2014 ESS Meeting and Workshop Final Schedule

Tuesday, Sep 30	
3:00 - 7:00	**Registration**
6:30 - 8:30	**Opening Reception**
Wednesday, Oct 1	
6:30 - 8:00	**Breakfast**
7:30 - 10:30	**Regional Meetings (start time determined by region)**
10:30 - 11:00	**Break**
11:00 ? 12:30	**ESS Business Meeting**
12:30 - 1:30	**Lunch**
1:30 - 3:00	**ESS Business Meeting**
3:00 - 3:30	**Break**
3:30 - 5:00	**University of Georgia Session -** Moderator: Bob Shulstad, Associate Dean for Research, University of Georgia • Overview of the GA Agricultural Experiment Station - Bob Shulstad • Mike Doyle, Regents Professor and Director, Center for Food Safety • Scott Jackson, Professor and GRA Eminent Scholar, Center for Applied Genetic Technology and Institute of Plant Breeding, Genetics, and Genomics • Steve Stice, Professor and Eminent Scholar, Regenerative Bioscience Center
	Dinner on your own
Thursday, Oct 2	
6:30 - 8:00	**Breakfast**
8:00 - 8:30	**"Leadership in Agriculture: Case Studies for a New Generation", a new book on leadership by John Patrick Jordan, Gale A. Buchanan, Neville P. Clarke and Kelly C. Jordan -** Moderator: Steve Slack, Director, The Ohio State University • Gale Buchanan and John Patrick Jordan
8:30 - 10:00	**ARS Update and Partnering with ARS -** Moderator: Dan Rossi, Executive Director, NERA • ARS Update - Chavonda Jacobs-Young, Administrator, USDA-ARS • Collaborations between AES and ARS Scientists Panel ○ Marc Linit, Senior Associate Dean for Research and Senior Associate Director, MO Agricultural Experiment Station, University of Missouri ○ Gary Thompson, Associate Dean for Research and Graduate Education and Director, PA Agricultural Experiment Station, The Pennsylvania State University ○ Joe West, Assistant Dean for Research, University of Georgia Tifton Campus

10:00 - 10:30	**Break**
10:30 - noon	**Phytobiomes Research -** Moderator: Mike Harrington, Executive Director, WAAESD • Jan Leach, Professor, Bioagricultural Sciences & Pest Management, Colorado State University • Kelley Eversole, President, Eversole Associates
12:00 - 1:15	**Lunch**
1:15 ? 1:30	**Cornerstone Report -** Hunt Shipman, Cornerstone Government Affairs
1:30 - 3:00	**International Germplasm Exchange -** Moderator: Eric Young, Executive Director, SAAESD • Background on the FAO International Treaty on Plant Genetic Resources for Food and Agriculture and other International Agreements - Peter Bretting, National Program Leader, USDA-ARS • Panel Comments ○ USDA-ARS Point of View - Peter Bretting ○ Industry Point of View - Tom Nickson, International Policy Lead, Monsanto Law Department, **SMTA Background** **and** **Powerpoint** ○ **University Point of View** - Scott Jackson, Professor and GRA Eminent Scholar, University of Georgia ○ Senate Ratification of International Treaty - Jane DeMarchi, Vice President, Government and Regulatory Affairs, American Seed Trade Association; and Hunt Shipman, Cornerstone Government Affairs • Q&A and Discussion
3:00 -3:30	**Break**
3:30 - 5:00	Public Access of Data and Publications **-** Moderator: Jeff Jacobsen, Executive Director, NCRA • Sylvie Brouder, Professor and Wickersham Chair of Excellence in Agricultural Research, Purdue University • Steven Daley-Laursen, NAREEE Board Member, Professor and Administrator, University of Idaho • Q&A and Discussion
6:00 - 10:00	**Group Dinner**
Friday, Oct 3	
7:00 - 9:00	**Breakfast and Depart**

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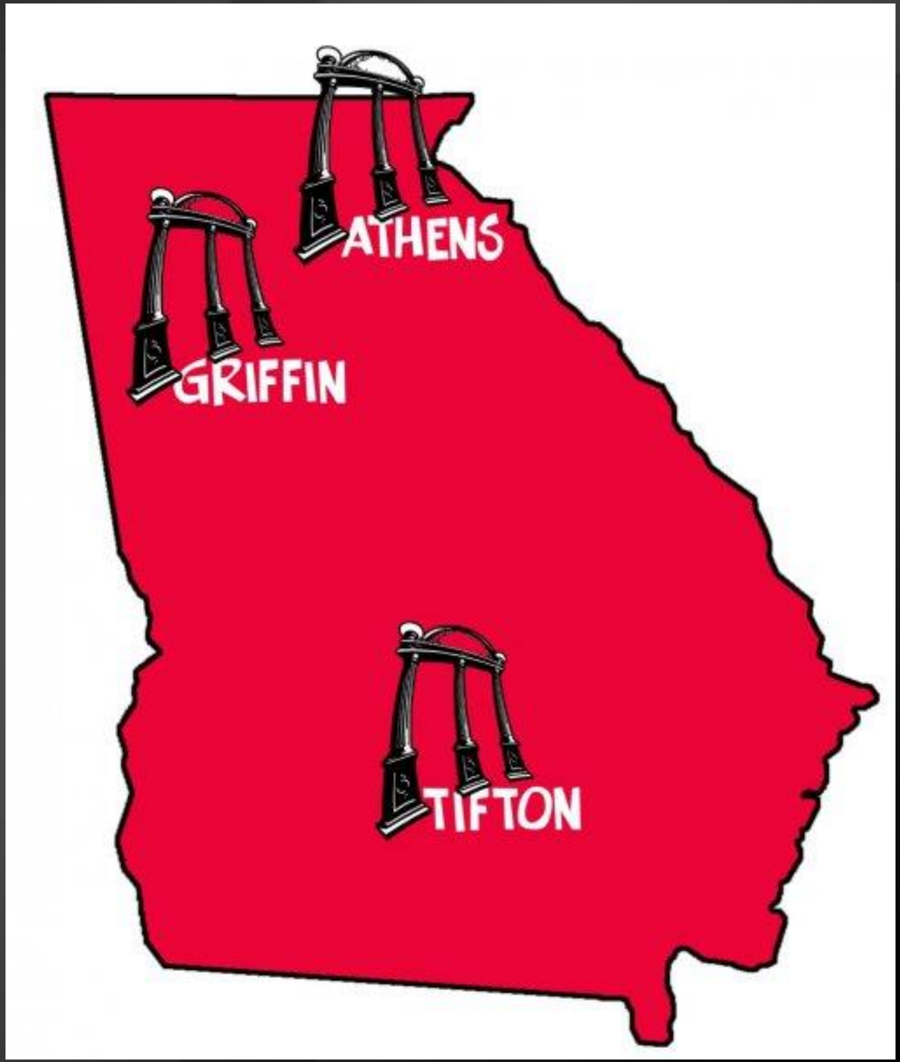
1785

The University of Georgia®

TIFTON CAMPUS

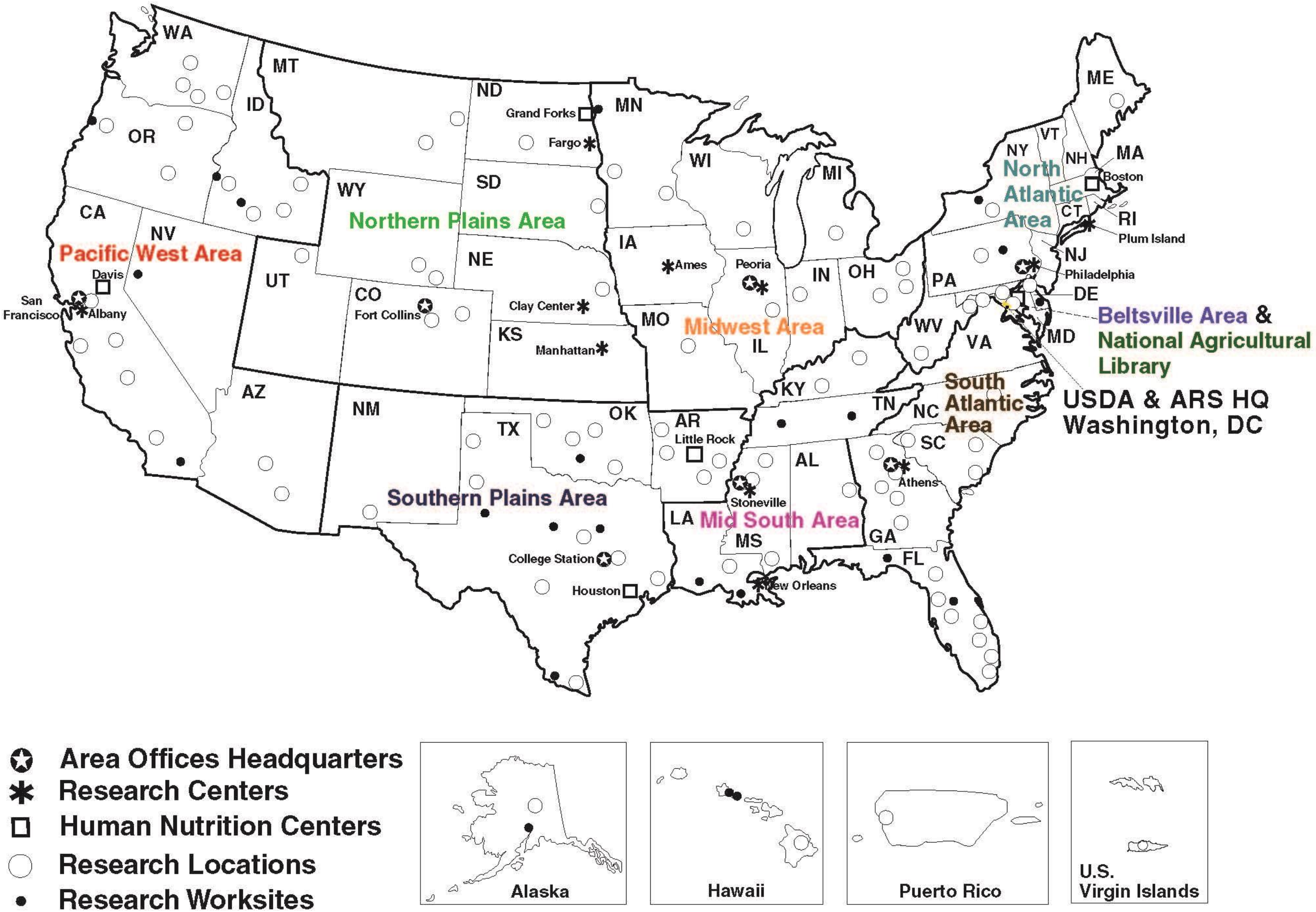
Collaboration Among UGA CAES & USDA ARS Scientists

UGA College of Agricultural and Environmental Sciences - Campuses



Agricultural Research Service Areas and Locations

USDA's Agricultural Research Service has over 2,000 scientists working in 100 locations.
Color all the states and territories. Can you name them? Find your state. Do our scientists work in you state?



UGA CAES Departments at the UGA Tifton Campus

- Agricultural & Applied Economics
- Agricultural Leadership, Education, & Communications
- Animal & Dairy Science
- Crop & Soil Science
- Entomology
- Horticulture
- Plant Pathology
- Poultry Science

United States Department Of Agriculture
Agricultural Research Service

Crop Genetics & Breeding

Southeast Watershed

Crop Protection & Management

University of Georgia
TIFTON CAMPUS – Personnel

(as of Sept. 2014)

	UGA	USDA-ARS
• Employees	402	85
• Scientists	62	20
• Support	100	65
• Technicians	78	
• Student workers	117	
• Utility, grad, post doc	45	

"*In Tifton, we operate as a fairly seamless team of researchers. ARS scientists collaborate daily with UGA scientists*. The UGA Assistant Dean allows ARS researchers to sign up for plot lands using the same process he requires of UGA scientists….."

Location Coordinator for USDA ARS, Tifton, GA

Shared Activities

- ARS is co-located with UGA CAES
  - USG Board of Regents owns property
  - ARS has some buildings, most are UGA
    - Ground leases granted for ARS
- ARS scientists have full access to CAES farms
  - Same criteria as CAES scientists

Shared Activities

- Adjunct appointments for most USDA ARS scientists
- Advising graduate students
- Co-PI of grants
- Use of research field labs
- IT support for campus
- Included in all campus wide events

Collaborators

UGA CAES

- Molecular genetics - peanuts, cotton
- Conventional breeding - turf
- Ag engineering – precision ag, water quality
- Dairy Science – forage, water quality
- Plant Pathology – biological control of nematodes

Collaborators

USDA ARS

- Conventional breeding – peanuts, corn
- Molecular genetics - turf
- Nematology – peanuts, cotton, turf
- SE Watershed
  - Research ecology
  - Hydrology engineering
- Soil sciences

Results of Collaborations

- Forage breeding–pest resistance, reduced nutrient & water use
- Water quality
  - Riparian buffers, bacterial contamination
  - Dairy manure nutrient recycling via crop application
  - Effects of conservation practices on water quality
- Biological controls – bacterial, entomological
- Corn genetics – forage, nutrient quality

Water Quality and Quantity

Measuring, modeling and limiting the impacts of agricultural production on water resources

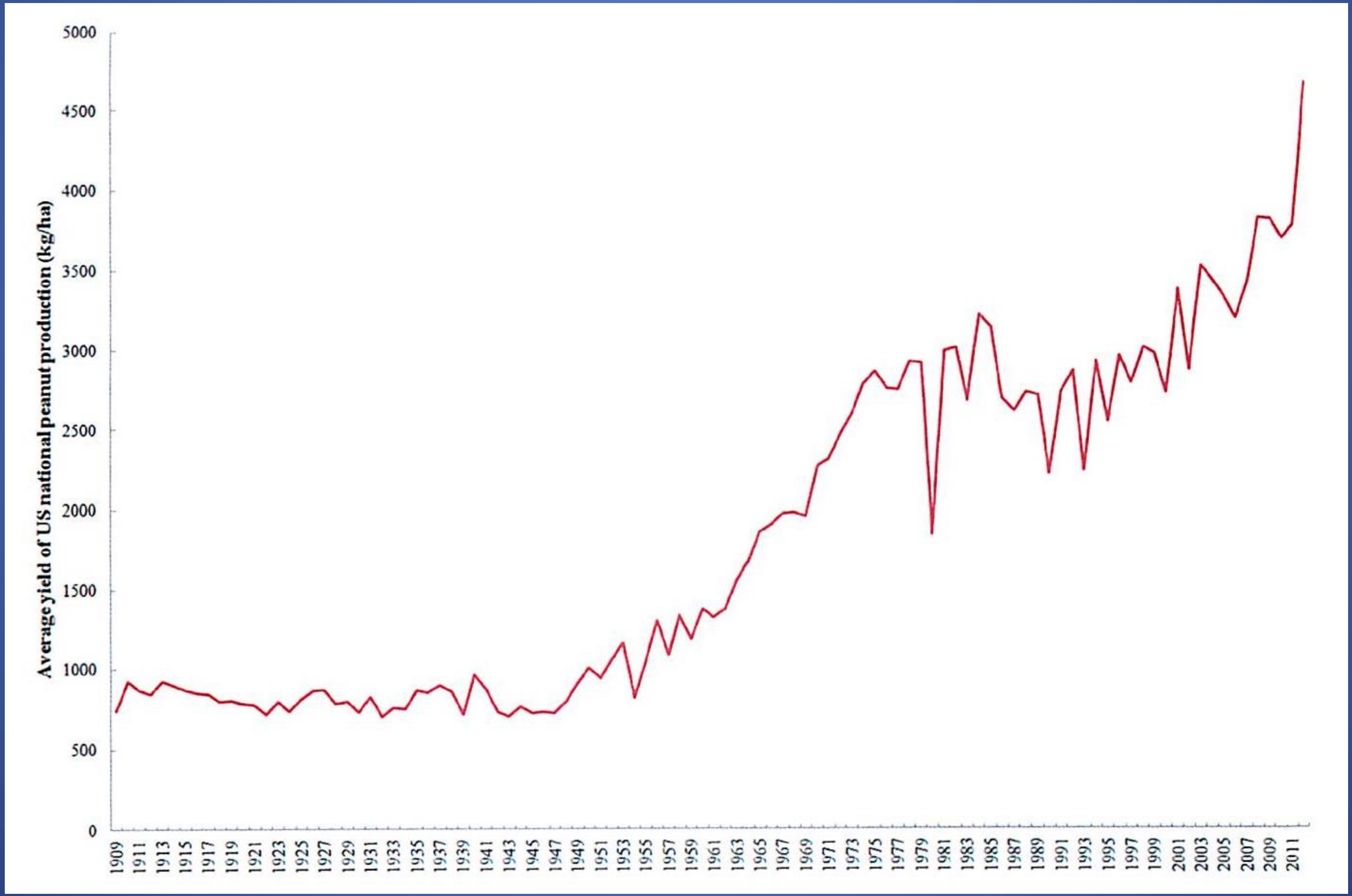
Results of Collaborations

- Marker assisted selection in peanuts
  - TSWV & nematode resistance, high oleic acid
- Molecular markers in:
  - Peanut disease resistance and seed quality
  - Pearl millet, root knot nematode resistance
  - Centipede turf, sting nematode resistance
  - Turf herbicide resistance
  - Tetraploidy in turf grasses

Root knot nematode
(*Meloidogyne arenaria*)


Tifguard

Yield per acre for US peanut for the past 100 years



Shared Results

- Co-authorship of publications
- Joint grant funding, co-PI's
- Joint release of new cultivars
  - Possible because of cooperation between ARS, GA Seed Development, GA Crop Improvement, and UGA Research Fndn.
  - Cultivar quality, inspections, licensing, and marketing

Collaborations work because:

- Scientists have complementary interests and skills
  - Because they want to make them work

- And can be inhibited by excessive or restrictive guidelines or “unnecessary” paperwork

Things that Work

- Research support agreements (RSA)
- Specific cooperative agreements (SCA)
  - Both should be facilitated
- Licensing and release of cultivars
- Synergy, critical mass

Challenges

- Restrictions on USDA ARS hiring of student workers
  - Currently handled via RSAs
- Passengers in federal vehicles
  - Weeks to get approval for CAES scientist to ride to USDA conference as an invited speaker
  - CAES scientist required to get quarterly approval
- Need to jointly fund graduate students and post-docs

“The location of USDA ARS scientists on the UGA Tifton Campus has helped foster collaborations. The ARS *scientists that are located in ARS buildings are a little isolated from the rest of the campus*. *I miss the interactions I had with UGA scientists when I was housed in Plant Sciences*. I find that being an adjunct in the Plant Pathology Department and going to the campus seminars helps me stay connected to other researchers on campus.”

