Transitioning Cereal Systems to Adapt to Climate Change

November 13-14, 2015

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Identifying and assessing adaptation strategies

What we know about public and private adaptation strategies
Bruce McCarl, Texas A&M

Improving Models & Data for Developing Pathways for Cropping System Adaptation to Climate Change
James W. Jones, University of Florida

Assessing How Agronomic and Economic Adaptations Affect Vulnerability to Climate Change
John M. Antle, Oregon State University

Adaptation Themes

- Data: The biggest barrier to adaptation is being able to define the problem. In order to define the problem you need good data from a variety of sources to define model parameter, (small data and big data). This was also touched upon by Bram Govaerts' in the Cropping system improvements and innovation session.
- Genetics: to improve the next generation of agricultural models aimed at assessing adaptation strategies.
- Money: to support modeling efforts, data collection and storage, AND implementation of innovations on the ground.

What we know about public and private adaptation strategies

Bruce McCarl, Regents Professor, Texas A&M University

Key takeaway points:

1. Cereal systems are vulnerable to extremes such as: temperature, soil moisture, drought, water availability
2. Adaptation is inevitable – farmers have always adapted to weather variations, but climate change will bring unprecedented rates of change
3. Adaptation will be costly, both private and public sectors need to support and invest in adaptations

Adaptation Challenge

Throughout history, people and societies have **adapted** to and coped with climate, climate variability, and extremes, with varying degrees of success particularly in agriculture.
- gave an example of NW migration of corn and wheat in MO and KS

With Climate change, the pace of adaptation may be unprecedented. We may be on the treadmill requiring almost constant adaptive actions.

Climate change adaptation could mean an investment of
$5 - $13 billion per year globally

Some people will make adjustments on their own, but we may need to subsidize some adaptation investments such as improved varieties, as well as additional facilities for irrigation, and infrastructure relocation.

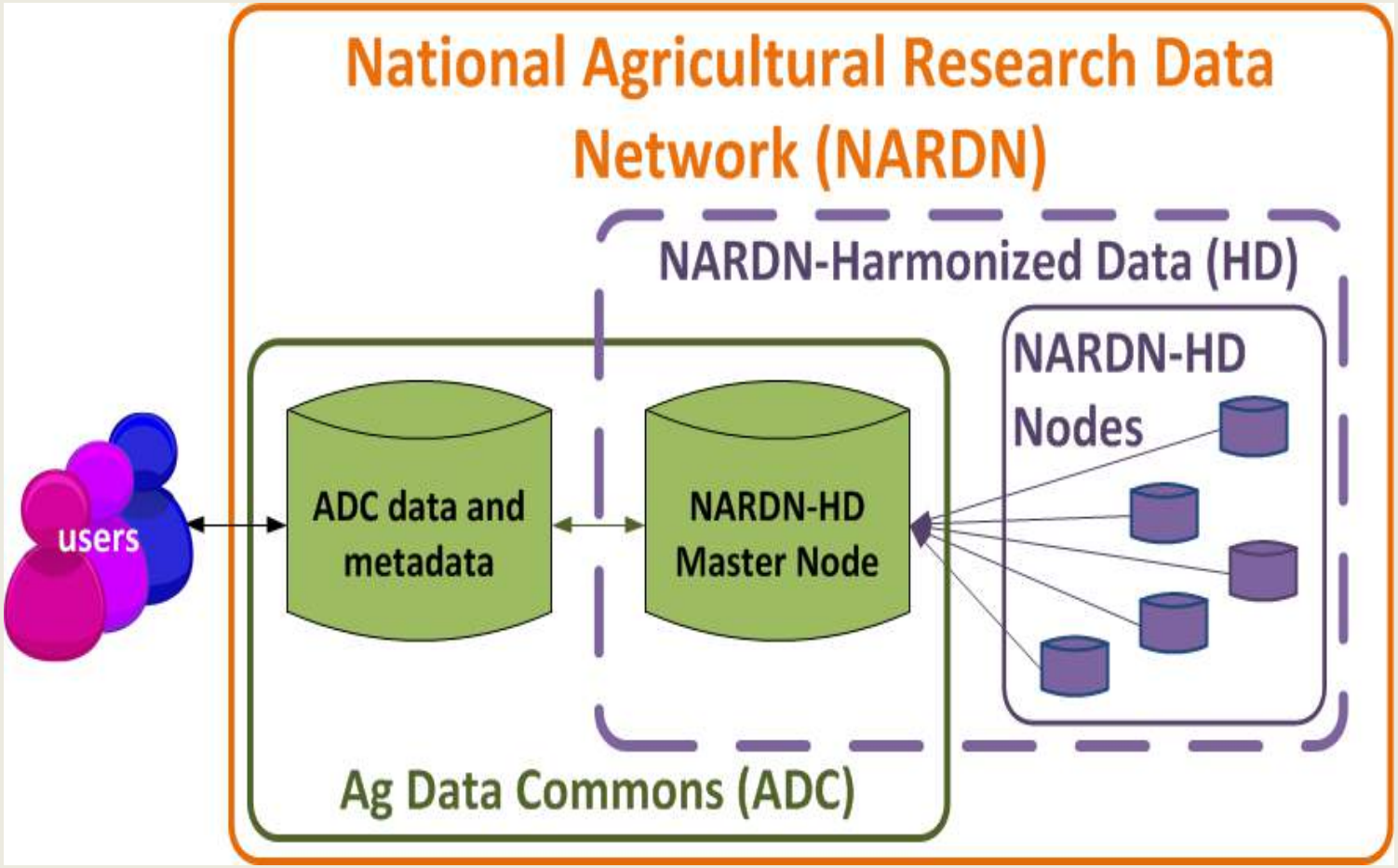
Improving Models & Data for Developing Pathways for Cropping System Adaptation to Climate Change

