Modelling farms: possible scenarios and systems responses to future changes

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Main objective

Examine the scope of new strategies, including land-based and management changes and innovations, for making sheep and goats production more sustainable, reducing its environmental impact and enhancing resilience to oncoming challenges (e.g. climate change).

Deliverable 4.4. POLICY BRIEF: NEW TRAJECTORIES TOWARDS INNOVATIVE SHEEP AND GOAT PRODUCTION SYSTEMS IN EUROPE

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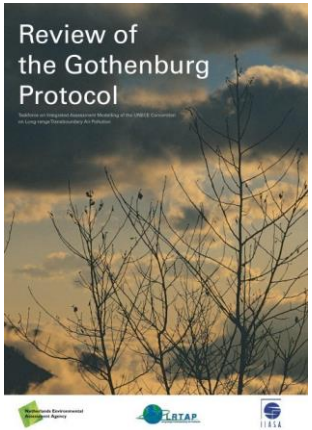
Policy challenges in Mediterranean/European small ruminants sector

- POLICIES AFFECTING LAND USE: Agricultural policies (CAP), Paris Agreement and environmental regulations



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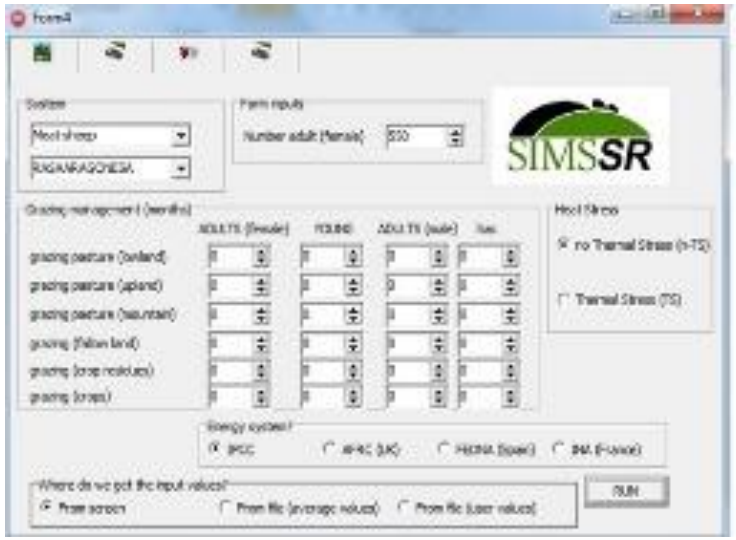
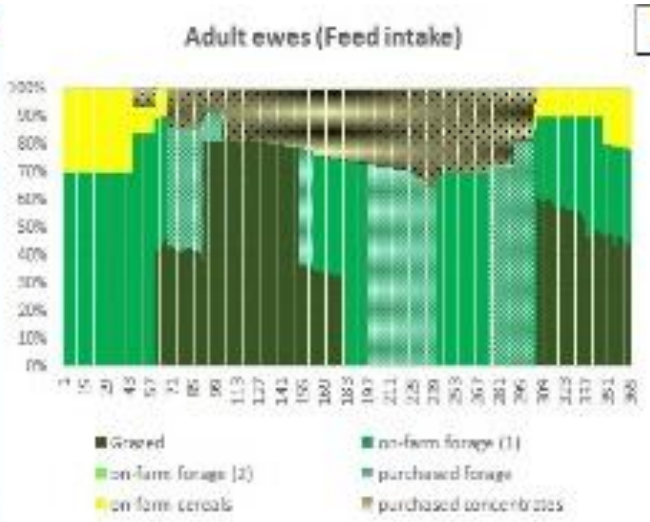
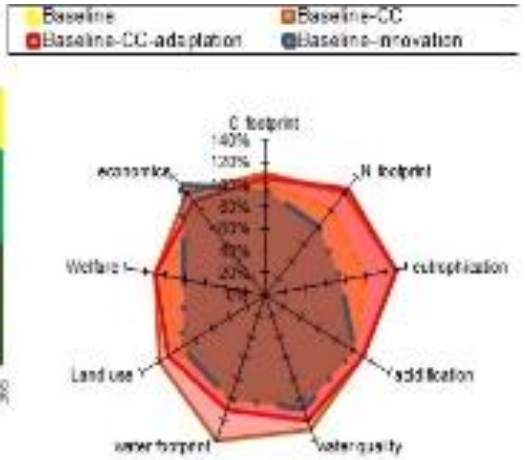
The farm model







Farm model to run scenarios (farm typologies)

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The tool to analyse farm scenarios:

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Deliverable No: 4.3.

New holistic model that can be used to redesign terrestrial small ruminant's livestock systems

Project acronym: **iSAGE**

Prject full name: **Innovation for Sustainable Sheep and Goat Production in Europe**

Grant agreement number: **679302**

Start date of project: **1 March 2016**

Duration of project: **48 months**

Project website: www.iSAGE.eu

Working Package	4
Short name of lead participant	BC3
Other Partners Participating	AUTH
Type* (R, DEM, DEC, OTHER)	R
Dissemination level** (PU, CO, CI)	PU
Deliverable date according to Grant Agreement	28/02/2019
Actual delivery date	28/02/2019

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Table 1 – Key information

Country	Spain
Authors of this Report	Agustin del Prado[1], Inmaculada Batalla[1], Guillermo Pardo[1], Asma Jebari[1], Athanasios Ragkos[2], Alexandros Theodoridis[2] and Georgios Arsenos[2] [1] *Basque Centre For Climate Change (BC3)* [2] *Aristotle University of Thessaloniki (AUTH),*
Date	28-02-2019

