Regional Partner Data Support

Part 1 of 2

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Sciences Division

Feedstock Platform Review

Annapolis, MD

April 7, 2011

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Goal Statement

- This project provides support to the Feedstock Platform through two tasks:
- Task A. Management of the Regional Feedstock Partnership data – The goal of this task is to develop and implement a method for acquisition, organization, and standardization of SGI data. Data must be uniform across SGI regions to create a comprehensive national dataset.
- Task B. Synthesis of Regional Feedstock Partnership Data - The goal of this task is to provide analyses of SGI data that are relevant to the national-scale research currently being conducted in the 1.6.1.3 (Feedstock Analysis), and 1.7.1.2 (Sustainability) projects.
- This presentation will report on Task A.
- Task B begins in late FY11

Project Overview & history

- **FY 08 focus on analysis of existing data available to ORNL and preparing for data collection from regional partners**
- **FY09-10 focus**
  - **Centralized collection, organization and standardization of all of the Partnership data for:**
    - Forty Institutions/Partners in 5 regional areas
    - Eight species of energy crop under field trials
    - Literature-based resource assessment and modeling
  - **Facilitating data upload and assimilation into the KDF**
  - **Facilitating creation of a queryable database of field data from the regional partner trials through creation of a data model that accommodates the diverse data collected by the 40 projects on hundreds of plots.**

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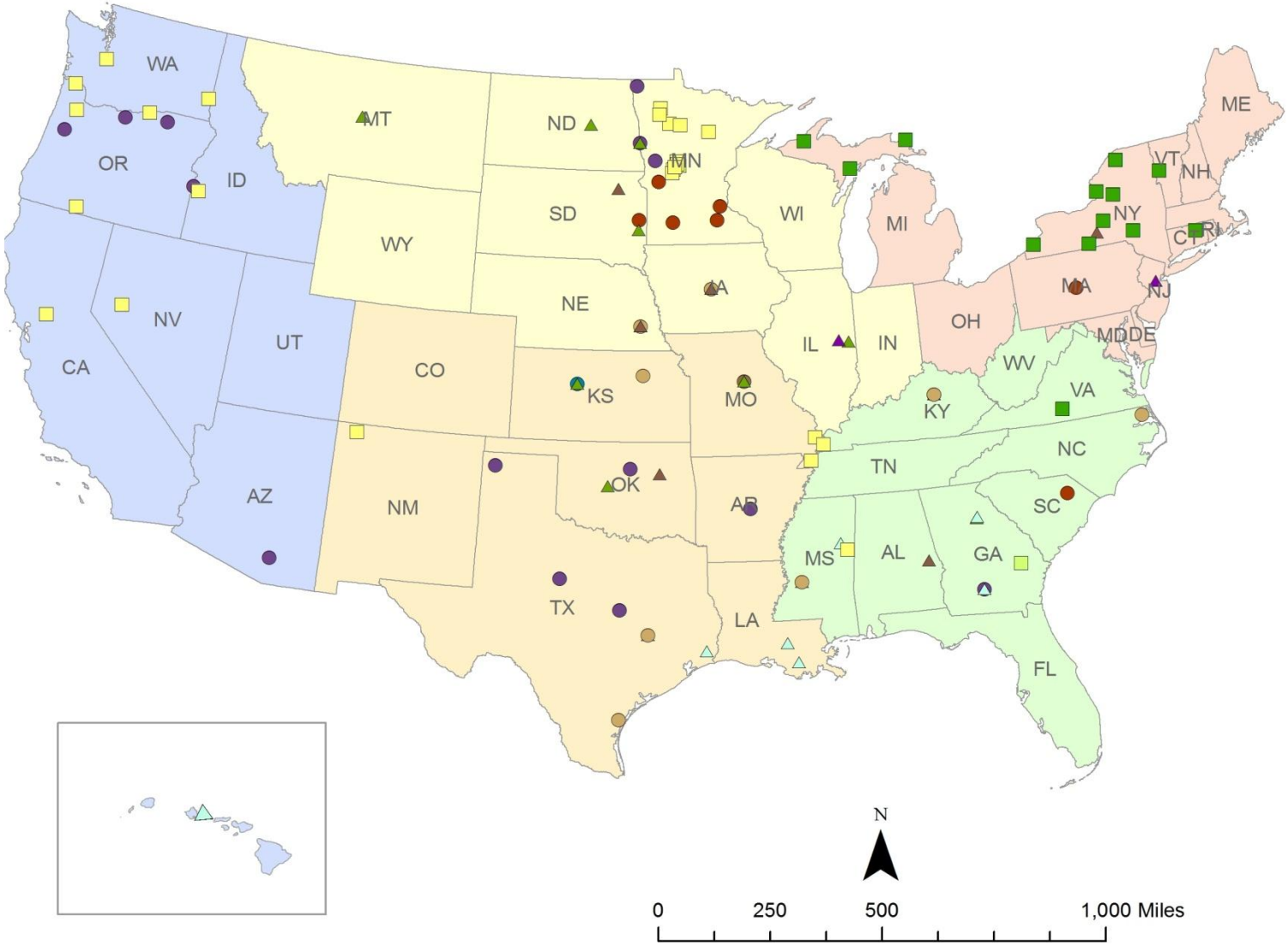
Sun Grant Initiative Regional Feedstock Partnership
Field Site Locations

Current as of October 25, 2010



Feedstocks
(number of sites)

- Cereal Stover (16)
- Corn Stover (8)
- Corn Stover, irrigated (1)
- Corn Stover, rain fed (1)
- Sorghum (8)
- Switchgrass (7)
- Miscanthus x giganteus (5)
- Energycane (9)
- CRP Grasses (9)
- Hybrid Poplar (30)
- Hybrid Poplar & Cottonwood (1)
- Willow (16)

Regions

- North Central
- Northeast
- South Central
- Southeast
- Western

Disclaimer: This map is intended for visual representation only. Many field trials occur within the same research location and may not be indicated on the map. Users of this information should contact the Department of Energy Golden Field Office for additional data information.

