



outline



1. introduction
2. **sustainability**
 - 2.1 evolution of pasture-based ruminant systems
 - 2.2 animal production and the environment
3. **multifunctionality**
 - 3.1 public goods (ecosystem services)
 - 3.2 product quality
4. wrapping up

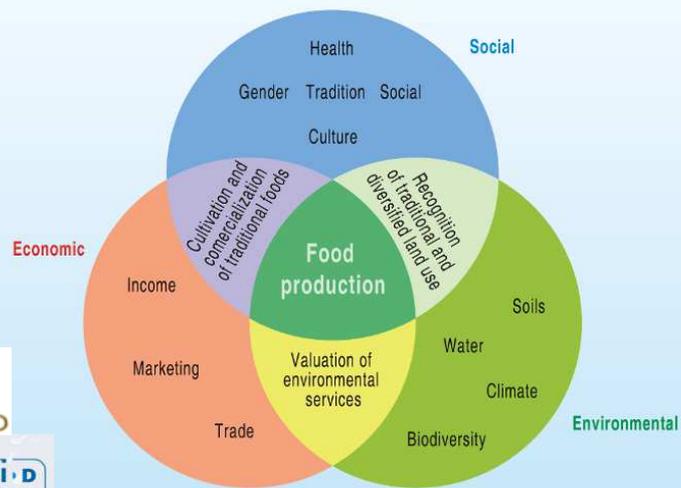
1. introduction



multiple dimensions of agriculture



The inescapable interconnectedness of agriculture's different roles and functions



2. sustainability



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a definition...

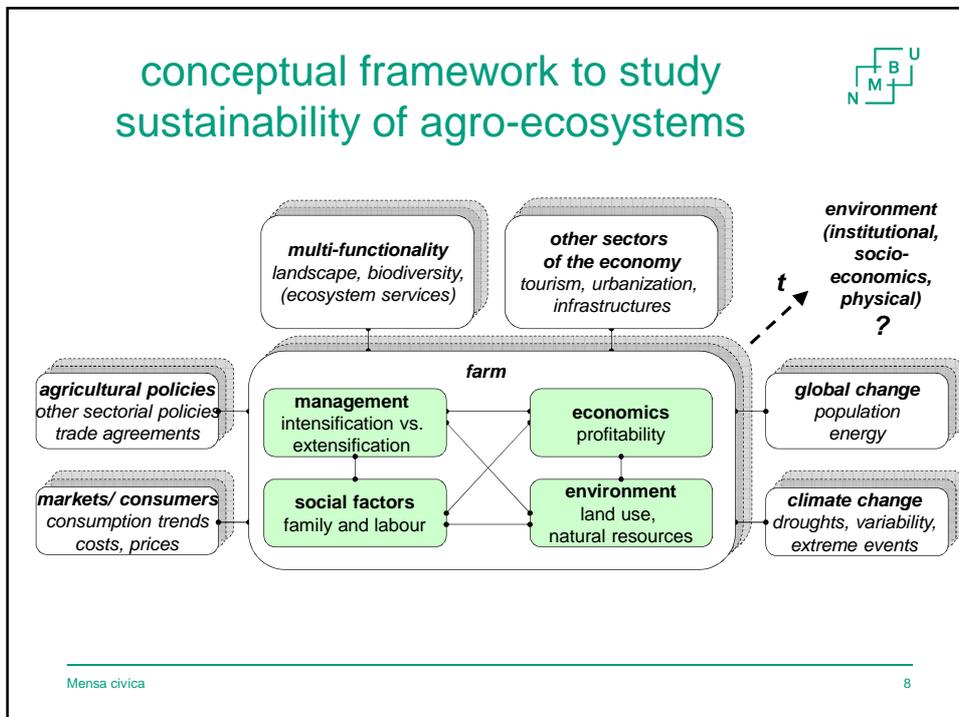
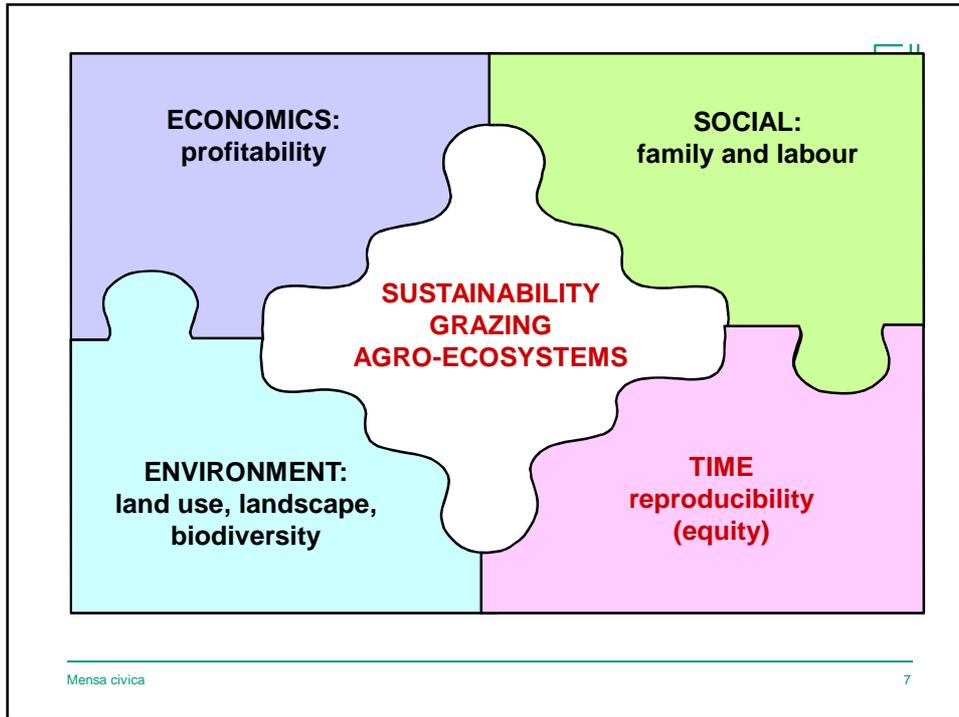


