Modeling the National Beef Supply Chain

Leading a multi-institutional, interdisciplinary collaboration

Elaine Hill and Nicole Tichenor

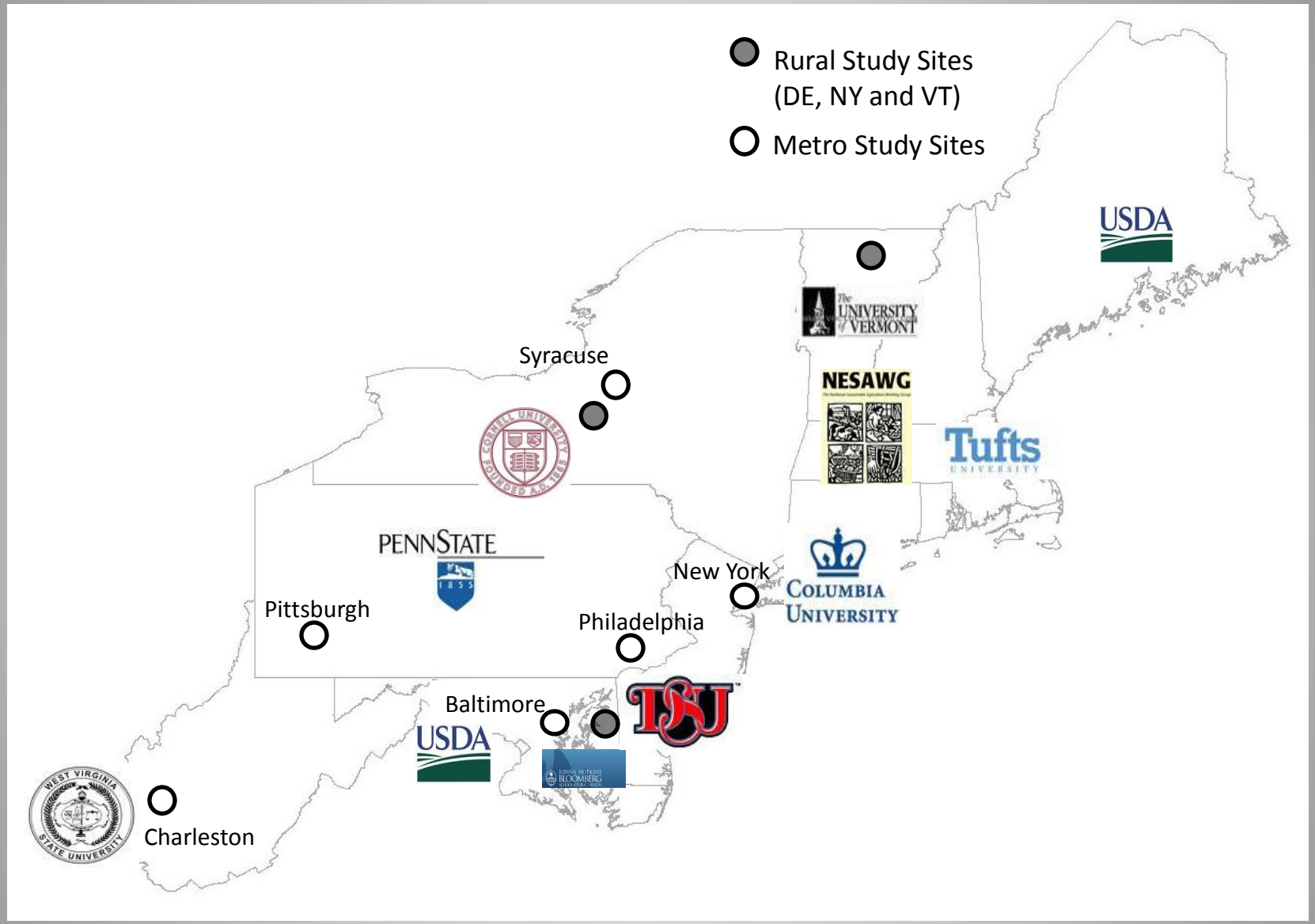
Where we're headed

- Larger project overview
- Formative research
- Team Beef
- Model
- Challenges
- Next steps

The EFNSE Project

- Enhancing Food Security in the Northeast through Sustainable Regional Food Systems
- 5 year NIFA-AFRI grant
- Teams
  - CONS
  - **DIST**
  - **PROD**
  - EDUC
  - OUTR
  - SCHEMO

EFSNE Project Sites and Collaborating Institutions



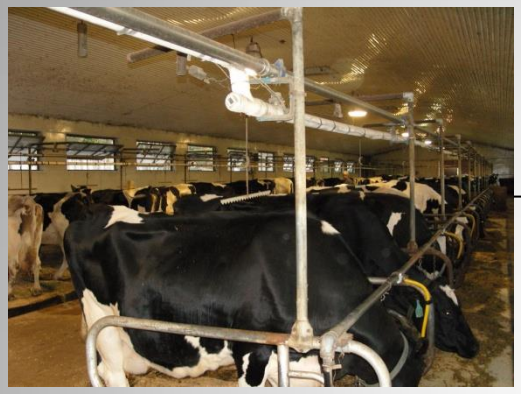
Market Basket Approach

- Low-income consumption and regional availability

Connecting PROD and DIST

- Identify production centers for market basket commodities
- Beef is special...