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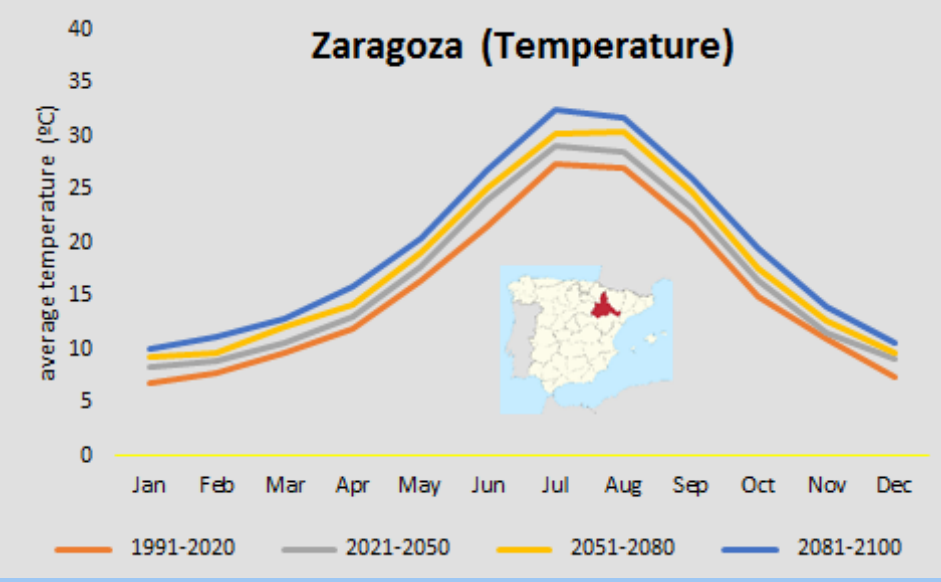
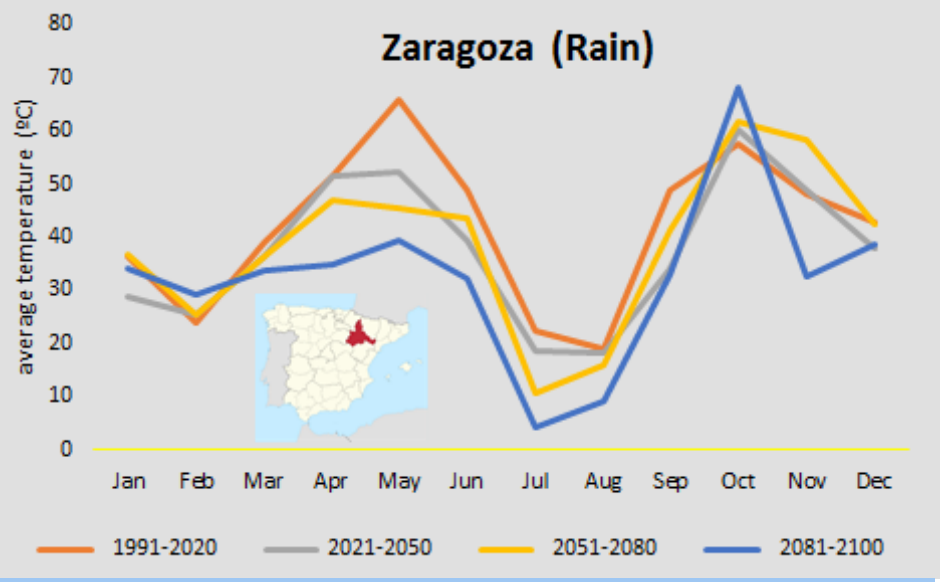
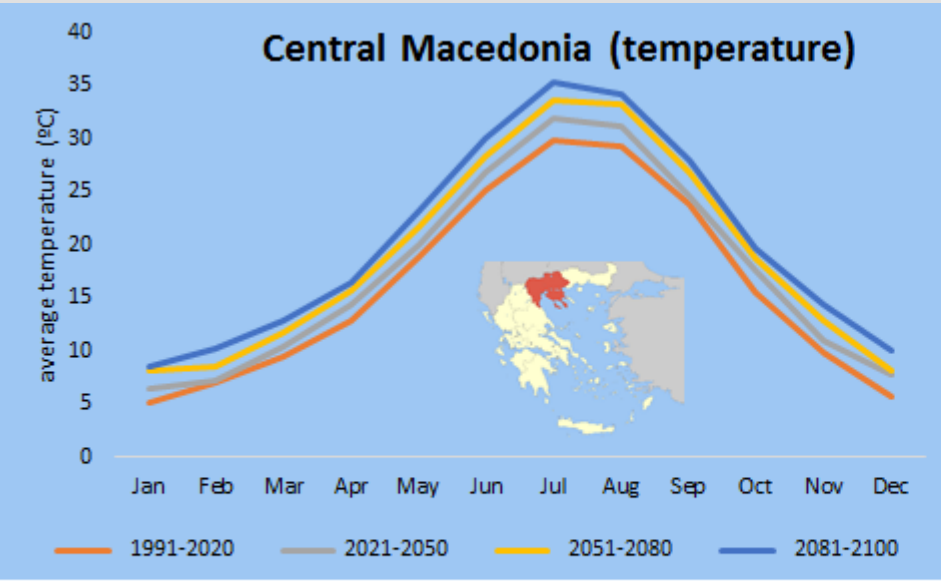
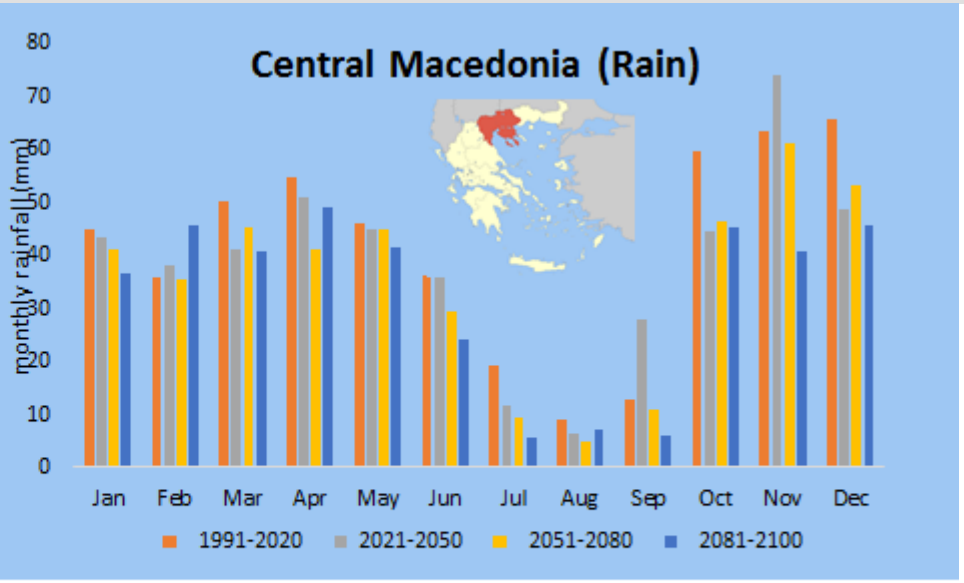
Climate Change:
an ongoing
challenge

Examples at farm level (Spain and Greece)



