Experience with Bovine Electronic Identification in Germany

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Contents

- introduction
- results of some selected studies from research units in Germany
- results of a farm project in North West Germany
- economic aspects
- conclusion
Design of Different Electronic Identification Systems on Animals

- bolus
- injectable transponder
- electronic ear tag

Requirements on Electronic Identification Systems

- ISO 11784
  Radio frequency identification of animals -- Code structure
- ISO 11785
  Radio frequency identification of animals -- Technical concept
Different Processes of Identification

Static Process
- animal is standing in a room, slow movement
- easy definition of head and rump position
- scanning distance: 0.3 to 0.5 m
- scanning speed requirements: low / middle
- examples: calf feeder, concentrate feeder

Dynamic Process
- animal is moving
- head and rump position are difficult to define
- scanning distance: 0.5 to 0.9 m
- scanning speed requirements: high (cow speed: ~ 3 m/s)
- examples: selection unit, walk through detection, milking parlour

Comparison Between Different Identification Systems

<table>
<thead>
<tr>
<th>Feature</th>
<th>Bolus</th>
<th>Injectable</th>
<th>Electronic Ear Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>+</td>
<td>(+)*</td>
<td>++</td>
</tr>
<tr>
<td>Scanning (hand held device)</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Scanning process control syst.</td>
<td>+ / -</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Withdrawal (abattoir)</td>
<td>+</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Lost identification systems</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Data protection</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Assessment
- ++ very positive
- + positive
- - negative
- * only trained staff
- ** only trained staff

(Prinkelmann and Kern, 1994 - modified)
Study 1: Combination with Biometric Sensors

Correlation between automatic measured body and rectal temperature 
(Injectable Transponder)

- methods
  - calves, 2 – 11 weeks pp.
  - transponder with integrated temperature sensor, injected near the ear (ventral to Scutulum)
  - recording the rectal temperature "by hand"

- results
  - high correlation: 0.82
  - differences in 2nd week: 1.5 K
  - differences later: 1.0 K (Kamann et. al., 1999)

Study 1: Combination with Biometric Sensors

Correlation between automatic measured body and rectal temperature 
(Injectable Transponder)

- detailed analysis: modified methods
  - controlled artificial hyperthermy

- results
  - high correlation between increasing and decreasing body temperature (injectable transponder vs. rectal temperature): 0.82

(Kamann et. al., 1999)
Study 2: Combination with Biometric Sensors

Correlation between automatic measured body and rectal temperature (Bolus)

- **methods**
  - 5 calves, 2 weeks old
  - bolus with integrated temperature sensor (prototype), located in the Reticulum
  - recording 2 times a day (morning / afternoon) at the same time
    - bolus body temperature by hand reader
    - rectal temperature "by hand"

  (Klintworth et. al., 2006)

- **results**
  - (high) correlation: 0.74
  - correlation depending on water intake

  (Klintworth et. al., 2006)
  (Klintworth, 2004)

1 cow, 1 day:

![Graph showing water intake and corresponding temperatures over time]
Germany: Concentration on Electronic Ear Tag

Reasons

- withdrawal (abattoir)
  - question of consumer policy:
    - What happens, if a consumer is finding a bolus or injectable in his meat?

- TID = VID
  - technical identification
  - visual identification

Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 1: 2 Hardware Components under Experimental Conditions

- methods
  - 80 cows, additionally their calves
  - ISO 11784 compatible ear tags
  - August 2003 – July 2004
  - automatic digital balance
    - static process of identification
    - reader TL-01 ISO (Texas Trading), ISO 11785 compatible
    - aim of study: automatic animal identification and weighing
Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 1: 2 Hardware Components under Experimental Conditions

- hand reader
  - reader HL-01 (Texas Trading), ISO 11785 compatible
  - data interface to a common PDA (HP iPAQ 5550)
  - aim of study:
    - automatic animal identification
    - data messages to the national I&R data base via PDA (birth, arrival, departure, death)

26 July 2008

Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 2: Several Hardware Components in Parallel Operation under Practical Conditions

- methods
  - 388 animals (cows, heifers and calves)
  - ISO 11784 compatible ear tags
  - July 2005 – December 2006
  - automatic digital balance (see periode 1)

26 July 2008
Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 2: Several Hardware Components in Parallel Operation under Practical Conditions

- calf feeder
  - static process of identification
  - reader T2S HDX V01 TIRIS (Texas Trading), not ISO 11785 compatible
  - aim of study: automatic animal identification and amount of assimilated drinks

- concentrate feeder (2 units)
  - static process of identification
  - reader DMS 21 ID HDX/FDX-B (Nedap), ISO 11785 compatible
  - aim of study: automatic animal identification and allocating an animal specific concentrate amount
Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 2: Several Hardware Components in Parallel Operation under Practical Conditions

- selection unit
  - dynamic process of identification: "walk through"
  - pre-identification unit
    VC4 Single Plus
    DMS 21 HDX/FDX (Nedap)
  - reader
    Twin Plus SF 4 ISO HDX/FDX – B (Nedap)
  - aim of study: automatic animal identification and selecting animals in different groups

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Study 3: Use of Electronic Ear Tags in an Experimental Farm

Periode 2: Several Hardware Components in Parallel Operation under Practical Conditions

- walk through detection (2 units)
  - dynamic process of identification: "walk through"
  - reader
    Full ISO Reader
    HDX/FDX – B (Botec)
  - aim of study: automatic animal identification
Study 3: Use of Electronic Ear Tags in an Experimental Farm

