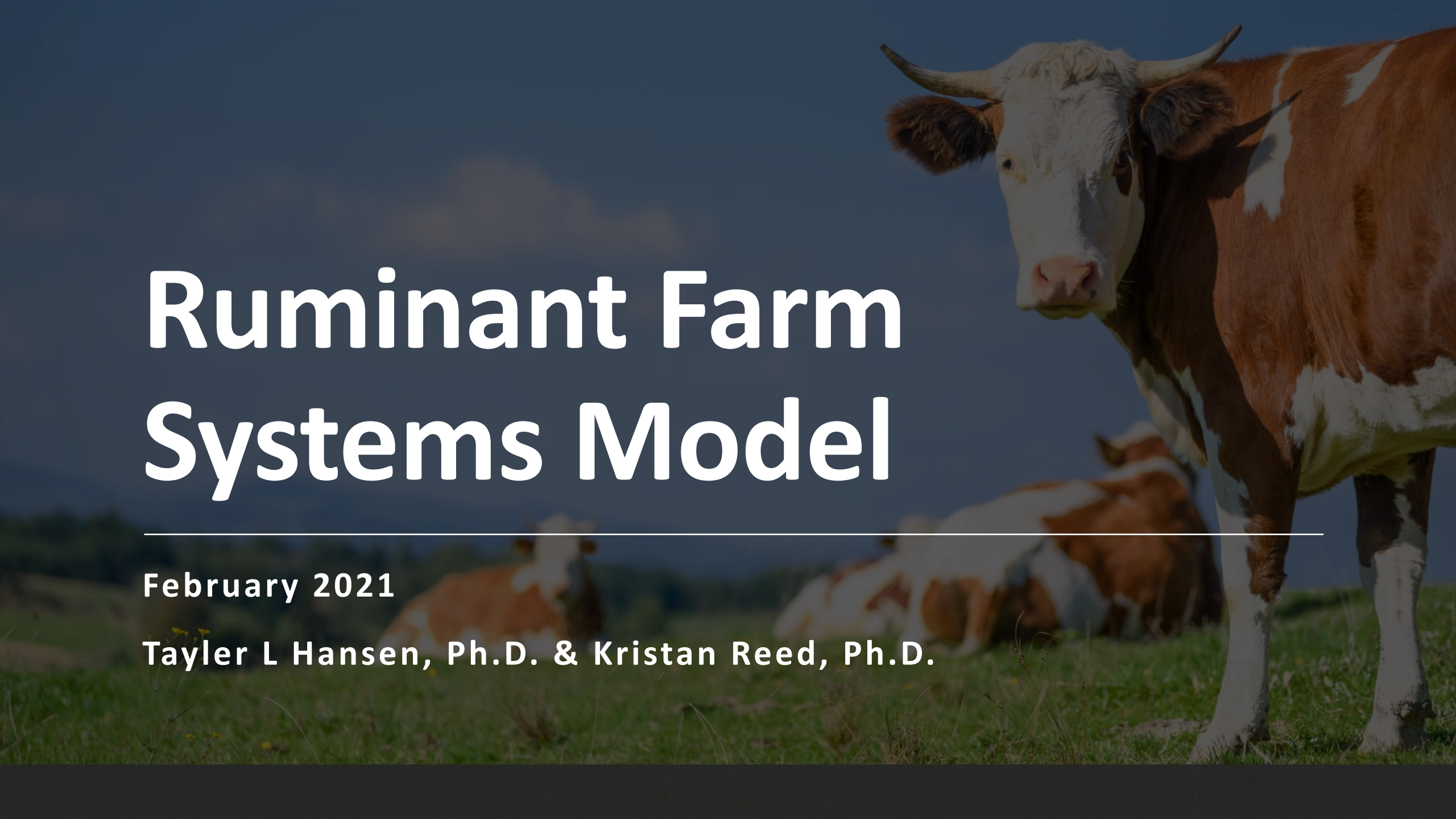


Ruminant Farm Systems Model

February 2021

Tayler L Hansen, Ph.D. & Kristan Reed, Ph.D.

Many models out already out there….

