



Evaluating ecosystem services and disservices of livestock agroecosystems for targeted policy design and management

Alberto Bernués, Tamara Rodríguez-Ortega, Ana Olaizola, Raimon Ripoll-Bosch

Outline

1. Introduction: ES and EDS of pasture-based livestock systems
2. ES valuation and management (PES)
 - Effect of farming practices on ES
 - PES framework
3. EDS valuation (LCA)

1. Introduction

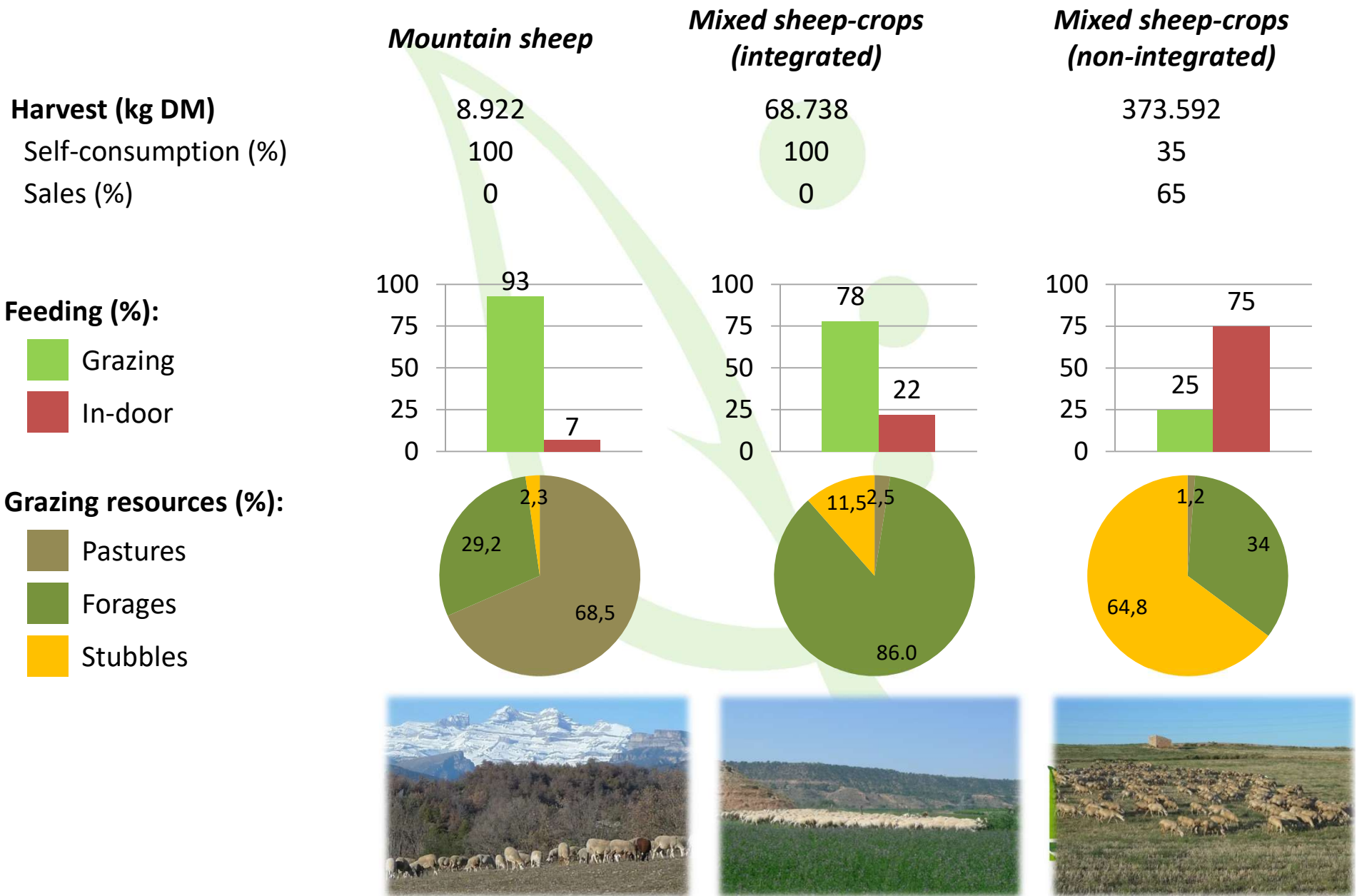
intensive vs. extensive



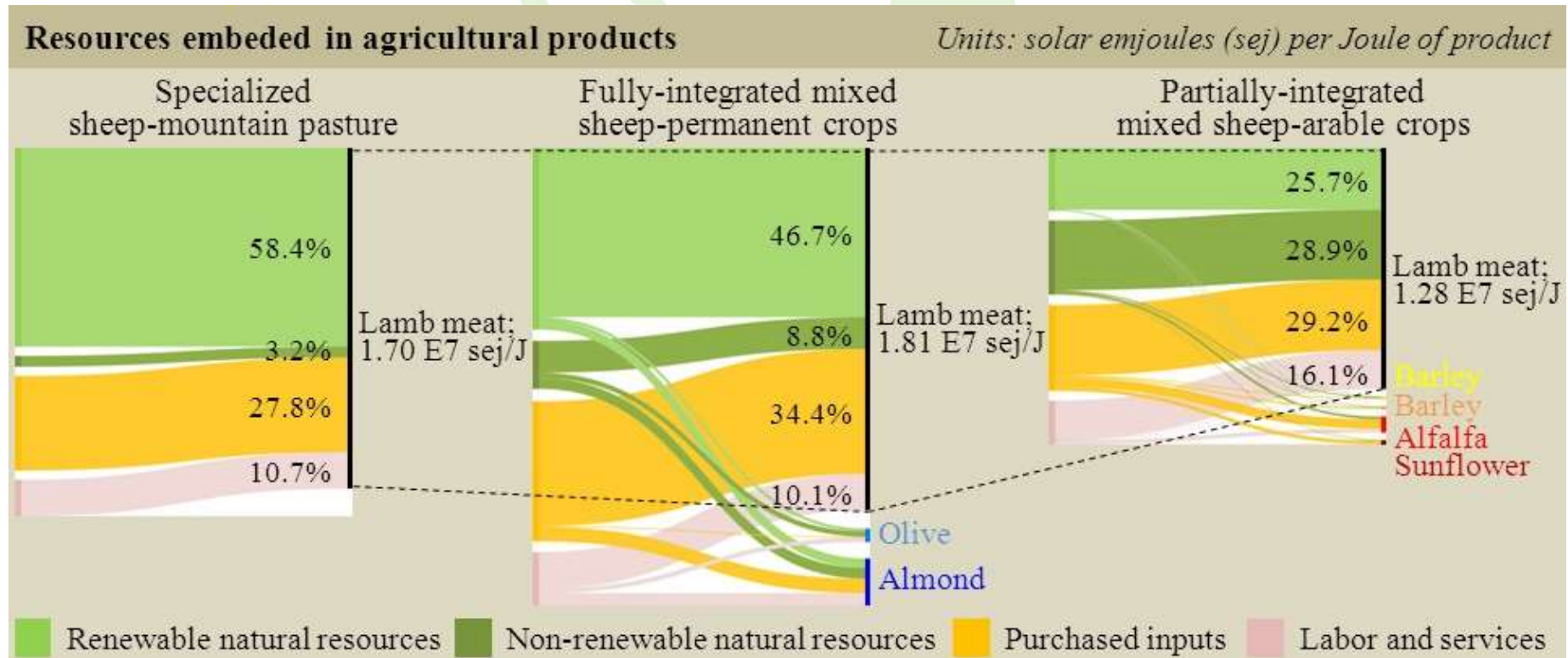
Imported feeds
Small (zero) land areas
High input
High output
No multifunctional
Ecosystem disservices
...

Natural resources
Large land areas
Low input
Low output
Multifunctional
Ecosystem services
...

