Diverse and resilient agro-pastoral systems: a common goal for the Mediterranean region

Serkan Ates¹, Isabel Casasús² and Mounir Louhaichi¹
Outline

Introduction

Section 1 Ecological intensification of livestock production systems in the Northern Mediterranean

Section 2 Improving the sustainability and resilience of crop-livestock production systems in the southern Mediterranean

Conclusions
used to be extensively practiced over large areas evolved into crop based agriculture intensive & productive (Landau et al., 2000; Bernué et al., 2011)

intensive land use unrelenting exploitation of natural resources (Hopfenberg and Pimentel, 2001; Le Houerou, 2000)

Traditional livestock farming

Norther Mediterranean

Southern

Abandonment vast grasslands widespread bush encroachment

Reduced number of livestock

The rapid population growth led to more intensive livestock farming
Climate change

Food Security and demand for animal products

Limited and degraded resources

Poor infrastructure and institutionalization

Population growth

Common agricultural policy of EU

Subsidies

Government subsidies

Consumer Preferences for nutrition and health

Population growth

Government subsidies

Food Security and demand for animal products

Population growth

Limited and degraded resources

Poor infrastructure and institutionalization

Ecological farming

Intensive vs. extensive agriculture

Mediterranean

Northern

Southern

The rapid population growth

More intensive and less sustainable exploitation of natural resources

More intensive crop-based agriculture

More intensive livestock farming

Reduced number of livestock

Abandonment of grasslands and meadows

Traditional crop and livestock farming

Used to be extensively practiced over large areas of land
Section 1

Ecological intensification of livestock production systems in the Northern Mediterranean
Ecological intensification
more food production per unit resource use
+ minimal impact on the environment

(Hochman, 2013)

But economic performance is the cornerstone of farm survival
How to increase?

<table>
<thead>
<tr>
<th>food production</th>
<th>Ù gross product and added value of production</th>
</tr>
</thead>
<tbody>
<tr>
<td>ecosystem services</td>
<td>Ù public payment (agri-environment schemes)</td>
</tr>
</tbody>
</table>

1. Matching livestock management to feed resources

2. Using livestock as a tool for environmental management
1. Matching livestock management to feed resources

Animal requirements
- genotype
- production level

Feed resources
- pasture type, seasonality
- available supplements

Feeding and reproductive management
- calving season
- weaning date
- product type

CASE 1
Suckler cattle farms in dry mountain areas
Spanish Pyrenees
Autumn-calving cows

<table>
<thead>
<tr>
<th>Housing</th>
<th>Forest pastures</th>
<th>High mountain pastures</th>
<th>Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spring-calving cows

<table>
<thead>
<tr>
<th>Housing</th>
<th>High mountain pastures</th>
<th>Forest pastures</th>
<th>Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Corrected LW gains kg/d**

- Autumn-calving cows: 599 kg (PPI 35 d) + 0.43 + 0.42
- Spring-calving cows: 574 kg (PPI 49 d) + 0.27 - 0.16

**Role of the grazing season**

- Autumn-calving: Recovery of body reserves
- Spring-calving: Maintenance of lactation

**Indoors feed restriction would compromise**

- Calf gains
- Condition at calving - PPI

**Solutions**

- Calf supplement
- Early weaning
- ???

(Casasús et al., 2002)
CASE 2
Finishing offspring on pasture

- Reduction of production costs
  vs. conventional feeding on concentrates

- Increased added value of products
  - nutritional quality (fatty acid composition)
  - consumer perception of production system

organic farming?

But less “reliable” systems: more dependent on climatic hazards, …
  farmers need of technical knowledge, responsiveness and flexibility
  … who said it was easy?
2. Livestock as a tool for environmental management

Shrub and forest pastures

• climactic vegetation of most Mediterranean mountain areas
• human-modulated landscape
• but stocking rates are decreasing: are they enough to modulate the succession process??

