

# Improving the use of grazed forage in Mediterranean ruminant systems: issues, options and perspectives



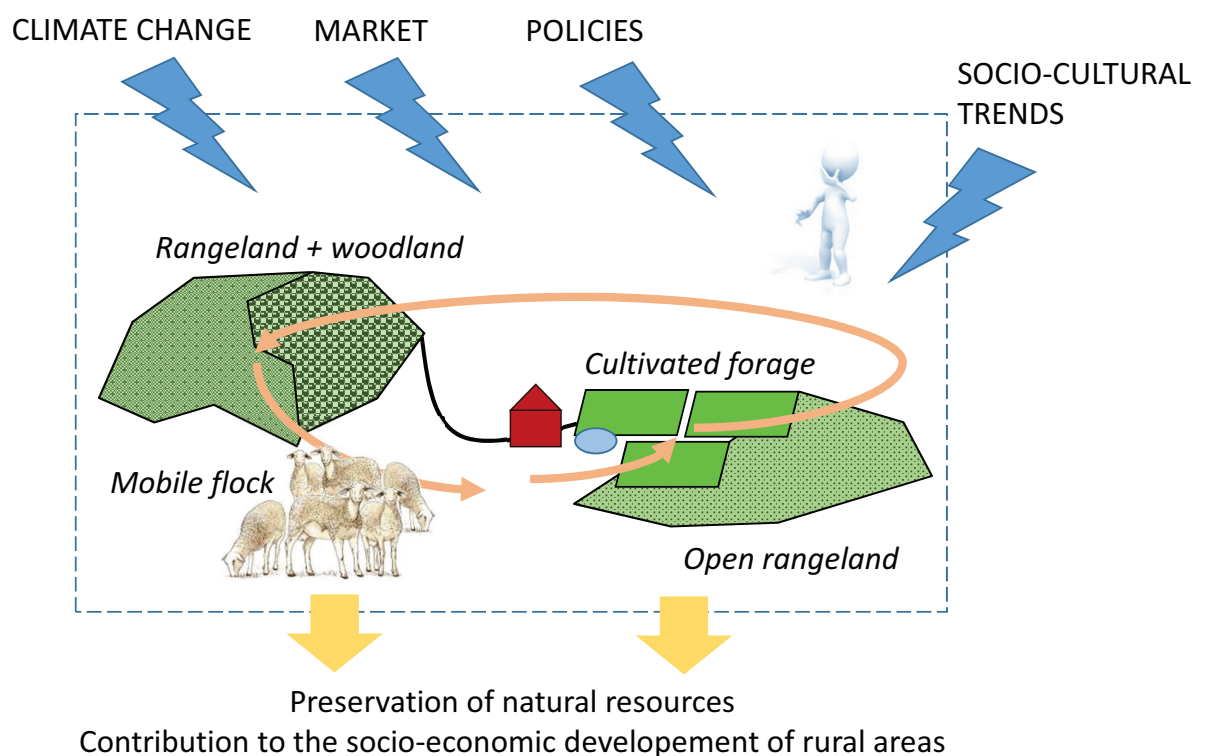
**Magali JOUVEN** (Montpellier SupAgro, UMR SELMET / UMT Pasto)

