



## MIXED production at the landscape level: an emergy assessment on Montado systems under the same management.

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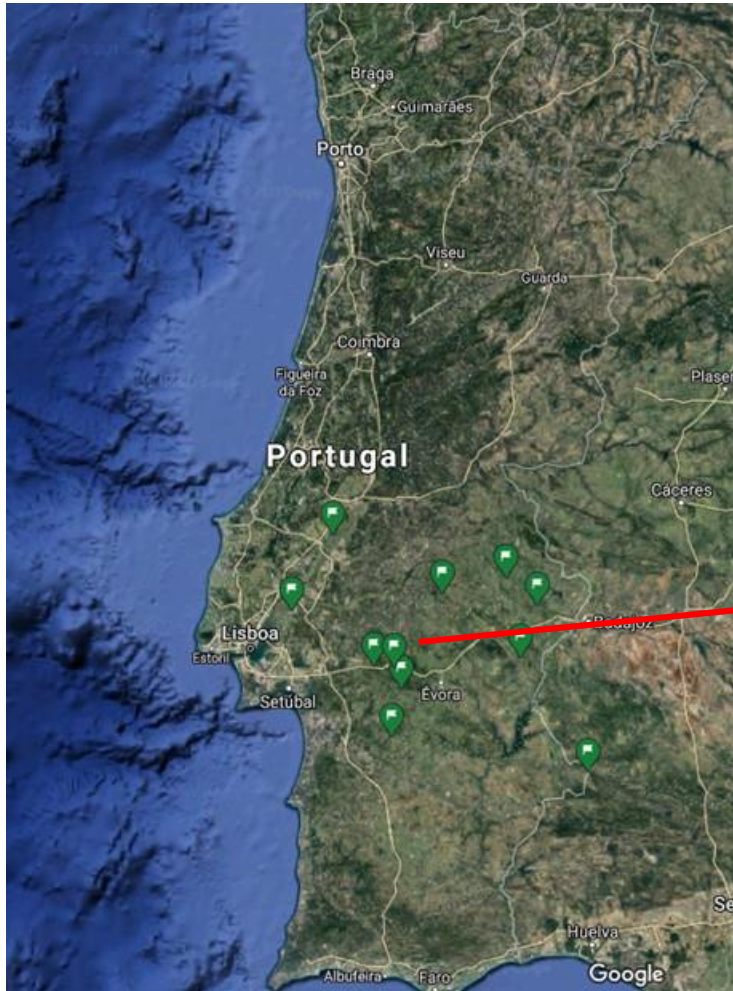
# Context



- ❖ Cultural Landscape
- ❖ High Nature Value (HNV) system
- ❖ Challenges
  - Tree regeneration -> desertification
  - Raise of Cattle -> decrease of local breeds and more traditional livestock (sheep, pigs)
  - Rural abandonment -> decreasing workforce available
  - Depreciation of product's marketed values