Approach

- Review all regional partner statements of work and extract expected data variables (5 regions, 8 species, 40 Partners/Institutions)
- Develop PI-friendly standard Excel templates for data collection for each of the broad feedstock types
- Develop method to ensure data security and satisfy PI needs while enabling data capture and access
- With KDF computer scientists develop data model for queryable database for Regional Partner field data (based on data entered into templates).
- Through regular calls/e-mails gather data from regional partners using templates. Attendance and presentation at all annual Sungrant meetings
- QA gathered data
  - In some cases reentered data into templates
  - Confirm/correct data units
  - Identify missing data
- Report to HQ on success of data collection – Quality, quantity, challenges
- Develop plan for synthesizing data for program application

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Technical Accomplishments/ Progress/Results

- **Created a Data Characterization and Data Synthesis Plan (Oct 2010)**
- **Creation of data model for queryable database in the KDF**
- **Status of data collection (PIs who submitted data)**

	2008	# plots with yield measurements	2009	2010*
Stover	7/7	245	4/7*	1
CRP	4/6	99	6/6	6/6
Energy cane	na	152	7/7	
Miscanthus	na	Too early	na	5/5
Sorghum	6/6	38	6/6	
Switchgrass	Na	Too early	4/6	

* Data will be uploaded directly to KDF

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Relevance

Supports accurate characterization of regional feedstock production potential and variation (spatial and temporal) across the US

Supports cross-comparison of feedstock potential within a region.

Enables creation and validation of feedstock production models necessary for estimating future resources and guiding environmental sustainability

Reduces investor risks and promotes biorefinery establishment by providing access to credible data on biomass production and environmental characteristics

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Critical Success Factors

- **Success Factors**
  - Development of data model relevant to specific feedstocks and desired future analyses
  - Clear regular communication with Regional Partner team leads
  - Willingness to address PI concerns for data security
- **Project Challenges**

Challenges	Solutions
Data security	One POC; trust; protocols
Release of data by PI	PI-relevant templates; regular communication with team leads
QA of data	Communication with PIs; data upload controls in the KDF
Relevance to region and national feedstock analysis	Engage analysts in data model creation

Future Work

- Upload resource development and resource assessment data to the KDF.
- Utilize the KDF to provide analyses of SGI data by feedstock and by region for:
  - Yield in dry tons/acre
  - Soil carbon and bulk density change over time
  - Tillage and harvest methods
  - Input and production costs
- Continue to manage Regional Partnership data and provide leadership to the woody crop team and the resource assessment (GIS) team.

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Summary

- This project will ensure that the data generated by each regional partner are captured, documented and made available for regional and national–level syntheses.
- This project will deliver a dataset to the KDF capable of contributing to feedstock analysis and development at a national scale.
- Data will be consistent across species and regions to allow for a detailed comparison.
- This project supports the EERE's goals of sustainable competitive biofuels, provides validation of biomass yield models, and will create a geospatial database to contribute to the national biomass assessment.
- Future efforts will focus on analysis of four years of field trials and a literature compendium spanning 10 years of research.

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Acronyms Used

- ORNL – Oak Ridge National Laboratory
- INL – Idaho National Laboratory
- SGI – Sun Grant Initiative
- KDF – Knowledge Discovery Framework
- ARS – Agricultural Research Service
- USFS – U.S. Forest Service
- EERE – U.S. DOE Energy Efficiency & Renewable Energy

Regional Feedstock Partnership Resource Assessment

Part 2 of 2

7 April, 2011
Feedstocks Platform

Peter Woodbury
Cornell University

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Goal Statement

Use geospatial modeling to upscale field-scale feedstock yield data to estimate feedstock production potential at regional and national scales.

Develop databases that can be used for further regional and national analyses of feedstock production potential.

Quad Chart Overview

Timeline

- Project start date – Oct 2007
- Project end date – Sept. 2013
- Percent complete -- 65%

Barriers Addressed

"Feedstock Availability and Cost: The lack of credible data on price, location .., and quantity of available biomass feedstocks creates uncertainty …"

Budget

- Total project funding
  - DOE share: $2,250,000
  - Contractor share: $562,500
- DOE Funds FY09: $750,000
- DOE Funds FY10 : $750,000
- ARRA Funding $0

Partners

Leads for 5 regions:

- Michael Dicks (South-Central)
- Chris Daly & Mike Halbleib (West)
- Sam Jackson (Southeast)
- Michael Wimberley & Rajesh Chintala (North-Central)
- Peter Woodbury (Northeast)

Project Overview

Key tasks:

- Conduct regional inventories of existing and potential bioenergy feedstock supply.
- Develop Regional Feedstock GIS Atlas Databases to model the production potential of multiple feedstocks.
- Conduct additional region-specific analyses, including facility siting, land availability, etc.
- Develop nationally consistent estimates of production potential for multiple feedstocks.