**Isabel CASASÚS** (CITA, IA2)

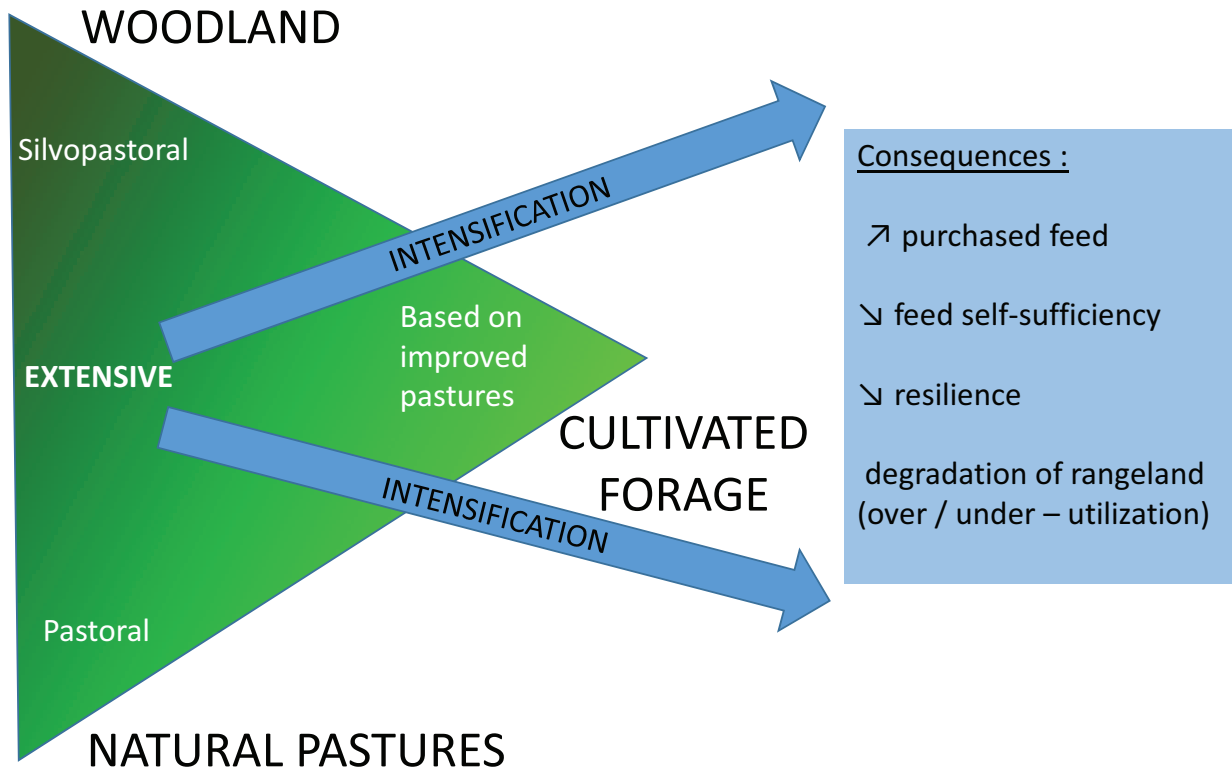
**Antonello Franca** (CNR, ISPAAM)



## Mediterranean small ruminant systems (MSRS)



# A diversity of systems and intensification levels



## More grazed forage, a solution ...

... to secure the sustainability of MSRS ?

**Optimizing the utilization of the diversity of local resources**

(grazing plan associated to adequate flock management)

+

**More grazing**

=

**Higher forage [feed] self-sufficiency**

+

**Improved economic return** (less expenses, added value to the products)

+

**Improved ecological footprint**

## More grazed forage, a solution ...

... to meet the consumers' demand?

**More grazed  
grass in the diet**

+ secondary  
metabolites



**Positive image for the consumer**

*Bardaji et al. (2009), Poore and Nemecek (2018)*

**More PUFA in the milk and meat**

*Cabiddu et al. (2005), Joy et al. (2012)*

**Soft, yellow cheese, typical flavour**

*Coppa et al. (2011), Martin et al. (2016)*

**Dark meat, yellow fat, pastoral flavour**

*Blanco et al. (2010), Lobón et al. (2017), Priolo et al. (2001)*

**Longer meat shelf-life**

*Vasta and Luciano (2011), Lobón et al. (2017)*

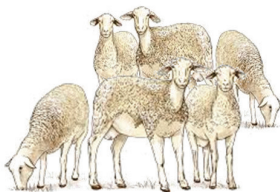
**Possible differentiation [traceability]**

*Lobón et al. (2019)*

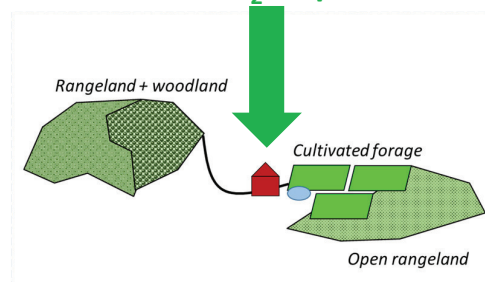
## More grazed forage, a solution ...

... to mitigate climate change ?

**CH<sub>4</sub> emissions**



**CO<sub>2</sub> sequestration**



Can be reduced by :

↗ forage quality (legumes, management)  
*LEAP (2019)*

↗ forages with secondary compounds  
*Waghorn et al. (2002), Archimede et al. (2011)*

... or with water-soluble carbohydrates  
*Lee et al. (2001), Jones et al. (2014)*

