The future of Mediterranean Livestock Farming Systems:
Opportunity and efficiency of Crop–Livestock Integration

CLIMED

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Brief introduction
Donors, Partners and collaborators
Background in Mediterranean agriculture systems ...

- Strong demographic growth, urbanization and increasing demand for animal products ...

- High competition for land and water => pressures on biomass to feed animals

- Multiple roles of livestock in reducing vulnerabilities in very fragile environments..
Hypothesis are...

- that livestock activities constitute a pillar of the environmental and social sustainability in the Mediterranean rural zone both at:
  - the farm level (biomass management, soil fertility/manure and feed production, insurance, income resource, domestic consumption, diversification, intensification)
  - and regional level (social capital, biodiversity, reduction of fire, cultural aspect, landscape preservation).

- But faced with the demographic growth and increasing demand, the intensification of livestock systems may damage the agro-ecological system, especially natural resources (soil & water).

- There is an urgent need to assess the past and on-going intensification process of crop-livestock farming systems and its efficiency or viability... (describing, understanding and modeling)

- Ecological intensification (EI) in crop-livestock farming system is both a pathway and a challenge for Mediterranean countries.
Frame of the Project CLIMED

**WP2: Global context for crop-livestock** (2.1. social & human geographical maps (including land & resource use); 2.2. demand/supply and market in livestock products; 2.3. Modeling livestock context)

**WP3: Assessment of the environmental and economy efficiency of Mediterranean crop-livestock systems** (3.1. Typology of farm, 3.2. Animal performance; 3.3 Environmental efficiency; 3.4 Economic efficiency)

**WP4: Assessment of the adaptive capacities to change** (4.1. Vulnerability (capital asset) and flexibility (practice) at farm level; 4.2. Collective vulnerability or adaptation; 4.3. Past policies and adaptation)

**WP5: socio-ecological sustainability and future scenarios** (5.1. Natural resources, ecosystem and future generation; 5.2. Future scenarios; 5.3. Social organization (rules, norms…) and rural development policies)

**WP1: Coordination and animation**
Expected results

• strengthening of synergies and scientific collaborations between the partners given the interdisciplinary nature of it

• assessing the bio-economic and socio-ecological viability of crop-livestock systems in the Mediterranean context

• to help farmers, local communities, researchers and decision markers in thinking for future Mediterranean livestock

• In designing priorities, rules, policies that could better deal with the socio-environmental issues in link with demographic and land pressure, increasing demand and high international competition.
Case studies: a geographical and social transect from the agro-pastoral zones in 3 countries (Ma, Eg, Fr + Lb)

- **Morocco**: From the south side of Haut-Atlas (pastoral mobility) to the plain of Gharb (drip irrigation associated with maize silage→ fodder production).

- **Egypt**: From the agro-pastoral system of North West Coastal zone to the NRL in West Delta region that is part of the national Egyptian strategy to increase agricultural production and to enhance its food security.

- **France**: From the mountainous hinterlands to the coastal zones in Mediterranean area in France that knows some significant changes in link with the development of irrigation in the 70s, the demographic pressure, the touristic development and the agricultural policies.

- **Lebanon**: from the Mount Lebanon to Bekaa Plain (in partnership with AUB and CNRS)
On-going Links & in Construction

- CRP1.1- Drylands on Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas (ICARDA)
- Project ELVulmed (ANR CEP&S) on the role of livestock in reducing vulnerability: cf. Pubs in AGSY, World Dev., Autrepart
- Project MOUVE (ANR) on ecological intensification in livestock farming systems and LIFLOD network (www.liflod.org)
- Project AIRD-STDF on *Collective action and agricultural productivity in Egypt’s New Lands*
- *Project IRD-Morocco-Haut Atlas on co-viability*
- *Project IMHOTEP CLIMED Egypt on crop-livestock farming systems*
- *AUB and CNRS, Lebanon: PhD Student Mabelle Shedid (indicators of sustainability in crop-livestock farming systems)*
Morocco  Two main research activities

- Crop-Livestock efficiency in Gharb Plain - monthly monitoring over 6 farms types based on expert typology on feed and milk productivity

- Hight Atlas / Ouarzazate: Partnerships ORMVAO, IAV, IRD, CIRAD
  - Analysis of transhumance systems at the territorial level
  - Interaction of the different systems (pastoral, agro-pastoral, oasis)
Gharb Plain: Main ongoing research themes

