Fruit & Vegetable Supply Chains: Climate Adaptation & Mitigation Opportunities

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USDA-NIFA AFRI Bioeconomy Agroecosystems Annual Project Director Meeting
October 2017 Tampa, Florida
Fruit and vegetable (F&V) supply chain challenges
Our project: origins and goals
Multi-disciplinary project team and objectives
Recent Advisory Committee input
Current project status and next steps
Key Challenges & Drivers

01 Increased demand for highly nutritious food grown in domestic production regions

02 Climate change & increased competition for natural resources

03 Cost & availability of labor in the US. Rise of protected & peri-urban production

04 Consumer preference for fresh F&V grown locally
To date, fruit & vegetable production has been largely ignored by the global change community

(relative to staple crops)
In the News

Sustainability of F&V Production: Not nearly as simple as switching annual crops

San Diego County (CA) farmers reducing avocado and citrus acres

Source: US National Public Radio

Olives in southern Europe battered by drought and disease

Source: UK Guardian
Average diet of a US child is improving … very slightly

- Main overall headline is reduced consumption of soda & lower total calories (by 186 kcal/day)
- Fruits & vegetables join desserts as the only food categories with an increase in daily caloric intake from 2004 to 2012
Origins of the Project

2015 Workshop
- Co-hosted by ILSI Research Foundation and UC Davis World Food Center
- Participation from public- & private-sector
- Specified overall objectives
- Selected crops, geographies & preferred modeling methods

2016 Submission
- ILSI Research Foundation & University of Florida Project Proposal submitted to USDA/NIFA/AFRI

2017 Project Award
- NIFA Award #2017-68002-26789
2015 Workshop Outcomes

Top 30 Specialty Crops in US
- Potatoes
- Grapes
- Almonds
- Oranges
- Sweet corn
- Tomatoes
- Apples
- Lettuce
- English walnuts
- Snap beans
- Green peas
- Pistachios
- Onion
- Broccoli
- Watermelons
- Sweet potatoes
- Cucumbers & pickles
- Peaches
- Carrots
- Sweet cherries
- Plums & prunes
- Cantaloupes & muskmelons
- Cabbage
- Avocados
- Strawberries
- Squash

Geography
- California is the primary US Source of most fruits & vegetables
- Washington State and Florida are distant second and third, respectively

Preferred Modeling Methods
- Mechanistic crop models
- Statistically-based models
Regionally-Specific Crop and LCA Modeling:
- Carrots
- Green Beans
- Oranges
- Potatoes
- Spinach
- Strawberries
- Sweet Corn
- Tomatoes

Multiple Geo-Scale Economic & Supply Chain Modeling
2017 Project Award

- Enhance the productivity, resilience, and sustainability of domestic produce supply chains
- Use integrated (crop, economic, environmental) modeling to identify and test adaptation & mitigation strategies for these systems
Project Details

Multi-disciplinary team
U Arkansas, U Florida, U Illinois, IFPRI, ILSI Research Foundation, WAEES, WSU

Economic modeling (full range of geo-scales)
Farm-scale & national models
IMPACT model runs

Crops
Include multiple crops based on importance to nutrition; data and model availability

Regionally-specific crop & LCA modeling
Emphasis on CA, PNW, SE

Extension & education outreach
Efforts primarily focused in PNW and SE
Complementary Efforts

AgMIP

British Food (U Leeds)

Increasing Resilience of UK F&V Supply Chains (Cranfield U)

Food Loss (WWF, FFAR, Walmart Foundation)

Stewardship Index for Specialty Crops

Field to Market
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Multi-Disciplinary Project Team

Crop Modeling

Economic Modeling

LCA Modeling

Stakeholders & Extension

Project Kickoff Workshop (June 2017)
Use mechanistic and statistical crop modeling to determine current and future climate and water availability impacts on yield and quality of selected fruit and vegetable crops in current and potential future production states, including land use change resulting from relocation to new production regions.