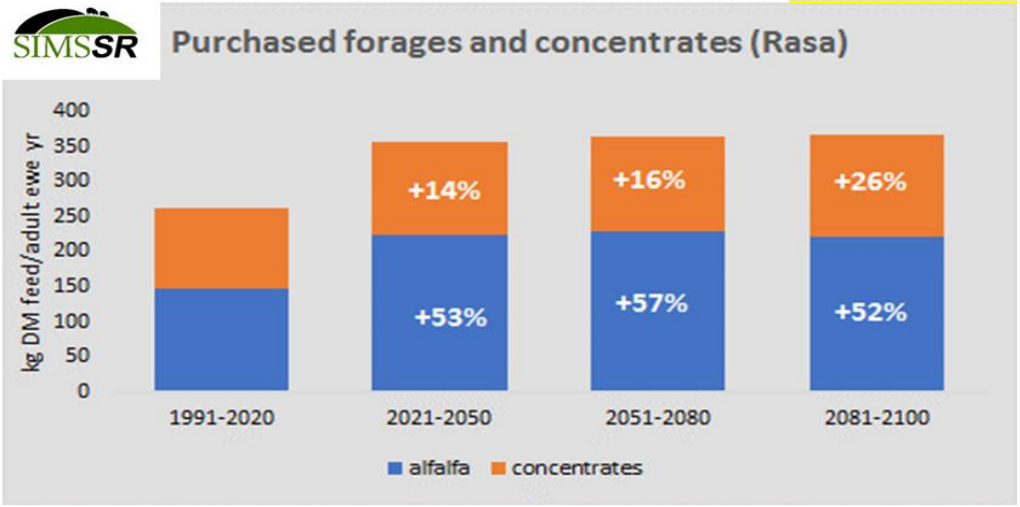




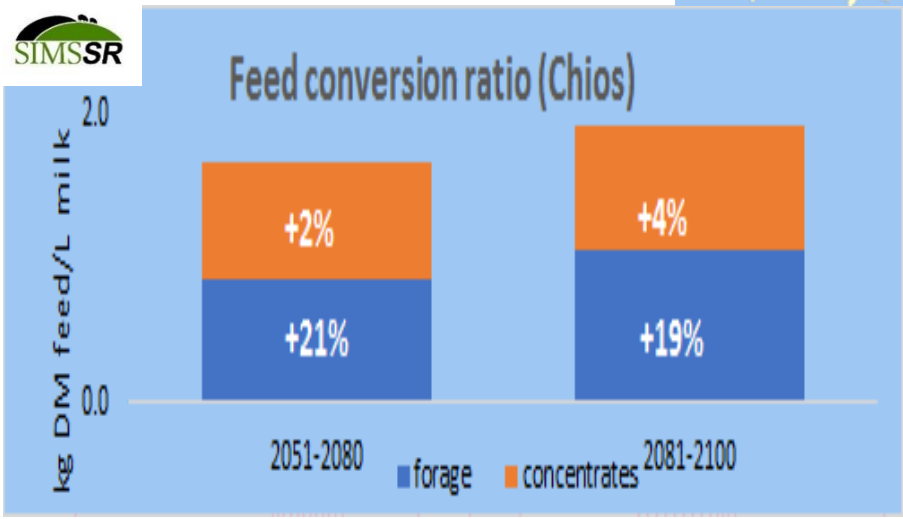


2021-2050 rainier in autumn, not so drier compared with 1991-2020

Examples at farm level (dairy sheep)



- From 2021 increase in feed purchase



- >20% more feed /L after year 2050

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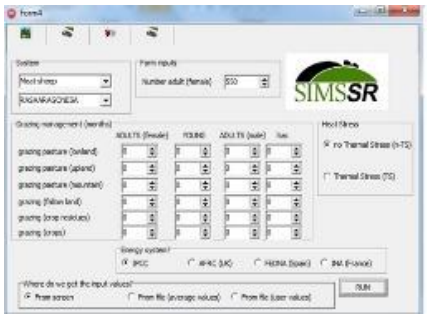
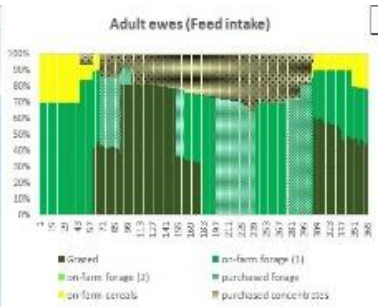
Adaptation at the farm level (example)

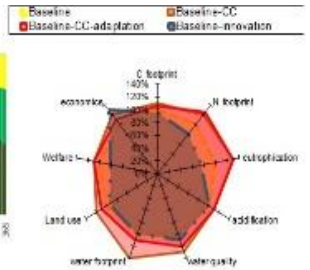
- Breed: Manchega (Spain) **{dairy breed}**
- Effect of heat on milk productivity on Summer Housed

Diet composition

FEED		GE	DE	ME
	%	MJ/kg DM	MJ/kg DM	MJ/kg DM
Alfalfa hay	90%	18.2	10.6	8.4
Corn	10%	18.7	16.1	13.6







4 scenarios

- No HS
- HS (non-adapted)
- HS (adapted-diet)
- HS (Adapted-spraying)

Modelled with $SIMS_{NIC}$ (Del Prado et al. 2019)

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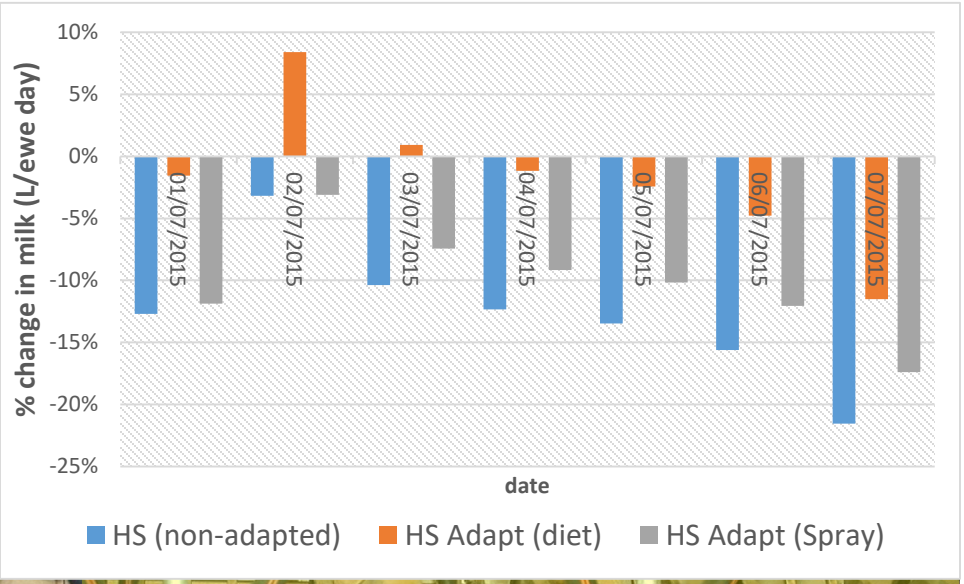
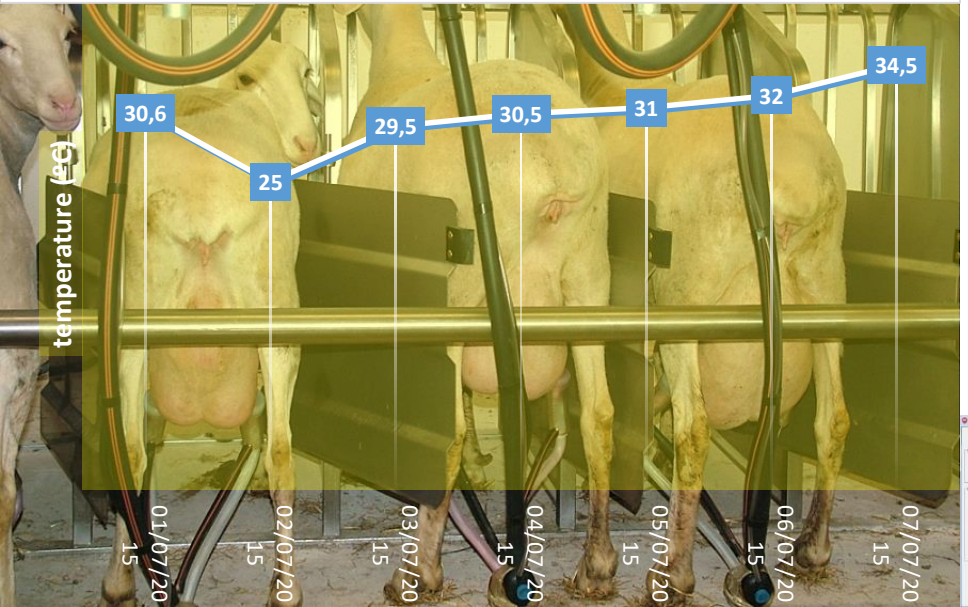
Adaptation at the farm level (example)





HS (non-adapted)

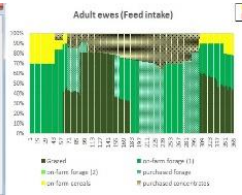
Aprox. 13% reduction in milk,
0.12 kg DM extra/L milk (less efficient)

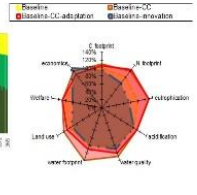
HS (adapt-diet)

More dense diet: more soybean meal
Aprox. 2% reduction in milk

HS (adapt-spraying)

