### Water and Land-use: Considerations for Feasibility of Value Chains and the Food System

Innovations in the Food System: Shaping the Future of Food National Academy of Sciences, Washington, D.C. August 8, 2019



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# **Opening remarks**

- Key natural resources
- Often held in private hands
- Essential to the public good
- Feasibility and sustainability of supply chains
- Transdisciplinary science

Land use change Development of irrigation Striving for efficiency Challenges of sustainability CONTEXT

## Time series of land use change

### THE MAPS

Depict agricultural land use

Created from Census of Agriculture data

Cover from **1860 to 1997**.

"Improved farmland" is analogous to total cropland

### LEGEND

Proportion of county in "improved farmland"



Waisanen, PJ and Bliss, NB. 2002. Changes in population and agricultural land in conterminous United States counties, 1790 to 1997. Global Biogeochemical Cycles 16(4): 1137-1155.













## Total factor productivity



Source: USDA, Economic Research Service productivity accounts.

Wang et al. 2015. Agricultural Productivity Growth in the United States: Measurement, Trends, and Drivers [ERR-189]. USDA Economic Research Service.

## Time series of irrigation in U.S.



Unpublished chart created by the presenter.



Fernandez-Cornejo, J. 2004. The Seed Industry in U.S. Agriculture: An Exploration of Data and Information on Crop Seed Markets, Regulation, Industry Structure, and Research and Development. USDA Economic Research Service, Agricultural Information Bulletin No. 786.

## Expanding range of concerns



Agricultural paradigms from Welch and Graham (1999)

Transdisciplinary study of food systems

## THE INNOVATION

## **Transdisciplinary Science**



Multidisciplinary

Interdisciplinary

#### Transdisciplinary

From **Kajigawa**, Y. 2008. Research core and framework of sustainability science. *Sustainability Science* 3: 215-239.

## Integration and participation



Fig. 1 from **Mauser**, W., Klepper, G., Rice, M., Schmalzbauer, B.S., Hackman, H., Leemans, R., and Moore, H. 2013. Transdisciplinary global change research: the co-creation of knowledge for sustainability. *Current Opinion in Environmental Sustainability* 5: 420-431.

Eastern Broccoli Project

## A CASE STUDY

# Eastern Broccoli Project

#### WHO

Collaborative team of research institutions and industry partners led by Cornell University

Specialty Crop Research Initiative funded

### GOAL

"Our vision is to create a regional food network for an increasingly important and nutritious vegetable that may serve as a model network for other specialty crops."



Goals: <u>https://blogs.cornell.edu/easternbroccoliproject/main/goals/</u> Map: <u>https://blogs.cornell.edu/easternbroccoliproject/main/regional-trials/</u>

### Broccoli as a case study

Share of U.S. Broccoli Acreage, 2010

Season	Eastern U.S.	Western U.S.
Spring	5%	95%
Summer	11%	89%
Fall	11%	89%
Winter	2%	98%



Eastern broccoli acreage by state, 2010

Table and figure created using data from Atallah, S.S. *et al.* 2014. Localization effects for a fresh vegetable product supply chain: Broccoli in the eastern United States. *Food Policy* 49: 151-159.

#### Cost of increased localization in fresh broccoli supply chain for Eastern U.S.

Scenario	Production costs	Transport costs	Total costs
		(\$ million year <sup>-1</sup> )	
Baseline	1,005	215	1,220
15% increase in acreage	1,007	210	1,216
30% increase in acreage	1,008	205	1,213
100% increase in acreage	1,011	186	1,197

#### Supply chain model

Includes eastern U.S., western U.S., and international producers Demand represented for major metropolitan areas

<u>Bottom line:</u> "Localization through reallocation of production may take place at no cost to the consumer"

Data from Atallah, S.S. *et al.* 2014. Localization effects for a fresh vegetable product supply chain: Broccoli in the eastern United States. *Food Policy* 49: 151-159.

# Steps involved

- Breed suitable varieties
- Test varieties across the region
- Produce sufficient seed for commercial varieties
- Revise and expand production recommendations
- Develop a grower base
- Establish and enhance distribution system
- Foster and evaluate retail acceptance

Adapted from <a href="https://blogs.cornell.edu/easternbroccoliproject/main/goals/">https://blogs.cornell.edu/easternbroccoliproject/main/goals/</a>

## Five challenges to transdisciplinarity

- 1. Lack of coherent framing
- 2. Integration of methods
- 3. Research process and knowledge production
- 4. Engaging practitioners
- 5. Generating impact

From **Brandt**, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J., and von Wehrden, H. 2013. A review of transdisciplinary research in sustainability science. *Ecological Economics* 92: 1-15.

# Who will pay for it?





Wang et al. 2015. Agricultural Productivity Growth in the United States: Measurement, Trends, and Drivers [ERR-189]. USDA Economic Research Service.