“Sustainable development is development that meets the **needs** of the present without compromising the ability of **future generations** to meet their own needs.” (UN Brundtland report, 1987)

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

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2.1 evolution of pasture-based ruminant systems



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

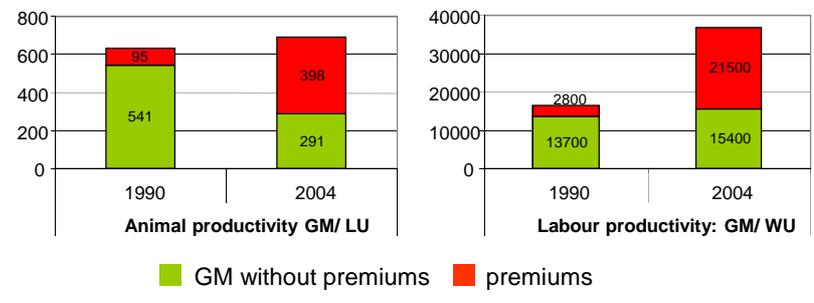
	2000		2007		Dif. (%)	
	holdings	heads	holdings	heads	holdings	heads
Beef Cattle						
Greece	28339	852.4	21520	732.0	-24.0	12.2
Spain	198210	6246.5	124010	5740.6	-34.1	-9.5
Italy	173620	6231.2	140000	6064.4	-15.3	2.1
Portugal	102460	1415.2	52130	1324.3	-49.1	-6.4
Sheep						
Greece	128550	8750.7	132080	13070.9	2.7	15.2
Spain	107000	20326.6	79140	13756.6	-26.0	-10.4
Italy	66150	6406.3	73380	6766.1	-21.6	-0.3
Portugal	71200	2628.8	48550	2328.6	-34.6	-20.1

Source: EUROSTAT

Miriam Pérez

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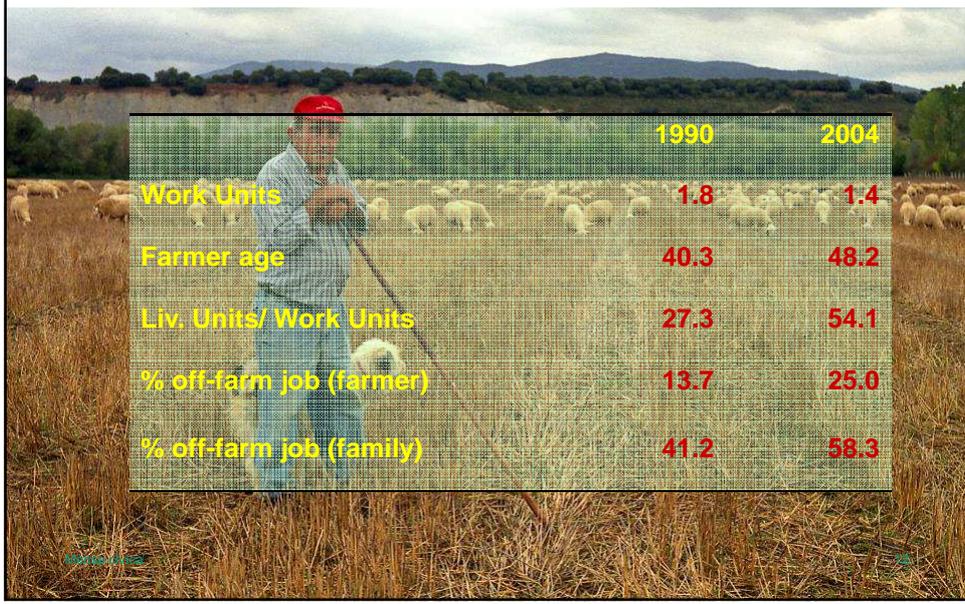
economics: beef cattle



