Sustainability of crop and livestock dominant dryland system of Alentejo region: do they have large differences in economic returns and environmental consequences?

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Introduction

This work presents a case study with two traditional dryland Mediterranean-type farming systems with 250 ha of area: grazing dominant and cropping dominant system, of the Alentejo region of Portugal. These farming systems are compared in terms of economic returns, environmental impacts and trade-offs.

Crops System

Sunflower - Durum Wheat 1 - Pea - Durum Wheat 2

Mixed Crop Livestock System

Wheat - Oats - OatxVetch - Durum Wheat - Rye

Natural and Improved grassland

Livestock: Extensive beef production with selling calves at weaning

Methodology

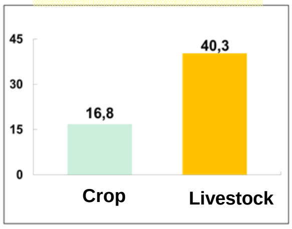
Environmental evaluation:
- Input-Output → Nitrogen balance, Energy input
- Life cycle assessment (SimaPro): Greenhouse; Acidification; Eutrophication; Eco 95

Economic evaluation of activities: → Full cost of production; Gross margin; Net margin

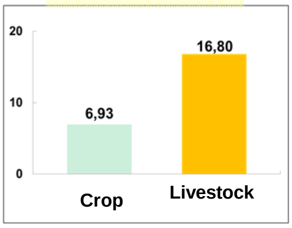
Environmental and economic evaluation: → Linear programming models (GAMS-General algebric model system): maximize net margin; environmental impact of land use; quantify the trade-offs between economic and environmental criteria

Results

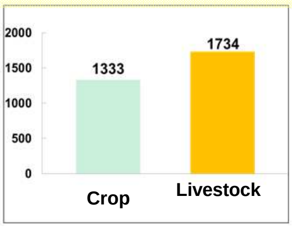
Nitrogen Balance (kg/ha)



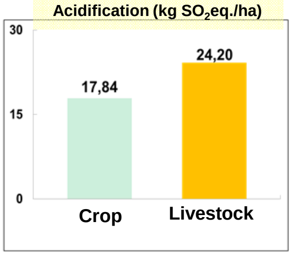
Energy Input (GJ/ha)



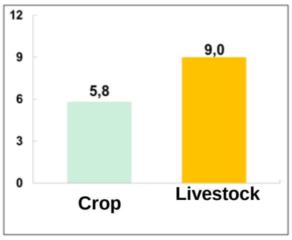
Greenhouse emissions (Kg CO_2eq./ha)



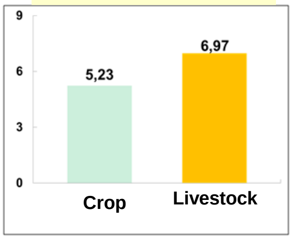
Acidification (kg SO_2eq./ha)



Eutrophication (Kg PO_4/ha)



Eco 95 Indicator (Pt/ha)



Environmental effects and economic trade-offs of the crop system

Variables Crops	Values	Dual Prices
Net Farm Income (€)	81 336	d.a.
Subsidies(€)	72 630	d.a.
Land (ha)	250	326 (€/ha)
Nitrogen Balance (Kg N)	4 203.75	19.35 (€/KgN)
Energy Input (GJ)	1 655	49.15 (€/GJ)
Greenhouse emissions ($KgCO_2$eq.)	333 175	0.244(€/$KgCO_2$eq.)
Acidification (Kg SO_2eq.)	4 458.75	18.24(€/Kg SO_2eq.)
Eutrophication (Kg de PO_4eq.)	1 450,63	56.07 (€/Kg PO_4eq.)
Eco 95 (Pt)	1 307.5	62.21 (€/Pt)

d.a.= doesn´t apply

Source: LP model results

Environmental effects and economic trade-offs of the mixed crop livestock system

Variables Mixed	Values	Dual Prices
Net Farm Income (€)	42 791	d.a.
Subsidies(€)	63 955	d.a.
Land (ha)	250	171 (€/ha)
Nitrogen Balance (Kg N)	8 075.4	5.30(€/KgN)
Energy Input (GJ)	1 813.6	23.60 (€/GJ)
Greenhouse emissions ($KgCO_2$eq.)	395 621	0.11(€/$KgCO_2$eq.)
Acidification (Kg SO_2eq.)	4 584.3	9.61(€/Kg SO_2eq.)
Eutrophication (Kg de PO_4eq.)	1 737.9	24.62 (€/Kg PO_4eq.)
Eco 95 (Pt)	1 378.6	31.05 (€/Pt)

d.a.= doesn´t apply

Source: LP model results

Conclusions

- The net income of the mixed crop livestock system was half of the crop system net income. Relatively to crop system farm subsidies for mixed system farm represent 88%. Mixed crop livestock system has higher environmental impacts than the arable crops.
- The trade-offs evidence potential costs of 31.05 €/Pt for the mixed crop livestock system and 62.21 €/Pt for the crop system associated with the reduction of farmer environmental impacts in aggregated terms (Eco95).
- The trade-offs determination gives an important input for the formulation and calibration of future agricultural policy which may lead to the development of more sustainable production systems.

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