...in many ways



Enter Team Beef

- Elaine Hill and Miguel Gomez

- Nicole Tichenor and Tim Griffin

- Leveraging disciplinary expertise of DIST and PROD teams

Team Objectives

- Year 3
  - Literature review
  - Cross-project dialogue about model flexibility and linkages
  - Compile data
  - Begin model development
- Year 4
  - Finish model
  - Prepare manuscript

How We Operate

- Conference calls
  - Duo
  - Team Beef
  - Greater project team
- Modeling and writing “retreats”
- Assistance from other Tufts and Cornell students
- Dropbox

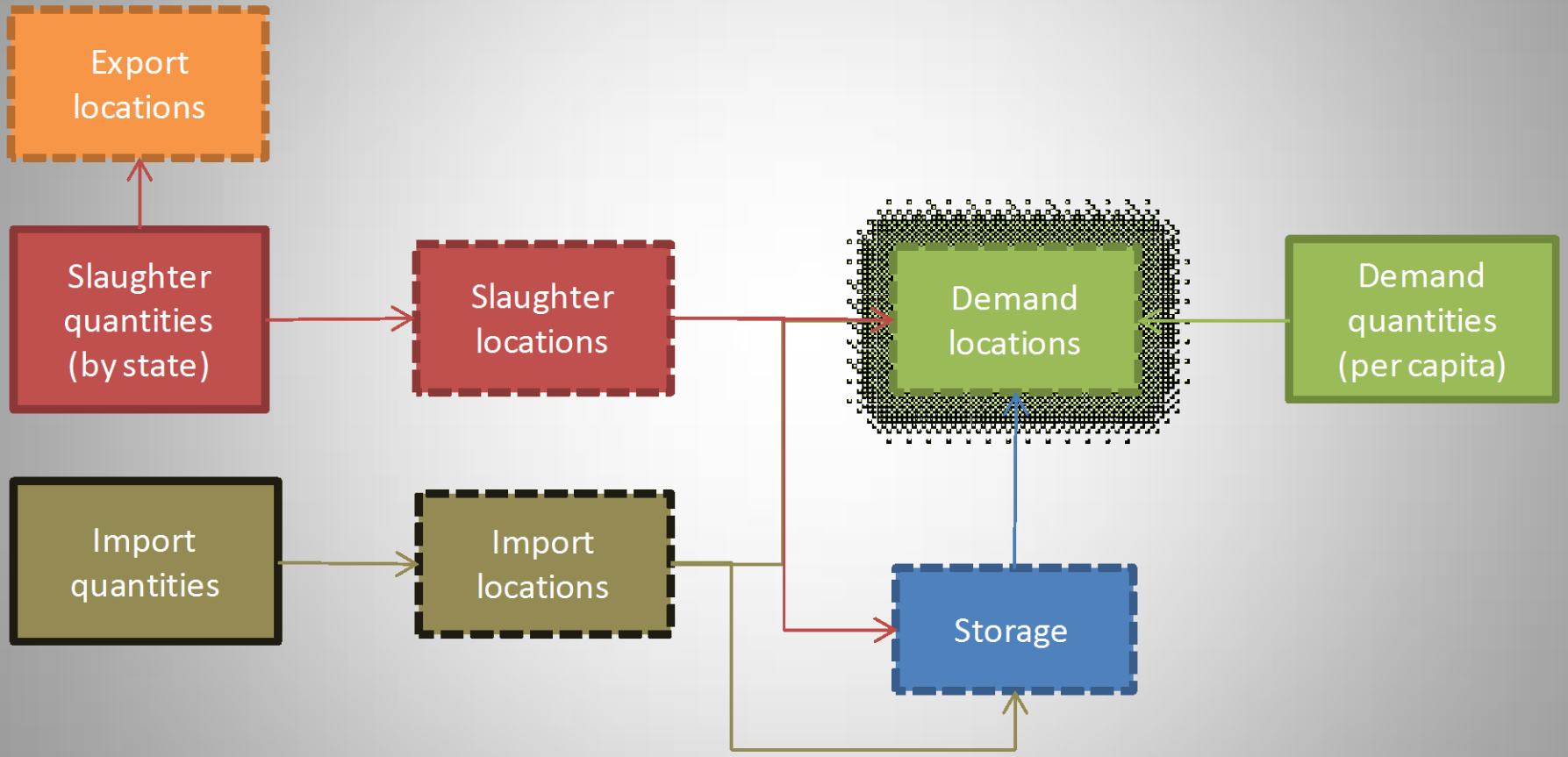
Methods

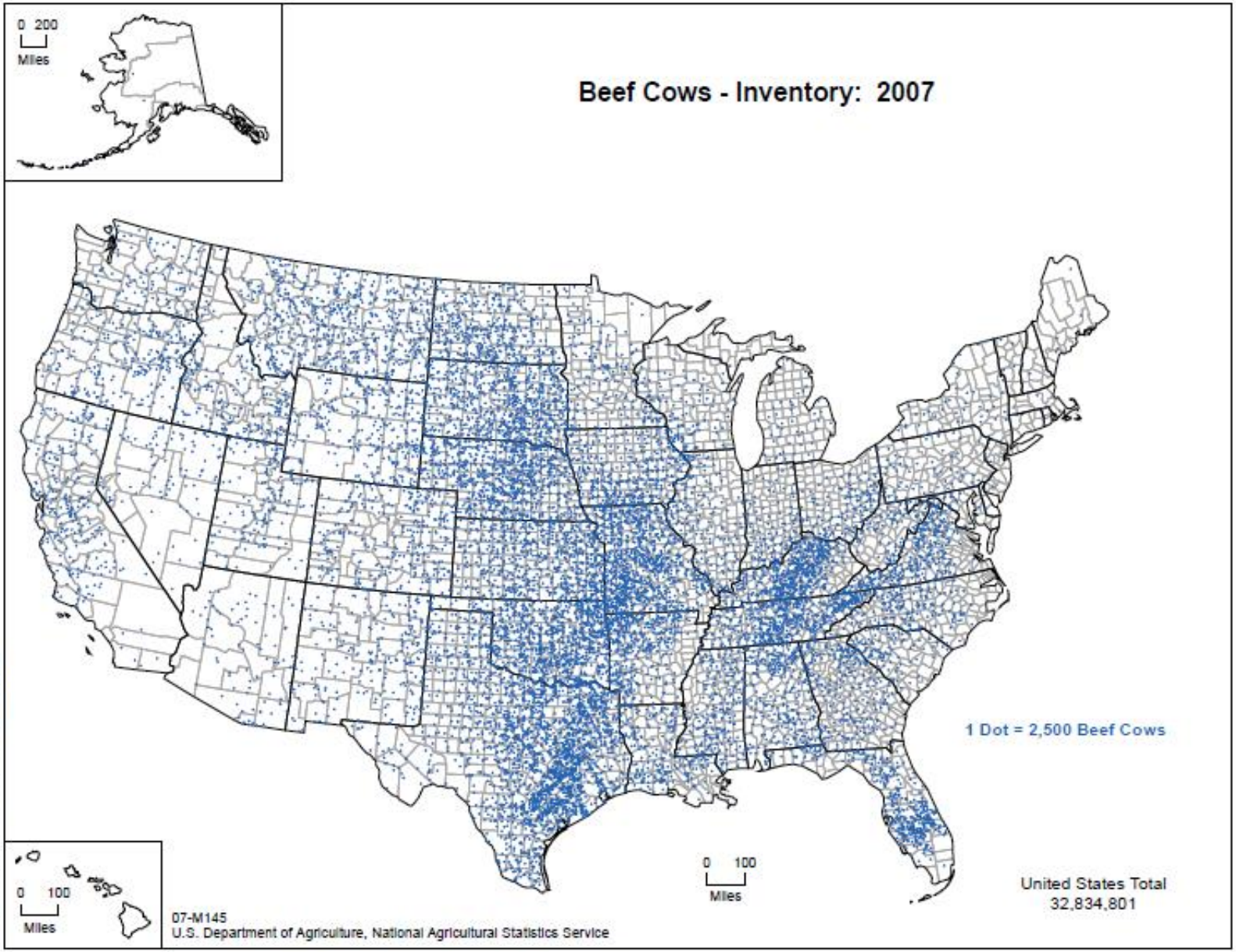
- Building supply chain optimization model
  - National scale, county-level resolution
  - Objective function minimizes costs
  - Excel, Stata and GAMS
  - Differentiated products
- Running baseline and scenario simulations
  - GAMS

