Improvement of grasslands in dry areas of Mediterranean region

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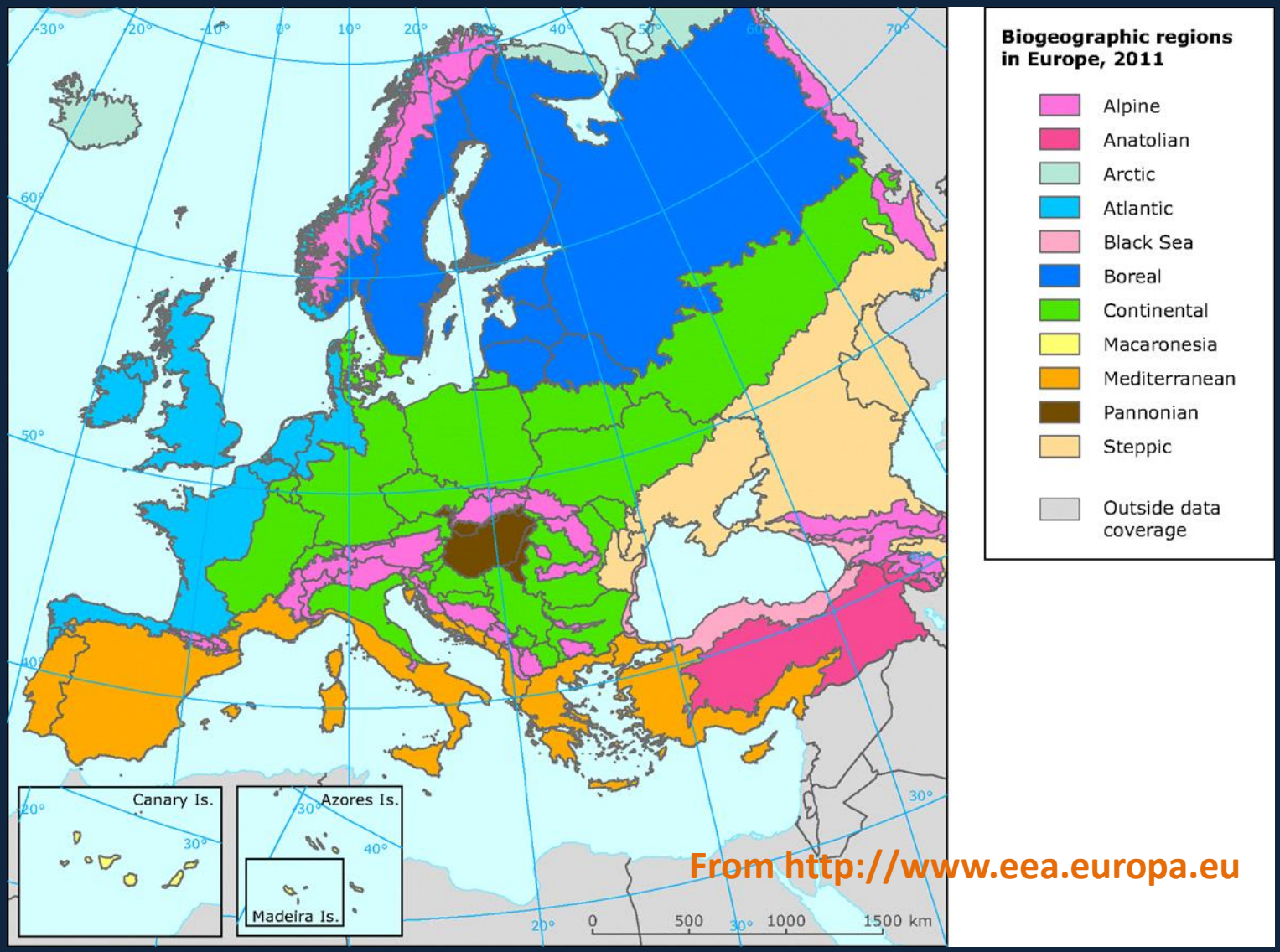
Outline

- Introduction
- Grassland-based farming systems typologies
- Practices to improve forage self-sufficiency of Med farms
- Improving research impact on farming systems
- Final remarks

