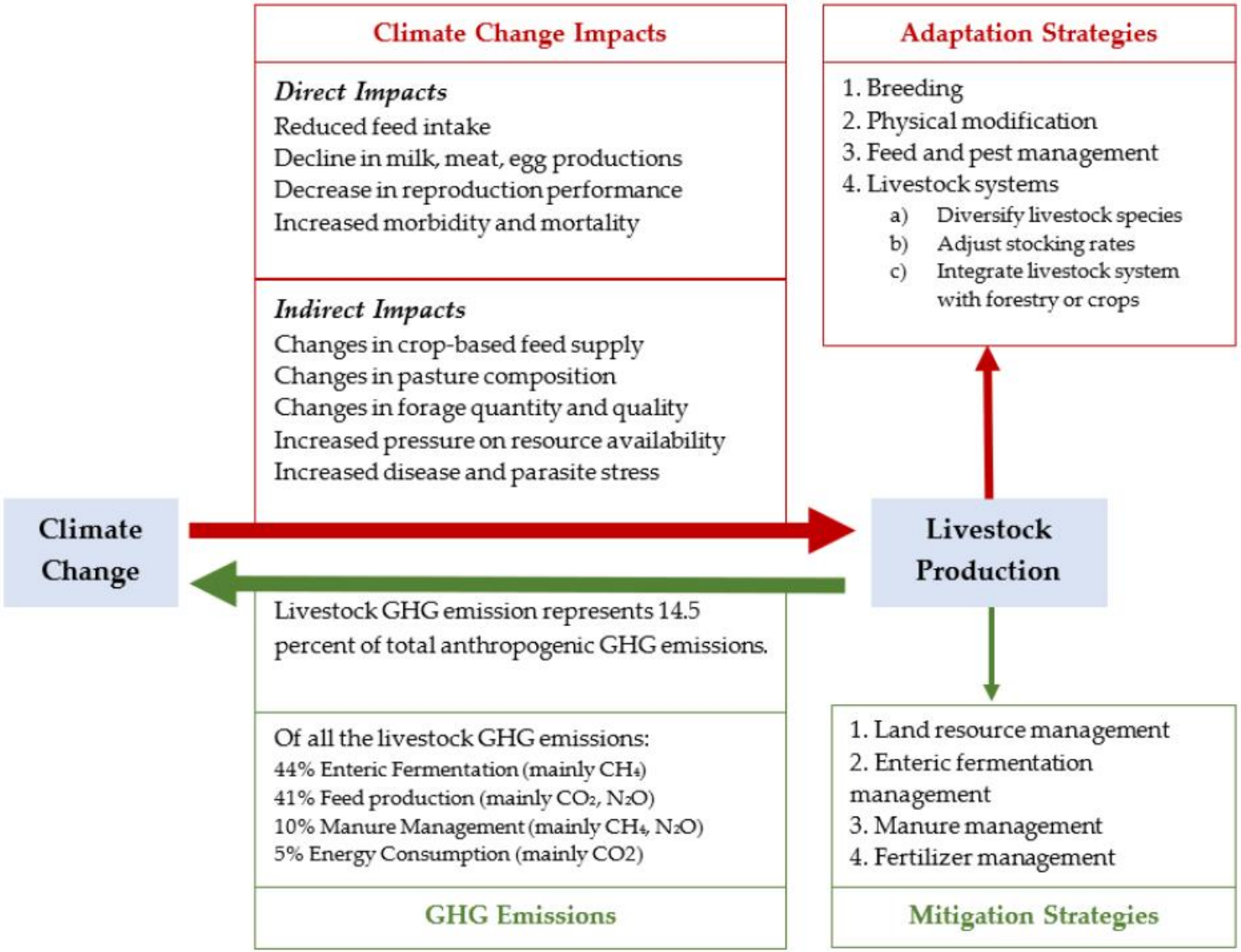
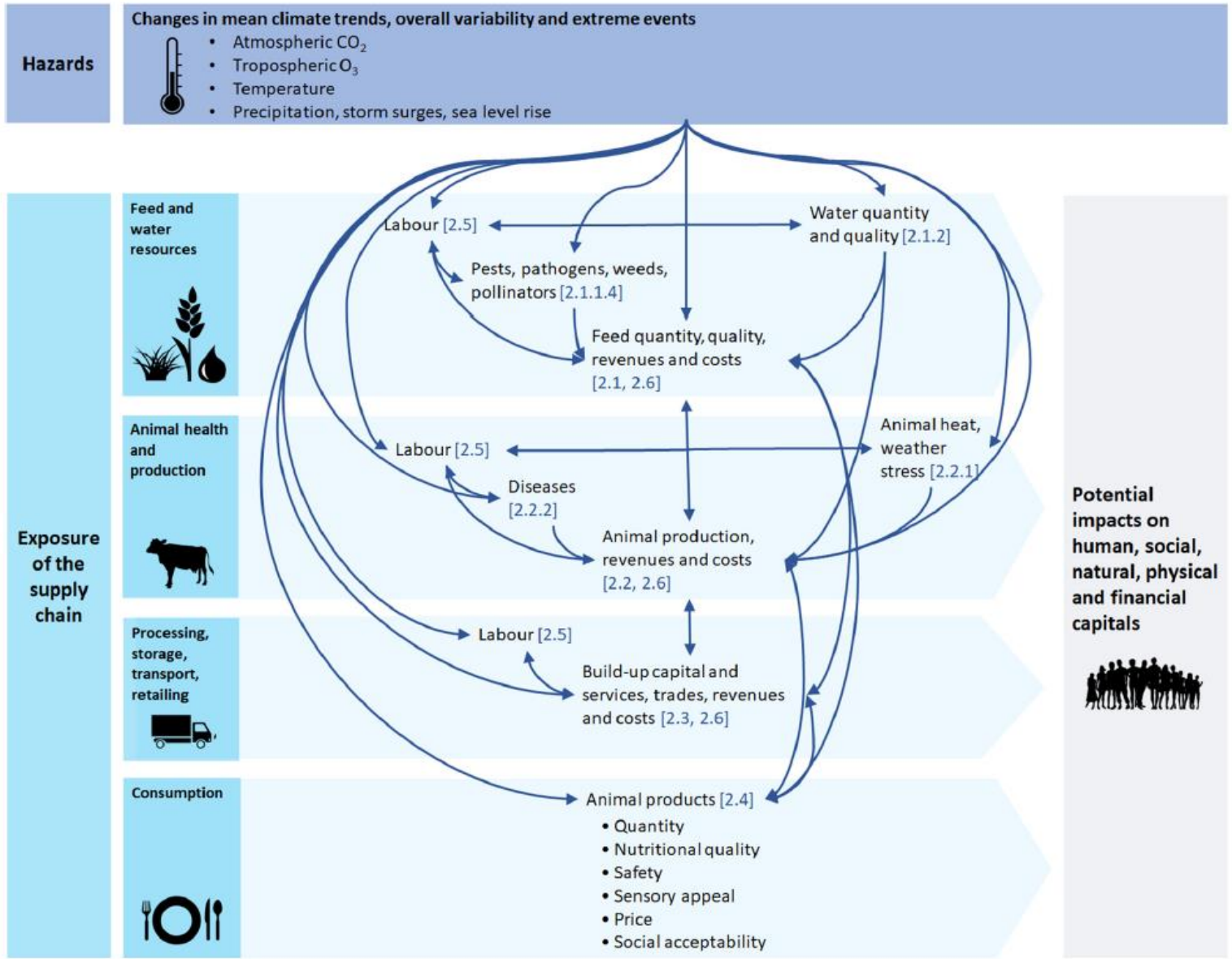


Figure 3. An overview of the relationship between climate change and livestock production.