Approach

Conduct an inventory of existing and potential bioenergy feedstock supply:

- Develop a database of measured yields of multiple feedstocks and associated environmental data from journal articles, experiment station reports, agricultural survey data, etc.

Develop Regional Feedstock GIS Atlas Databases:

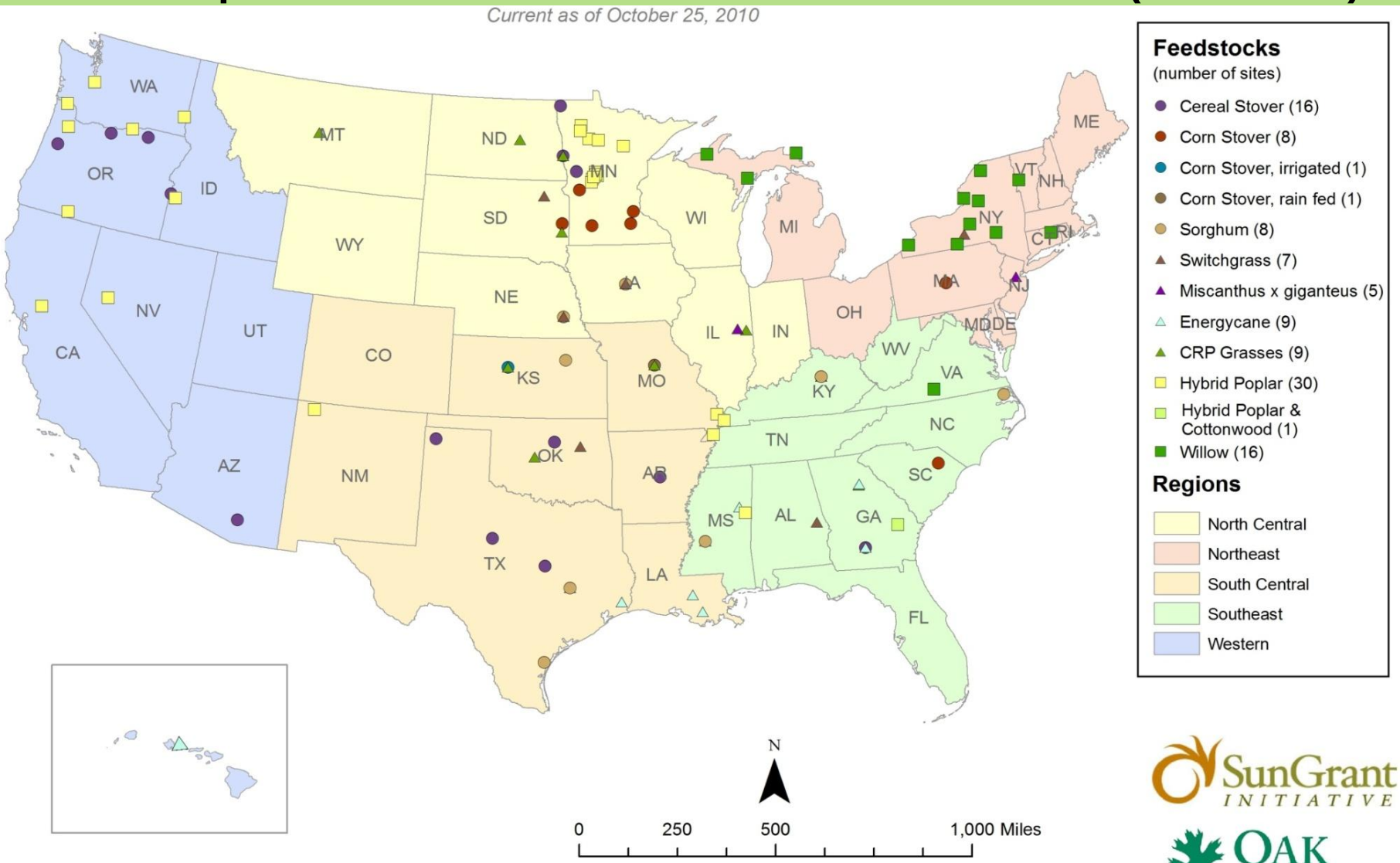
- Use geospatial technologies and other modeling tools to develop estimates of the current and potential yield of multiple feedstocks based on soil, climate, and other environmental conditions.

Conduct additional regional analyses, such as:

- Develop web-based tools for data visualization, bioenergy conversion facility siting, and feedstock logistics modeling.
- Geospatial analysis of costs of feedstock production and transport.
- Use geospatial technologies and other tools to model the availability of land suitable and available for feedstock production.

Approach: Upscale from field data

Includes current field trials (below) as well as previous field trials derived from the literature (not shown)



Disclaimer: This map is intended for visual representation only. Many field trials occur within the same research location and may not be indicated on the map. Users of this information should contact the Department of Energy Golden Field Office for additional data information.

SunGrant INITIATIVE

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Technical Accomplishments/ Progress/Results

Conduct an inventory of existing and potential bioenergy feedstock supply.