Diversity of systems



E.g. resources embedded in lamb meat

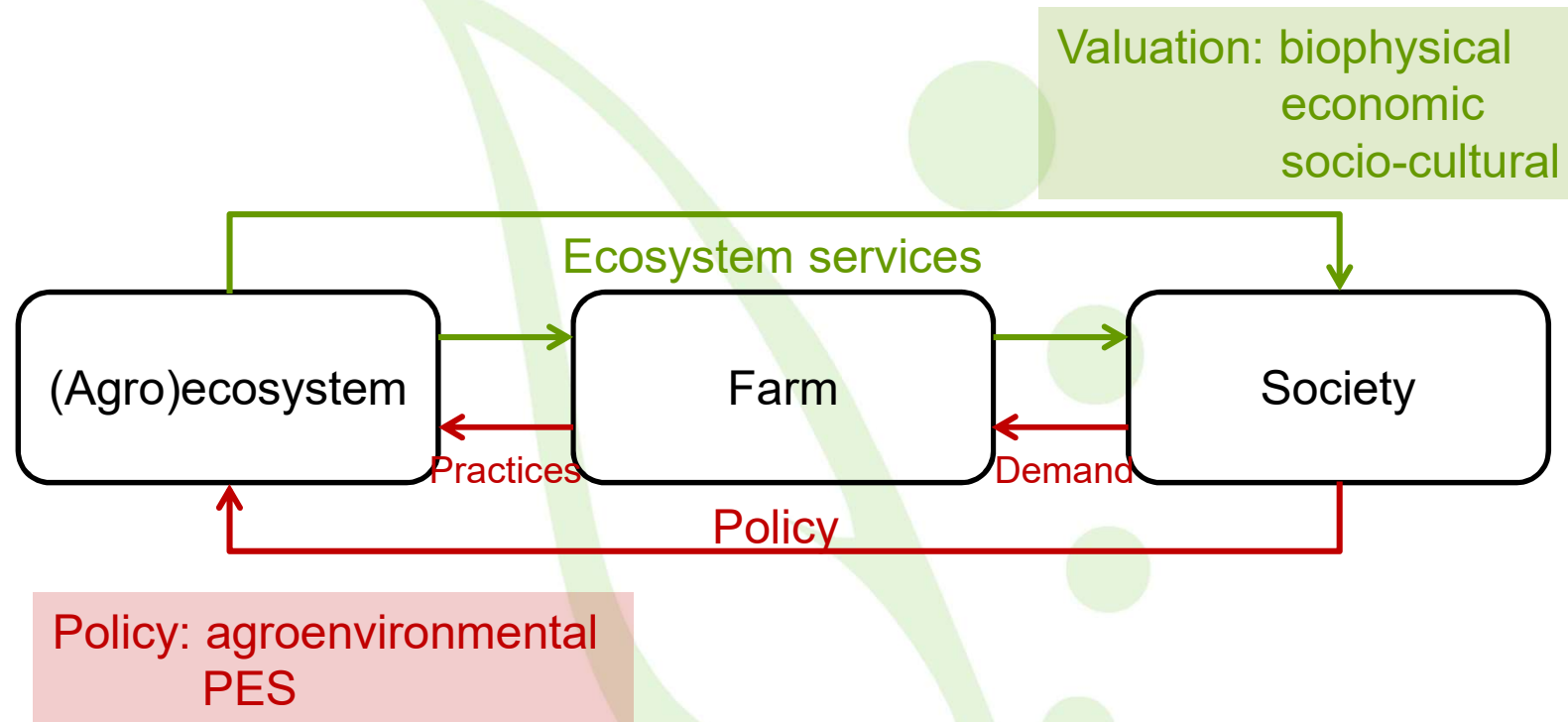


Rodriguez-Ortega et al. (2017)