Cheng et al 2022



Godde et al 2021

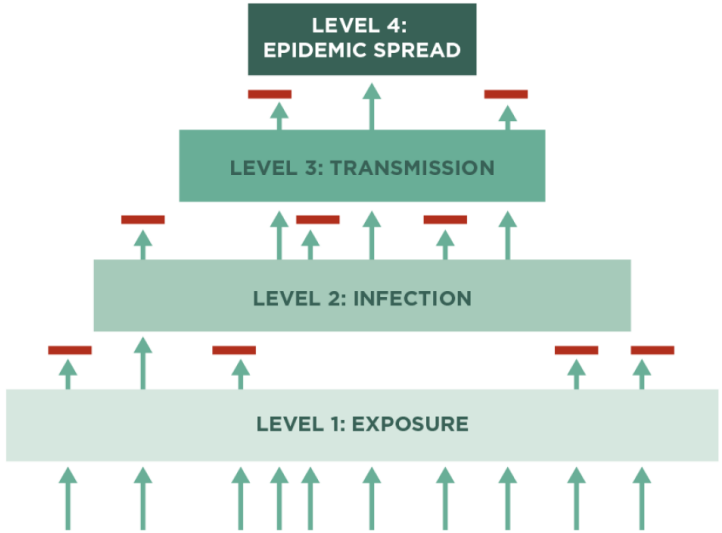


Figure 7: The pathogen pyramid. Each level represents a different degree of interaction between pathogens and humans, ranging from exposure through to epidemic spread between humans or livestock. Some pathogens are able to progress from one level to the next (arrows); others are prevented from doing so by biological or ecological barriers (bars).

Source: Redrawn from Woolhouse, *et al.* (2011).

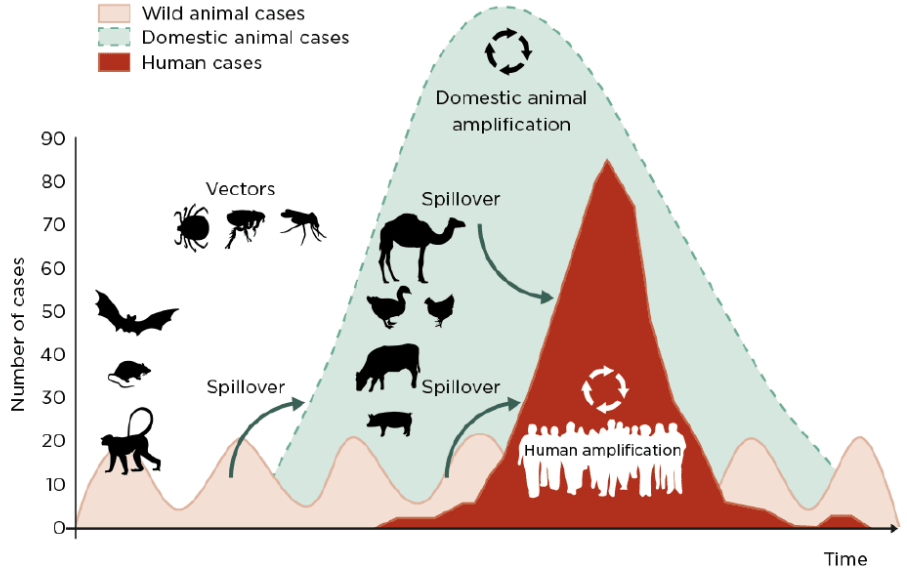


Figure 12: Transmission and amplification of zoonotic diseases. Transmission of a pathogen to people can occur directly from a wild animal or following an outbreak in livestock that amplifies the likelihood of transmissions to humans.

Source: Redrawn from Karesh, *et al.* (2012).

Table 3. Summary of human adaptation strategies.

Animal Genetics	•Choose species that are more heat-tolerant •Genetic selection to changed conditions
Physical modification	•Provide shade and sprinklers for outdoor animals •Improve/supply cooling systems indoors
Feed and pest management	•Modify diet composition and feeding time •Supplemental feeding •Adoption of integrated pest management
Livestock system	•Diversify livestock species •Adjust stocking rate •Integrate livestock system with forestry or crops

Cheng et al 2022

Summarize many potential mitigation options in Table 4 and discuss them below.

Table 4. Summary of mitigation strategies.

Land resource management	• Improve grazing management • Alter grazing intensity and or manure use to enhance Carbon sequestration
Enteric fermentation management	• Modify diet and nutrition for livestock • Genetic selection
Manure management	• Alter storage practices • Modify diet and nutrition for livestock
Fertilizer management	• Increase nitrogen efficiency • Offest commerial nitrogen use by using manure

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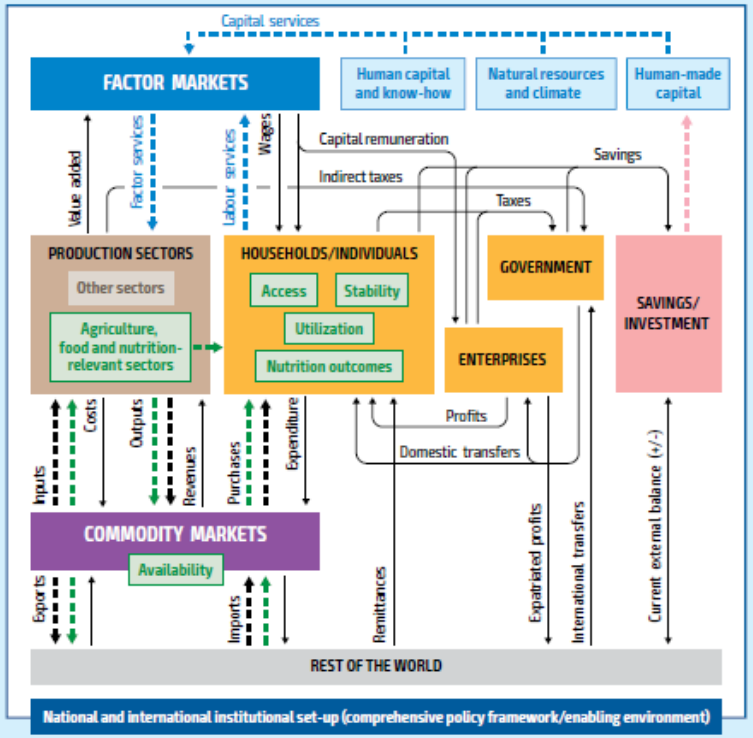
BOX 2 Food security and nutrition: the analytical framework

In economies where goods and services are exchanged on markets, food availability, access, stability, utilization and resulting nutritional outcomes all depend on complex interactions among diverse agents and institutions. These actors comprise households, governments, enterprises, production sectors, foreign investors and other agents within and outside of the food and agricultural system. This report considers these interactions directly and indirectly, both through quantitative modelling and qualitative assessments, to analyse the evolution of food and agricultural systems in an economy-wide system and their implications for food security and nutrition.