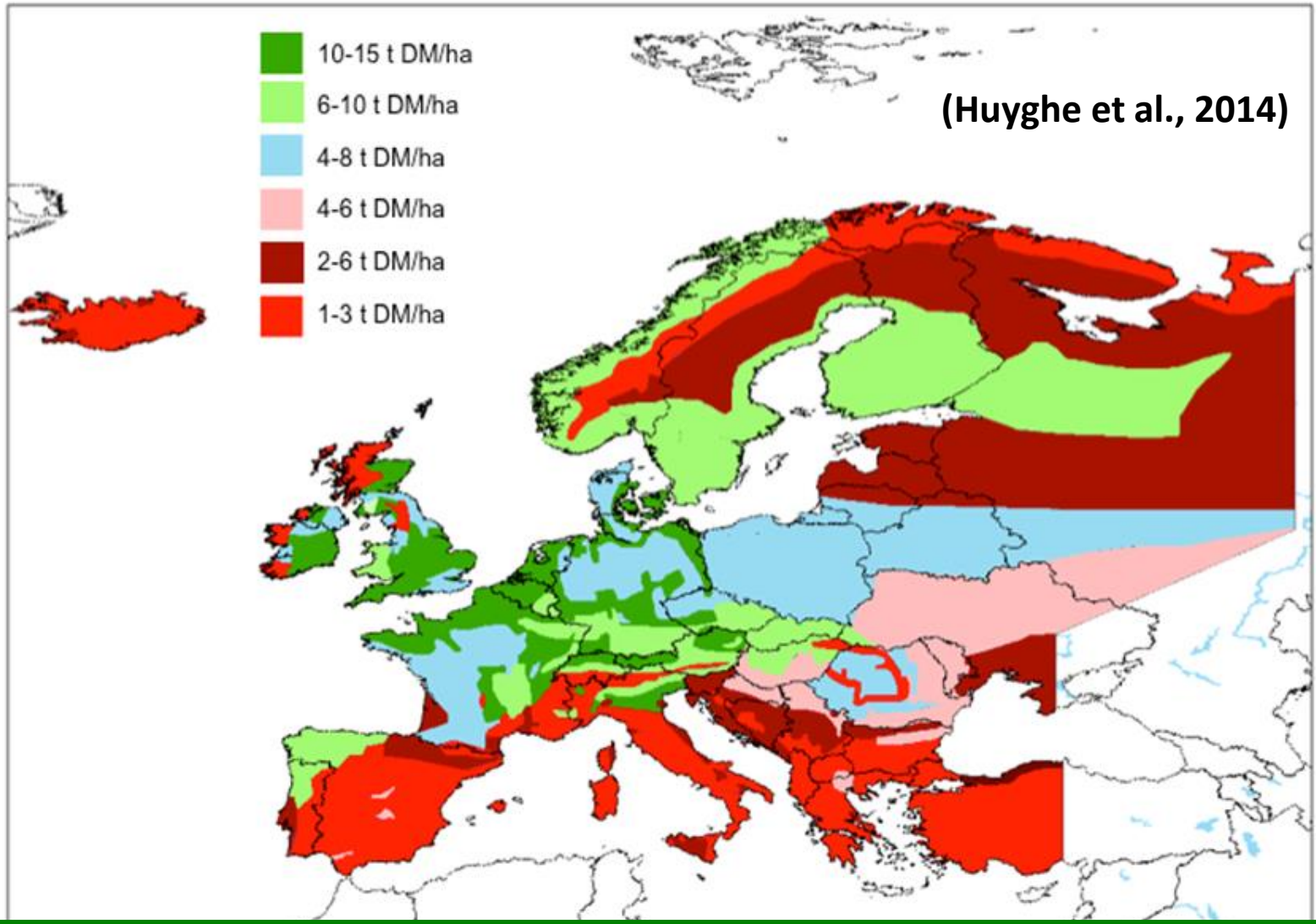
Introduction



From http://www.eea.europa.eu

The most important climate trait of Med areas is the concentration of rainfall between autumn and spring, with a relatively mild winter season, and its total absence during hot summer, associated to a large intra- and inter-annual variability.