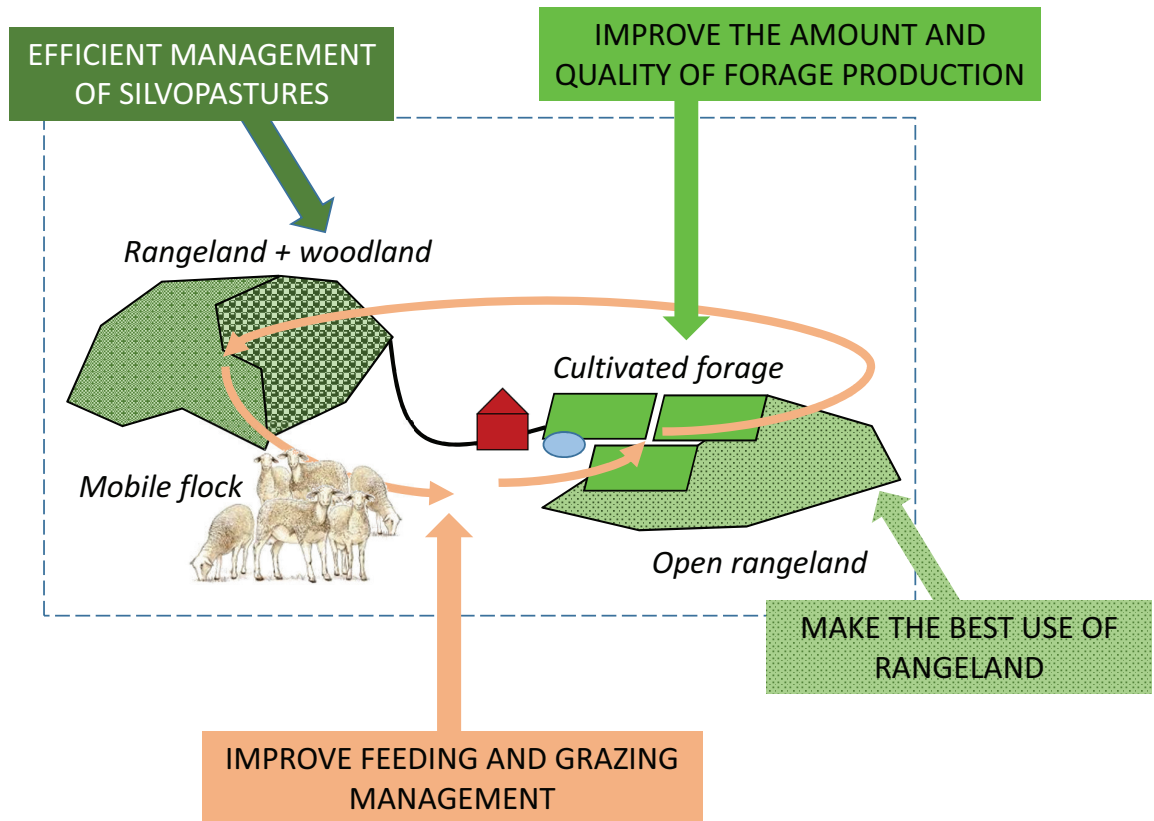
Can be improved by :

↗ surface area of permanent vegetation  
*Bernués et al. (2017)*

Regulating grazing pressure  
*Vigan et al. (2017)*

... and more grazing can ↘ CO<sub>2</sub> emiss<sup>o</sup>  
(↘ mechanization) *Vagnoni and Franca (2017),  
Soteriades (2016), Rotz et al. (2010)*

# Technical options to increase grazed grass

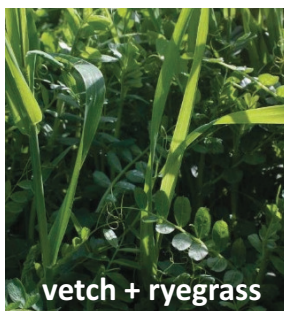


## IMPROVE THE AMOUNT AND QUALITY OF FORAGE PRODUCTION

The issue: produce high-quality forage (legumes) adapted to the specific Mediterranean conditions, and available all-year round.

### Annual crops

grazed (W) + cut (S)  
« grass+legume » or  
« cereal+legume »



Porqueddu *et al.*, 2017

### Perennial leg.

available 365d/y  
Source of protein  
(+ tannins )



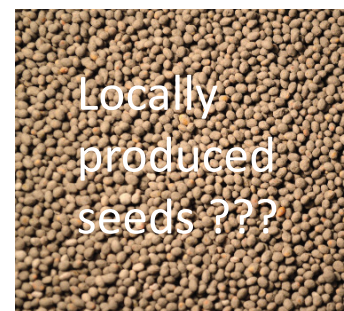
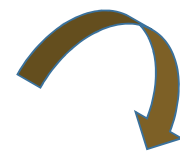
Re *et al.*, 2014

### Perm. grassland

Choice of mixtures  
New locally-adapted  
legume species



Nichols *et al.*, 2007



Porqueddu *et al.*, 2010

# IMPROVE FEEDING AND GRAZING MANAGEMENT

The issue : obtain high animal production at pasture, while reducing waste and GHG emissions.