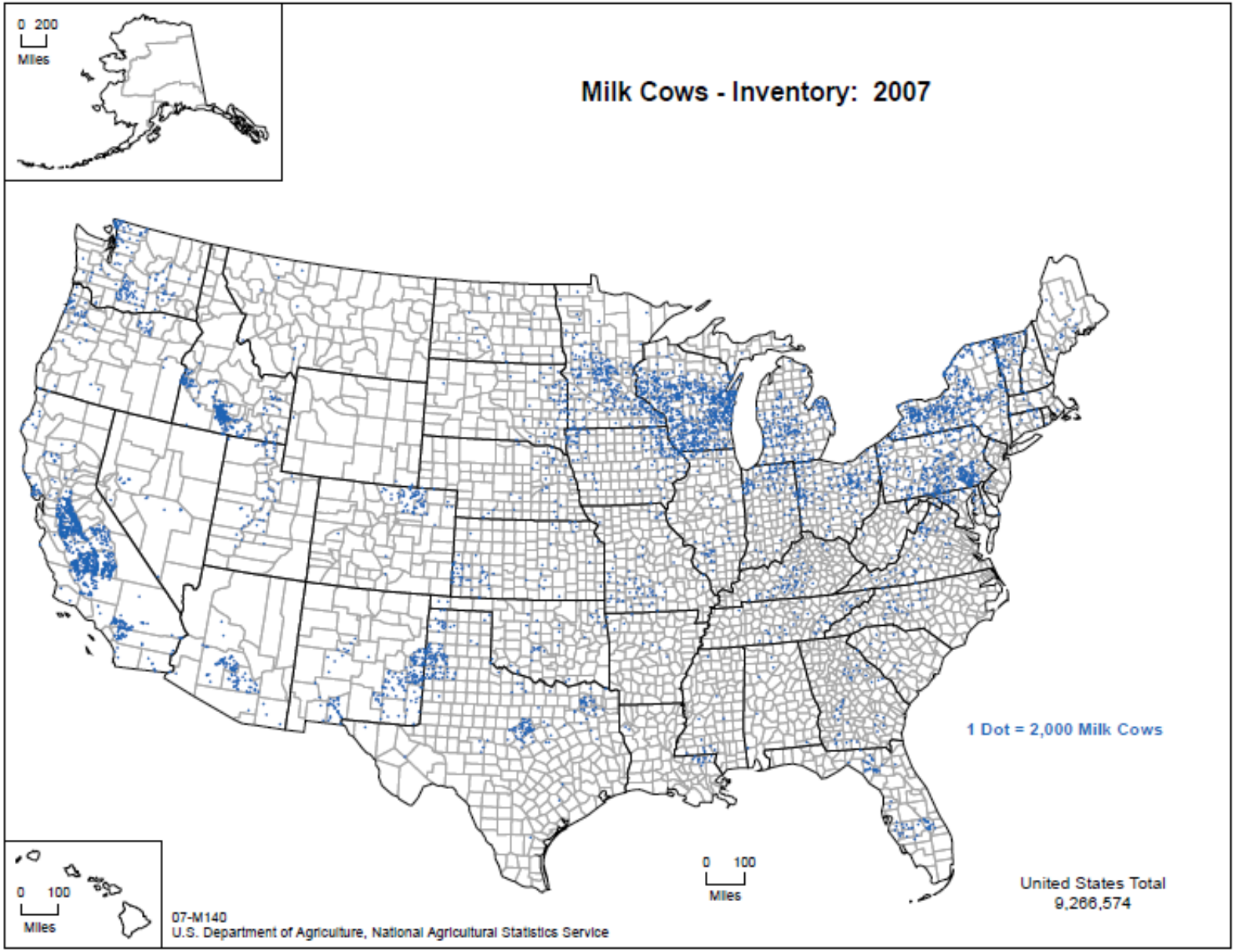
Datasets

- Supply and sales of cattle
  - USDA NASS
- Slaughter
  - USDA NASS, USDA APHIS, CBP, publicly-available data from firms
- Imports/Exports/Storage
  - USDA ERS
- Demand
  - USDA ERS, American Meat Institute