Potential Mediterranean grassland production



Med grasslands show a low production compared to the other European grasslands

Grassland-based Farming Systems in Med Countries

A huge variety of farming systems can be found

SPAIN

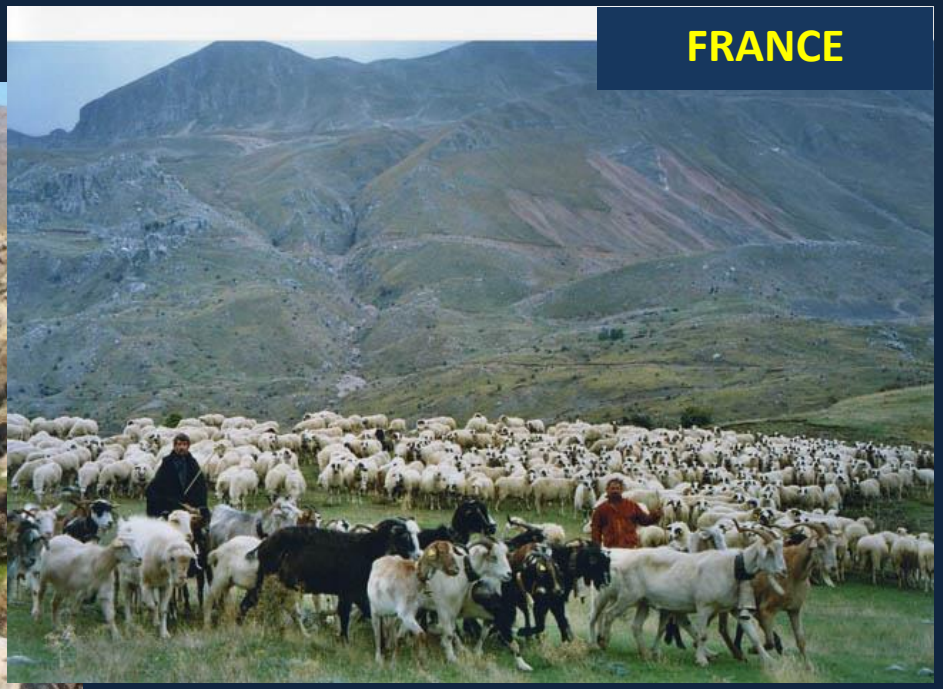
Silvo-pastoral systems

PORTUGAL

Dehesa & Montado types

Grassland-based Farming Systems in Med Countries

Agro-pastoral systems



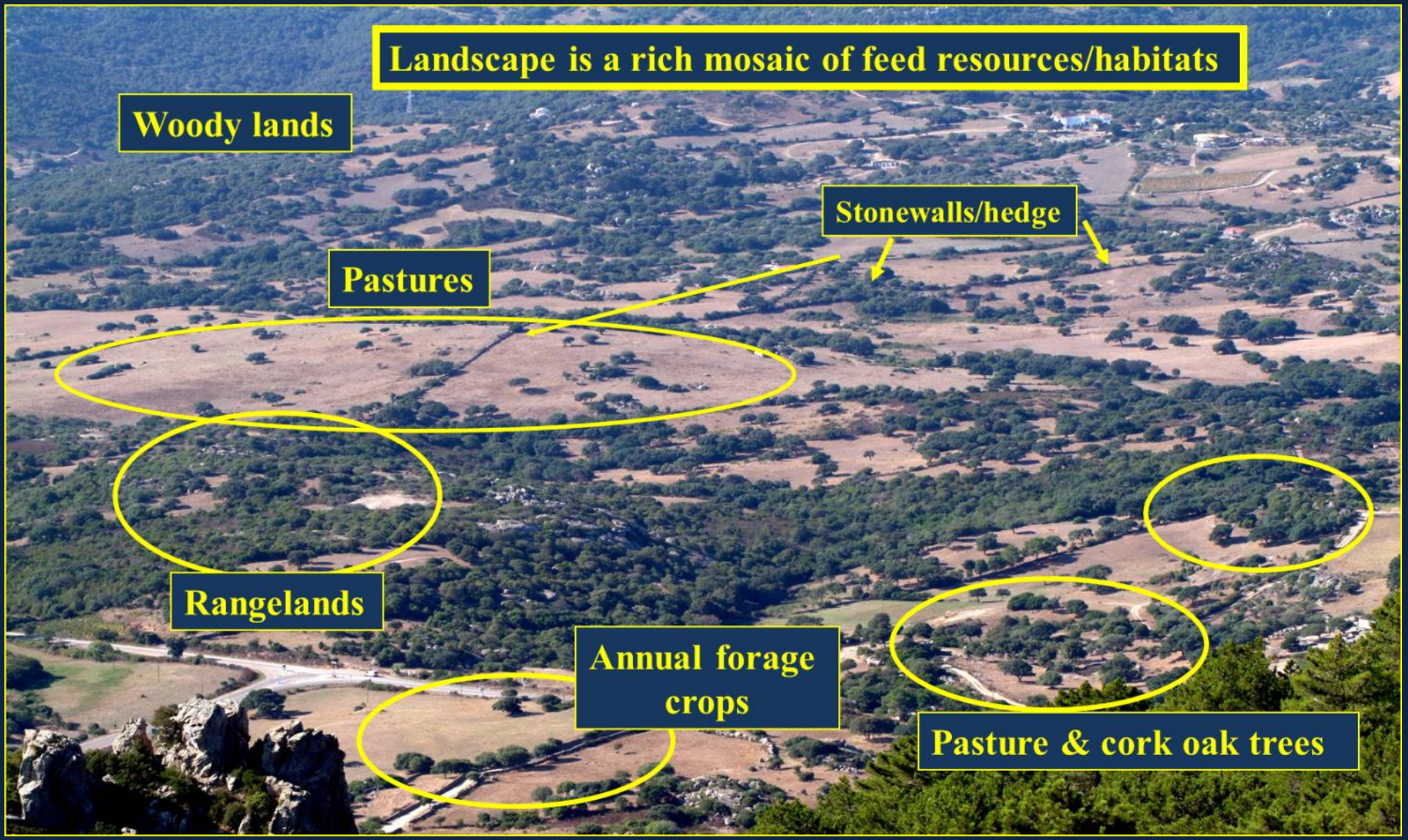
Prygana type

Grassland-based Farming Systems in Med Countries

Mixed cereal-livestock farming systems

Permanent grasslands confined to the marginal soils

Farming Systems typologies: Sardinia as case study



90% LFA – 60% permanent grasslands – 3 million dairy sheep