2. ES valuation and management (PES)



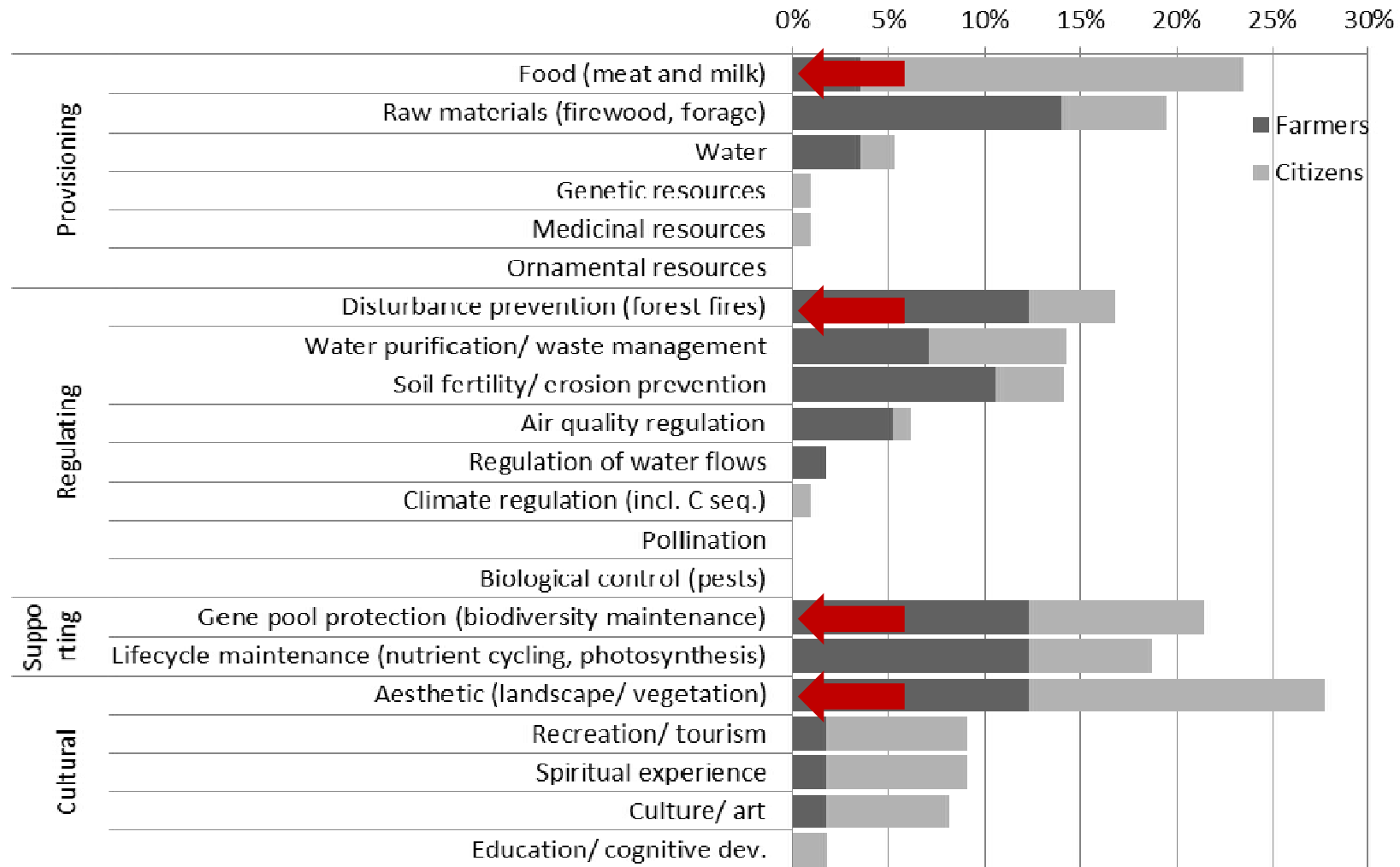
ES framework



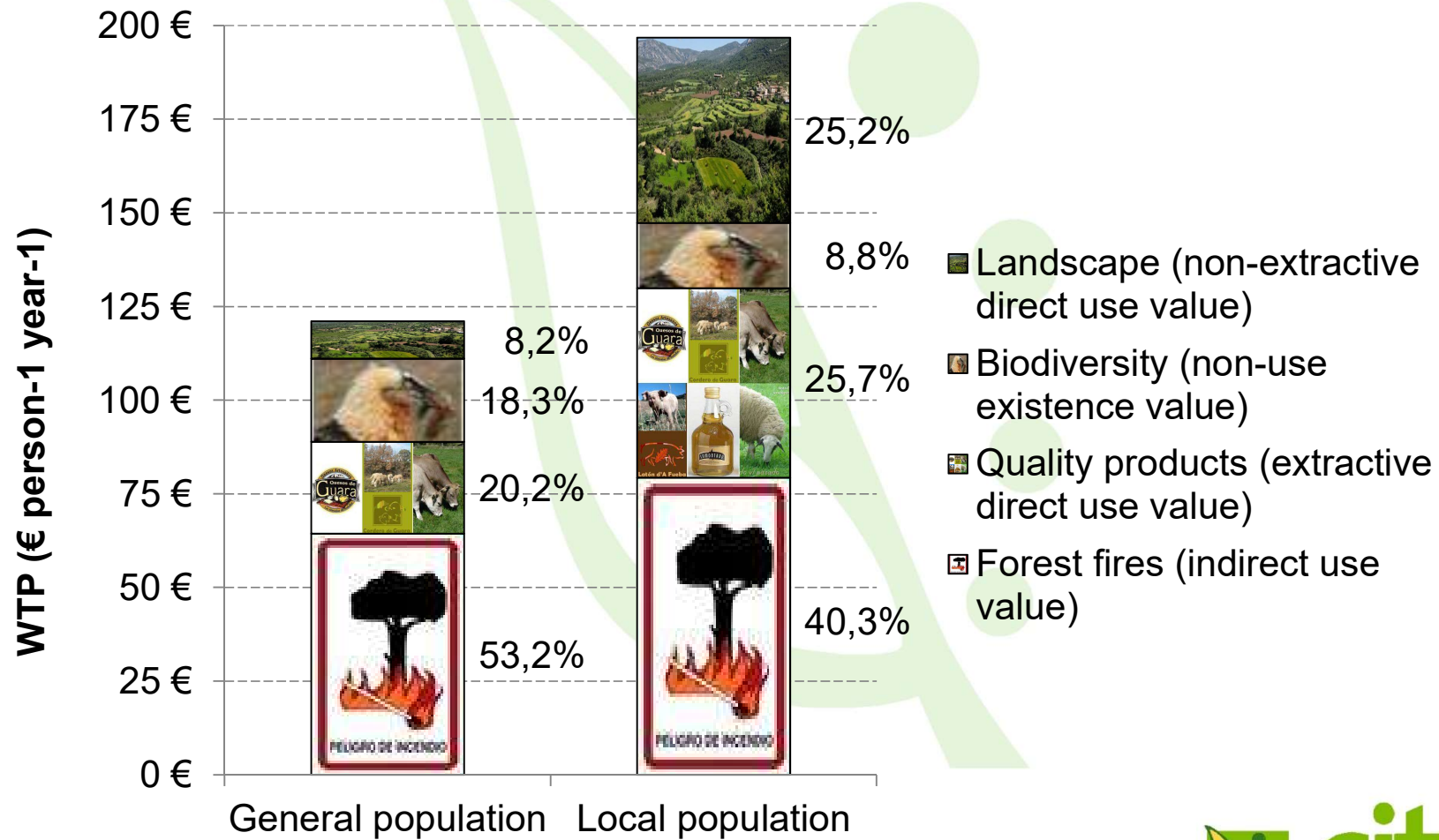
Objectives

- Evaluate, according to expert knowledge, the contribution of farming practices to ES in Mediterranean agro-ecosystems
- Design a PES system based on management

What ES are relevant to society?



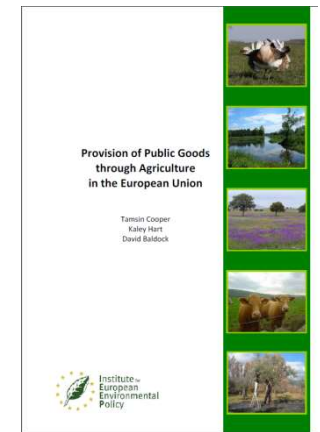
What ES are relevant to society?



Bernués et al. (2014)

Effect of agricultural practices on ES

- 10 sheep and mixed farms monitored
- 36 farming practices (out of 66 possible)
- Delphi panel (2 rounds)
 - Researches (n=29)
 - Technicians/managers (n=32)
 - Self appraisal on knowledge
 - Contribution of practices to ES (Likert scale: 0 none to 5 very high)



Effect of agricultural practices on ES

Ranking	Landscape	Biodiversity	Wildfires	Carbon seq.	Quality prod.
1st	35	23	36	22	10
2nd	1	1	30	20	32
3 th	4	35	29	1	23
4 th	32	2	32	35	27
5 th	2	4	31	2	26
...36 th

