Sostenibilidad y multifuncionalidad de la agricultura de montaña

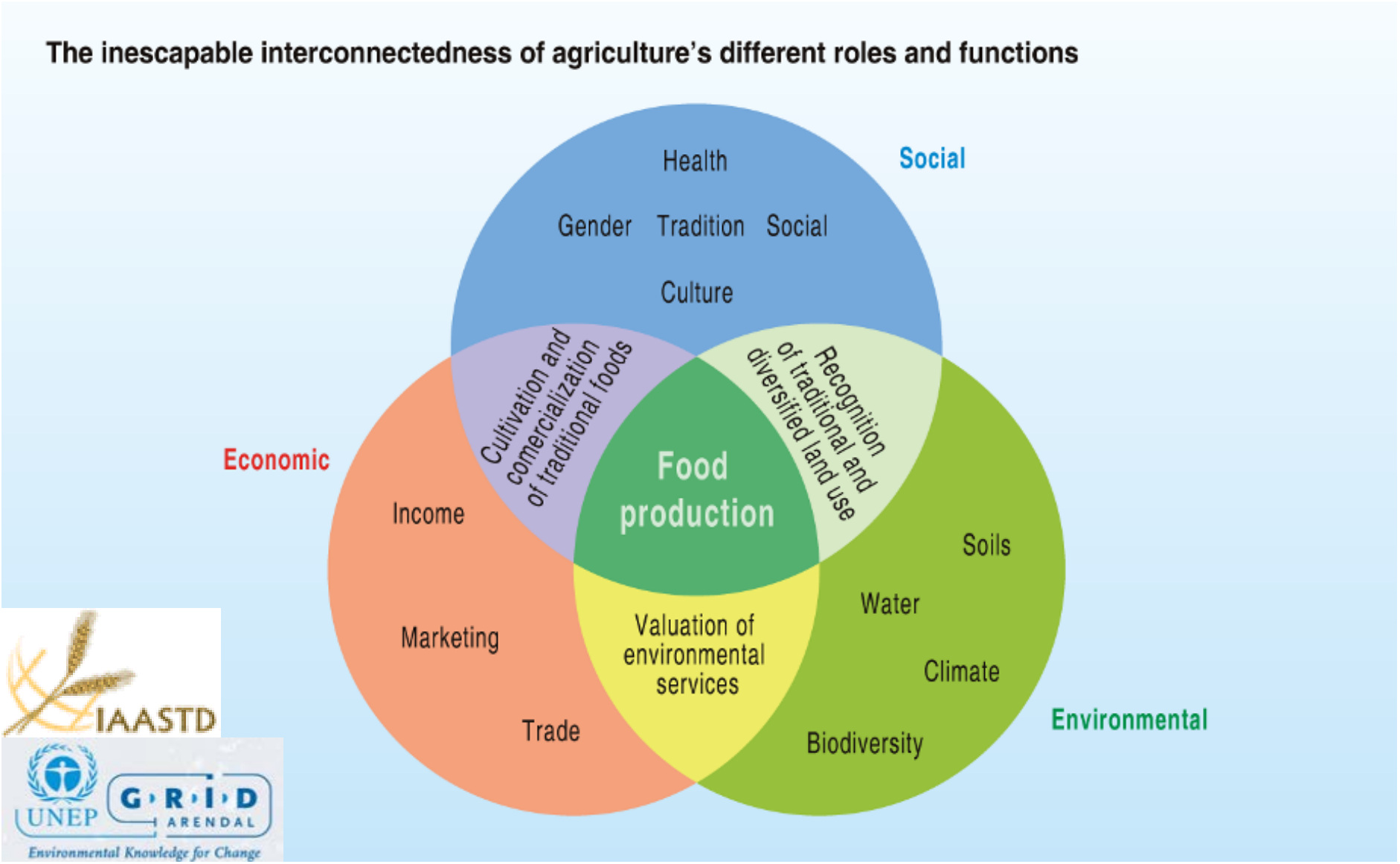
Alberto Bernués
abernues@aragon.es

outline

1. introduction
2. **sustainability**
    - 2.1 evolution of pasture-based ruminant systems
    - 2.2 holistic sustainability assessment and trade-offs
    - 2.3 animal production and the environment
        - (case study: carbon footprint of lamb meat)
3. **multifunctionality**
    - 3.1 public goods (ecosystem services)
    - 3.2 product quality
4. wrapping up

1. introduction

multiple dimensions of agriculture

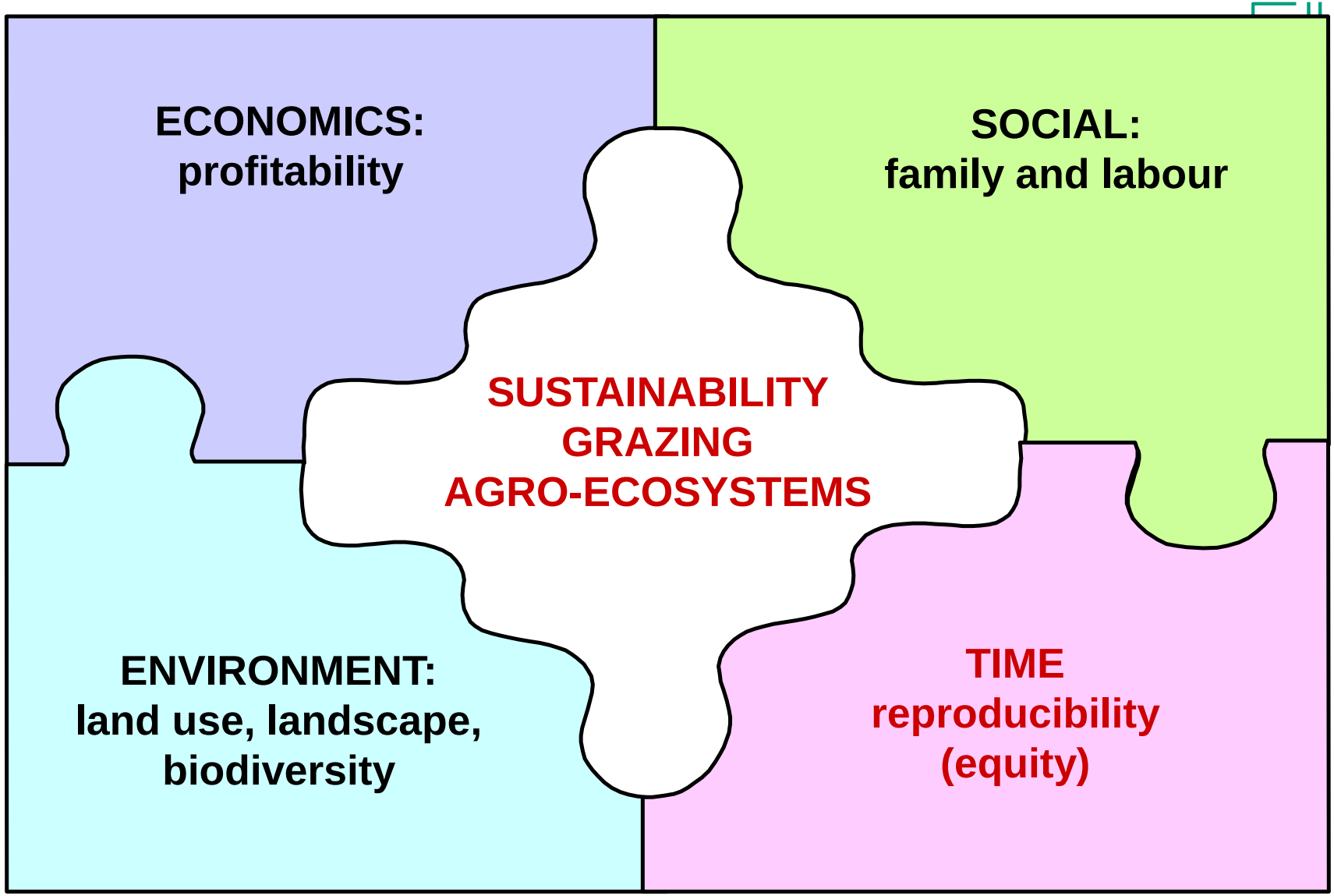


2. sustainability

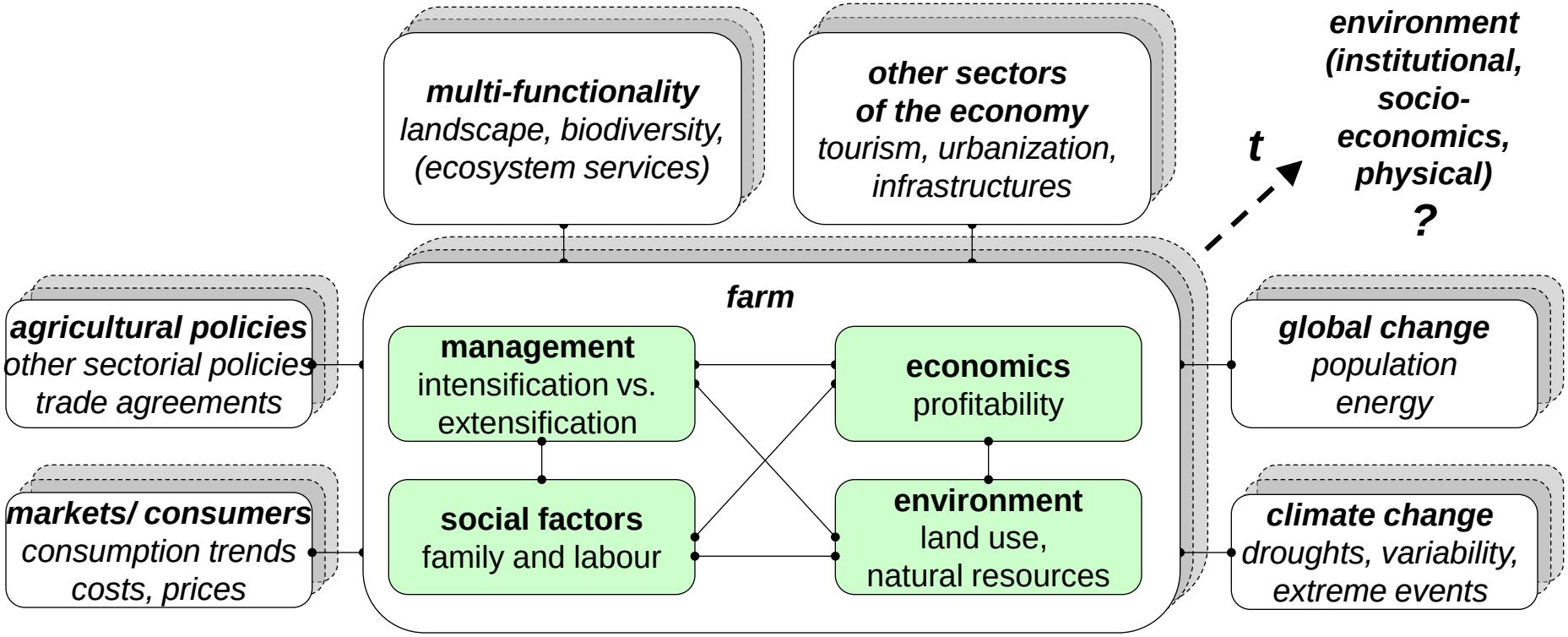
a definition…

"Sustainable development is development that meets the **needs** of the present without compromising the ability of **future generations** to meet their own needs." (UN Brundtland report, 1987)

Sustainability is the capacity to **endure**… it is the **long-term** maintenance of **responsibility**, which has **environmental**, **economic**, and **social** dimensions


