HYDRAULIC IRRIGATION INSTALLATION

DIAGNOSIS: KNOWING OF THE SYSTEM TO IMPROVE IT

GENDRE Sophie
s.gendre@arvalisinstitutduvegetal.fr
Presentation outlines

1. Study context

2. Methodology

3. Results
Electricity cost increasing between 2004 and 2013 in France (without taxes and subscription)

New law about electricity market:

Yellow and Green rates will disappear at the end of 2015.
From sensor to indicator: spatial data warehouse to evaluate farm energy performance
Irrigation part

Methods development to build a diagnosis on:

• Water efficiency and consumption
• Energy performances

Technical partners

Financial partners
Presentation outlines

1. Study context

2. Methodology

3. Results
Monitoring from 2012 to 2014

- 26 Farm irrigation systems monitored (some monitored during 3 years)
  - 3 systems with measurement chain
  - 23 systems monitored with manual measurements
Mobile gun measurement chain
Mobile gun measurement chain

Data logger transmitter on battery, Diaxys

Pressure sensor

Datalogger unit on battery, Paratronic

Organizer

Data logger
Redlion
1. Study context

2. Methodology

3. Results
82% of electrical power are used to carry water to the gun, 18% for water field spreading.
Definition of simple indicators

<table>
<thead>
<tr>
<th>Installation</th>
<th>kWh/m³ &quot;water meter&quot;</th>
<th>kWh/m³ &quot;flow measure&quot;</th>
<th>Difference between &quot;water meter&quot; and flow measure</th>
<th>%</th>
<th>kWh/m³ &quot;optimized&quot;</th>
<th>Difference between &quot;water meter&quot; and &quot;optimized&quot;</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40</td>
<td>0.38</td>
<td>0.02</td>
<td>5.9%</td>
<td>0.28</td>
<td>0.12</td>
<td>30.5%</td>
</tr>
<tr>
<td>2</td>
<td>0.61</td>
<td>0.63</td>
<td>-0.01</td>
<td>-2.2%</td>
<td>0.64</td>
<td>-0.03</td>
<td>NA</td>
</tr>
<tr>
<td>3</td>
<td>0.49</td>
<td>0.39</td>
<td>0.10</td>
<td>21.3%</td>
<td>0.35</td>
<td>0.14</td>
<td>28.6%</td>
</tr>
<tr>
<td>4</td>
<td>0.62</td>
<td>0.43</td>
<td>0.19</td>
<td>30.9%</td>
<td>0.36</td>
<td>0.26</td>
<td>41.6%</td>
</tr>
<tr>
<td>5</td>
<td>0.62</td>
<td>0.59</td>
<td>0.03</td>
<td>4.2%</td>
<td>0.54</td>
<td>0.08</td>
<td>12.7%</td>
</tr>
<tr>
<td>6</td>
<td>0.49</td>
<td>0.47</td>
<td>0.02</td>
<td>4.2%</td>
<td>0.41</td>
<td>0.08</td>
<td>15.9%</td>
</tr>
</tbody>
</table>
Kwh/m³ per material

Average kWh/m³ by material

- Sprinkler irrigation: 0.41 kWh/m³
- Center pivot: 0.39 kWh/m³
- Mobile gun: 0.56 kWh/m³

Installations average
Pressure loss calculation

Hazen Williams formula

\[ j = 10.68 \times (QC_{\text{wh}})^{1.852} \times D - 4.871 \]

With \( j \) = pressure loss in water column meter/meter, \( Q \) = flow in m\(^3\)/sec., \( C_{\text{wh}} \) = Hazen-Williams coefficient, \( D \) = diameter in meter.
Example of pressure loss in a studied installation

- Sluice gate 22% (1.37 bar)
- Surface pipe 19% (1.17 bar)
- Buried PVC pipe 7% (0.44 bar)
- Mobile gun turbine 8% (0.5 bar)
- HDPE to the gun 40% (2.5 bar)
- Difference in height 4% (0.25 bar)
Definition of a constraint coefficient to consider topographic difference and distance to the water between farm

Constraint coeff. = length pump/ position in meter* pressure loss + water level difference
Relation between kWh/m³ “water meter” and constraint coefficient for mobile gun
Conclusion and prospect

• Testing working diagnosis in 2015 on 15 new installations
• Building a database on energy in irrigation
• Improving our global knowledge about energy consumption in irrigation installations
Thanks for your attention

If you have any questions, feel free to ask