Environmental issues of intensive livestock production

The rationale behind the choice of nutrient and energy recovery from manure as a focus area

Pierre Gerber
Seoul National University, 25 April 2012
OUTLINE

• Trends in the sector
• Environmental implications
• Rationale for this thematic area
• Potential lines of intervention
Meat consumption

Source: Alexandratos, 2011
Estimated distribution of livestock production systems

FAO, 2006
Estimated distribution of industrialized produced pig populations. Livestock’s Long Shadow, 2006

Globally - 900,000,000 hogs

FAO, 2006
Total 60,000,000 hogs

Honeyman, Duffy, 2006. Iowa State Univ
Hogs in North Carolina

- 9,800,000 hogs and pigs
- 45% are in 2 of the 100 counties of the state and are on the coastal plain
Estimated soymeal surplus/deficit
N use efficiency in dairy systems

\[ y = -6 \times 10^{-8} x^2 + 0.0028x + 2.48 \]

\[ R^2 = 0.929 \]

Powel et al., forthcoming
Estimated contribution of livestock to total $\text{P}_2\text{O}_5$ supply on agricultural land, in area presenting a $\text{P}_2\text{O}_5$ mass balance of more than 10 kg per hectare.

FAO, 2006
GHG emissions from the livestock sector

- Deforestation: 34%
- Enteric fermentation: 26%
- Manure spreading/dropping: 25%
- Chemical N. fert. production
- On-farm fossil fuel
- Deforestation
- OM release from ag. soils
- Pasture degradation
- Processing fossil fuel
- Transport fossil fuel
- Enteric fermentation
- Manure storage/processing
- N fertilization
- Legume production
- Manure spreading/dropping
- Manure indirect emissions

FAO, 2006
Manure management options

Concrete floor
- In house separation
  - "Solid manure"
  - "Liquid manure"
  - Slurry

Partially-slatted floor
- Below-floor temporary storage

Slatted floor
- In house separation
  - "Solid manure"
  - "Liquid manure"
  - Slurry

Collection
- Solid
- Liquid

Composting
- Black soldier fly
- Earthworm
- Drying
- Anaerobic storage

Storage/Process
- Feed
  - Fish, cattle

Fertilizer
- Solid
- Liquid

Soil
- Water
- Fish ponds

Energy

Fertilizer Liquid

Storage/Process
- Composting
- Anaerobic digestion
- Wetlands
- Ponding
- Time of storage
- Cover
- Additives
- Aerobic digestion
- Aerobic / Anaerobic
- Other

Utilisation
- By hand
  - High value and low handling cost

Low value and high handling cost
- Digested effluent value > effluent value (ammonia emission are more important with digested effluent)

Value ?

Mineral fertilizer
Nutrient balances on pig farms

**Thailand**
Ratchaburi Province
N=205

**Vietnam**
Thaibinh, Dongnai Provinces : N=420
Towards zero discharge: recovery of nutrient and energy from animal manure

- **Issue:** Discharge of animal manure into the environment causes pollution of soils and water resources, as well as the emission of noxious gases
  - total amounts of nutrients in livestock excreta > synthetic fertilizers
  - 50 to 90 percent of the nutrients contained in feed are excreted in manure
  - livestock is reacting to a rapidly changing socio-economic context through structural changes
IMPACT OF INTENSIVE LIVESTOCK ON CLIMATE AND WATER AND SOIL POLLUTION - Who cares?

- Civil society
- Governments
- Producers that have direct interest
  - Farmers aware of environmental consequences or exposed to complaints of local communities
  - Exporters with specific trade agreements
Towards zero discharge: recovery of nutrient and energy from animal manure

• **Proposition:** move towards zero discharge and recovery of nutrient and energy from animal manure

• **Rationale**
  - manure management technologies and practices broadly developed but not adopted
  - remove barriers and create the conditions for adoption

*Nutrient and energy recovery: any activity that uses the nutrients or energy embedded in animal manure*
IMPACT OF LIVESTOCK ON WATER AND SOIL POLLUTION
Nutrient flows in farming systems

Adapted from Saleem, 1998
Changes in manure management practices, what can make it happen?

**Government**
- Policy framework
  - Law
  - Regulatory enforcement
  - Financial incentives

**Extension services**
- Awareness
- Technical capacity

**Farmers associations**
- Technical capacity
- Recognition

**Available technical options**

**General public**
- Social/moral pressure
- Accountability

**Market**
- Incentive for “clean” products

**Motivation**

**Economic and technical changes**

**FARMER**
- Manure management practices
Policy options to address soil and water pollution issues

— Given the determinant role of livestock geography...
  ➤ Establish zoning laws preventing further concentration and encourage growth in less saturated areas

— Given the inadequacy and low enforcement of current regulations...
  ➤ Improve current standards (discharge, recycling, trading)
  ➤ Foster enforcement of rules and regulation

— Given that large units tend to generate more pollution per unit of output, and that small farmers have limited investment capacities...
  ➤ Enforce regulations for large units first
  ➤ Provide subsidies to smallholders who implement effective manure management practice
Policy options to address soil and water pollution issues

- Given the number small and middle size production units and the limited public resources ...
  
   Focus on voluntary approaches, develop training and extension and “Good Agricultural practices”

- Given the strong reactivity of the sector to economic conditions
  
   enforce market based measures such as taxes and subsidies
## Review of public policies

<table>
<thead>
<tr>
<th>Nutrient recovery (N &amp; P use efficiency)</th>
<th>On-farm level</th>
<th>Territorial level</th>
<th>National level</th>
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</thead>
</table>
| **Discharge standards** | • Discharge standards  
• **Subsidies** for manure management technologies  
• **Taxes** on N/P surplus  
• **Extension** and capacity building  
• **Awareness raising** | • **Cap and trade** system  
• Support to **manure transportation**  
• Specific **fertilization norms** in sensitive areas  
• **Livestock production zoning** (Land access) | • **Fertilization standards**  
• **Mandatory practices**: field cover crop during winter, intermediate crops |

| Energy recovery | • **Subsidies** for anaerobic digesters  
• **Extension** and capacity building | • **Promote business model** for biogas industry: consider every inputs and outputs (e.g. US Dairy) | • **Price support** for electricity from biogas plants  
• **Taxes** on fossil fuel  
• **Promote** machines fueled with biogas  
• **Promote carbon credits market** |
Effect of policies to control nutrient-based pollution from animal production in Denmark

Mikkelsen et al., 2009
Effect of policies to control nutrient-based pollution from animal production in Denmark

Mikkelsen et al., 2009