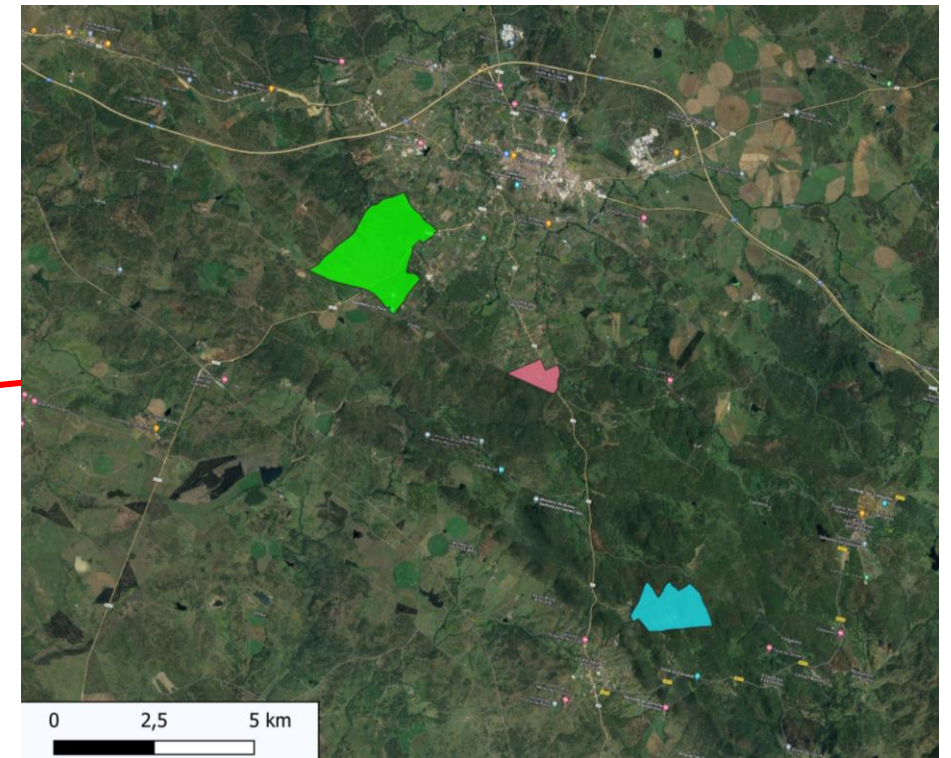


# Case study



Municipality: Montemor-o-Novo

District: Évora



# Case study

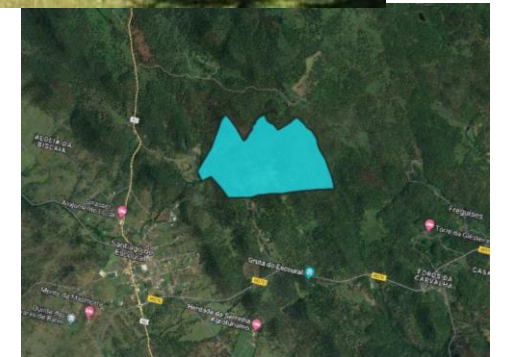


## Terra das Freiras (TF)

- Area: 175 ha
- Sheep:
  - Regional merino sp.
  - 870 sheep / yr
- Forest: ~ 50 trees / ha (98% cork oak, 2% holm oak)



Source: [www.merina.pt](http://www.merina.pt)



# Case study



## Herdade das Lages (HL)

- Area: 440 ha

### Cattle:

- Mixed breed: Charolês (~60%) / Black Breed (~70%)
- 70 cows / yr + 80 calves / yr