USDA ARS research scientist, Tifton, GA

Keeping It Simple

- Long-term MOUs
  - To share equipment and services
  - For vehicular travel
- Unfunded cooperative agreements
  - Providing necessary liability protection without repetitive and time consuming submissions
- Joint funding of graduate students

Keeping It Simple

"It's great here, but sometimes the institutions get in the way."

Scientist at UGA Tifton

Team Work

What Makes the UGA Center for Food Safety Tick?

Michael Doyle
Director
UGA Center for Food Safety

CFS
UGA CENTER FOR FOOD SAFETY
College of Agricultural and Environmental Sciences

Center for Food Safety

To maintain or improve the safety of foods through the development of methods that detect, control, or eliminate pathogenic microorganisms or their toxins

CFS

UGA CENTER FOR FOOD SAFETY

College of Agricultural and Environmental Sciences

UGA Center for Food Safety - Background

- Established in 1993
  - Initially Center for Food Safety and Quality Enhancement at Griffin Campus
  - Changed to Center for Food Safety in 2001
    - Increased faculty with sole focus on food safety and more Athens faculty

Board of Advisors

KRAFT
Kraft Foods

Nestlé
Good Food, Good Life

Cargill

Coca-Cola

MeadJohnson
Nutritionals

Con Agra
ConAgra Foods™

ECOLAB

MARS

Publix.

Hormel
Foods

Unilever

Kellogg's

Yum!

PEPSICO INC.
PEPSI
FritoLay
Tropicana

CHOBANI

McDonald's

Loblaw
COMPANIES LIMITED

Heinz

TM

Earthbound
Farm.
ORGANIC

DR PEPPER
SNAPPLE GROUP

Governmental & Institutional Collaborators

Georgia public health

USDA

CDC

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

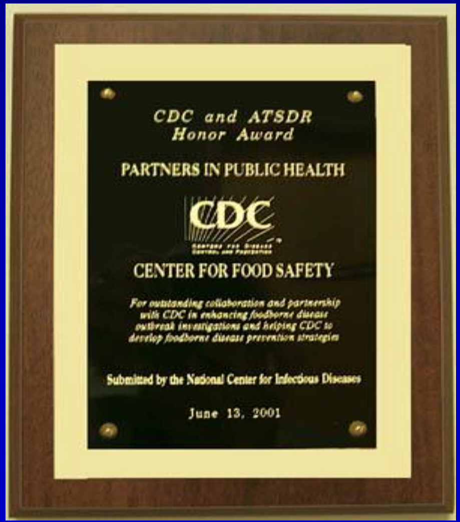
Georgia Institute of Technology

UCDAVIS

MICHIGAN STATE UNIVERSITY

FDA

CLEMSON UNIVERSITY



UGA Center for Food Safety - Faculty

Principal Researchers

18 Faculty Members

5 - 10 Postdoctoral Scientists

Multi-disciplinary

- Environmental Health Science (College of Public Health)
- Avian Medicine (College of Veterinary Medicine)
- USDA
  - Toxicology
  - Microbiology
- Food Science (College of Agriculture & Environmental Sciences)
- Microbiology (CAES)

UGA Center for Food Safety - Faculty

- Bacteriologists
  - *E. coli* O157 (STEC), *Listeria*, *Salmonella*, *Campylobacter*, etc.
- Parasitologist
  - *Cyclospora*, *Cryptosporidium*
- Virologist
  - Noroviruses, Hepatitis
- Mycotoxicologists
  - Aflatoxin, Trichothecenes, Vomitoxin
- Avian veterinarians
  - *Salmonella*, *Campylobacter*
- Epidemiologist
- Food toxicologist; risk assessment
- Bioinformatics

Dr. Michael Doyle

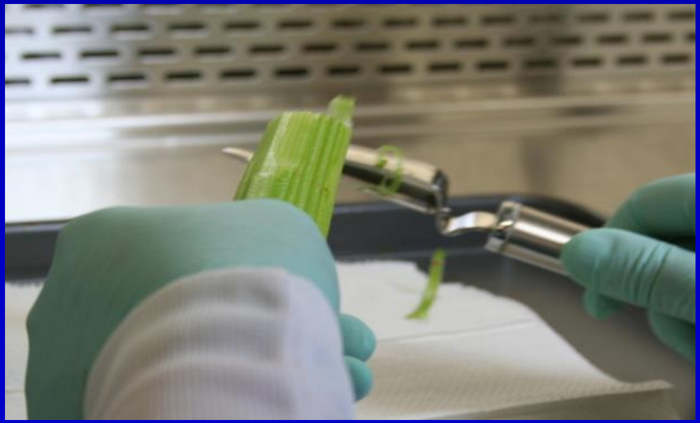
Regents Professor of Food Microbiology
Director, Center for Food Safety

- Food microbiology with a focus on bacterial foodborne pathogens
- Pathogens under study include *Escherichia coli* O157:H7 and other serotypes of enterohemorrhagic *E. coli, Salmonella* spp., *Campylobacter jejuni, and Listeria monocytogenes*
- Develops treatments to kill harmful microbes on produce, meat and poultry

Dr. Larry Beuchat

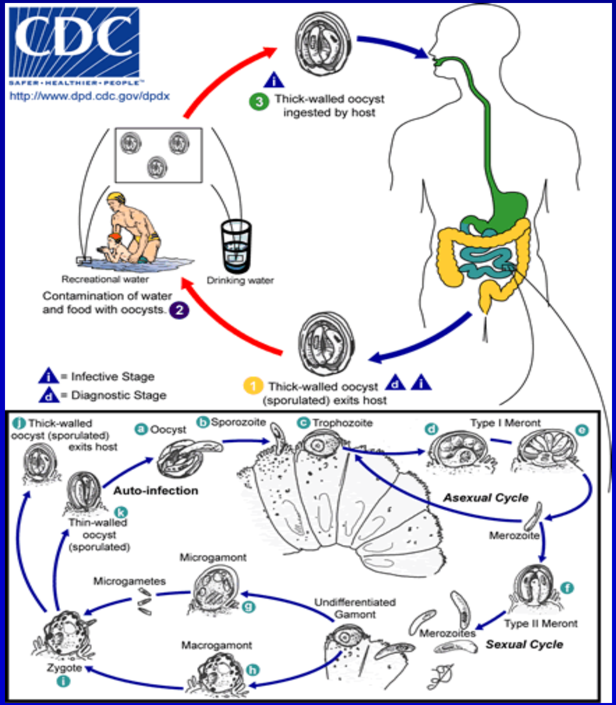
Distinguished Research Professor

- Over 40 years of research at Center for Food Safety
- Over 380 publications
- Evaluate various methods for reducing *Salmonella* on pecans
- Behavior and survival of *Salmonella* on dried fruits



Dr. Jennifer Cannon
Assistant Professor

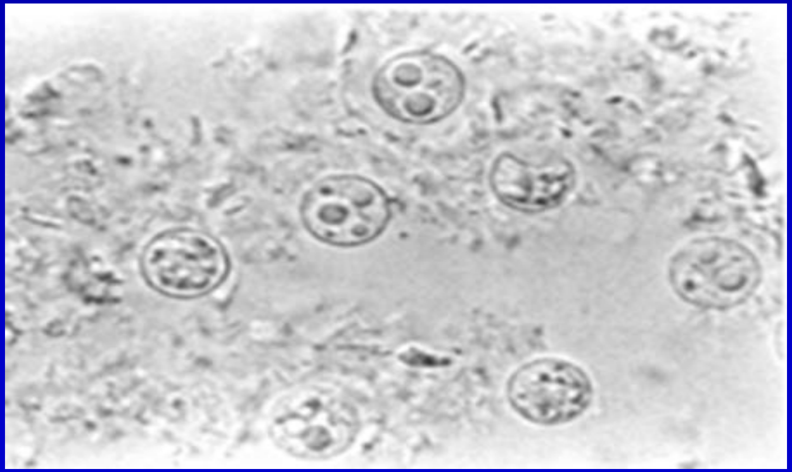
- Improving methods for detecting viruses in foods and water by molecular and cell culture assays
- Determine virus transfer to kitchen utensils and produce items during in home preparation
- Evaluate the effectiveness of commonly used treatments to control harmful microbes in food processing
- Investigate alternative methods for sanitizing produce and hands
- Epidemiologic studies addressing the risk of virus contamination of ready-to-eat foods by farm workers



Dr. Ynes Ortega

Associate Professor

- Food Parasitology
- Detection of human and animal parasites in foods and the environment; pathogenesis of coccidian parasites with emphasis on *Crytosporidium parvum* and *Cyclospora cayetanensis*
- Methods to kill parasites on foods



Dr. Walid Alali

Assistant Professor

- Research aims at understanding foodborne pathogen transmission and levels in farm animals (especially in poultry production systems)
- Evaluating methods to control harmful microbes in pre- and post-harvest animal production environments

Dr. Marilyn Erickson

Associate Professor

- Determine the role of different types of manure and carbon amendments on killing harmful microbes during composting

- Determine pathogen survival on gloves worn by field workers during harvesting fruits and vegetables and the effectiveness of sanitizers to inactivate those pathogens

- Identify the conditions under which harmful microbes get into lettuce when its growing in the field

Dr. Xiangyu Deng

Assistant Professor

- CDC Fellow
- Molecular subtyping of foodborne bacterial pathogens
- Bioinformatics of foodborne bacterial pathogens, including *Salmonella* and *Listeria monocytogenes*

Dr. Tong Zhao

Assistant Research Scientist

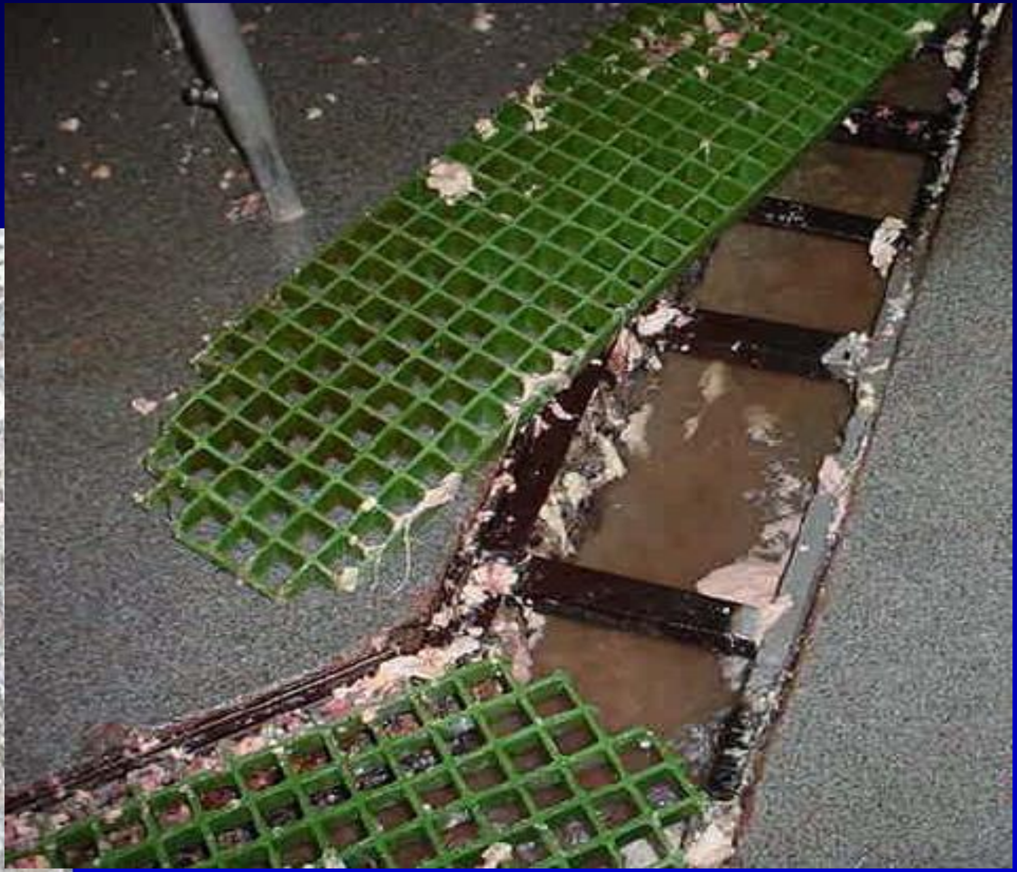
- Detection of harmful bacteria on food, including *E. coli* O157:H7*, Salmonella, Listeria monocytogenes,* and *Campylobacter*

- Ecology and reduction of carriage of *Escherichia coli* O157:H7 in cattle

- Development of beneficial bacteria to reduce/eliminate *E. coli* O157:H7 and *L monocytogenes* in processing plants

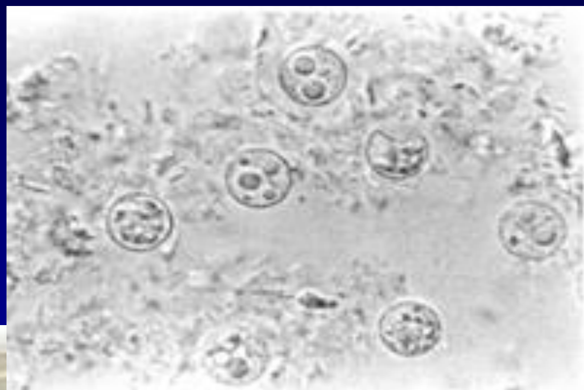
Isolation of Competitive Exclusion Bacteria for Reduction of *Salmonella* or *Campylobacter* in Chickens

Biocontrol of *Listeria monocytogenes* in Floor Drains of Processing Plants



Real-time Detection of Pathogens Using Biosensors

Optimizing Detection of Protozoan Parasites in Produce



Treatments for Elimination of Pathogens in Produce and on Poultry

Norovirus transfer to gloves and field-appropriate inactivating treatments

UGA Center for Food Safety – Examples of Research Projects

- $400,000 - $500,000 annually in unrestricted contributions from food industry
  - Receive general input from CFS-BOA
- USDA – Norocore - Norovirus detection in foods – Grant
- USDA – *E. coli O157* interventions for cattle – Grant
- Center for Produce Safety – Pathogen interventions for produce - Grant
- USDA – *E. coli O157* on leafy greens - Grant
- USDA-FAS-EMP - *Salmonella* on raw poultry - Grant

UGA Center for Food Safety – Examples of Research Projects

- AMI – *Salmonella* levels in bone marrow and neck skin of turkey - Grant
- USDA-GA Tech – Efficient capture and preconcentration with magnetic microbeads – Grant
- State of Georgia – Pathogens interventions for produce – Grants
- USDA – Controlling *Salmonella* on nuts – Grant
- NIH – Effect of biogeography on *Salmonella* diversity – Grant
- NSF – Food safety workshop – Grant

UGA Center for Food Safety – Examples of Research Projects

- FDA – Detection of foodborne parasites – Grants
- USDA – Competitive exclusion bacteria for *Salmonella* in poultry – Grant
- USDA – Persistence of *Salmonella* in low-moisture foods - Grants
- FDA – Dose response risk assessment for *Listeria* – Grant
- USDA – Vaccine for *Salmonella* in poultry – Grant
- American Meat Institute – *Salmonella* in turkeys - Grant

UGA Center for Food Safety – Annual Meeting

- Presentations by leaders at FDA, CDC, USDA and selected CFS faculty addressing timely topics on food safety
- Topics and speakers largely input of BOA
- Invitation only
- 150-200 participants
- No media; no lawyers
- Open discussions; no report of proceedings

UGA Center for Food Safety – Keys to Success

- Engage the food industry; a research and outreach program that is both relevant to the industry and addresses real solutions
- Only food companies highly committed to raising the bar for safer foods
- Be focused
  - Well-defined mission; don't dilute
- **Credibility** with federal and state food-related agencies, industry and consumers
- Strong collaboration with government (especially CDC)
  - Host CDC Food Industry Safety Forum
- A faculty that is willing and committed to addressing topics that are relevant to the industry's interests

Center for Applied Genetic Technologies

Technology-driven
Genotype-to-phenotype research space
Product driven

Adjacent to greenhouse space.

