# Capacity for meeting food needs with local and regional production: Tales from the Northeast United States

John Glenn Colloquium
Ohio State University, Columbus
October 10, 2013

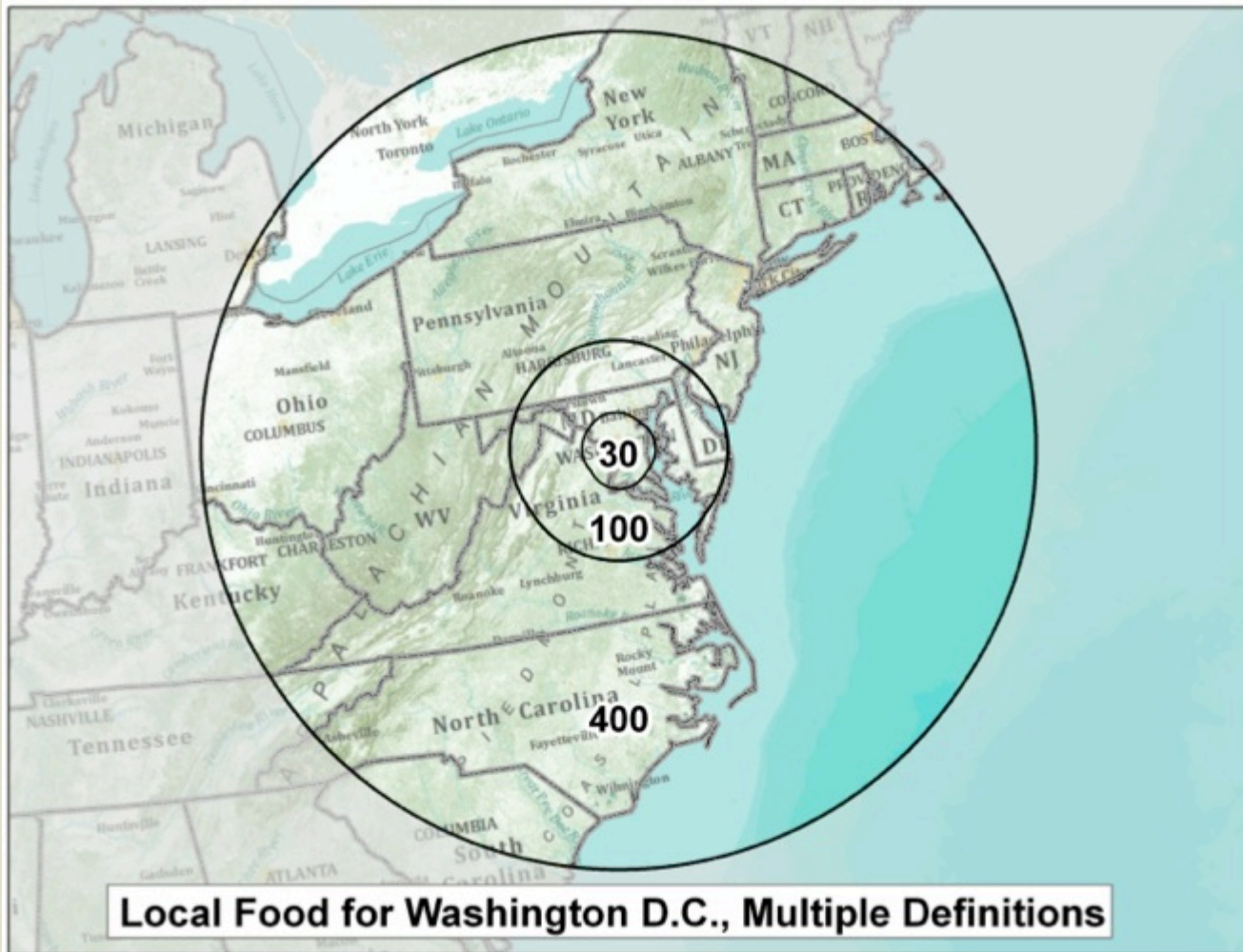**Dr. Christian Peters**, Assistant Professor, Tufts University

# Agenda

- Context on local and regional food
- Three stories
  - Land requirements of diet
  - Mapping foodsheds
  - Net balance studies
- Closing remarks

# What is local food?



Local Food for Washington D.C., Multiple Definitions

Figure by C.J. Peters

"There is no legal or universally accepted definition of local food."

- Martinez et al. (2010, p.3)

# Models of local food production

- Farm to consumer
  - Farmers' markets
  - Community Supported Agriculture (CSA)
  - Farm stands
  - Pick your own
- Farm to business or institution
  - Restaurants
  - Retail stores
  - Schools

Martinez et al. (2010)