### Pigs:

- Black Iberian
- 80 pigs / yr

Forest: ~40 trees/ha

Extra activities: Hunting, wild mushroom and asparagus



# Case study

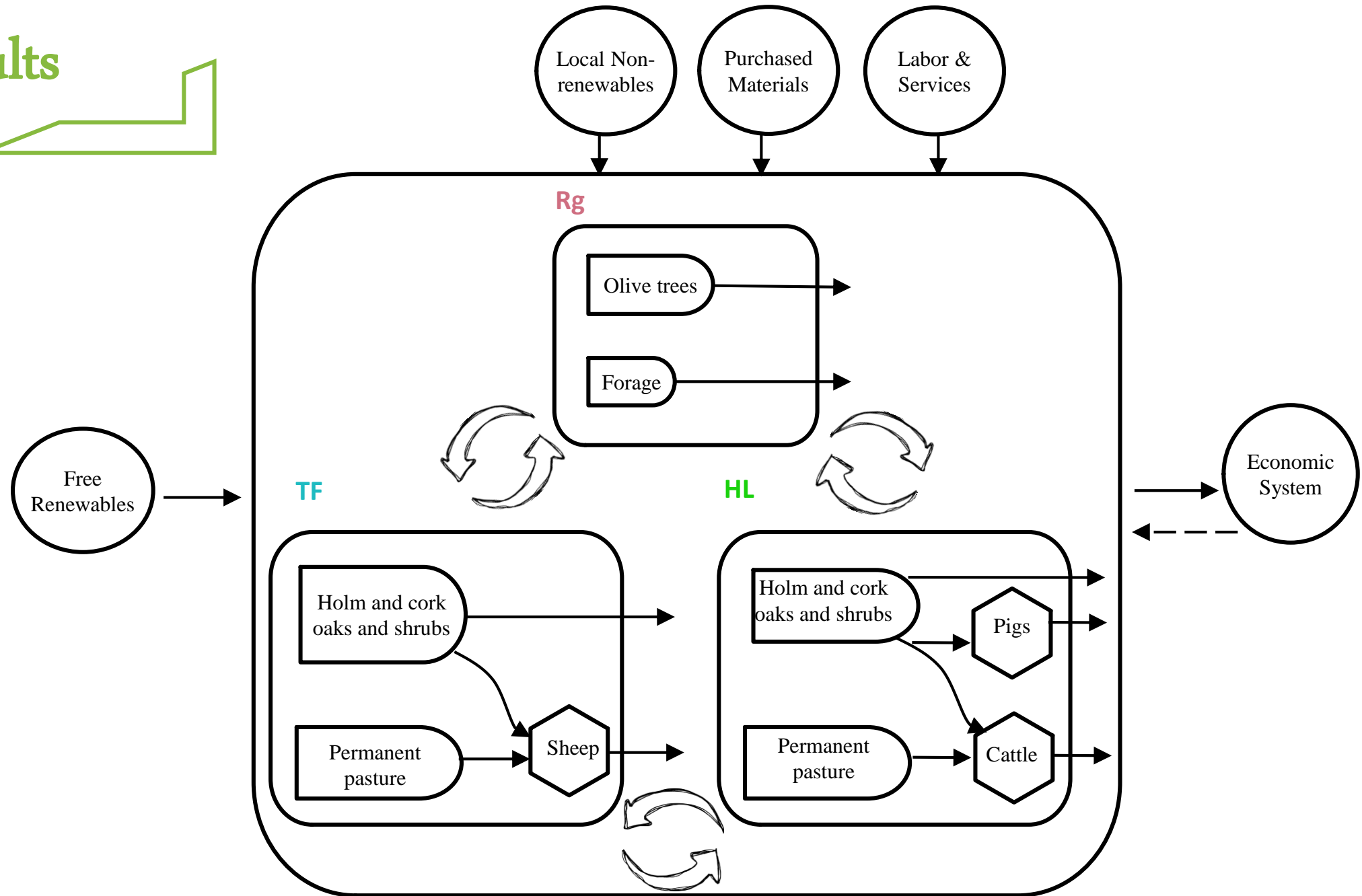


## Reguenginho (Rg)

- Area: 70 ha
- Olive orchard: 50 trees/ha
- 600 bales / yr



# Results





# Emergy



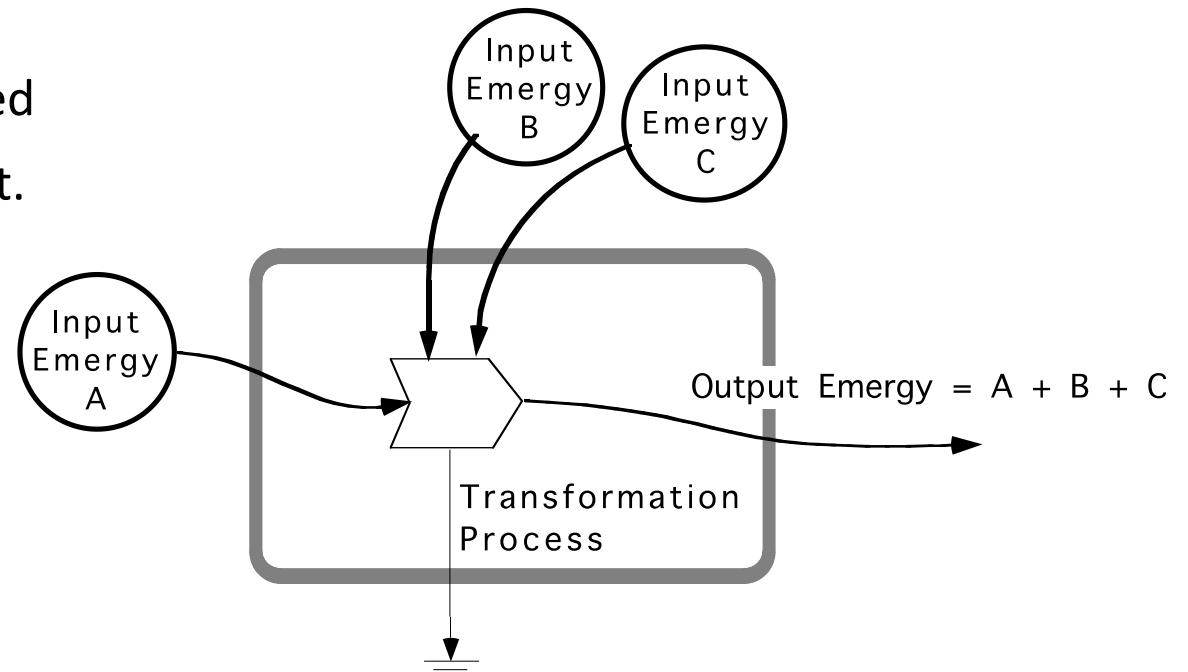
**Definition:** The available energy required directly and indirectly to generate a product or a service.

**Units:** solar emjoules = sej

**Formula:** Emergy (sej) = Raw Units (unit) \* UEV (sej/unit)

UEV – Unit Emergy Value is the amount of energy required to produce a given amount of mass or energy of a product.

Product	UEV	Units
Phosphorous	1.67E+10	sej/g
Limestone	7.23E+06	sej/g
Sun radiation	1	sej/J
Fuels and Lubricants	8.53E+04	sej/J