AMTS

CFT

SWAT Soil & Water Assessment Tool

COMET Farm

USDA United States Department of Agriculture Natural Resources Conservation Service

Colorado State University

Whole Farm and Ranch Carbon and Greenhouse Gas Accounting System.

DSSAT

RuFaS Founders

USDA

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

UNIVERSITY OF ARKANSAS

UC DAVIS
UNIVERSITY OF CALIFORNIA

INNOVATION CENTER FOR U.S. DAIRY
HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET

RuFaS Evolution

2017

Formalized vision and established principles for RuFaS development

2018

Computer simulation structure established, and first lines of code written.

Submitted first federal proposal.

Expanded collaborators to include Cornell.

2019

First paper published.

Formalized documentation and version control methods

Submitted first successful Federal proposal.

2020

Formalized Industry Advisory Council

Connected nutrient cycle in biophysical model.

Excelled in a challenging year.

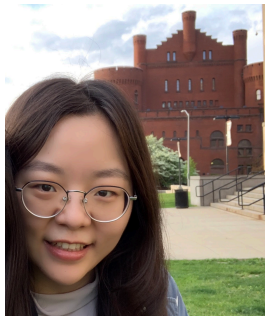
RuFaS Goals

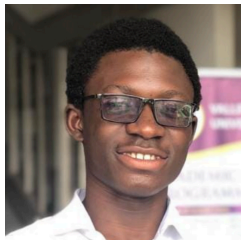
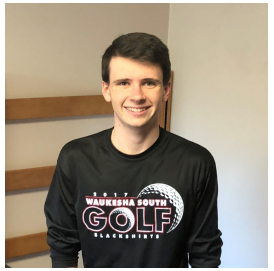
Interoperable

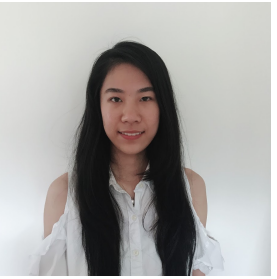
Documented

Open Source

Sustainable





UNIVERSITY OF ARKANSAS
The Nature Conservancy
Cornell University
UCDAVIS
UNIVERSITY OF CALIFORNIA
WWF
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON
NEAFA
Northeast Agribusiness & Feed Alliance
Advocate · Educate · Collaborate
INNOVATION CENTER FOR U.S. DAIRY
HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET
General Mills
Making Food People Love
USDA