Small positive effect, aprox. 10% reduction in milk





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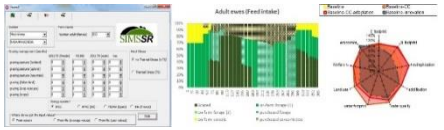
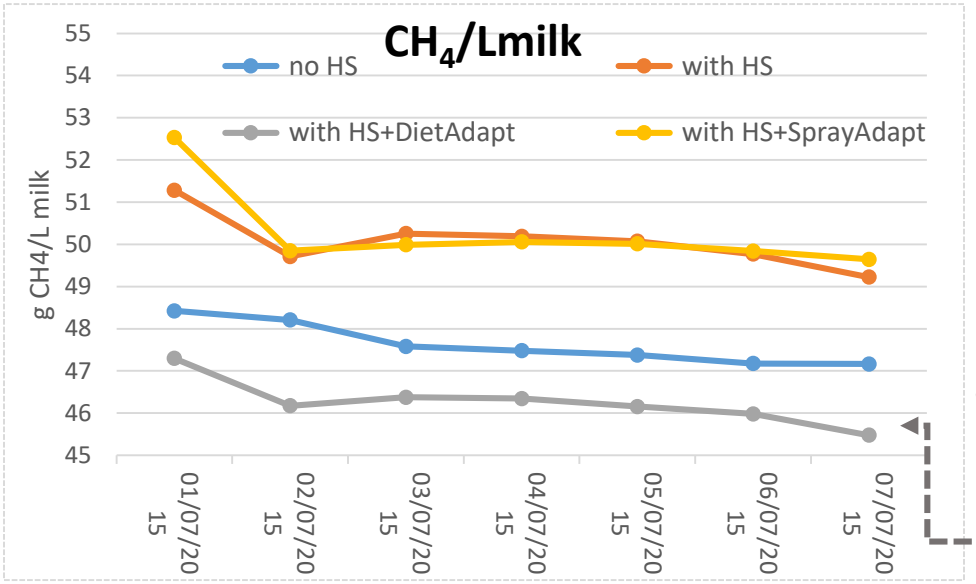
Trade-off/synergy adaptation *vs.* mitigation GHG



Modelled with $SIMS_{NIC}$ (Del Prado et al. 2019)



Enteric-CH_4

- Total CH_4 is reduced with heat stress but **CH_4/Lmilk**?...
- CH_4 intensity (CH_4/L milk) increases with heat stress **except if adapted with diet**

So, supplementation of more dense diet is a win-win for both adaptation to climate change and mitigation?

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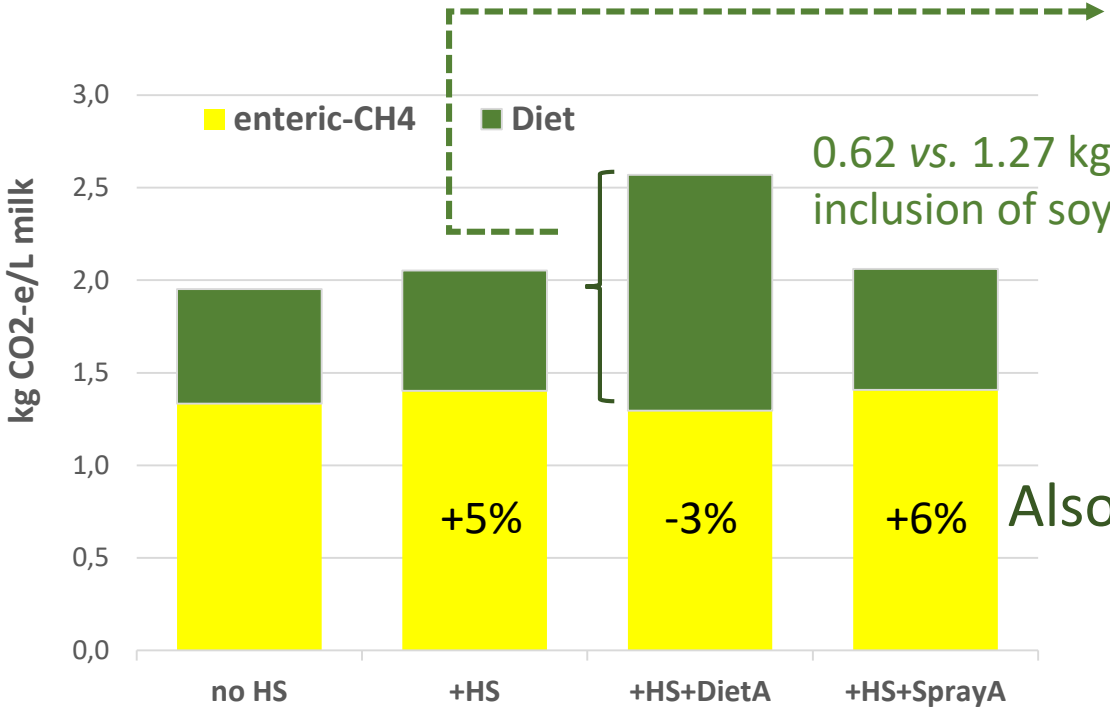
Trade-off/synergy adaptation vs. mitigation GHG

+32% total C-footprint using soybean meal



0.62 *vs.* 1.27 kg CO2-e/kg DM feed after inclusion of soybean meal (10% repl. alfalfa)

Also more human-edible feed!

C footprint accounting enteric CH_4+ feed footprint

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Are (small) ruminants (in Europe) to blame for climate change?

https://www.youtube.com/watch?v=NbO4EEaH7YM&t=29s (English)

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Over-estimation of GHG from small ruminants in Europe

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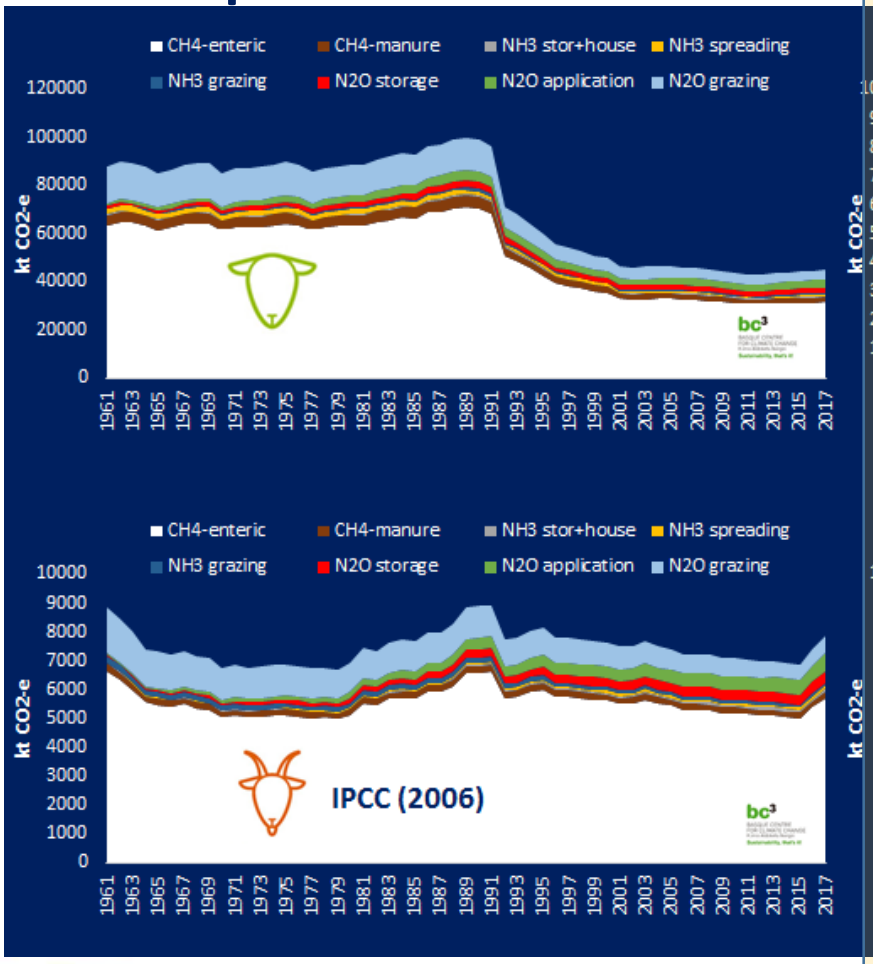

