SMAll RuminanTs breeding for Efficiency and Resilience

Agro-ecological impacts of breeding at farm level

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Final Annual Meeting: AUTH, Toledo

22-23 May 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°772787

WP 7 – Task 7.1

Agro-ecological impacts of breeding at farm level

- Leader: AUTH
- Involved Partners: IDELE, INRAE, FRIZARTA, CNR, AbacusBio UK

Milestones and deliverables

- MS27: **Code** for model incorporating animal performance under infectious and non-infectious challenges from task 3.3 and updated farm model from task 7.1
- D7.3: **Paper** on economic, labour and environmental trade-offs for breeding for R&E traits

Objectives

- ✓ Develop a **farm-scale LP model** for S & G farms
- ✓ **Simulate** farm operation under new R&E traits that counteract presence of **infectious and non-infectious diseases**
- ✓ Estimate the **economic performance**
- ✓ Shape **novel sustainable farm profiles**

iSAGE
Innovation for Sustainable Sheep and Goat Production in Europe

Work done - SMARTER model

- The basic idea was to simulate the operation of a farm through the maximization of its economic performance

maximize Gross Margin

- Subject to a set of *Constraints*:

✓ Land

✓ Labor

✓ VC requirements

✓ Animal and flock-related constraints

The solution indicates the **optimal structure of the farm**

Work done - SMARTER model

Simulate diseases!

Relative **constraints** have been introduced to account for:

1. **Prevalence of disease** in the flock
2. Impact on **milk yield**
3. Impact on **veterinary expenses**
4. Impact on **labor requirements**
5. Impact on **lamb/ewe carcass weight**

- With this design, the model examines a wide variety of **scenarios** related to traits that **prevent infectious and non-infectious diseases**

- Diseases VS Healthy flock

Work done

Diseases simulated with SMARTER model:

1. **Mastitis**
2. **Parasites (Gastro-Intestinal Nematode – GIN)**
3. **Lameness**

Work done

Breed	System
Chios sheep (GR)	Semi-intensive
Assaf sheep (GR)	Intensive
Frizarta sheep (GR)	Semi-intensive
Boutsiko sheep (GR)	Extensive
Lacaune sheep (FR)	Semi-extensive
Skopelos goat (GR)	Semi-extensive

Work done - Results

- Existing situation of a typical farm
- **Scenario 1**: Simulates farm's performance under the presence of diseases (Disease Plan)
- **Scenario 2**: Optimal farm under perfect conditions with healthy animals (Future Plan)

- ➢ Results produced under 2 Scenarios are compared
- ➢ Show the impact of traits that make animals tolerant to diseases on sustainability

Work done - Results

Frizarta sheep (GR)	Current situation	Optimal situation	
		Diseases present	No diseases
Ewes	240	263	270
Land[1] (ha)	35	26	26
Labor (hrs)	4200	4200	4200
Forage (tonnes)[2]	48.0 (100%)	36.0 (68.4%)	38.8 (62.8%)
Concentrates (tonnes)[2]	31.1 (3.5%)	28.4 (79.6%)	28.8 (79.6%)
Gross revenue (€)[3]	60936 (254)	69381 (264)	79817 (296) **12%**
Variable cost (€)[3]	25012 (104)	21487 (82)	21740 (81)
Gross margin (€)[3]	35924 (150)	47894 (182)	58076 (215) **18%**

[1] includes irrigated and non-irrigated land for on-farm production of feed and grazing land

[2] the figure in the parenthesis indicates the percentage of home-grown feed in total feed

[3] the figure in the parenthesis refers to €/ewe

Main Messages

- ✓ Significant **improvement in the economic performance** of the farm in the future plan with no diseases
- ✓ The improvement in the profitability of the farms stems mainly from the **increase of production** and not from the reduction in the health care expenses and/or increased labor
- ✓ The two optimal plans show **similarity** in terms of farm structure
- ✓ Farmer **does not change the management plan**