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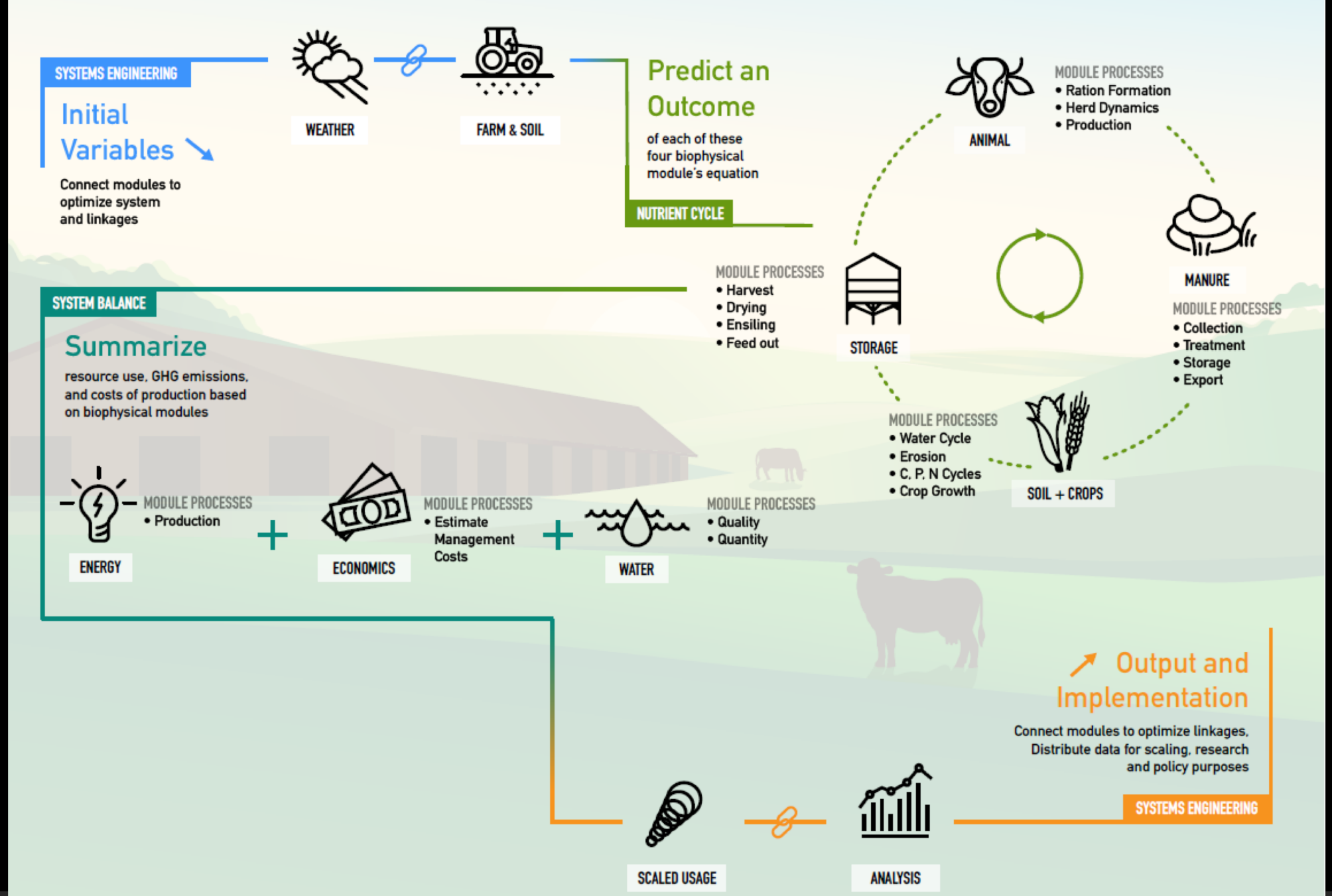
Participatory Modeling

- Involves stakeholders in all parts of the model development
  - 2020: Stakeholder Advisory Council
- Creates a shared understanding of the system, the problem and the solutions
- Increases stakeholder ownership of the research outcomes



Ruminant Farm Systems (RuFaS) Model

RuFaS: Soil and Crop

Kristan Reed, Peter Vadas, Jacob Johnson, Max Donovan, Michael Tang, and Hector Menendez III