Effects of grazing on herbage and shrub vegetation and quality

• Cattle at a moderate stocking rate in pine forests: OK
  (Casasús et al., 2007)
• Sheep/cattle, low SR, semi-abandoned forest pastures: not enough to prevent shrub encroachment!!
  (Riedel et al., 2013)
**CASE 1**
Suckler cattle herd in Mediterranean woodlands

700 ha forest & agricultural pastures
30 Pirenaica suckler cows

**Production system designed to match pasture availability**
- calving season (autumn)
- cow-calf management
- supplements (early winter)

**Temporal heterogeneity of forage resources**
... large seasonal variation in cow diet
- Nutritional quality
- Animal behaviour
- Animal performance
- Habitat preferences

Adequate performance
System reproducibility
Search for **synergies** between co-existing activities

- Adequate forage consumption in the grazing season guarantees the stability of the snowpack during the winter
- Ski-related tourism is a source of income for farmers that often capitalizes livestock production
Actual use of each pasture type (11 categories) vs. advised management

Livestock performance, resource sustainability, snow quality

Recommendations

• modifying temporal & spatial management

• providing infrastructures

(Casasús et al., 2013, FAO-Mt Past)
Section 2

Improving the sustainability and resilience of crop-livestock production systems in the southern Mediterranean
Integrated approach involving the three pillars of sustainable agricultural development
## Winter cereals  Feed legumes


<table>
<thead>
<tr>
<th>Year</th>
<th>Fallow</th>
<th>Wheat</th>
<th>Lentil</th>
<th>Chickpea</th>
<th>Vetch</th>
<th>Medic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>1.64</td>
<td>0.74</td>
<td>1.20</td>
<td>1.29</td>
<td>1.18</td>
<td>1.08</td>
</tr>
<tr>
<td>1998</td>
<td>2.36</td>
<td>1.07</td>
<td>1.90</td>
<td>1.35</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.43</td>
<td>1.08</td>
<td>2.05</td>
<td>1.59</td>
<td>2.16</td>
<td>1.87</td>
</tr>
</tbody>
</table>

**SEM** ± 0.061

- **Once in every 2 years**
- **N in the grain (1.80%)**
- **Low production**
- **Disease build-up**
- **Low SOM**
- **N in the grain (1.95%)**
- **High potential**
- **Lentil straw is desired**
- **Labor intensive**
- **High value for cash crop but reduced wheat yield**
- **High wheat production and gross margin**
- **Improved feed availability**
- **N in the grain (2.20%)**
- **Low input costs**
- **N and SOM enhancement**
- **N in the grain (2.57%)**
- **Low adoption**

(Ryan et al., 2008)
Advances in Agronomy

**No premium for additional quality**

**Higher system productivity**
<table>
<thead>
<tr>
<th>Diet</th>
<th>Total LWG (g/d)</th>
<th>Average daily gain (g/d)</th>
<th>Total cost in 49-d trial/lamb (US$)</th>
<th>Feed efficiency (kg diet/kg weight gained)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green barley grazing +500 concentrate</td>
<td>14.4 ± 0.6</td>
<td>300.1 ± 45.3</td>
<td>11.27</td>
<td>7.8</td>
</tr>
<tr>
<td>Concentrated feed</td>
<td>15.3 ± 0.6</td>
<td>305.6 ± 43.5</td>
<td>10.19</td>
<td>5.1</td>
</tr>
<tr>
<td>Vetch grazing +300 g concentrate</td>
<td>15.9 ± 0.6</td>
<td>321.8 ± 44.3</td>
<td>8.97</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Better feed efficiency as compared to
### Animal requirements

- **Feeding system**
- **Genotype**

### Feed resources

- *Forage based vs.*
- *Concentrate feeding*

---

**Daily liveweight gain (g/head/d) of Akkaraman and Anatolian merino lambs that were fed either concentrated feed, Hungarian vetch, triticale or a mixture of the two (HV+T)**

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Diet</th>
<th>LWG g/head/d</th>
<th>Feed efficiency (kg diet/kg weight gained)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-28 d</td>
<td>28-56 d</td>
</tr>
<tr>
<td>Akkaraman</td>
<td>H. vetch</td>
<td>160</td>
<td>167</td>
</tr>
<tr>
<td>(fat tailed)</td>
<td>Triticale</td>
<td>176</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>HV+T</td>
<td>153</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>Concentrate</td>
<td>267</td>
<td>306</td>
</tr>
<tr>
<td>Anatolian</td>
<td>H. vetch</td>
<td>153</td>
<td>164</td>
</tr>
<tr>
<td>merino</td>
<td>Triticale</td>
<td>179</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>HV+T</td>
<td>163</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>Concentrate</td>
<td>308</td>
<td>280</td>
</tr>
</tbody>
</table>