Food security and nutrition in the economy-wide context



Note: Physical flows of goods and services are represented by dashed lines, while income flows in monetary terms occurring in the opposite direction are represented by solid lines. Food security and nutrition-relevant flows and items are reported in green. Not all the flows of good and services and countervailing payments are represented.

Source: Adapted from Dervis, de Melo and Robinson, 1982.

In this framework, **food availability and stability at national level** is ensured by domestic production and/or the ability of the country to pay for imports. Both domestic production and imports (net of exports) flow into domestic markets. The same applies

M. Mourad / Journal of Cleaner Production 126 (2016) 461–477

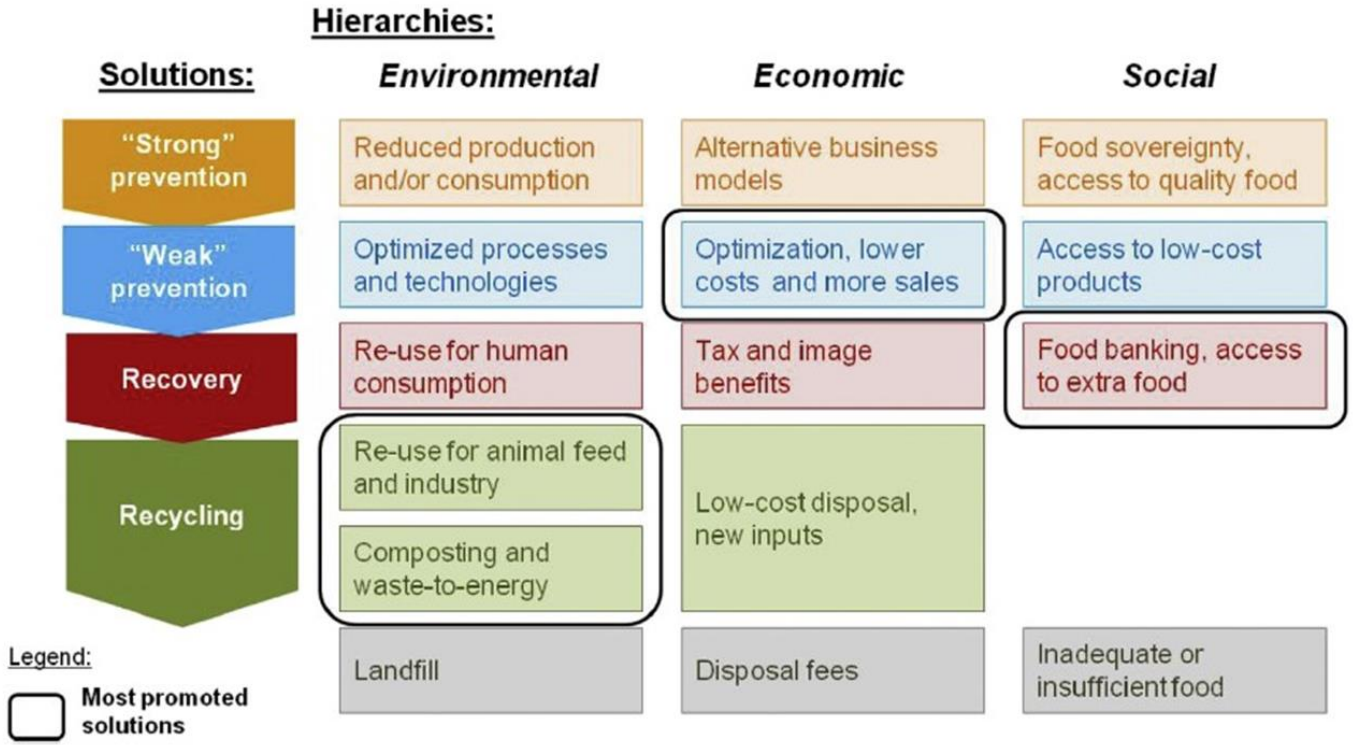


Fig. 2. Competing hierarchies of solutions to surplus food.