**High requirements in spring**



Gonzalez-G. *et al*, 2014

**Legumes with CT**  
Protein nutrition



Molle *et al.*, 2008

**Perennial crops to extend forage availability**



Alvarez-Rodríguez *et al.*, 2010  
Blanco *et al.*, 2011

+ Strategic supplementat°



## MAKE THE BEST USE OF RANGELAND

The issue : take advantage, at a yearly scale, of the low-cost forage resource available on rangelands + secure such resource.

**Combine complementary areas (+/- shrubby)**



Gobindram *et al*, 2018

+ Strategic supplementat°



**Mixed grazing**



**Payment for ES**



Rodriguez-Ortega *et al.*, 2018

# EFFICIENT MANAGEMENT OF SILVOPASTURES

The issue : improve herbage production (amount, quality) and thus animal production.

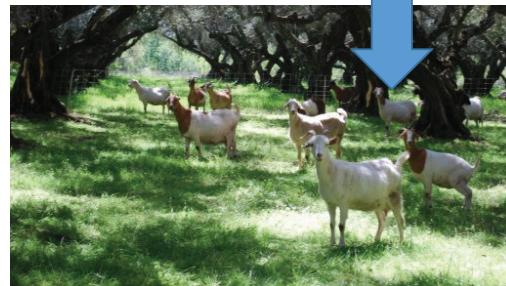
## Mediterranean silvopastoral systems



Multiple products  
Ecological value  
Cultural value  
Socio-economic issues

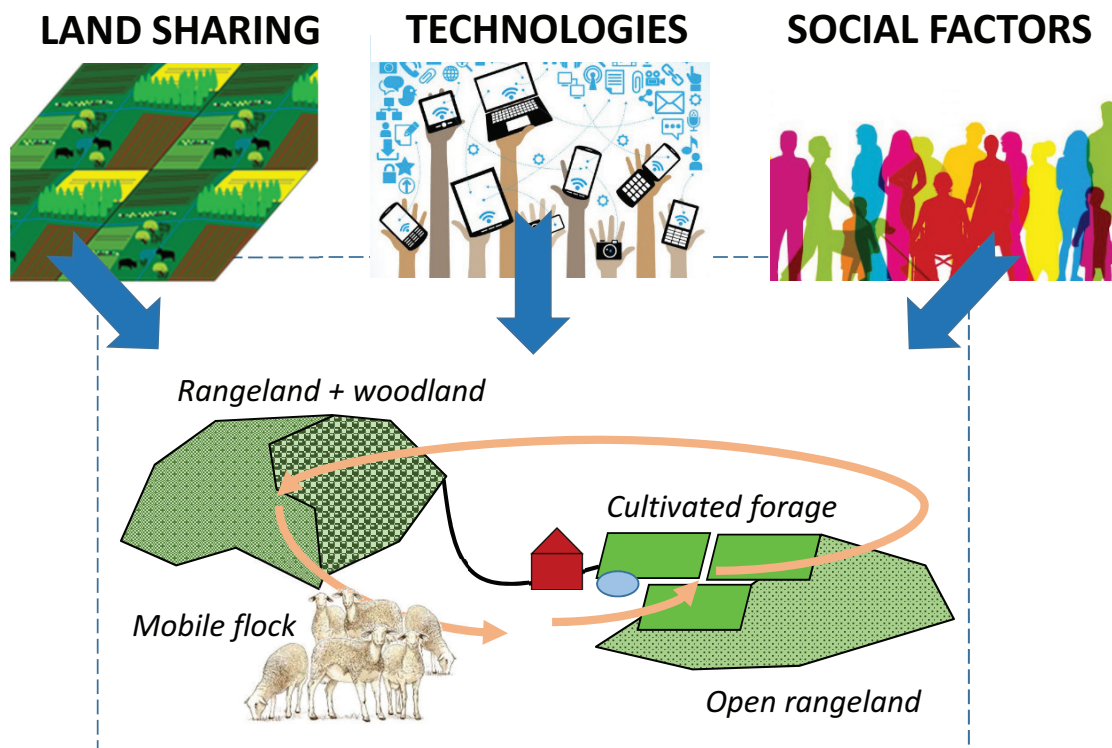
## Silvopastures

Improved grassland (shade-tolerant species)  
Targeted P fertilization  
Rotational multi-paddock grazing  
Mixed grazing