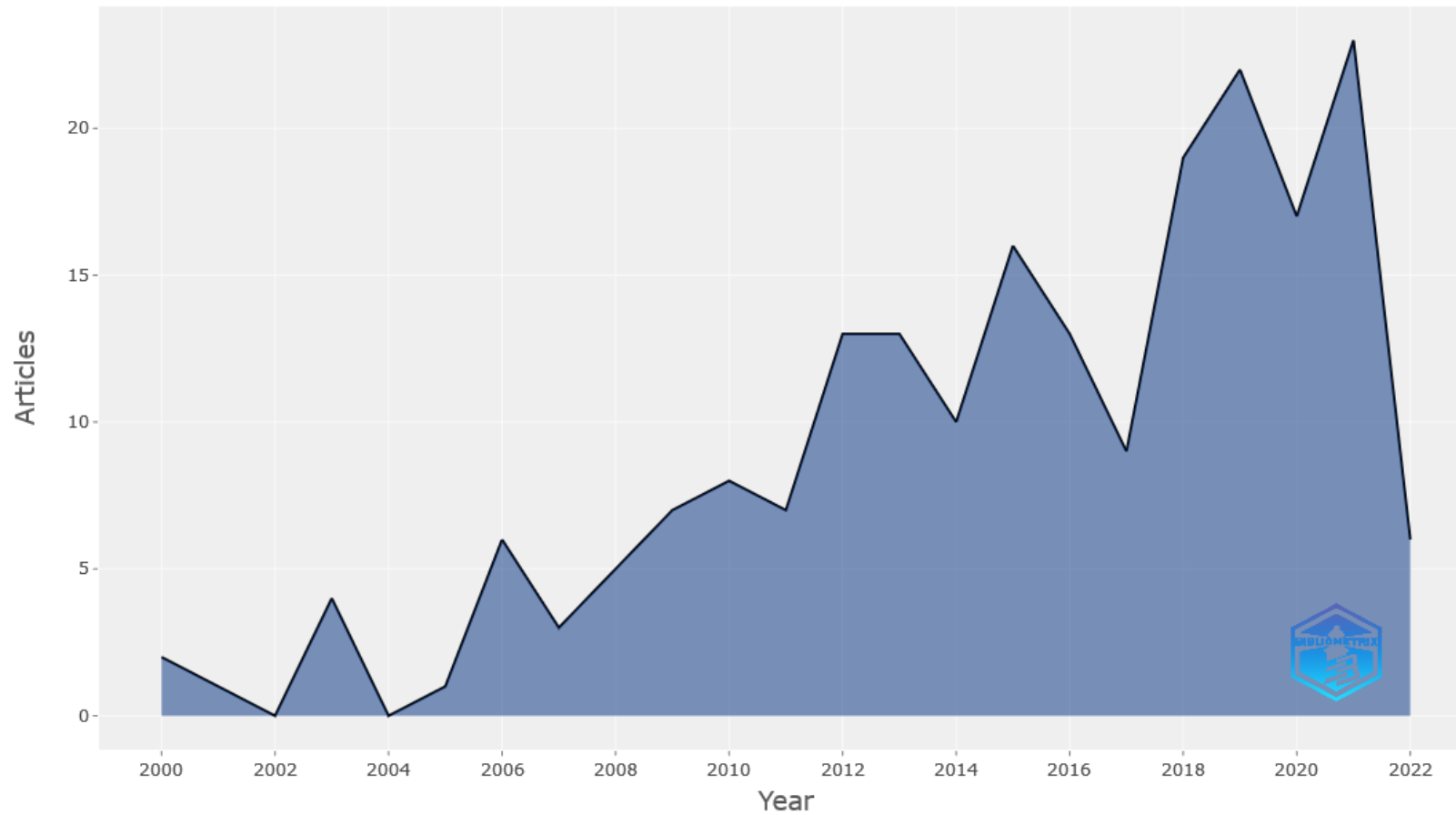


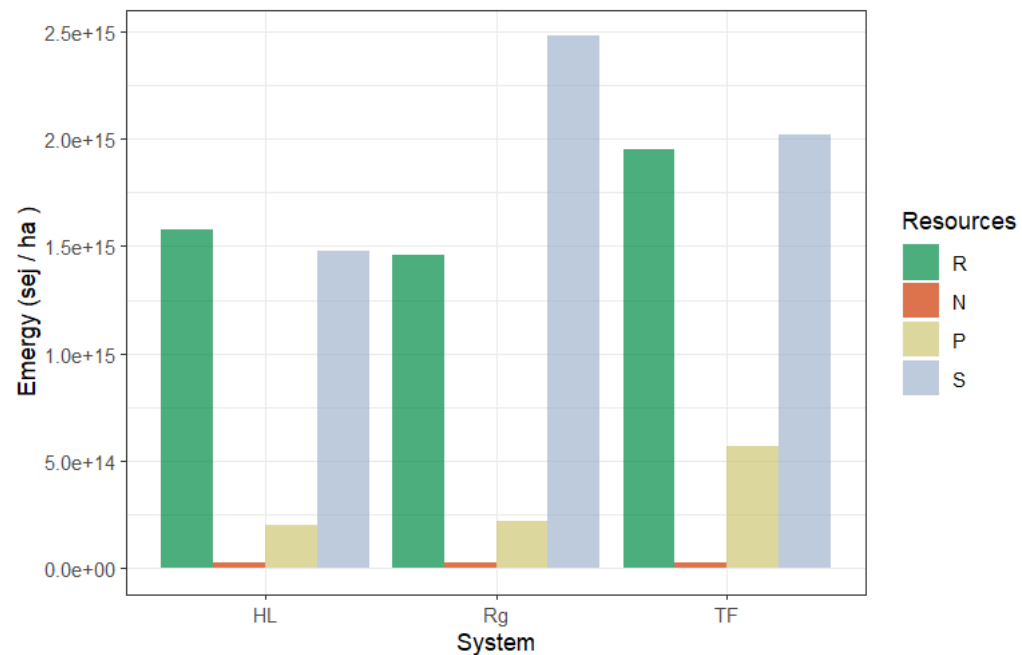
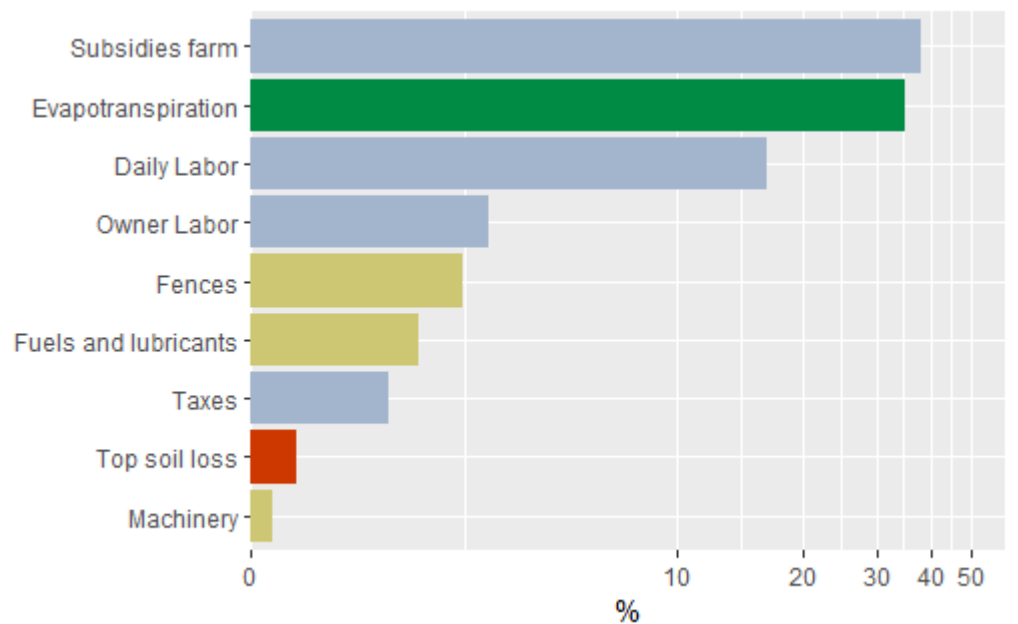