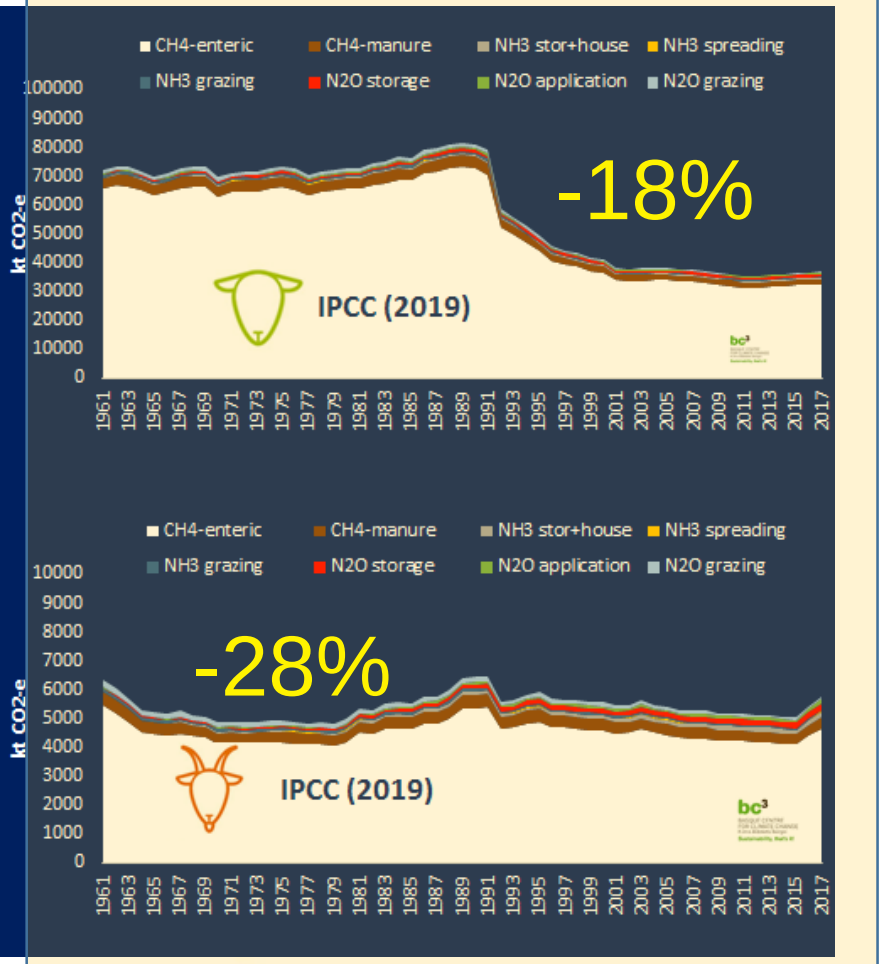

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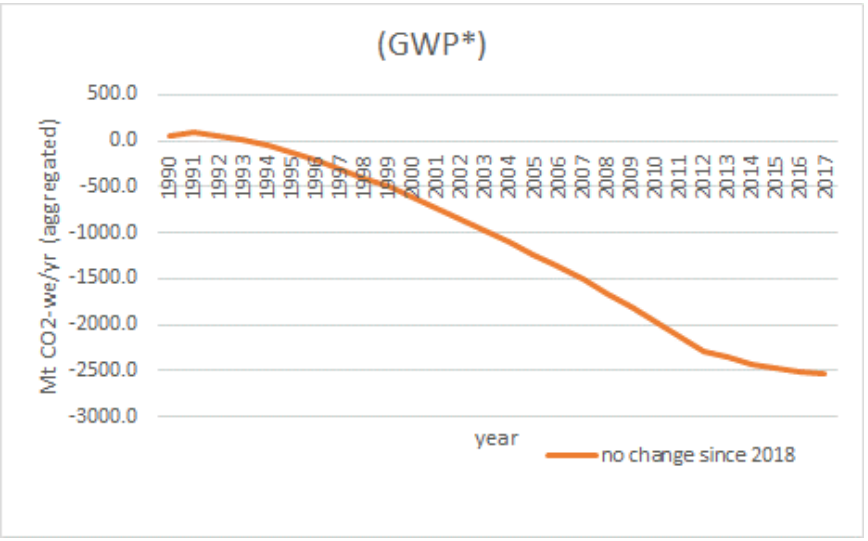
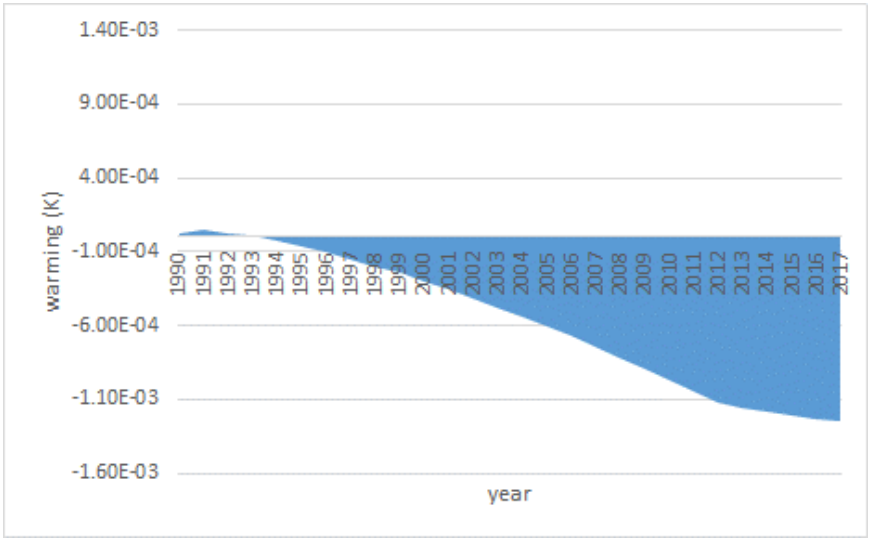
Aggregated CO_2-we from CH_4 sheep and goats in Europe (GWP*)

NEW-ISAGE!!





reduction in CH4 emissions have caused a cooling effect on the atmosphere (using 1990 reference).