James W. Jones, University of Florida

Key takeaway points:

1. There are many data sets out there (small, medium and large), and we need to be able to store and access this data to improve crop models
2. Engage more with plant breeders and geneticists
3. Engage more with stakeholders and include ALL disciplines to have more confidence in parameters and outcomes of crop models

Schematic of Proposed Data Network



Proposed NARDN-HD showing its relationship with the NAL's Ag Data Commons and its contribution to the broader NARDN

Current Crop Models Have Limitations

(due to lack of data and communications with other diciplines)

- They do not adequately incorporate modern genetic information that breeders now work with
- They do not currently incorporate biotic stresses
- They have not dealt with many of the known management adaptation options
- Evaluation of the models have been very limited, usually being done for very few combinations of environments, genetics, and management
- Next generation models need to address these

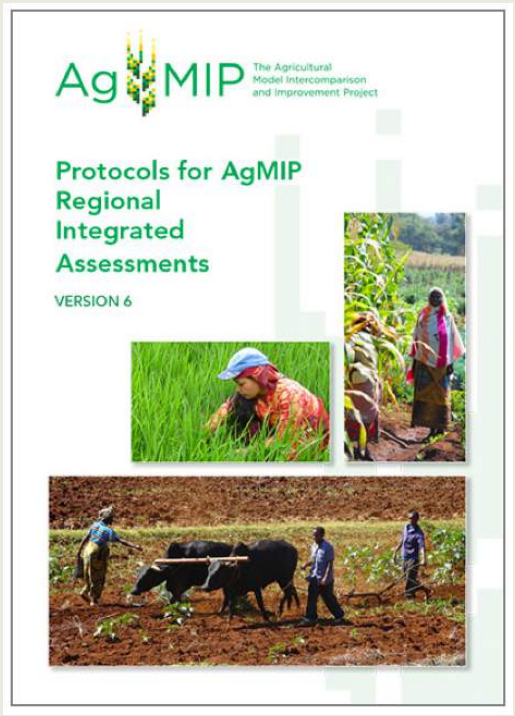
Assessing How Agronomic and Economic Adaptations Affect Vulnerability to Climate Change

John M. Antle, Professor of Applied Economics, OSU,
AgMIP Co-PI and Regional Economics Leader

Key takeaway points:

1. Need a **clear experimental design** in order to distinguish the effects of climate change from other changes such as changes in technology
2. Crop simulation models can be used to assess effective adaptation and link that to economic analyses
3. AgMIP is collaborating with various researchers to develop a new set of coordinated regional and global assessments.