# What is a regional food system?

**Local v. Regional**:

- Volume of food

- Management of natural resources

- Economic efficiency

- Diversity

(Clancy and Ruhf, 2010)
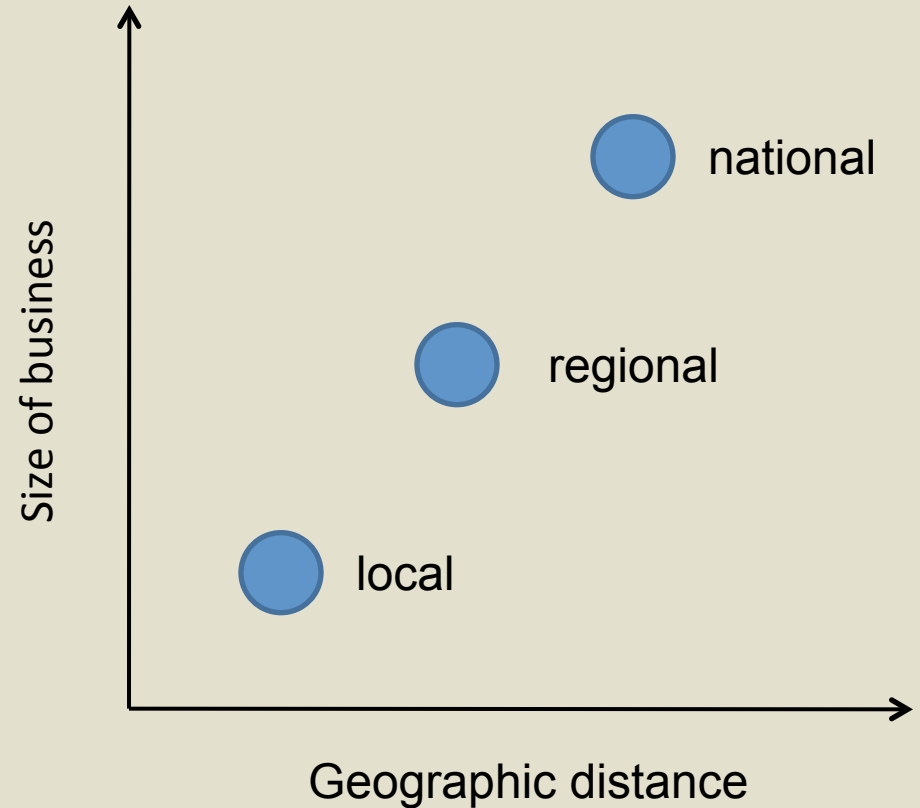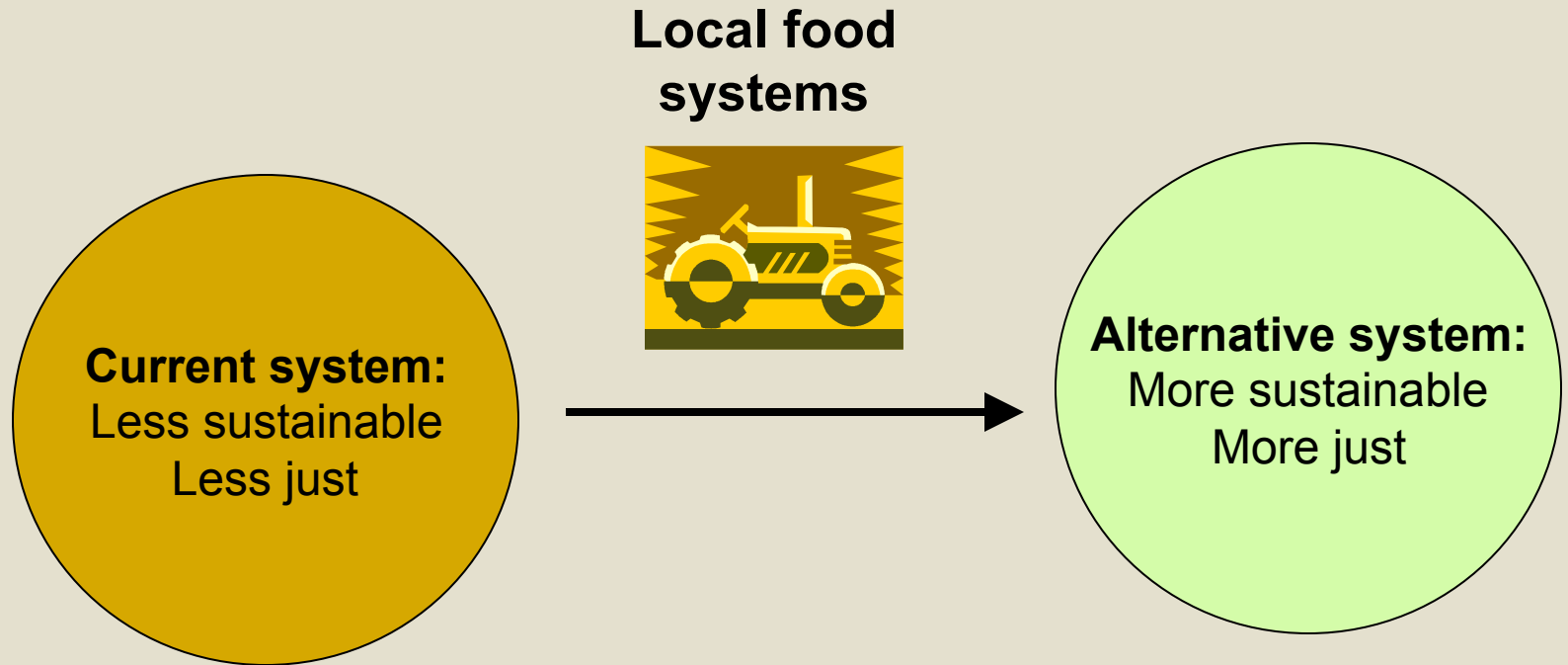
# Why does local food matter?

The Claims

- Fresher
- More nutritious
- Tastier
- Safer
- Keeps farmers farming
- Supports local economy
- Less energy use
- Lower emissions
- Connection to food



Photo by Keith Weller (from USDA-ARS Photo Library:
http://www.ars.usda.gov/is/graphics/photos/k3839-3.htm)

# Avoiding the local trap

**Local food systems**



**Current system:**
Less sustainable
Less just

**Alternative system:**
More sustainable
More just

To what degree can localizing the food supply serve as a vehicle for achieving these goals?*

Born and Purcell (2006)

# The big questions

1. What is the place of local and regional production in the U.S. food system?

2. What capacity does a location have for producing local and regional food?

# Foodshed analysis

# Funding streams

2000-2004

Department of Crop and Soil Sciences, Cornell Univesity; Hatch funding from the Cornell University Agriculture Experiment Station
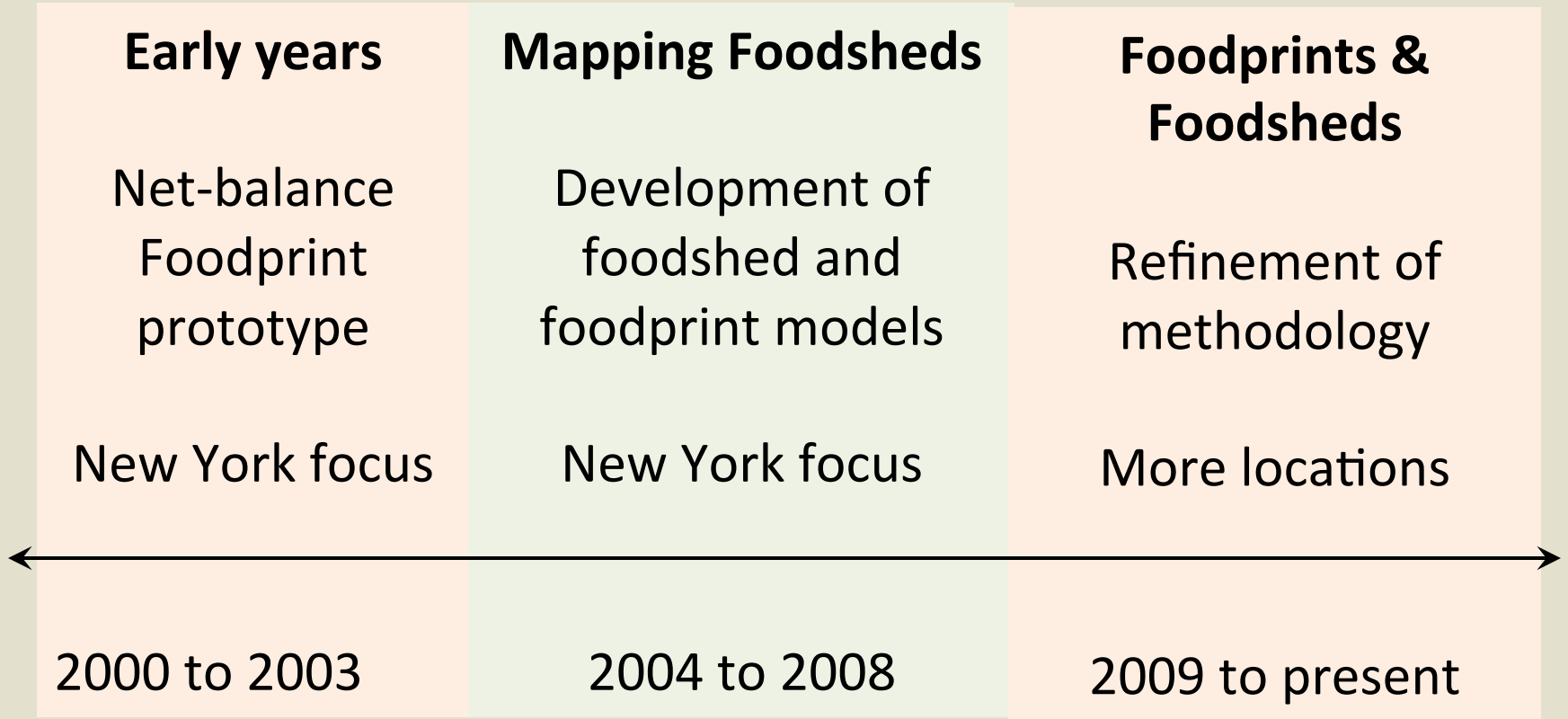
2005-2008