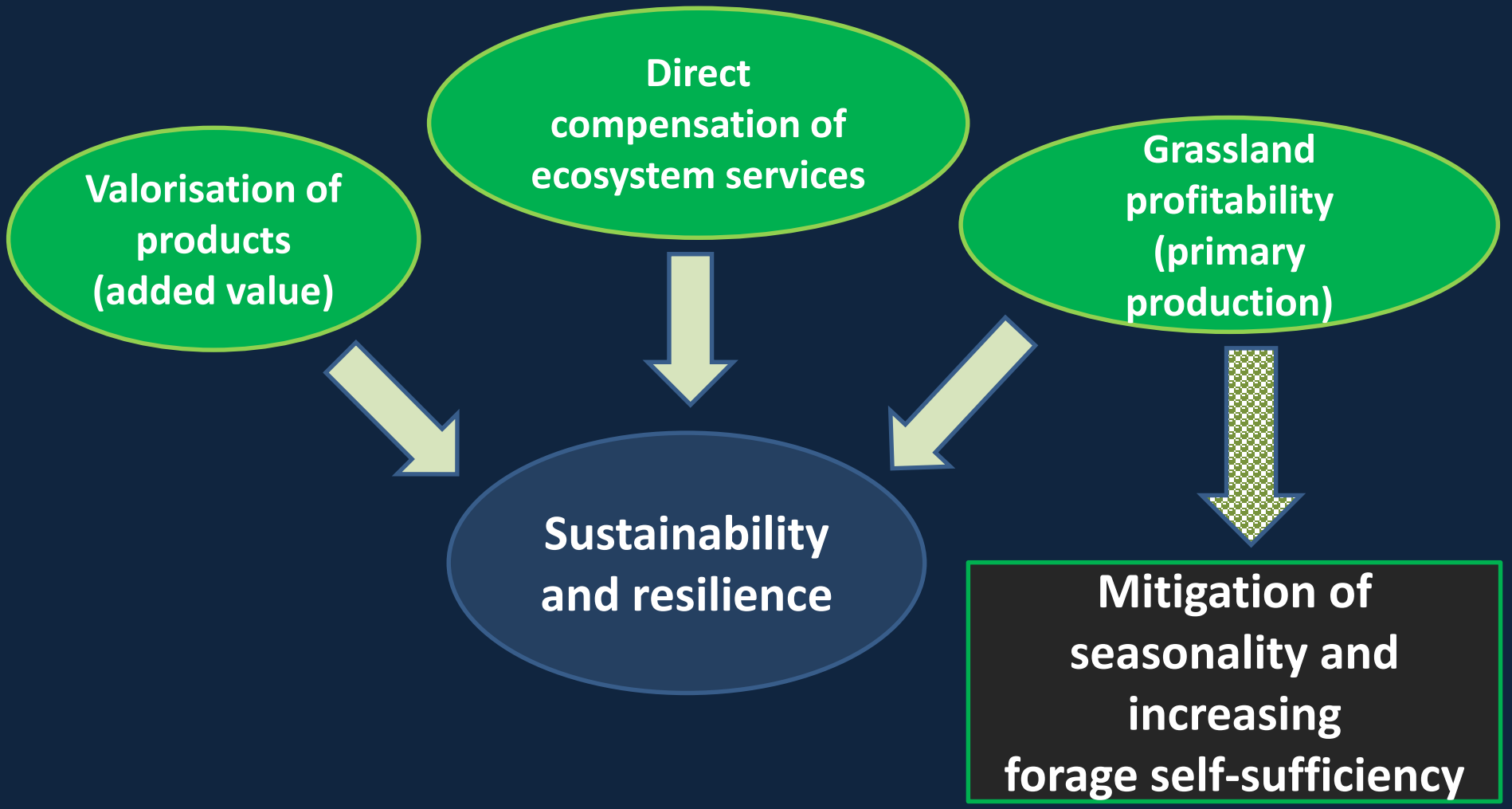
Contribution of grassland in the animal diet in different Sardinian pedoclimatic zones

	Pedoclimatic zones						
	AH	AL	GH	GL	BH	Average	CV
N. sheep farms (36 in total)	5	6	4	10	11	7.2	8.7
Stocking rate (ewes/ha)	9.1	8.7	12.7	4.3	5.6	7.1	46.3
Milk yield (kg/head)	193	190	188	175	106	157	23.3
Hay (kg/head)	41	181	50	13	68	66	98.2
Concentrate (kg/head)	101	90	152	64	120	101	32.7
Total Net Energy req. (FU)	411	409	408	399	354	388	6.1
Hay contribution (FU)	21	91	25	7	34	33	98.2
Concentrate contribution (FU)	81	72	122	51	96	81	32.7
Grazed herbage contribution (FU)	310	247	261	342	224	274	17.5
Grazed herbage contribution (% of total NE requirements)	75	60	64	85	63	71	15

