Relationship between technological innovation and the variability of dairy sheep production in the Mancha, Spain

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Introduction (Sheep production)

The sheep farms are family based, that make use of local resources and promote the endogenous development, the preservation of the bio-diversity and the maintaining of employment in rural areas.
Introduction

The identification of technologies and its grouping into packages acquires strategic relevance in the competitive positioning of the firm; de Pablos-Heredero et al., (2012)
Objetive

• How can they improve? ..How can technologies be implemented?

• Tools

- Reproductive strategies
- Feeding
- Management and production system
- Organizational aspects
- Milk quality and hygiene
the aim is to identify technological packages in mixed dairy systems and its practical implications in the variation of the results. ...
Material and methods (Data collected)

✓ Castilla-La Mancha
✓ 907 farms y 800.000 ha. Mixed system.
✓ Survey 236 items
✓ 157 farms
✓ Period 2011 - 2013
Selection of technologies and technological packages

- 77 Technological Variables
- 14 Experts
- 38 technologies
- 6 technological packages
Selection of technologies and technological packages
## Technological packages

| **PT1. Management.** Technologies oriented to data entry and its transformation into information, ideas and knowledge that allows generating strategies for the improvement of production |
| **PT2. Feeding.** Technologies that allow the identification and optimization of the animal feeding system (minimal cost – maximum production) |
| **PT3. Biosecurity.** Technologies that allow reducing the risk associated with animal health, and the improvement the quality of the milk |
| **PT4. Land use.** Technologies that identify strategies that improved the use of the natural pastures, the rests of the crops and and processing of food (ensilage or hay) |
| **PT5. Equipments.** Technologies that allow the optimization of the infrastructures and human resources without compromising the animal and environmental welfare |
| **PT6. Reproduction.** Technologies that allow optimizing the production and promote the genetic improvement of the flock |

**i.e. reproduction Variables:**
1) The putting into practice of reproductive techniques (male effect, flushing, hormonal treatments, etc.).
2) The use of ultrasound scans is a routine and it is oriented to identify non productive animals (empty).
3) Androgen evaluations are realized to warranty the fertility rates and the optimization of copulations.
4) The rams that take part in the reproduction follow a genetic evaluation.
5) The use of artificial insemination is used as a tool to promote the genetic improvement.
6) The copulation is guided, a male is assigned to a female by applying technical criteria.
7) The planning of the reproductive process is aligned with the dynamic of the operational processes at the farm.
Results
Table 1. Level of adoption of the technological packages (43%)

<table>
<thead>
<tr>
<th>Technological packages</th>
<th>Technologies</th>
<th>Evaluated (n)</th>
<th>Adopted (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP1. Management</td>
<td></td>
<td>7</td>
<td>55.7</td>
</tr>
<tr>
<td>TP2. Feeding</td>
<td></td>
<td>5</td>
<td>56.0</td>
</tr>
<tr>
<td>TP3. Biosecurity</td>
<td></td>
<td>8</td>
<td>67.8</td>
</tr>
<tr>
<td>TP4. Land use</td>
<td></td>
<td>5</td>
<td>32.0</td>
</tr>
<tr>
<td>TP5. Equipment</td>
<td></td>
<td>6</td>
<td>41.6</td>
</tr>
<tr>
<td>TP6. Reproduction</td>
<td></td>
<td>7</td>
<td>35.7</td>
</tr>
</tbody>
</table>
• **Table 2. Effect of innovations in milk production**

![Graph showing milk production per cow](image-url)
### Table 3. Correlation coefficients amongst technological packages and productive variables