[www.agforward.eu](http://www.agforward.eu)  
[www.regenerate.eu](http://www.regenerate.eu)

## Contextualizing technical changes



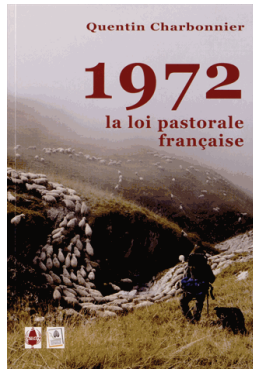
# Social factors impacting pasture-based systems

## STATUS OF RANGELAND

Common land governed by ...  
old / new rights ?



In France,  
specific legal  
tools for  
multifunc\_  
tional  
grazing  
lands.



Bourbouze & Gibon (1999), Ait-Alhayane (2016)

## PERCEPTION OF RANGELAND...

- Low-quality resource, incompatible with good animal performance.
- Low-cost forage resource for animals with low nutrient requirements.
- Diverse forage resource, which can provide interesting feed at certain periods of the year, in certain management conditions.

## ... ASSOCIATED WITH SPECIFIC LOCAL ECOLOGICAL KNOWLEDGE

Lasseur (2005), Jouven *et al.* (2015),  
Gobindram *et al.* (2018)

# What can we expect from modern technologies ?

**Smart farming in extensive systems** = provide data and information to the farmer, in order to improve his local ecological knowledge and to help him/her adapt the management practices.

- (1) Real-time localisation of flocks
- (2) Alert in case of panic or exit from limits
- (3) Virtual fences
- (4) Knowledge of animal grazing circuits
- (5) Monitoring of animal activities



Virtual fencing collars

Jouven *et al.* (2011)



CLOChète project



*Pastoral Rummy* : a board + a simulator to test and discuss grazing strategies.

Zapata *et al.* (2017)

# Reconnecting MSRS and other activities

Livestock and biodiversity conservation :  
the LIFE program (E.U.)



Livestock and tourism



Grazing on land devoted to other productions



## Conclusions and perspectives

- Increasing the contribution of grazed forage in MSRS is an interesting option to answer climatic, economic, ecological and socio-political issues.
- A range of technical solutions are available to improve the amount and quality of forage intake at pasture; certain solutions are more adapted to improved grasslands, others concern mainly natural pastures.

- Objectivize the specific features of MSRS
- Value the range of ecosystem services rendered by MSRS
- Reconnect MSRS with other activities
- Optimize management practices in a multifunctional context
- Produce tools adapted to MSRS : seeds for improved pastures, technological packages, legal framework for pastoral use of land





## PROGRAMME

### DAY 1: 23<sup>RD</sup> OCTOBER

8:30 – 9:00	Registration
9:00 – 9:30	<b>Opening by authorities</b>
9:30 – 10:00	<b>INTRODUCTORY CONFERENCE: Moroccan production systems, rangelands and forages.</b> A. Keli, M. Mounsif (ENA Meknès, Morocco), M. Chentouf (INRA Morocco) and A. Araba (IAV Hassan II, Morocco)
10:00 – 11:15	<b><u>PLENARY SESSION 1: WHAT PRODUCTION SYSTEMS AND PRODUCT CHAINS TO MEET THE SOCIETAL DEMAND?</u></b>  <i>Chairperson: M. Chentouf (INRA, Morocco)</i>  - <b>Keynote presentation: Resilient and efficient small ruminant value chains in the Mediterranean basin: Challenges and opportunities from societal and consumers' needs.</b> R. Zanolì (Univ. Politecnica delle Marche, Italy)  - <b>Keynote presentation: Impact of feed quality on animal health and food safety.</b> M. Bengoumi (FAO-Subregional Office for North Africa)
11:15 – 11:45	Coffee break
11:45 – 13:15	- <b>Short oral presentations:</b>  S1-35 – <b>Diversité des systèmes de production agricole dans le massif forestier du Boutaleb, Algérie.</b> H. Sahraoui (Univ. of Setif 1, Algeria)  S1-44 – <b>A collaborative multi-stake holder analysis of the sheep and goats sector challenges.</b> A. Belanche (CSIC, Spain)  S1-20 – <b>Factors influencing sheep farmer attitudes towards breeding tools across Mediterranean local breeds.</b> D. Martín-Collado (CITA, Spain)  S1-30 – <b>Flavored Moroccan goat cheese prepared with rosemary (<i>Rosmarinus officinalis</i> L.) and white wormwood (<i>Artemisia herba-alba</i> Asso) essential oils: Sensory profile and physicochemical properties.</b> Y. Noutfia (INRA, Morocco)  S1-27 – <b>Dietary inclusion of whole pomegranate by-product to improve oxidative stability of lamb meat.</b> A. Natalello (Univ. of Catania, Italy)  - <b>Posters focus by session chair</b>  - <b>Open discussion</b>
13:15 – 14:30	Lunch