ECONOMICS:
profitability
SOCIAL:
family and labour
SUSTAINABILITY
GRAZING
AGRO-ECOSYSTEMS
ENVIRONMENT:
land use, landscape,
biodiversity
TIME
reproducibility
(equity)

conceptual framework to study sustainability of agro-ecosystems



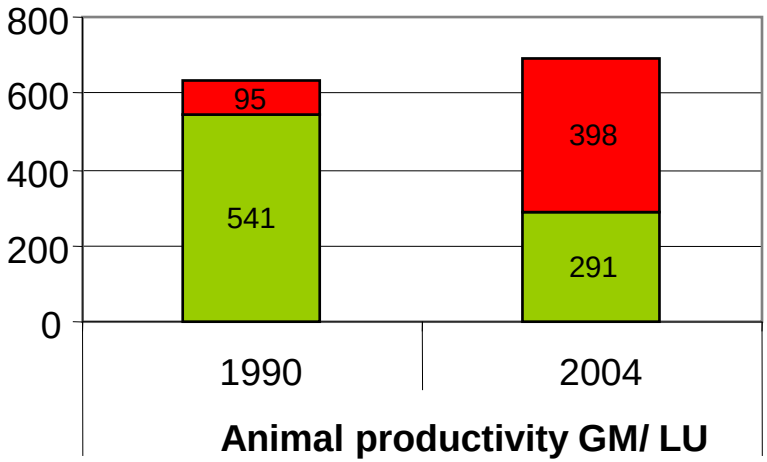
2.1 evolution of pasture-based ruminant systems

Evolution of grazing livestock holdings and heads (x1000) in selected Mediterranean countries

	2000		2007		Dif. (%)	
Beef Cattle	holdings	heads	holdings	heads	**holdings**	**heads**
Greece	28330	652.4	21520	732.0	**-24.0**	**12.2**
Spain	188210	6346.5	124010	5740.6	**-34.1**	**-9.5**
Italy	173620	6231.2	146990	6364.4	**-15.3**	**2.1**
Portugal	102460	1415.2	52130	1324.3	**-49.1**	**-6.4**
Sheep	holdings	heads	holdings	heads	**holdings**	**heads**
Greece	128550	8752.7	132080	10079.9	**2.7**	**15.2**
Spain	107000	20926.8	79140	18758.6	**-26.0**	**-10.4**
Italy	96150	6808.3	75380	6790.1	**-21.6**	**-0.3**
Portugal	71200	2929.8	46550	2339.6	**-34.6**	**-20.1**

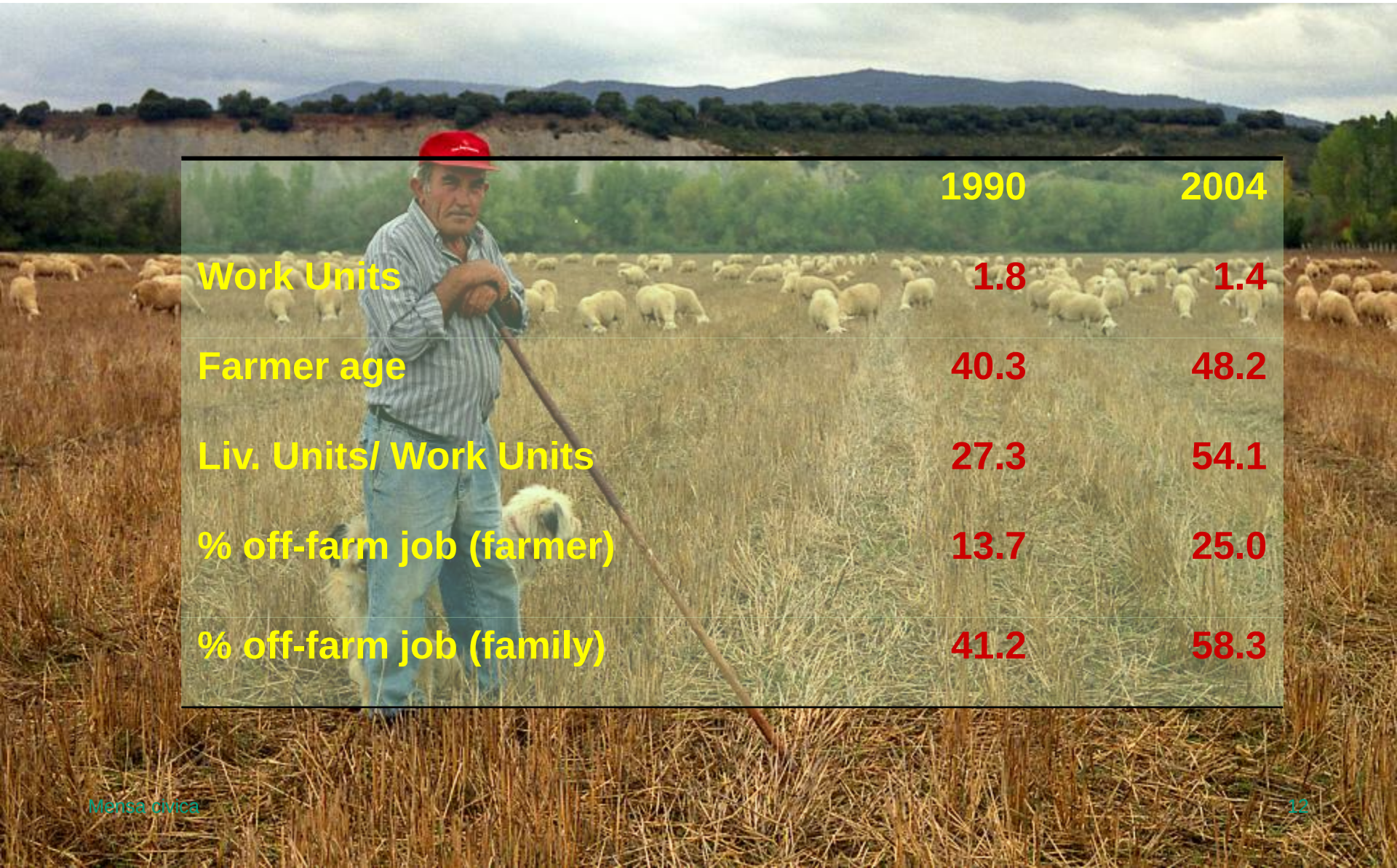
Source: EUROSTAT

economics: beef cattle



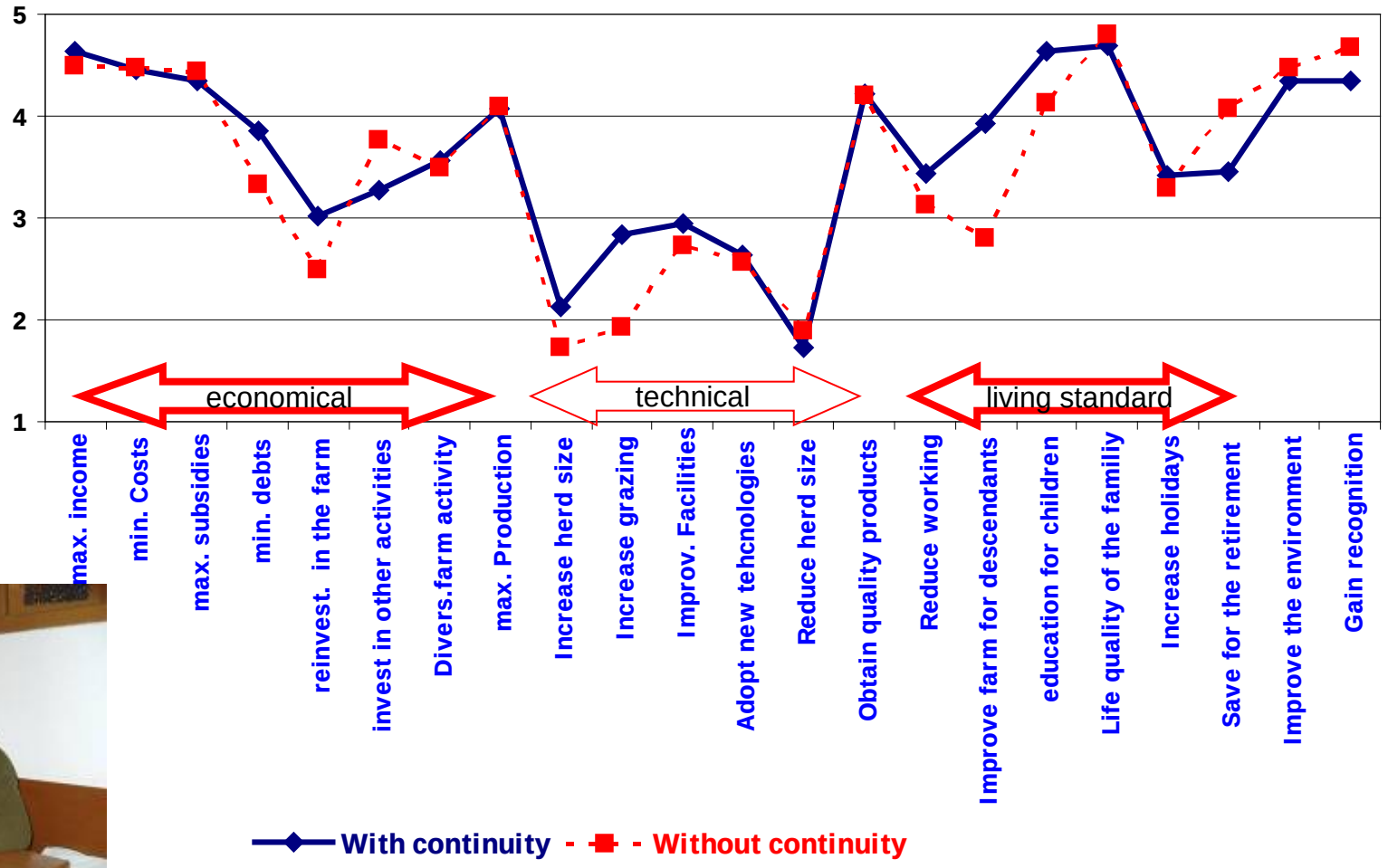
GM without premiums premiums

social factors: family and labour



	1990	2004
Work Units	1.8	1.4
Farmer age	40.3	48.2
Liv. Units/ Work Units	27.3	54.1
% off-farm job (farmer)	13.7	25.0
% off-farm job (family)	41.2	58.3

social factors: farmer objectives



2.2 holistic sustainability assessment and trade-offs

Cheese makers

1 lambing/ year

Basque Country

1 lambing/ year

Meat producers

Aragon

3 lambings/ 2 year

Meat producers

Catalonia

5 lambings/ 3 year

indicators, attributes and pillars

ATRIBUTE	INDICATOR	Pillar	INDICATOR	Pillar
Productivity (8)	Labour productivity 16%	€	Feed efficiency 13%	€
	Animal productivity 15%	€	Animal sales 12%	€
	Economic efficiency 14%	€	Herd fertility 9%	€
	Land productivity 13%	€	Animal/ WU 8%	€
Stab, rel, res. (5)	Farm continuity 32%	S	Facilities 15%	S
	Off-farm income 22%	€	Wildlife conflicts 10%	E
	Advisory services 21%	S		
Adaptability (7)	No. Incomes 23%	€	Distance markets 10%	S
	Main agric. income 17%	€	Communal areas 10%	E
	Education 16%	S	Distance to	S
	Land access 17%	S	Slaughterhouse 7%	
Equity (10)	Salary level 14%	S	Distance to services 11%	S
	Satisfaction level 13%	S	Hired labour 8%	S
	Grazing 13%	E	Leisure time 6%	S
	Energy efficiency 13%	E	Stocking rate 6%	E
	Protected areas 11%	E	Local breeds 5%	E
Self-sufficiency (7)	Feed self-sufficiency 18%	€	Own area 13%	€
	Forage self-sufficiency 16%	€	Subsidies 13%	€
	Indebtedness 15%	€	Added-value 11%	€
	Family labour 14%	S		