Main Messages

Intensive systems

- Large farms to utilize Economies of Scale
- Organize labor & implement labor-saving technologies
- Reduce dependency on home-grown feed
- Meat production to increase their economic resilience and reduce their risk

	Variable			Reduced	
ol	Name	Status	Type	Price	Activity	Cost
1	Bar		NON-NEG	-0.22	0.000000	-0.010000
2	Ch1		BASIC NON-NEG	7	12667.386	0.000000
3	Clov		NON-NEG	-0.16	0.000000	-0.115000
4	CotPi		BASIC NON-NEG	-0.25	10631.347	0.000000
5	CulBar		NON-NEG	-70	0.000000	-40.538695
6	CulClov		DEGEN NON-NEG	-130	0.000000	0.000000
7	CulMai		BASIC NON-NEG	-110	37.610897	0.000000
8	CulWh		NON-NEG	-65	0.000000	-33.901437
9	DUP		BASIC NON-NEG	0	15421165.82	0.000000
10	ERDP		BASIC NON-NEG	0	27629588.761	0.000000
11	Gr		BASIC NON-NEG	0	304704.16463	0.000000
12	Grass		BASIC NON-NEG	0	413.770	0.000000
13	Hlab		BASIC NON-NEG	-3	6300.000	0.000000
14	MJ		BASIC NON-NEG	0	3961291.857	0.000000
15	Maize		NON-NEG	-0.22	0.000000	-0.061112
16	Milk		BASIC NON-NEG	0	147786.17244	0.000000
17	OtExp		BASIC NON-NEG	0	18351.187	0.000000
18	PEweMeat		BASIC NON-NEG	2.2	3212.743	0.000000
19	PLamMeat		BASIC NON-NEG	5	12529.697	0.000000

LINEAR PROGRAMMING PROCEDURE	
SOLUTION SUMMARY	
Terminated Successfully	
Objective value	192624.0713
Phase 1 iterations	0
Phase 2 iterations	26
Phase 3 iterations	0
Integer iterations	0

Extensive systems

- Manage labor more wisely
- Proper use of rangelands
- Mitigate the risk that stems from the market of concentrates through on-farm feed production

Main Messages

- The SMARTER model works!
- Simple, comprehensive, inclusive and flexible…
- The model allows the examination of scenarios related to:

✓ *turbulences in the economic environment*

✓ *development of animals resistant to diseases*

✓ *shocks in the availability of labor*

✓ *changes in the marketing of products*

✓ *decision-making regarding the choice of the production system*

Challenges

- Impact of diseases on performance indicators
- Built <u>simple models</u>, easy to understand, with meaningful and robust output/scenarios
- <u>Readjustments</u> are required in the model depending on the scenario that will be simulated
- Demanding in data

max	object	.	.
.	object	Sheep	-45.36
.	object	Sheep2	-49.36
.	object	Sheep3	-48.36
.	object	Sheep4	-49.62
.	object	Pmilk	0.96
.	object	Pmilk2	0.96
.	object	Pmilk3	0.96
.	object	Pmilk4	0.96
.	object	PLamMeat	5
.	object	PLamMea2	5
.	object	PLamMea3	5
.	object	PLamMea4	5
.	object	PEweMeat	2.2
.	object	PEweMea2	2.2
.	object	PEweMea3	2.2
.	object	PEweMea4	2.2
.	object	Ch1	7
.	object	Ch2	7
.	object	Ch3	7
.	object	Ch4	7
.	object	Hlab	-3
.	object	VetEx	0
.	object	OtExp	0
.	object	CulWh	-65
.	object	CulMai	-110
.	object	CulClov	-130