**DAY 1: 23<sup>RD</sup> OCTOBER (cont.)**

14: 30 – 17:30	<p><b><u>PARALLEL SESSION 1: NUTRITIONAL STRATEGIES TO IMPROVE SHEEP AND GOAT ADAPTATION AND PRODUCTION EFFICIENCY</u></b></p> <p><i>Chairperson : M. Joy (CITA, Spain)</i></p> <p>- <b>Key note presentation: Smart feeding for improved performances and meat and milk quality of small ruminants.</b> <i>B. Valenti, (Univ. of Perugia, Italy) , H. Ben Salem (IRESA, Tunisia)</i></p> <p>- <b>Short oral presentations:</b></p> <p><b>P1-01 – Replacement of soybean meal with lupine in barbarin lamb diet: Effect on intake, digestion, blood metabolites and growth.</b> <i>S. Abidi (INRAT, Tunisia)</i></p> <p><b>P1-03 – <i>In vitro</i> fermentation and acidification potential of several carbohydrates sources used in concentrate-based diets for growing ruminants.</b> <i>Z. Amanzougarene (Univ. Zaragoza-CITA, Spain)</i></p> <p><b>P1-09 – Effects of ensiled sugar-beet pulp incorporation in the diet on performance of lamb fattening.</b> <i>M. Benbati (INRA, Morocco)</i></p> <p><b>P1-14 – Halophytes and grass pea as alternative fodder resources for rearing lambs on saline area: The case of Kerkennah archipelago.</b> <i>M. Friha (ISA de Chott-Mariem, Tunisia)</i></p> <p><b>P1-15 – Feed efficiency of barn-dried hay obtained in a sustainable goat farming system (Patuchev) for dairy goats.</b> <i>S. Giger-Reverdin (UMR INRA-AgroParisTech MoSAR, France)</i></p>
	<p>15:45 – 16:15: <i>Coffee break</i></p> <p>- <b>Short oral presentations:</b></p> <p><b>P1-18 – Characterization of goat neonatal mortality in northern Morocco and impact of colostrum supplementation.</b> <i>N. Hamidallah (Univ. Hassan Premier Settat, Morocco)</i></p> <p><b>P1-27 – Nutritional and production aspects of partially or totally replacement of berseem hay by cassava in ewes feeding.</b> <i>A.S. Morsy (Arid lands Cultivation Research Institute, Egypt)</i></p> <p><b>P1-28 – Garlic (<i>Allium sativum</i> L.) in ruminant nutrition: Chemical composition, antioxidant and antimicrobial activities and <i>in vitro</i> effect on digestion in sheep.</b> <i>N. Moujahed (INAT, Tunisia)</i></p> <p>- <b>Posters focus by session chair</b></p> <p>- <b>Open discussion</b></p>
14:30 – 17:30	<p><b><u>PARALLEL SESSION 2: PROMISING FORAGE RESOURCES FOR MEDITERRANEAN PRODUCTION SYSTEMS</u></b></p> <p><i>Chairperson: M. Jouven (Montpellier SupAgro, France)</i></p> <p>- <b>Key note presentation: Promising forage resources for production systems in Mediterranean areas.</b> <i>L. Peccetti (CREA, Italy)</i></p> <p>- <b>Short oral presentations:</b></p> <p><b>P2-03 – Seed yield and some agricultural traits of cowpea (<i>Vigna unguiculata</i> L (L.) Walp) grown with different densities as double crop.</b> <i>Ý. Ayan (Ondokuz Mayıs Univ., Turkey)</i></p> <p><b>P2-07 – Performance of local populations of <i>Medicago truncatula</i>, <i>M. laciniata</i> and <i>M. minima</i> collected in the Algerian steppe areas.</b> <i>A. Chebouti (INRAA, Algeria)</i></p> <p><b>P2-08 – Influence of altitude and seasons on the forage quality of <i>Prosopis juliflora</i> shrubs.</b> <i>M. El-Morsy (Desert Research Center, Egypt)</i></p>