stakeholders perception of sustainability: farmers point of view

Importance of indicators

- 46% economics
- 35% social
- 19% environmental

Top 3 per attribute

- 60% economics
- 33% social
- 7% environmental

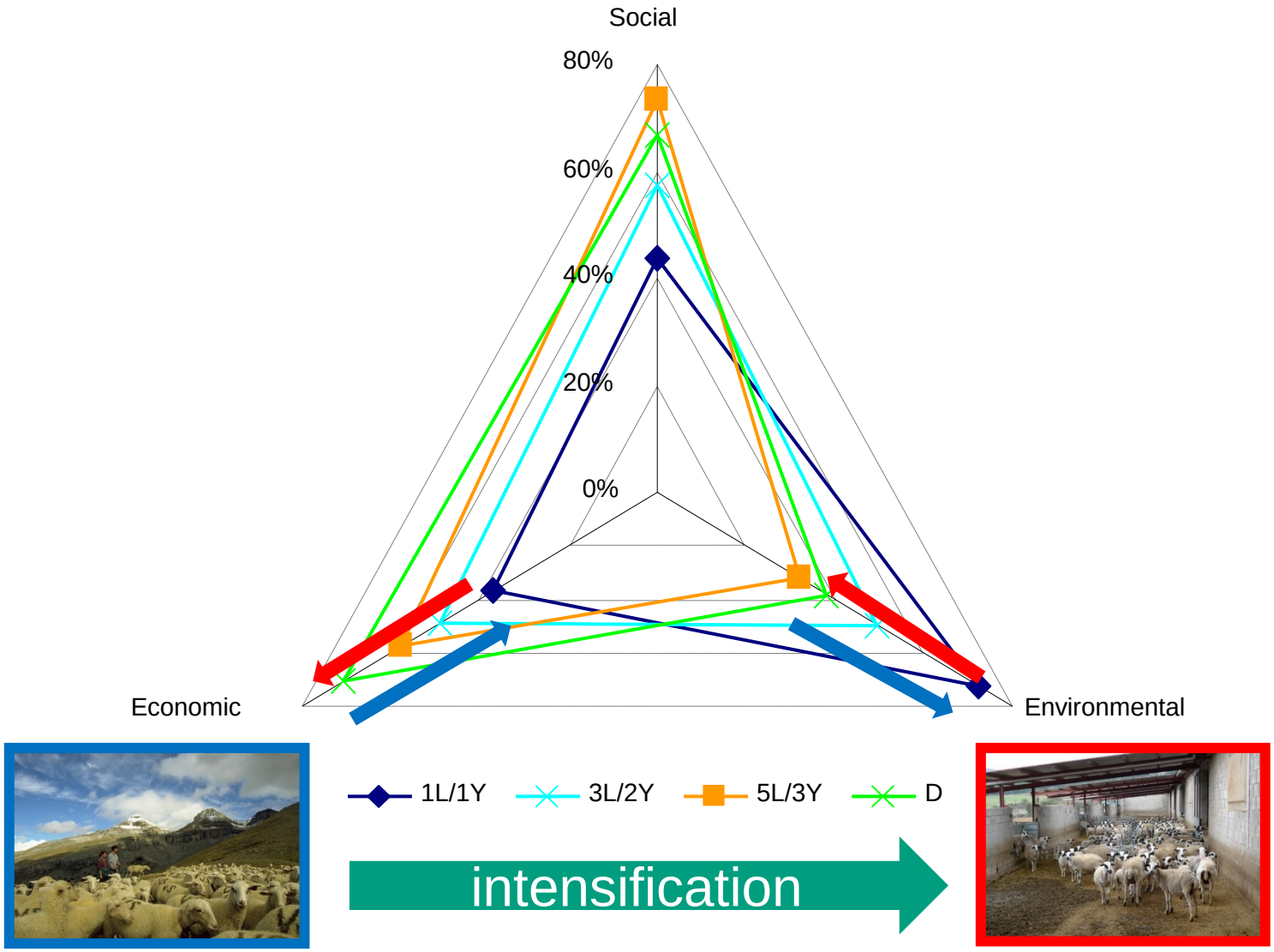
Policy makers' priorities

- Climate change (GHG)
- Pollution
- Water
- Land use change
- Landscape
- Biodiversity

Farmers' priorities

- Maximize grazing
- Energy efficiency
- Use of protected areas
- Stocking rate
- Local breeds
- Wildlife conflicts

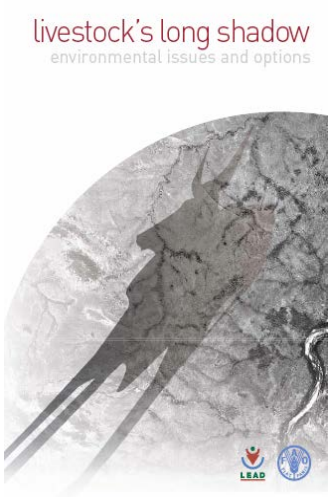
E.g.: trade-offs **among** sustainability pillars



2.3. animal production and the environment

livestock – environment

- negative impacts
  - emission of greenhouse gases (CO_2, CH_4, N_2O) and ammonia
  - land degradation and deforestation
  - pollution of soils and water
  - biodiversity loss



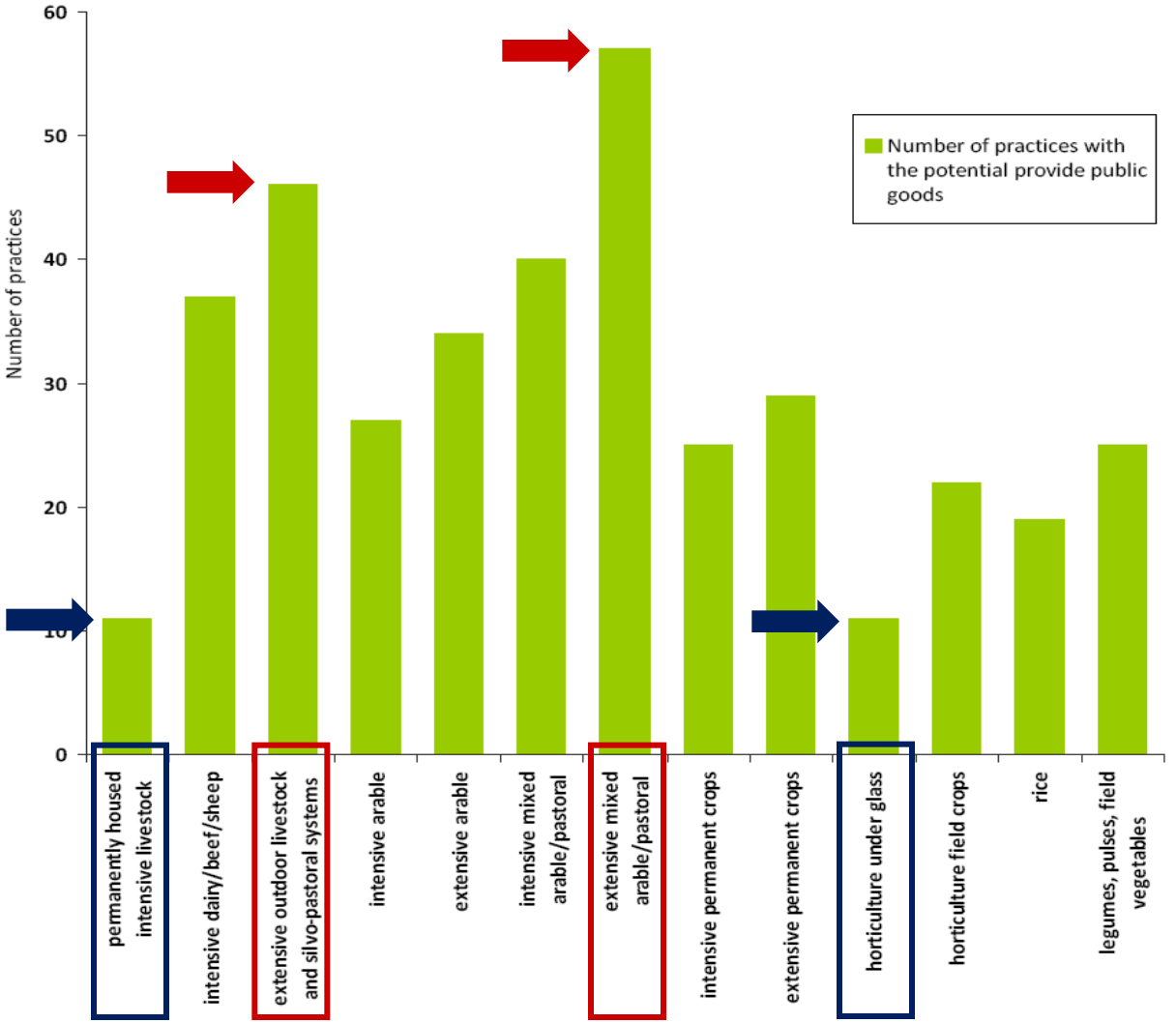
- positive impacts
  - extensive systems (low-input): landscape and biodiversity conservation
  - prevention/ regulation of environmental hazards (forest fires, erosion, desertification)
  - storage of carbon in grasslands (34%, forests 39%)

different farming systems render different ecosystem services/ public goods

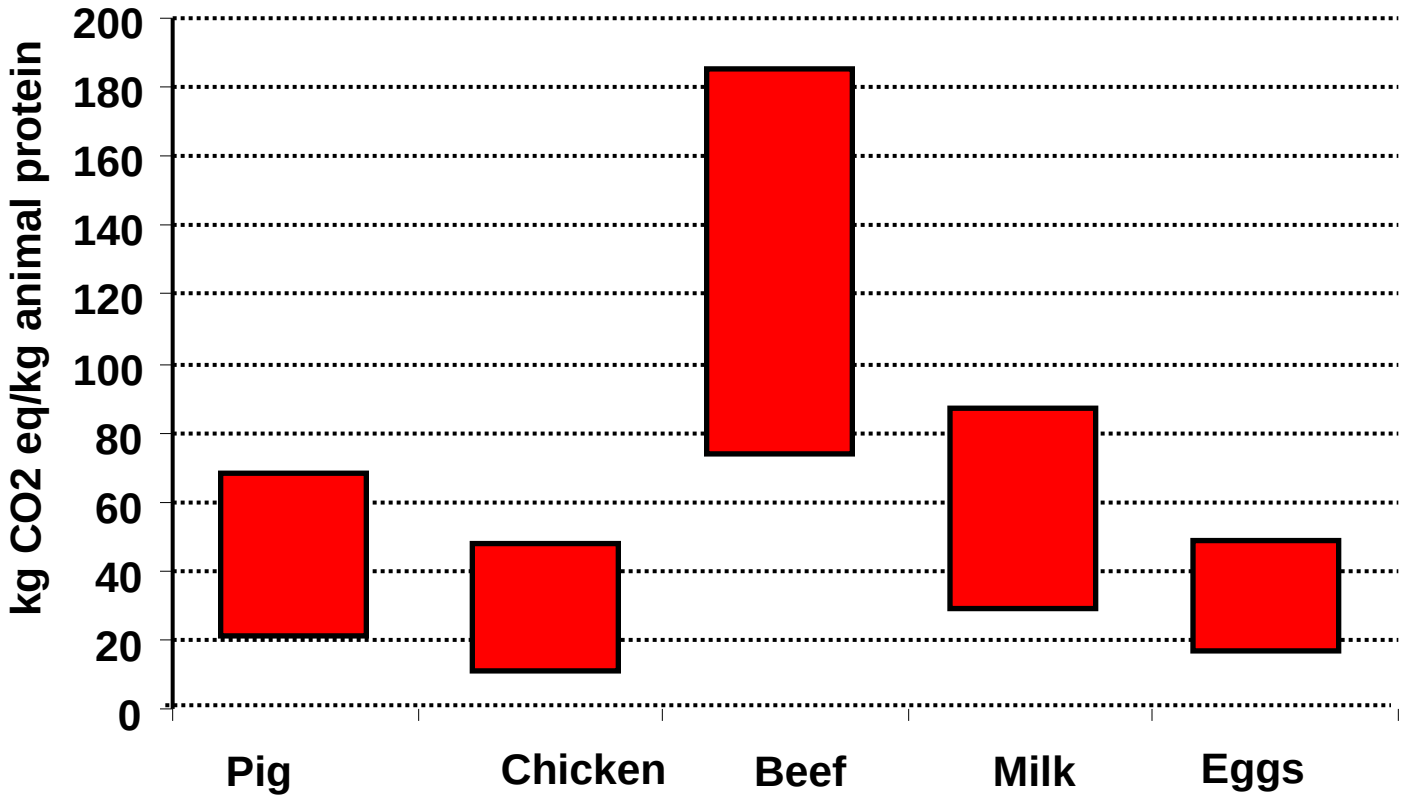
Provision of Public Goods through Agriculture in the European Union

Tamsin Cooper
Kaley Hart
David Baldock

Institute for European Environmental Policy



emissions of different animal types



¿What about sheep?

