CLIMATE-SMART Agriculture 2015

Global Science Conference

March 16-18, 2015
Le Corum, Montpellier France

Building Climate Smart Agriculture for the 21st Century & Beyond

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March 16-18, 2015

Agriculture Marches On:

- Industrial Revolution: Mechanization
  - Large areas – *Fast!*
- "Green Revolution"
  - Crop genetics focus – *Continues!*
- Information Revolution: Precision agriculture
  - Spatial & temporal variability
    - Yields & limiting factors
- *What's next??*

Challenges to *intensify* production still exist…..and……now……

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Climate Change & Agriculture: Effects & Adaptation* Key Messages

- **Climate change poses new challenges**
- **Climate more of a decision-making criteria – adds greater uncertainty**
- **All agricultural systems will be affected to some degree**
  - **Yield reductions, production cost increases**
- **Soil, water, ecosystem services will be affected**
- **Extreme events impact significant**
- **Decision-making for adaptation is complex**
  - **Economics, policy, abiotic & biotic effects, physical & social scales, risk management…..**

- *Research: Genetics* ***+ Management Practices***

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Research to Build Agricultural Resilience: Vulnerability

- Understand Potential *Exposures**
  - Focus on extremes as well as mean changes
- Understand *Sensitivities**
  - Define critical thresholds & interactions
- Enhance *Adaptive Capacity**
  - Resilient systems: *Climate-ready crops & production systems*

**Vulnerability = (exposure + sensitivity - adaptive capacity)*

(IPCC)

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G x E x M: Departure From Classic *G x E* Interaction

- ***Genetics x Environment x Management***

  - *Genetics: Variety, breed, or animal haplotype*

    "Potential"

  - *Environment: Stress effects on agriculture*

    "What cannot be controlled"

  - *Management: Production practices*

    "What can be controlled"

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An Alternative to Science Reductionist Approach

- Highlight the effects of *climate variability on the environment factor*
- Highlight opportunities for *management to optimize performance of genetic resources under varying environmental conditions*
- *Enhances problem solving*
  - *Which is the limiting factor: G? E? M?*
  - *What can we do about it?*
- *Producers view*

Yield Gap Analysis

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Challenge: Increase Yields *Sustainably*

- Satisfy *human needs** for food, feed, and fiber, & contribute to biofuel
- Enhance *environmental quality* & the resources base
- Sustain *economic viability* of agriculture
- Enhance the *quality of life* for farmers, farm workers, & society as a whole

* *Quantity & Quality*

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G x E: Phenotypic data

- Link animal/crop/variety development & choice with
  - *Current* environment
  - *Projected changes* of environment
  - Means & *extremes* of environment
  - Abiotic & biotic stresses

Sustainability:
- Yield/Production
- Economics
- Environment
- Quality of life

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G x M : What genotypes respond well to management practices?

- Link crop/variety development & choice with
  - Soil management practices
  - Water management
  - Pest & pathogen management
  - Timing of planting
  - Cover crops & crop rotations
  - Erosion & conservation management
  - Nutrient management

Sustainability:
- Yield/Production
- Economics
- Environment
- Quality of life

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G x M : What genotypes respond well to management practices?

- Link animal breed or haplotype choice with
  - Nutrition
  - Health
  - Pest & pathogen management
  - Housing
  - Production system
  - Nutrient management

Sustainability:
- Yield/Production
- Economics
- Environment
- Quality of life

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E x M: **How do we separate management effects from environment?**

- Link choice of management & environment
  - Reduced emissions, runoff
  - Efficient input application
    - Method
    - Temporal & spatial decisions
    - Production system/Housing

Sustainability:
- Yield/Production
- Economics
- Environment
- Quality of life

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Sustainable Agriculture & Soil Quality/Soil Health

- Soil Health management for
  - Crop yield
  - Ecosystem functions
  - Reduced risks to health
- *Soil Health: physical, chemical, biological*

"Soil as a living entity"

Indicators & indices?