## DAY 1: 23<sup>RD</sup> OCTOBER (cont.)

14:30 – 17:30	<p><b><u>PARALLEL SESSION 2: PROMISING FORAGE RESOURCES FOR MEDITERRANEAN PRODUCTION SYSTEMS (Cont.)</u></b></p> <p>- Short oral presentations (cont.):</p> <p><b>P2-10 – Developing annual cereal-legume mixtures in dairy goat farms in South-West of France, to improve protein self-sufficiency and reduce feeding costs.</b> <i>J. Jost (Institut de l'Élevage, France)</i></p> <p>15:45 – 16:15: <i>Coffee break</i></p> <p>- Short oral presentations</p> <p><b>P2-11 – Biomass production of different annual cereal-legume intercrops under Moroccan conditions.</b> <i>R. Kallida (INRA, Morocco)</i></p> <p><b>P2-20 – Influence of different <i>Rhizobium sullae</i> strains and soil fertility on the agronomic performance of Sulla (<i>Sulla coronaria</i> L.).</b> <i>M. Sitzia (AGRIS Sardegna, Italy)</i></p> <p><b>S3-13 – Comparative evaluation of winter forage legumes under Mediterranean rain-fed conditions.</b> <i>I. Hadjigeorgiou (Agricultural Univ. of Athens, Greece)</i></p> <p>- Posters focus by session chair</p> <p>- Open discussion</p>
14:30 – 18:15	<p><b><u>PARALLEL WORKSHOP OF THE ISAGE PROJECT</u></b></p> <p>Presentation of main results by project team members, flash presentations from participants and open discussion (see separate programme).</p>

## DAY 2: 24<sup>TH</sup> OCTOBER

Full day field trip to Middle Atlas area to visit small ruminant production systems under grazing conditions.

## DAY 3: 25<sup>TH</sup> OCTOBER

9:00 – 11:15	<p><b><u>PLENARY SESSION 2: MEETING THE CHALLENGE OF CLIMATE CHANGE IN MEDITERRANEAN AGRO-PASTORAL SYSTEMS.</u></b></p> <p><i>Chairperson: Y. Pueyo (CSIC, Spain)</i></p> <p><b>Key note presentation: Climate change impacts on Mediterranean small ruminant production systems and mitigation options.</b> <i>A. del Prado (BC3, Spain)</i></p> <p>- Short oral presentations:</p> <p><b>S2-03 – Rehabilitation of Algerian rangelands : effects of <i>Atriplex canescens</i> plantation on biodiversity, soil physico-chemical parameters and soil surface elements.</b> <i>F. Amghar (Univ. M'Hamed Bougara Boumerdes, Algeria)</i></p> <p><b>S1-08 – The prospects of pastoral sheep and goat dairy systems in the Mediterranean to cope with global changing: An analysis from the Corsican case.</b> <i>J.P. Dubeuf (INRA, France)</i></p> <p><b>S2-05 – Dynamics of livestock farming systems and adaptation strategies to climate and socio-economic changes in the Sétifienne semi-arid zone (Algeria).</b> <i>M. Benidir (INRAA, Algeria)</i></p>
--------------	--