"Mapping Local Food Systems in New York State" USDA National Research Initiative, grant number 2005-55618-15640

2009-present

"Foodprints and Foodsheds: Tools for Evaluating the Sustainability of Dietary Patterns and the Geography of the Food System"W.K. Kellogg Foundation Grant No. P3008987

# Timeline

| Early years | Mapping Foodsheds | Foodprints & Foodsheds |
|:---:|:---:|:---:|
| Net-balance Foodprint prototype | Development of foodshed and foodprint models | Refinement of methodology |
| New York focus | New York focus | More locations |
| 2000 to 2003 | 2004 to 2008 | 2009 to present |

# PROLOGUE
## Threat of nationwide railroad strike

**July 1, 1921:**

U.S. Labor Board authorizes 12.5 percent wage cut

**October 15, 1921:**

"Big Four" unions authorize strike to begin on October 30

**October 27, 1921:**

Settlement reached at 11:30PM and strike orders were canceled



PEACE VOTE UNCONDITIONAL

"Big Four" Unions and the Switchmen Act After Critical Day.

RESOLUTION REVOKES ORDER

Committee in Four Hours Drafts Agreement Terms, but They Are Not Made Public.

SOURCE: Anonymous. 1921. Peace vote unconditional: "Big Four" unions and the Switchmen act after critical day. The New York Times. 28 October, p.1.

# Study of New York City food supply

**Hedden**, Walter.1929. *How Great Cities Are Fed.* D.C. Heath and Company, New York, NY.

Chapter titles include:

"The revolutionary activities of the refrigerator car"

"The geography of food terminals and food industries"

"Who are the Middlemen?"

"An apple a day costs a lot on the way"
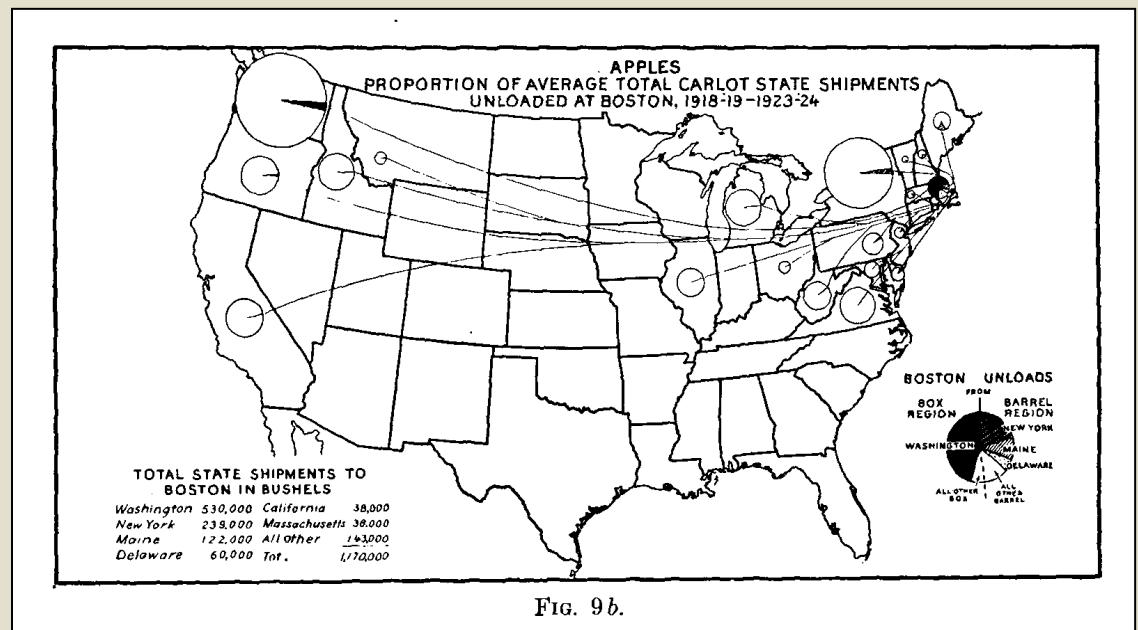
"Watersheds, milksheds, and foodsheds"

# FOODSHED
## Concept and its origins

**FOODSHED**: The geographic area which supplies a population with food

A rough history...

1. *How Great Cities Are Fed*

2. "Coming in to the foodshed"

3. Foodshed analyses



APPLES
PROPORTION OF AVERAGE TOTAL CARLOT STATE SHIPMENTS
UNLOADED AT BOSTON, 1918-19 - 1923-24

BOSTON UNLOADS

BOX REGION | BARREL REGION
NEW YORK
WASHINGTON | MAINE
DELAWARE
ALL OTHER BOX | ALL OTHER BARREL

TOTAL STATE SHIPMENTS TO
BOSTON IN BUSHELS

| | | | |
|---|---|---|---|
| Washington | 530,000 | California | 38,000 |
| New York | 239,000 | Massachusetts | 38,000 |
| Maine | 122,000 | All Other | 143,000 |
| Delaware | 60,000 | Tot. | 1,170,000 |

FIG. 9 b.

[1]Hedden (1929), [2]Kloppenburg et al. (1996), [3]Thompson et al. (2008), [3]Peters et al. (2009), [3]DVRPC (2010)