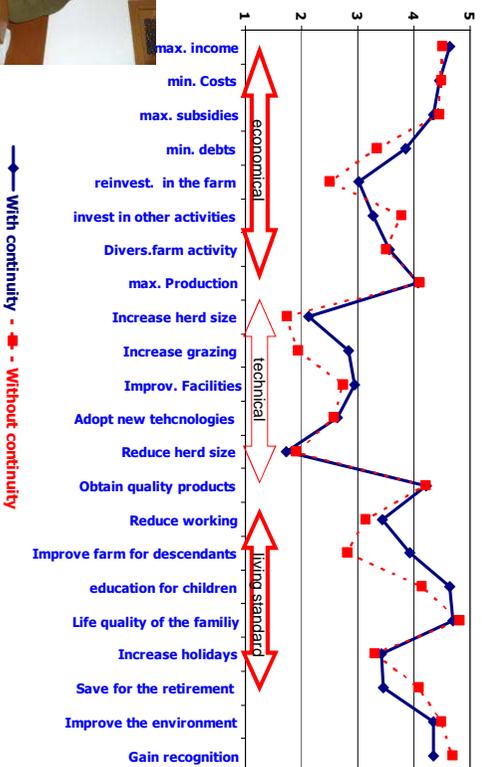
social factors: family and labour



	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



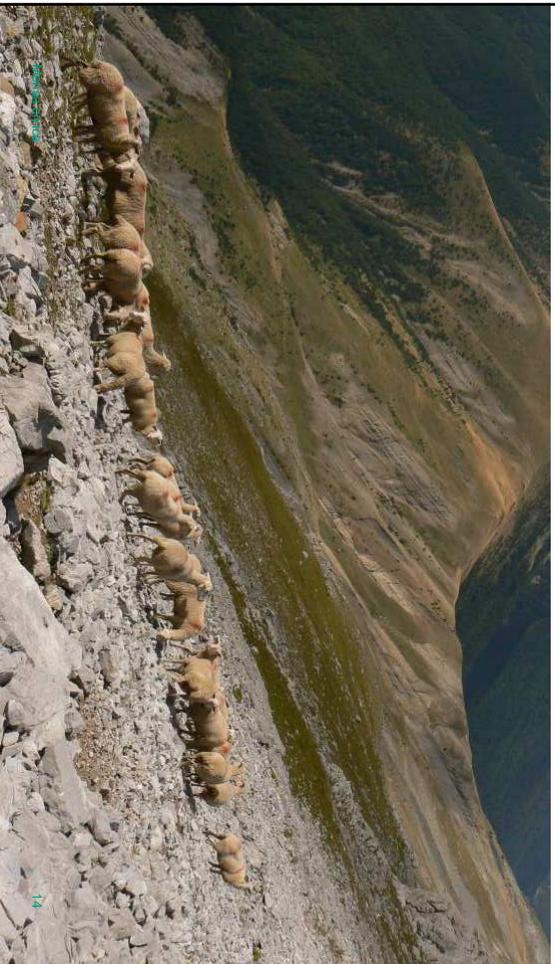
social factors: farmer objectives



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2.2 animal production and the environment: e.g. carbon footprint



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livestock – environment



- negative impacts

- emission of greenhouse gases (CO₂, CH₄, N₂O) and ammonia
- land degradation and deforestation
- pollution of soils and water
- biodiversity loss

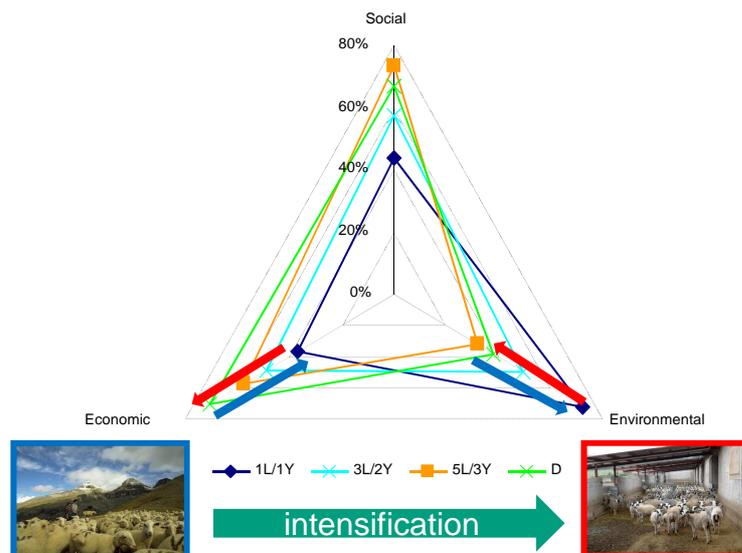
livestock's long shadow
environmental impacts and options