CAGT Faculty

Wayne Parrott (198?): Plant transformation, biotechnology, insect resistance

Zenglu Li (2012): Soybean breeding, molecular/genomic breeding, phenomics, drought

Ali Mossaui (2012): Feedstock/biofuel breeding, phenomics

Scott Jackson (2011): Plant genomics, marker development, germplasm enhancement

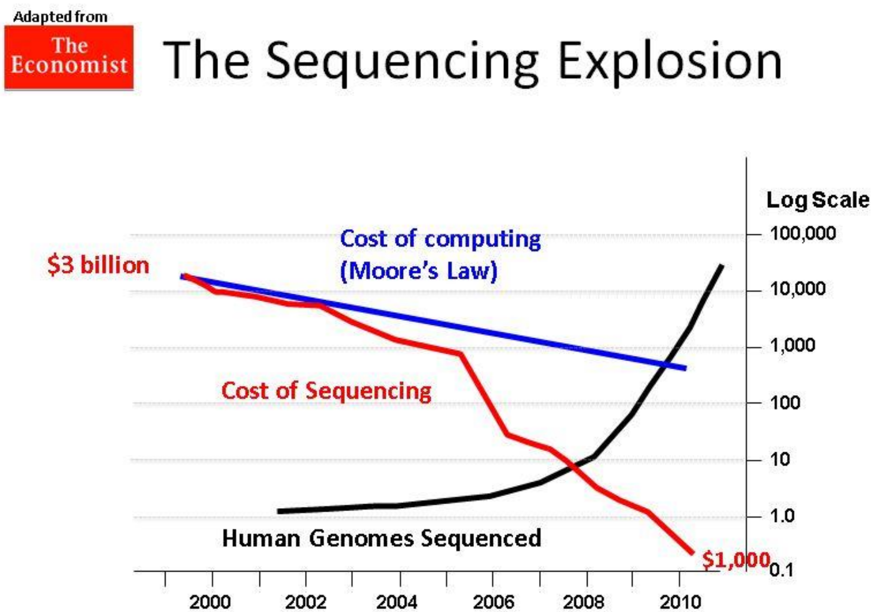
Ongoing search: Quantitative genetics/genomics

Technology

Genotype → Phenotype

…actggtccgatcgcgtagatcgaaatcg…

Genotyping

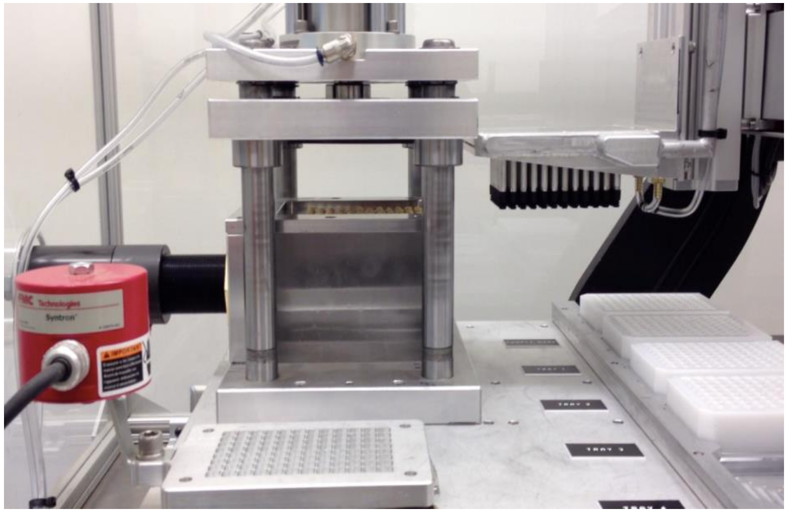


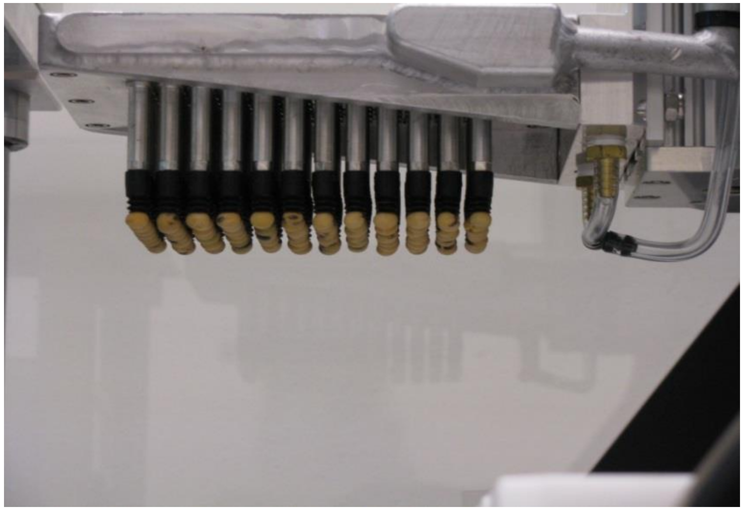
- Maize and soybean cost ~$25-50 Million
- We can now resequence soybean for ~$500.
- The human genome was a game changer for human medicine.
- How will this play out in agriculture?

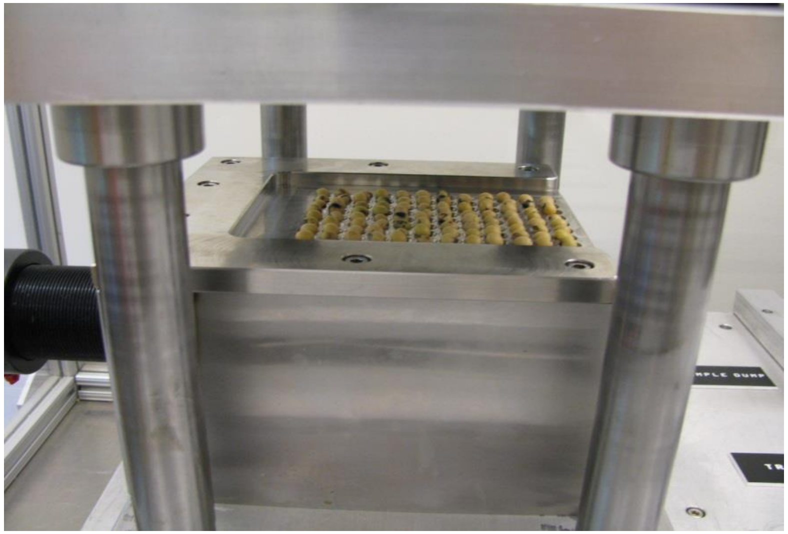
$120,000

5x coverage of human genome, ~$900

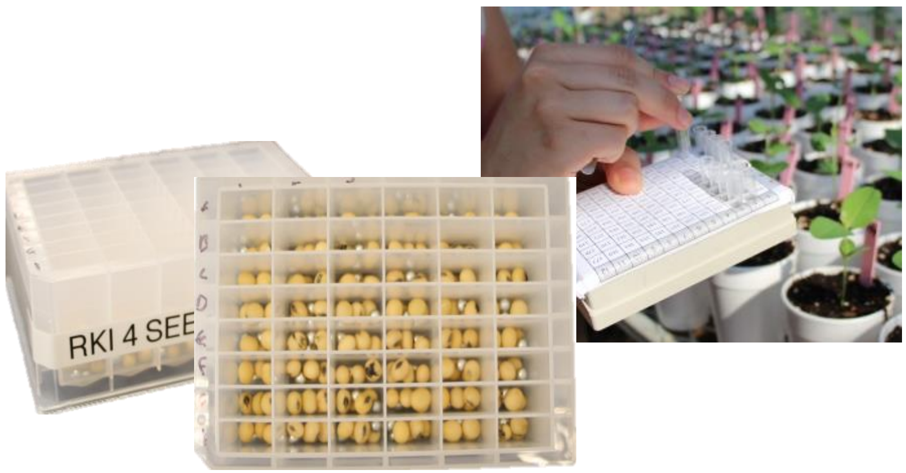
Seed Chipping & Marker Technology Play an Important Role in Accelerating Soybean Breeding



