Managing Manure To Improve Air and Water Quality

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Presented at USDA Agricultural Air Quality Task Force Meeting, November 15, 2005, Wailea-Maui, Hawaii
The Issue

- The multi-media (air and water) nature of pollution from animal waste poses challenges to farmers and to resource managers because environmental laws typically take a single-medium view.

- Failure to account for the multi-path nature of animal waste in policy design can lead to unintended consequences in terms of costs to farmers and degradation to environmental quality.
The Application

• The fate of nitrogen from animal feeding operations is a good example
• Nitrogen can follow a number of pathways in different forms
• We focused on ammonia emissions to the atmosphere and nitrate losses to water
Ammonium compounds, nitrogen gases

Other sources of nitrogen

Atmospheric deposition

Nitrogen gases

House ventilation

Inorganic fertilizer

Nitrogen in feed

Runoff

Crop production

Leaching

Nitrogen in manure

Manure storage

Nitrogen in animal products

Nitrogen in manure

Nitrogen gases

Nitrogen gases

Other sources of nitrogen

Ammonium compounds, nitrogen gases
Background

The policy context included the Clean Water Act regulations for concentrated animal feeding operations (CAFOs) promulgated in 2003, and air quality regulations contained in the Clean Air Act and CERCLA.

- CAFOs must have a nutrient management plan
- Clean Air Act restrictions on fine particulates could lead States to restrict ammonia emissions
- CERCLA could require reporting on emissions from animal feeding operations
We assessed the costs of complying with the new land application requirements for CAFOs under the Clean Water Act and found that implementing a nutrient management plan could significantly increase the cost of spreading manure.
Our new analysis consists of three parts

- Farm level assessment of economic and environmental tradeoffs under coordinated and uncoordinated air and water policies
- National level assessment of the broader impacts, including long-term structural adjustments and impacts on producers and consumer
- Implications of adding air quality regulations to existing Clean Water Act regulations in a region where the land base for spreading manure is relatively limited
Farm-Level Analysis: Focus on Hogs

- Nitrogen application standards had little impact on air emissions, overall.
- Reducing ammonia emissions increased excess nitrogen applications to land.
- Coordinated policy that reduces both ammonia and excess nitrogen would require a mix of practices different than either of the previous two scenarios.
Increasingly stringent ammonia reductions increase the amount of excess nitrogen applied to fields

Source: Aillery et al., Economic Research Service, 2005
### National Analysis: A Focus on Agricultural Markets

<table>
<thead>
<tr>
<th></th>
<th>CAFO</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
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</thead>
<tbody>
<tr>
<td><strong>Nitrogen reductions</strong>&lt;br&gt;(lbs. runoff, leaching, and air emissions)</td>
<td>1,169</td>
<td>1,553</td>
<td>1,599</td>
<td>1,653</td>
<td>1,779</td>
</tr>
<tr>
<td><strong>Net returns to crop production ($)</strong></td>
<td>449</td>
<td>328</td>
<td>307</td>
<td>267</td>
<td>196</td>
</tr>
<tr>
<td><strong>Net returns to livestock production ($)</strong></td>
<td>-897</td>
<td>-700</td>
<td>-724</td>
<td>-566</td>
<td>-268</td>
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<tr>
<td><strong>Consumer surplus ($)</strong></td>
<td>-402</td>
<td>-786</td>
<td>-876</td>
<td>-1,304</td>
<td>-2,053</td>
</tr>
<tr>
<td><strong>Returns to agriculture and consumer surplus ($)</strong></td>
<td>-850</td>
<td>-1,158</td>
<td>-1,293</td>
<td>-1,602</td>
<td>-2,125</td>
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</tbody>
</table>

**Source:** Aillery et al., Economic Research Service, 2005
Tradeoffs in environmental quality if water and air policies are uncoordinated

Source: Aillery et al., Economic Research Service, 2005
Regional Analysis:
Focus on the Chesapeake Bay Watershed

- Region with high concentration of animals relative to land available for spreading
- Meeting CAFO requirements costly because of competition for land and distance manure must be hauled
- Any change in manure management that increases nutrient content of manure would increase costs of complying with environmental regulations
Increased nutrient content of manure requires more land

Case A – CAFOs meet water standards, no ammonia controls
Case B – CAFOs meet water standards, CAFOs adopt ammonia-N controls
Case C – CAFOs meet water standards, All AFOs adopt ammonia-N controls
Case D – All AFOs meet water standards, All AFOs adopt ammonia-N controls

Source: Aillery et al., Economic Research Service, 2005
Cost of meeting nitrogen standard and reducing ammonia emissions

Source: Aillery et al., Economic Research Service, 2005
Major Findings

• Tradeoffs between air and water are prevalent in manure nitrogen management
• Uncoordinated policies would impose extra costs on farmers
• Unintended consequences of uncoordinated policies can lessen environmental gains
• Other tradeoffs may be important
• Reducing nitrogen at the source could address multiple problems
Full report can be obtained online at [http://www.ers.usda.gov](http://www.ers.usda.gov)

Or contact Marc Ribaudo at [mribaudo@ers.usda.gov](mailto:mribaudo@ers.usda.gov)
202-694-5488
Changes in regional production

<table>
<thead>
<tr>
<th>Region</th>
<th>Base</th>
<th>CAFO</th>
<th>WaterAir10</th>
<th>WaterAir20</th>
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</thead>
<tbody>
<tr>
<td>NE</td>
<td>4.176</td>
<td>-0.004</td>
<td>-0.123</td>
<td>-0.144</td>
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<td>LA</td>
<td>7.847</td>
<td>-0.099</td>
<td>-0.302</td>
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<td>CB</td>
<td>16.874</td>
<td>-0.375</td>
<td>-1.550</td>
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<td>NP</td>
<td>19.461</td>
<td>-0.848</td>
<td>-0.549</td>
<td>-0.648</td>
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<td>AP</td>
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<td>-0.323</td>
<td>-0.164</td>
<td>-0.225</td>
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<tr>
<td>SE</td>
<td>3.871</td>
<td>0.005</td>
<td>0.019</td>
<td>-0.013</td>
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<td>DL</td>
<td>3.082</td>
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<td>SP</td>
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<td>MN</td>
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<td>PA</td>
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<td>US</td>
<td>108.333</td>
<td>-1.172</td>
<td>-1.671</td>
<td>-1.850</td>
</tr>
</tbody>
</table>

Source: Aillery et al., Economic Research Service, 2005