The future of food agricoluture FAO 2018

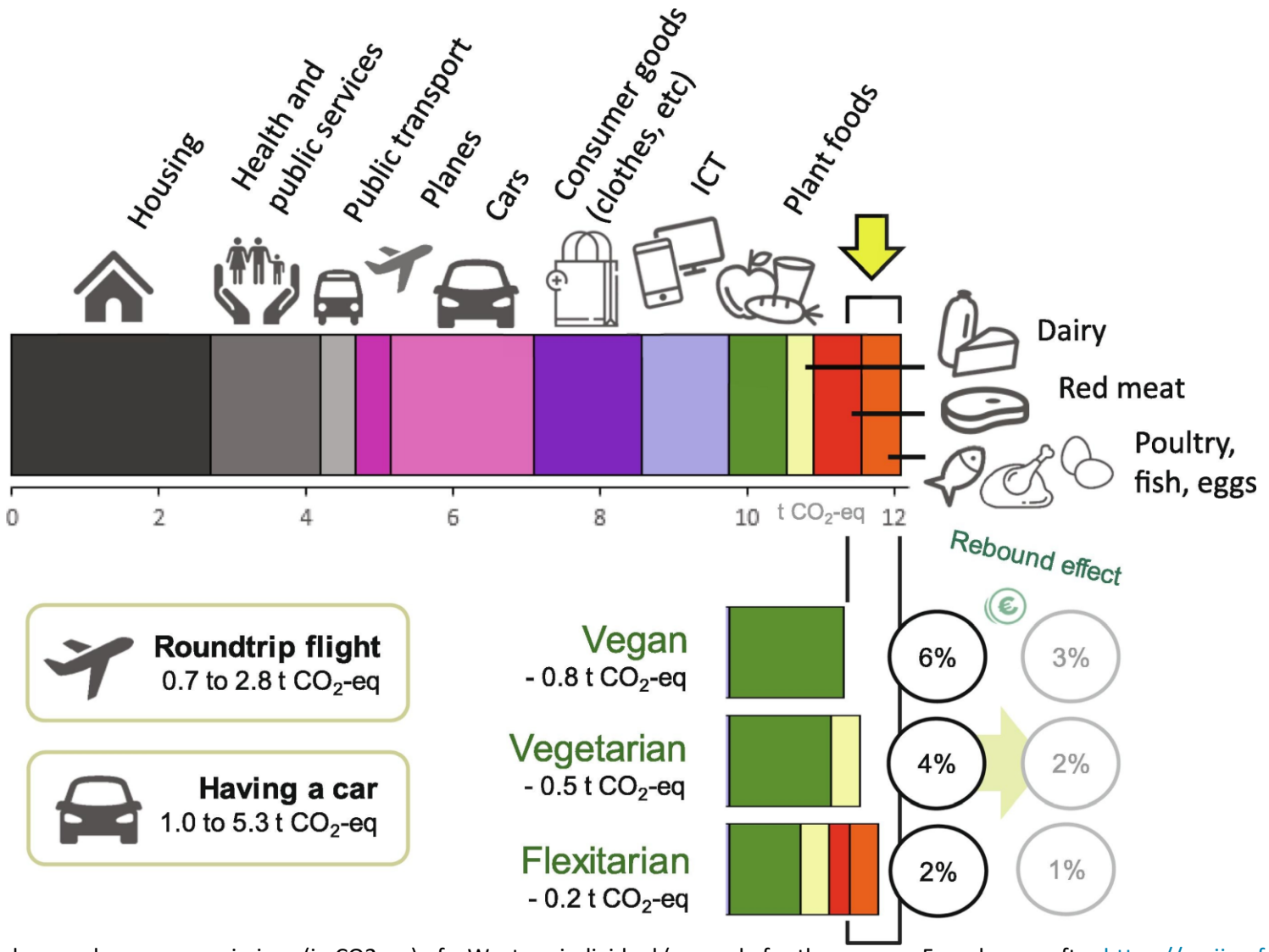
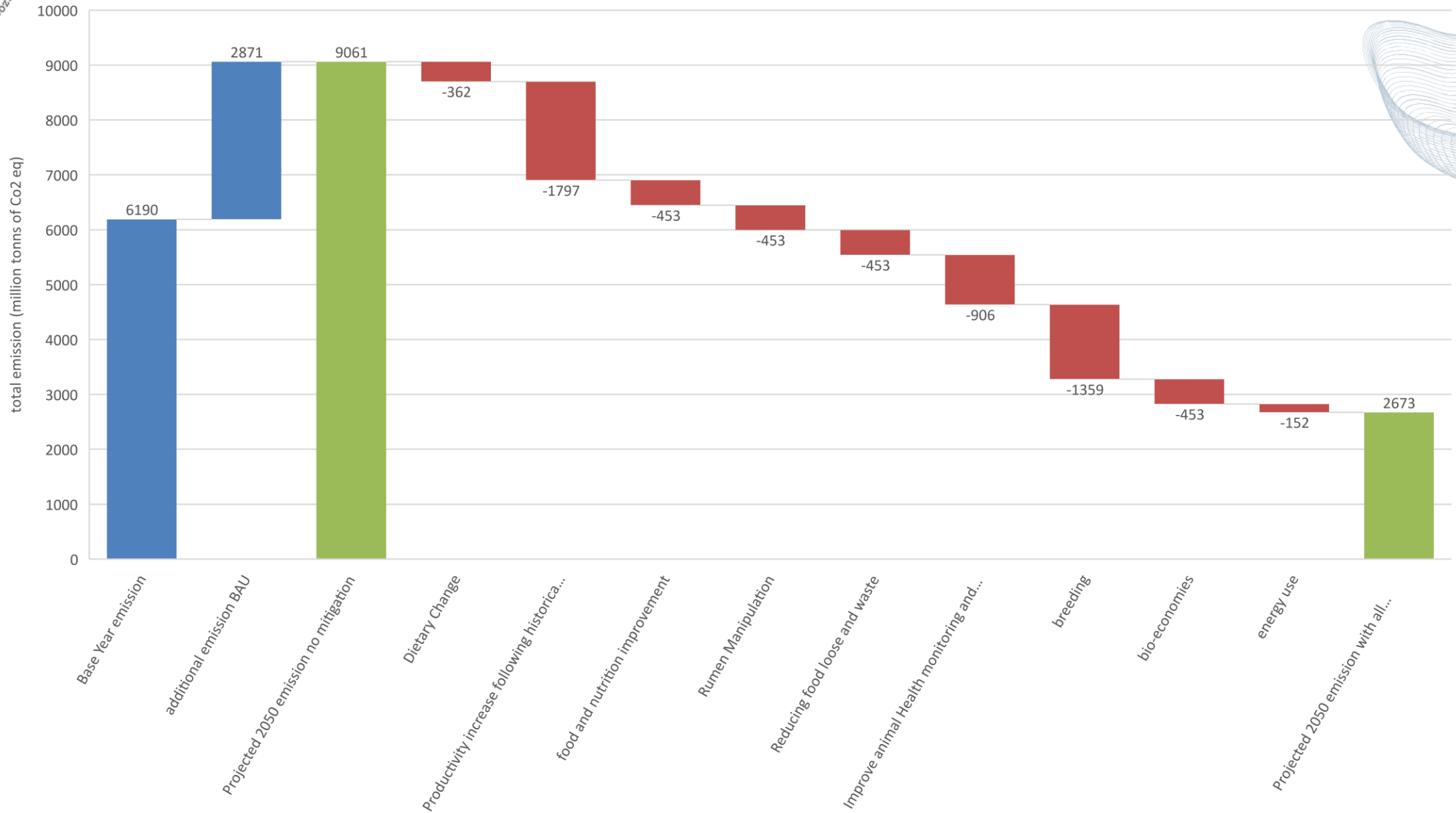


Fig. 2. Effect of dietary shifts on the yearly greenhouse gas emissions (in CO2-eq) of a Western individual (example for the average Frenchmen; after https://ravijen.fr/?p=440), taking into account the dietary effects of veganism and vegetarianism (Hallström et al., 2015; Wynes & Nicholas, 2017) and flexitarianism (a 60% decrease in meat intake, from 200 to 80 g/p/d), as well as potential rebound effects (Grabs, 2015). Transportation data (car and flights) are obtained from Wynes and Nicholas (2017). ICT = information and communications technology.

Leroy et al 2022

Pathways to lower emission livestock



Wisser et al 2023 Fao

Pathways to lower emission livestock - Caveats

- ❑ Uncertainties in data
- Feed
- Manure management systems
- Herd parameters
- ❑ Uncertainties interventions
- Size of the effects
- Adoption rates???
- Economic feasability!!!!
- Scale
- ❑ Overlapping Impacts
- ❑ Trade off with other goals