# The basic methodology



Peters et al. (2009)
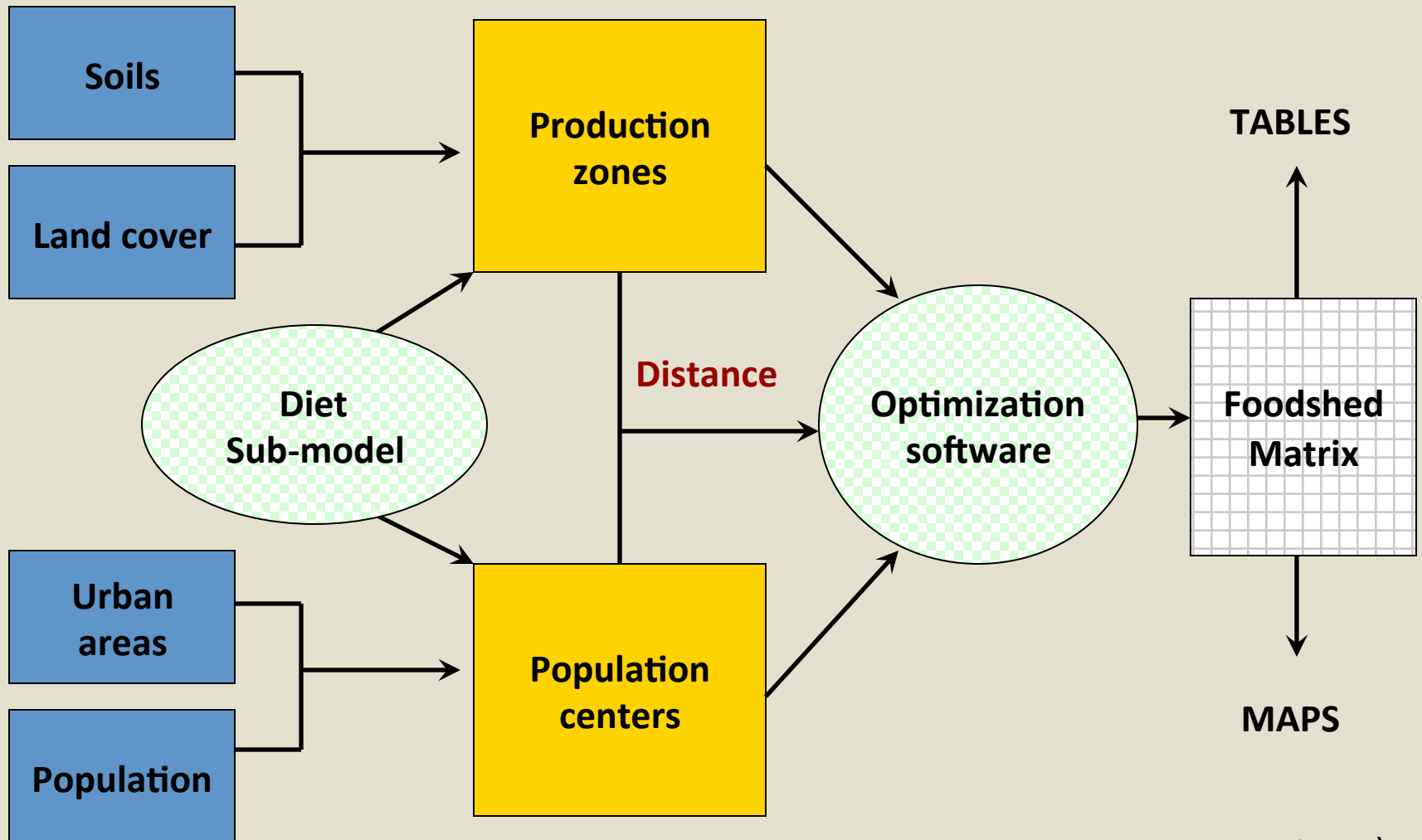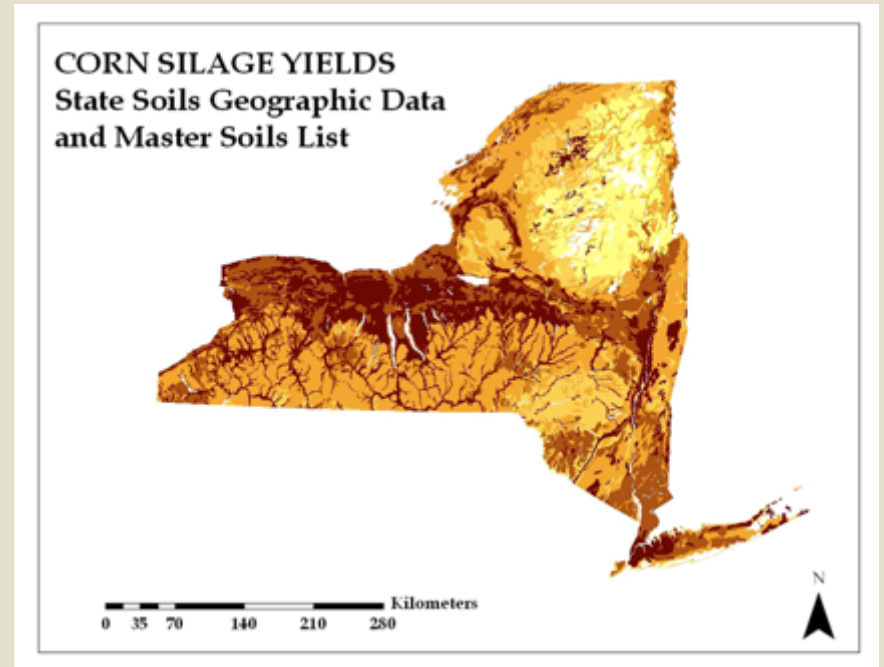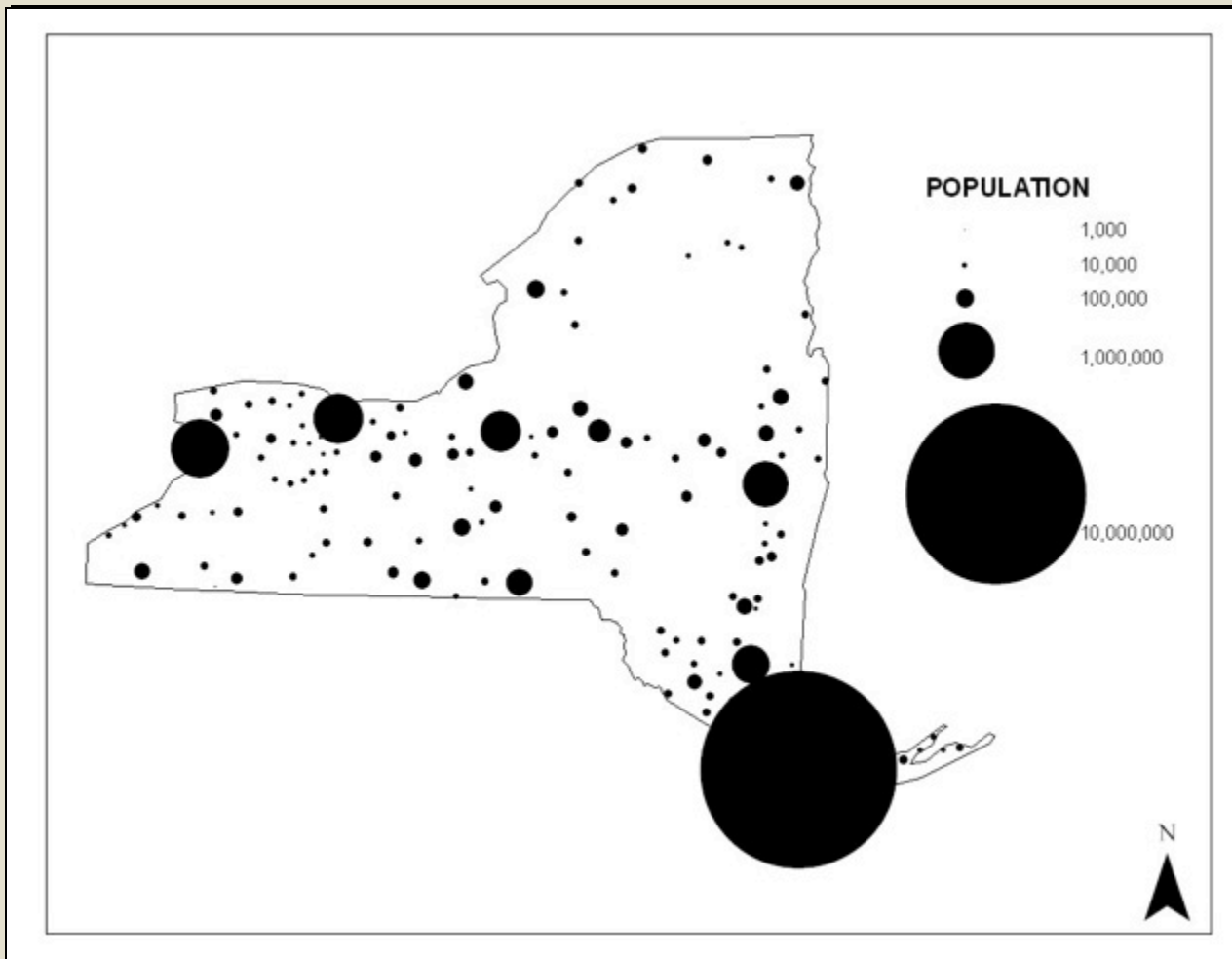
# Characterizing land productivity
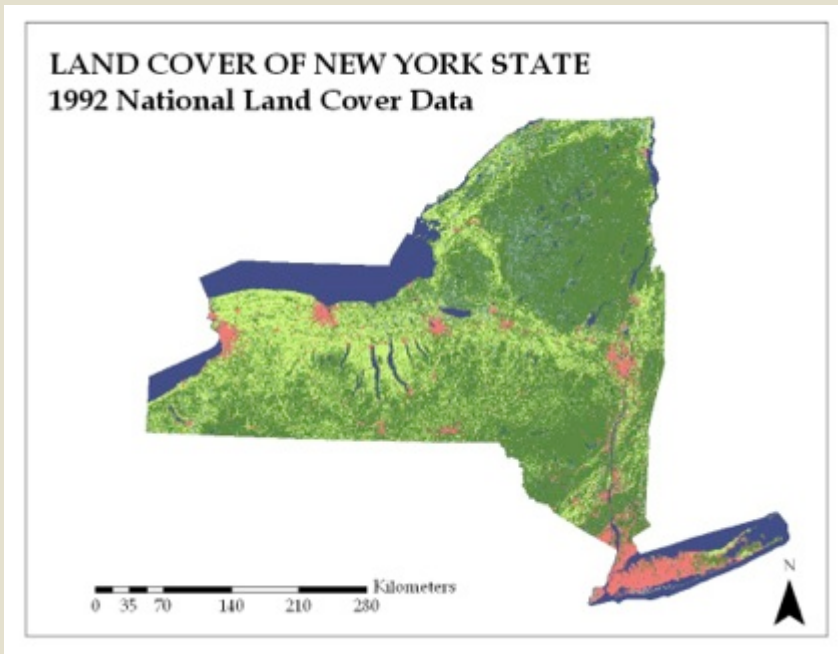