- Collect data on feedstock yields in each region.
- Develop templates so that different types of data can be uploaded and integrated into the Knowledge Discovery Framework (KDF).
- Upload yield and environmental data to the KDF.
- Upload bibliographic references documenting all feedstock data to KDF.

Develop Regional Feedstock GIS Atlas Databases.

- Develop geospatial estimates of current and potential feedstock yield.
- Upload these geospatial data layers to the KDF.

Results (continued)

Conduct additional regional analyses, including:

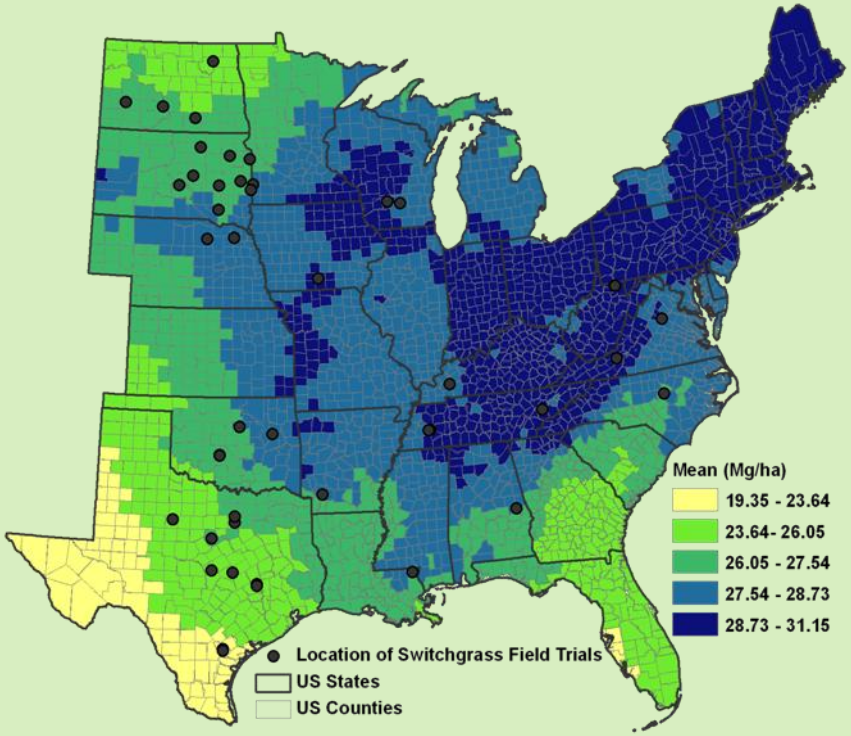
- Develop web-based tools for data visualization, facility siting, logistics modeling.
- Conduct economic analysis of feedstock production, transport, and other costs.
- Model the availability of land suitable for different feedstocks.

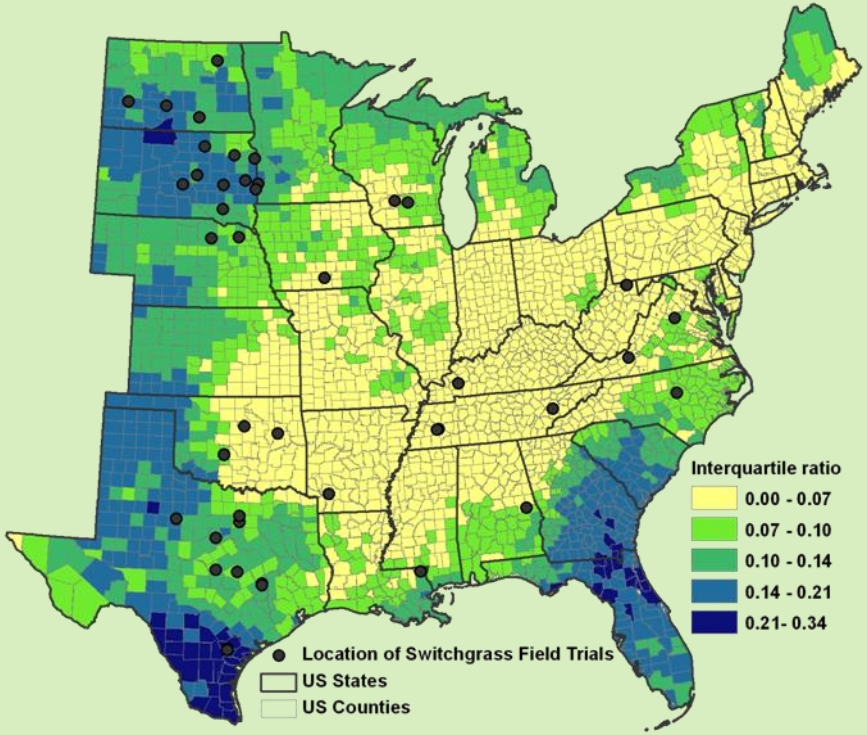
Project management, coordination, and reporting.

Conference calls, Annual meetings, Quarterly reports, Liaisons to coordinate with the Sun Grant Initiative.

Results (Continued)

Example 1: Switchgrass Lowland Cultivars
Mean Yield and Interannual Variability





Predicted switchgrass yield (Mg/ha) from 1970-2008:
(Left) mean predicted yield, (Right) Interannual variability computed as the median yield divided by the interquartile range.