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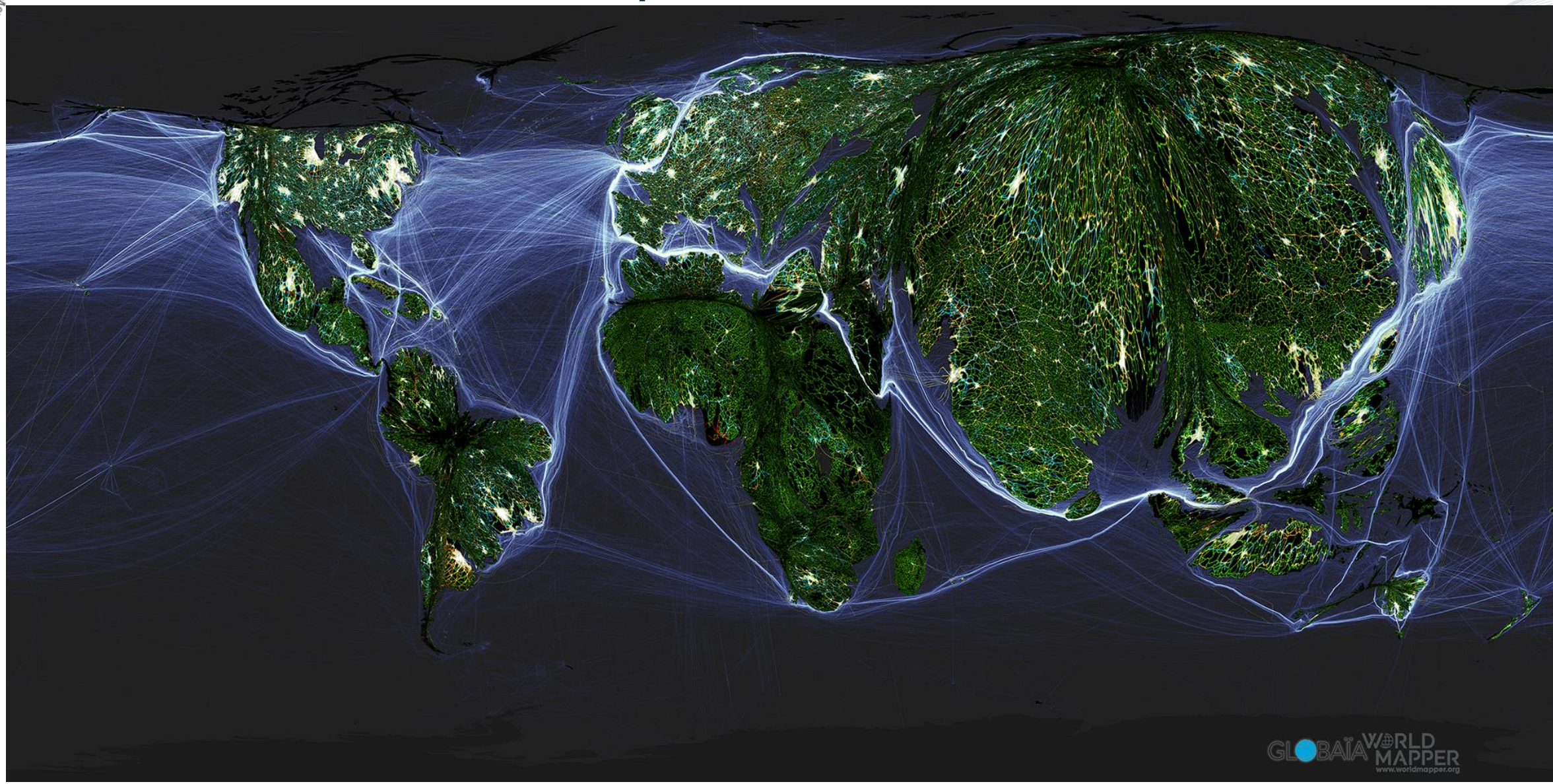
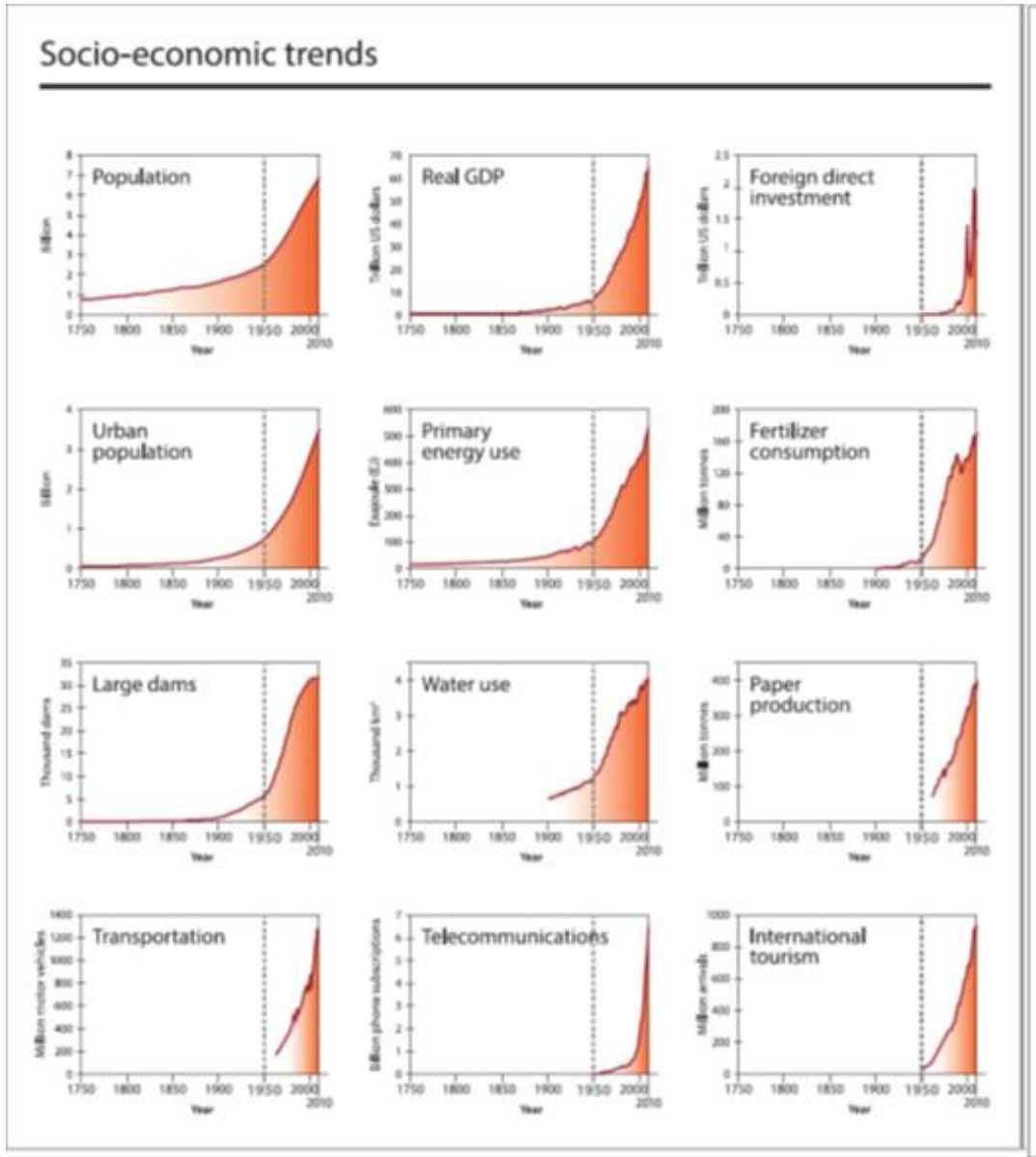
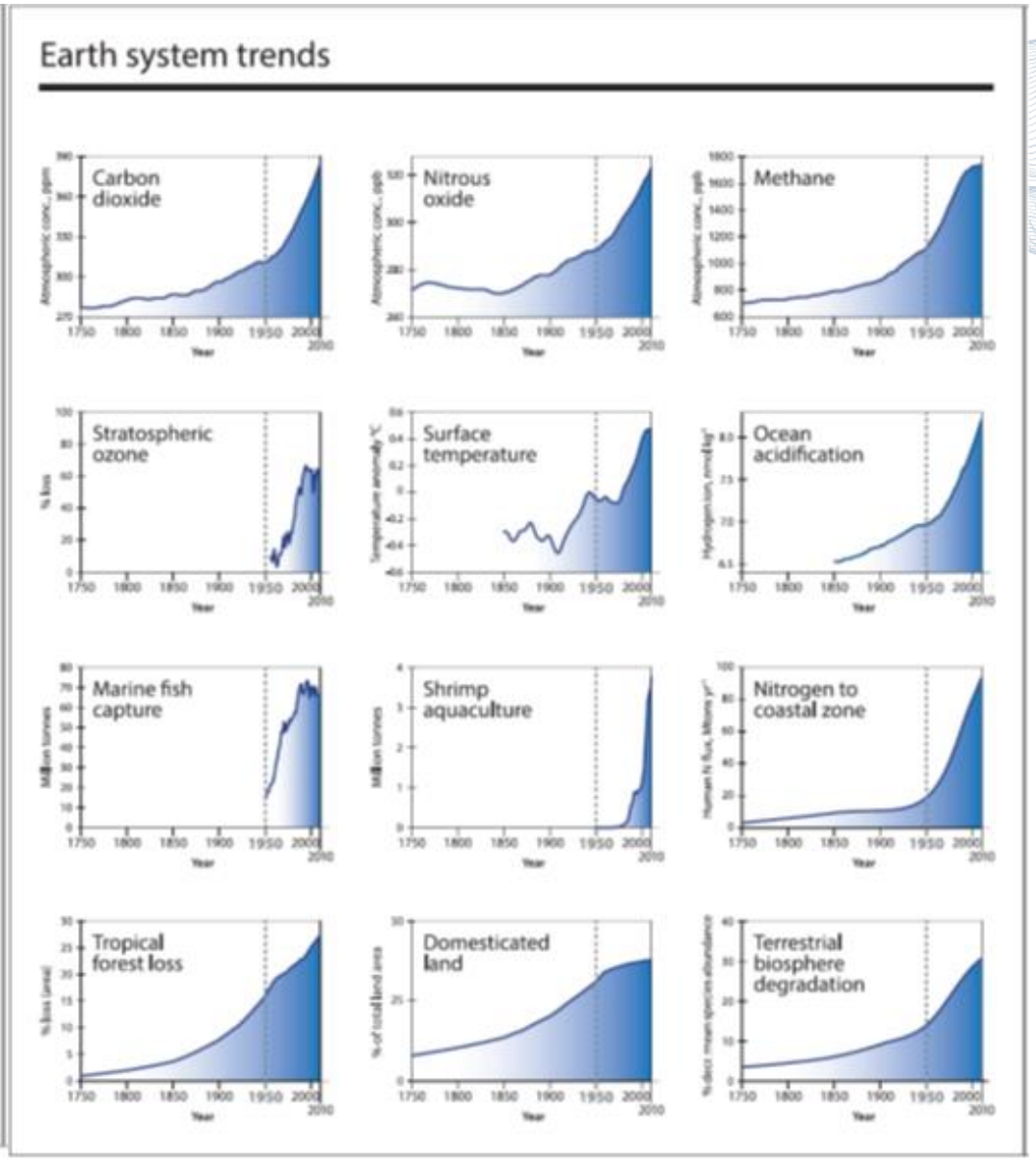
Anthropocene Worlds