Area of agricultural land



Relative productivity

# Spatial distribution of food needs



**Population** concentrated in the NYC metropolitan area

SOURCE: Population map from Peters et al. (2009)

# Foodshed Optimization: Minimum food miles

**GOAL:** Minimize distance food travels **(DFT)**

$$\textbf{DFT} = \Sigma \, (\textbf{F}_{ij} \times \textbf{D}_{ij})$$

**F** = Q of food shipped from **(i)** to **(j)**

**D** = distance between **(i)** and **(j)**

**CONSTRAINTS:**

1) Consumption ≤ food requirement

2) Cultivated production = potential capacity

3) Perennial production = potential capacity

# Capacity to meet food needs, model 1

| Population center(s) | Food allocated HNE$_t$ | | Food distance HNE$_t$ | |
|---|---|---|---|---|
| | *Tg* | *% of need* | *Tg-km* | *km* |
| NYC | 0.33 | 2.2 | 88 | 264 |
| Urbanized areas | 4.58 | 83.7 | 233 | 51 |
| Urban clusters | 3.22 | 98.4 | 81 | 25 |
| TOTALS | 8.13 | 34.4 | 402 | 49 |

**HNE$_t$** = Human nutritional equivalents (total)

**Tg** = teragrams (or million metric tons)

Peters et al. (2009)

# Potential local foodsheds
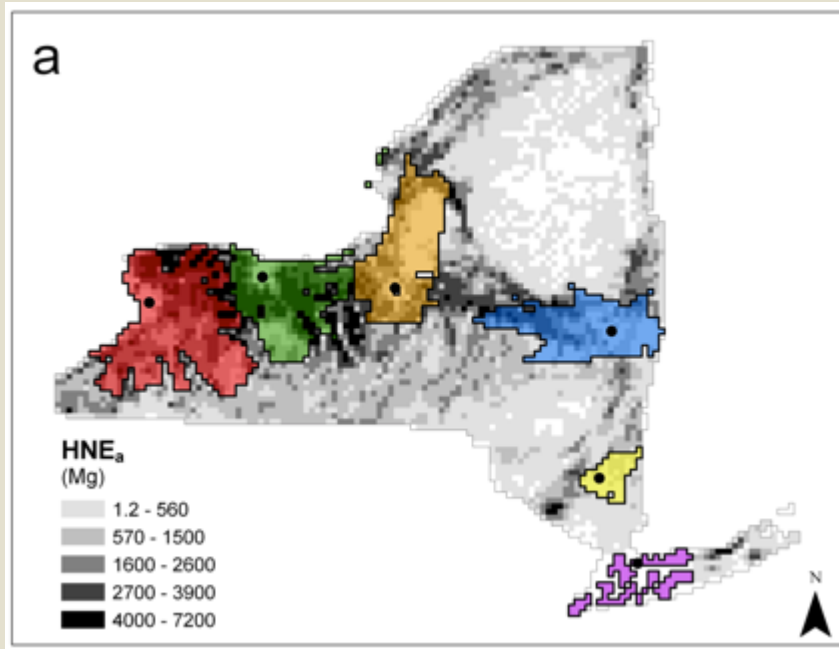


**Annual crops and fruits**
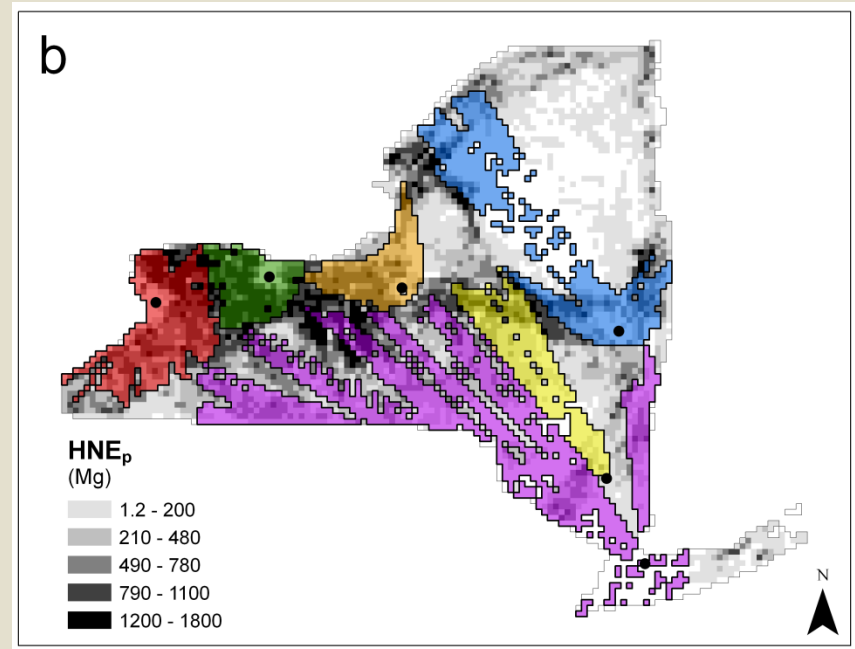
**Perennial forages**

Peters et al. (2009)