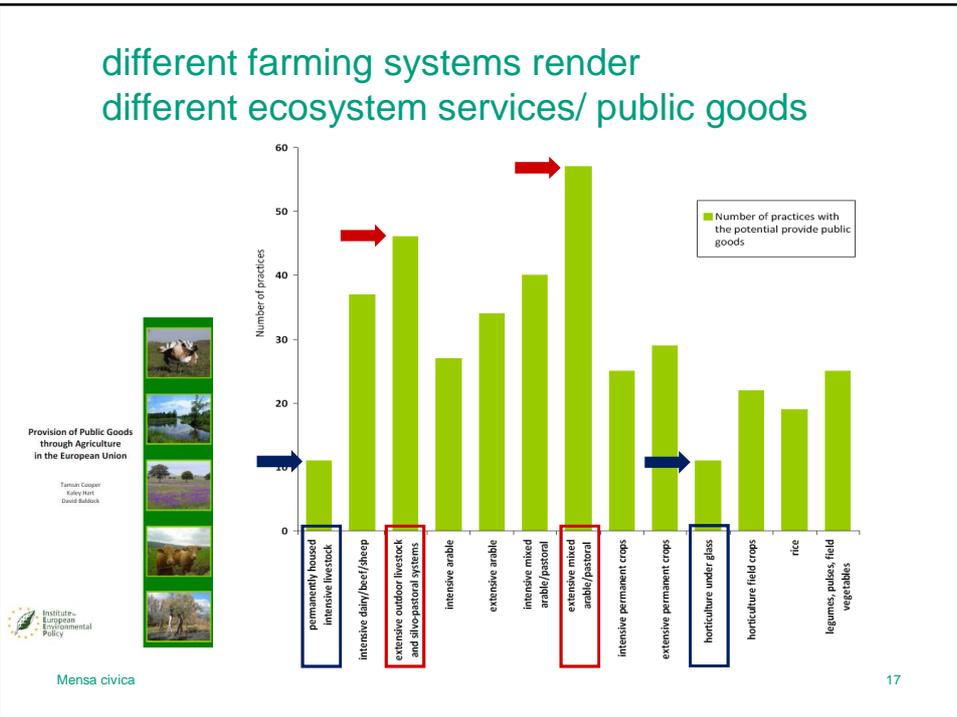
- positive impacts

- 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%)

E.g.: trade-offs among sustainability pillars



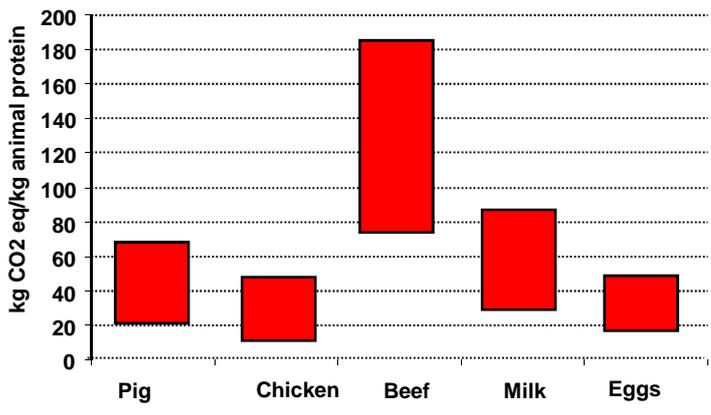
different farming systems render different ecosystem services/ public goods



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carbon footprint of different animal types



¿What about sheep?

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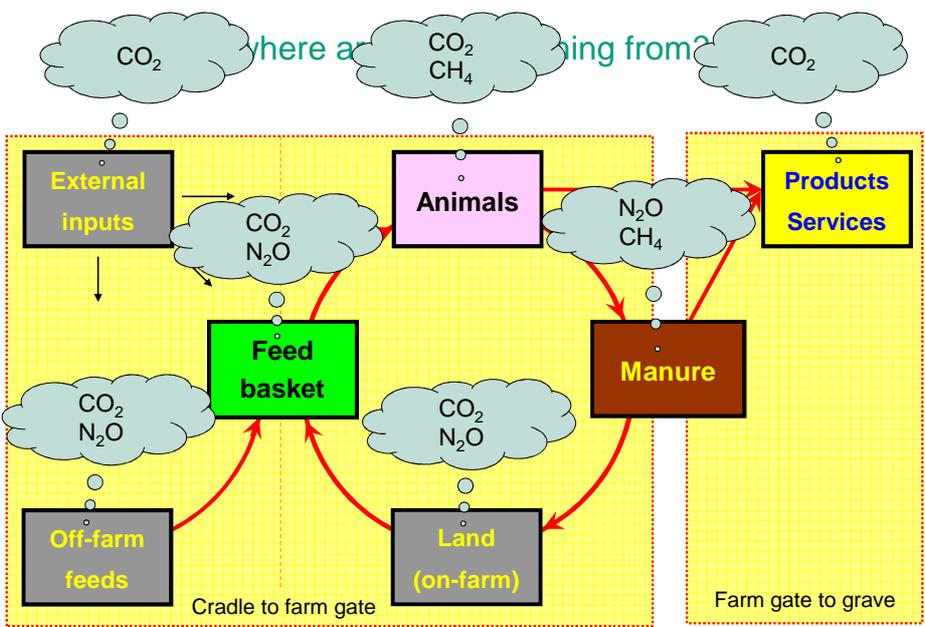
3 contrasting sheep systems



- 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.