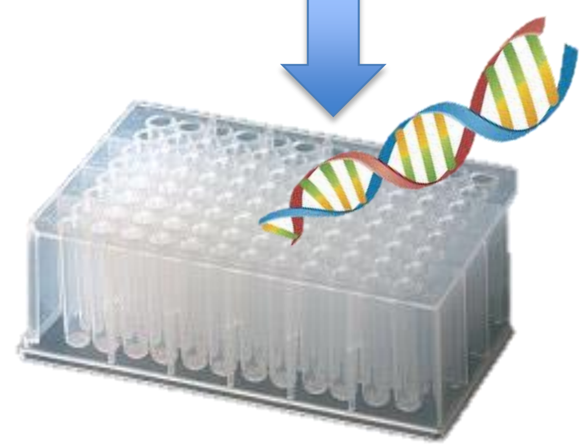


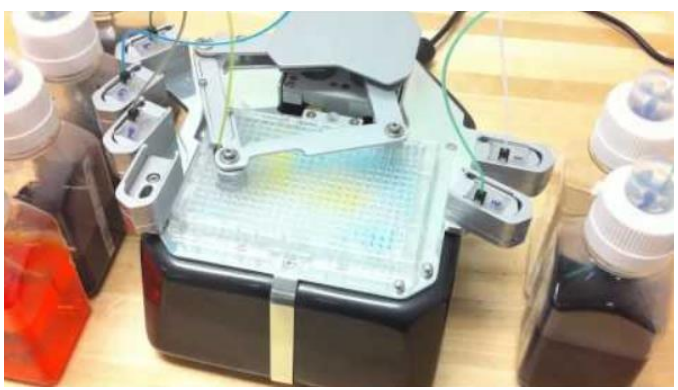


High-Throughput DNA Extraction from Leaf and Seed Samples



Bravo Liquid Handler

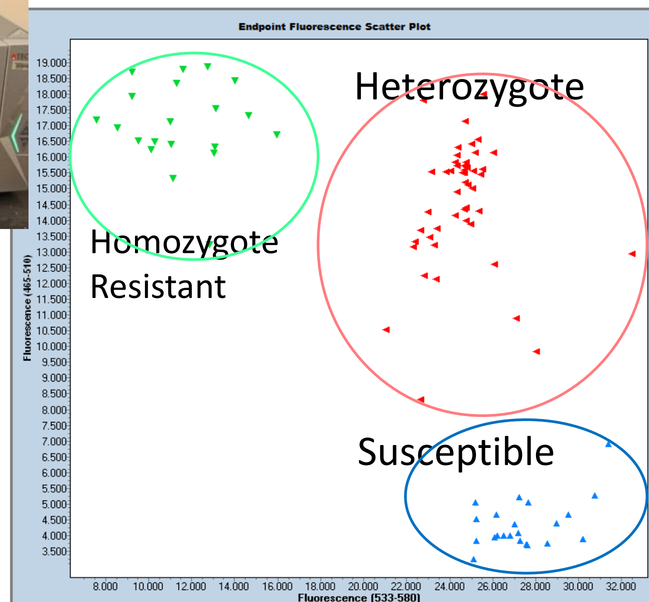


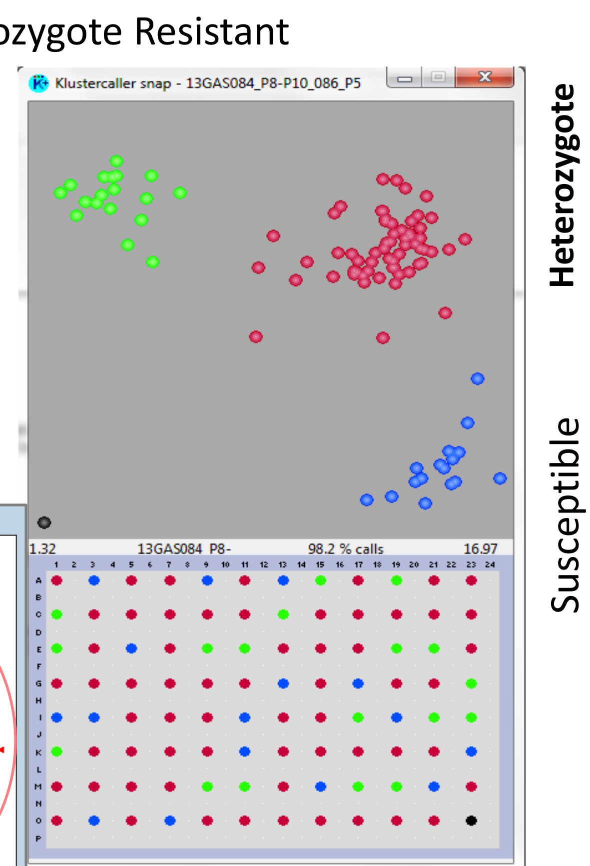


Mantis Dispenser

High-Throughput Genotyping SNP Assays For Molecular Breeding

- Robust markers for genotyping
- Over 40,000 samples were screened 2013



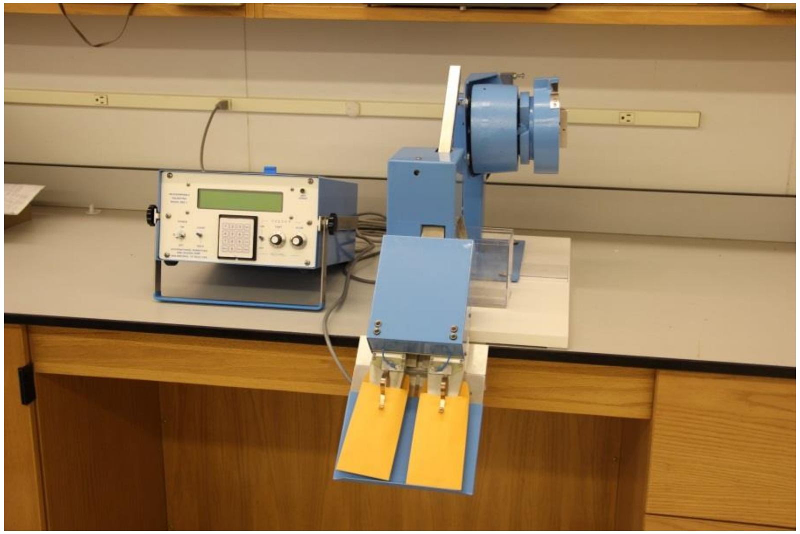


Phenotyping

High Throughput Seed Composition Analysis

Phenotyping

Advanced Seed Packaging Equipment



Accufast P4 Small Card & Packet Printer

Precision and high speed seed counter

Phenotyping

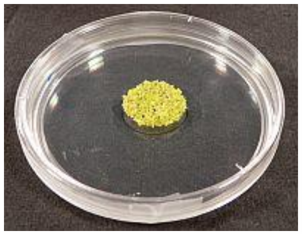
Advanced Field Plot Equipment

Plot combine

GPS guided precision planter

Single plant threshers

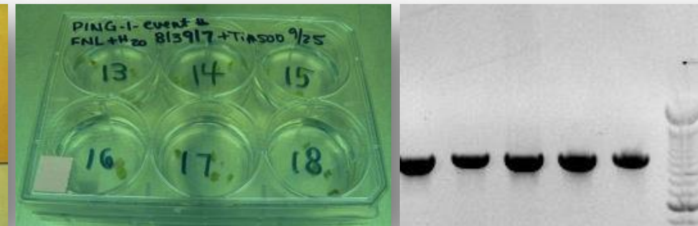
Biotechnology: Plant transformation


Somatic embryos
4 days


Bombardment
1 day

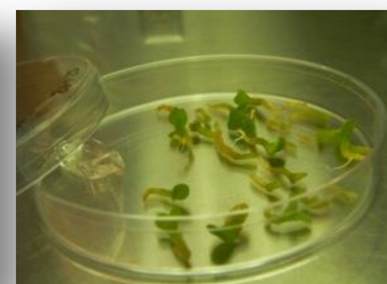

Recovery
1 wk


Selection
6-8 wk



Tissue amplification and PCR
4-6 wk


Differentiation
5-8 wk

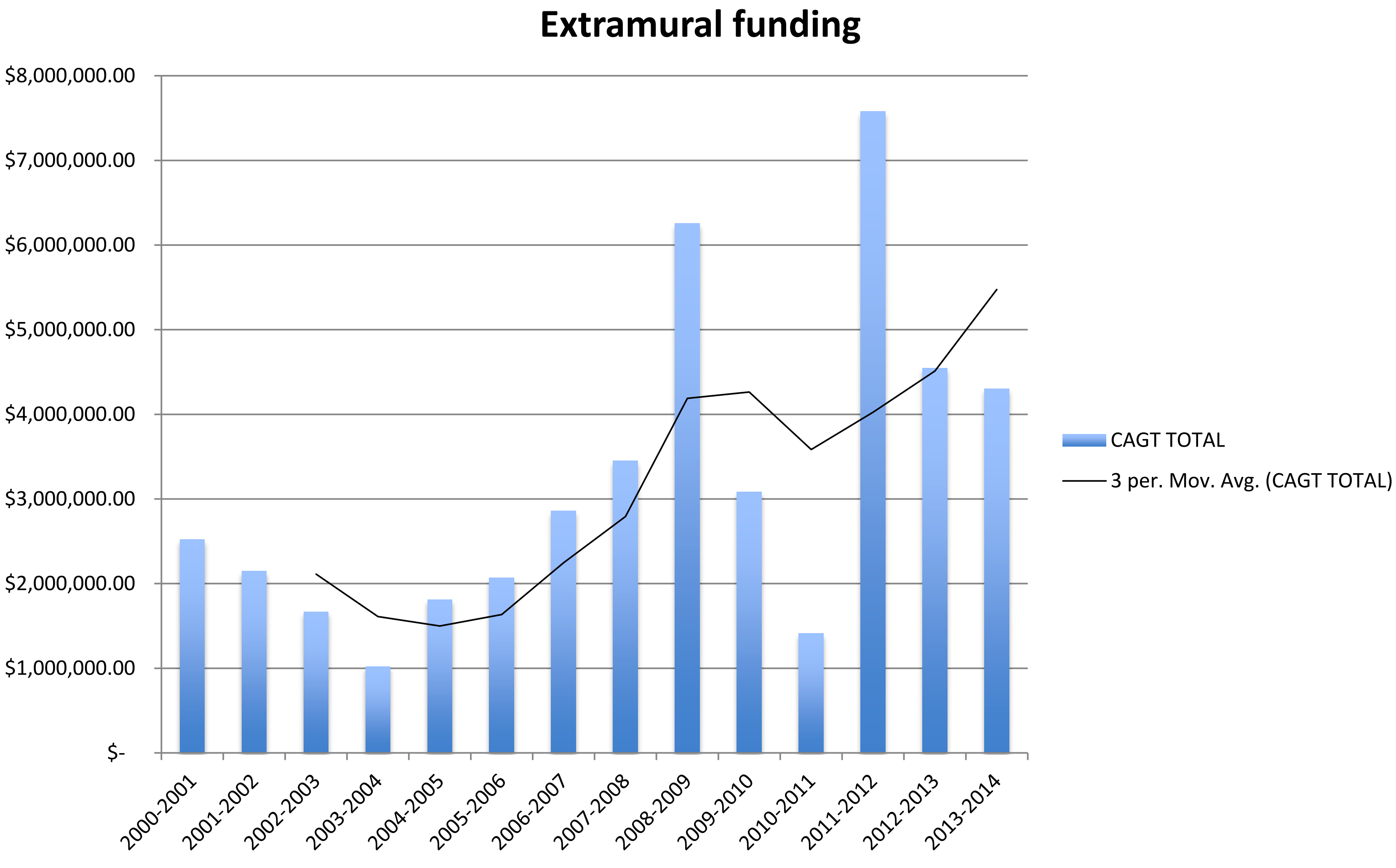

Desiccation
1 wk


Germination
1-2 wk


Conversion
1-2 mo


Greenhouse
3 mo

Metrics: Impacts



Publications and Presentations, since 2010

- Published > 140 papers in peer-reviewed journals. (including *Nature*, *Nature Biotech*, *Nature Genet*, *Science*…)
- >10 book chapters
- Over 100 invited presentations
- ~10 utility patents/patent disclosures

Soybean Variety and Germplasm Releases

- Released 12 soybean varieties
  – UGA Roundup Ready® dominate soybean production in the lower southeastern United States.
- Released 27 soybean germplasm with unique traits
  – widely used by private companies in breeding programs

Impact of UGA-developed crops

- Annual contributions of UGA varieties
  - **$60,000,000 from seed sales**
  - **$10,000,000 from turf sales**
- Number of jobs generated in GA to produce & sell seed of UGA varieties
  - **~2000**
- Annual royalties to UGA
  - **~$4 million**

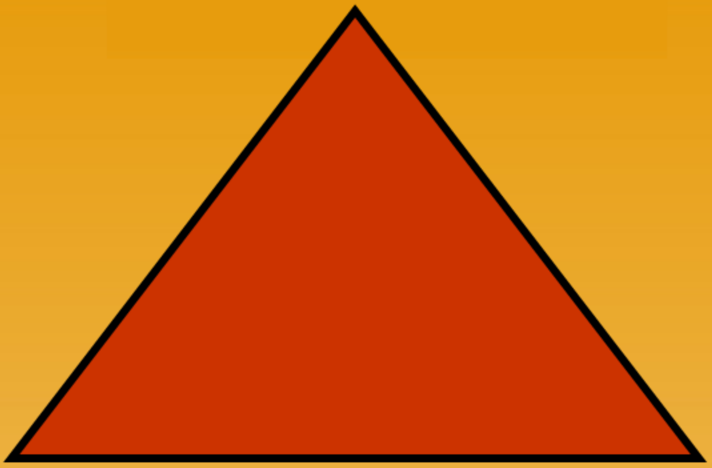

WSRC 2017 10
SAVANNAH GEORGIA USA
CELEBRATING 250 YEARS OF SOYBEAN IN NORTH AMERICA
World Soybean Research Conference 10
September 10-16, 2017 • Savannah, Georgia, USA
www.wsrc10.com