# Foodshed optimization: Maximum returns to land

**GOAL:** Maximize total land use value **(LUV)**

$$\textbf{LUV}_{\textbf{total}} = \Sigma \, (\textbf{A}_{\textbf{ij}} \times \textbf{LUV}_{\textbf{ij}})$$
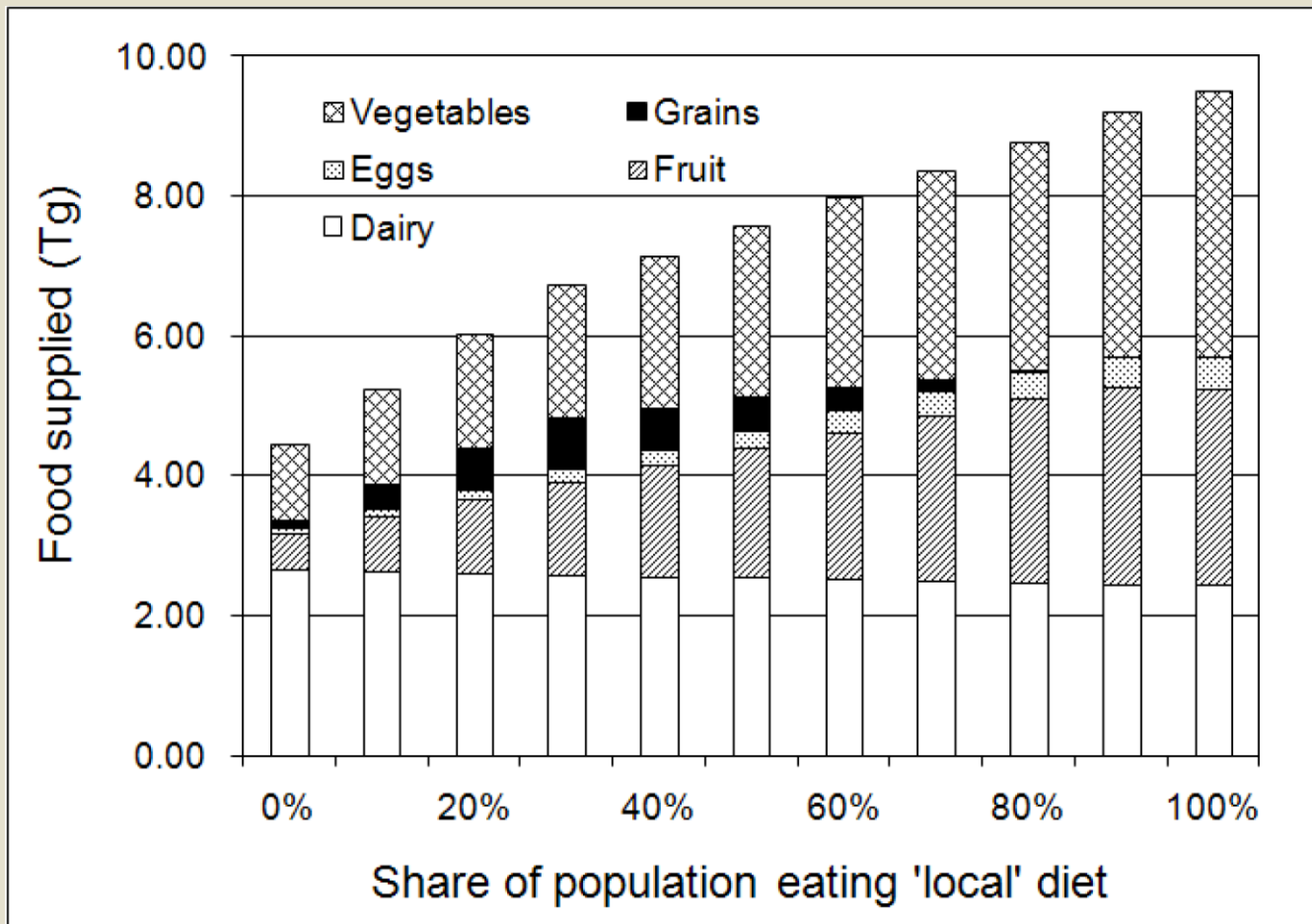
**A** = Q of food shipped from **(i)** to **(j)**

**LUV** = distance between **(i)** and **(j)**

**CONSTRAINTS:**

1) Consumption ≤ food requirement

2) Area in annuals ≤ area available for annuals

3) Area in perennials ≤ area limited to perennials

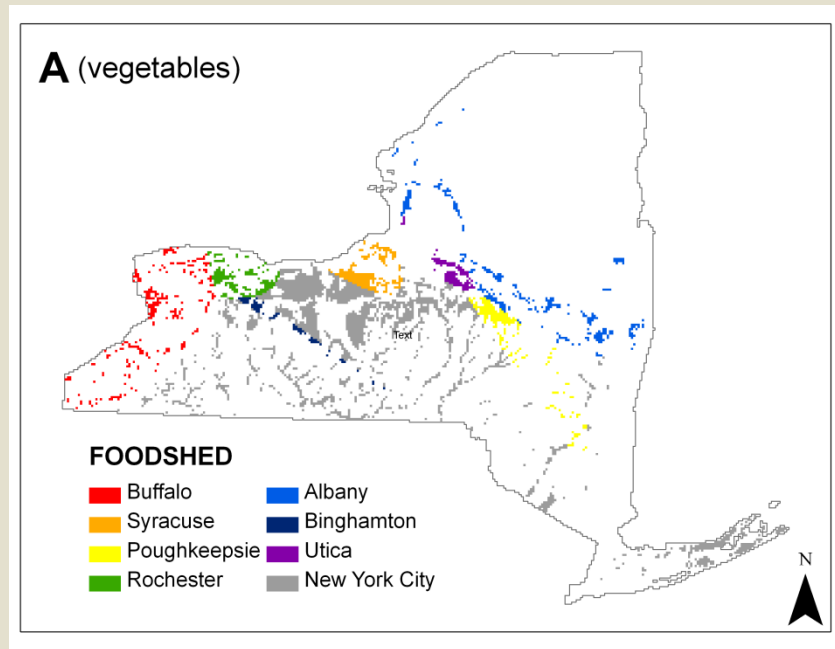# Prioritizing what is produced locally



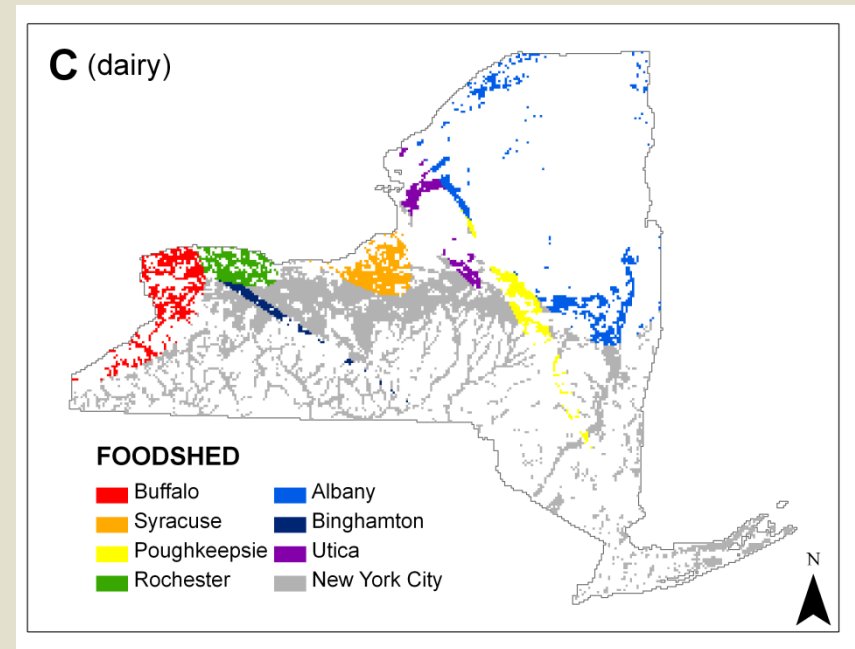Could meet up to **69%** of food requirements

