Livestock impact on the environment: grazing as a tool for landscape preservation

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Workshop on Carrying Capacity of Rangelands
AGR 61049
TAIEX and Lebanese Ministry of Agriculture
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1. Livestock and landscape
   just compatible or inseparable?

2. Livestock impact on the environment
   some examples

3. Grazing as a tool for landscape preservation
   some examples
Livestock and environment: just compatible or inseparable?

International Air Transport Association

DANGER CO₂W

Air transport produces 2% of global CO₂ emissions

... less than the CO₂ produced worldwide by cattle (9%)

LIVESTOCK’S LONG SHADOW

environmental issues and options

(FAO report, 2006)
NH₄, P in dejections

• CO₂ production and transport of feedstuffs and animals
• Fertilizers in feedstuff production

**OPTIONS**: Different products and production systems...

• **Increase production efficiency**

• **Intensive systems:**
  technical improvement
  RRR (reduce – reuse - recycle)

• **Extensive systems:**
  efficient animal production
  + environmental services!!!

HOW CAN THIS BE ACHIEVED?
Competitiveness of extensive LPS

• product quality
• environmental sustainability
• economic efficiency

a) increase INCOME

b) reduce COSTS

- maintenance of the dams
- raising the offspring

Implement or increase grazing efficiency within the system

Questions to be solved for increased grazing efficiency

- What kind of pastures
  - surface availability
  - forage production and quality
  - alternative uses

- What kind of animals
  - species, breed
  - physiological stage, requirements

- What kind of systems
  - resources
  - socio-economic context

- What can be expected
  - animal performance
  - product quality
  - environmental impact
1. Livestock and landscape
   *just compatible or inseparable?*

2. **Livestock impact on the environment**
   *some examples*

3. Grazing as a tool for landscape preservation
   *some examples*

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**Livestock impact on the environment**

<table>
<thead>
<tr>
<th>Pollution</th>
<th>Erosion</th>
<th>Encroachment</th>
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<tbody>
<tr>
<td>Air</td>
<td>Soil</td>
<td>Water</td>
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</table>
Livestock impact on the environment

Pollution
*air, soil, water*

Erosion

Encroachment

Not only in intensive systems!!
How does livestock interact with the environment?

**Small-scale**
- Botanic species diversity
- Biomass
- Vegetation structure
- Forage quality

**Large scale**
- Landscape diversity
  - fauna diversity
  - open pastures
- Environmental hazards

*Satyrium spini*: egg lying on dwarf shrubs in warm microclimate - open pastures with long sunshine duration.
*(Stuhldreher et al. EJE 2012)*

**Magnitude of the effects**
- Animal species and breed?
- Pasture type?
- Grazing management?
- Stocking rate?
Landscape and Livestock today

Shrub and forest pastures
- Climactic vegetation in Mediterranean areas
- Human-made landscape

Southern Europe: reduction in extensive livestock censuses

Livestock censuses and Landscape

Evolution 1957-2000 in a Pyrenean mountain valley
Trends in sheep farms in Guara Natural Park (Huesca, Spain)  
• intensification vs. extensive pasture use  
• farm continuity?

¿Can current stocking rates guarantee landscape preservation?

• Animal species and breed?  
• Pasture type?  
• Grazing management?  
• Stocking rate?

Some examples...
(1) Extensive cattle grazing on forest pastures: impact on vegetation dynamics

Forest pastures, 6 yr, 4 areas, 0.2 LU/ha

Herbaceous vegetation
- Identification
- Sward height biomass
- Green : dead ratio
- Nutritive quality

Herbage availability

14.5 cm
Pasture height

Herbage quality

Species identification

Shrub vegetation
- Identification
- 3 diameters: volume biomass

(Casasús et al., 2007. Agriculture, Ecosystems & Environment)
**Shrubs**

*Fixed transects (min n=5/sp)*

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**Species identification**

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### Measurements

... Volume

... biomass

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### a. Herbaceous vegetation

**Herbage biomass, kg DM/ha**

- Cattle grazing maintains herbage biomass and quality
- Senescent material accumulates in Non-Grazed areas, and forage nutritive value is reduced
b. Shrub vegetation

Shrub biomass, kg DM/ha

- *Woody species proliferate and grow larger in non-grazed areas*
  528 kg DM/ha/year

- *Negative effects of a dense shrub cover on pasture use ...*
Optimal use of forest pastures by beef cattle

- Animals with low requirements
  *Dry cows, in spring*

- Constraints in lactating cows:
  *effect of continuous presence of calf by the dam on reproductive performance... early weaning?*
But the magnitude of this effect depends on:
- Animal species and breed?
- Pasture type?
- Grazing management?
- Stocking rate?

(2) Extensive sheep grazing in shrub pastures
Sierra de Guara Natural Park, shrub pastures, 9 yr, 6 areas, 0.15 LU/ha
Herbaceous vegetation

- Grazing MAINTAINS herbage availability
- Herbage biomass increases in NON Grazed areas, particularly the dead fraction
- Pasture quality decreases in NON Grazed areas: NDF, ADF, lignin increase; protein decreases

(Riedel et al., REM 2013)

Shrub vegetation

- Very large species diversity in the different locations ... different response to grazing

- Shrub biomass increases BOTH in Grazed and NON Grazed areas!!
- Higher increase in NON Grazed areas

At the current stocking rate, grazing reduces but does not stop shrub encroachment
URGENT NEED TO ACT

At the current stocking rate, grazing reduces but does not stop shrub encroachment.