REGIONAL INTEGRATED ASSESSMENTS HANDBOOK



Protocols for integrated assessments are available in this handbook on AgMIP's web site.

http://www.agmip.org/regional-integrated-assessments-handbook/#

Agricultural Model Intercomparison and Improvement Project…

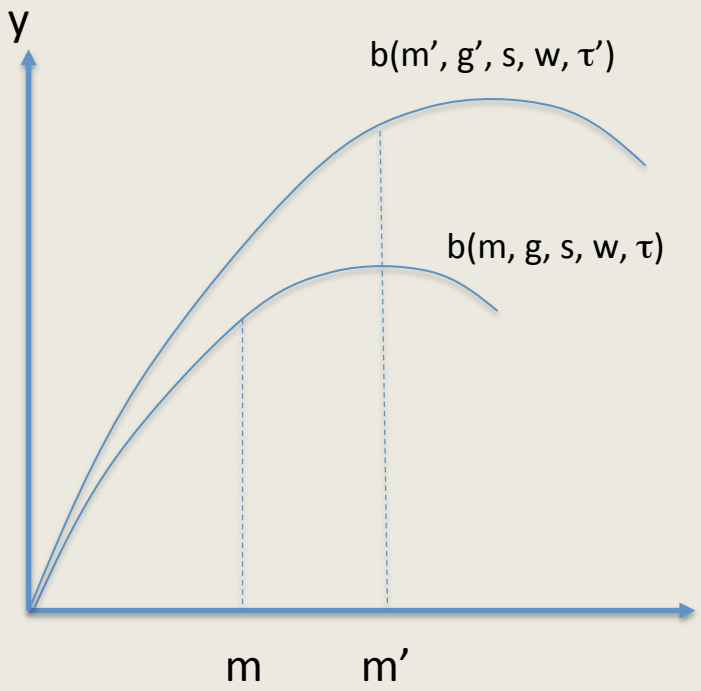
For the AgMIP story (agmip.org):

Linking Crop Models to Economic Models: Relative Yields

Agronomic and economic concepts of production function

$y = b(m, g, s, w, \tau)$

y = yield (kg/ha)
m = management variables (unit/ha)
g = genetic characteristics of the crop
s = soil variables
w = weather variables
τ = parameters