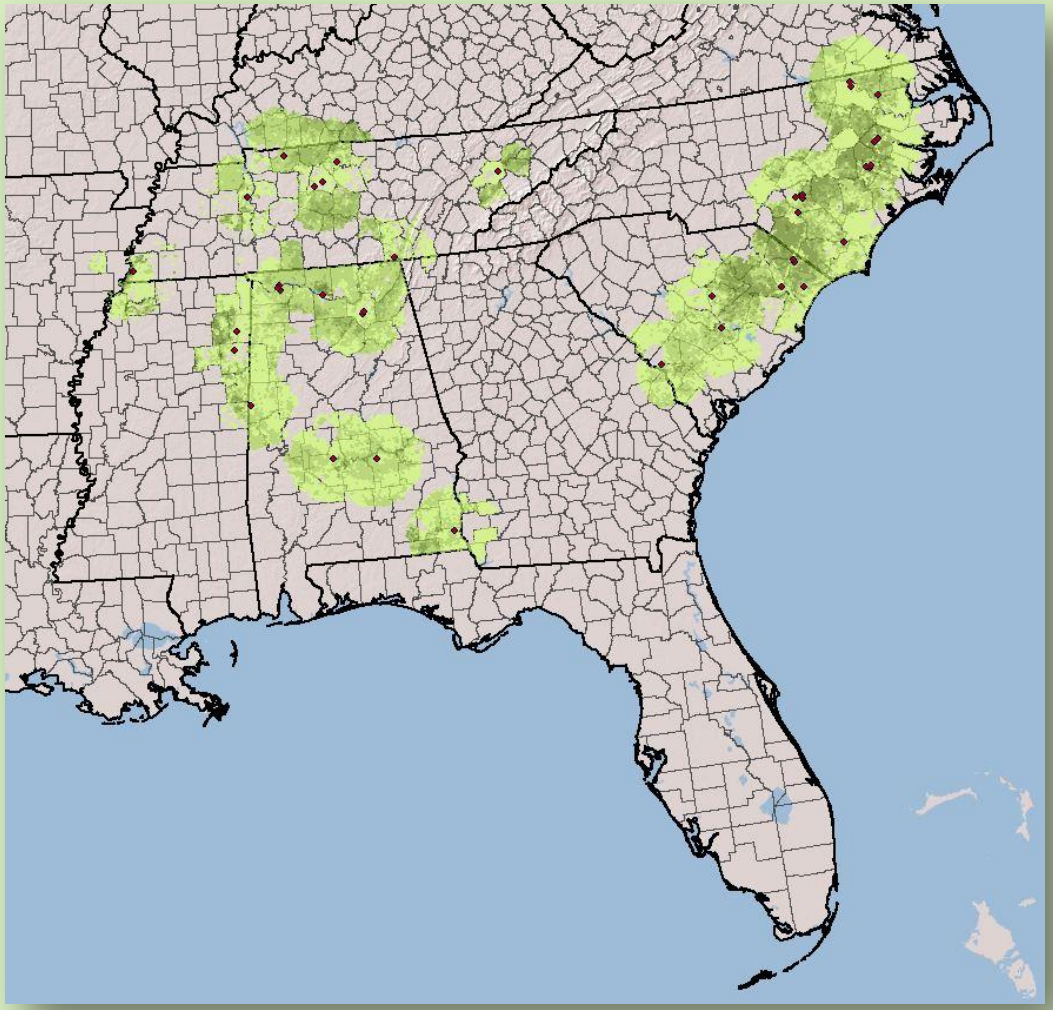
Tulbure et al., *In Prep*, North-Central Center

Results (Continued)

Example 2. BIOFLAME web-based facility siting model: Results for multiple sites for selected regions