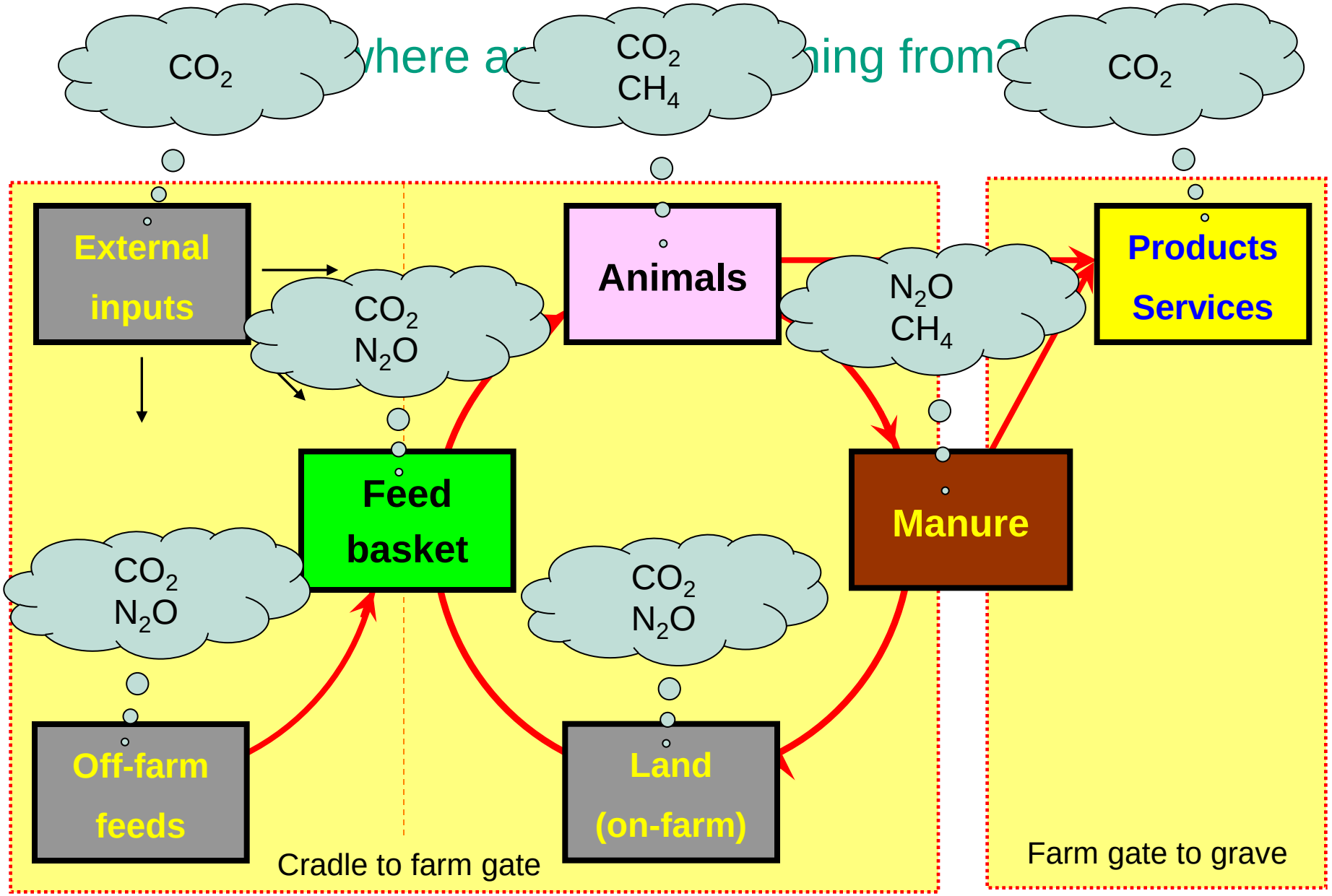
3 contrasting sheep systems

1. **Grazing** or **pastoral system**:
   - Alpine mountains.
   - 1 lambing per ewe per year.
   - Free ranging.

2. **Mixed sheep-cereal crop system**:
   - Mid-altitude Mediterranean ranges and plateaus.
   - 3 lambings per ewe every 2 years.
   - Grazing daily with shepherd.

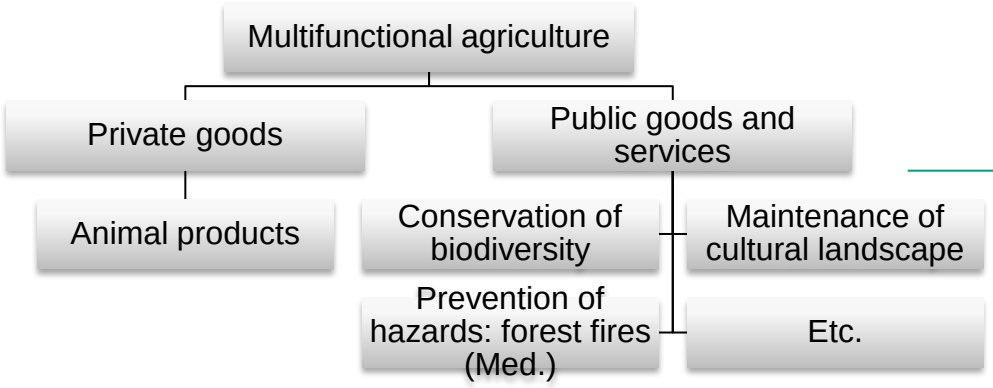
3. **Industrial system** or **zero grazing**:
   - Low altitude semi-arid conditions.
   - 5 lambings per ewe every 3 years.
   - Kept indoors all year round.

where a ming from?



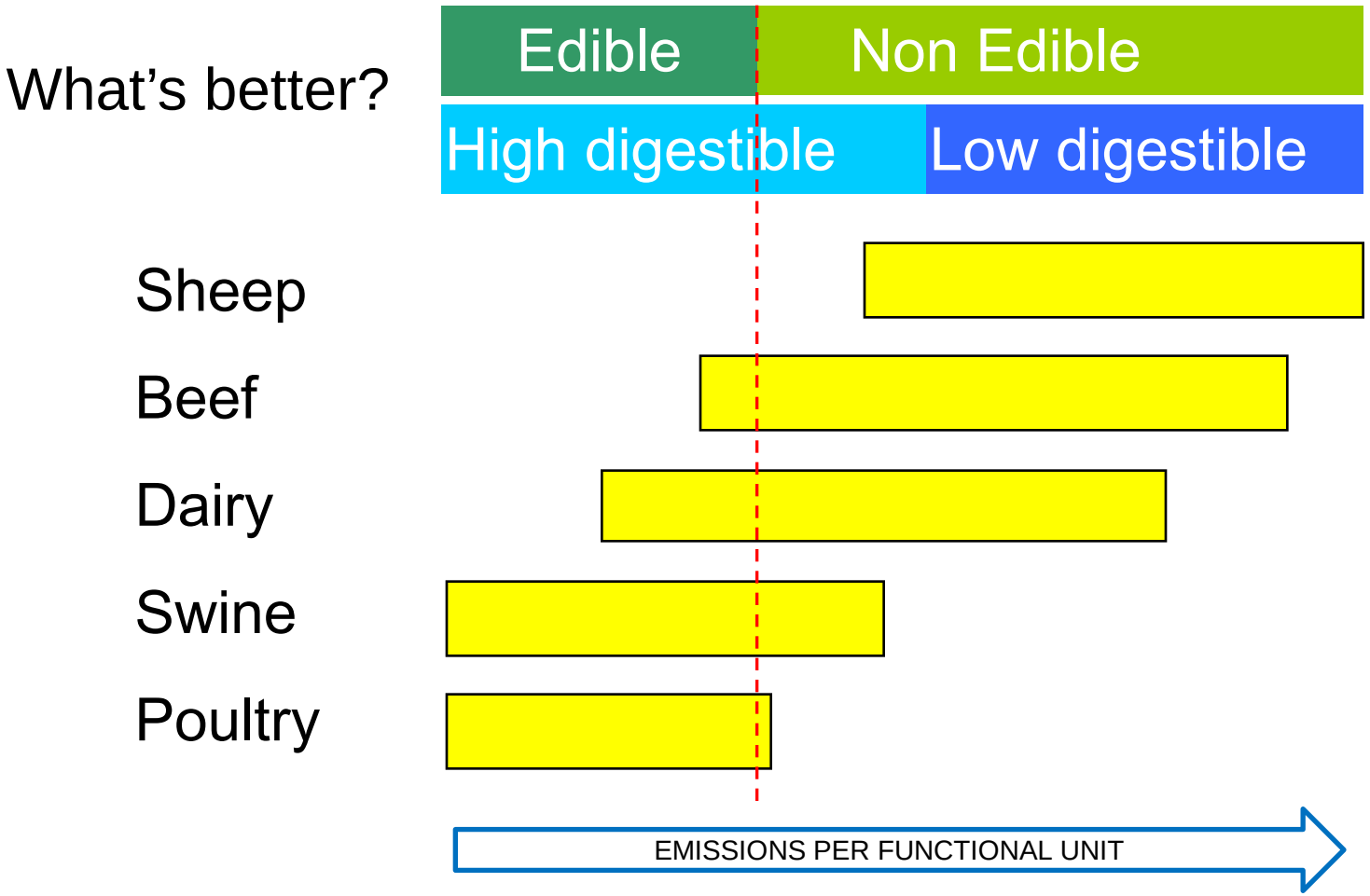
GHG emissions corrected for each SFS

	No allocation kg CO_2-eq / kg LW	Allocation	Corrected kg CO_2-eq / kg LW
Grazing (1L/1Y)	25.9	53.6 %	13.9
Mixed (3L/2Y)	24.0	73.9 %	17.7
Zero grazing (5L/3Y)	19.5	100 %	19.5