LEADERSHIP IN AGRICULTURE

CASE STUDIES

FOR THE NEXT GENERATION

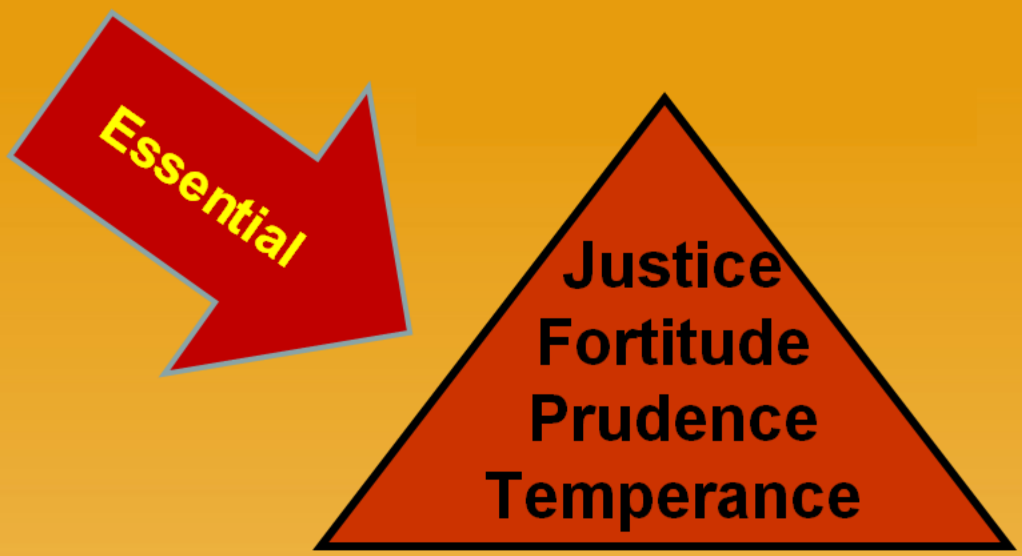
A Framework of Character for Leaders



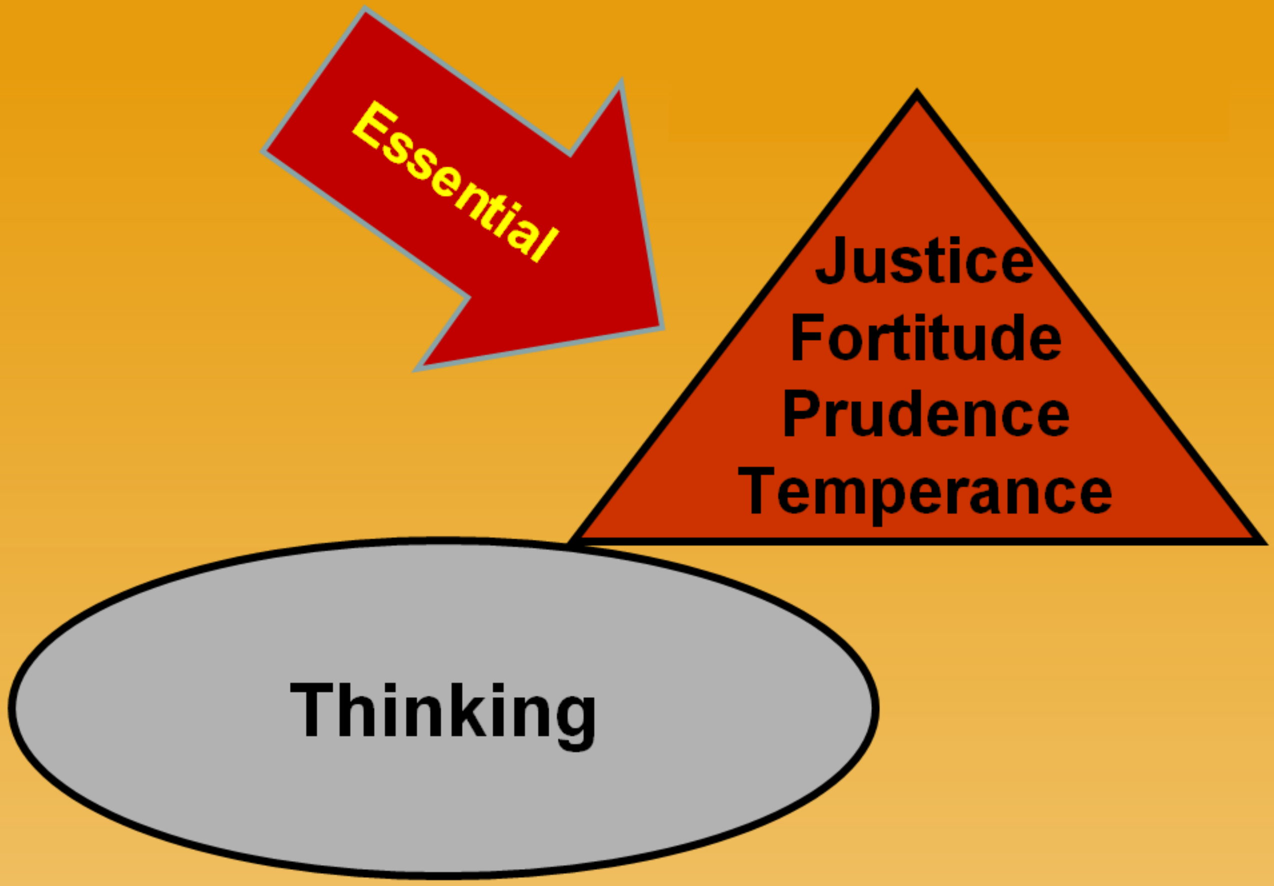
A Framework of Character for Leaders

Justice
Fortitude
Prudence
Temperance

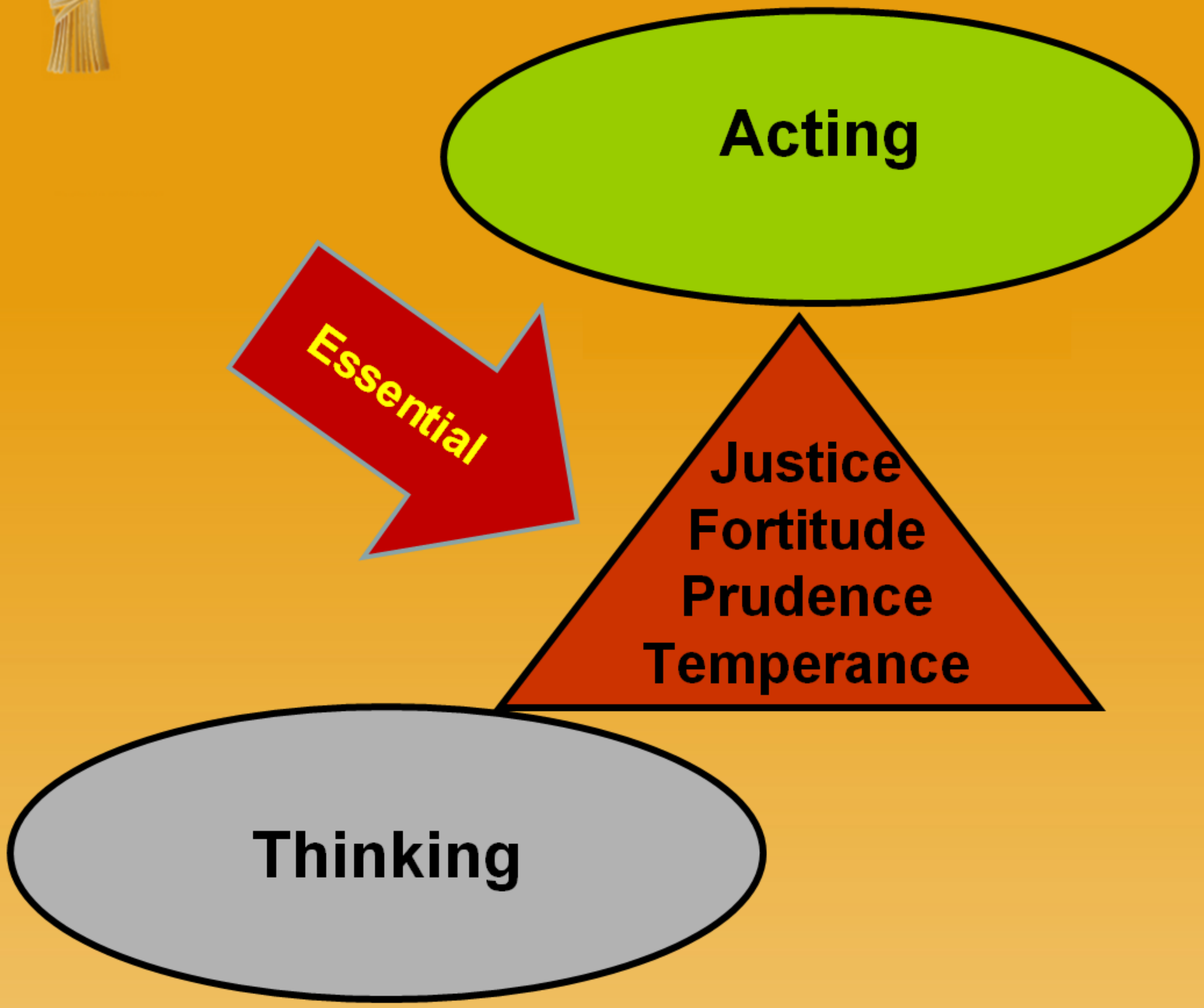
A Framework of Character for Leaders



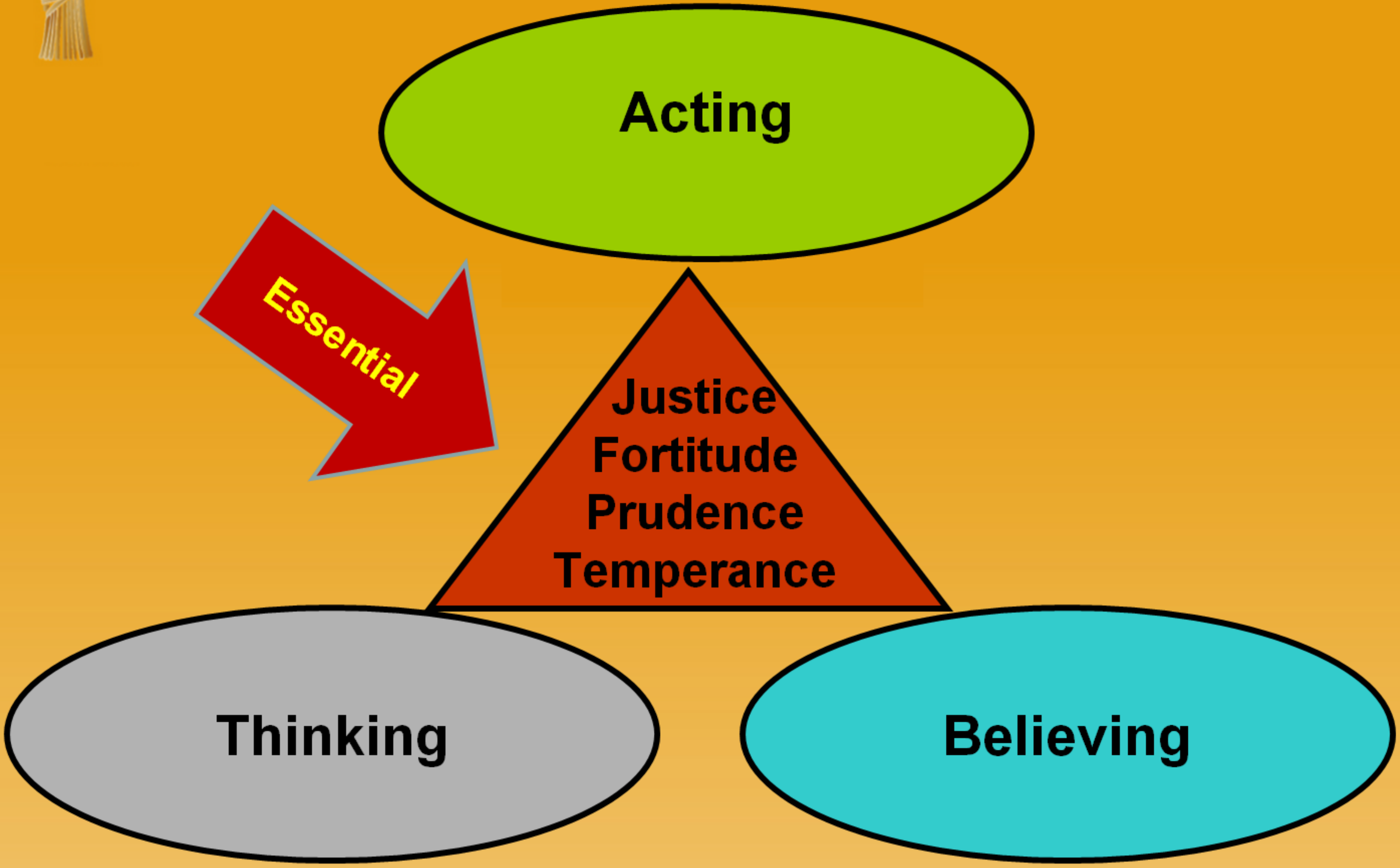
A Framework of Character for Leaders



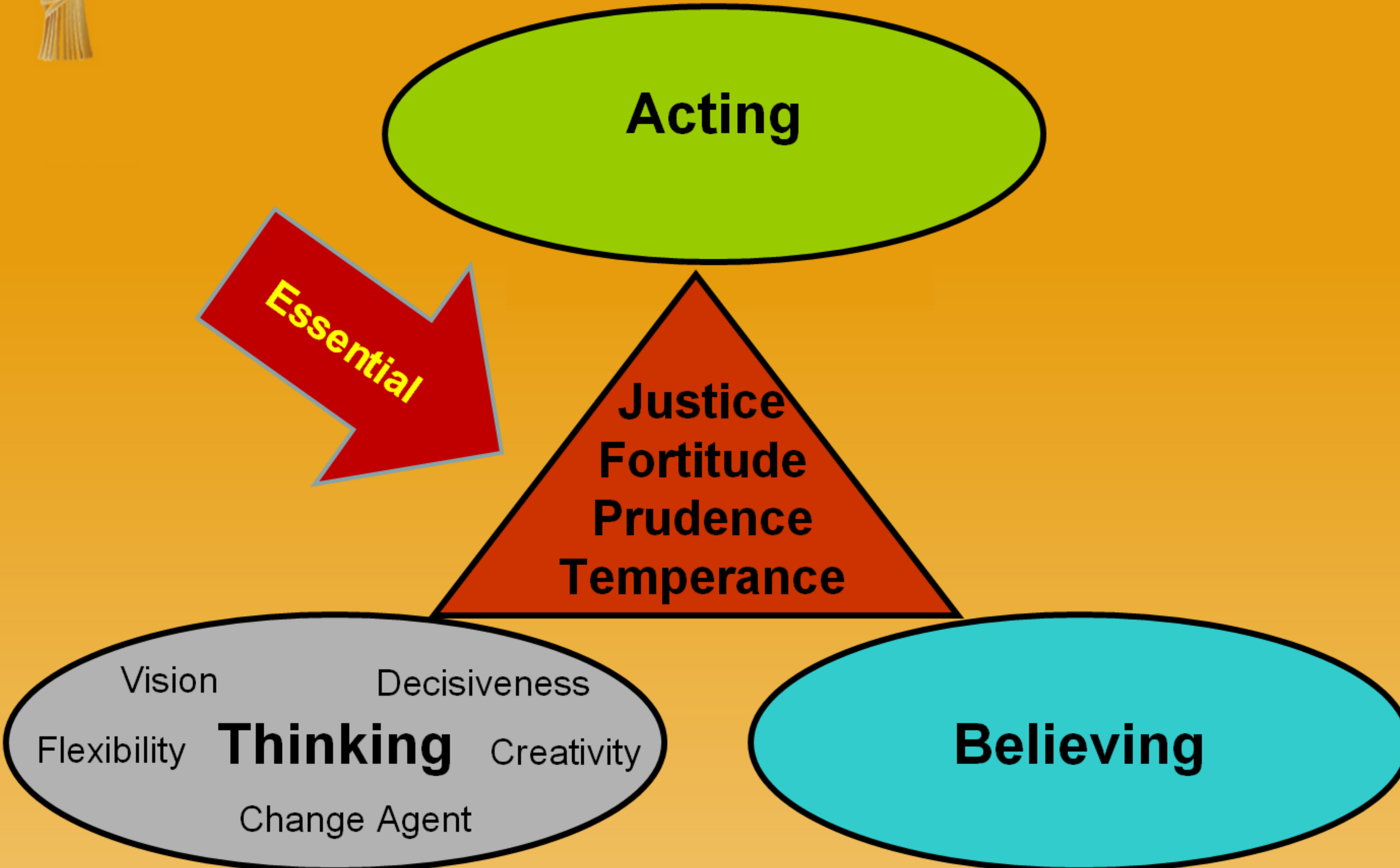
A Framework of Character for Leaders



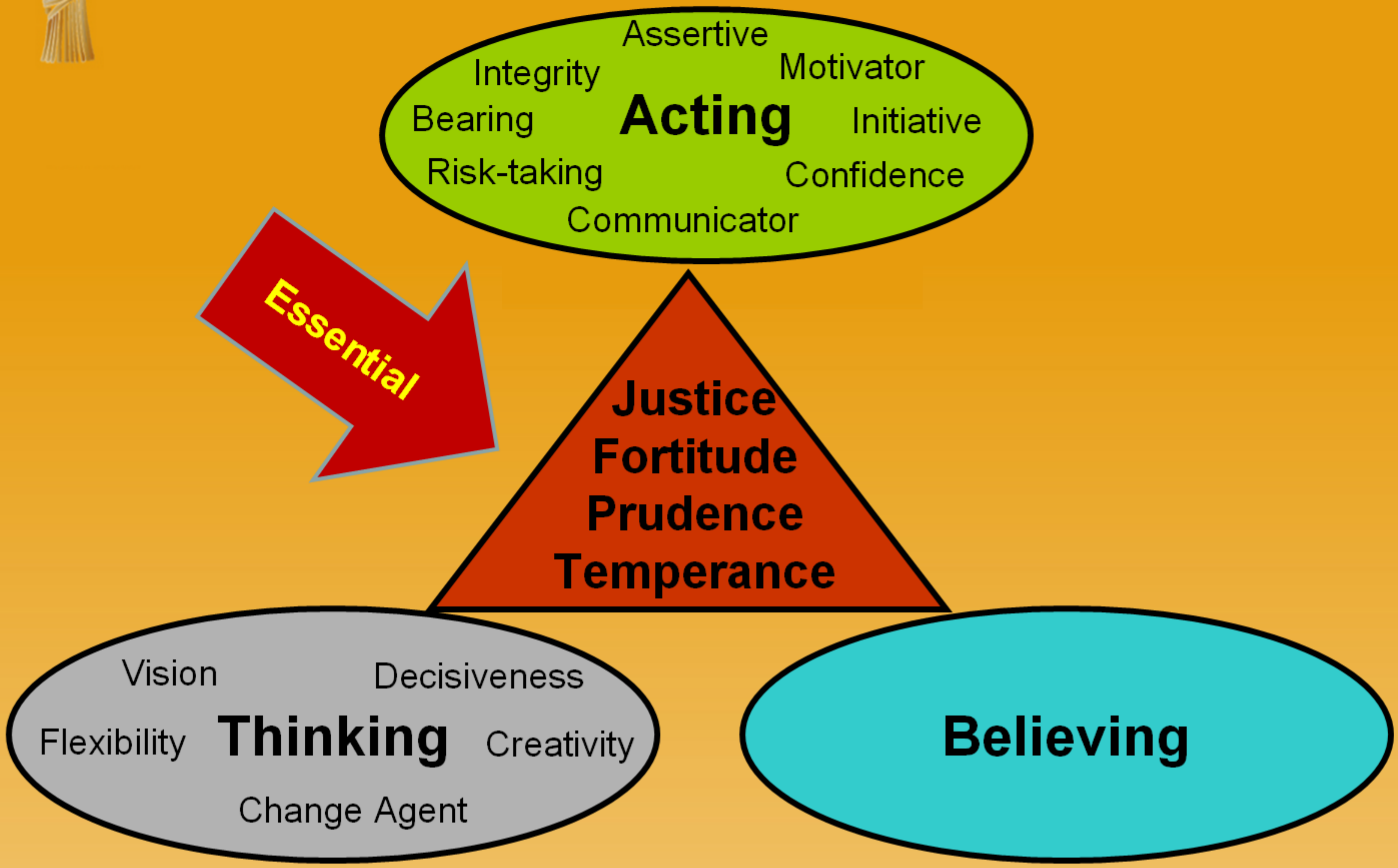
A Framework of Character for Leaders



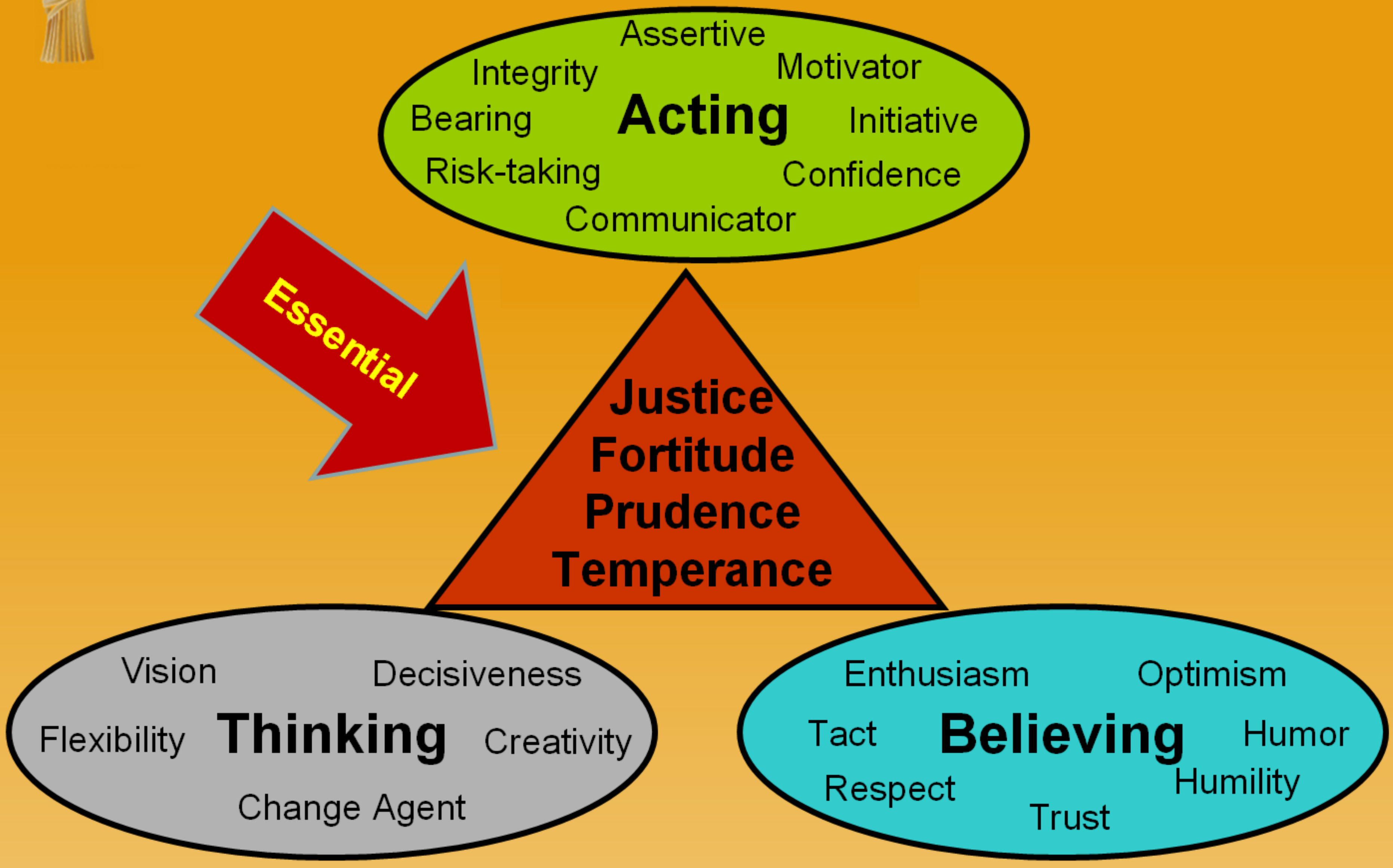
A Framework of Character for Leaders



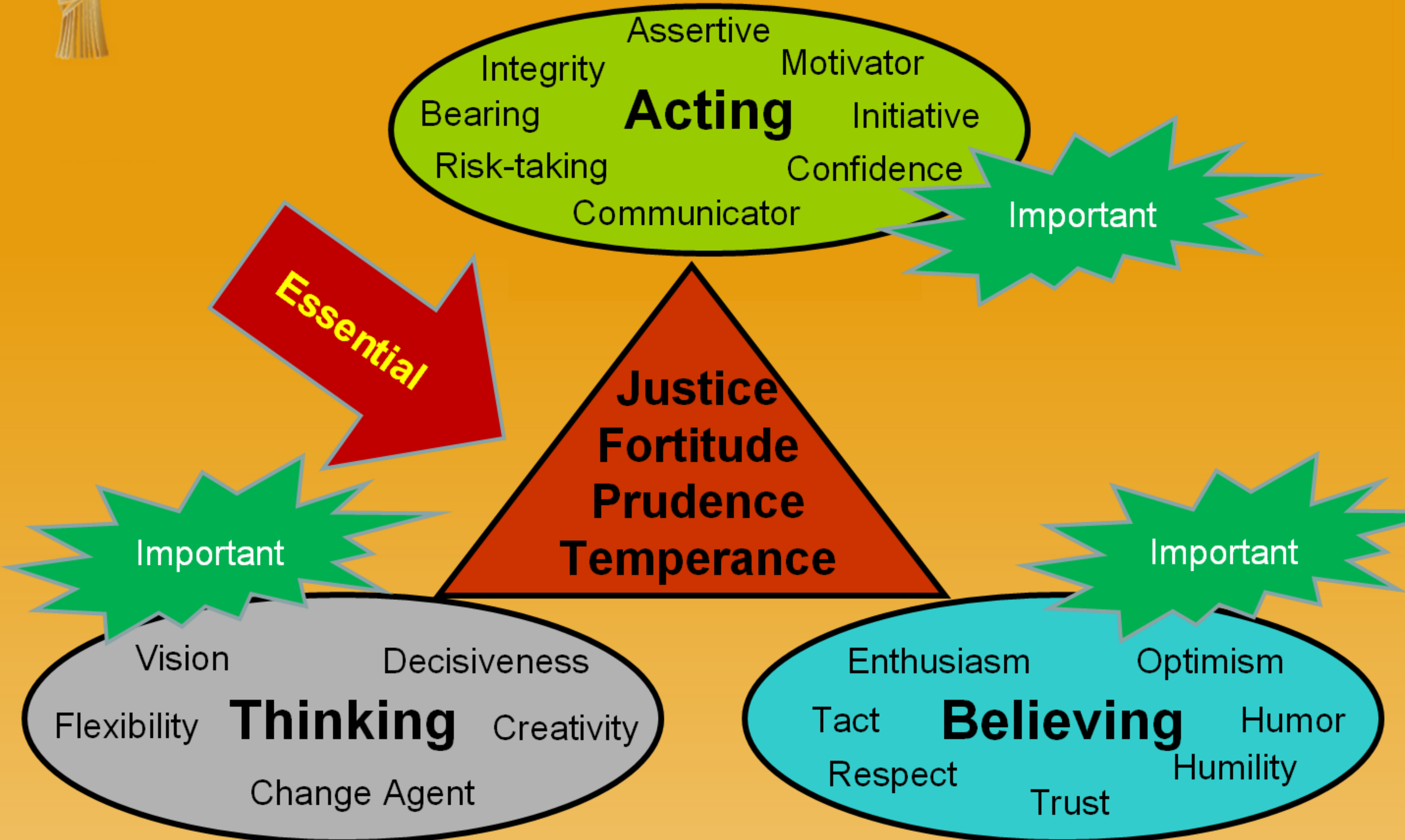
A Framework of Character for Leaders



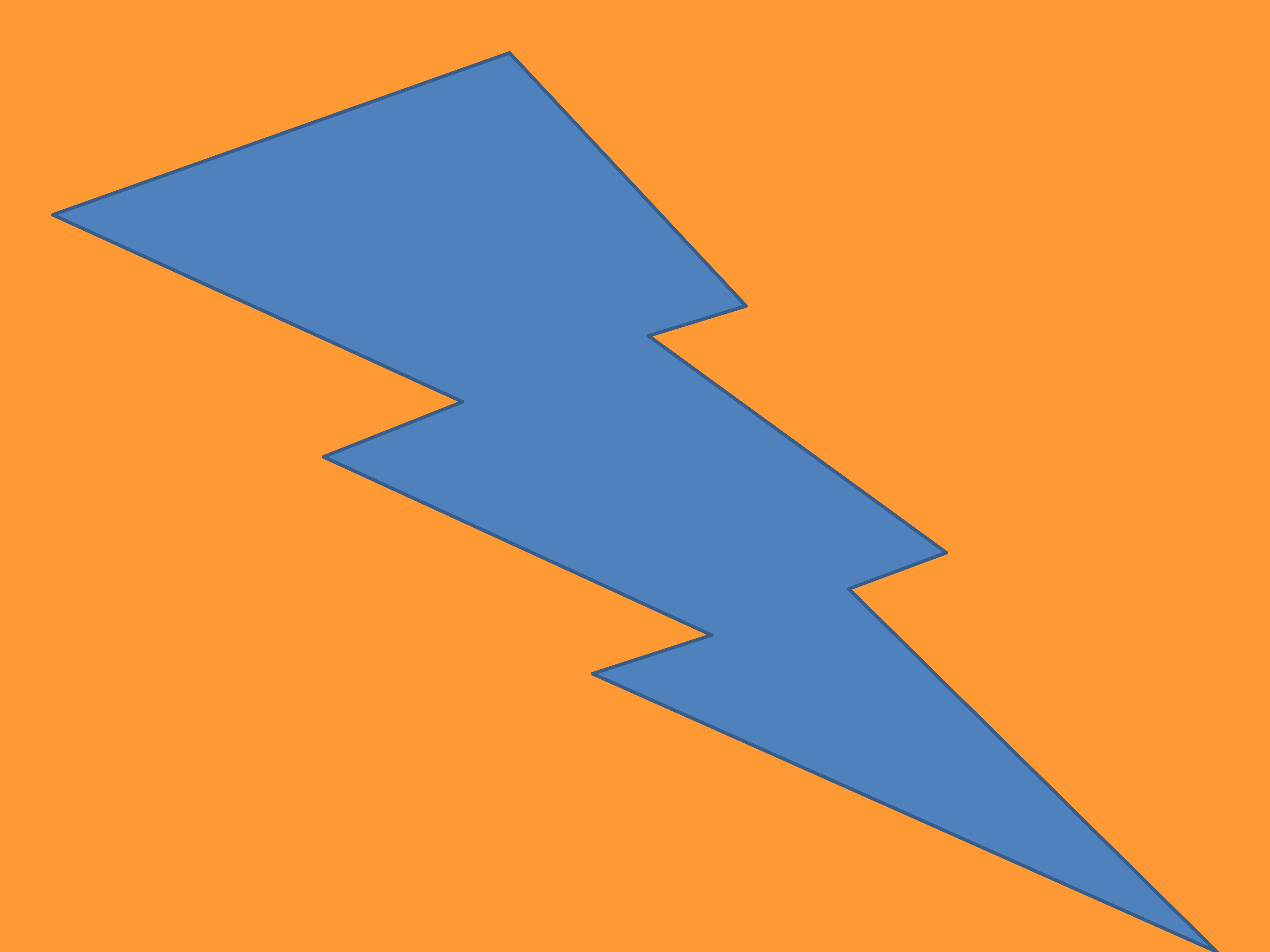
A Framework of Character for Leaders



A Framework of Character for Leaders



- As a text for a course on leadership
- Leadership framework and selected case studies for seminars a/o workshops
- Thematic use of case studies
- Content-driven study of agricultural issues
- Apply leadership framework to own cases
- Employ in differentiated development
- Read on own for personal and professional development



SRRC August 30, 2005

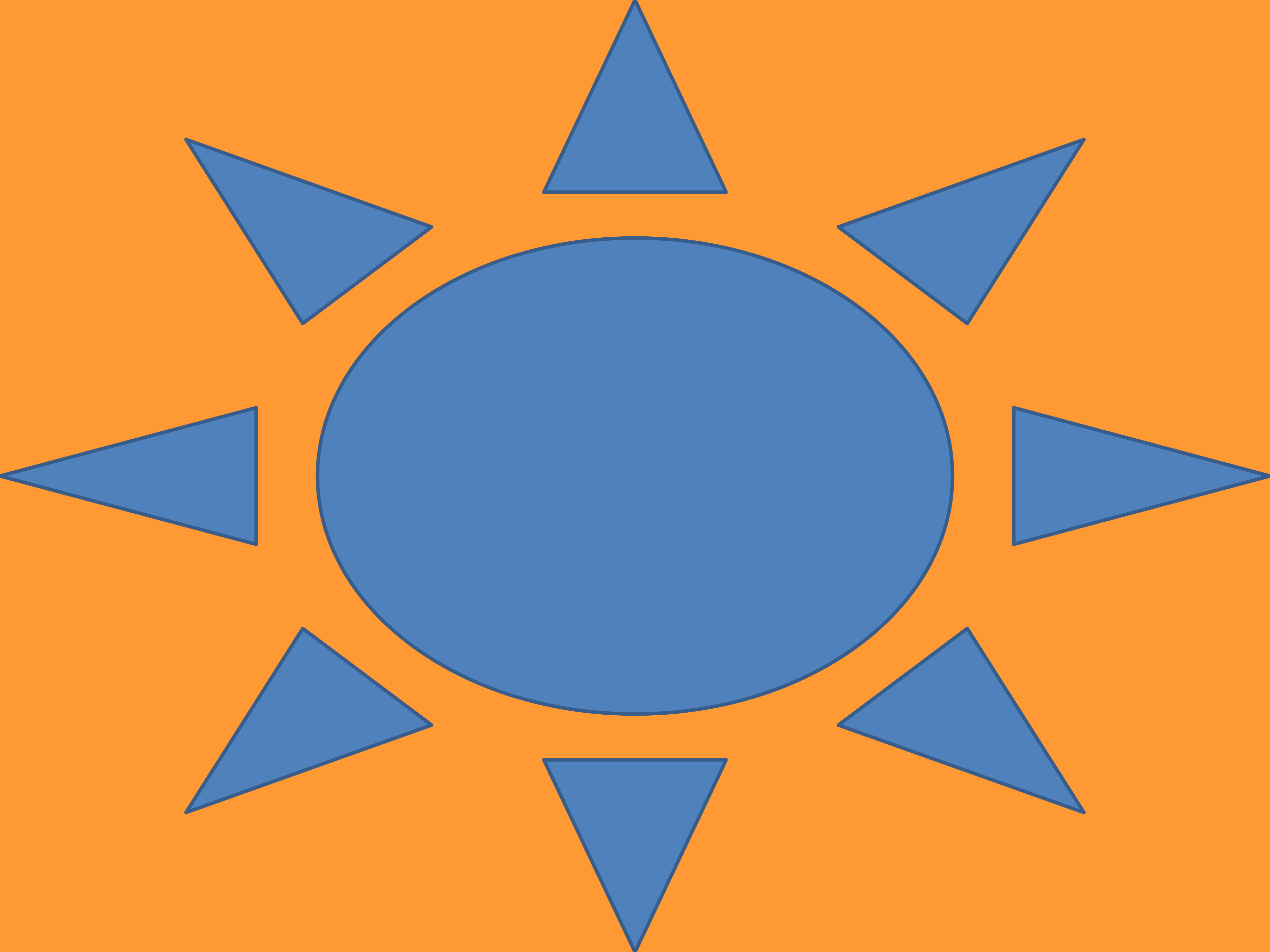
Southern Regional Research Center and Katrina

- August 29, 2005
- Evacuation of HQ to Stoneville, MS
- Scientists and staff located across the U.S.
- Challenge of finding people
- Leadership efforts
  - Daily/weekly bulletins
  - Research leaders/Project Leaders to visit their personnel *OFTEN* – research and personal issues
  - Per diem paid to all on staff & IRS Form 1040 for 2004
  - Each person brought back to check their lab & home

- Built FEMA trailer park on Campus
- Found $50,000,000 to repair damage to Center