BIOFLAME Model

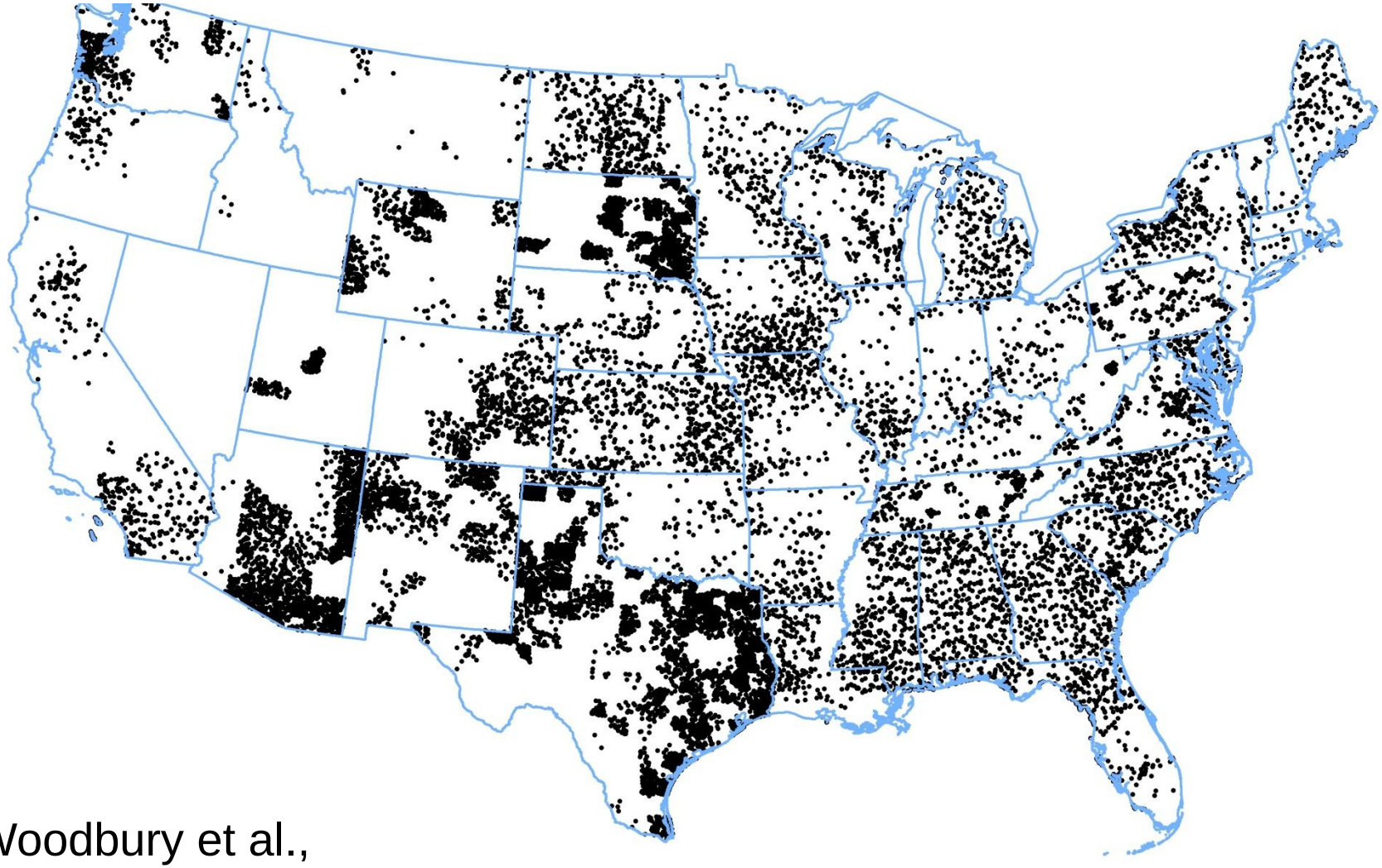
- Selects sites based on user choices about biorefinery capacity, feedstocks prices, transport cost, feedstock yield, land availability, profit, and more.
- Provides output including feedstock availability, land conversion, feedstock costs, transportation costs, and more.
- Switchgrass is current focus, other feedstocks will be added.



Jackson et al., Southeast Center

Results (continued)

Example 3. Quantify potentially available herbaceous land that is not currently being harvested



1 Dot = 10,000 acres

Woodbury et al., Northeast Center

Relevance

This project is improving estimates of bioenergy feedstock supply at local, regional, and national scales.

Relevant Feedstock Supply R&D Resource Assessment targets:

By 2012, establish geographic and economic criteria under which 130 million dry tons (DT) per year would be available.

By 2017, establish geographic, economic, quality and environmental criteria under which 250 million DT per year would be available.

How this project supports the above targets:

Supports accurate characterization of regional feedstock production potential and variation (spatial and temporal) across the US.

Supports comparison of the production potential of multiple feedstocks within and among region.

Access to credible data on biomass production reduces investor risks and promotes biorefinery establishment.

Critical Success Factors

Success Factors:

Use geospatial technologies to integrate data from current feedstock field trials, previous feedstock field trials, crop and crop residue yield data, soil survey data, and remotely sensed data.

Perform both “bottom up” regional geospatial analyses and “top down” national geospatial analysis.

Challenges:	Solutions:
Integrate feedstock yield data from journal articles, reports, etc.	With ORNL, refine data templates to integrate yield and environmental data from the literature into the KDF.
Nationally consistent estimates but also meet needs of each region.	Perform two kinds of analyses, (1) nationally-consistent feedstock supply estimates, (2) region-specific estimates of yield potential, cost, land availability, logistics, etc.

Future Work

Primary Feedstocks: These feedstocks will be analyzed in all regions of the country where they are suitable.

Corn Stover	Cereal Stover
Energycane	CRP Grass
Miscanthus	Sorghum
Switchgrass	Willow
Poplar	

Secondary (regional) feedstocks: Additional feedstocks specific for each region may also be analyzed where they are suitable.

Future Work (continued)

Conduct an inventory of existing and potential bioenergy feedstock supply.

Continue to collect data on primary feedstock yields in region.

Collect data on secondary feedstocks that can be grown in the region.

Format data and references and upload to the KDF.

Develop improved Regional Feedstock GIS Databases and upload into the KDF.

For primary feedstocks, develop national geospatial data layers.

Build on existing suitability modeling by Western Center.

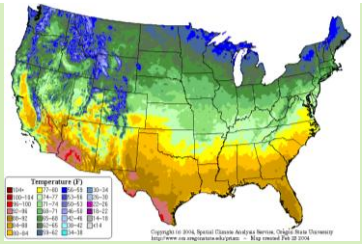
Include yield data from databases developed in this project, including field research funded through the Feedstock Partnership.

For secondary feedstocks , develop regional geospatial data layers.

