Modeling the Nutrition-Environment Nexus

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The Changing Dairy Landscape

- Clean Water Act, 1972
- CAFO Defined, 1976
- NMP Requirement, 2003

Progress towards Environmental Goals

- Nutrition Models
  - CNCPS
  - NRC
- Genetic Selection Models

Models in the Changing Dairy Landscape

(Capper and Bauman, 2013)
“Achieving the higher level of productivity needed—itself a formidable task—will not be sustainable without innovative solutions to challenges posed by shortages of arable land and water, the degradation of ecosystems, and the negative impacts of climate change.”


Multi-Objective Nutrition Modeling

Enteric Emissions
Manure Excretion

Production

What's happening on the rest of the farm?

Beyond the Barn

Manure Management

NH$_3$ = $-34.7 + 0.089$(TKN) + 3.38$(Wind) + 0.492$(Ta)
NH$_4$ = $-71.3 + 0.112$(TAN) + 3.19$(Wind) + 0.437$(Ta) + 7.45$(dry)

(Leytem et al., 2018)
NAS Report

- **Breakthrough 1:** A systems approach to understand the nature of interactions among the different elements of the food and agricultural system can be leveraged to increase overall system efficiency, resilience, and sustainability.

- **Breakthrough 3:** The application and integration of data sciences, software tools, and systems models will enable advanced analytics for managing the food and agricultural system.
Questions for Farm Systems Models

- How does herd nutrition affect nutrient fate in crop uptake and crop quality?
- Does reduction in enteric methane shift emissions to manure or soil?
- How do crop system choices affect whole farm nutrient efficiency?
- How does dairy nutrition affect soil health parameters and overall farm productivity?
Ruminant Farm Systems Model (RuFaS)

Model Objectives

- Simulates N, P, and C cycling
- Estimates:
  - Production
  - GHG production
  - Energy and water use
  - N and P losses
- Account for weather and soil types
- Respond to common management practices and cropping systems
- Reflect current state of knowledge

Thank you for your attention...

Questions?

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