FARMING PRACTICES

1 - Maintaining semi-natural vegetation (trees and shrubs) of the area

2 - Maintaining grasslands

4 - Retention of hedges, shrubs and trees among arable fields

10 - Growing locally adapted crop varieties and breeds

20 - Reducing ploughing/tilling

22 - Utilizing manure correctly

23 - Reducing pesticide use

26 - Reducing proportion of animal concentrates

27 - Reducing off-farm dependency (e.g. feed, fertilizers)

29 - Grazing in semi-natural habitats

30 - Grazing in remote and/or abandoned areas

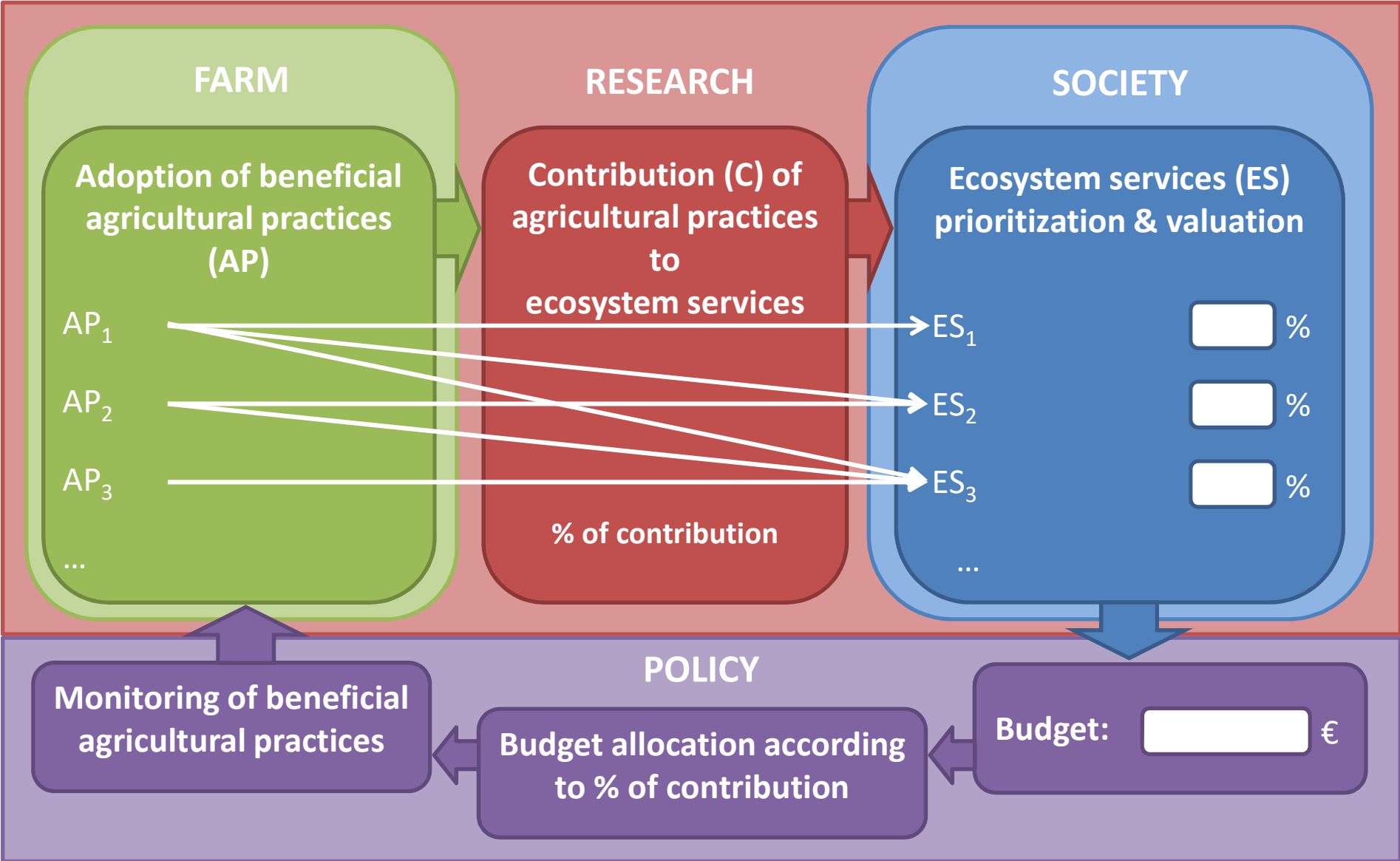
31 - Grazing with several species (mixed or sequential grazing)

32 - Moving flocks seasonally between areas (e.g. from valley to mountain)

35 - Adapting stocking rate to the carrying capacity of agro-ecosystem

36 - Active management of forest (forestry/silviculture)