1. Crop/livestock integration in smallholder farms: the role of work strategies

A study in a sample of 15 farms
The “Work Balance” method developed by Dedieu et al. (2000)

Expected results:

a. How do farmers cope with work requirements to manage their farms?
b. Which incomes are generated by crops and livestock, with regards to the work needed?
2. Dairy cattle farms’ economic results

A study in a sample of 20 farms

The structure of milk production costs, according to various scenarios

Expected results:

a. What are the current terms of profitability in various types of dairy herds?
b. Which variables affect the most the production cost of milk?
High Atlas: Resilience & Co-viability

Resilience: Yes
Climate Change Adaptation

- Climate change: reducing of rainfall and pasture (quality and quantity), disappearance of some plants + overgrazing

Go out to find other pasture in order to preserve local pasture/rangeland (seasonal migration, …)

- Aoudal System: sustainable rangeland management based on the control of access

Relationships in the douar, including local settlers (no pastoral households)

- No change in the rangeland management
  => Low rainfall + overgrazing = degradation
- No diversified activities = no reducing pressure
- Wood extraction for housing use (juniper trees)
- No restrictive rules for the users (breeders and others)

Aoudal System: conditioned by rainfall (no rain = no access) and if regular rainfall, access based on the concurrence between the tribes

Resilience: No
No adaptation to Climate Change

- No change in the rangeland management
- No diversified activities = no reducing pressure
- Wood extraction for housing use (juniper trees)
- No restrictive rules for the users (breeders and others)
Co-viability of socio-ecosystems

- Lack of regulation leads to rangeland practices with negative impacts on natural resources

- Care the rangeland today to survive tomorrow

- Viability of pastoral system depends on ecosystem viability

- Sustainable rangeland management = need to go out the rangeland during winter

- Great challenge = Control the access to the rangeland according to the ecological cycle and human needs

Local demand: implementation of specific and shared/negotiated regulation, accepted by both local and national groups aiming to sustainable rangeland management as the base of socio-ecosystem (including exogenous mediation)

Socio-ecosystem Pact/Agreement
France
Languedoc-Roussillon and Provence-Alpes-Côte d’Azur

Main on-going research questions

What are the modalities of crop-livestock integration (CLI), in landscapes with various spatial combination of Ager, Saltus and Sylva, at several scales?

1. Farm
2. Local territory
3. Region, with complementarity between local territories (exchanges of feed, manure, mobility of flocks)

What are the economic and environnemental efficiency of those CLI modalities?

What are adaptive capacities allowed by those CLI modalities to cope with global changes?
Research framework

- Mountains or altitude plateaus
- Piedmont, hills, small valleys
- Large valleys and littoral plains
- Deltas

Regional spatial analysis from statistical data (RGA 2000 et 2010) + surveys with experts

CLI typology at farm scale and modelisation of farm types (from previous data)

Agrarian systems analysis for 4 local territories, in a diversity of areas

Combination of methods to characterize and appraise CLI efficiency at various scales (LCA, ENA)
Expected results

Characterization of CLI at regional scale (typology of administrative units, main exchanges between local territories)

Combination of methods to characterize and appraise CLI efficiency at farm and local territory
- economic and environmental efficiency (LCA, ENA)
- related to global stakes (climate mitigation…) or local stakes (especially, capacity to maintain open rangelands: biodiversity, fire prevention…)

Appraisal of the various CLI modalities, in terms of efficiency but also adaptive capacities
- Types of farms
- Local territories
- Complementarities of local territories

Present situations / simulation of scenarios (interest to reinforced CLI? At what scale?)
Egypt

In the New/Old New Reclaimed Lands
Changes of land use 1984 - 2007
165 family surveys done in 5 zones → 3 villages per zone

El Nardha
Bengar
El Hamam
Tiba
Ext. Bustan
Pilot phase from March to June 2014 → Integrated Crop-Livestock management monitoring

Gov: Behira - Zone/Vill: Bustan/Tabarani  
Farmer: Mohamed Mabrouck Eler / T1  
Area: 2.5 + 2.5 + (2.5 rent)  
Labor:  

| Name: Black  
| Number: 3 (F)  
| Age: # July 2009  
| Mother: White / 2  
| Entrance: Born  
| Nb. Calving (2013): 3  
| Main production: Milk |  
| نظام التغذية:  
| يناير: برسيم + 1.5 كجم (ردة + بقايا محاصيل)  
| إنتاج الحليب:  
| يناير: 4 (4 جنيهات/ كجم)  
| الإجابات:  
| آخر ولادة (الثالثة): 10 ديسمبر 2013  
| الخروج: |