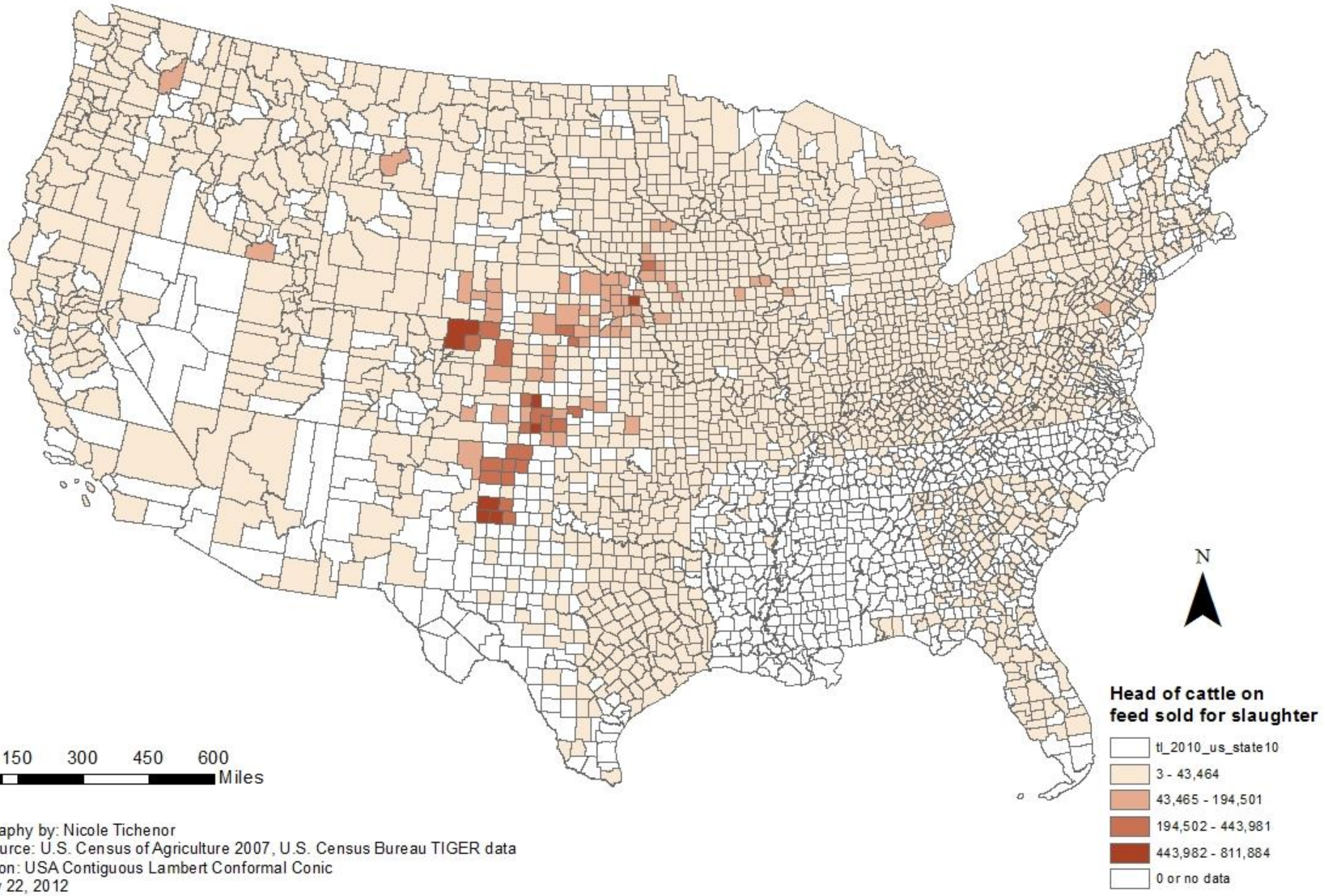
Starter Model




Beef Cows - Inventory: 2007
0 200
Miles
1 Dot = 2,500 Beef Cows
0 100
Miles
United States Total
32,834,801
0 100
Miles
07-M145
U.S. Department of Agriculture, National Agricultural Statistics Service
2007 Census of Agriculture