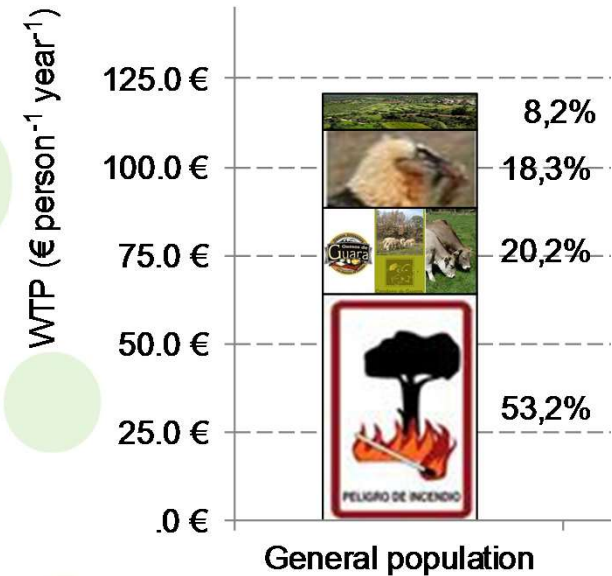
PES design



An example

‘Sierra and Cañones de Guara’ Natural Park

Based on **Preference** of population
according to their WTP for ES



Top 5 farming practices

- 1°. Moving flocks seasonally between areas (e.g. from valley to mountains)
- 2°. Grazing in semi-natural habitats
- 3°. Active management of forest (forestry/silviculture)
- 4°. Maintaining grasslands
- 5°. Extend grazing annual period

3. EDS valuation (LCA)

e.g. carbon footprint of lamb: a comparison of three contrasting Mediterranean systems



3 contrasting sheep systems

1. Grazing or pastoral system:

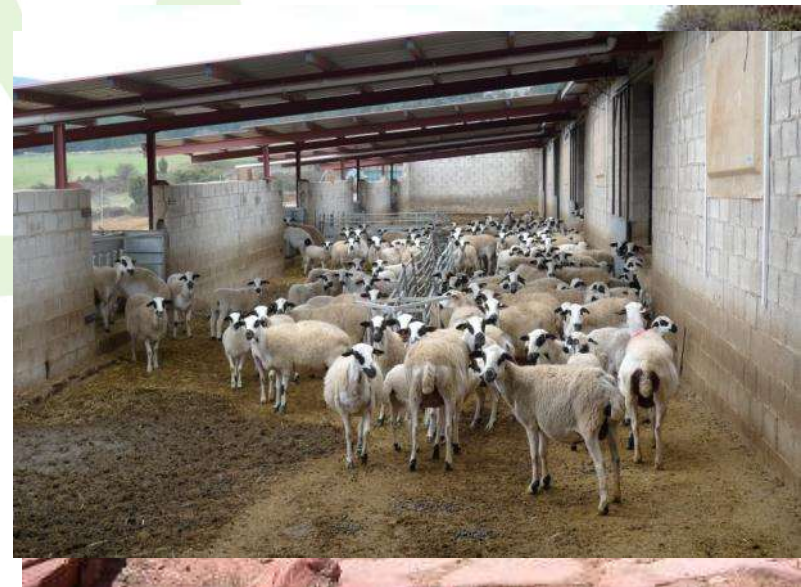
- Alpine mountains.
- 1 lambing per ewe per year.
- Free ranging.

2. Mixed sheep-cereal crop system:

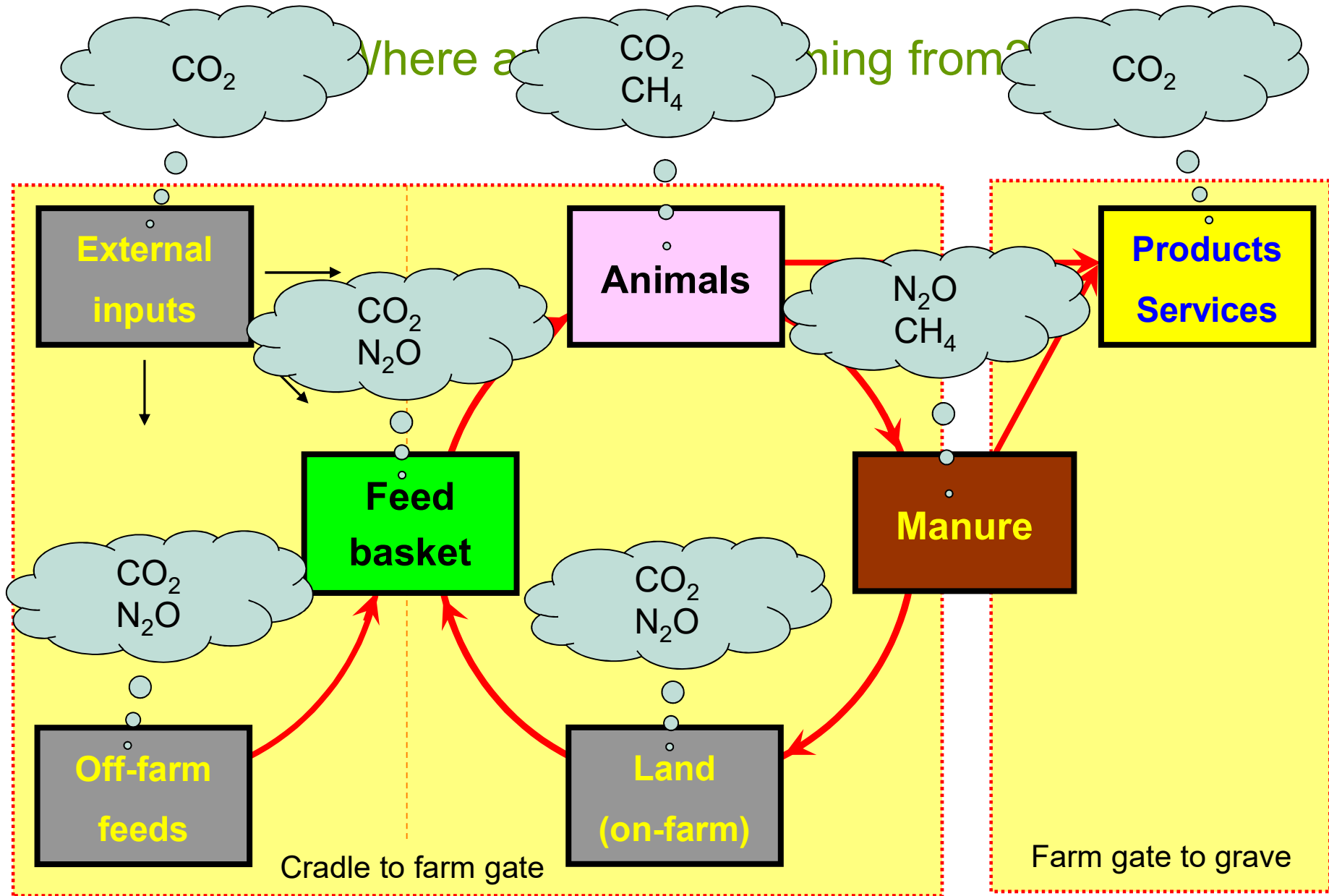
- Mid-altitude Mediterranean ranges and plateaus.
- 3 lambings per ewe every 2 years.
- Grazing daily with shepherd.