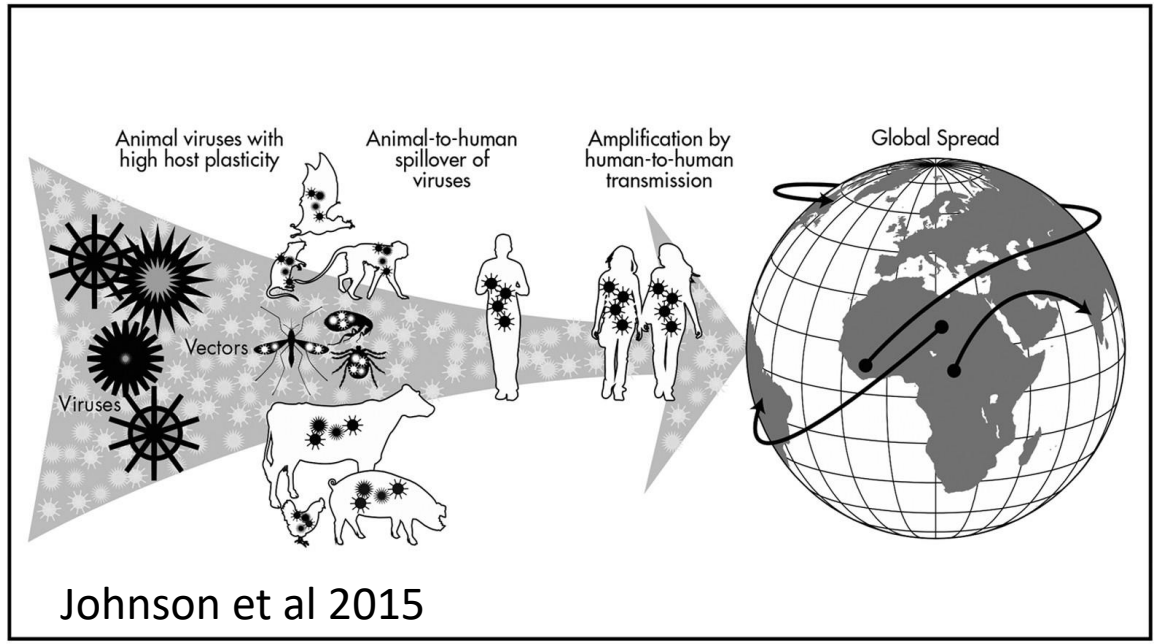


https://worldmapper.org/map-animation-covid19/#&gid=1&pid=1





Steffen et al 2015



Johnson et al 2015

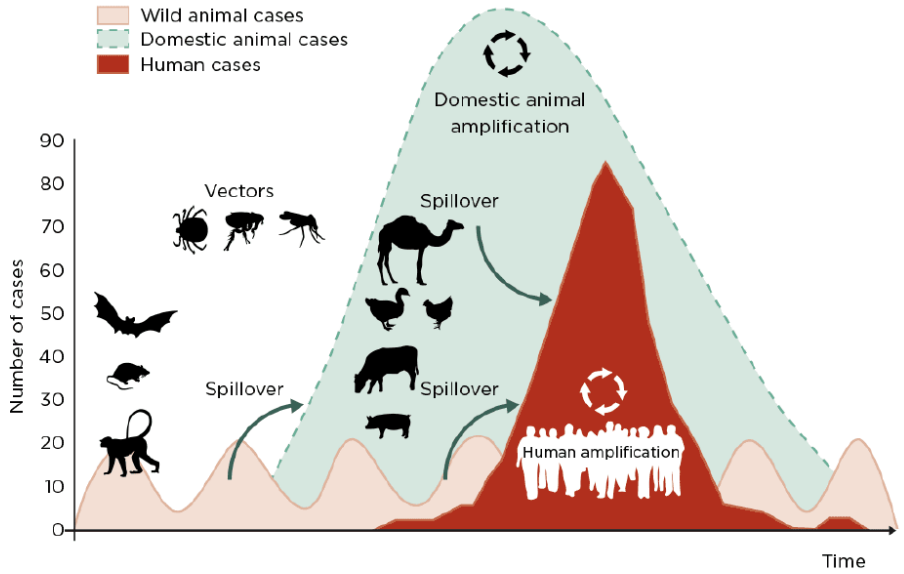


Figure 12: Transmission and amplification of zoonotic diseases. Transmission of a pathogen to people can occur directly from a wild animal or following an outbreak in livestock that amplifies the likelihood of transmissions to humans.