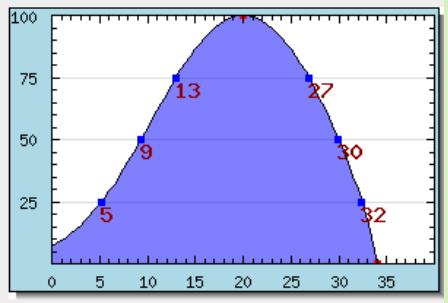
Future Work (continued)

Approach for national geospatial feedstock yield estimates

SSURGO Soil Maps

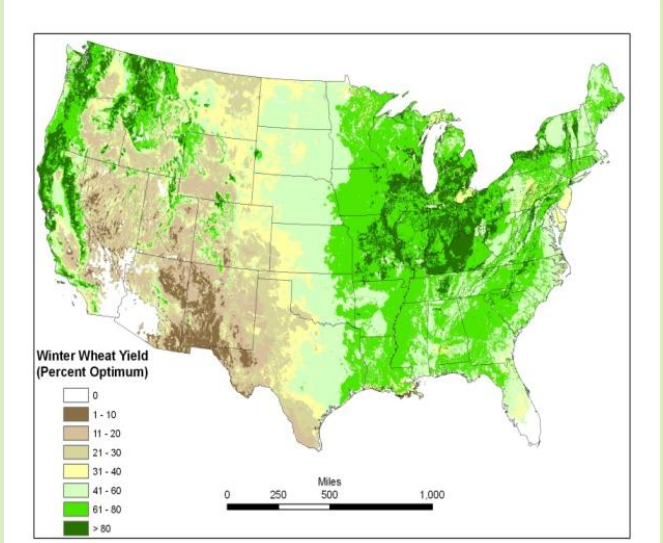


PRISM Climate Maps

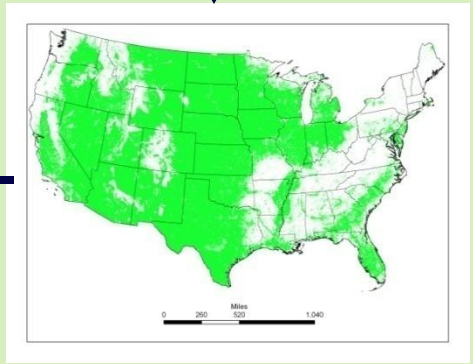


Environmental Model

Internet Map Server

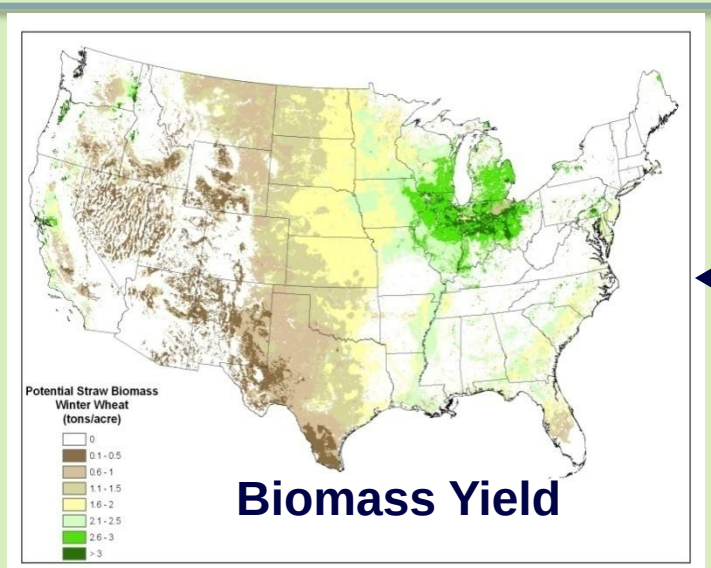


Percent of Maximum Yield



Terrain/Land Cover Constraints

Observed Yield



Biomass Yield

Summary

Project deliverables

- Feedstock yield data culled from the scientific and technical literature in a format suitable for geospatial analyses of feedstock production potential.
- Regional analysis targeted to the needs of each region, including web-based tools for data visualization, facility siting, logistics modeling, and analyses of available and suitable land for feedstock production.
- Geospatial analyses of the yield potential of multiple bioenergy feedstocks throughout the USA.

Sharing deliverables

- Data and national analyses uploaded to the Knowledge Discovery Framework to contribute to ongoing national feedstock analysis and to become available to the public for further analyses.
- Many analyses and tools will also be available on regional web sites and in reports and journal articles.

Acronyms Used

- BIOFLAME – Biofuels Facility Location Analysis Modeling Endeavor
- KDF – Knowledge Discovery Framework
- ORNL – Oak Ridge National Laboratory
- SGI – Sun Grant Initiative