General Results

- delivery time of electronic ear tags
  - 1st order: max. 7 days
  - reorder: max. 10 days

- 1st test of electronic ear tags before application: hand reader
  - test OK: 556 ear tags (99.64 %)
  - deficient: 2 ear tags (0.36 %)

- no. of lost ear tags

<table>
<thead>
<tr>
<th></th>
<th>electronic ear tag</th>
<th>plastic ear tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>ear tags applied</td>
<td>558</td>
<td>796</td>
</tr>
<tr>
<td>ear tags lost</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>quota</td>
<td>0.9 %</td>
<td>5.6 %</td>
</tr>
</tbody>
</table>
Study 3: Use of Electronic Ear Tags in an Experimental Farm

Results of Periode 1

- A combination of commercial hardware is possible.
- Data exchange with the national data base is possible and works without problems.

<table>
<thead>
<tr>
<th>unit</th>
<th>no. of readings</th>
<th>detection correctly (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>automatic digital balance</td>
<td>1,180</td>
<td>100.0</td>
</tr>
<tr>
<td>hand reader</td>
<td>5,008</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Modified experiment: automatic digital balance as "walk through detection"

```
\begin{align*}
\text{Tag} & \quad \%\text{ successful detections} \\
\text{morning} & \quad \text{evening} \\
\end{align*}
```

\[ \bar{O} = 98.41\% \]
### Study 3: Use of Electronic Ear Tags in an Experimental Farm

#### Results of Periode 2

<table>
<thead>
<tr>
<th>unit</th>
<th>detection</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>automatic digital balance</td>
<td>16,332</td>
<td>power supply, humidity</td>
</tr>
<tr>
<td>calf feeder</td>
<td>83,808</td>
<td>only HDX</td>
</tr>
<tr>
<td>concentrate feeder</td>
<td>202,498</td>
<td></td>
</tr>
<tr>
<td>selection unit</td>
<td>3,875</td>
<td>***</td>
</tr>
<tr>
<td>walk through detection</td>
<td>2,434</td>
<td>***</td>
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</tbody>
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<table>
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<tr>
<td>99.8</td>
</tr>
<tr>
<td>100.0</td>
</tr>
<tr>
<td>78.0</td>
</tr>
<tr>
<td>49.0</td>
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ca. 12m
Study 3: Use of Electronic Ear Tags in an Experimental Farm

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Economic Aspects of Using Electronic Ear Tags

Replaced Plastic Ear Tags in Lower Saxony

<table>
<thead>
<tr>
<th>year</th>
<th>registered cattle</th>
<th>applied ear tags</th>
<th>replaced ear tags</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2,827,016</td>
<td>5,654,032</td>
<td>679,899</td>
<td>12.03</td>
</tr>
<tr>
<td>2002</td>
<td>2,719,416</td>
<td>5,438,832</td>
<td>697,046</td>
<td>12.82</td>
</tr>
<tr>
<td>2003</td>
<td>2,661,117</td>
<td>5,322,234</td>
<td>497,065</td>
<td>9.34</td>
</tr>
<tr>
<td>2004</td>
<td>2,586,887</td>
<td>5,173,774</td>
<td>347,610</td>
<td>6.72</td>
</tr>
<tr>
<td>2005</td>
<td>2,561,585</td>
<td>5,123,170</td>
<td>289,698</td>
<td>5.65</td>
</tr>
</tbody>
</table>

If each cattle is registered with 1 plastic and 1 electronic ear tag,
- ca. 0.5 x 300,000 = 150,000 plastic ear tags has to be replaced,
- ca. 24,000 electronic ear tags has to be replaced potentially.

(5.65 % x (0.90 %)^1 x 0.5 x 300,000)
Economic Aspects of Using Electronic Ear Tags

Costs of Replacing an Ear Tag

- costs of replacing an plastic ear tag: 11.22 Euro
  - controlling and booking: 0.30 Euro
  - fabrication and logistics of an replacement ear tag: 0.92 Euro
  - time and effort for the farmer (application): 10.00 Euro

- costs in Lower Saxony: 300,000 \times 11.22 \text{ Euro} = 3,366,000 \text{ Euro}

- Which reduction of cost can be achieved, if the number of replacement ear tags is decreasing to 150,000 plastic + 24,000 electronic ear tags?

- not included: - benefits at abattoirs and other cattle collecting points,
  - benefits because of decreased number of accidents concerning ear tag application

Conclusion

- Identification of bovine animals with electronic ear tags is easy and reliable.

- Integration of electronic ear tags and readers into the on-farm production engineering is possible and reliable to operate.
  - technical synchronisation of different systems is necessary!

- Input for administration, farm management and work flow can be reduced using electronic animal identification systems.

- Integration of electronic ear tags is the next step
  - to automize the data management on farm;
  - to automize and the data exchange between business partners.
Conclusion

- Concerning all costs and savings, electronic ear tags are not automatically more expensive than plastic ear tags.

- Further developments of RFID technologies can lead to get more information about animals.
  - sensoric measurement of temperature, pH, etc.
  - relevant to practice?
  - cost-benefit ratio?
  - at the moment only via bolus or injectable tranponder

- The continuous data flow between different systems (process control, management software, data base software) makes more standardization of data interfaces, formats and algorithms necessarily, especially on international level.