Source: Redrawn from Karesh, *et al.* (2012).

Spillover, la goccia che pesa più del vaso?

Olaf Hajek The New York Times "The Ecology of Disease" (2012)

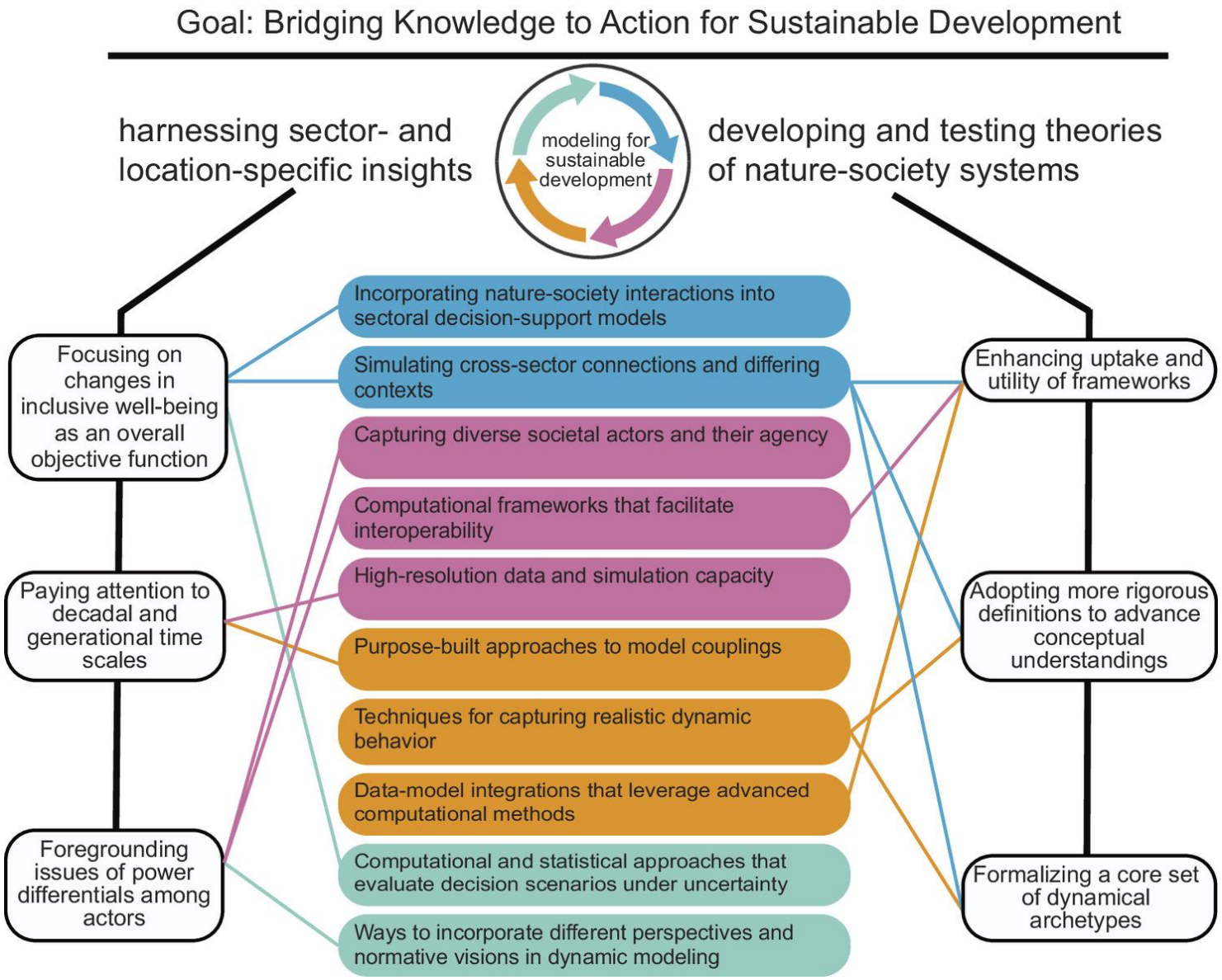
An illustration of the ecology of vector-borne diseases like the 2018 ebolavirus and 2019 coronavirus (Covid-19) by the artist Olaf Hajek.

The Butterfly effect

Professor Edward Lorenz (1917-2008):
Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas?

Chaos theory -- also known as the science of nonlinearity, the science of complexity, the science of random recurrent behavior or the science of turbulence and discord -- has thus been called the third great scientific revolution of the 20th century, along with relativity and quantum physics.