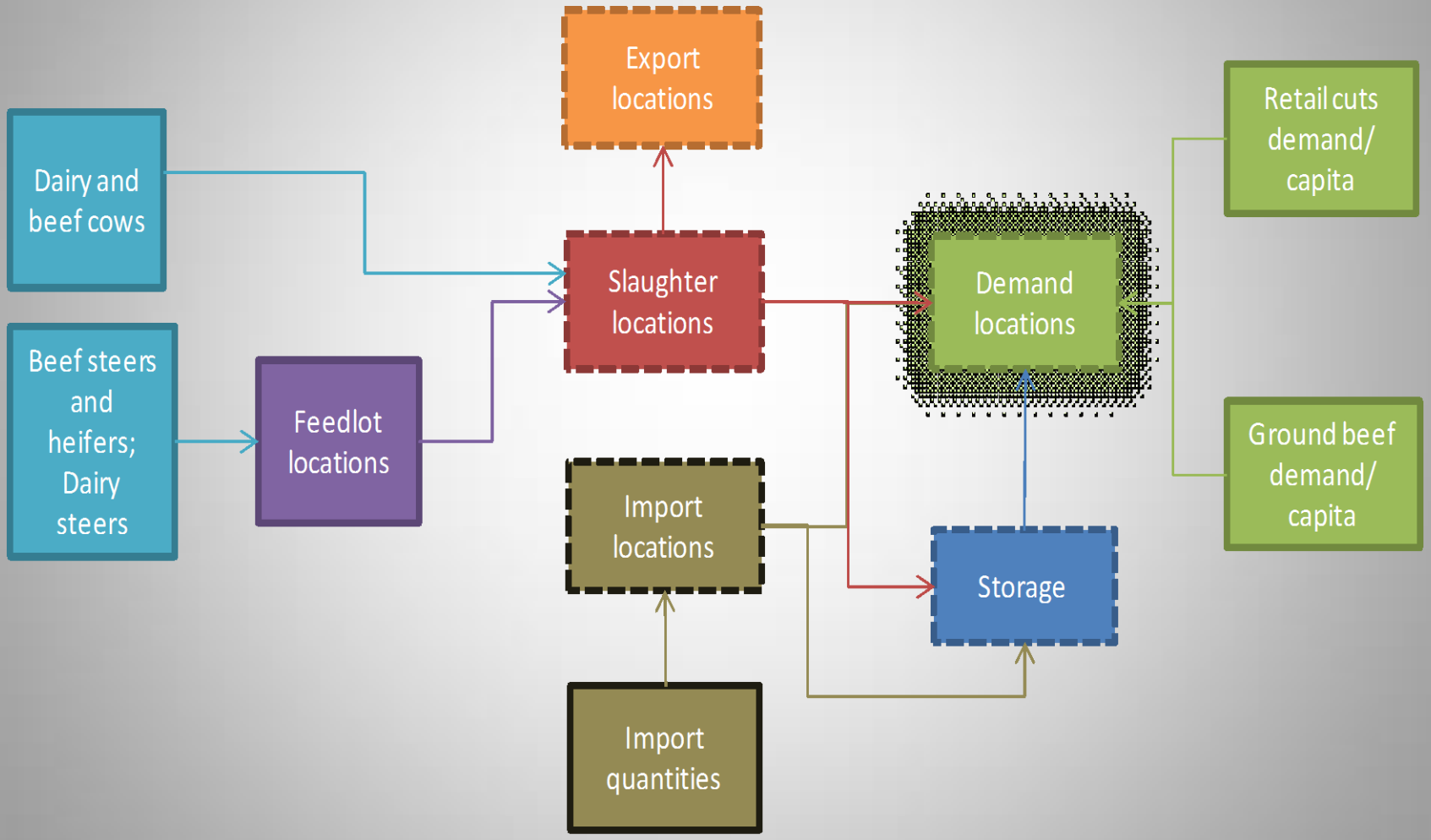

Milk Cows - Inventory: 2007
0 200
Miles
1 Dot = 2,000 Milk Cows
0 100
Miles
United States Total
9,266,574
0 100
Miles
07-M140
U.S. Department of Agriculture, National Agricultural Statistics Service
2007 Census of Agriculture