USDA ARS

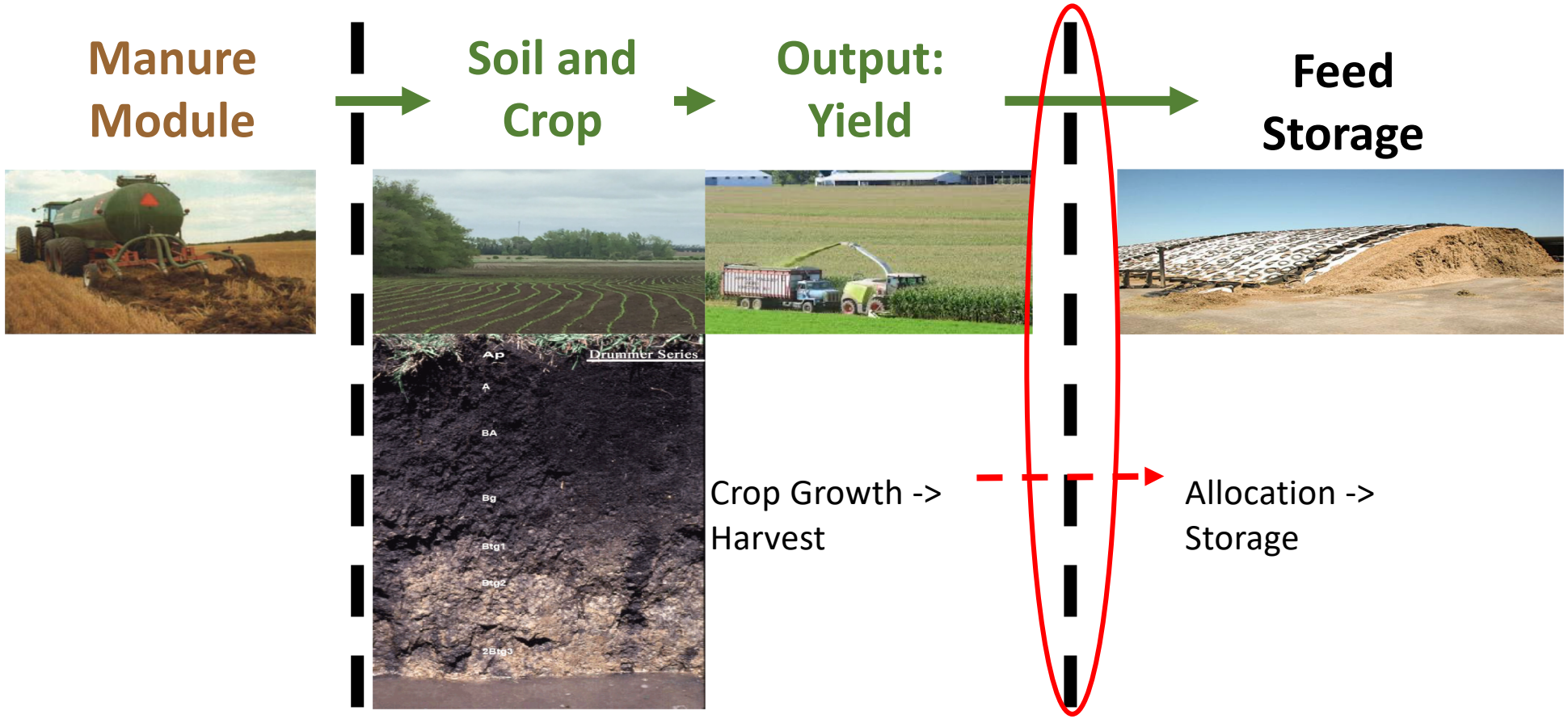
Cornell University

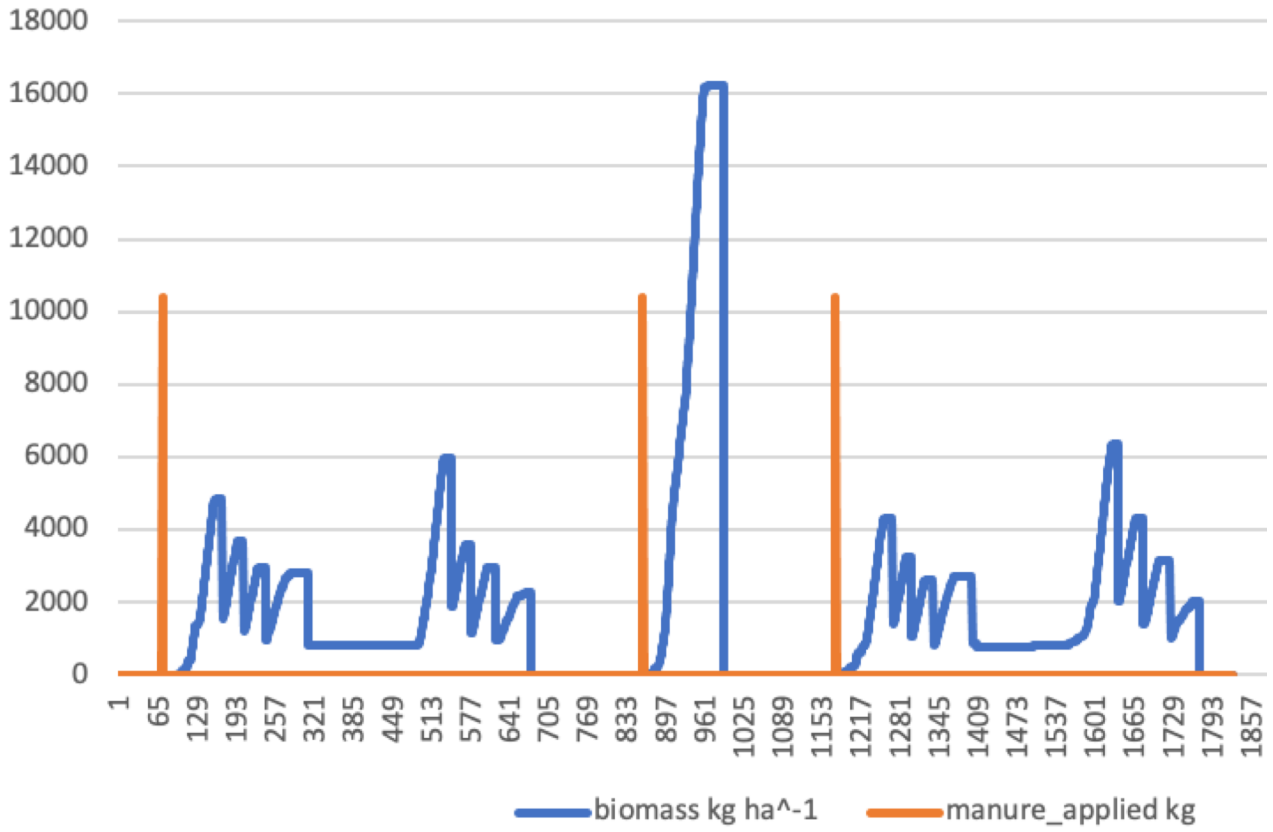
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