Molle *et al.*, unpublished data

Open question

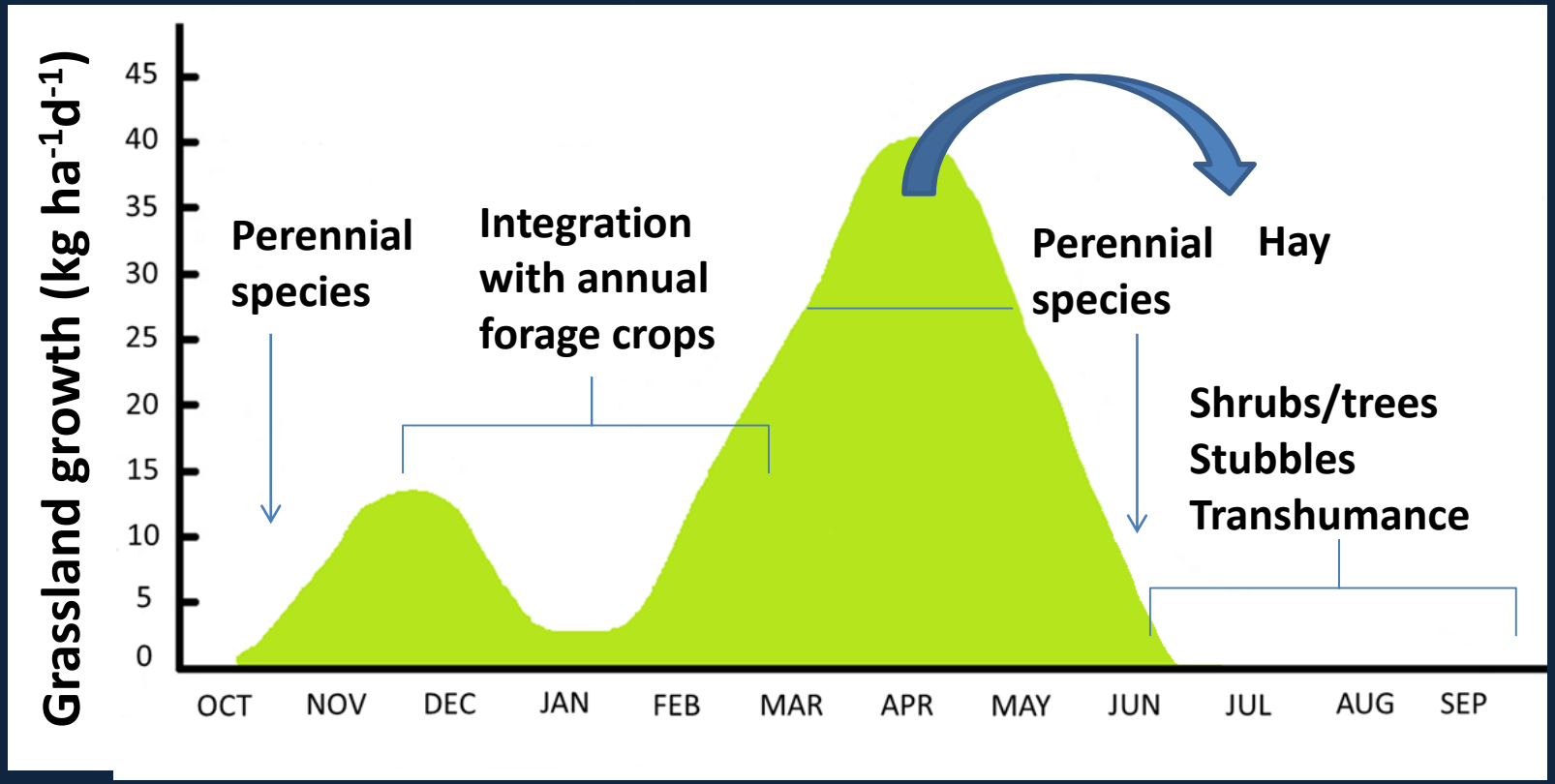
How to increase sustainability of Mediterranean grassland-based farms?