Feeding system:  
Jan: Berseem ad libidum + 1.5kg (bran + crop residues)  
Milk production:  
Jan: 4+4 (EGP4/Kg)  
Reproduction:  
Last calving (3rd): 2013, December, 10 Exit:
Design of the protocole for monitoring

○ Surveyed species: cattle, buffaloes, sheep and goats

○ Follow-up of demography (entries, exits, parturitions and abortions) and production (milk production, liveweight gain);

○ One visit bi-monthly in each farmer. Given the size of herds and the small number of events during one month, we can decrease the frequency of visits;

○ Sample: around 24 to 30 farmers
### Integrative approach of the crop-livestock system

#### Feeding system

<table>
<thead>
<tr>
<th>Category of animals (Specie)</th>
<th>Physiological stage</th>
<th>Nb heads</th>
<th>Unit</th>
<th>Quantity (Number of units) Yesterdays</th>
<th>Quantity (Number of units) Yesterday morning</th>
<th>Quantity (Number of units) Yesterday evening</th>
<th>Total (Number of units) 1 day Yesterday</th>
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#### Biomass

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<thead>
<tr>
<th>Plot Number</th>
<th>Crops</th>
<th>How many sample</th>
<th>Area of sample (meter )</th>
<th>Fresh weight (kg)</th>
<th>Dry weight</th>
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#### Cropping system

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<thead>
<tr>
<th>Surface et sol events</th>
<th>Plot 1. Crop</th>
<th>Plot 2 Crop</th>
<th>Plot 3 Crop</th>
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<tbody>
<tr>
<td></td>
<td>Operations</td>
<td>Variables</td>
<td>Technique</td>
</tr>
<tr>
<td>Spraying organic manure</td>
<td>Quantity (carts)</td>
<td>period</td>
<td>origin</td>
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<tr>
<td>Ploughing (land preparation)</td>
<td>Date of seeding</td>
<td></td>
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<tr>
<td>Seed</td>
<td>Quantity</td>
<td>Source</td>
<td>Date</td>
</tr>
<tr>
<td>Herbicides + pesticide n°1</td>
<td>Quantity</td>
<td>Name</td>
<td>Date</td>
</tr>
<tr>
<td>Herbicides + pesticide n°2</td>
<td>Quantity</td>
<td>Name</td>
<td>Date</td>
</tr>
<tr>
<td>Chemical fertilizer n°1</td>
<td>Quantity</td>
<td>Name</td>
<td>Date</td>
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<tr>
<td>Chemical fertilizer n°2</td>
<td>Quantity</td>
<td>Name</td>
<td>Date</td>
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<tr>
<td>Chemical fertilizer n°3</td>
<td>Quantity</td>
<td>Name</td>
<td>Date</td>
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### Harvesting

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<thead>
<tr>
<th>Harvesting (main products)</th>
<th>Plan</th>
<th>Sold quantity</th>
<th>Where sold?</th>
<th>Why?</th>
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<tr>
<th>Harvesting (by-products)</th>
<th>Plan</th>
<th>Sold quantity</th>
<th>Where sold?</th>
<th>Why?</th>
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<tr>
<th>Grazing (green fodder, crop residues)</th>
<th>Plan</th>
<th>Sold quantity</th>
<th>Where sold?</th>
<th>Why?</th>
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<tr>
<th>Past harvesting operations and by products</th>
<th>Plan</th>
<th>Sold quantity</th>
<th>Where sold?</th>
<th>Why?</th>
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Conclusion
Some orientations

• the main research capitalization is done on the monitoring to assess the efficiency of the crop – Livestock systems in the New Reclaimed Lands (Egypt) and Plaine de Gharb (Morocco) in semi intensive to intensive systems. This monitoring should feed analysis on vulnerability and resilience of systems.

• Establishment of an original partnerships and scientific program to address co-viability (WP5) in haut Atlas (Morocco)

• In France : approach of the resilience of Crop-livestock systems though the interactions between efficiency and vulnerability at different scales.
Thanks for your attention