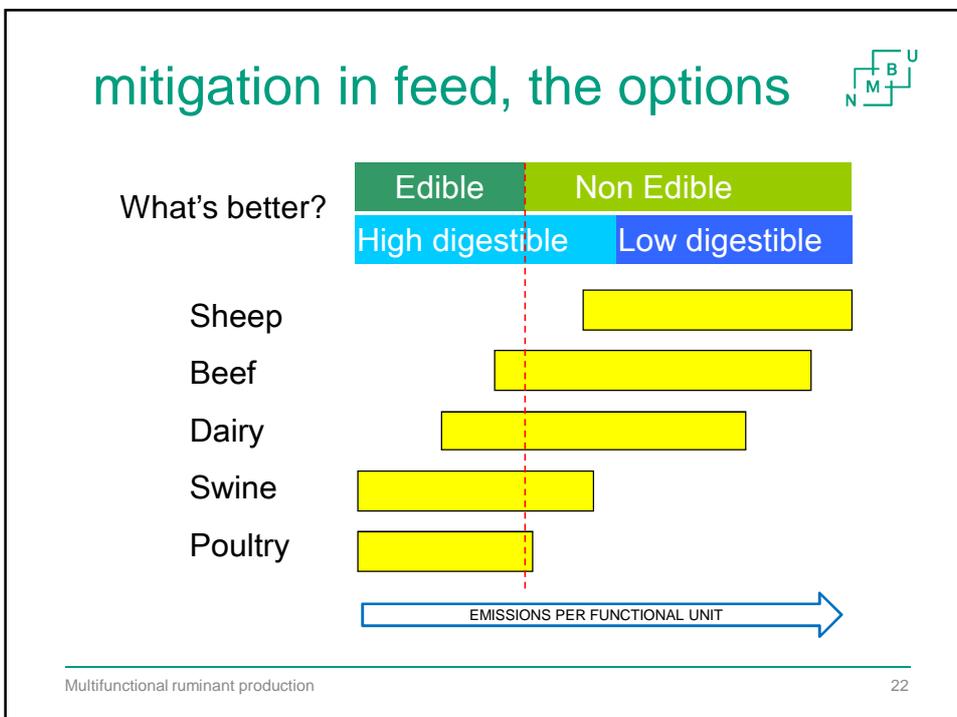
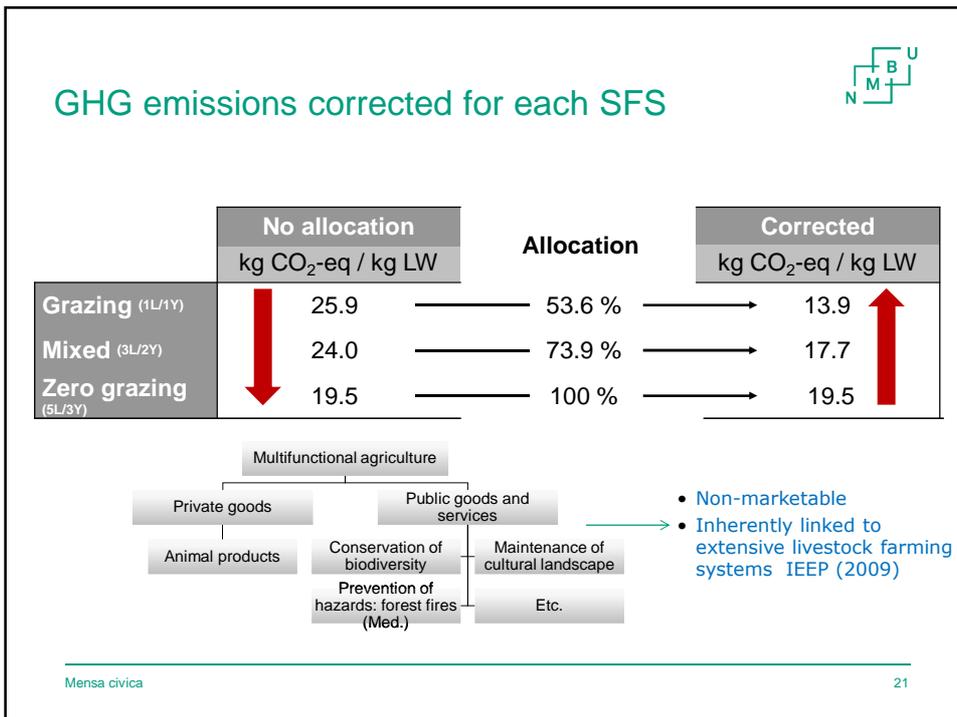


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3. multifunctionality



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a definition...