Based on Cain et al. (2019)

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Potential emissions reductions linked with warming/cooling

SCENARIOS	Annual reduction
No change (2018-)	0%
Small reduction	0.3%
Medium reduction	0.5%
Ambitious reduction	1%
Very ambitious reduction	2%
Increase	-1%
Large increase	-2%

Warming effect: Pathways with CH_4 reduction

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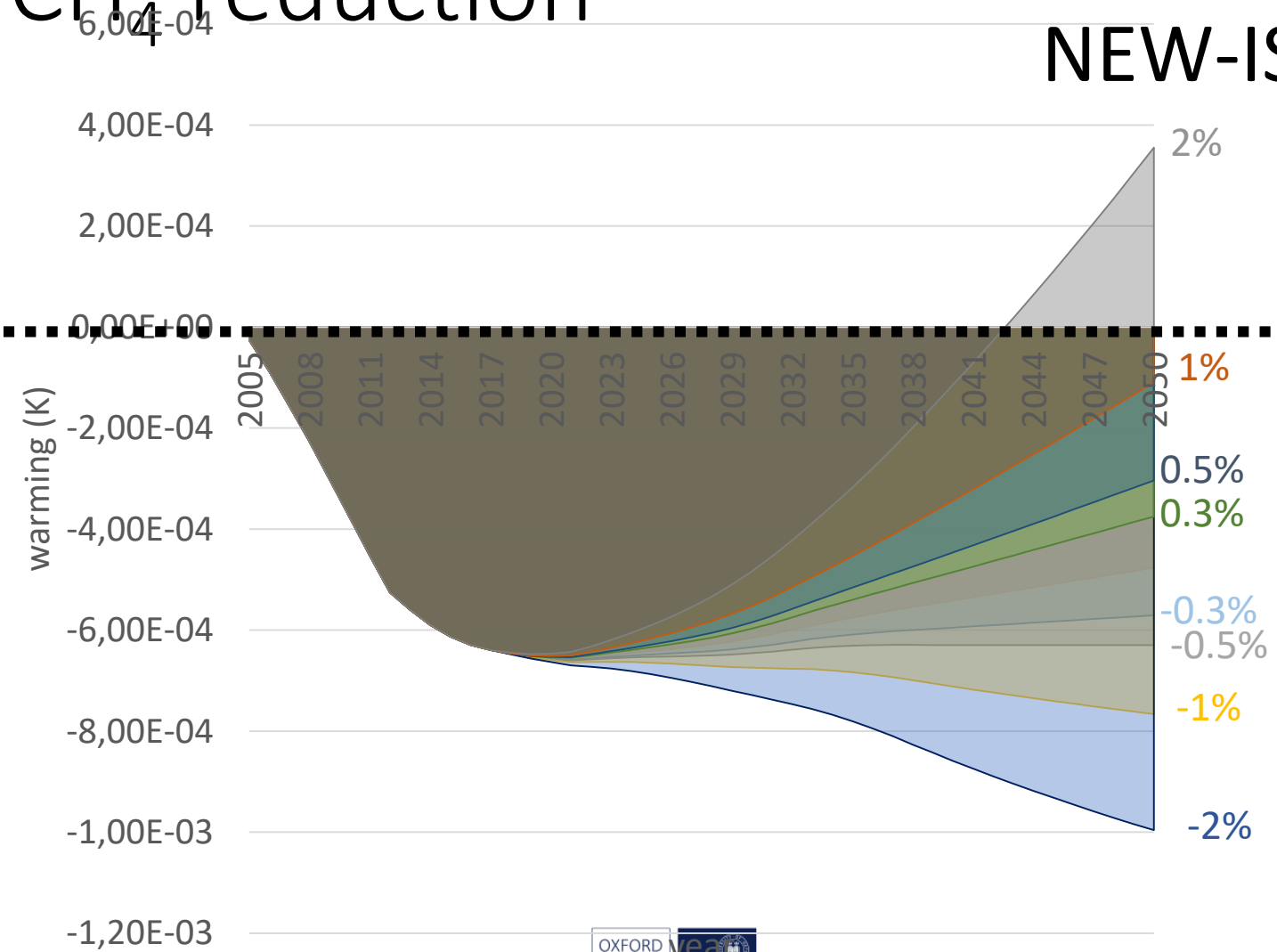


Based on Cain et al. (2019)

Novel mitigation measures (CH_4)

*In vitro (*Kinley et al., 2016; Vucko et al., 2017; Maia et al., 2017)
In vivo: UC Davis (US)

Holstein cows feeding at a dairy farm in Merced, California. MARMADUKE ST. JOHN / ALAMY

How Eating Seaweed Can Help Cows to Belch Less Methane

3-nitrooxypropanol (NOP)

Antiburp compound could reduce methane emissions from cows

Duin *et al*. (2016) Proc Natl Acad Sci 31;113(22):6172-7

	Martinez-Fernandez et al. (2013)	Haisan et al. (2014)	Haisan et al. (2013)	Reynolds et al. (2014)	Romero Perez et al. (2014)
Location of study	Spain	Alberta	Alberta	UK	Alberta
Animals	sheep	dairy cows	dairy cows	dairy cows	beef cattle
Dietary forage, % DM	60	40	60	52	60
NOP dose, g/d	0.1	2.5	1.25, 2.5	0.5, 2.5	0.5, 1.4, 2.8
Method of NOP supplementation	2×day pulse dose	mixed into diet	mixed into diet	2×day pulse dose	top dressed onto TMR
% CH_4 (g/kg DMI) reduction	25	60	35, 51	4, 7	4, 9, 33
% DMI reduction	0	0	0	0	2.5, 5.8, 5.0

DMI = dry matter intake

Is it a solution to reduce sheep grazing in marginal land?

Rasa-aragonesa (Spain)

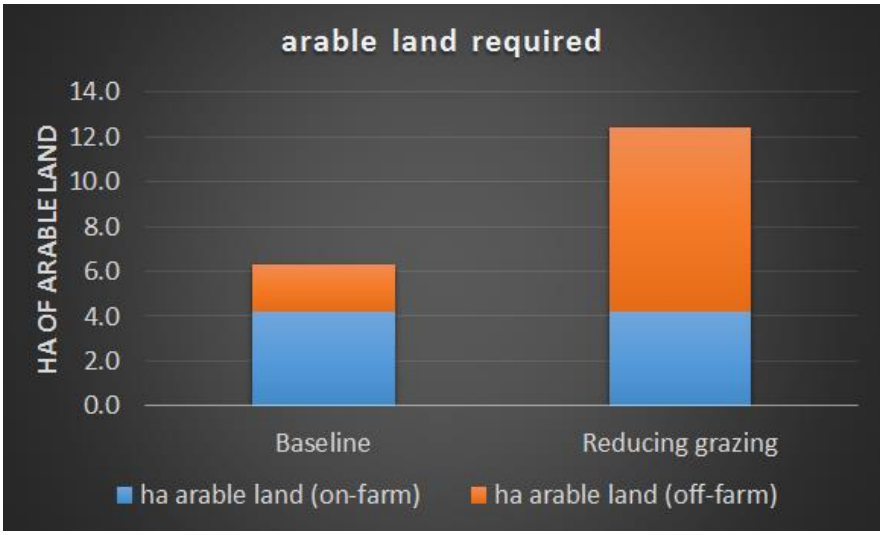
FEED

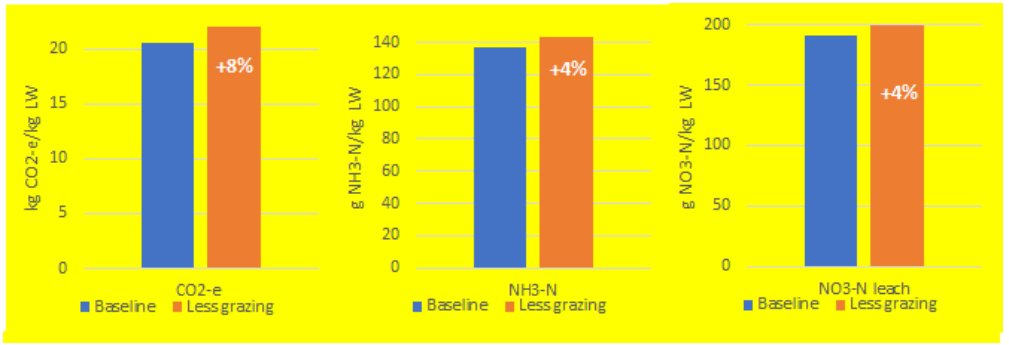
- **Grazed mountain pastures**
- Grazed rainfed alfalfa
- Alfalfa hay
- Cereals (homegrown barley)
- Barley straw (homegrown barley)
- Concentrates

Assumption: no extra land

Is it a solution to reduce sheep grazing in marginal land?

