Emerging Layer Housing Systems in USA

Hongwei Xin, Distinguished Professor
Depts of Ag & Biosystems Engineering and Animal Science, Iowa State Univ.
Director of Egg Industry Center
hxin@iastate.edu

A Webinar on Livestock & Poultry Housing: March 6, 2015

U.S. Egg Industry

- Human population: 314.5 million
- Number of laying hens: 297 million
- Eggs produced: ~83 billion/year
- Per-capita egg consumption: 258 eggs
  - 69% shell eggs & 31% processed eggs
- 95% of eggs produced in cage housing systems (high-rise or manure belt).

Today's Issues/Challenges

- Animal Welfare
- Consumer Education
- Efficiency & Profitability
- Egg Safety & Quality
- Environmental Impact
- Hen & Worker Health

Sustainability
Recent Developments in European Union and USA

1. Jan 1, 2012, EU banned egg production from hens in cages. ~25% did not meet deadline. Shortage of egg supply and price hike.

2. CA Prop 2 went into effect Jan 1, 2015: Shell eggs sold in CA must comply with new space and SE vaccination/testing requirements:

<table>
<thead>
<tr>
<th># hens/cage</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>in²/hen</td>
<td>322</td>
<td>205</td>
<td>166</td>
<td>146</td>
<td>135</td>
<td>127</td>
<td>121</td>
<td>117</td>
<td>116</td>
</tr>
</tbody>
</table>

Current industry standard (UEP certified): 67 in²/hen

Modern Hen Housing Has Come a Long Way

High-Rise (Cage) Hen House

This presentation is archived at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Manure-Belt (Cage) Layer House

Forced Air Drying of Manure on Belt

Distribution of Electricity Use

(Xin et al., 2013)
Enriched Colony Hen House

Colony size: 60 hens
Area/hen: 116 in²
Perch/hen: 6 in
Nestbox/hen: 9.3 in²
Scratch pad: 7.8 in²

Sources: Big Dutchman web site & CSES Project

Aviary Hen Houses

Aviary Hen Houses

Inspection Aisle

Litter Area

This presentation is archived at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Non-Cage Hen Houses

A Holistic Evaluation of Three Hen Housing Systems in USA
- Michigan State University
- University of California-Davis
- Iowa State University/EIC
- USDA – ARS
- Cargill and McDonalds

Ammonia (NH₃) Concentrations of Three Hen Housing Systems

Average Daily NH₃ Concentration

CC = conventional cage; EC = enriched colony; AH = aviary house

(Xin et al., 2013)
**PM\textsubscript{10} Concentrations of Three Hen Housing Systems**

![Graph showing PM\textsubscript{10} concentrations over time for different housing systems: CC, EC, AH.

CC = conventional cage; EC = enriched colony; AH = aviary house.

(Xin et al., 2013; Zhao et al., 2015)

**Ammonia (NH\textsubscript{3}) Emissions of Three Hen Housing Systems**

<table>
<thead>
<tr>
<th>Source</th>
<th>Housing System</th>
<th>CC</th>
<th>EC</th>
<th>AV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/hen –d</td>
<td>% Total</td>
<td>g/hen –d</td>
<td>% Total</td>
</tr>
<tr>
<td>House</td>
<td>0.083\textsuperscript{b}</td>
<td>28%</td>
<td>0.054\textsuperscript{c}</td>
<td>31%</td>
</tr>
<tr>
<td>Storage</td>
<td>0.21</td>
<td>72%</td>
<td>0.11</td>
<td>69%</td>
</tr>
<tr>
<td>Farm</td>
<td>0.29\textsuperscript{a}</td>
<td>100%</td>
<td>0.16</td>
<td>100%</td>
</tr>
</tbody>
</table>

Within a row, means with different superscripts significantly differ (P < 0.05).

(Xin et al., 2013; Shepherd et al., 2015)

**House-Level PM Emissions of Three Hen Housing Systems**

<table>
<thead>
<tr>
<th>PM Size</th>
<th>Unit</th>
<th>Daily Emission Rate (Mean ± SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CC</td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>mg/hen-d</td>
<td>15.7 ± 1.0\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>g/AU-d</td>
<td>5.4 ± 0.3\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>mg/kg egg</td>
<td>299 ± 0.02\textsuperscript{b}</td>
</tr>
<tr>
<td>PM\textsubscript{2.5}</td>
<td>mg/hen-d</td>
<td>0.9 ± 0.3\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>g/AU-d</td>
<td>0.30 ± 0.08\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>mg/kg egg</td>
<td>18.0 ± 4.7\textsuperscript{b}</td>
</tr>
</tbody>
</table>

Within a row, means with different superscripts significantly differ (P < 0.05).

AU = Animal Unit, 500 kg live body weight.

(Xin et al., 2013; Shepherd et al., 2015)
Closure

- Concerns over animal welfare have led to development and adoption of alternative egg production systems.
- Each system has its pros and cons.
- A holistic approach should be used when assessing sustainability of a production system (i.e., animal welfare, food safety, environmental impact, food affordability, work ergonomics, etc.).

EIC Annual Forums

- 2009 – Des Moines, Iowa
- 2010 – Chicago, Illinois
- 2011 – Columbus, Ohio
- 2012 – Denver, Colorado
- 2013 – St. Louis, Missouri
- 2014 – Indianapolis, IN
- 2015 (April 7&8) – Des Moines, Iowa

This presentation is archived at: http://www.extension.org/pages/21819/chronological-webcast-archive