What organisms? What are their functions/roles?

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Management: Fertilizers

- Inorganic
- Organic
- Liquid
- Encapsulated/slow release
- Innoculants
- Paired Innoculant-crop combinations
- *Other soil-biology oriented: biotic fertilizers*

Promising signs for sustainability….

Why do these work?
How do these work?

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How do we fully realize the genetic potentials of new crop varieties for sustainable agriculture?

- *Mounting evidence points to benefits of managing soil biology component of soil health*

- *Crop Genetics + Management Practices*
  - *Nutrient Management Focus on Soil Biology*

The Next Revolution for Agriculture?

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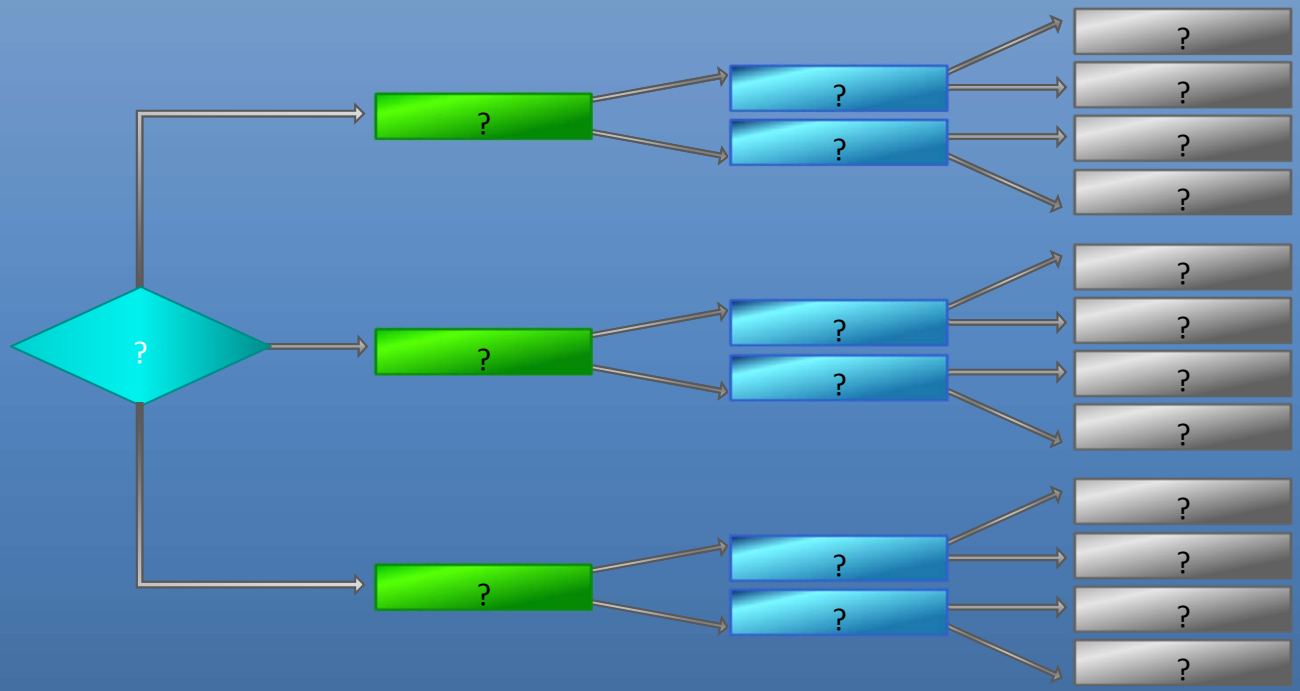
Adaptation: Decision Support via Decision Trees?



Options…

What are the model, forecast, and data needs at each decision point?

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A Way Forward

- *Genetics x Environment x Management*
  - Interactions
  - Cross/Trans Disciplinary
  - Matches producer decision-making
  - Yield gap focus
- Management: soils
  - Soil biology

Collaborations are essential……

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