- Non-marketable
- Inherently linked to extensive livestock farming systems IEEP (2009)

mitigation in feed, the options



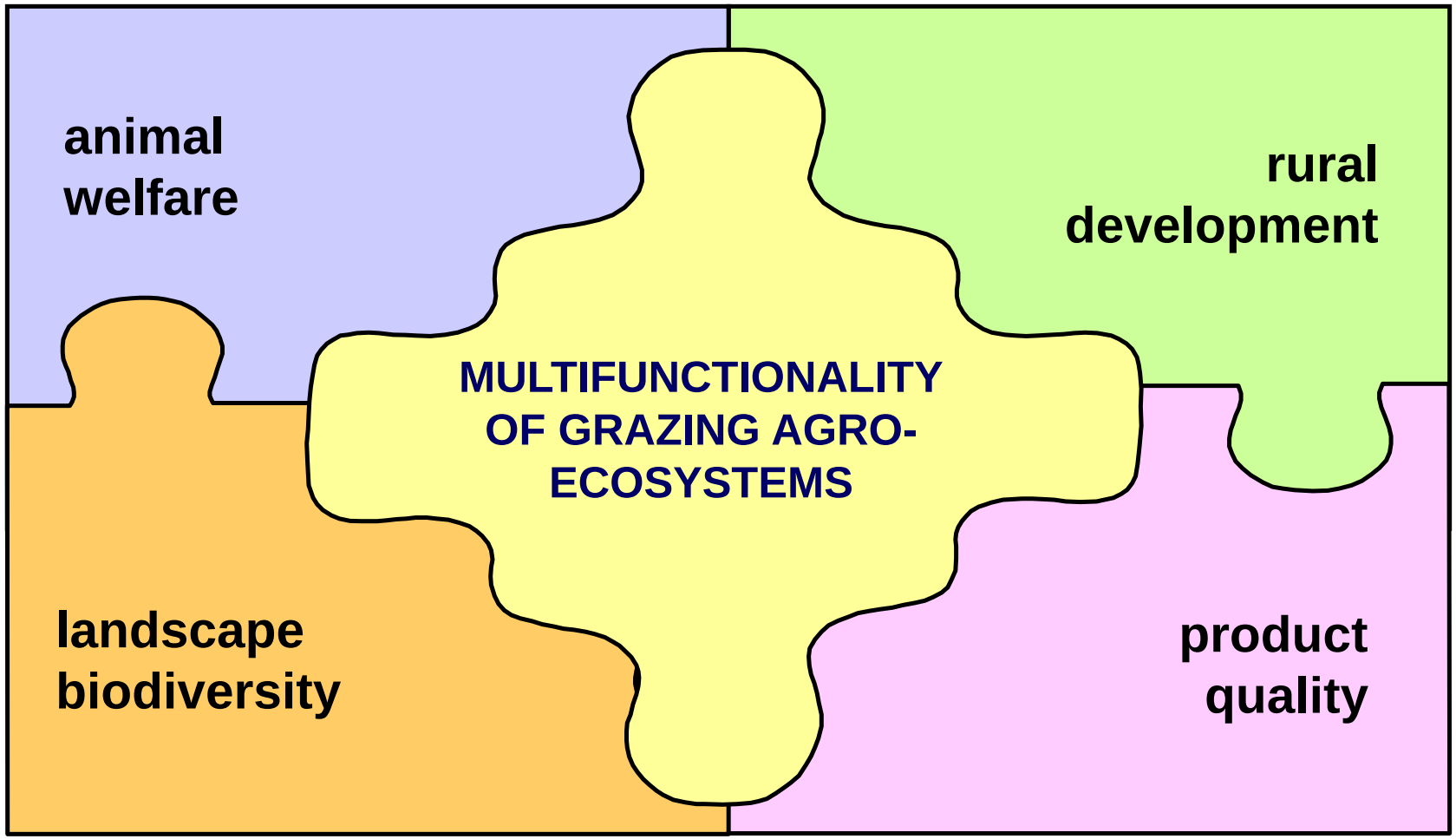
3. multifunctionality

a definition…

Multifunctionality is a **systems** oriented concept. It addresses the fact that in addition to the provision of private goods like food and fibre, agriculture also provides a set of **public goods**.

The most central public goods are:

- **Landscape & biodiversity** values: cultural heritage, amenity value of the landscape, recreation/access, scientific/educational value.
- Food related aspects: **food safety and food quality**.
- **Rural activity**: rural settlement and economic activity.


animal welfare
rural development
MULTIFUNCTIONALITY OF GRAZING AGRO-ECOSYSTEMS
landscape biodiversity
product quality

ecosystem services…

Humankind benefits from a multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as ecosystem services.

ecosystem services are benefits that people get from nature

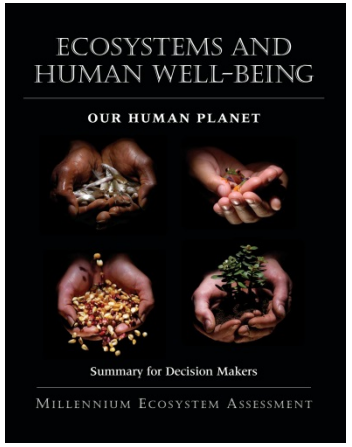
types of ecosystem services

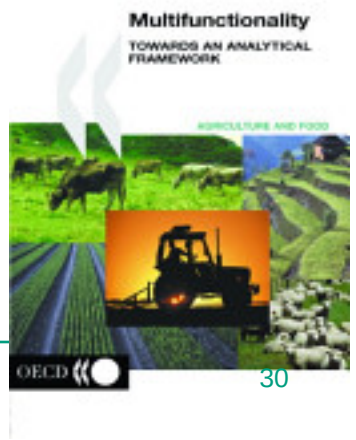
Provisioning: products obtained from the ecosystem, i.e. food, timber, fiber, fresh water, etc.

Regulating: benefits obtained from the regulation of ecosystem processes, i.e. regulation of climate, erosion prevention, water regulation, etc.

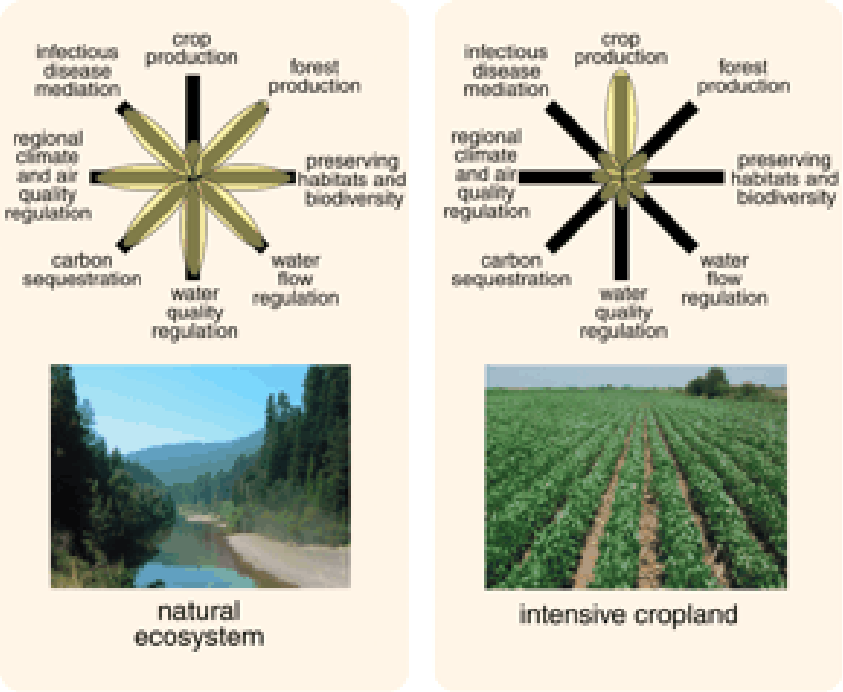
Cultural: nonmaterial benefits people obtain from ecosystems, i.e. spiritual enrichment, cognitive development, recreation, aesthetic experience, etc.

Supporting (habitat): ecosystem services that are necessary for the maintenance of all other ecosystem services, i.e. primary production (photosynthesis), soil formation, nutrient cycling, water cycling, etc.





Trade-offs between production and environment



- Trade-offs occur when the delivery of one product or service is reduced as a consequence of the increased delivery of another product or service

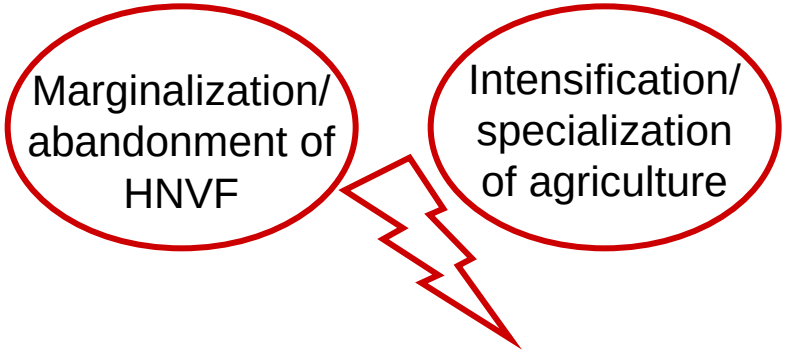
ecosystem services & biodiversity

…what is the role of Biodiversity?

- for ecologists, provision of ecosystem services is directly related to biodiversity
- biodiversity underpins ecosystem integrity or ecosystem state

drivers of biodiversity loss in Europe

EEA, 2004. **High Nature Value Farmland: characteristics, trends and policy challenges**. European Environmental Agency.



Biodiversity conservation
Provision of public goods

greater biodiversity index = **HNVF** = **semi-natural grassland**

Annex Table 5 The number of practices providing each public good within each farming system

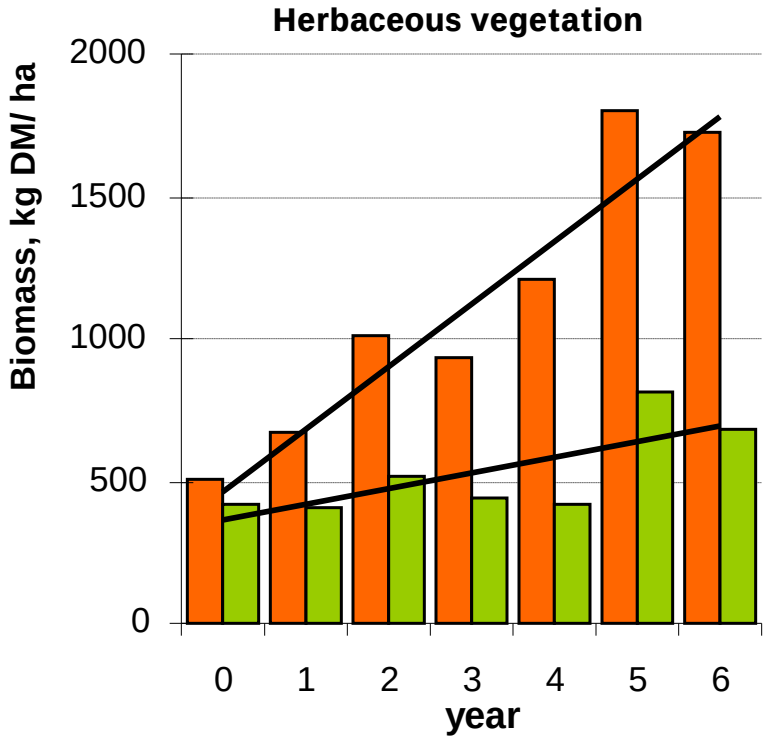
inherently linked to certain types of agricultural activity

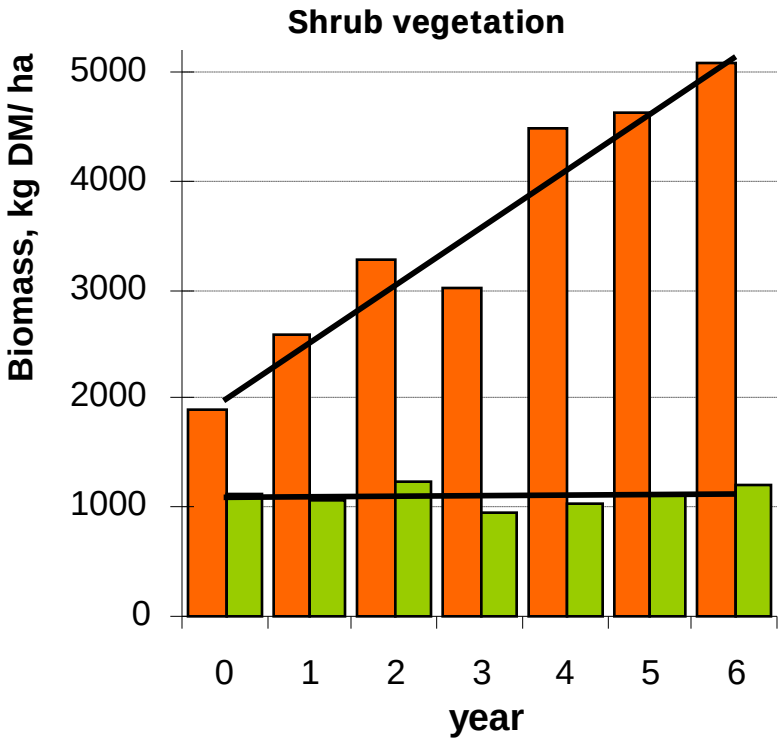
Farming System	Total number of practices occurring	Landscape	Biodiversity	Water quality	Water availability	Soil functionality	Climate stability – carbon storage	Climate stability – reduced GHG emissions	Air quality	Resilience to flooding	Forest fires
Permanently housed intensive livestock	11	1	2	2	1	0	1	8	0	0	0
Intensive dairy/beef/sheep	37	14	21	18	1	13	6	16	2	6	1
Extensive outdoor livestock and silvo-pastoral systems	46	24	31	18	1	17	7	16	2	11	8
Intensive arable	27	10	19	16	7	9	6	6	2	4	0
Extensive arable	34	13	24	19	2	15	5	8	5	8	3
Intensive mixed arable/pastoral	40	12	20	22	3	10	4	16	4	4	1
Extensive mixed arable/pastoral	57	27	42	30	4	24	9	15	5	11	8
Intensive permanent crops	25	8	16	9	3	11	5	4	4	6	0
Extensive permanent crops	29	19	25	11	3	12	5	3	4	3	1
Horticulture under glass	11	0	3	10	3	4	0	4	4	1	0
Horticulture field crops	22	7	10	14	3	12	2	4	2	4	0
Rice	19	8	16	9	2	10	1	4	3	2	0
Legumes, pulses, field vegetables	25	6	12	15	3	10	3	5	4	4	0