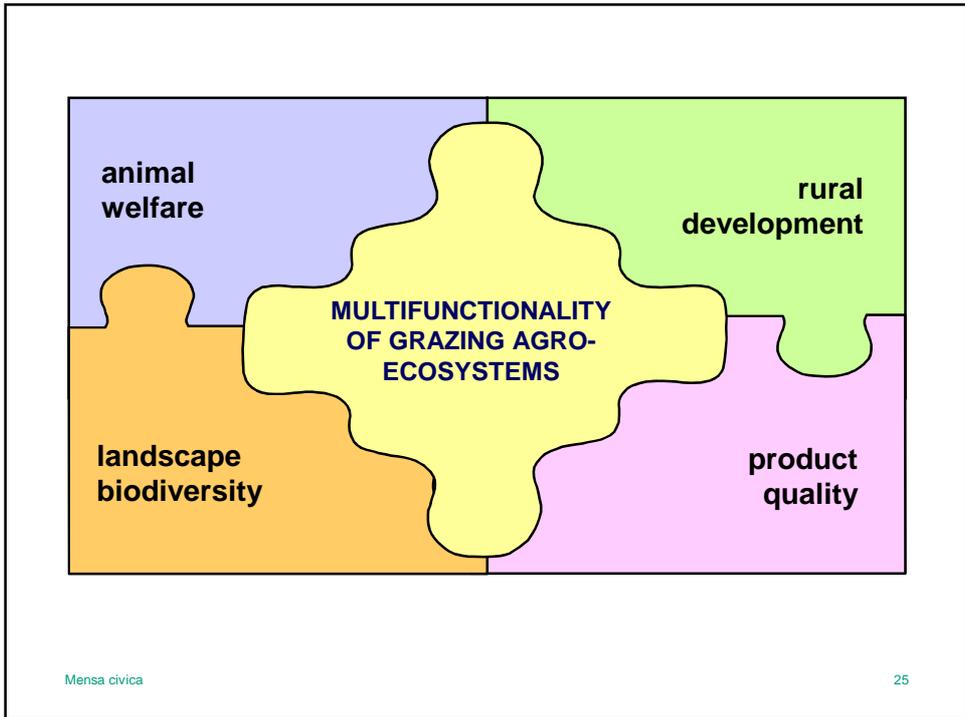
Multifunctionality is a **systems** oriented concept. It addresses the fact that in addition to the provision of private goods like food and fibre, agriculture also provides a set of **public goods**.

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.

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drivers of biodiversity loss in Europe

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

Marginalization/abandonment of HNVF

Intensification/specialization of agriculture

Biodiversity conservation
Provision of public goods

greater biodiversity index = HNVF = semi-natural grassland

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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

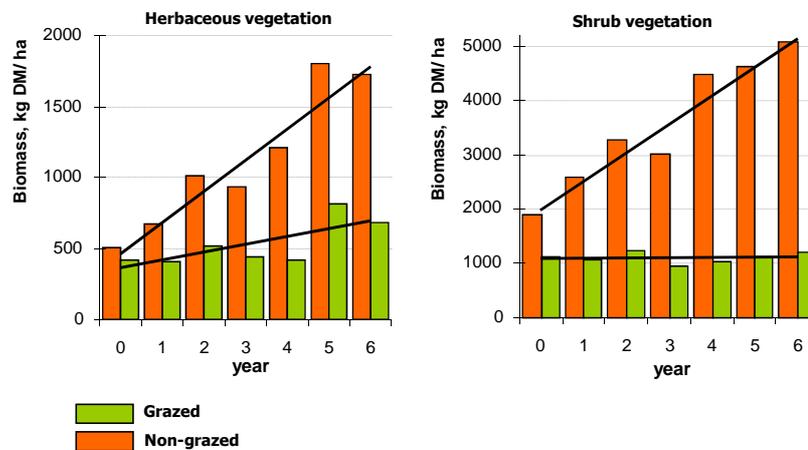
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Key 10 – 19 high-scoring practices
20+ high-scoring practices

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effect of grazing on vegetation

250 ha *Pinus nigra*
0.2 LU/ ha





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



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Ecosystem Services valuation: socio-cultural






Category	Service	Farmer Valuation (%)	Citizen Valuation (%)
Producing	Food (meat and milk)	25	25
	Raw materials (firewood, forage)	10	25
	Water	5	10
	Genetic resources	5	10
	Medicinal resources	5	10
Regulating	Ornamental resources	5	10
	Disturbance prevention (forest fires)	15	15
	Water purification/ waste management	10	15
	Soil fertility/ erosion prevention	10	15
	Air quality regulation	5	10
Supporting	Regulation of water flows	5	10
	Climate regulation (incl. C. seq.)	5	10
	Pollination	5	10
	Biological control (pests)	10	15
	Gene pool protection (biodiversity maintenance)	10	15
Cultural	Lifecycle maintenance (nutrient cycling, photosynthesis)	10	15
	Aesthetic (landscape/ vegetation)	10	15
	Recreation/ tourism	10	15
	Spiritual experience	10	15
	Culture/ art	10	15
	Education/ cognitive dev.	10	15

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Ecosystem Services valuation: economic

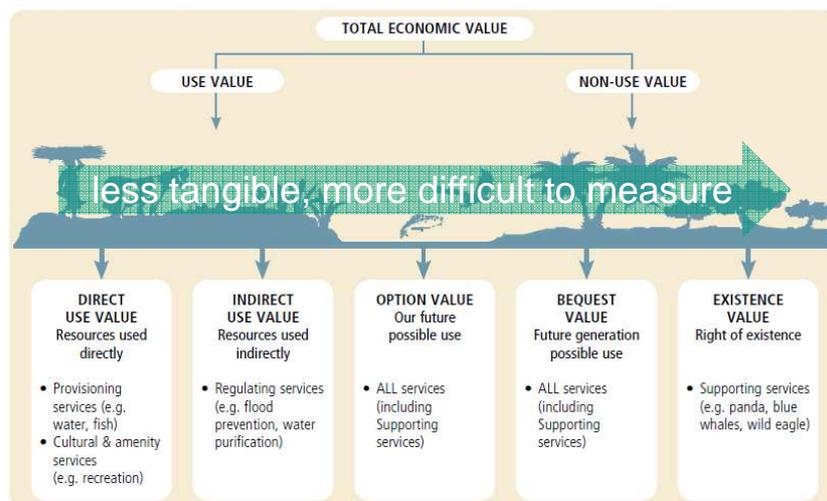
How do we measure ES/public goods?