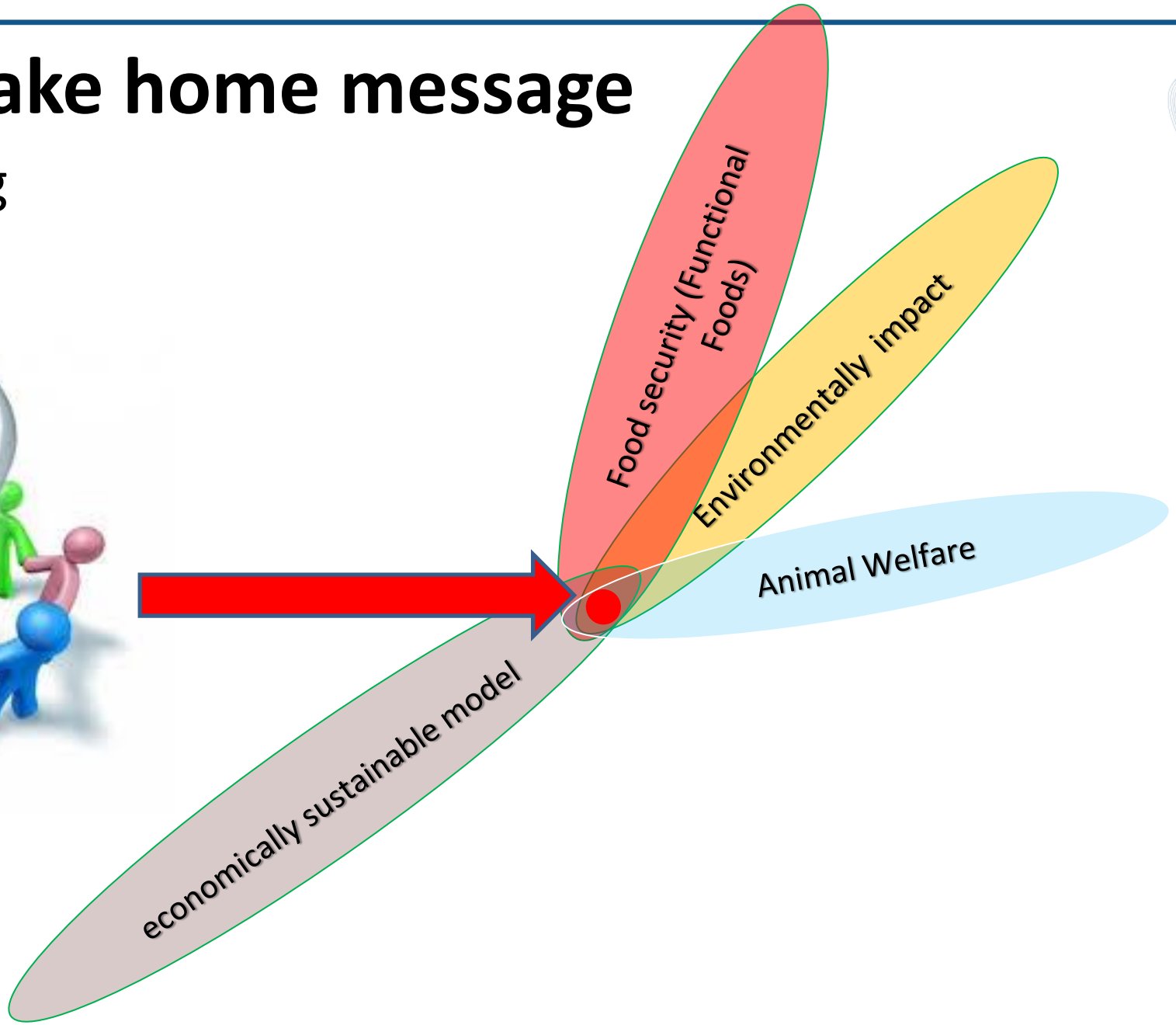
Thinking in Systems



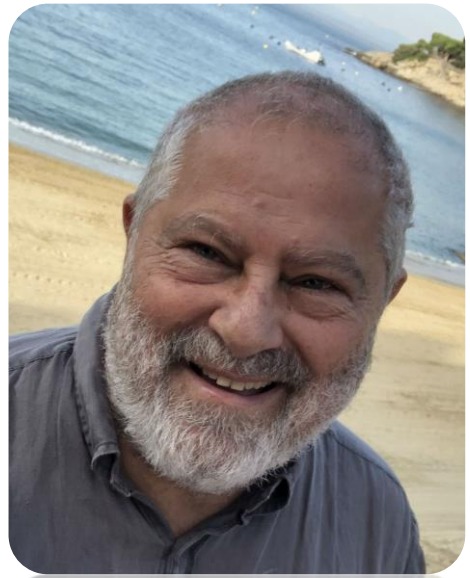
Noelle et al 2023

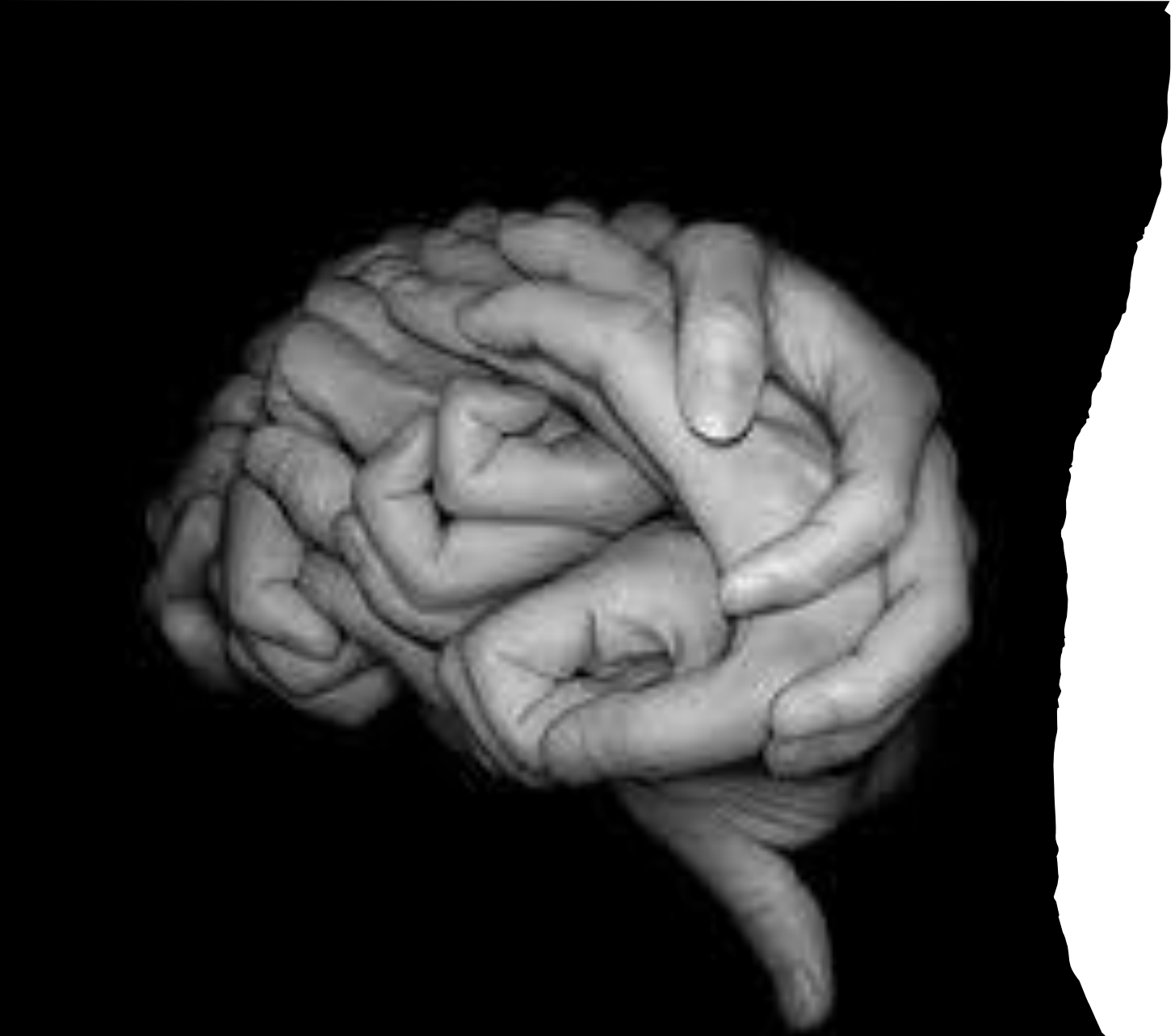
Take home message

BrainStorming




Do they want this?
Desirability
Should we do this?
Viability
Can we do this?
Feasibility
The most
valuable design





“ Caminante no hay camino, se hace camino al andar”
[Antonio Machado]

...TO BE CONTINUED...

Ciao Fabio

Istituto Zooprofilattico
Sperimentale del Mezzogiorno
Campania | Calabria

Thanks for your attention

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