3. Industrial system or zero grazing:

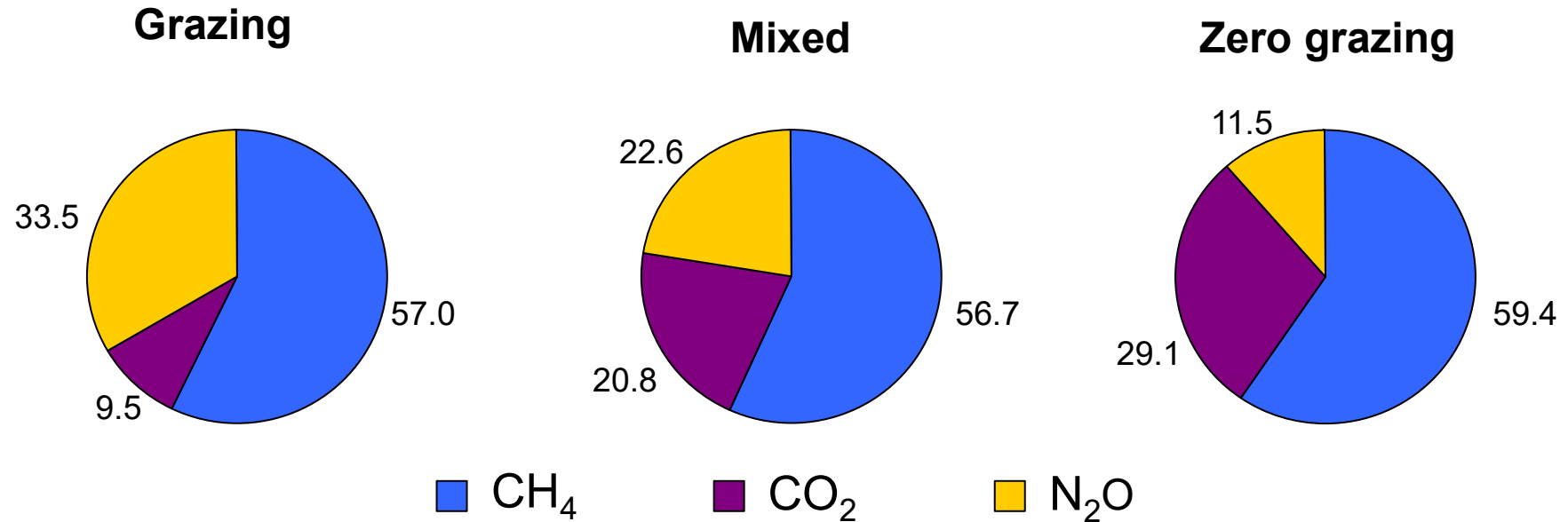
- Low altitude semi-arid conditions.
- 5 lambings per ewe every 3 years.
- Kept indoors all year round.



Where are emissions coming from?



Contribution of CH₄, CO₂ and N₂O in % to total emissions

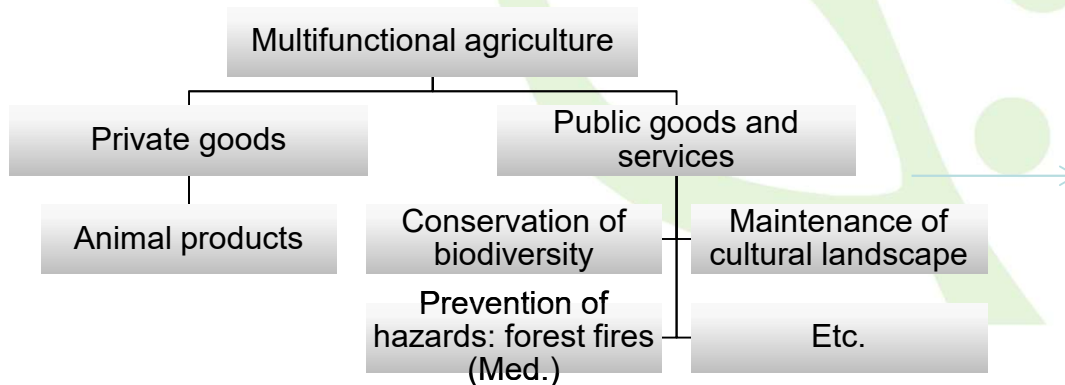


- CH₄ is the major contributor in each SFS and remains almost steady across the systems.
- N₂O and CO₂ contribution vary depending on the system.
 - Use of fossil fuels is responsible for differences of CO₂ contribution.
 - Deposition of manure on pastures is related to high N₂O emissions.