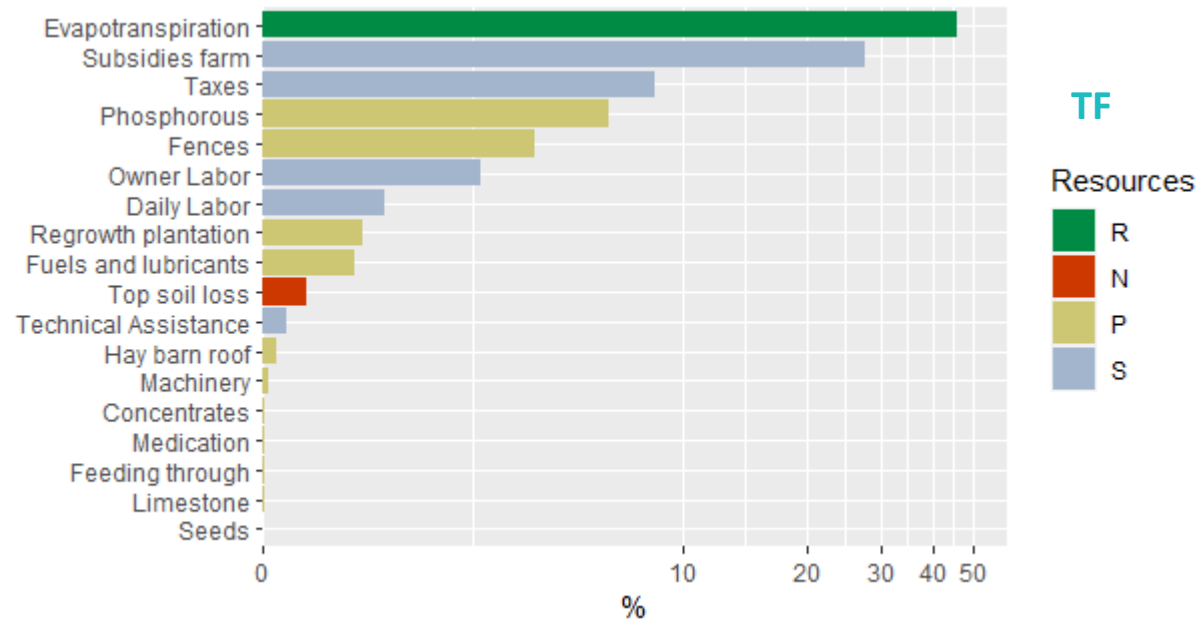
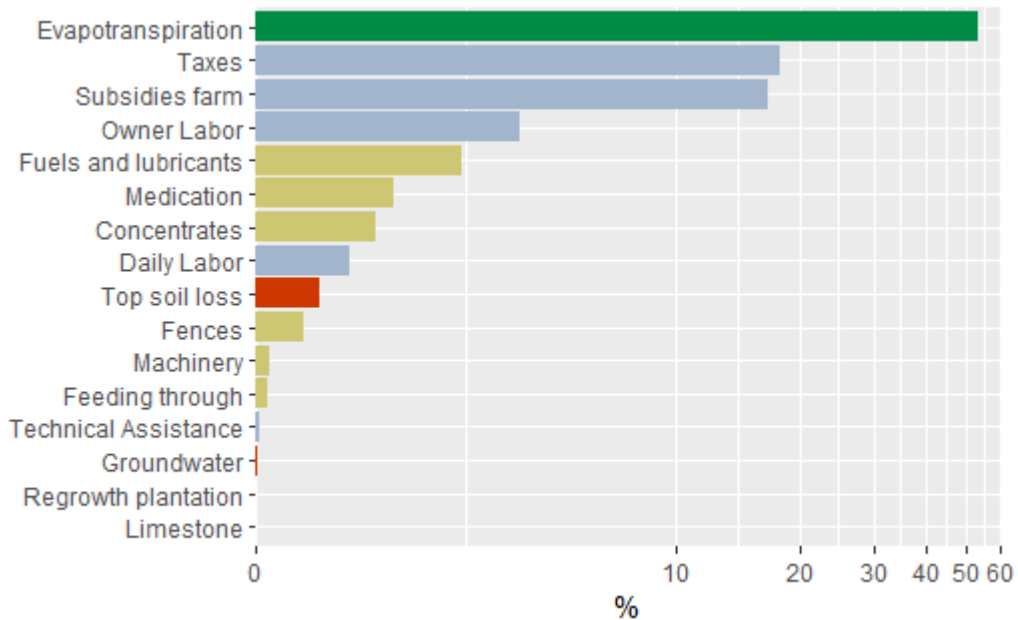
Source: Mark Brown (2022) "Emergy Accounting Introduction" [PowerPoint Slides].