SE Diet × Genotype × Period

18.6

0.74

(Ates et al., In press)

J. of Agricultural Science
Shrubs established within cropland could play an important role in improving the feed quantity and quality.
Multifunctionality of cactus crop

Rangeland improvement
- Increase plant cover
- Carbon sequestration
- Livestock feeding
- Soil and water conservation
- Wildlife
- Food

Combat desertification
- Fruit & cladodes (natural products, high nutritional value)

Cash crop with high value-added products
- Agro-industries (juice, liquor, jellies, colorants)
- Cosmetics & medicinal uses

JM FAO CIHEAM 24-26 June, 2014 Clermont-Ferrand, France
Rangeland and marginal land rehabilitation

Rangeland productivity increases from 100 FU to 1000 FU

Cactus helps solving watering problems in arid areas.

<table>
<thead>
<tr>
<th>Regions/countries</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>600</td>
</tr>
<tr>
<td>Other SA Countries</td>
<td>75</td>
</tr>
<tr>
<td>Mexico</td>
<td>230 + 3 M</td>
</tr>
<tr>
<td>Other NA countries</td>
<td>16</td>
</tr>
<tr>
<td>Tunisia</td>
<td>600</td>
</tr>
<tr>
<td>Algeria</td>
<td>150</td>
</tr>
<tr>
<td>Morocco</td>
<td>150</td>
</tr>
<tr>
<td>Italy</td>
<td>70</td>
</tr>
</tbody>
</table>

**Area Cultivated (x 1,000 ha)**
Reality

Arab countries are the largest cereal importers

Despite being the origin of settled farming, the region is a food deficit one.

Source: Data extracted from online FAOSTAT website, 2013.

Courtesy of Roberto Telleria (ICARDA)
Food deficiency

Continuous cereal cultivation

Subsidies for cereals

Poor crop-LS integration

Lack of mechanization and costly labor for food legumes
AMMAN – Consumption of subsidised flour has increased by over 35 per cent in the past two years due to hosting hundreds of thousands of Syrian refugees, according to President of the Bakery Owners Association Abdul Ilah Hamawi.
As demand for livestock has increased, so too has the area devoted to barley, exceeding that of wheat in Syria and Morocco.

Barley subsidies cost €48 million/year.

(Ryan et al., 2008) Advances in Agronomy

- Drought
- Grazing pressure
- Barley encroachment
Consequently

- Continuous cereal cropping
- Barley based livestock production
- Low forage production
- Poor crop-livestock integration
- Poor adaption of forage technologies
- Low availability of locally adapted cultivars
- Poor resource management

The odds are not much in favor of forage production

Unsustainability
Degradation
Poverty
Subsidies on forage crops led to a 5-fold increase in the area dedicated to forage production.

In Spain

A renewed interest in vetches
Increased availability of forage seeds in the market

“Although the surface dedicated to vetches in Spain, has been decreasing in the last 40 years, in later years there has been a renewed interest in the crop, because of the EU subsidies to the production of grain legumes and to the forages. For this reason, many new cultivars have been released to the market.”

Lloveras et al. (2004)

In Turkey

5 folds increase (2000-2008)

Subsidies on forage crops led to a 5-fold increase in the area dedicated to forage production.

Sabanci et al. (2010)
Conclusions

Ecological intensification can be achieved by increasing food agricultural production and ecosystem services simultaneously.

Matching livestock management to feed resources is crucial for efficient resource management.

The current agro-ecological, environmental and socioeconomic conditions pose a major challenge to increase production and to ensure food security without further degrading the capacity of the resource base in the southern Mediterranean.

Appropriate management practices to address worsening feed shortage with simple and cost-effective feeding techniques is becoming more critical for the sustainability of small ruminant production and rangeland ecosystems.

Increasing availability of locally adapted forage legumes is essential.

Successful biophysical interventions and options exist for sustainable intensification.

Technology transfer, policies and adoption are the key issues.
Thank you

Wow, look at the grass stains on my skin.

I say, if your knees aren’t green by the end of the day, you ought to seriously re-examine your life.