Mitigation of seasonality and increasing forage self-sufficiency of Med farms

Problem with natural/semi-natural pastures: matching animal requirements with grassland forage availability

Daily growth rate of a Mediterranean semi-natural pasture



Grassland fertilisation

Pasture DMY (t ha-1) in six sites (average of 5 years) measured with the method of Corrall and Fenlon (1978). From Bullitta and Caredda (1982)

Site	Altitude (m a.s.l.)	Type of soil	DMY (t ha^{-1})		DM %	Extension of forage availability (in weeks)
			Not fertilised	Fertilised		
BONASSAI	80	Limestone	4.23	8.23	95	+7
CHILIVANI	350	Alluvial	2.77	5.05	82	+7
BADDE ORCA	600	Trachitic	3.13	5.52	76	+3
PATTADA	650	Granite	4.44	6.33	43	+4
CAMPEDA	650	Basaltic	3.92	6.41	63	+3
S. ANTONIO	650	Basaltic	2.39	5.38	122	+8

Fertilisation: 100 kg P_2O_5 ha^{-1}, 50 + 50 kg N ha^{-1}

Use of self-reseeding annual legumes

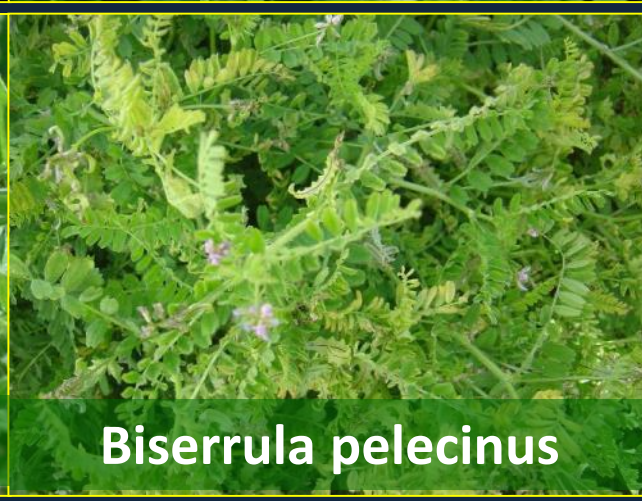
Pastoral annual legumes with hard seeds for permanent pastures


Trifolium subterraneum


Trifolium resupinatum


Medicago polymorpha


Ornithopus compressus


Biserrula pelecinus

Drought escape is the main adaptive strategy that exhibit for surviving during the dry period as seed

High production and tolerance under heavy grazing

Use of perennial legumes for rainfed grasslands

Sheep grazing on lucerne

Sulla coronaria

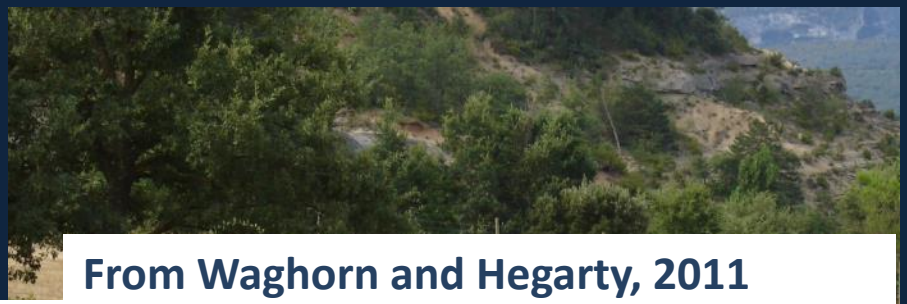
Onobrychis viciifolia

- Drought tolerant
- Flexibile use (grazing/ hay)
- Presence of beneficial secondary compounds
- Multi-use (i.e. honey production)

Plants containing condensed tannins (<5%)

Beneficial effects

- Lower protein degradation rate in the rumen
- higher amino acid absorption



From Waghorn and Hegarty, 2011

Table 3
An illustration of changes in emissions intensity (Ei; CH_4/kg live weight gain) in sheep fed diets of varying quality.

Dietary ME (MJ/kg DM)	Forage	Gain (g/d)	Methane (g/kg DM intake)	Feed:gain ratio (kg DM intake/kg gain)	Ei (g/kg gain)
10.0	Ryegrass pasture	100	24.0	13.6	300
11.0	Ryegrass pasture	150	22.0	9.4	210
12.0	Ryegrass pasture	200	21.0	7.5	160
11.5	Lucerne	250	20.0	6.7	130
12.0	Sulla[a]	300	17.5	6.2	110

ME: metabolisable energy; DM: dry matter.
Calculated CH_4 emissions per unit of liveweight gain from growing lambs fed forages with a range of feeding values (from Waghorn and Clark, 2006).
[a] Sulla (*Hedysarum coronarium*) contains condensed tannins.