- Productivity shown by authoring 75% of a normal number of scientific papers during the year
- Complete return to full activity by July 2006
- Celebrated this success and rededicated SRRC

- Weakness – did not have contact information on sta *outside* of the New Orleans area

FEMA Trailers, SRRC 2006



ARS and the Agricultural Research Agenda

Chavonda Jacobs-Young

Administrator
USDA Agricultural Research Service

A Year of Change for ARS

Evaluating corn grown in soil treated with alum in Maryland.

- New Administrator
- New funding increases
- New initiatives
- But same commitment to collaboration and research innovation

USDA and ARS

ARS is one of four agencies in the USDA Research, Education, and Extension mission area.

The others are:

- The National Institute of Food and Agriculture (NIFA),
- The Economic Research Service (ERS), and
- The National Agricultural Statistics Service (NASS).

Thomas Vilsack
USDA Secretary

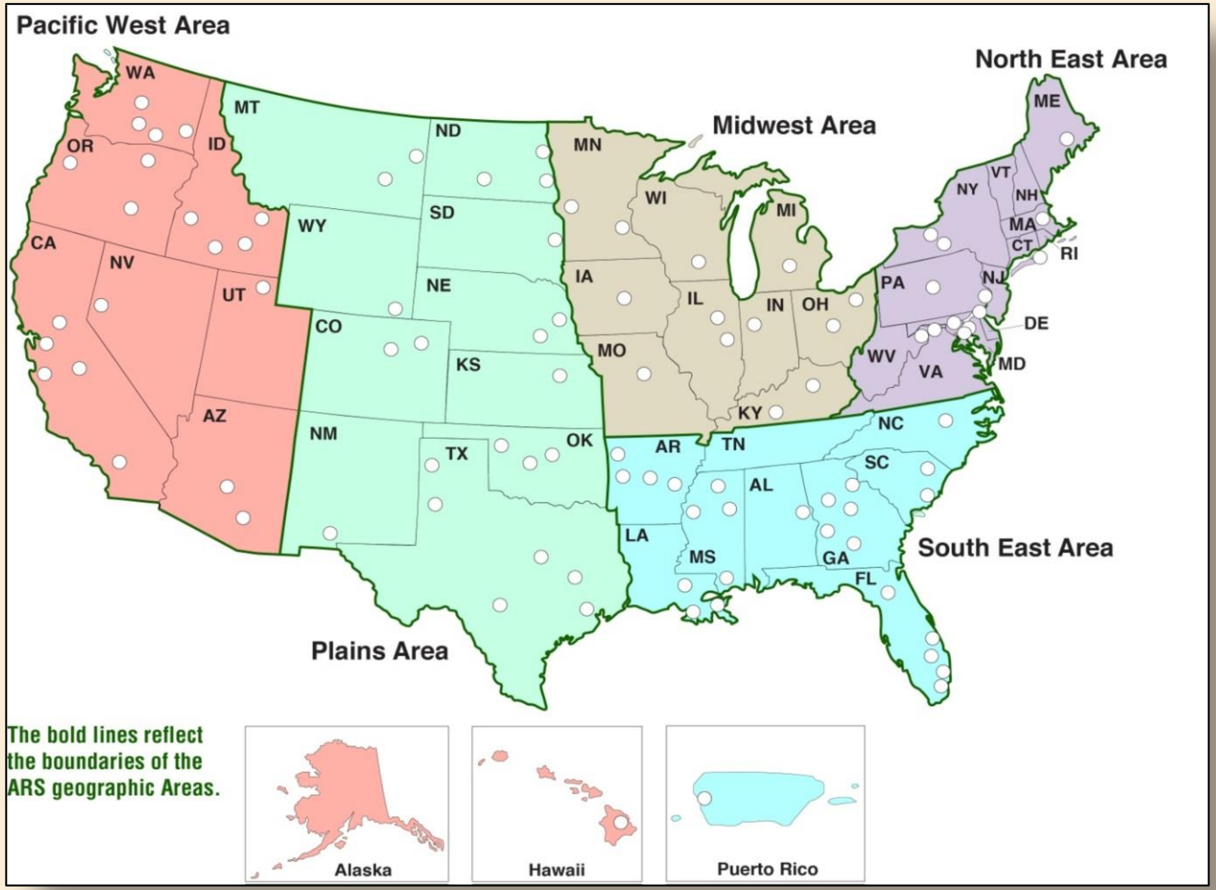
Dr. Catherine Woteki
Under Secretary, Research, Education, and Economics (REE)

Dr. Chavonda Jacobs-Young
Administrator
Agricultural Research Service

Dr. Steven Shafer
Associate Administrator
National Programs

Dr. Andrew Hammond
Associate Administrator
Research Operations
(Acting)

USDA's principal intramural research agency



- 8,000 employees
- 2,100 Ph.D. scientists
- 800+ research projects
- About 90 U.S. locations and labs in Argentina, Australia, China, and France

ARS Research Priorities

- Food Security and Hunger
- Sustainable Energy and Bioproducts
- Food Safety
- Climate Change/Sustainability
- Human Nutrition and Obesity

Monitoring weather equipment used in Jornada Range climate change studies.

ARS' Budget in FY 2014

Testing sanitizers to enhance the microbial safety of spinach.