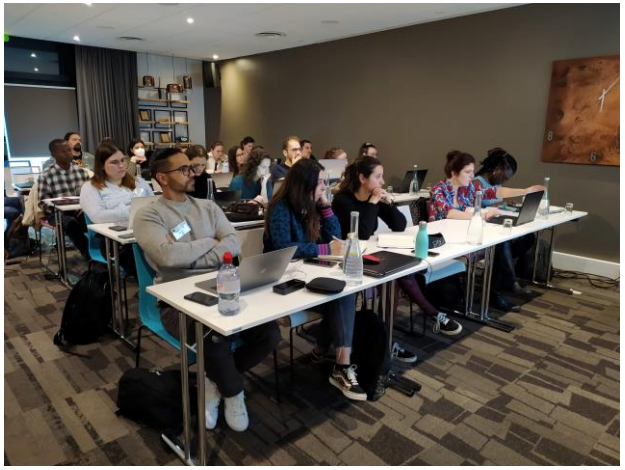
Deliverables and Milestones

- MS27 - **Code** for model incorporating animal performance under infectious and non-infectious challenges from task 3.3 and updated farm model from task 7.1 (**AbacusBio UK - M32**) **COMPLETED**
- D7.3 (D31): **Paper** on economic, labour and environmental trade-offs for breeding for R&E traits (**AbacusBio UK – 30 June**) **PENDING**

Deliverables

AES 2022 Conference
KU Leuven (Belgium)
4-6 April 2022

Smarter Training School
Toulouse (France)
27-30 March 2023



SMARTER PARTNERS

abacusbio. BRIDGING SCIENCE & BUSINESS
A.R.A. LOMBARDIA
ARISTOTLE UNIVERSITY OF THESSALONIKI
Capgenes
EAAP European Federation of Animal Science
FiBL
ICAR
INSTITUT DE L'ELEVAGE idele
INIA Instituto Nacional de Investigación Agropecuaria URUGUAY
National Research Council of Italy
INRAE › transfert
RACES DE FRANCE
neiker tecnalia
cagasc
INRAE
NSG Norsk Sau og Geit
Ovigén
SRUC
TEXEL SHEEP SOCIETY
UNIVERSITY of DEBRECEN
universidad de León
THE UNIVERSITY of EDINBURGH
CENTRE FOR GENETIC IMPROVEMENT OF LIVESTOCK
YORKSHIRE DAIRY GOATS

Thank you for your attention

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°772787

	A	B	C	D	E	F
29	.	object	Sil	-.045		
30	.	object	Straw	-0.04		
31	.	object	Wheat	-.21		
32	.	object	Milk	0		
33	.	object	Pbar	0		
34	.	object	Pclov	0		
35	.	object	Pmai	0		
36	.	object	PWh	0		
37	.	object	DUP	0		
38	.	object	ERDP	0		
39	.	object	MJ	0		
40	.	object	Gr	0		
41	.	object	Grass	0		
42	Le	IrrCrop	.	.		
43	.	IrrCrop	CulMai	1		
44	.	IrrCrop	CulClov	1		
45	.	IrrCrop	_rhs_	120		
46	Le	NonIrrCr	.	.		
47	.	NonIrrCr	CulWh	1		Land Restrictions in ha
48	.	NonIrrCr	CulBar	1		
49	.	NonIrrCr	_rhs_	60		
50	Le	Graze	.	.		
51	.	Graze	Grass	1		
52	.	Graze	_rhs_	800		
53	Le	WheatPr	.	.		
54	.	WheatPr	PWh	1		
55	.	WheatPr	CulWh	-268		
56	.	WheatPr	_rhs_	0		
57	Le	BarleyPr	.	.		
58	.	BarleyPr	Pbar	1		
59	.	BarleyPr	CulBar	-265		
60	.	BarleyPr	_rhs_	0		
61	Le	CloverPr	.	.		Home-grown Feed (crop yeilds per ha)
62	.	CloverPr	Pclov	1		
63	.	CloverPr	CulClov	-1350		
64	.	CloverPr	_rhs	0		

Problems encountered

- Data availability for the application of the model to all breeds described in the DoW
- Sheep breeds: Churra and Castellana
- Goat breeds: Alpine and Saanen

✓ Prevailing systems in EU covered