Sheep grazing on sulla pasture in Sardinia

- Decrease of dependence on pharmaceutical treatments and avoidance of helminths resistance
- **Higher animal production**
- **Lower enteric CH_4 generation**

Perennial grasses for permanent pasture

Areas with annual rainfall over 400 mm

Phalaris aquatica

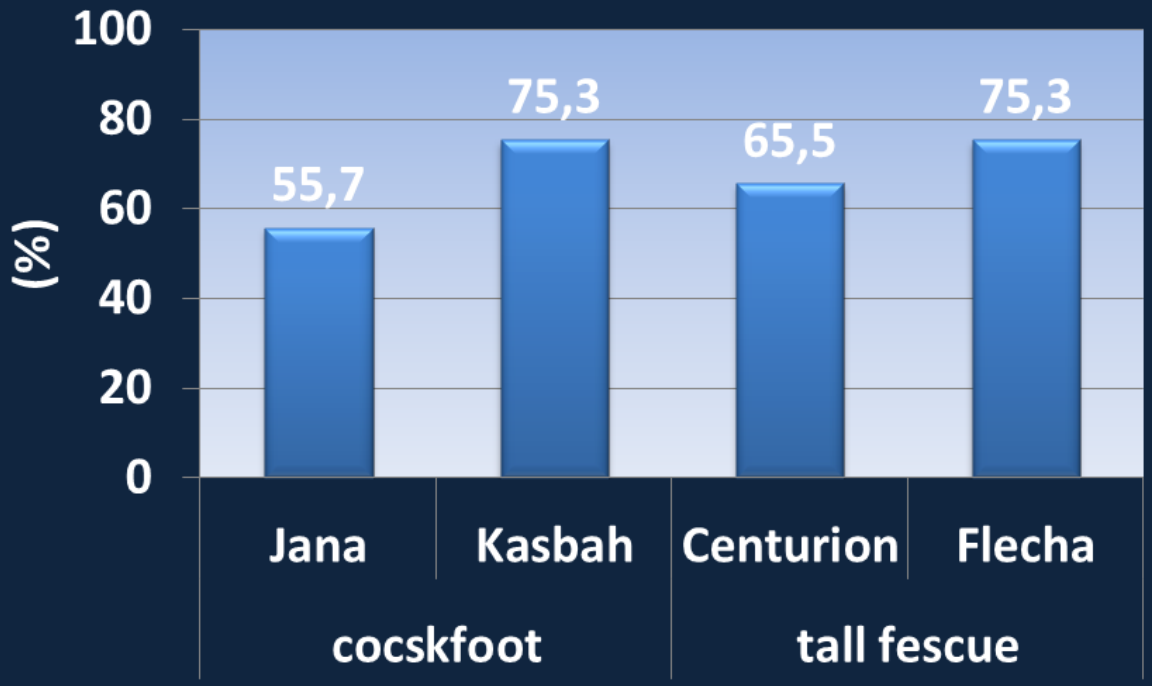
Festuca arundinacea

Dactylis glomerata

Traits: summer dormancy and high water use efficency

Persistence in perennial grasses for permanent pasture

Average row cover (%) after 6 years. Mean values among six sites in Mediterranean environments. From Annicchiarico *et al*. (2013)