Sales of Cattle on Feed for Slaughter by U.S. County, 2007

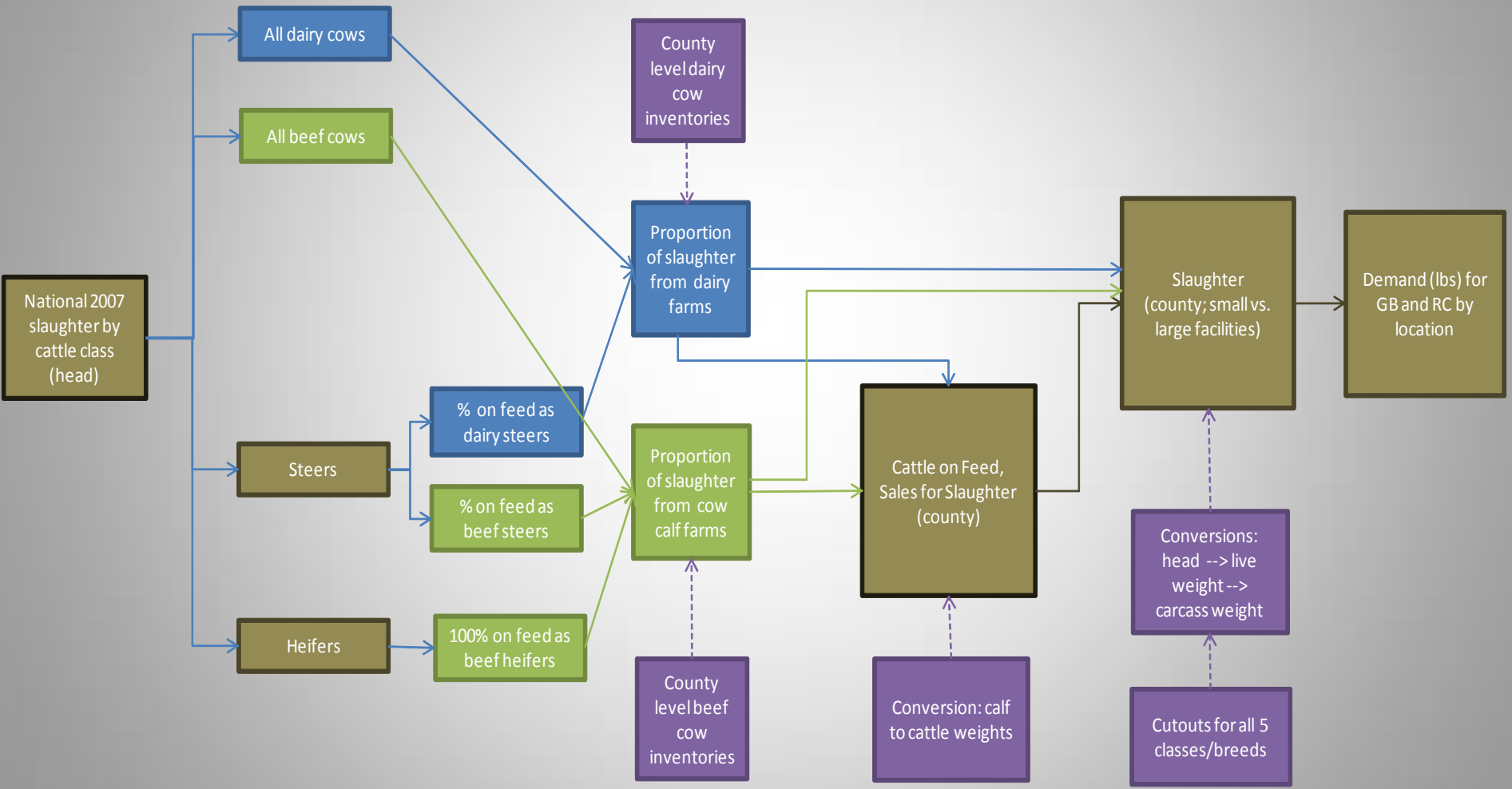


Cartography by: Nicole Tichenor
Data source: U.S. Census of Agriculture 2007, U.S. Census Bureau TIGER data
Projection: USA Contiguous Lambert Conformal Conic
January 22, 2012

Expanded Model



Data Flow



Notes: Bulls omitted. All fed heifers are beef heifers.