# Emergy



Annual Scientific Production – Emergy method applied to agricultural systems





### Energy Exchange Ratio

$EER < 1$  Energy benefit to the producer

$EER = 1$  Indicates a fair trade

$EER > 1$  Energy benefit to the buyer

### Energy Investment Ratio

**EIR**- Low : Dependable on local resources

**EIR** – High: Most inputs are paid, weakens the competition ability

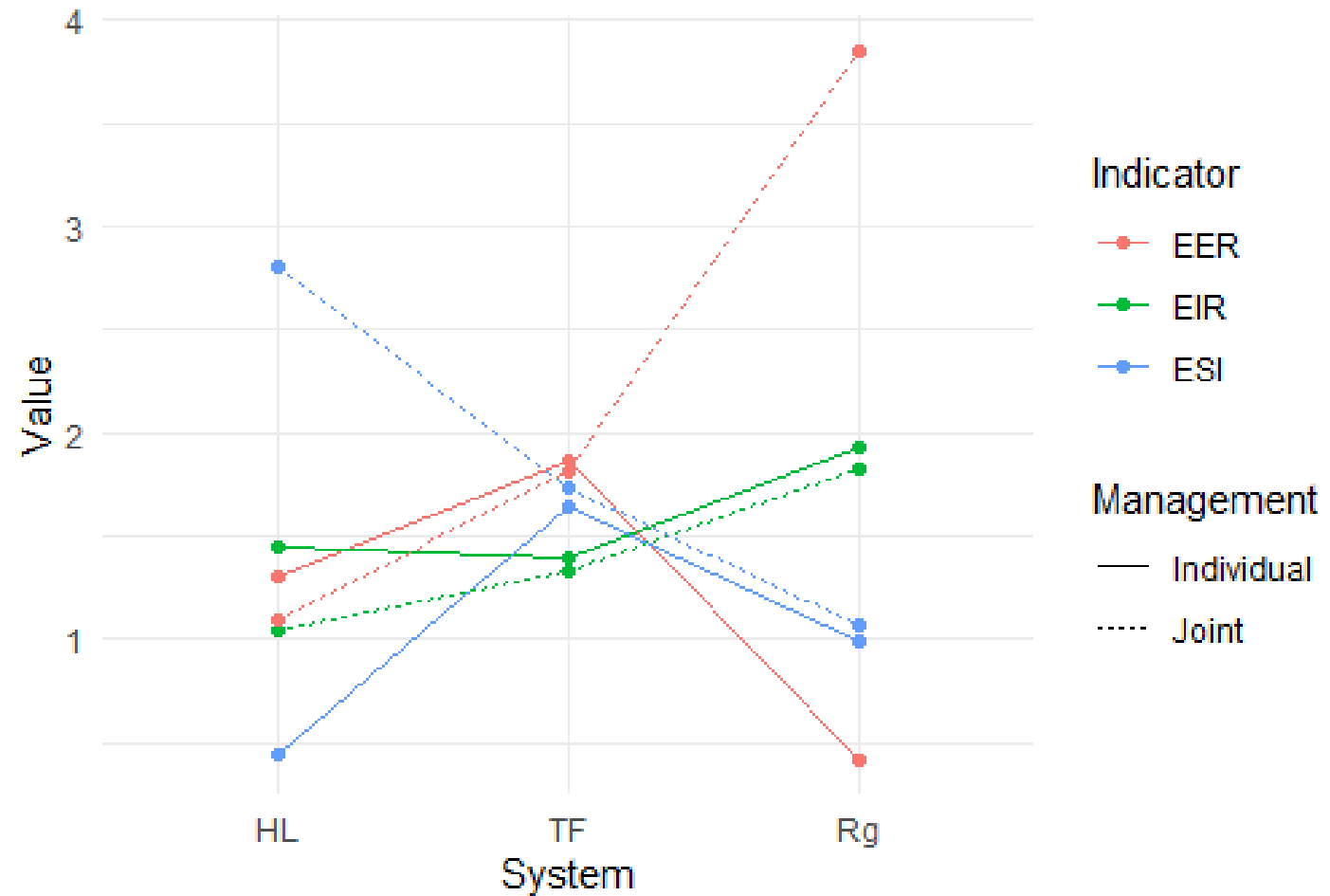
### Energy Sustainability Index

$ESI < 1$  developed consumer-oriented systems

$1 < ESI < 5$  developed economy with low impact

$ESI > 10$  underdeveloped economies

### Indicators for the whole systems



**EER** < 1 Energy benefit to the producer

**EER** = 1 Indicates a fair trade

**EER** > 1 Energy benefit to the buyer

**EIR**- Low : Dependable on local resources

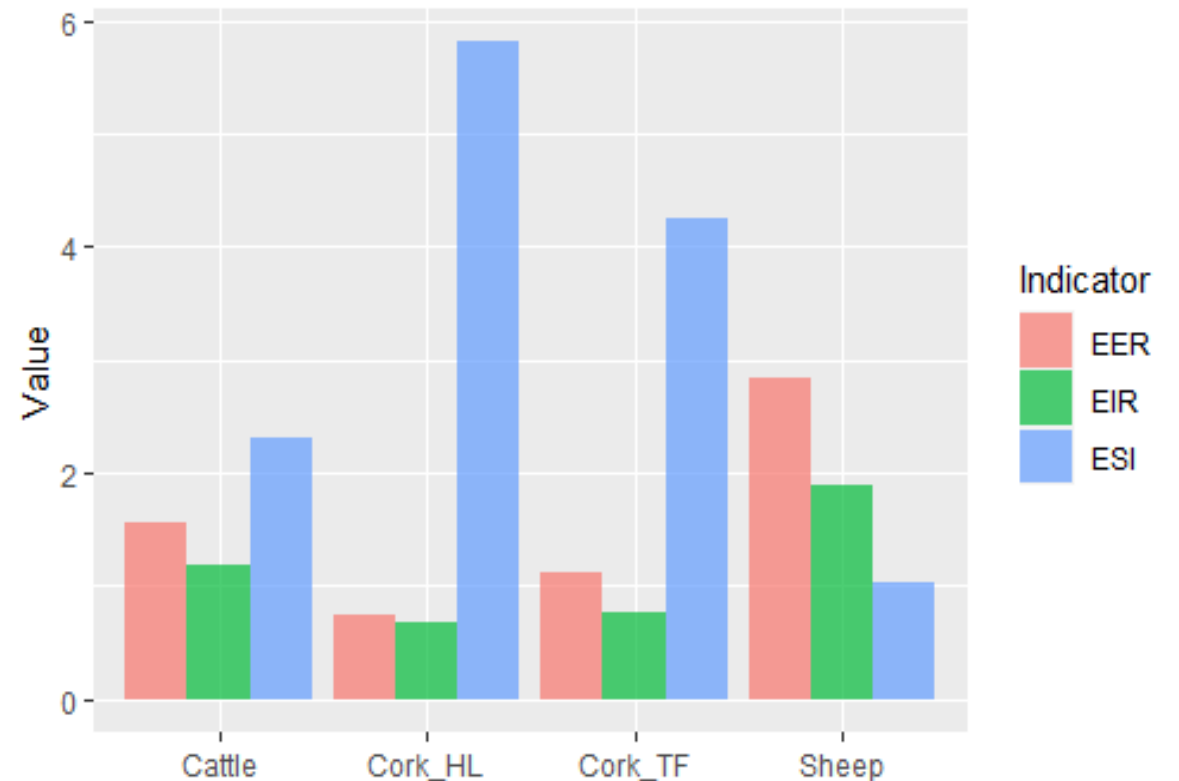
**EIR** – High: Most inputs are paid, weakens the competition ability

**ESI** < 1 developed consumer-oriented systems

1 < **ESI** < 5 developed economy with low impact

**ESI** > 10 underdeveloped economies

**Individual products**



# Conclusions



Sheep production value has not been matched by the market value of its products;

Cattle production is more prone to be less sustainable. Forage purchase can have a big impact on terms of investment and environment;

# Conclusions



A sustainable management of farms should contribute to the differentiation and valorisation of its product;

Multifunctional systems, with an economy of scope, can help mitigate the impacts on investment and on the environment.