Key	
	10 – 19 high-scoring practices
	20+ high-scoring practices

effect of grazing on vegetation

250 ha *Pinus nigra*
0.2 LU/ ha





Grazed

Non-grazed

effect of grazing on landscape: current situation

effect of grazing on landscape: abandonment

effect of grazing on landscape: optimal

3.1 valuation of public goods (ecosystem services)

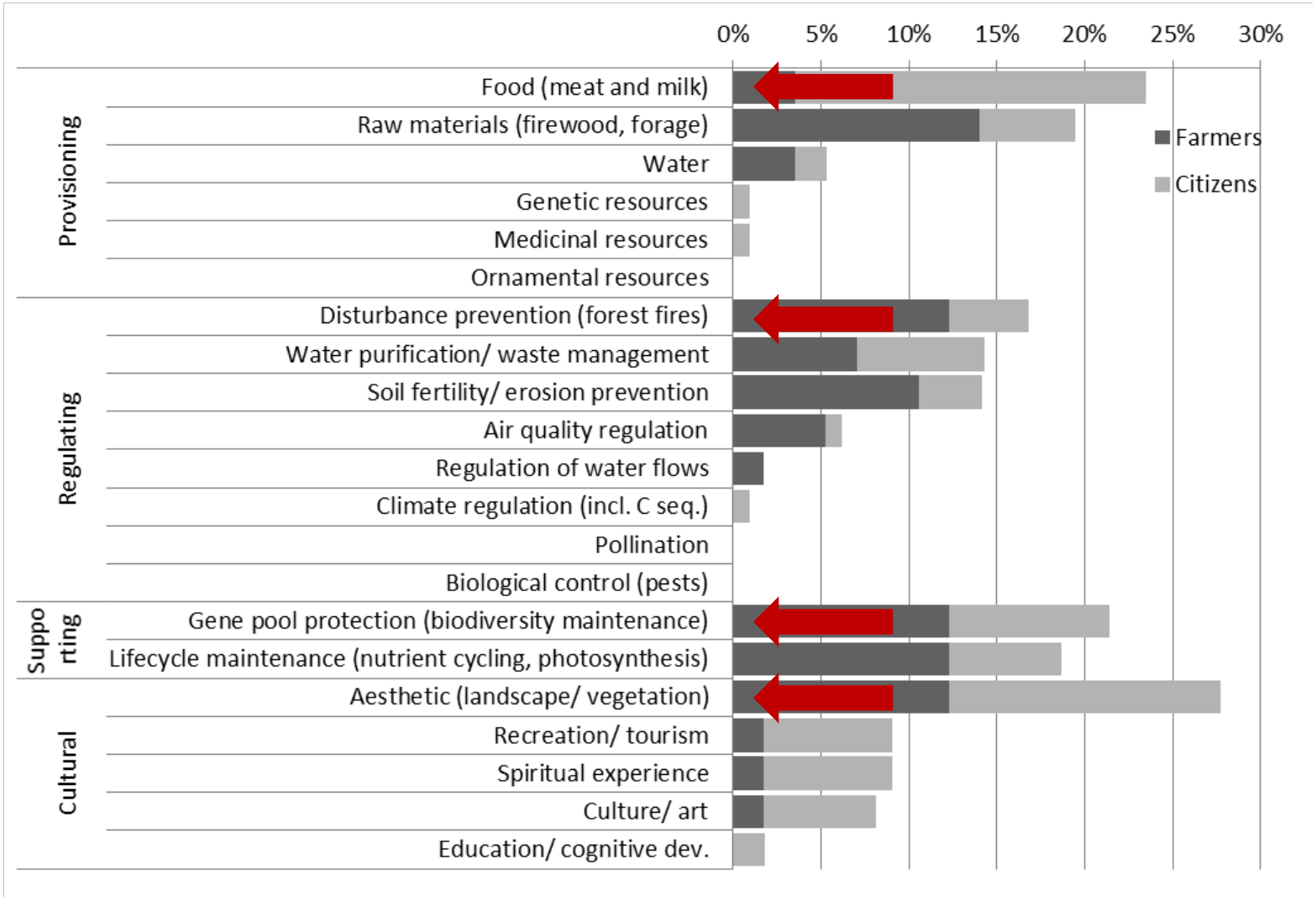
- Different functional units
- Different temporal and spatial scales
- Different perceptions by society
- No market price

1. BIOPHYSICAL
2. SOCIO-CULTURAL
3. ECONOMIC

Ecosystem Services valuation: socio-cultural

1. Do you know the term “ecosystem services”? (Other words for the term, examples)
2. How do you think livestock production affects the environment and vice versa?
3. How these relationships between livestock production and the environment affect you?
4. What geographical areas/ places can you identify that show the effect of livestock on the environment?
5. Do you agree society needs to pay the delivery of environmental services? Who? In what way?

Ecosystem Services valuation: Mediterranean

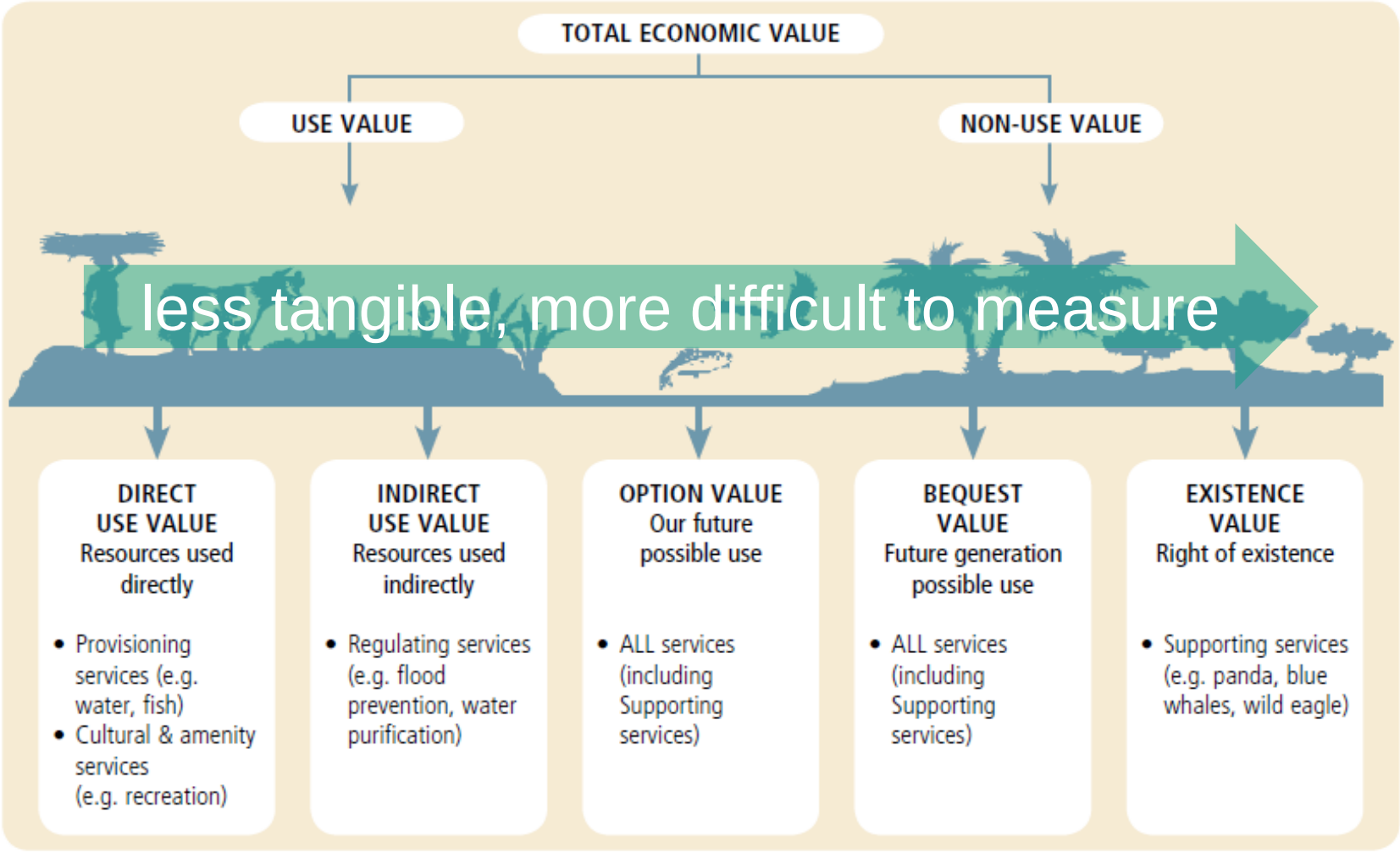


Ecosystem Services valuation: economic

How do we measure ES/public goods?

Total economic value (TEV): sum of output values (the values generated in the current state of the ecosystem, e.g., food production, climate regulation and recreational value) as well as insurance values, now and in the future.

Total Economic Value (TEV)



Non-use value

- do not involve direct or indirect use of the ecosystem service, but reflect the satisfaction that individuals derive from the knowledge they exist (e.g. enjoyment of a beautiful landscape)
- related to moral, religious of aesthetic properties of individuals
- **markets do not exist**

