Early warning systems for disease detection in pigs

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ILVO
Flanders research institute for agriculture, fisheries and food

Plant
Animal
Social
Technology & Food

630 employees
320 scientists
200 ha fields
>15,000 m² greenhouses
>20,000 m² barns
Food Pilot Factory etc.
"Agro Food Valley" @ Merelbeke/Melle
ILVO Today?
ILVO is fully up to date

• New experimental greenhouse (2011)
• New pilot factory (2011)
• New Dairy Barn (2014)
• New pig research complex (2015)
Integrated research approach

Soil $\rightarrow$ Fork

Fork $\rightarrow$ Soil
Growing farms: number of animals per stockman
Management by exception
Precision Livestock Farming

On time & better informed decision making

(à Blokhuis et al, 2003)
Limited Succes of PF

- Participatory processes
- Knowledge platforms
- Technology as a service

- False alarms
- Unused data
- Benchmarking

- Show cost-benefit
- Lower prices

- Too hard
  - Available technology is unknown
  - Technology is too complex to use
  - Not enough time

- Too expensive
  - Technology: no value for money

- Too much
  - Plenty of data, How to use it?
Challenges pig farmers
visual monitoring

Daily check of the farmer
+ automated monitoring

Continuous, individual data
Management by exception
**SowSIS: lameness in sows**

**Force plate analysis**

![Force plate analysis](image1)

**Image analysis**

![Image analysis](image2)

Liesbet Pluym, PhD 2009-2013  
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Prof. Dominiek Maes, dr. Annelies Van Nuffel
ZeuSense: lameness in sows

Olga Szczodry, PhD 2015 -2019
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Prof. Frank Tuyttens, dr. Annelies Van Nuffel
ISense: PLF case

Localisation system  Low cost ammonia sensor

Shaojie Zhuang, Shaojie.Zhuang@ilvo.vlaanderen.be, PhD 2016-2019; Prof. Bart Sonck
PigWise: monitoring fattening pigs

RFID

Feeding/drinking pattern individual pig

Synergistic control

Differentiate abnormal and normal variation

ALARM for problems

Online warning system for health, welfare and productivity problems

Jarissa Maselyne, PhD 2011-2016; prof. Wouter Saeys, dr. Annelies Van Nuffel
High Frequency RFID

⇒ who comes to feed, when and how long
RFID feeding & drinking system

- RFID ear tag
- RFID antenna
- Nipple drinker
- Triangles to block presence of non-drinking pigs

storage tank
RFID antenna
metal trough
Research farm

35 pigs/ pen
4 pens
barrows + gilts

Piétrain boar x Hybrid Sow
Develop warning systems

- Fixed (group) limits
- Individual and time-varying limits: SGC

©De Ketelaere, KU Leuven
Pig 125

Recovered

Problem not noticed by caretakers

Thin + longer hair; mildly lame (new)

Severely lame, fever, reduced activity, sunken in flanks
Pig 7

Severely lame, tail infection, fever, pale, sunken in flanks, lost weight
Pig 2

Diarrhea + sunken in flanks

Open wound, fever up & down, trouble breathing, reduced activity and growth

Treated

# reg pig 2

SGC on # reg pig 2

# reg - model estimate

Day

Day

# reg

0 50 100

0 1000 2000

0 1000 2000

0 1000 2000

0 1000 2000

0 1000 2000
Warning system

Future perspectives and conclusions
Feedback to farmer

Early Warning System
## Results best warning system

<table>
<thead>
<tr>
<th></th>
<th>Optimized SGC # reg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity</strong></td>
<td>66.1 %</td>
</tr>
<tr>
<td><strong>Specificity</strong></td>
<td>98.2 %</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>96.5 %</td>
</tr>
<tr>
<td><strong>Precision</strong></td>
<td>67.4 %</td>
</tr>
<tr>
<td></td>
<td>(&gt;71.8 % without pig 133)</td>
</tr>
<tr>
<td><strong># alerts</strong></td>
<td>771</td>
</tr>
<tr>
<td><strong>Detection of red blocks</strong></td>
<td>73.3 %</td>
</tr>
<tr>
<td>&gt; 1 day (n = 90)</td>
<td></td>
</tr>
<tr>
<td><strong>Speed of detection of red blocks</strong></td>
<td>1.1 days</td>
</tr>
</tbody>
</table>
Room for improvement!!

• Even with extensive daily observations: hard to determine status!
  – Problems present part of the day?
  – Subclinical disease?
  – Symptoms still seen, but pig is feeding again -> recovery? (now counted as FN)

• Further optimize variables and warning systems
  – Sensitivity and precision need to ↑

❓ What does a farmer detect and want to detect?
Conclusions

Validated HF RFID system
- For feeding & drinking behaviour
- Range ~ tag orientation & position
- Variable & individual behaviour!!
- RFID variables related to observed variables

Validated warning systems
- Individual control limits perform best
- A lot of problems -> change in behaviour

Valuable data for research & on-farm monitoring!
Future perspectives

• Added value for & feedback of farmer
• Improve performance, smarter algorithms
• Action plan, identify the alert-pig
• Integration of data
  – use RFID tag!
  – Compare data of groups, pens, etc.
• Relation to feed intake and weight gain?
• Warning system based on drinking?
=> Practical system for on the farms!
IoF2020 fosters a large-scale uptake of IoT in the European farming and food sector

- Demonstrate the business case of IoT for a large number of application areas in farming and food sector;
- Integrate and reuse available IoT technologies by exploiting open infrastructures and standards;
- Ensure user acceptability of IoT solutions in farming and food sector by addressing user needs, including security, privacy and trust issues;
- Ensure the sustainability of IoT solutions beyond the project by validating the related business models and setting up an IoT ecosystem for large scale uptake.
IOF2020 IN BRIEF

71 PARTNERS ORGANISATIONS

16 COUNTRIES

4 YEARS
Start = January 2017

€35 MILLION BUDGET
(€30 million co-funded under EU H2020 programme)
IoF2020 will pave the way for:

- Data-driven Farming
- Autonomous Farm Operations
- Virtual Food Chains
- Personalized Nutrition for European citizens
5 TRIALS, 19 USE CASES

ARABLE
FRUITS
DAIRY
VEGETABLES
MEAT
Optimize pig production management via on-farm sensors and slaughter house data
Objective

Provide the pig farmers with crucial information to effectively steer their management to reduce boar taint, health problems, increase productivity.

Data gathering → Data analytics → Info to farmer
Data acquisition throughout the entire supply chain

- Climate
- Feed
- Water
- Weight
- ...
Thank you