# THANK YOU!

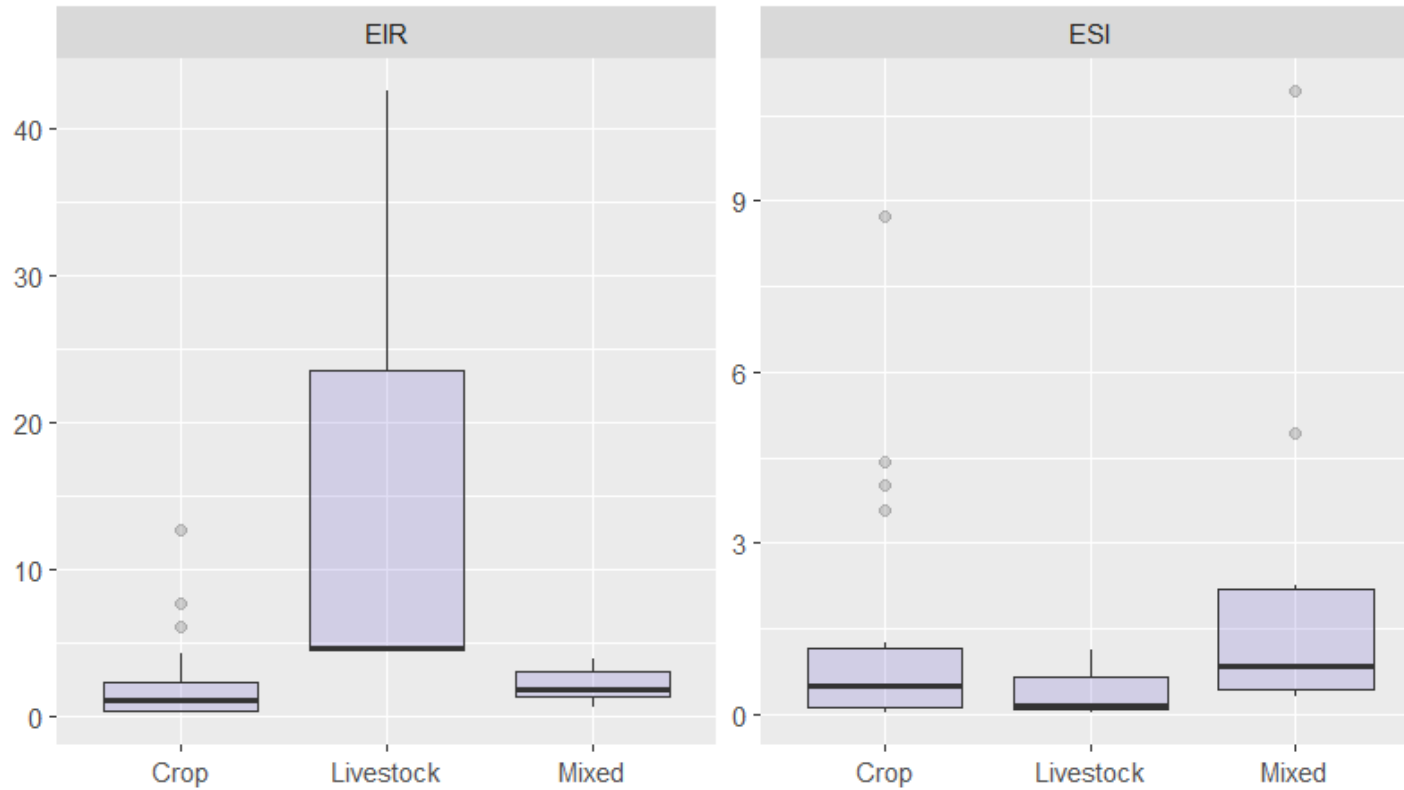


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862357



<b>Indicator</b>	<b>Formula</b>	<b>Description</b>
EYR – Emergy Yield Ratio	$EYR = Y / P$	Ratio of the total emergy used to the emergy invested from the economic system.
ELR – Emergy Loading Ratio	$ELR = (N + P) / R$	Indicates the pressure of a process on the local environment.
ESI – Emergy Sustainability Index	$ESI = EYR / ELR$	Based on the assumption that more sustainable systems have higher ability to exploit free local resources whilst creating less pressure on local environment.
EIR – Emergy Investment Ratio	$EIR = P / (N + R)$	Indicates if the process is a good user of the emergy that is invested, in comparison with alternatives.
EER – Emergy Exchange Ratio	$EER = Y/Em\$$	Ratio of emergy exchange in a trade or purchase. If $EER = 1$ , there is a balanced exchange; if $EER > 1$ the consumer takes advantage of the producer.

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Similar Systems	ESI	EIR	EER	Refs
Fully integrated mixed sheep and permanent crops in Spain;	2.27	0.86	10.68	
Semi-intensive of sheep with pasture rotation in Brasil;	1.13	4.49	0.09	
Grazing cattle Argentina	6.80	0.37	-	

### Comparação entre sistemas especializados e mistos

	ESI			EIR		
	Crop	Mixed	Livestock	Crop	Mixed	Livestock
Avg	1.42	1.67	0.90	2.31	2.14	17.23
Max	8.74	10.94	3.86	12.67	3.88	42.65
Min	0.03	0.30	0.02	0.19	0.62	4.49
n	27	18	14	20	11	3