Stated preference methods

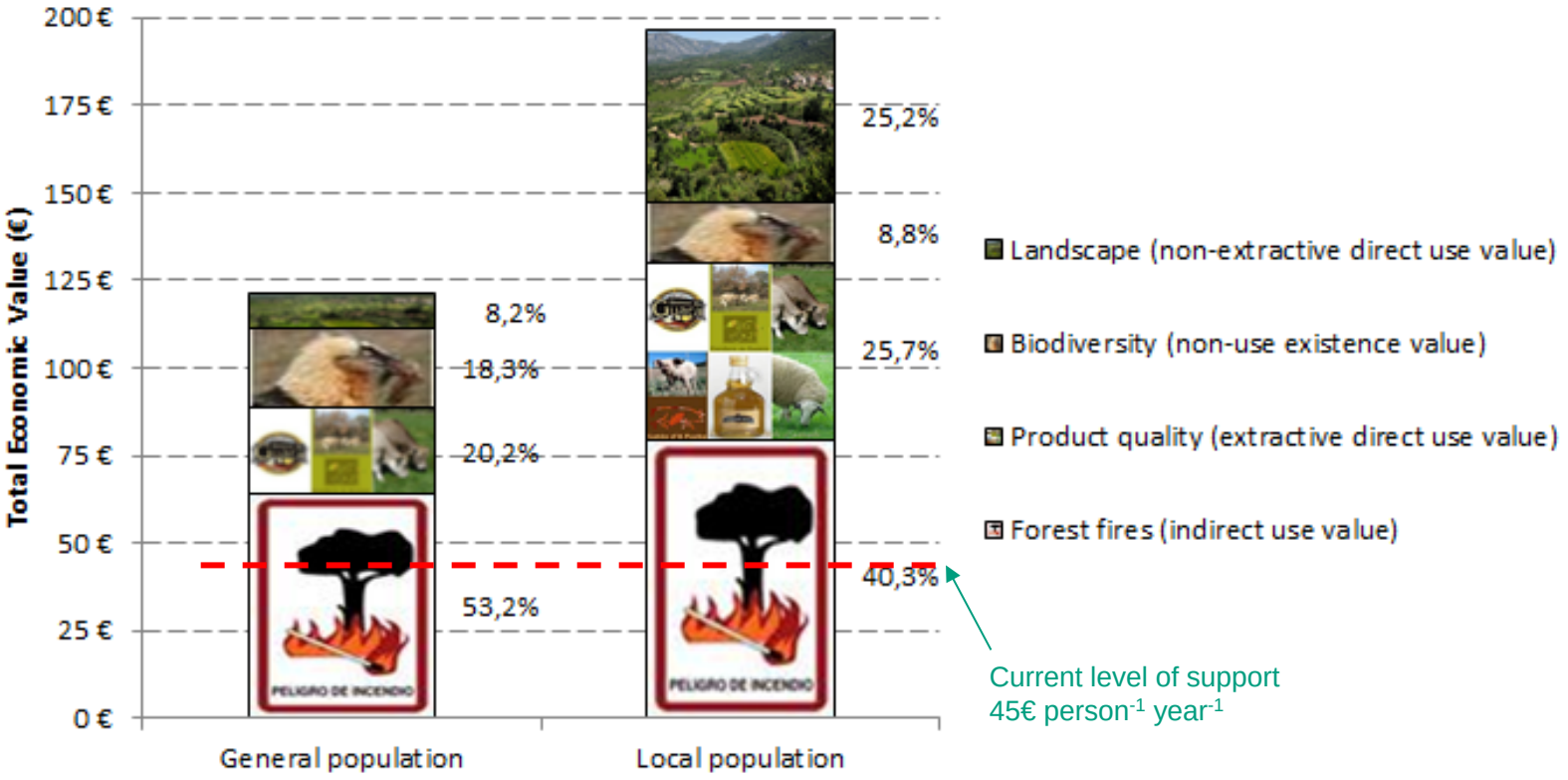
- **Choice modelling** Individuals are asked to choose their preferred alternative among several hypothetical land uses. Each scenario of land use is described by a number of attributes (e.g. vegetation cover, landscape fragmentation, biodiversity index, human activities, etc.). Individuals make trade-offs between the levels of the attributes describing the different alternatives in a choice set.
- **Underlying rational decision process**

Ecosystem Services valuation: choice model

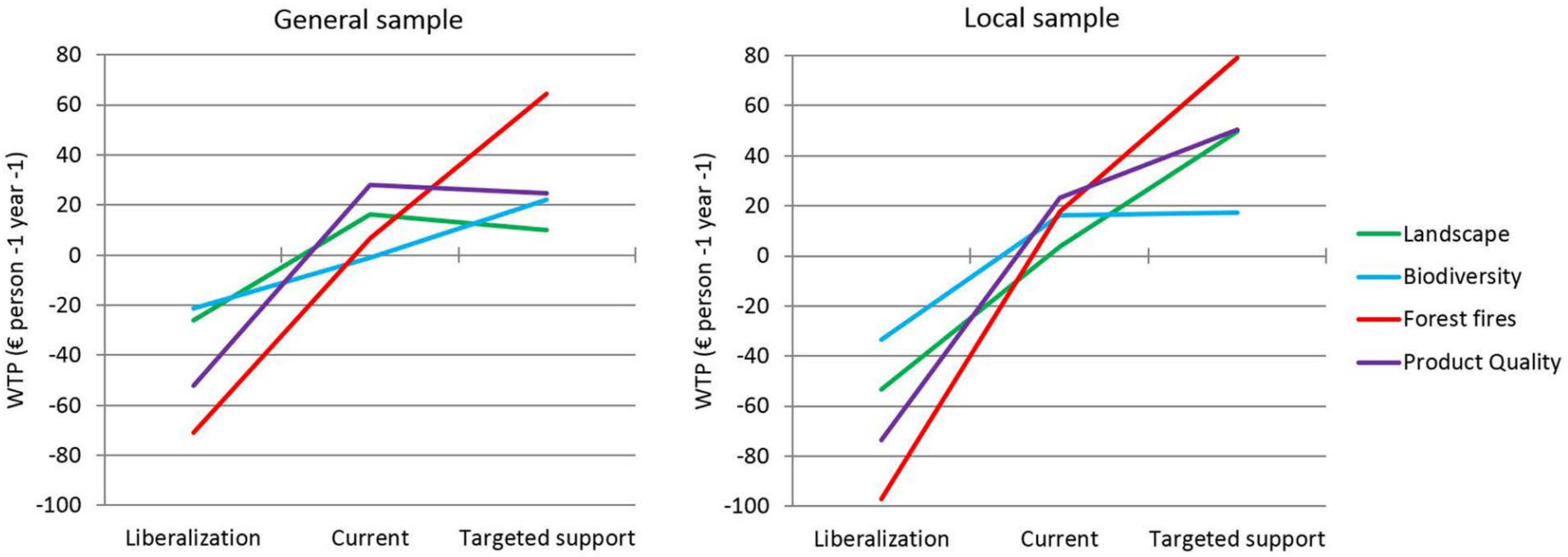
	Policy A	Policy B	CURRENT policy
Landscape	 strong increment of bushes reduction of meadows and crops	 light decrement of bushes light increment of meadows and crops	 light increment of bushes meadows and crops are maintained
Bearded vulture	 7 pairs	 15 pairs	 11 pairs
Forest fires	 **6** forest fires per year	 **2** forest fires per year	 **4** forest fires per year
Product quality linked to territory	 **2** quality products available sheep cheese and lamb meat	 **6** quality products available sheep cheese, lamb meat, pasture pork meat and olive oil, pasture beef and organic lamb	 **4** quality products available sheep cheese, lamb meat, pasture pork meat and olive oil
Annual cost	 15 €	 75 €	 45 €
CHOICE	◯ A	◯ B	◯ C

Example of ES quantification: economic

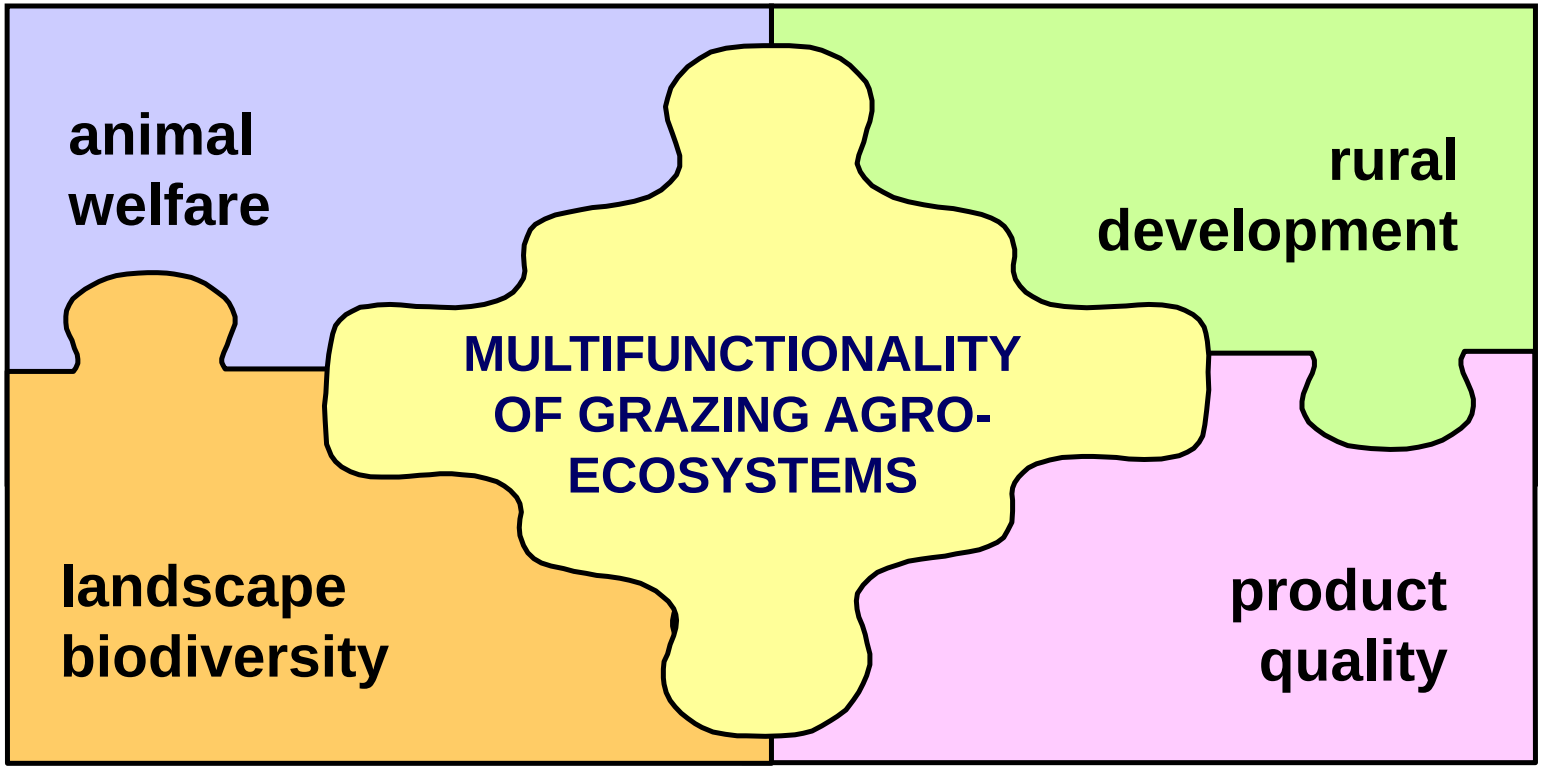
Total Economic Value (TEV) (€ person^{-1} year^{-1})

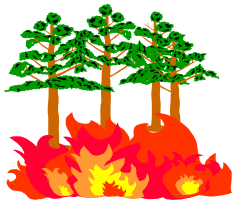


Willingness to Pay (WTP) (€ person-1 year-1) for ecosystem services in different policy scenarios



3.2 food quality: conservation of natural resources as extrinsic quality attribute