Total NYS requirements = **13.8 Tg**

Peters et al. (2011)

# Potential foodsheds by food group



Vegetables only

Dairy only

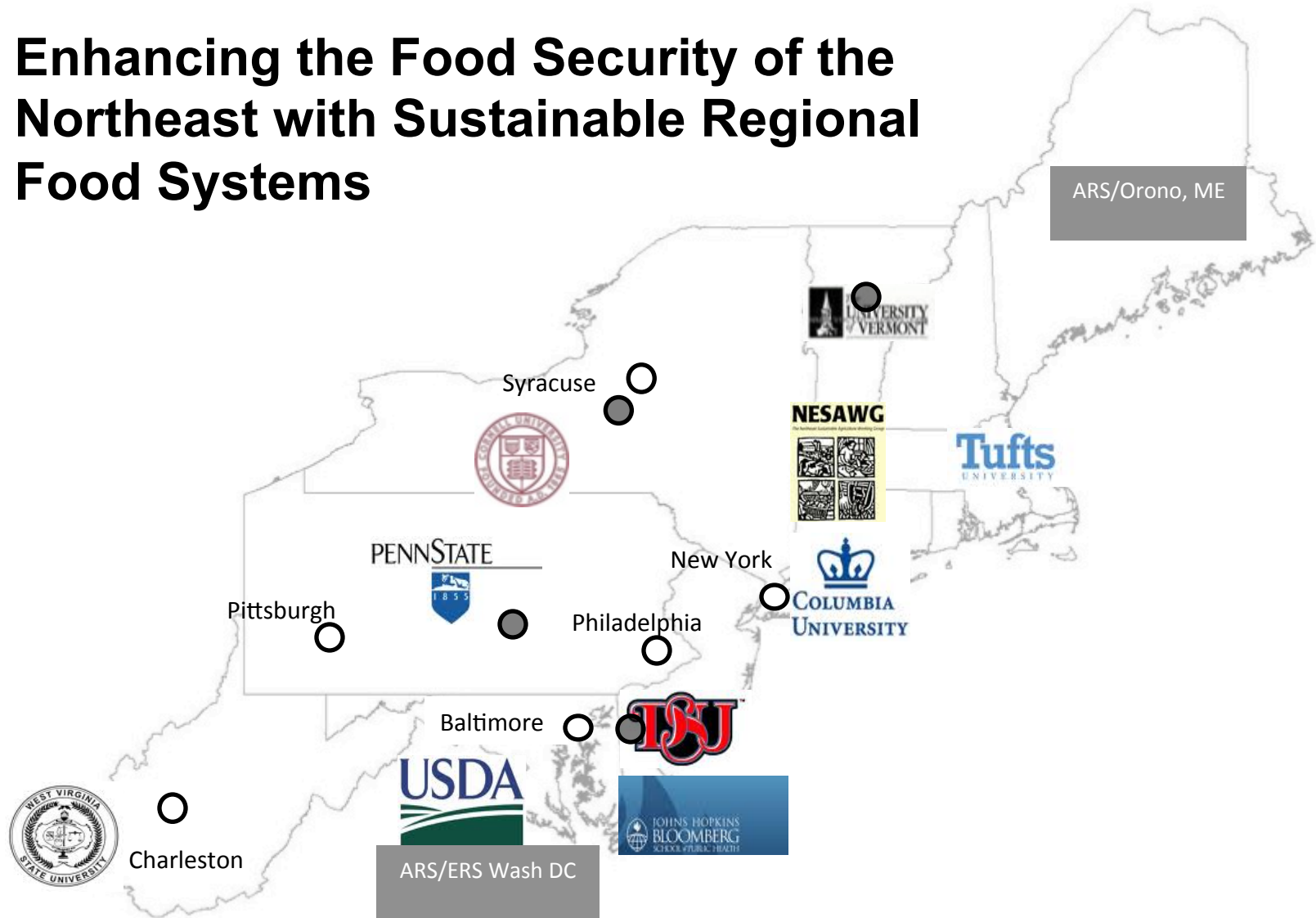Peters et al. (2012)

# Summary of foodshed analyses

- Not all food can be local
- Some cities better positioned than others
- Optimizing for returns to land favors different foods rather than different locations
- Potential "localness" influenced by location and population size

*What should be grown locally? Regionally? What role do these systems play in the larger food system?

# Northeast Baseline

# Enhancing the Food Security of the Northeast with Sustainable Regional Food Systems

ARS/Orono, ME

UNIVERSITY of VERMONT

Syracuse

NESAWG

Tufts UNIVERSITY

PENNSTATE

New York

COLUMBIA UNIVERSITY

Pittsburgh

Philadelphia

Baltimore

ISU

USDA

West Virginia State University

JOHNS HOPKINS BLOOMBERG School of Public Health

Charleston

ARS/ERS Wash DC

NE RCRD

# Systems Approach to Food

Distribution

Consumption
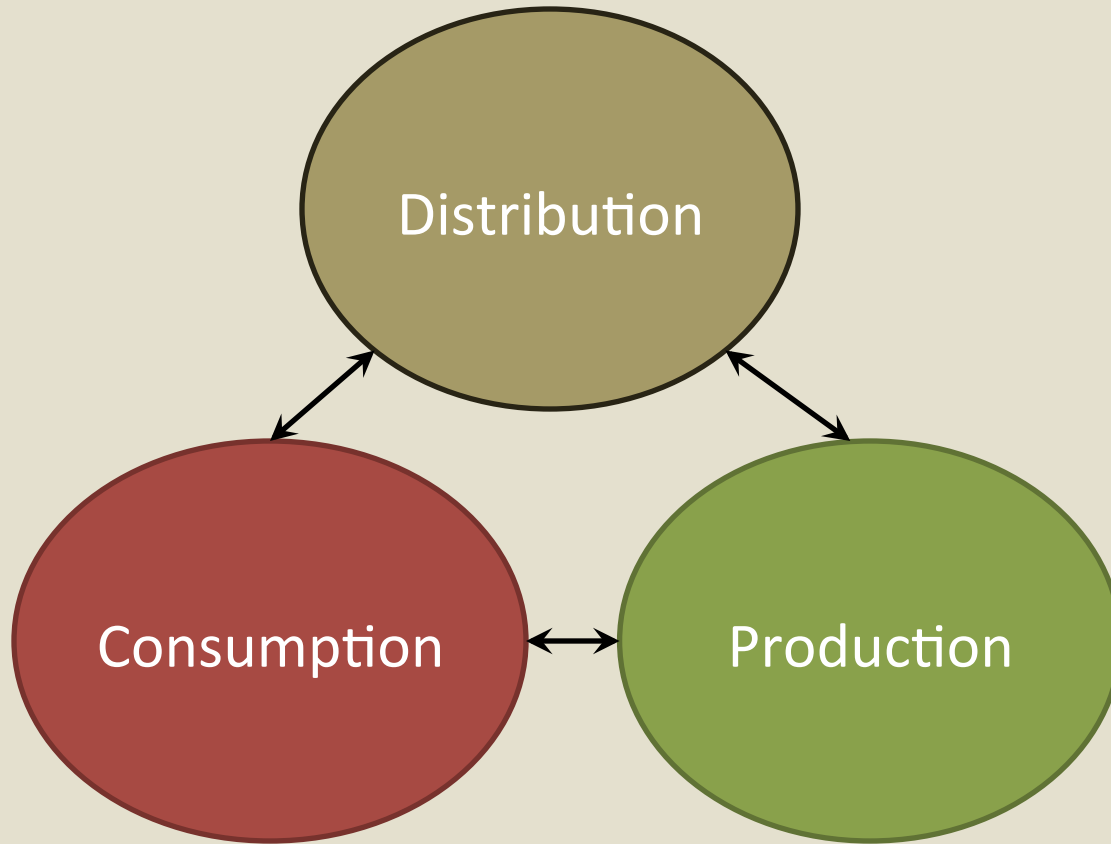
Production

**Actual supply chains**
(9 study sites)

**Modeling**
(throughout region)

**Integrated project**
(Outreach & Education)

# Net balance approach

$$\frac{\text{Production}}{\text{Consumption}} = \text{Self-sufficiency ratio}$$

Examples:

Messing et al. (1981)

Herrin and Gussow (1989)

Cowell and Parkinson (2003)

# The basic methodology

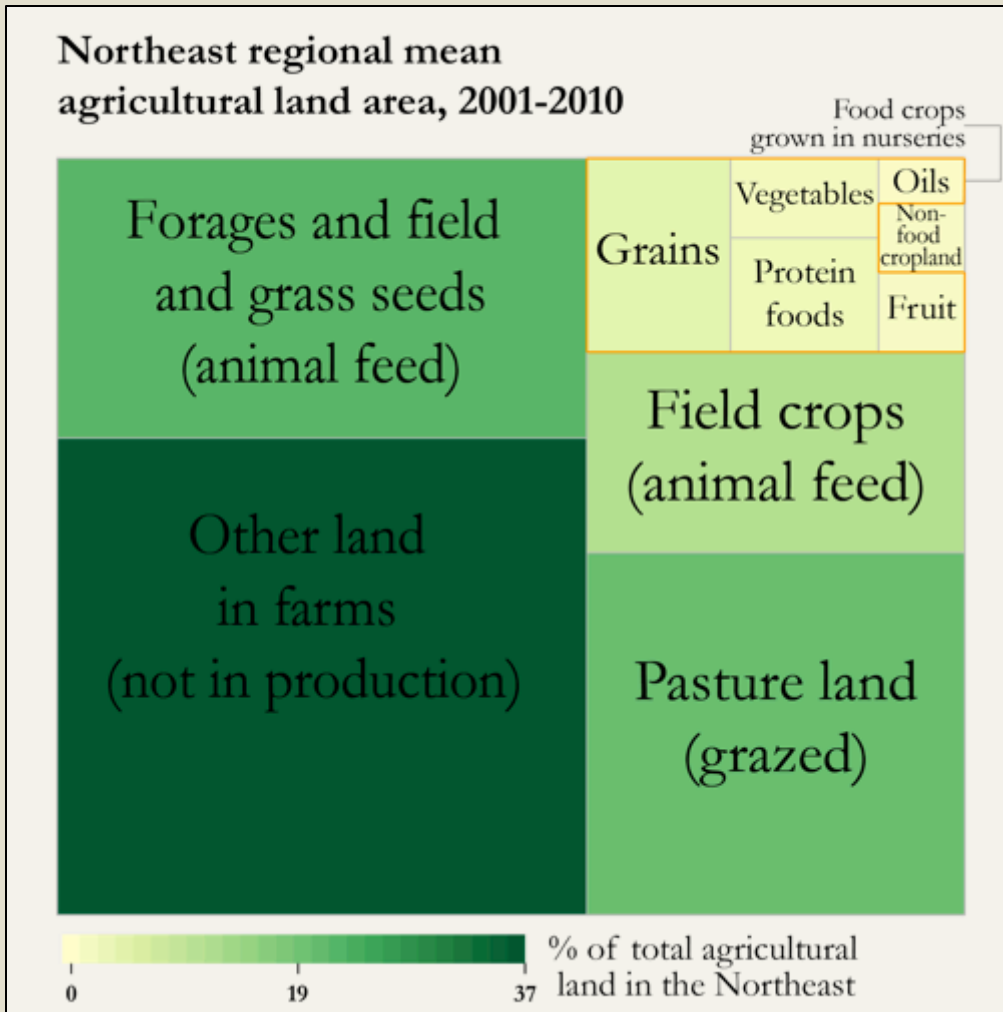**Production** = Area × Yield

No. of animals × output

Seafood landings

**Consumption** = Food availability × population

Food availability × conversion to farm weight × population

# What does the Northeast grow?



Northeast regional mean agricultural land area, 2001-2010

- Forages and field and grass seeds (animal feed)
- Other land in farms (not in production)
- Food crops grown in nurseries
- Grains
- Vegetables
- Oils
- Protein foods
- Non-food cropland
- Fruit
- Field crops (animal feed)
- Pasture land (grazed)

% of total agricultural land in the Northeast

0 — 19 — 37

**Land in farms:**
24 million acres

**Northeast region:**
CT, DE, MA, ME, MD, NH, NJ, NY, PA, RI, VT, and WV

Derived from Griffin et al., in review.

# Self-reliance in plant foods

**Northeast regional self-reliance, 2001-2009**

| Self-reliance category | Mean regional production ($10^6$ kg) | Mean regional consumption ($10^6$ kg) | Mean regional self-reliance (%) |
|---|---|---|---|
| Fruit | 1,389 | 7,622 | 18 |
| Vegetables | 2,953 | 11,387 | 26 |
| Grains | 1,150 | 14,627 | 7.9 |
| Pulses | 15 | 212 | 7.2 |
| Oils | 1,396 | 14,398 | 9.7 |
| Sweeteners | 290 | 3,752 | 7.7 |
| **Total** | **7,193** | **47,199** | **15** |

Derived from Griffin et al., in review.

# Self-reliance in animal products

**Northeast regional self-reliance, 2001-2009**

| Self-reliance category | Mean regional production ($10^6$ kg live weight) | Mean regional consumption ($10^6$ kg live weight) | Mean regional self-reliance (%) |
|---|---|---|---|
| Dairy[b] | 13,043 | 17,297 | 75 |
| Eggs[c] | 692 | 954 | 72 |
| Shellfish | 169 | 375 | 45 |
| Chicken | 1,549 | 3,869 | 40 |
| Turkey | 187 | 626 | 30 |
| Fish | 224 | 997 | 22 |
| Lamb | 12 | 68 | 17 |
| Beef | 696 | 4,437 | 16 |
| Pork | 390 | 2,565 | 15 |

Derived from Griffin et al., in review.

# Lessons from the net-balance study

**Conclusions**

- Animal agriculture dominates land base
- Wide range in self-reliance ratios
- Net food importer

**Caveats**

- Seasonality of production
- Effect of aggregation
- Livestock feed not necessarily regional

Closing comments

# Placing the work in context

**Midwest relative to Northeast:**

- Climate is similar

- Population density is lower

- Area in agriculture is much greater

- Expect greater biological capacity to meet food needs

# Directions for future work

- Foodprints and Foodsheds Project:
  - Complete models for states of interest
  - Complete models for conterminous U.S.
  - Dissemination through papers
- Enhancing Food Security of the Northeast:
  - Foodprint of Northeast
  - Interdisciplinary team of modelers