**UF:** Senthould Asseng, Gerrit Hoogenboom, Chuang Zhao; **WSU:** Claudio Stöckle Stewart Higgins, Tina Karimi, Roger Nelson; **UIUC:** Kaiyu Guan, Albert Yu
Objective 2: Economic Modeling

Use economic modeling (farm-scale, national, and international) coupled to crop modeling results to determine current and future prices and production costs of selected fruit and vegetable crops, with a focus on CA, PNW, and SE.

IFPRI: Tim Sulser; WAEES: John Kruse, Walaiporn (Pon) Intarapapong
Use Life Cycle Assessment (LCA) modeling of current and potential future fruit and vegetable supply chains to identify and evaluate cost-effective adaptation and mitigation opportunities (as informed by crop modeling linked with economic models).

**U ARK:** Marty Matlock, Ranjan Parajuli, Greg Thoma
Objective 4: Stakeholder Engagement

Engage stakeholders/decision makers throughout the modeling activities to ensure models reflect realistic practices and that outputs provide useful, actionable information, which will then be communicated throughout the fruit and vegetable supply chains.

ILSI-RF: Dave Gustafson, Morven McLean, Layla Tarar, Libby Williams; UF: Kati Migliaccio; WSU: Chad Kruger, Kirti Rajagopalan
Project Advisory Committee (AC)

Role
- Supply chain experts invited to provide input
- Serve on a volunteer basis
- Meet by 2 hour telecons ~3X per year

- Sergio Alvarez (Florida DACS)
- Bill Dean (AgriNorthwest)
- Hank Giclas (Western Growers)
- Kris Johnson (The Nature Conservancy)
- Wendy Reinhardt Kapsak (Produce for Better Health Foundation)
- Shaun Lough (Westbridge)
- Kevin Morgan (FL Farm Bureau)
- Steven Ostoja (USDA Climate Hub)
- Sambhav Sambhav (Driscolls)
- Victor Verlage (Walmart)
- Kevin Walsh (Seminis)
Incorporate expected trend for production sites to move much closer to the point of consumer purchase.

Confirm that planned modeling methodologies will be appropriate for current and new protected production systems (e.g. hydroponics, non-soil substrates, etc.).

Address the growing impact of imports, now filling domestic production gaps caused by climate, disease, and the cost/availability of labor.
Current Project Status & Next Steps
<table>
<thead>
<tr>
<th>Year</th>
<th>Crops</th>
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</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Potatoes, Tomatoes, Oranges</td>
</tr>
<tr>
<td>Year 2</td>
<td>Green Beans, Strawberries, Sweet Corn</td>
</tr>
<tr>
<td>Year 3</td>
<td>Carrots, Spinach, Grapes*</td>
</tr>
<tr>
<td>Year 4</td>
<td>Broccoli*, Melons*, Onions*</td>
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</tbody>
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*Inclusion of Broccoli, Grapes, Melons, & Onions all contingent on additional funding*
Current Status

Crop Modeling
- Developing simplified mechanistic models for F&V crops by expanding upon methods already available for other crops, assembling data for statistical models

Economic Modeling
- Assembled data on productivity, costs, and incentives for F&V and other competing crops in all production areas of interest, developing farm-scale models

LCA Modeling
- Established initial supply chain process diagrams for all F&V of interest, now selecting LCA system boundaries, impacts to track, and functional unit

Stakeholders & Extension
- Identifying and meeting with key points of contact throughout these supply chains, designing future stakeholder engagement events
Ensure overall modeling approach (e.g. climate scenarios, SSPs, RAPs, etc.) is in sync with the approaches of AGMIP and IFPRI

The team has identified 4 more crops that would be modeled if additional resources are secured: Year 3: grapes; Year 4:, broccoli, melons, onions
Stakeholder Outreach

October 22, 2017
Tampa, FL

- All AFRI workshop attendees are encouraged to contact us on topics of mutual interest

November 16, 2017
Kansas City, MO

- Breakout session planned for Sustainable Agriculture Summit
THANK YOU!
Any questions?

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