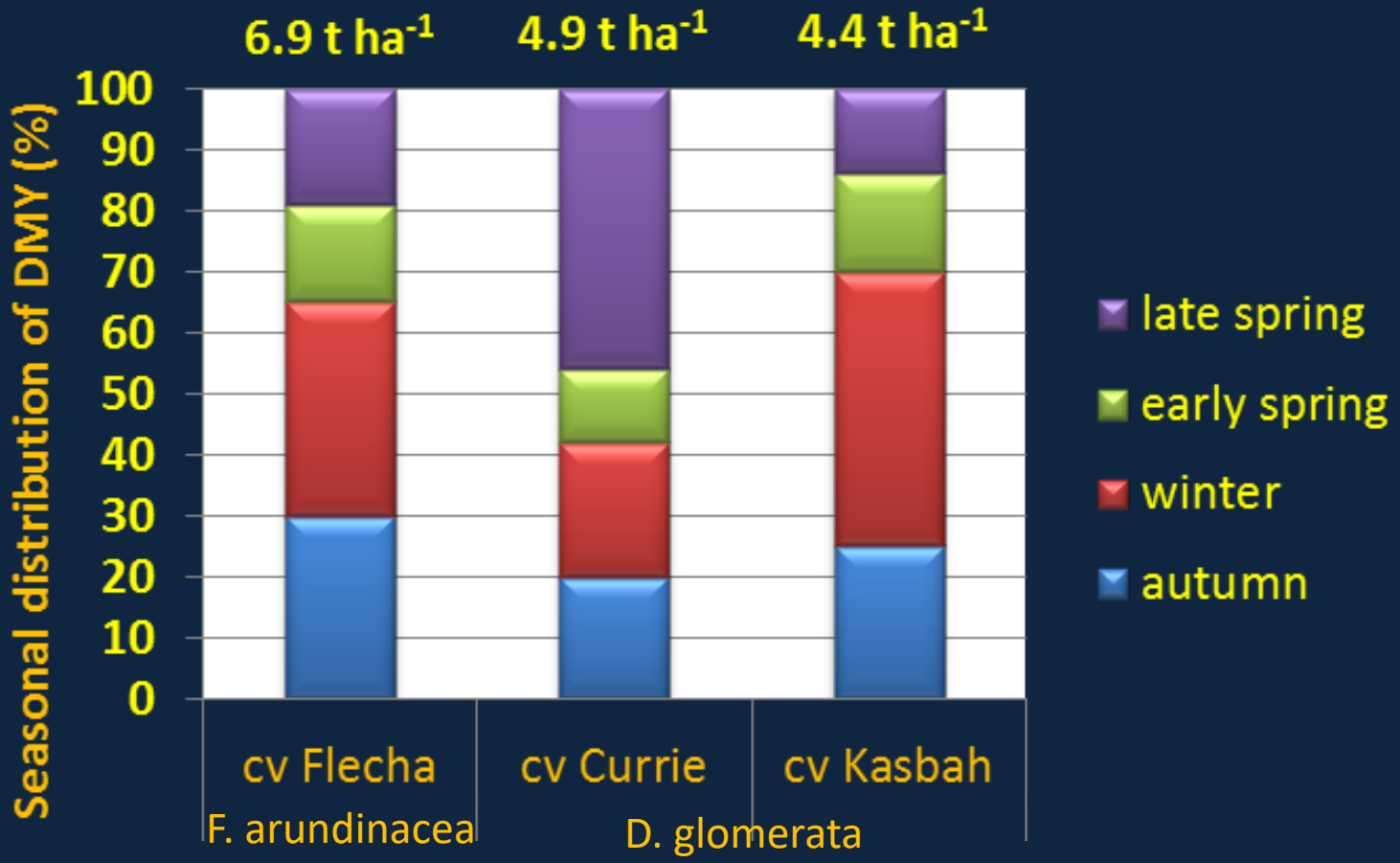


Survival after summer

Dactylis **temperate origin**

Dactylis **Med origin**

Total and seasonal production of native grasses adapted to Mediterranean environments



Porqueddu *et al*. (2008)

Use of mixtures of adapted native grasses and legumes

EU Action COST 852 "Quality Legume-Based Systems for Contrasting Environments"

Species belonging to 4 functional groups:

- **Grass / Legumes**
- **Fast establishing / Slow establishing (= annuals/perennials)**

NATIVE SPECIES (Dry Mediterranean mixture)

G_1= *Lolium rigidum* Nurra

G_2= *Dactylis glomerata* Currie

L_1= *Medicago polymorpha* Anglona

L_2= *Medicago sativa* Surigheddu

Improving forage quality using native species-based mixes

Plot	CP	NDF	IVDMD
L2 mono	20.0	42.9	69.8
centroid	18.5	47.5	67.8
dom G2 and L2	18.4	48.0	67.6
dom L2	18.4	46.2	69.1
dom L1 and L2	18.1	47.1	68.1
dom G1 and L2	17.9	48.0	66.9
dom G2 and L1	17.7	46.8	68.2
dom G2	17.6	48.7	66.9
dom G1 and G2	17.5	47.3	68.2
dom G1	17.3	46.3	67.9
dom L1	17.2	47.0	68.6
dom G1 and L1	15.8	46.2	66.8
L1 mono	14.8	42.1	68.1
G2 mono	14.3	59.2	58.5
G1 mono	12.9	47.1	64.7
mean mono	**15.5**	**47.8**	**65.3**
% change mono/centr.	**19.3**	**-0.7**	**3.9**

G1 = *L. rigudum*
G2 = *D. glomerata*
L1 = *M. polymorpha*
L2 = *M. sativa*
1 = fast establishing species
2 = slow establishing species

Average values of 5 harvests along the year

Maltoni et al. (2007)

Improving research impact on farming systems

Involvement of stakeholders: farmers

ARIMNET - Project REFORMA http://reforma.entecra.it/

Traits

- ❑ DMY
- ❑ Forage quality
- ❑ Interest as a crop
- ❑ Interest as feed
- ❑ Crop global value

Score ranking

1= very poor/low
2= poor/low
3= sufficient
4= high/good
5= very high/very good

Involvement of stakeholders: farmers, advisors and researchers

Sheeptoship LIFE Project aims to develop and promote eco-innovative dairy sheep production models using Life Cycle Approach

LCA is a powerful method to provide a holistic assessment of the production processes, in terms of resources use and environmental impacts, as well as identification of hotspots at farm level

A survey on 20 representatives dairy sheep farms is being carried out in Sardinia where a model of actions and measures on climate change will be tested

Science of the Total Environment 502 (2015) 354–361

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Environmental performances of Sardinian dairy sheep production systems at different input levels

E. Vagnoni [a,d,*], A. Franca [b], L. Breedveld [c], C. Porqueddu [b], R. Ferrara [a], P. Duce [a]

http://www.sheeptoship.eu/

Involvement of stakeholders: multi-actor approach

Take home message

- **Mediterranean grassland-based systems have a high degree of diversity and require a complex holistic multidisciplinary approach and the identification of solutions adapted to a local scale, involving also stakeholders**

Acknowledgements to

iSAGE
Innovation for Sustainable Sheep and Goat Production in Europe

Thanks for your attention!