Trade-offs within sustainability pillars

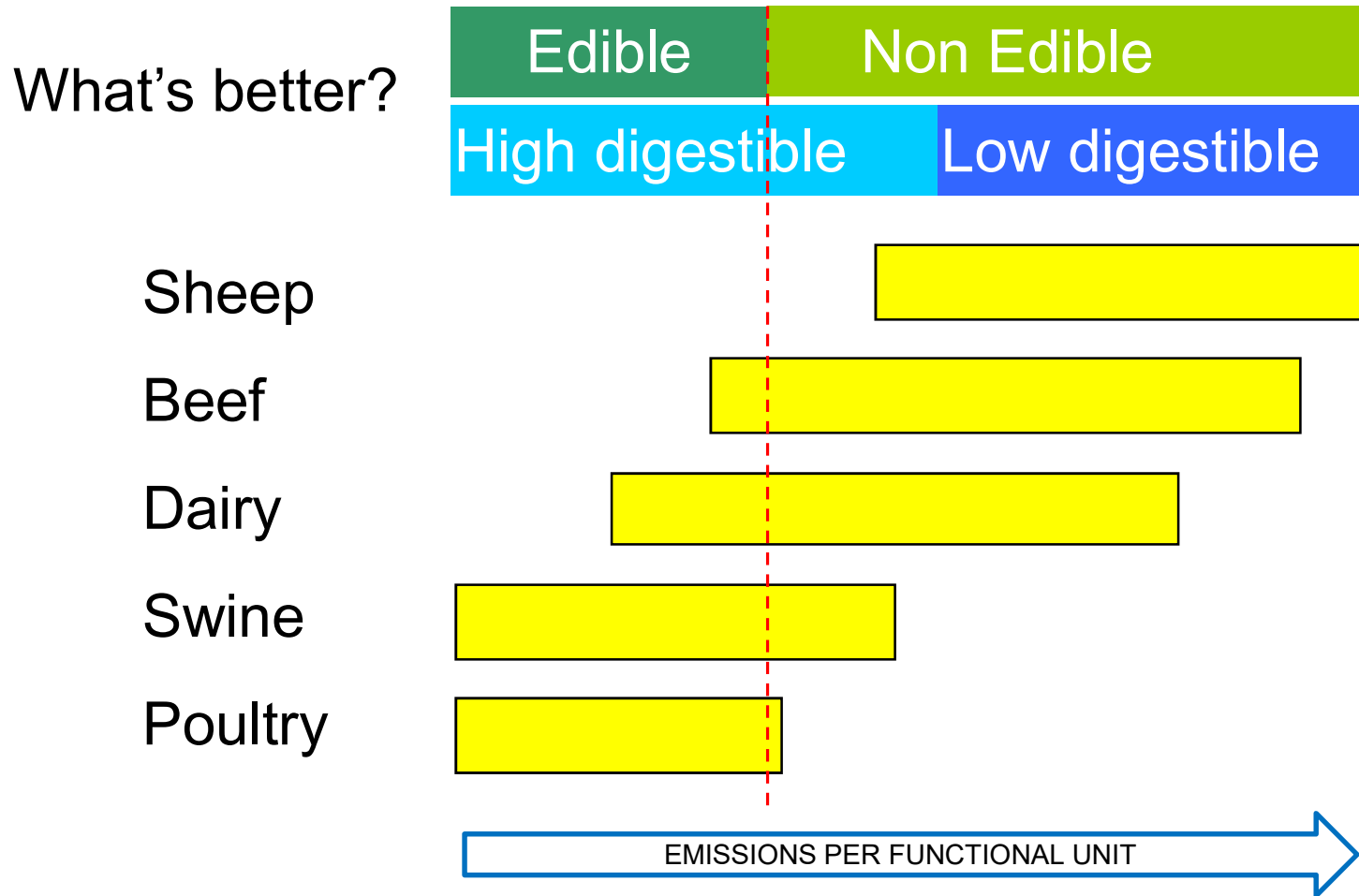
E.g. carbon footprint of lamb meat and ES

	No allocation		Allocation	Corrected	
	kg CO ₂ -eq / kg LW			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



Other limitations

- Direct comparisons are difficult: functional unit, system boundary, allocation method...
- Land use issues: communal pastures, transhumance...
- Carbon sequestration: sequestration potential, soil dynamics, grassland management...
- Data availability, variability...
- Incorporation of multifunctionality, non-use values...

19th EGF Symposium 2017

“Grassland resources for extensive farming systems in marginal lands: major drivers and future scenarios”

Thank you