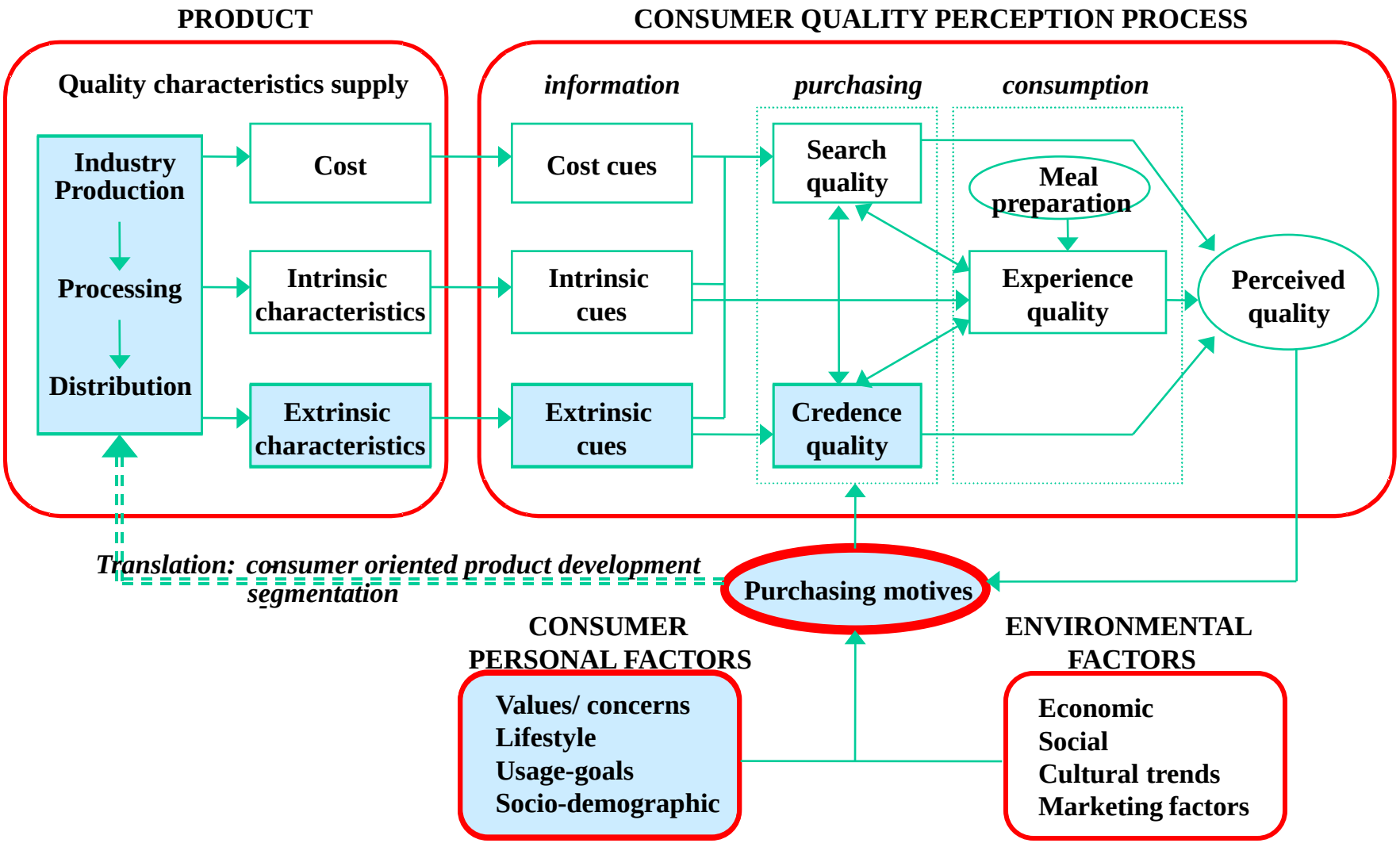


producers ⟺ consumers

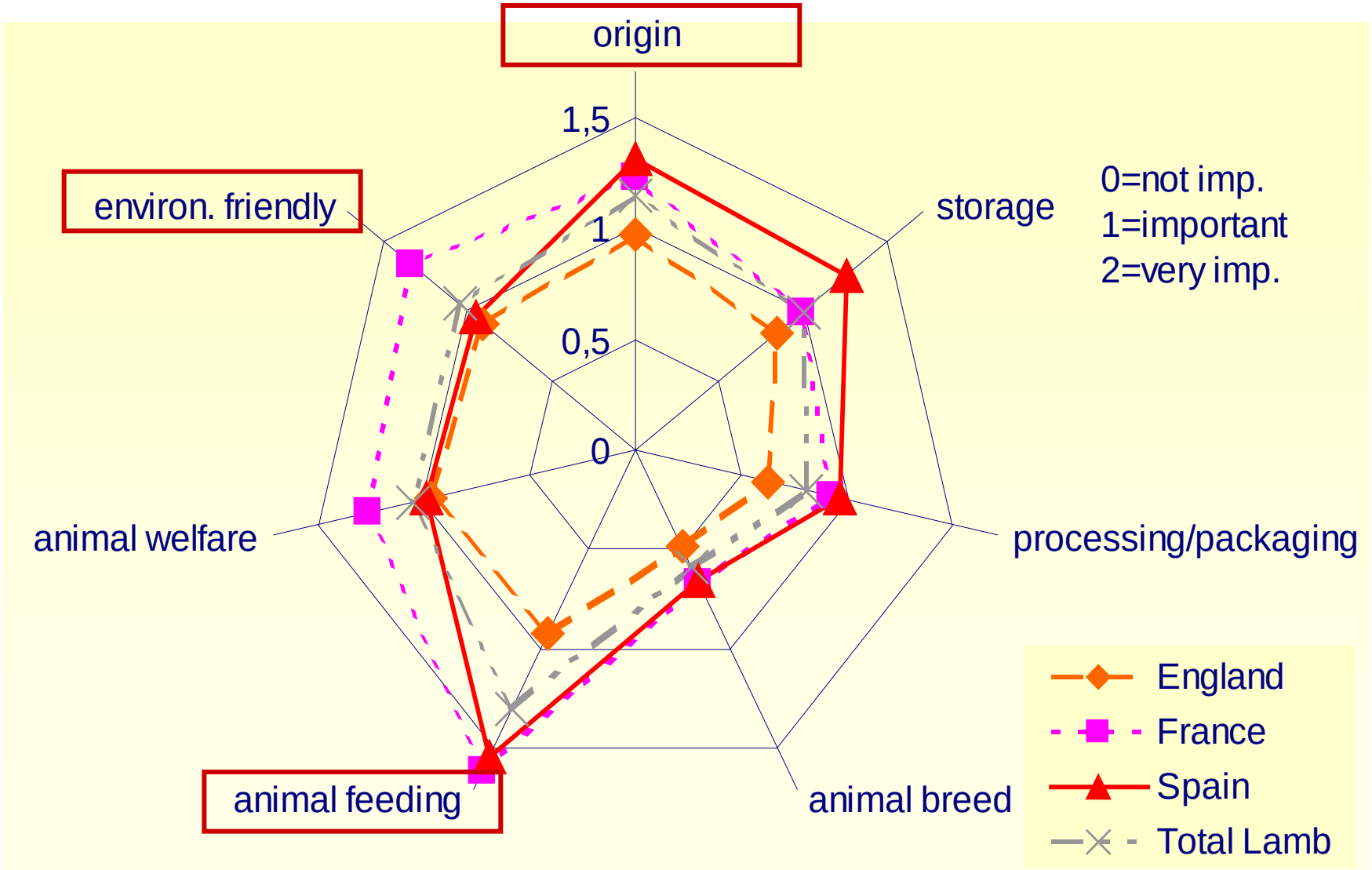
the “perceived quality approach”

- concept of food quality is multidimensional, subjective and constantly evolving
- extrinsic attributes (focus on the production process) are increasingly important for consumers. e.g. environmental friendly or animal welfare considerations
- the relative importance of these attributes differs for consumers with different characteristics

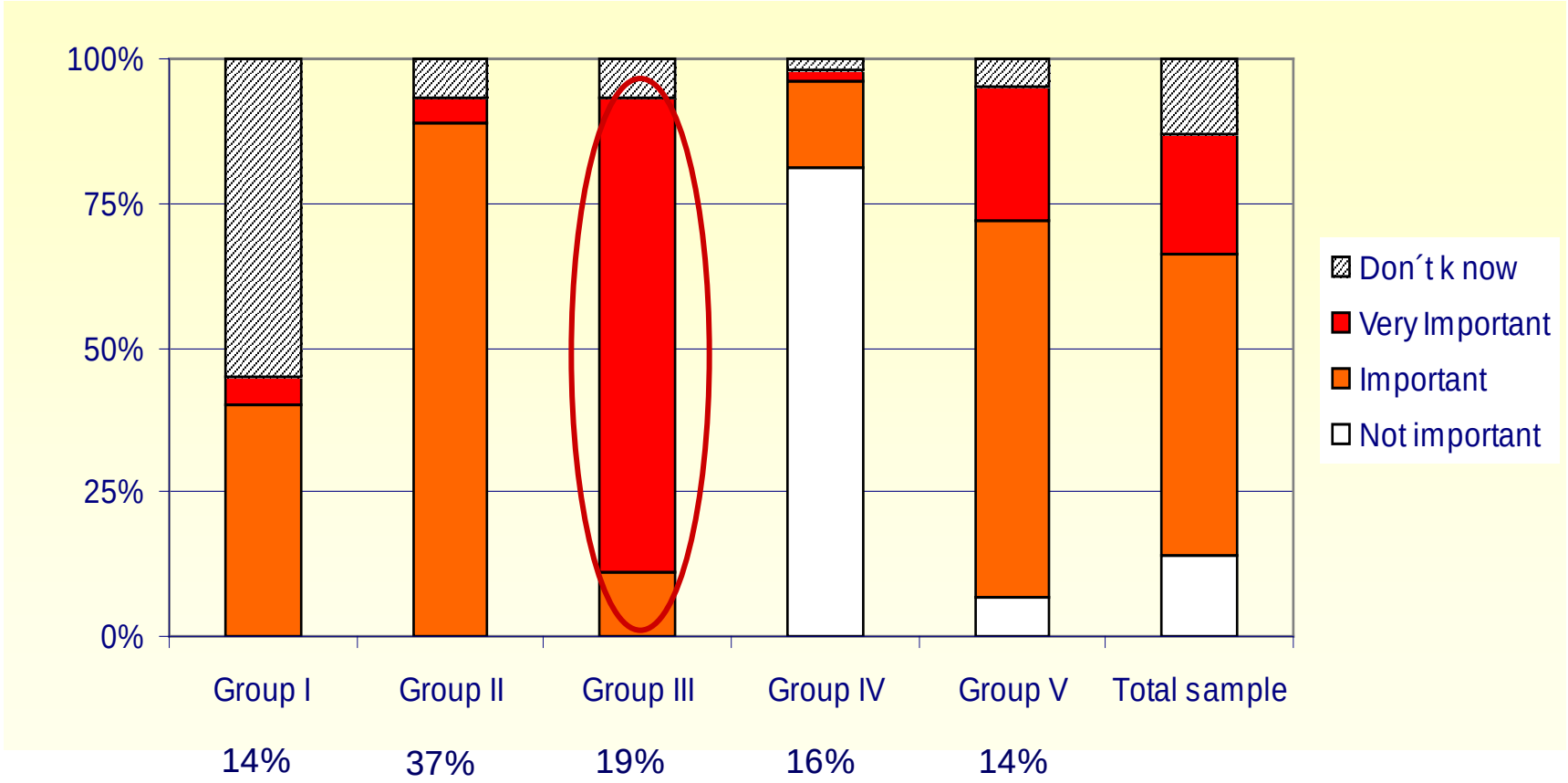
conceptual model of perceived quality



importance of lamb extrinsic quality attributes



importance of “environmental friendly” production of lamb for different groups of consumers in Aragón



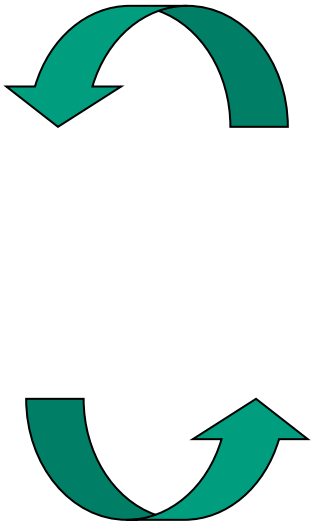
linking producers and consumers: "*consumer-led product development*"

consumer research
-purchasing motives
-market segments

lamb producers in HNVF

extrinsic attribute of the product:

"extensive sheep farming systems are essential for the conservation of natural resources and landscape in HNVFs"



consumers with ethical concerns

increasing importance of credence quality:
-environmental friendly production
-animal welfare
-safety/health concerns

Product development
-certification
-branding/ labelling
-communication

4. wrapping up!

take-home messages

1. animal production systems are not static, they evolve according to general drivers (policies) but also to family/ local circumstances
2. sustainable agriculture ≠ env. friendly agriculture
   - environment
   - economics
   - social
3. multiple trade-offs or compromises
   - e.g. economic vs. environmental
   - e.g. carbon footprint and ecosystem services (biodiversity, landscape)

take-home messages

4. animal agriculture can be multifunctional (delivery of public goods or ecosystem services), but not all farming systems are
5. there is need to objectively value “non-market” functions of animal agriculture and integrate public goods into global evaluation frameworks

take-home messages

5. concept of quality is multidimensional, subjective and changing
6. quality does not only depend on the product itself, but on the production process (ethical concerns)

take-home messages

7. to understand sustainability/ multifunctionality it is necessary a systems perspective:
    - multiple factors or dimensions
    - multiple interrelations
    - diverse spatial and temporal scales
    - multidisciplinary dynamic approaches