Emissions increase!!





Reducing grazing requires a shift from using marginal land (not suitable for other agricultural purposes except forest) to using more arable land (land suitable to grow crops that can be directly consumed by humans)

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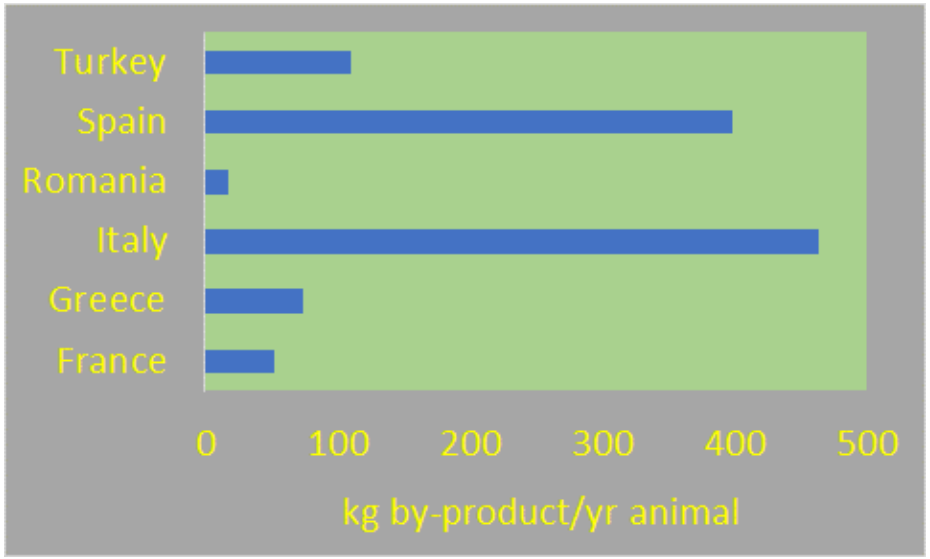
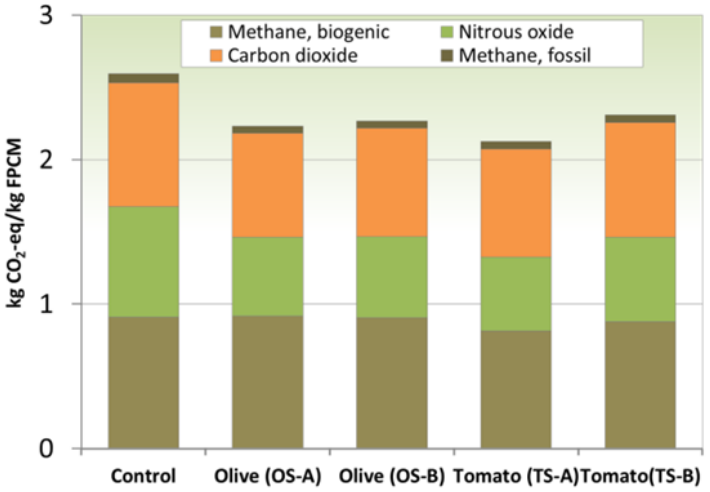
Improving feed sources and use of alternative feed sources (an example, by-products)

Availability in different countries



Also decrease emissions



Murciano-granadina dairy goat, compared With other uses of by-products

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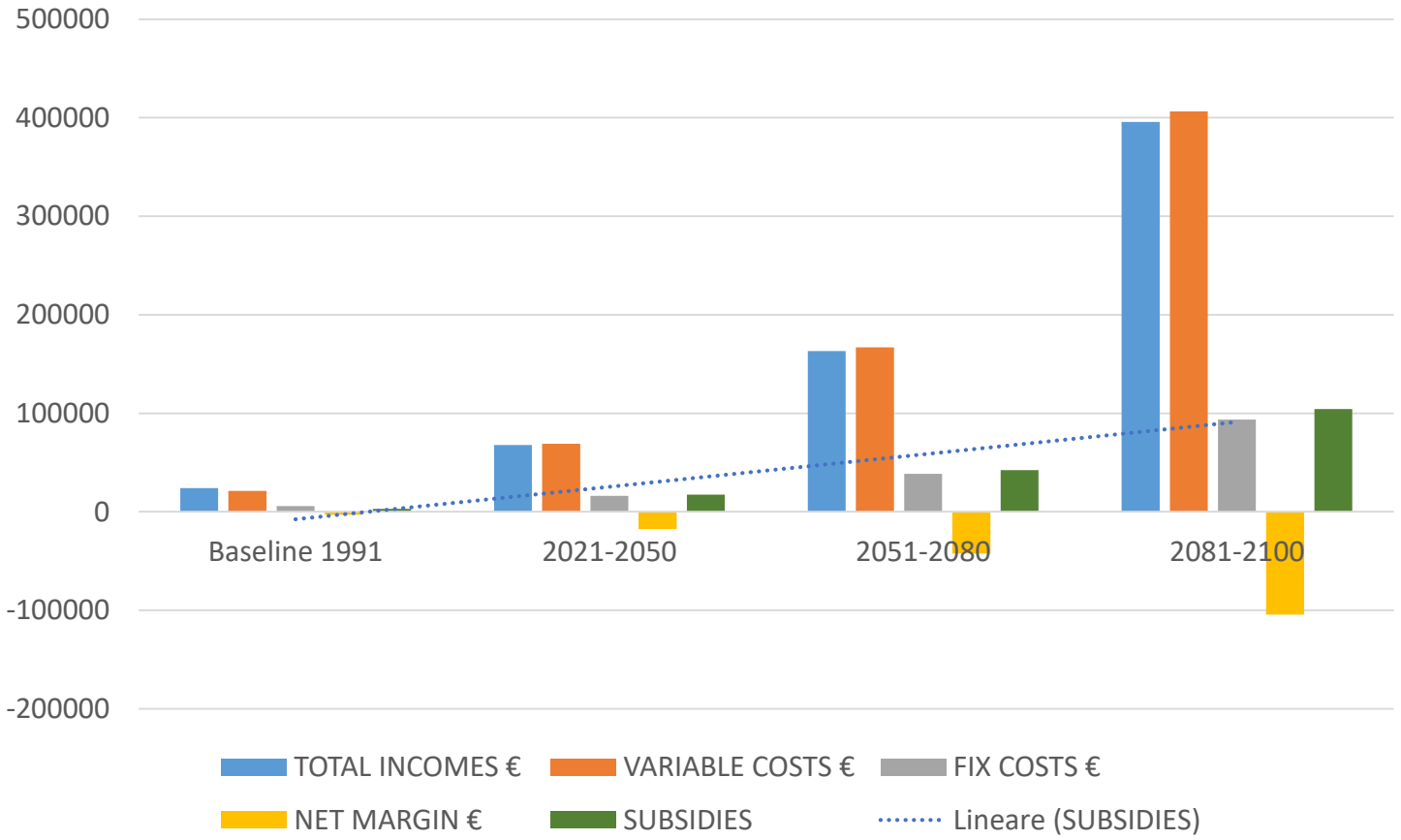
Examples at farm level (meat sheep)