**DAY 3: 25<sup>TH</sup> OCTOBER (cont.)**

9:00 – 11:15	<p><b><u>PLENARY SESSION 2: MEETING THE CHALLENGE OF CLIMATE CHANGE IN MEDITERRANEAN AGRO-PASTORAL SYSTEMS (Cont.)</u></b></p> <p>- Short oral presentations (cont.):</p> <p>S2-11 – Evolution and transformation dynamics of rangeland in Moroccan north Atlasic plains and plateaux: Rhamna's case. <i>M. El Koudrim (INRA, Morocco)</i></p> <p>S2-17 – Phytomass estimation of Moroccan Rangeland using Sentinel-2 satellite indices and <i>in situ</i> biomass measurements. <i>H. Mahyou (INRA, Morocco)</i></p> <p>S2-19 – Ameliorating soil acidity improves the resilience of pasture production under extended drought. <i>M. Norton (Wagga Wagga Agricultural Institute, Australia)</i></p> <p>- Posters focus by session chair</p> <p>- Open discussion</p>
11:15 – 11:45	Coffee break
11:45 – 13:00	<p><b><u>PLENARY SESSION 3: IMPROVE THE CONTRIBUTION OF GRAZED AND CROPPED FORAGE IN THE FEEDING SYSTEMS</u></b></p> <p><i>Chairperson: M. Mounsif (ENA Meknès, Morocco)</i></p> <p><b>Keynote presentation: Improving the use of grazed forage in Mediterranean ruminant systems: issues, options and perspectives. <i>M. Jouven (AgroSup Montpellier, France), A. Franca (CNR-ISPAAM, Italy), and I. Casasús (CITA, Spain)</i></b></p> <p>Keynote presentation: Management and restoration of pastures and rangelands in the Mediterranean basin from the Northern and the Southern perspective. <i>Y. Pueyo (IPE-CSIC, Spain) and A. El Aich (IAV Hassan II, Morocco)</i></p>
13:00 – 14:00	Lunch
14:00 – 15:45	<p><b><u>PLENARY SESSION 3 (CONT.): IMPROVE THE CONTRIBUTION OF GRAZED AND CROPPED FORAGE IN THE FEEDING SYSTEMS</u></b></p> <p>- Short oral presentations:</p> <p>S3-28 – Extending forage production using mixtures in a Mediterranean rainfed environment. <i>C. Porqueddu (CNR-ISPAAM, Italy)</i></p> <p>S3-29 – Intensive rotational grazing for small ruminant feeding in Mediterranean areas. <i>R. Primi (Univ. of Tuscia, Italy)</i></p> <p>S3-14 – The Northwestern meadows of Tunisia: Feed source to efficiently produce a healthy sheep meat. <i>H. Hajji (IRA Médenine, Tunisia)</i></p> <p>S3-16 – Fertilization ameliorates the production of natural wet meadows in the oriental Atlas mountain of Morocco: The case of Imilchil region. <i>A. Homrani Bakali (INRA, Morocco)</i></p> <p>S3-19 – Developing a toolbox for rangeland restoration/rehabilitation in arid environments. <i>M. Louhaichi (ICARDA, Jordan)</i></p> <p>S3-22 – Analysis of forage balances in the Djelfa region from 2001-2015. What is the place of the pastoral and cultivated resources? <i>M. Kanoun (INRAA, Algeria)</i></p> <p>S3-18 – Autonomy and forage grasses in goat farming of western France: First results of a sociological survey. <i>B. Leroux (GRESKO/Univ. of Poitiers, France)</i></p> <p>S3-24 – Different forms of Crop-Livestock Integration. Analysis in the South of France. <i>M. Napoléone (INRA, UMR Selmet, France)</i></p>

### DAY 3: 25<sup>TH</sup> OCTOBER (cont.)

14:00 – 15:45	<p><b><u>PLENARY SESSION 3: IMPROVE THE CONTRIBUTION OF GRAZED AND CROPPED FORAGE IN THE FEEDING SYSTEMS (Cont.)</u></b></p> <p>- <b>Posters focus</b> <i>by session chair</i></p> <p>- <b>Open discussion</b></p>
15:45 – 16:15	<p><i>Coffee break</i></p>
16:15 – 17:45	<p><b><u>ROUND TABLE ON PASTORALISTS AND EXTENSIVE LIVESTOCK FARMERS</u></b></p> <p><i>Chairperson: A. López-Francos (IAMZ-CIHEAM, Spain)</i></p> <p><b>Panellists:</b></p> <ul style="list-style-type: none"><li>- <i>M. Bengoumi (FAO). Improving governance of pastoral lands (FAO Voluntary guidelines)</i></li><li>- <i>M. Mounsif (ENA Morocco). Pastoral livestock sector in Morocco</i></li><li>- <i>S. Fagouri (Arab Network of Pastoralists, Morocco). Roles of pastoral networks for sustainable rangeland management</i></li><li>- <i>M. Jaouad (IRA, Tunisia). Pastoral livestock sector in southern Tunisia</i></li><li>- <i>M. Kanoun (INRA Algeria). Sheep shepherds in the Algerian agro-pastoral steppes: Which reading?</i></li><li>- <i>F.A. Ruiz Morales (IFAPA, Spain). Shepherd school as a tool for the empowerment of the livestock sector</i></li><li>- <i>J. Lasseur (INRA, France). Approach to the social sustainability of livestock farms</i></li><li>- <i>E. Yilmaz (Yolda Initiative, Turkey). Mobile Pastoralism as a retro-innovation for a sustainable future</i></li><li>- <i>A. El Mokaddem (Ministry of Agriculture, Morocco). Plans for rangeland management in Morocco</i></li></ul> <p><b>Open discussion</b></p>
17:45 – 18:15	<p><b><u>CLOSING SESSION</u></b></p> <p>Synthesis of the Meeting, closing ceremony and prizes.</p>