1. Livestock and landscape just compatible or inseparable?

2. Livestock impact on the environment some examples

3. Grazing as a tool for landscape preservation some examples
Grazing by livestock is often the only tool for an adequate management of forest areas integrating both productive and landscape preservation goals.
Grazing as a tool for landscape preservation

Study in Sierra de Guara NP

80000 ha, 33000 sheep, 1000 cattle

- Six pasture types (SEEP)
- Altitude, slope, hydrology, structural variables (GIS)

- Actual stocking rates questionnaires (LU/ha)

Driving factors of habitat preference by livestock

Potential Grazing Index

Comparison Actual vs. Potential use

Questionnaires to farmers (63)

- Pasture location
- census / area = stocking rate

Geographic Information System

Spatial information + Associated Data Base … layers

<table>
<thead>
<tr>
<th>Farm</th>
<th>heads</th>
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<tbody>
<tr>
<td>Aínsa</td>
<td>x</td>
</tr>
<tr>
<td>Alquézar</td>
<td>y</td>
</tr>
<tr>
<td>Colungo</td>
<td>z</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Pasture type</th>
<th>ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shubland</td>
<td>a</td>
</tr>
<tr>
<td>Agricultural</td>
<td>b</td>
</tr>
<tr>
<td>Grassland</td>
<td>c</td>
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Different pasture types

According to the Spanish Society for the Study of Pastures

- Dense forest land
- Open forest pasture
- Shrublands
- Grasslands
- Agricultural pastures
- Non-productive land

**Actual use (80 000 ha)**

**Low stocking rate**
- 92% of the area
- <= 0.25 LU/ha

Cattle in the N area: shorter grazing season, higher SR

**Stocking rate**
- LU / ha / yr
  - < 0.25
  - 0.25-0.50
  - 0.50-0.75
  - 0.75-1.00
  - 1.00-1.25

- only 53.2% of the area is grazed
- average stocking rate 0.15 LU/ha

Little grazing in the central area
- partially related to pasture type
- physical and “human” factors:
  - far from villages
  - water constraints

Agricultural pastures in S and E areas: intensive sheep farms

SR related to Pasture type, Slope, Altitude, Distance to roads, villages, rivers, ...
Potential use

Potential Grazing Index = pasture type \times grazing value
\times [3 \times \text{slope}^{-1} + 2 \times \text{altitude}^{-1} + 2 \times \text{distance to roads}^{-1}
+ 1.5 \times \text{distance to villages}^{-1} + 1 \times \text{distance to rivers}^{-1}
+ 0.5 \times \text{distance to water points}^{-1} ]

Application of PGI to whole Park area

Grazing Potential of all Park pastures

Comparison of Actual Use (SR) vs. Potential Use (GP)

Discordance... high priority intervention areas to adjust livestock use to availability of grazing resources

- **AREA 1 and 2**: High and Very High GP, but low use, mainly shrub and forest pastures, easy access, close to agricultural pastures
- **AREA 3**: 15 000 ha Medium GP, dense shrub and forest pastures: high environmental risk. Less accessible, may sustain low stocking rates.
Different solutions for the high priority intervention areas

- Environmental impact
- Technical and economic performance
**Treatment PASTURE:** meadow grazing + supplement:
- lambs and ewes 24 h on pasture until lamb slaughter (22 kg LW)

**Treatment INDOORS:**
- 45 d lactation: ewes on hay + 800 g barley, lambs on concentrates
- intensive fattening of lambs after weaning
- Lamb ADG: slightly higher INDOORS + 1 week to reach target slaughter weight on PASTURE
- Similar carcasses
- Lower feeding costs on PASTURE, higher profit

Joy et al., 2007

Let’s turn them out... it is cheaper!

at least in the spring lambing season

<table>
<thead>
<tr>
<th></th>
<th>PASTURE</th>
<th>INDOORS</th>
</tr>
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<tbody>
<tr>
<td>€ feed sheep</td>
<td>1.54</td>
<td>7.70</td>
</tr>
<tr>
<td>€ feed lamb</td>
<td>0.24</td>
<td>6.09</td>
</tr>
<tr>
<td>€ feed total</td>
<td>1.78</td>
<td>13.79</td>
</tr>
<tr>
<td>Lamb wt slaughter</td>
<td>22.8</td>
<td>23.9</td>
</tr>
<tr>
<td>€ income / lamb</td>
<td>50.47</td>
<td>52.90</td>
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seasonal interest?

**AREA 3: R&D PROJECT**
Farming practices towards environmental management in a Protected Natural Area

Application of science-based knowledge on livestock production systems and specific management for ecosystem services

30 Pirenaica cows
700 ha forest
& agricultural pastures

Casasús et al. (2012). Animal Farming and Environment Interactions in Mediterranean Regions. EAAP Publ. 131
Design of a cattle production system in a dry Mediterranean mountain area

COW management
Calf management
COW feed supplement
Calf feed supplement

Forest pastures
Meadows
Triticale
How did animals perform?

Cow performance

How did cows cope with temporal and spatial homogeneity of forage resources?

⇒ Cow diet selection throughout the year
visual observation...
corroborated by fecal N content

Large seasonal variation in diet...

• nutritional quality
• animal behaviour
• animal performance
• habitat preferences
Cattle spatial distribution throughout the year (LU/ha.month)

Spatial & temporal heterogeneity of forage resources

Spring

Summer

Autumn

Winter

Pasture type
- Oak forests
- Forage crops
- Pine-Oak forests
- Non-productive land

... heterogeneous impact & output

... and environmental impact?
- Heterogeneous spatial and temporal availability of forage conditioned cattle distribution and diet selected

- **Browse** was a significant part of the diet in autumn and winter
  
  ... *encroachment control*

- System designed to match seasonality of forage resources, at the expense of **large variations in animal body reserves**

  + no competition for arable land, no land use alternative!
Extensive systems: animal production + environmental services

Sometimes designing specific production systems for obtaining these environmental services...