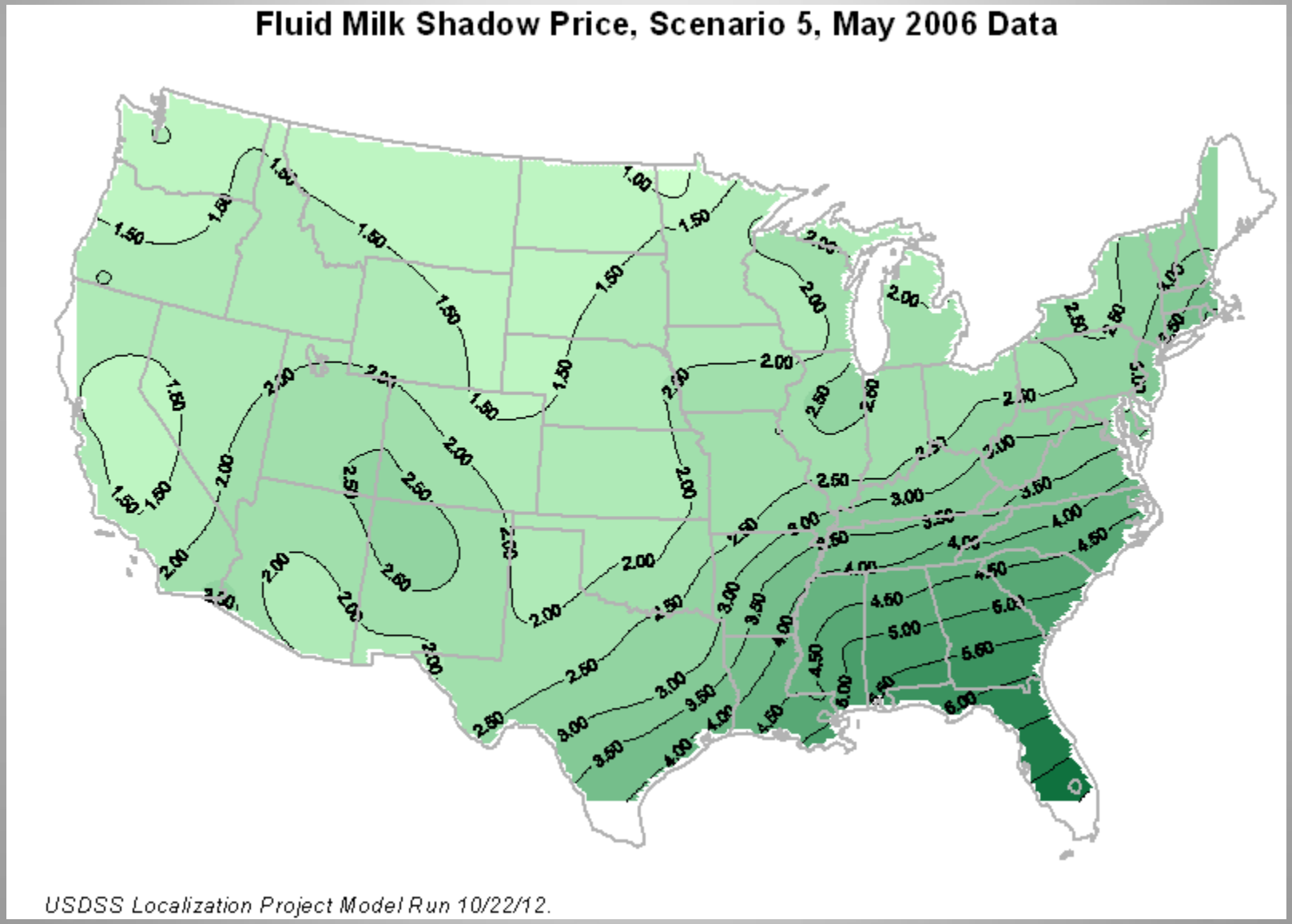
Supply Nodes

Nicholson et al. 2010

Demand Nodes

Nicholson et al. 2010

Example Output



Scenario Analysis

- Increasing supply from dairy operations
  - Greek yogurt
  - Climate change
- Changing seasonality of calving
- Slaughter vs. fuel efficiency
- Expanding capacity of slaughter and processing in the Northeast

Building a model from scratch

- How would you start?
- Defined demand by population centers
  - Per capita beef consumption * county level population
- Supply
  - No origins for slaughtered cattle
  - Calculate county proportions from inventory data and assign national slaughter by cattle class to county

Building a model from scratch

- How do you convert head to lbs?
- Head → live weight at slaughter→ carcass weight → retail cuts + GB + inedible
  - For 5 breeds/classes…

Other Challenges

- Integrating supply from dairy
- Culling vs. feeding
- Multi-product supply chain
- Slaughter and economies of scale
- Transport costs
- Balancing
- Seasonality
- Production cycles

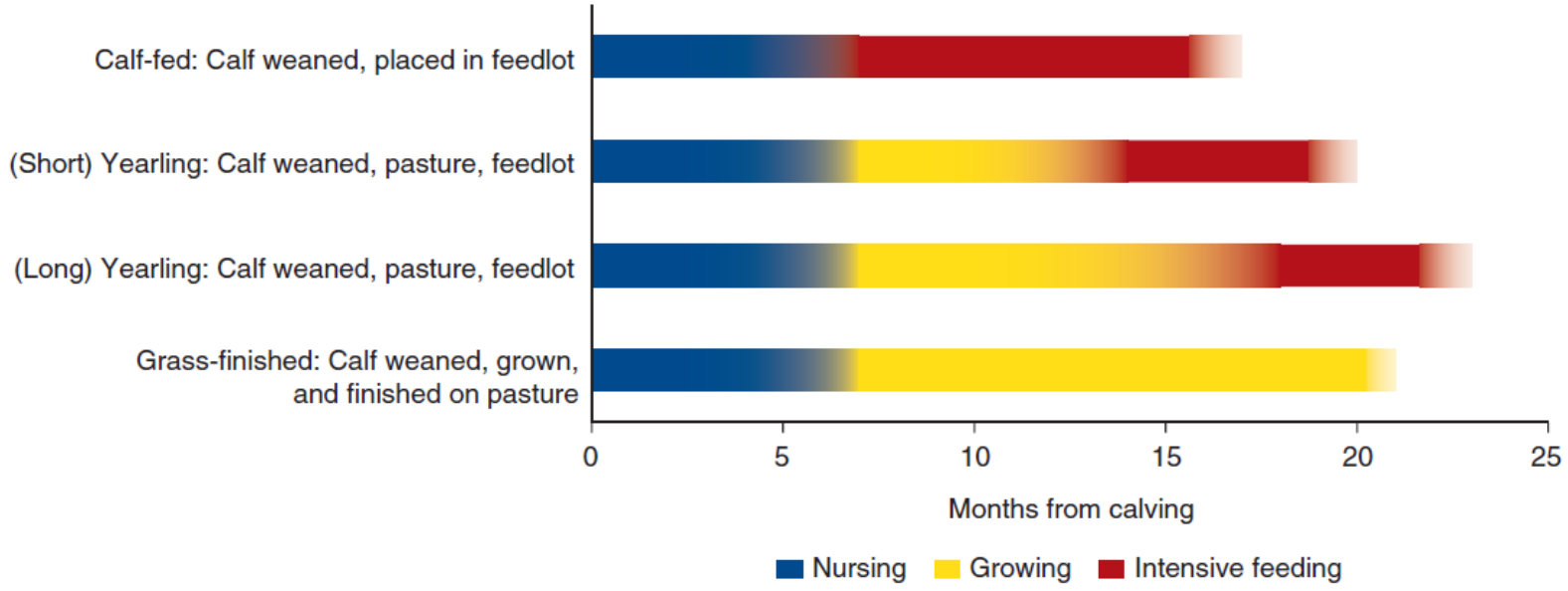
Going Forward

- Finishing expanded model
- Adding precision
  - Consumption, costs, slaughter capacity
- Drafting baseline manuscript
- Conducting scenario analyses

Questions?

Figure 1

Production-cycle timelines for grass-finished versus conventional grain-fed beef production[1]



Source: USDA, Economic Research Service.

Source: Mathews and Johnson, 2013.