Additional Slides

Publications and Presentations

Northeast Region -- Selected Presentations

- What is the Potential for Sustainable Bioenergy Feedstock Production in New York and the Northeast? Woodbury PB. Invited presentation to the 72nd Annual Cornell Seed Conference, 2 December, 2010, Geneva, NY.
- Sustainable Biomass Feedstock Production Potential and Greenhouse Gas Balance in the Northeast Sun Grant Region. Woodbury PB, Ahmed Z, Peters C, Wightman J. Invited platform presentation, Northeast Sun Grant Regional Conference, 26 May 2010, Syracuse, NY.
- Sustainable Biomass Resources in the Northeast. Woodbury PB, Ahmed Z, Peters C, Wightman J. Invited presentation to the 2009 Workshop: Re-imagining Sustainable Landscapes, 3 December, 2009, Pennsylvania State University, State College, PA.
- Organizer and moderator of a special session on bioenergy in New York State and the Northeastern USA in the Energy Panel, Cornell Cooperative Extension Agriculture and Food Systems In-Service Meeting, 11 November, 2009, Ithaca, NY.
- Multi-scale integrated modeling of sustainable herbaceous biomass feedstock production potential in the Northeastern USA. Woodbury PB, Peters C, Ahmed Z, Wightman J, Waltman S, Richard T. Invited Platform Presentation to the 2009 International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, 1-5 November, 2009, Pittsburgh, PA.
- Geospatial analysis of sustainable biomass feedstock production potential in the Northeast USA Sun Grant region. Ahmed Z *(presenter*), Peters C, Wightman J, Woodbury PB. Poster Presentation to the 2009 International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, 1-5 November, 2009, Pittsburgh, PA.
- A Researcher's View of Biofuel and Bionergy Sustainability Analysis. Woodbury PB. Invited presentation and discussion, U.S. Department of State, 13 March, 2009, Washington D.C.
- Cellulosic Bioenergy: Sustainability and Environmental Issues. Woodbury PB. Invited Briefing on Regional Cellulosic Bioenergy by the Sun Grant Initiative, 13 March, 2009, U.S. House of Representatives Cannon Office Building, Washington D.C.
- Approaches for Quantifying Bioenergy Feedstock Production Potential and Environmental Impacts in the Northeast Sun Grant Region. Invited Plenary Presentation, Woodbury PB, Ahmed Z, Peters C, Wightman J. Sustainable Bioenergy and Bioproducts Research for a Better Environment and a Growing Economy, Sun Grant Initiative, 11 March, 2009, L'Enfant Hotel, Washington D.C.

Publications and Presentations (Continued)

North-Central Region – Publications

- Chintala, R., M. C. Wimberly, G. Dijra, and M. G.Tulbure. *In Prep*. Interannual variability of crop residue potential in the North Central Region of the United States. For submission to *Biomass and Bioenergy*.
- Liu, Y., M. K. Rop, and M. C. Wimberly. 2010. On the construction of the framework of a web-based atlas (FWA). Proceedings of the Association of Computing Machinery Southeastern Conference, Oxford, MS. April 15-17.
- Tulbure, M. G., M. C. Wimberly. A. Boe, and V. Owens. *In Prep*. Climatic and genetic controls of yields of switchgrass, a model bioenergy species. For submission to *Environmental Research Letters*.
- Tulbure, M., M. C. Wimberly, D. P. Roy, and G. M Henebry. *In Press*. Spatial and temporal distribution of fires in the central United States from three years of MODIS active fire detection data. *Landscape Ecology* (to be published in 2011).

Publications and Presentations (Continued)

South-Central Region -- Publications / Presentations / Proposals Submitted

- Acheampong, Kwame, Michael Dicks and Brian Adam. "*The Impact of Biofuel Mandates and Switchgrass Production on Hay Markets."* NCCC-134: Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management: St. Louis, Mo. April 19-20, 2010
- Acheampong, Kwame, *The Impact of Switchgrass production on Oklahoma Hay Markets,* Master's Thesis, Oklahoma State University*, Dec 2009*
- Arjun Basnet, Theo Depona, Wesley Hedges, and Michael R. Dicks, *"Potential Biomass Yields in the South Central US",* February 5-8, 2011, Corpus Christi, TX
- Dicks, Michael R., Daniel De La Torre Ugarte, Chad Hellwinckel and Jody Campiche, *"Land Use Implications of Expanding Biofuel Demand",* Southern Agricultural Economics Association 41st, Annual Meetings, January 31 – February 3, 2009, Atlanta, Georgia.
- Dicks, Michael R., Jody Campiche, Daniel De La Torre Ugarte, Chad Hellwinckel, *Land Use Implications of Expanding Biofuel Demand, Journal of Agricultural and Applied Economics* Vol. 41, No.2, August 2009, pp 1-19.
- Dickson, Amanda and Michael R. Dicks, *"The Potential Economic Impacts of the Managed Haying and Grazing of CRP",* Southern Agricultural Economics Association, 41st Annual Meetings, January 31 – February 3, 2009, Atlanta, Georgia.
- Folakemi Sobowale, Mike Dicks, and Jody Campiche, *"Impact of US Corn-based Ethanol Production on Land Use",* February 5-8, 2011, Corpus Christi, TX
- Kwame Acheanpong, Michael R. Dicks, and Brian D. Adam, "*The Impact of Biofuel Mandates and Switchgrass Production on Hay Markets",* February 5-8, 2011, Corpus Christi, TX
- Pujula, Aude L., David Maradiaga, and Michael Dicks, *"Contemporary Issues in Estimating Yield Distributions",* Southern Agricultural Economics Association 42st Annual Meetings, February 7 – February 9, 2010, Orlando, Florida.
- Pujula, Aude Liliana, David Isaias Maradiaga, Hector O. Zapata and Michael R. Dicks, *"A Century of Crop Yield Density Estimation with Perspectives",* Presented at the American Agricultural Economics Association meetings in Denver, Co, July 2010.