U.S. Dairy Forage Research Center
Leading the world in integrated dairy forage systems research.

Soil + Crop

Feed Storage





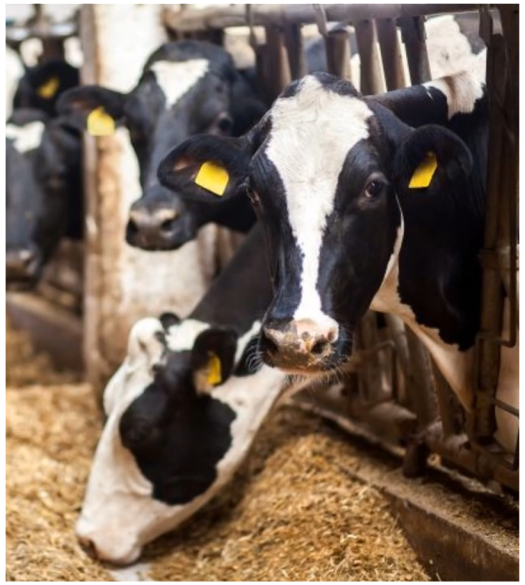
Harvest - Default Rotation

Storage grouped by:

- *Crop type*
- *Harvest date*
- *Crop quality*

Feed out:

- *Prioritize lactating cows*

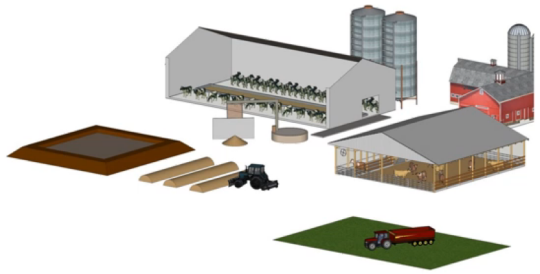


Ruminant Farm Systems Model: Animal Module

WINTER 2021

Cornell University

Animal Module



RufaS: Manure module

Modeling greenhouse gas emissions from dairy housing and manure management system