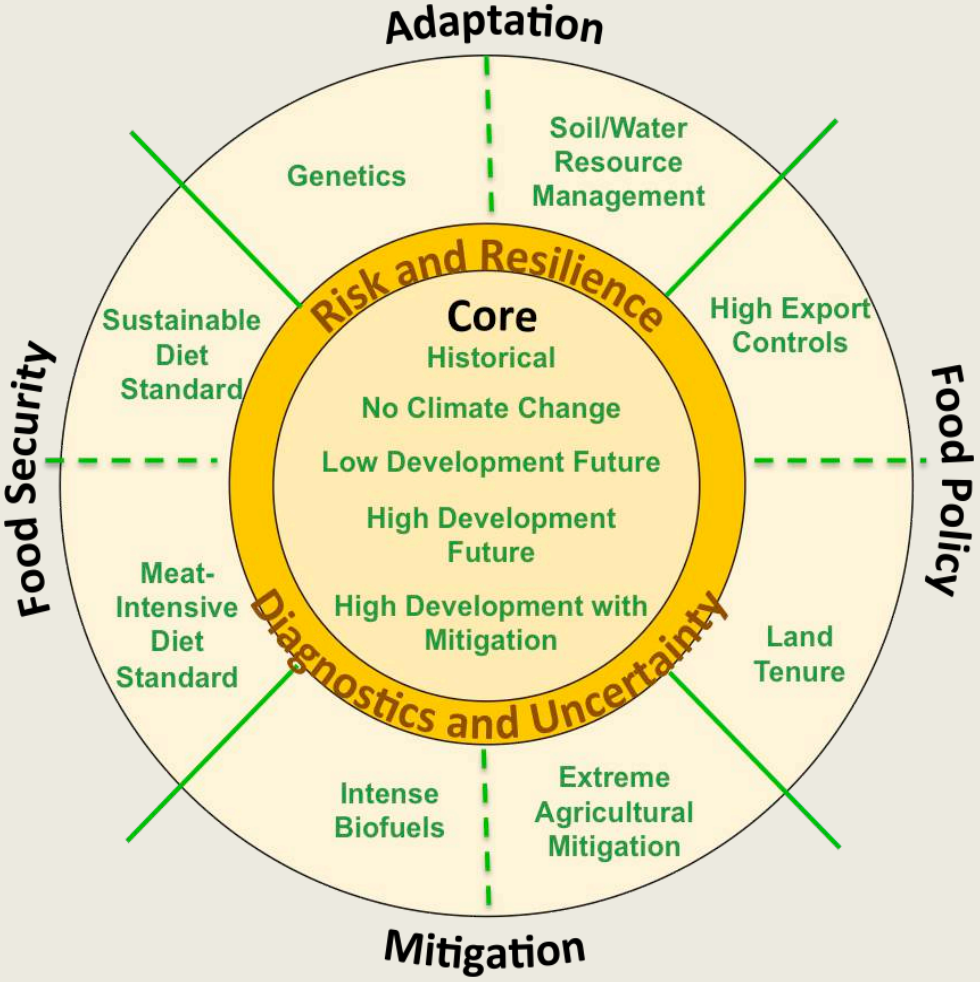


Technological change = shift in production function
= change in m, g and τ

(note: can add other biotic factors: pests & diseases)

The way forward: AgMIP Coordinated Global and Regional Assessments (CGRA)

- Goal: results ready for AR6
- Key features:
  - New food security and nutrition indicators
  - Focus on risk and resilience to extremes, and long-term CC impact and adaptation
- Core project for global scenario design and model simulations
- Regional/national assessments with common protocols
- 1st year:
  - pilot projects for protocol development
  - Food security and nutrition indicator development



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REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE

Thank you!