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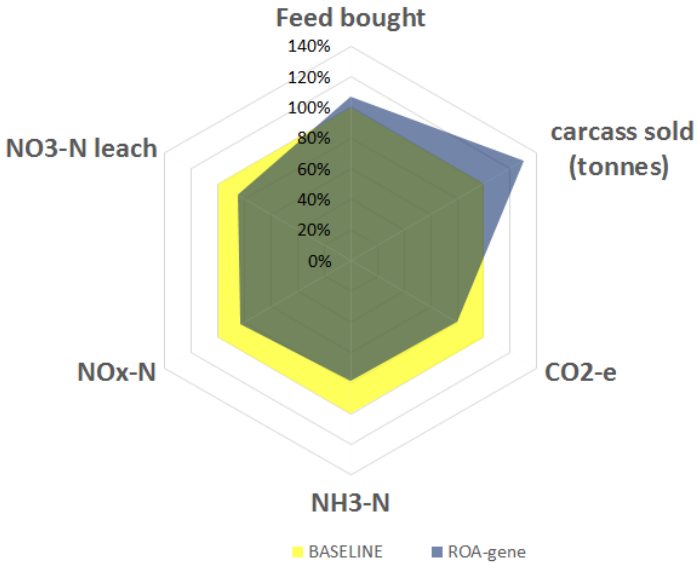
Role of innovations to meet sustainable challenges

Rasa-aragonesa (Spain)

- ***prolificacy (e.g. ROA allele)***



FEED

- Grazed mountain pastures
- Grazed rainfed alfalfa
- Alfalfa hay
- Cereals (homegrown barley)
- Barley straw (homegrown barley)
- Concentrates

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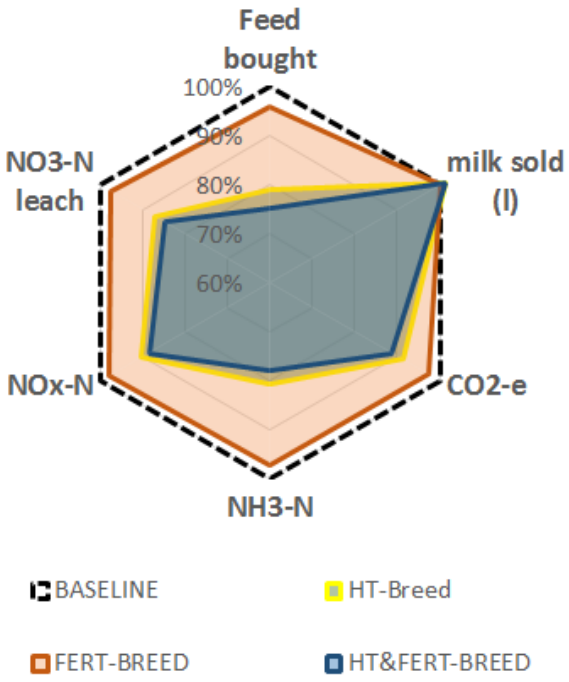
Role of breeding to meet sustainable challenges

Chios (dairy) (Greece)



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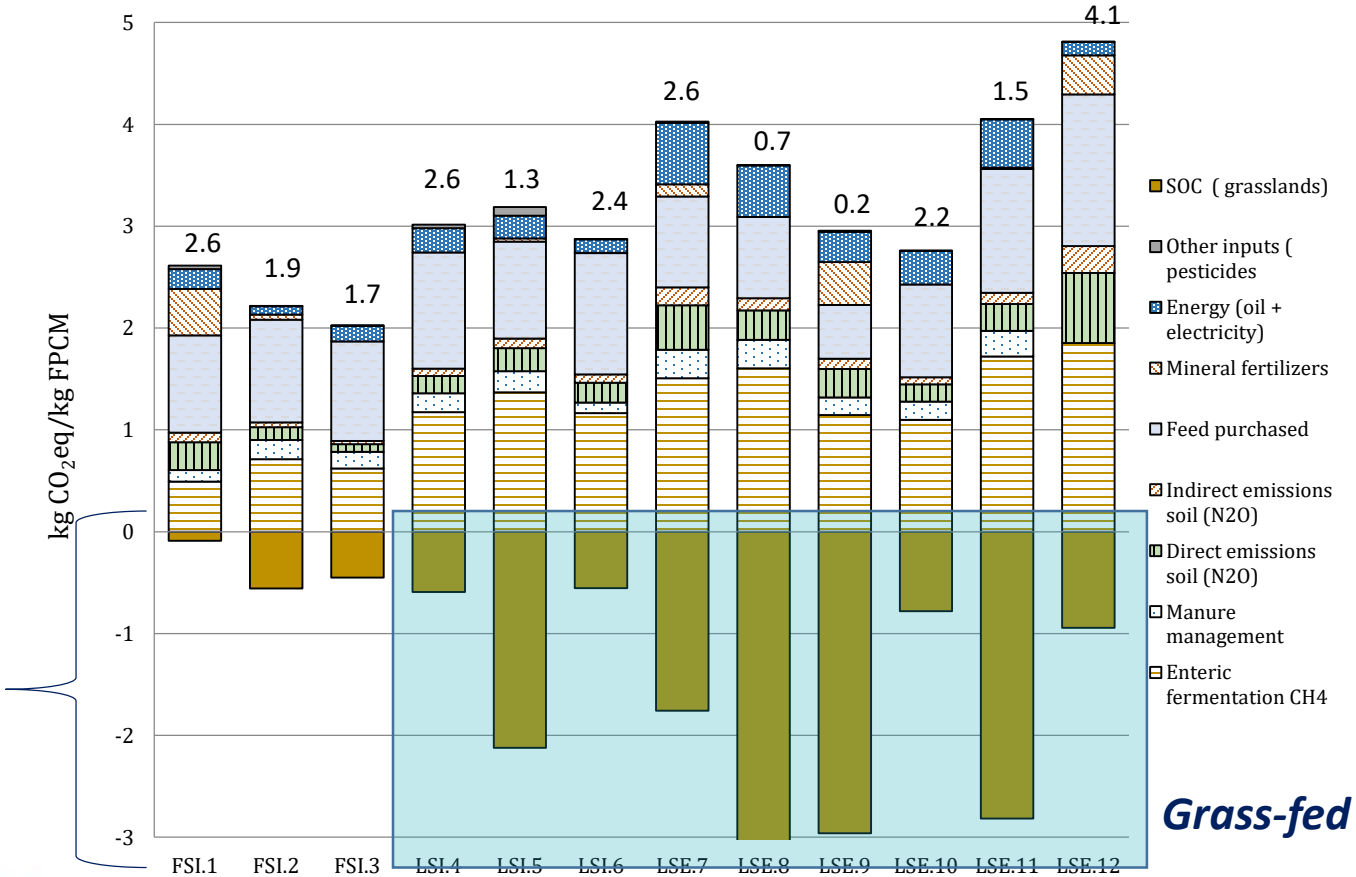
Important to include SOC sequestration



Carbon sequestration

Grass-fed sheep Systems

Batalla et al. (2015)

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Take homes

- New land use policies (link with climate) will affect sustainability of sheep and goats in EU
- Scope for improving farm performance for all systems (innovations, breeding, feeding…)
- Main strategy should be to move towards high production standards

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ευχαριστώ
Thanks
Gracias

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