Dr. Greg Thoma, Vempalli Sudharsan Varma, Max Donovan, and Yunus Mohammed

USDA ARS

UNIVERSITY OF ARKANSAS

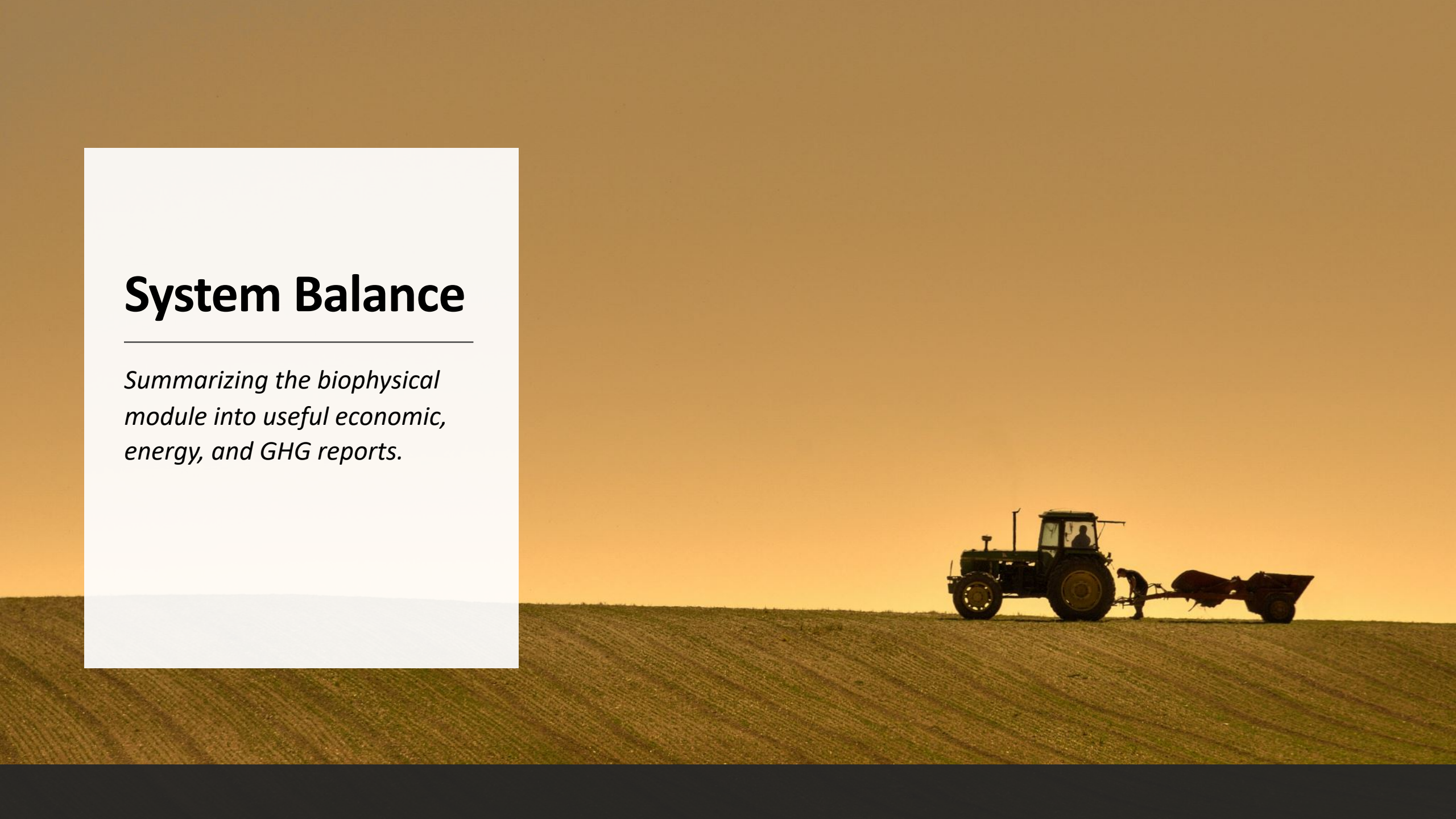
WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

Cornell University

Manure Module

System Balance

Summarizing the biophysical module into useful economic, energy, and GHG reports.



2021 Publication Goals

1. Ration Optimization
2. Animal Life Cycle
3. Milk Production
4. Animal Module/RFI Example
5. Crop + Soil Module
6. Manure Module