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 or 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

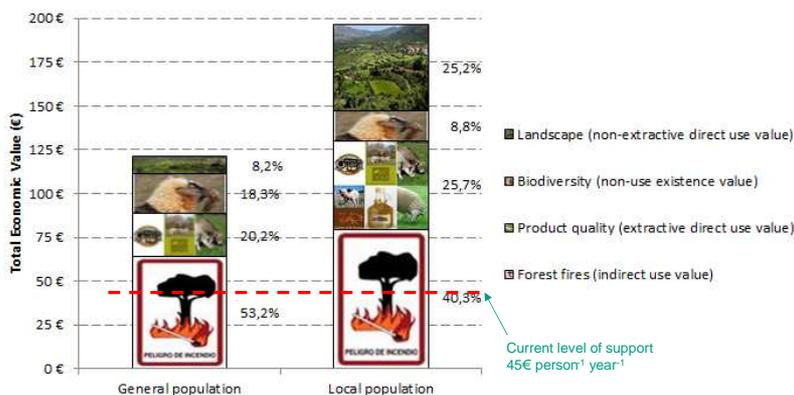


	Policy A	Policy B	CURRENT policy
Landscape	 strong increment of bushes reduction of meadows and crops	 light decrement of bushes light increment of meadows and crops	 light increment of bushes meadows and crops are maintained
Bearded vulture	 7 pairs	 15 pairs	 11 pairs
Forest fires	 6 forest fires per 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	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C



Example of ES quantification: economic

Total Economic Value (TEV) (€ person⁻¹ year⁻¹)



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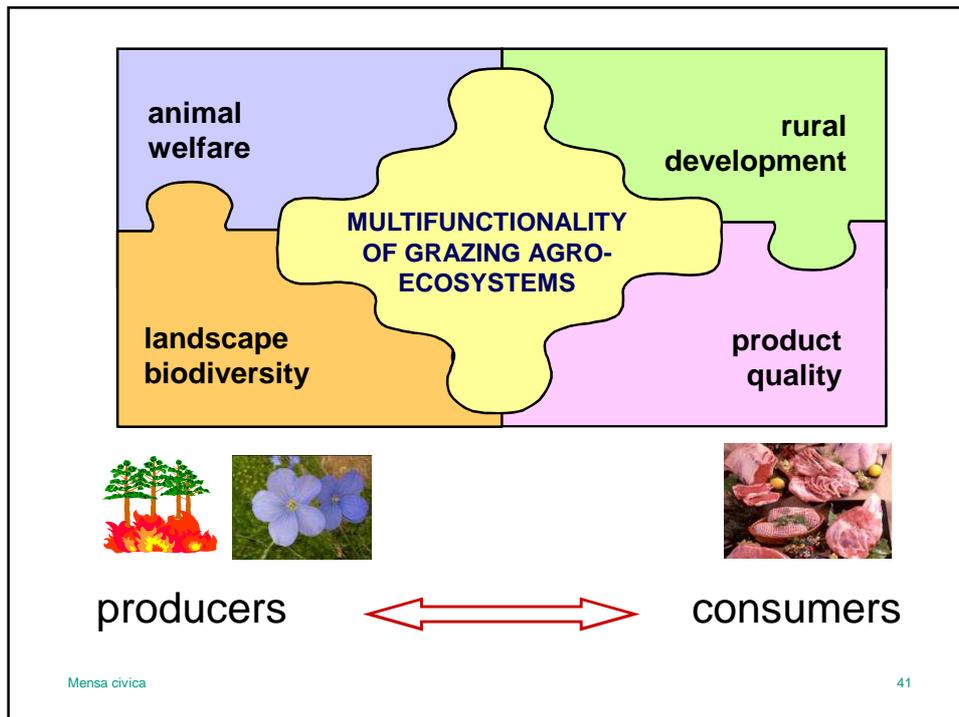
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3.2 food quality: conservation of natural resources as extrinsic quality attribute



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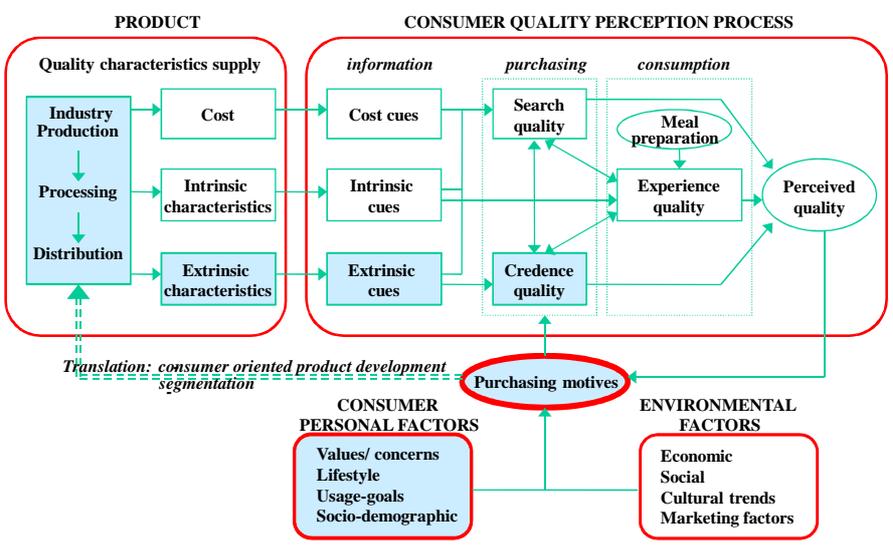
the “perceived quality approach”