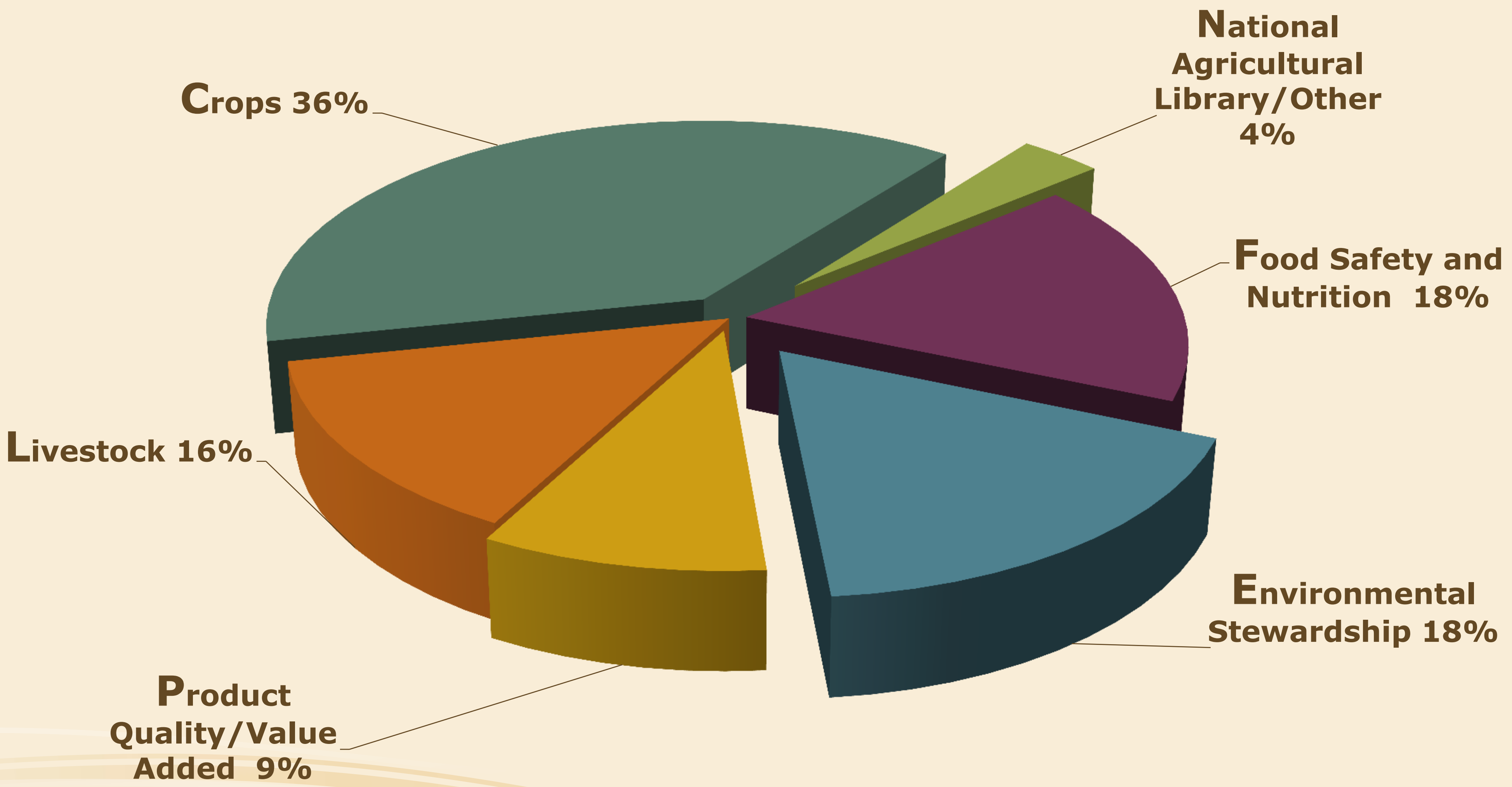
- Current level: $1.12 billion
- Net $105 million increase (9.4%) from FY 2013
- Funding below FY 2010 level, but higher than FY 2012 & FY 2013
- First employee pay increase (1%) since 2010.

New Funding Initiatives in FY 2014

- Big Data
- Antimicrobial resistance
- Long-Term Agro-ecosystem Research (LTAR) network
- Genetic resources and information

Using a nitrogen loss model to assess nitrogen management.

ARS Program Distribution



USDA
AGRICULTURAL RESEARCH SERVICE

USDA 2014 Farm Bill

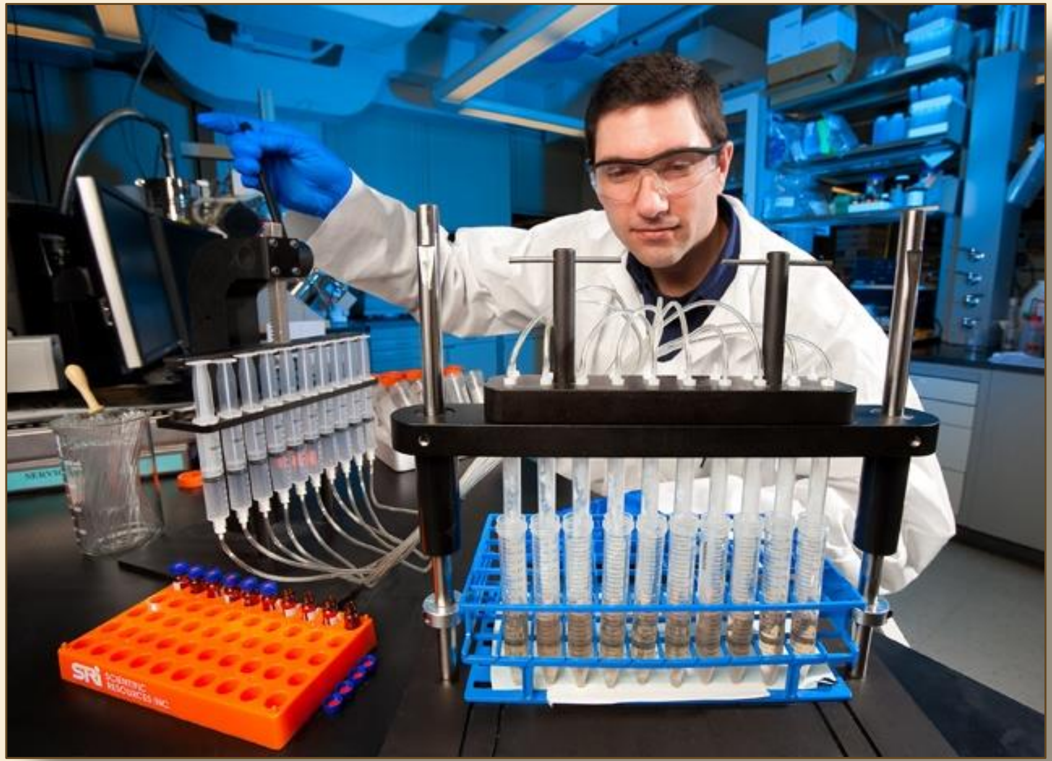
- Most research grant programs extended and funding levels increased
- New Emergency Citrus Disease Research and Extension Program added - $24 million/year
- Federal funding now considered part of grant match requirement.
- New cooperative funding opportunities for ARS-University collaborations

USDA 2014 Farm Bill

- Establishes new non-profit Foundation for Food and Agriculture Research; Private/Public partnership
- $200 million from USDA with match from industry
- Leverages Federal investment in agricultural research to supplement USDA research activities

President’s FY 2015 Proposed Budget

- Continuing resolution to Dec. 15 at FY 2014 levels
- FY 2015 proposed funding level – $1.10 billion
- Net $18 million reduction (1.6%) from FY 2014
- $155 million for Southeast Poultry Disease Research Lab



Testing food samples for contaminants.

USDA AGRICULTURAL RESEARCH SERVICE

President's FY 2015 Proposed Budget

Inspecting honey bees for mites and brood disease in Maryland

FY 2015 Budget proposes two new crosscutting, multidisciplinary program initiatives:

- Climate Resilient Land, Crop, Grazing, and Livestock Production Systems, $44 million.
- Advanced Crop and Livestock Genetic Improvements and Translational Breeding for Enhanced Food Production, $25.9 million.

In addition, ARS is requesting $4 million for pollinator health and additional research on Colony Collapse Disorder.

The Future …

- Develop technology platforms to help us stay connected and work better together, within ARS and with outside partners
- Value excellence; Be proactive in seeking high-quality science and innovations
- Streamlining business processes; Consolidating administrative functions and Areas
- Succession planning – bringing in the next generation of scientists

Pointing out bluetongue virus proteins on autoradiographic film to student researcher.

Our Challenges for the Future

- Food Security and Hunger
- Sustainable Energy
- Food Safety
- Climate Change
- Nutrition and Health

Training the Next Generation

ARS involvement in training and mentoring – 2013	
Pathways Interns	360
Graduate Students	850
Undergraduate Students	960
Post-Docs	335
Adjunct Appointments	1,137
Scientists serving as Student Advisors	714

Sorting aquatic insects for biological monitoring of water quality In Florida.

USDA AGRICULTURAL RESEARCH SERVICE

Research with ARS Land-Grant Partners

Students sample blood from hybrid striped bass grown on diets containing high levels of flax oil and probiotics.

ARS Cooperative Research Funding – 2014	
Number of Projects	359
Participating Universities	46
Number of States	43
Total Funding	$30.45 million

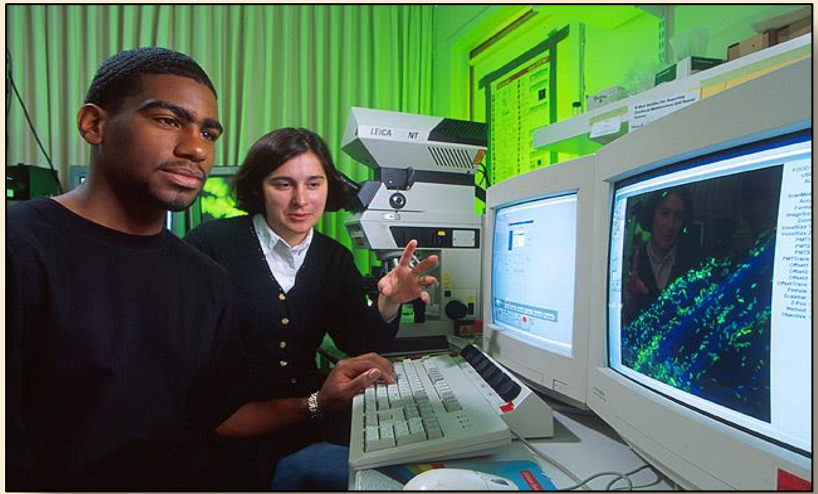
Research with ARS Land-Grant Partners

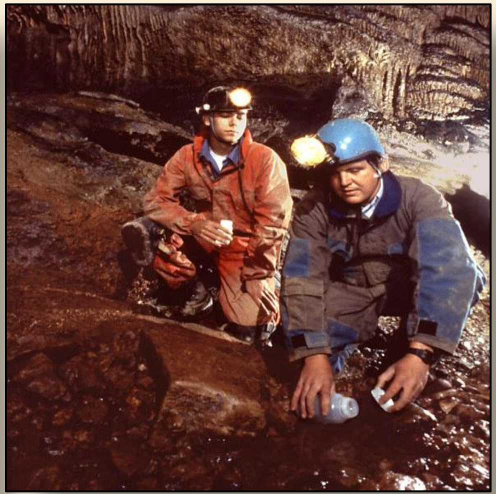
ARS Cooperative Research Funding from University Partners – 2014	
Number of Projects	270
Participating Universities	42
Total Funding	$22.8 million

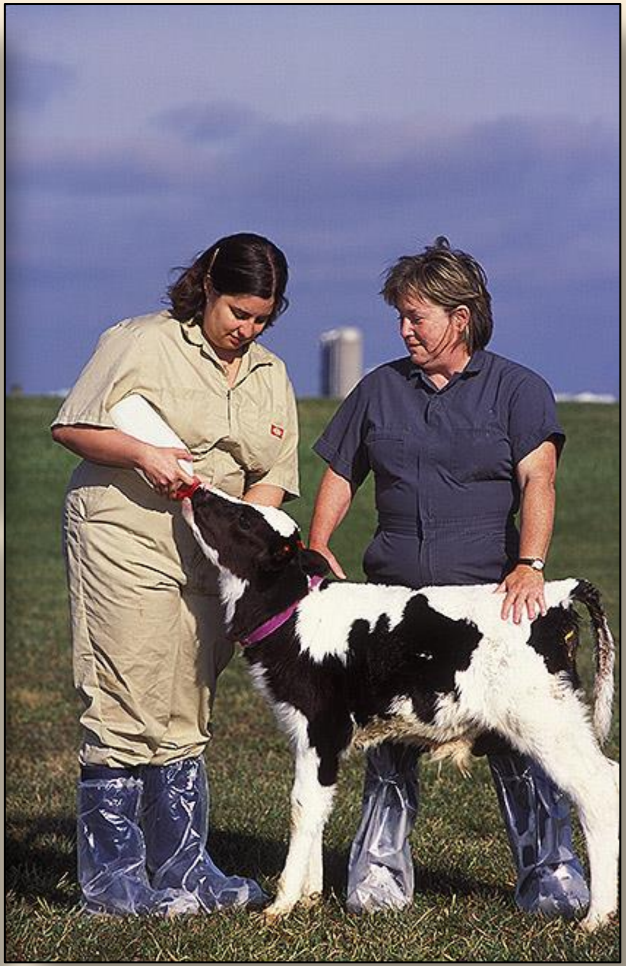
Measuring arsenic levels in water samples from the Eastern Shore area of Maryland.

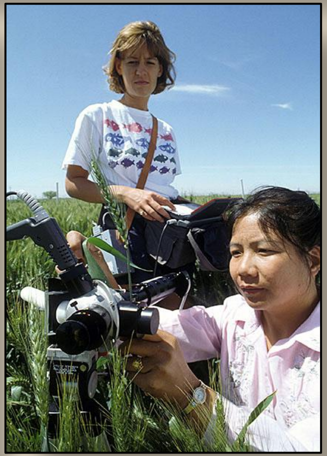
USDA AGRICULTURAL RESEARCH SERVICE

Meeting the Future Challenges at ARS

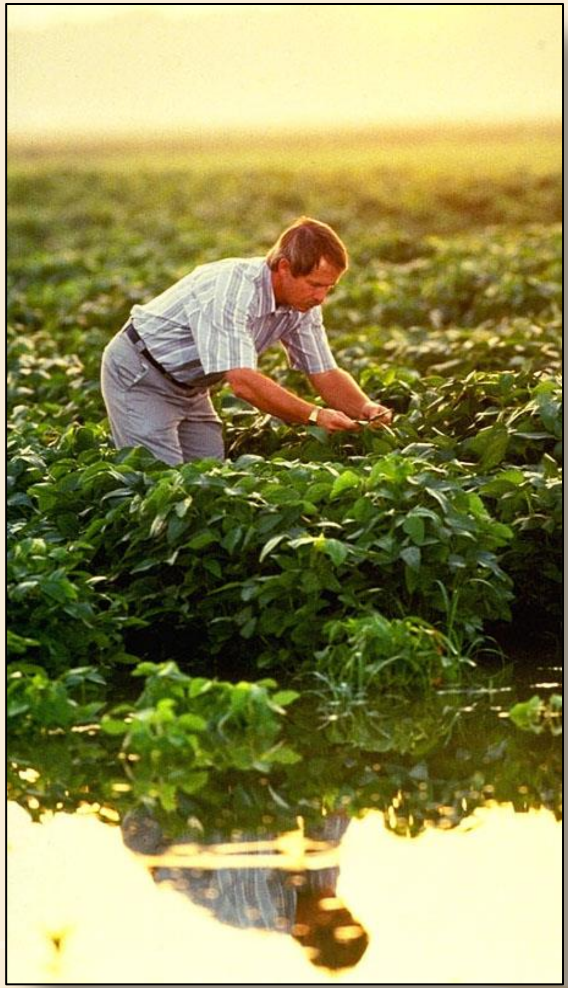








Leading America towards a better future through agricultural research and information.