<table>
<thead>
<tr>
<th></th>
<th>TP</th>
<th>TP1</th>
<th>TP2</th>
<th>TP3</th>
<th>TP4</th>
<th>TP5</th>
<th>TP6</th>
<th>MP</th>
<th>LP</th>
<th>EI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TP1. Management</strong></td>
<td>1</td>
<td>-0.17*</td>
<td>0.51**</td>
<td>0.29**</td>
<td>0.63***</td>
<td>0.61**</td>
<td>0.52**</td>
<td>0.52**</td>
<td>-0.36**</td>
<td></td>
</tr>
<tr>
<td><strong>TP2. Feeding</strong></td>
<td>1</td>
<td>-0.02</td>
<td>-0.12</td>
<td>-0.08</td>
<td>-0.07</td>
<td>0.22**</td>
<td>0.22**</td>
<td>-0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TP3. Biosecurity</strong></td>
<td>1</td>
<td>0.29**</td>
<td>0.34**</td>
<td>0.35**</td>
<td>0.46**</td>
<td>0.42**</td>
<td>-0.28**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TP4. Land use</strong></td>
<td>1</td>
<td>0.34**</td>
<td>0.34**</td>
<td>0.34**</td>
<td>0.37**</td>
<td></td>
<td>-0.69**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TP5. Equipment</strong></td>
<td>1</td>
<td>0.89**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TP6. Reproduction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.43**</td>
<td>0.44**</td>
<td>-0.35**</td>
<td></td>
<td></td>
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<tr>
<td>Milk production (MP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.87**</td>
<td></td>
<td>-0.36**</td>
<td></td>
</tr>
<tr>
<td>Lambs production (LP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>-0.37**</td>
<td></td>
</tr>
<tr>
<td>Feeding costs (EI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4. Effect of technological packages adoption

<table>
<thead>
<tr>
<th></th>
<th>Milk production</th>
<th>Lambs (n)</th>
<th>Feed cost (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>P</td>
<td>β</td>
</tr>
<tr>
<td>Constant</td>
<td>-35,509.5</td>
<td>0.036</td>
<td>-396.8</td>
</tr>
<tr>
<td>TP1. Management</td>
<td>0.187</td>
<td>0.024</td>
<td>0.176</td>
</tr>
<tr>
<td>TP2. Feeding</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TP3. Biosecurity</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TP4. Land use</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TP5. Equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TP6. Reproduction</td>
<td>0.458</td>
<td>0.000</td>
<td>0.494</td>
</tr>
<tr>
<td>R²</td>
<td>0.350</td>
<td>0.382</td>
<td>0.623</td>
</tr>
<tr>
<td>P</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Conclusions and recommendations
The identification of technological packages and its degree of implementation facilitates the transformation of processes and the improvement of the competitive dryland mixed system cereal-sheep. The higher levels of technology adoption are materialized in the Animal health, feeding and management packages and its implementation respond to a coordinated process.

The technological packages show synergies amongst them, and the adoption of a new technology requires the modification in some key processes. Besides the technological options are developed therefore in the dynamic context of the firm that is involved in multiple interactions.
<table>
<thead>
<tr>
<th>TP</th>
<th>Improvement</th>
<th>Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP1. Management</td>
<td>Animal identification</td>
<td>Incorporating animal identification and decision making records.</td>
</tr>
<tr>
<td></td>
<td>Records</td>
<td>More participation in milk recording</td>
</tr>
<tr>
<td></td>
<td>Operating planning secluded</td>
<td>Breeding program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comprehensive operating plan</td>
</tr>
<tr>
<td>TP2. Feeding</td>
<td>Mineral block</td>
<td>Optimize feed and feeding</td>
</tr>
<tr>
<td></td>
<td>Unifeed</td>
<td>Use of by products in animal diets</td>
</tr>
<tr>
<td></td>
<td>Supplementation</td>
<td></td>
</tr>
<tr>
<td>TP3. Animal health-quality milk</td>
<td>Basic health plan</td>
<td>Adapt the health plan to the farm</td>
</tr>
<tr>
<td></td>
<td>Use post milking teat dip</td>
<td>Enhancing plan of quality of milk</td>
</tr>
<tr>
<td>TP4. Pasture-land use</td>
<td>Guided grazing</td>
<td>Improvement of the grazing strategy</td>
</tr>
<tr>
<td></td>
<td>Mixed system</td>
<td>Forage reserves</td>
</tr>
<tr>
<td>TP5. Equipments-facilities</td>
<td>Milking parlour</td>
<td>Hygiene rooms</td>
</tr>
<tr>
<td></td>
<td>System for milk refrigeration</td>
<td>Optimize the use of the implemented technology</td>
</tr>
<tr>
<td></td>
<td>Maternity and feeding rooms</td>
<td></td>
</tr>
<tr>
<td>TP6. Reproduction-genetic improvement</td>
<td>Reproductive techniques</td>
<td>Reduction of the lambing interval</td>
</tr>
<tr>
<td></td>
<td>Heat synchronization, A.I., flushing, male effect, induced mating</td>
<td>Early diagnosis of pregnancy</td>
</tr>
<tr>
<td></td>
<td>Improving ram</td>
<td>Androgenic male evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detection of non productive ewes</td>
</tr>
</tbody>
</table>