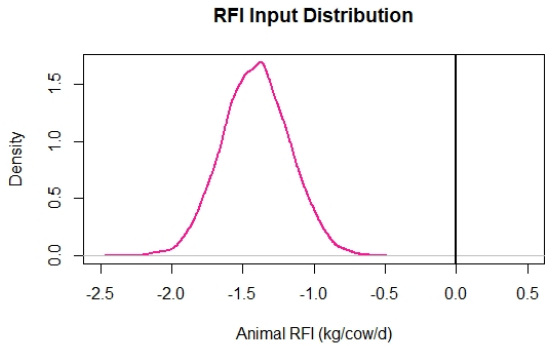
Case Study: Residual Feed Intake

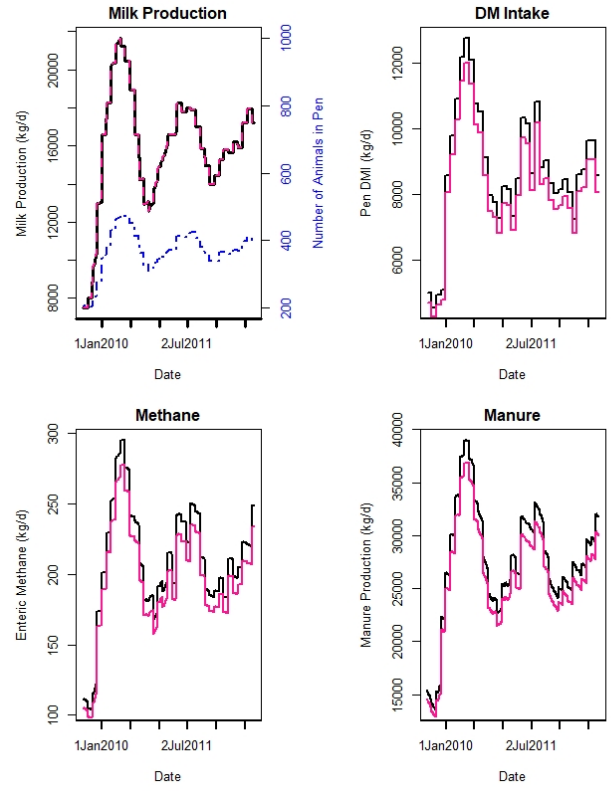
Objectives: Compare production and environmental outcomes of herds with different feed efficiencies

Methods:

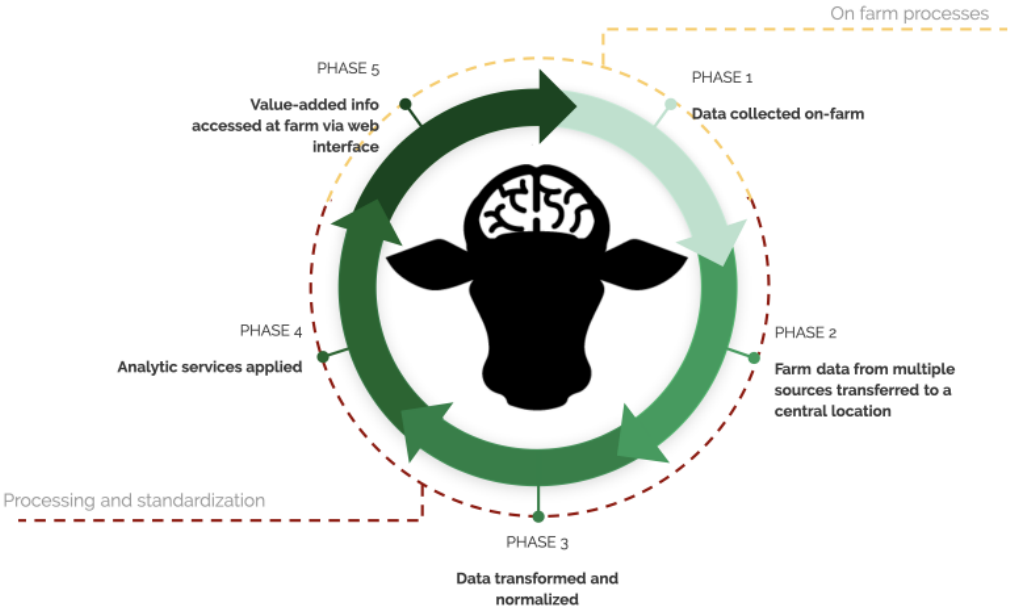
- Implement ***animal level*** efficiency parameter

- Estimate feed use and milk, manure, and enteric methane production for a normal and high-efficiency herd





Next Steps

Anticipate researcher model available Spring 2022

1. **Continued Optimization**
   - *New modules, more flexibility*
2. **Pilot Testing**
   - *On farm assessment of model*
3. **Connecting with Dairy Brain**