University of Idaho

Washington State University

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

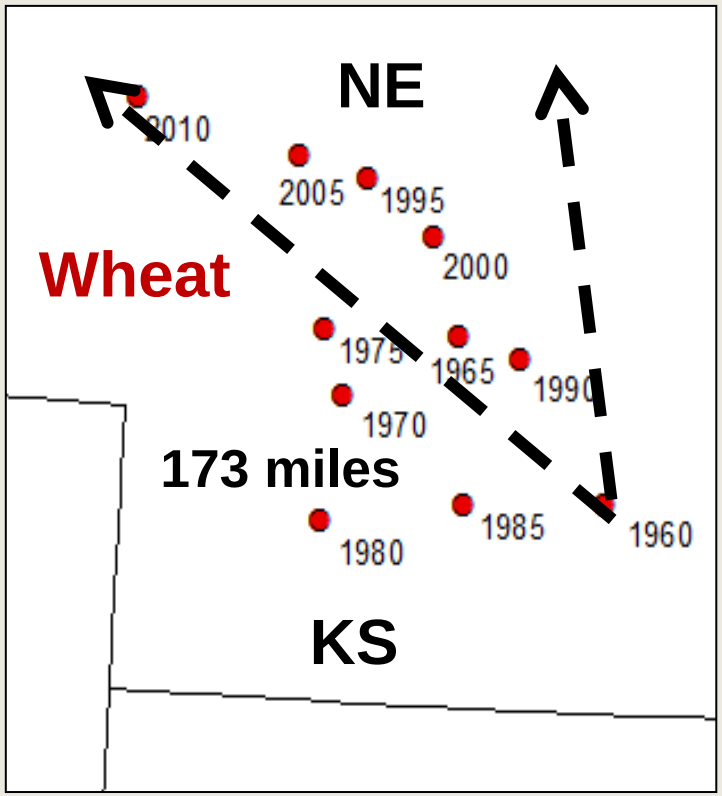
Oregon State University OSU

CHS

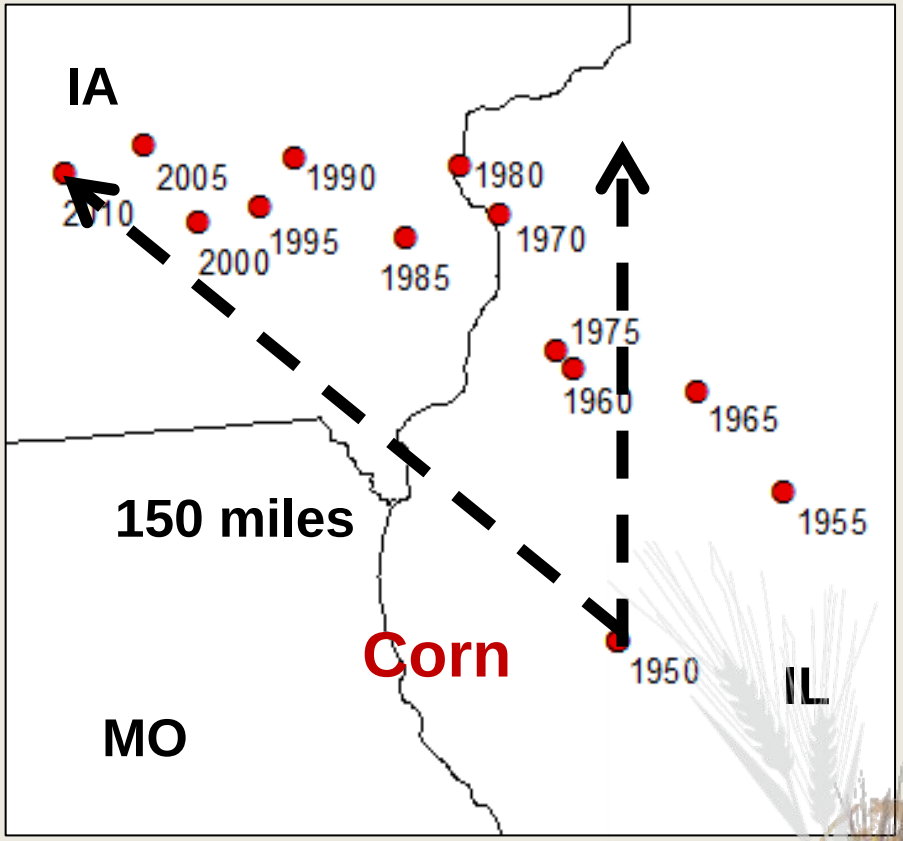
Pacific Northwest Farmers Cooperative

Monsanto

Observations - Autonomous Adaptation



Production Weighted Centroid 1950-2010



Attavanich, W., B.A. McCarl, Z. Ahmedov, S.W. Fuller, and D.V. Vedenov, "Climate Change and Infrastructure: Effects of Climate Change on U.S. Grain Transport", Nature Climate Change, on line at doi:10. 1038/nclimate1892, VOL 3 JULY 2013, 638-643, 2013.

Genetics & Plant Breeding Will Enhance Crop Models

- Plant breeders contribute considerably to the transition/adaptation of production systems
- Tolerance to abiotic stresses (e.g., high temperature, drought, low soil fertility, salinity, flooding)
- Resistance/tolerance to biotic stresses (diseases, insects, weeds)

From stakeholders and other disciplines Will need data on Adaptation/Transitioning Complexities

- Future varieties (e.g., heat-tolerant, drought tolerant, resistance to pests/diseases, …)
- New fertilizer technologies
- Irrigation, water harvesting
- Pest & disease impacts
- Sustainable practices
- Supporting industries, policies

Intensive drip irrigation, plastic mulch systems, Florida

Water harvesting with Zai system, with micro-dosing nutrients, Niger