- 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

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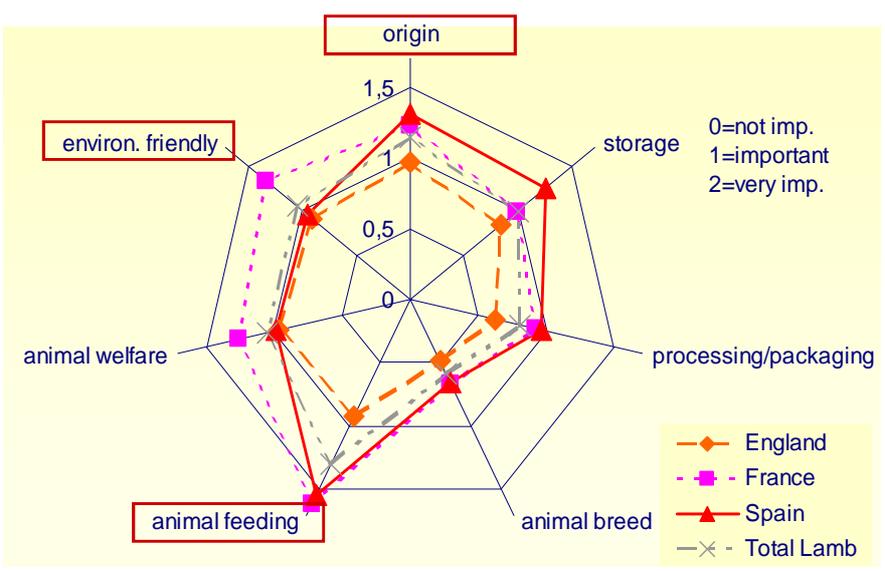
conceptual model of perceived quality



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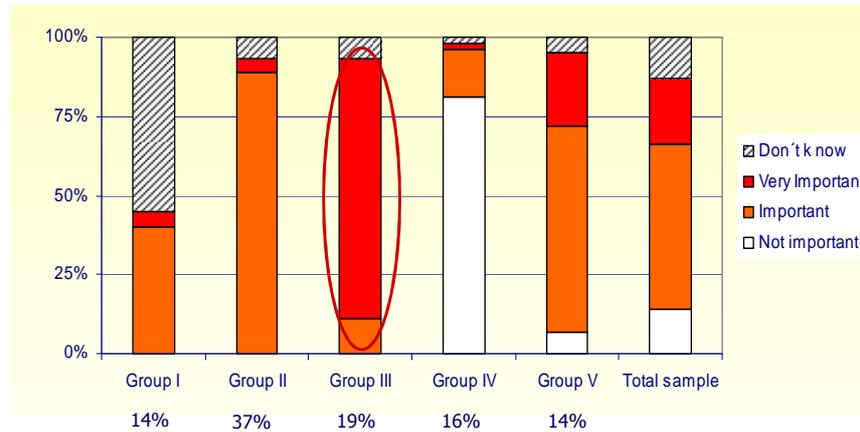
importance of lamb extrinsic quality attributes



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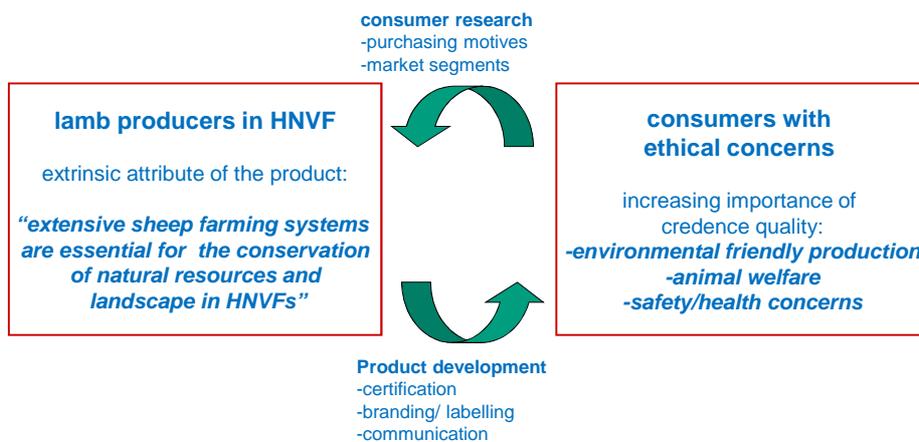
importance of “environmental friendly” production of lamb for different groups of consumers in Aragón



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linking producers and consumers: “consumer-led product development”



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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 \neq 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