USDA

AGRICULTURAL RESEARCH SERVICE

CAFNR
College of Agriculture, Food and Natural Resources

ARS Interactions with the College of Agriculture, Food and Natural Resources

University of Missouri

Collaborating for the Greater Good

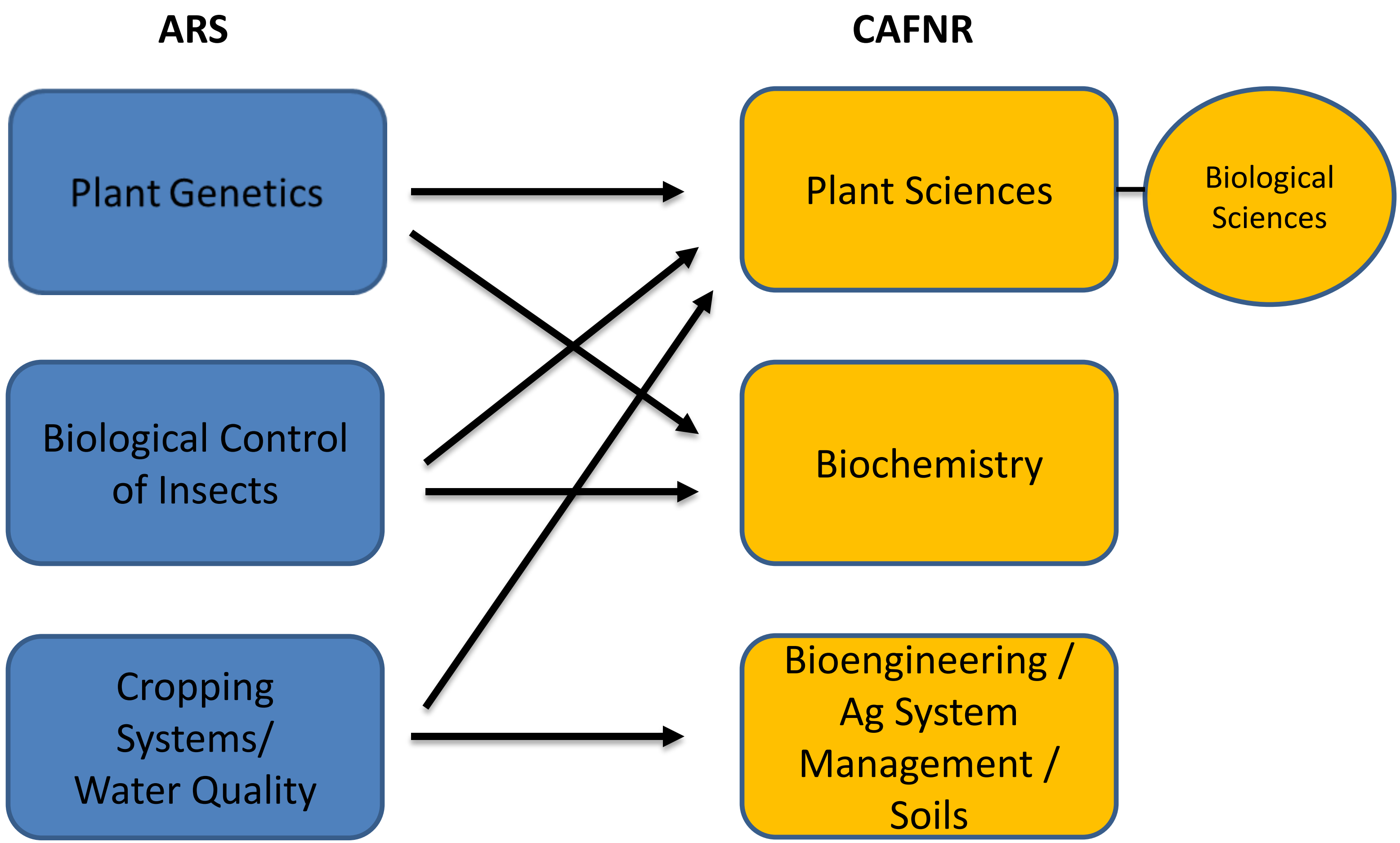
CAFNR: six academic divisions

- Plant Sciences
- Biochemistry
- Animal Sciences
- Food Systems and Bioengineering
- Applied Social Sciences
- Natural Resources

ARS Research Units

- Plant Genetics Research Unit
- Biological Control of Insects Research Laboratory
- Cropping Systems & Water Quality Research Unit

CAFNR
College of Agriculture, Food and Natural Resources



Collaborating for the Greater Good

Positive Interactions

- Adjunct Faculty Status in CAFNR Divisions
- Guest Lectures
- Collaborative Grant Proposals
- Shared Use of Facilities / Equipment
- Joint Authorship on Publications
- Graduate Education
  - Advising Graduate Students
  - Service of Graduate Committees
- Participation in Ag Research Center Field Days, Workshops, etc.

Challenges

- ARS Leadership
  - National /Regional
  - Research Units RLs (Research Leaders)

- Geography
  - Co-located with College Faculty in Academic Bldgs

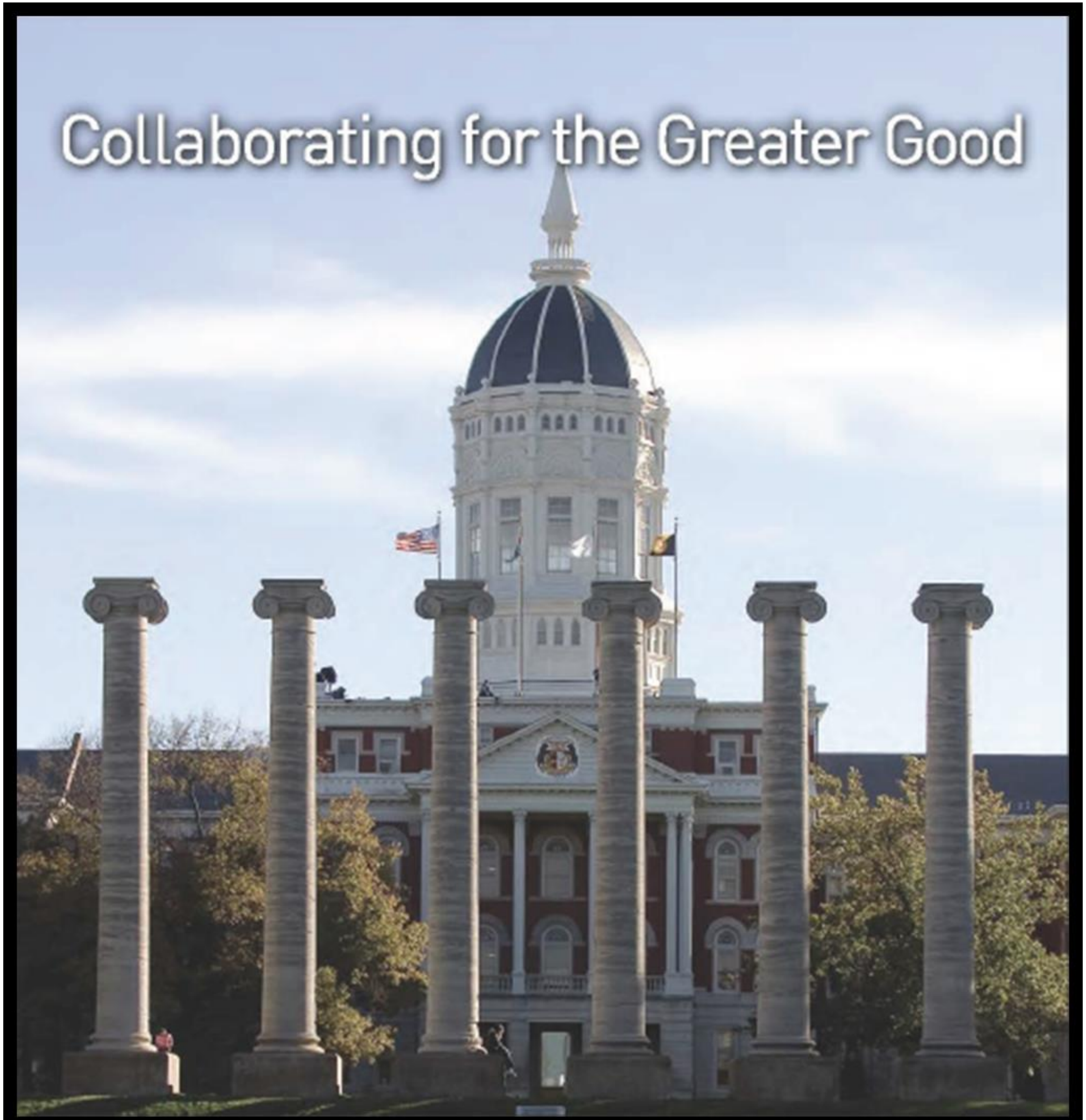
    or
  - Located in ARS Facility

Successful Collaborations

- Interdisciplinary Plant Group (IPG)
  - ~60 faculty: Plant Sciences, Biochemistry, Biological Sciences, ARS Plant Genetics Unit

- Maize Genetics Center

- High Oleic Soybean Technology
  - Grover Shannon (MU) & Kristin Bilyeu (ARS)
  - The only non-GM hi-oleic technology
    - Joint patent (USDA-MU-MO Soybean Association)


Collaborating for the Greater Good

THE PHYTOBIOMES INITIATIVE

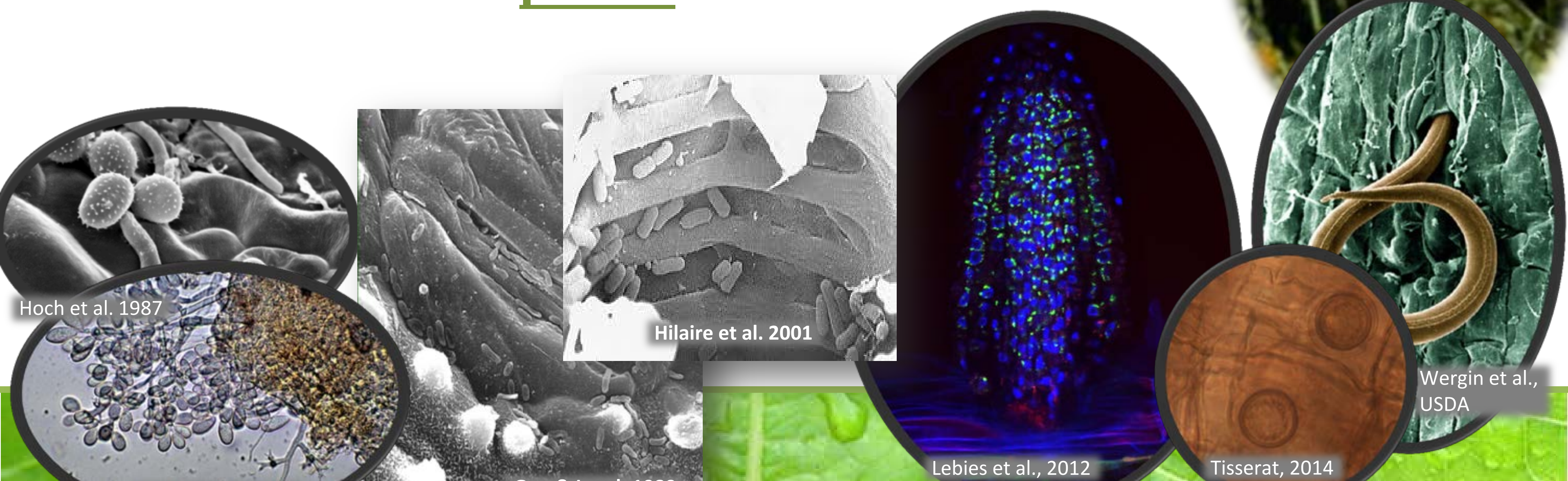
An initiative from the American Phytopathological Society (APS)

Jan E. Leach, Chair
APS Public Policy Board
Colorado State University

Phytobiomes Initiative

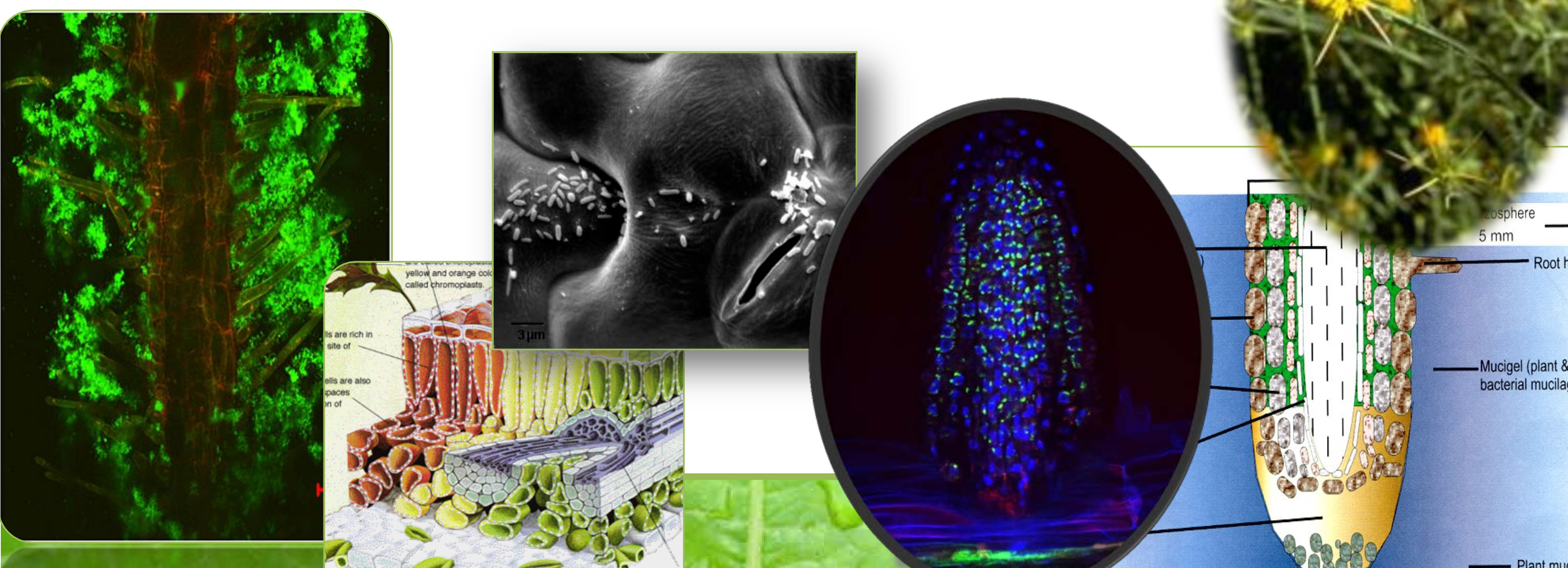
What is the *Phytobiome*?

- All organisms living in, on and around plants
  - microbes (the plant microbiome)
    - animals (insects, nematodes, etc)
      - other plants



What is the *Phytobiome*?

- Encompasses the many organisms that influence or are influenced by the plant or plant environment (including the soil)



Phytobiomes Initiative

Phytobiomics is focused on systems biology:

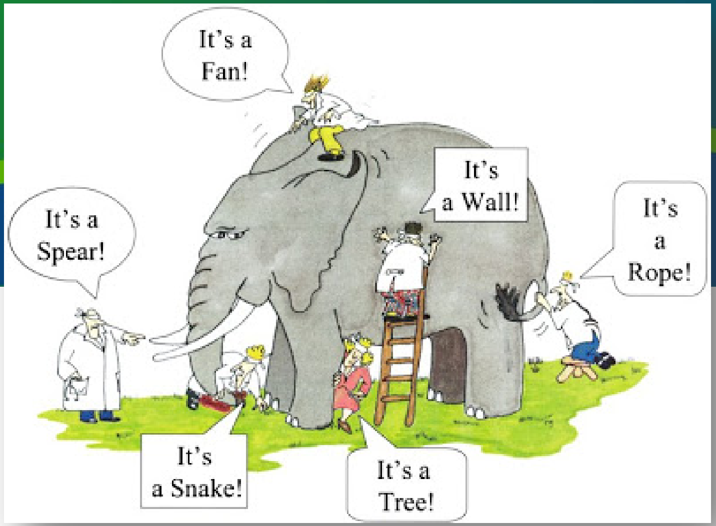
- Understanding interactions <u>in context</u>
- Integrated analysis of biotic and abiotic impacts on plants and their environment

The Phytobiomes Initiative targets an understanding of:

- how organisms associated with plants influence or are influenced by the plant or the plant environment,
- how that information can be used to improve crop productivity, quality, and safety

GOAL

- By 2025, a comprehensive understanding of phytobiomes to improve crop productivity



Where are we starting?
Phytobiomes:

- include individual organisms that function as commensals, pathogens and beneficials
  Most studies of one/few organisms → **What about communities?**

- include cultured and non-cultured organisms
  Most studies of cultured organisms → **Roles for non-cultured?**

- are influenced by many biotic and abiotic stresses
  Most studies of one plant/microbe/stress at a time
  → **Can we integrate our knowledge of the *SYSTEM*?**

Phytobiomes Initiative

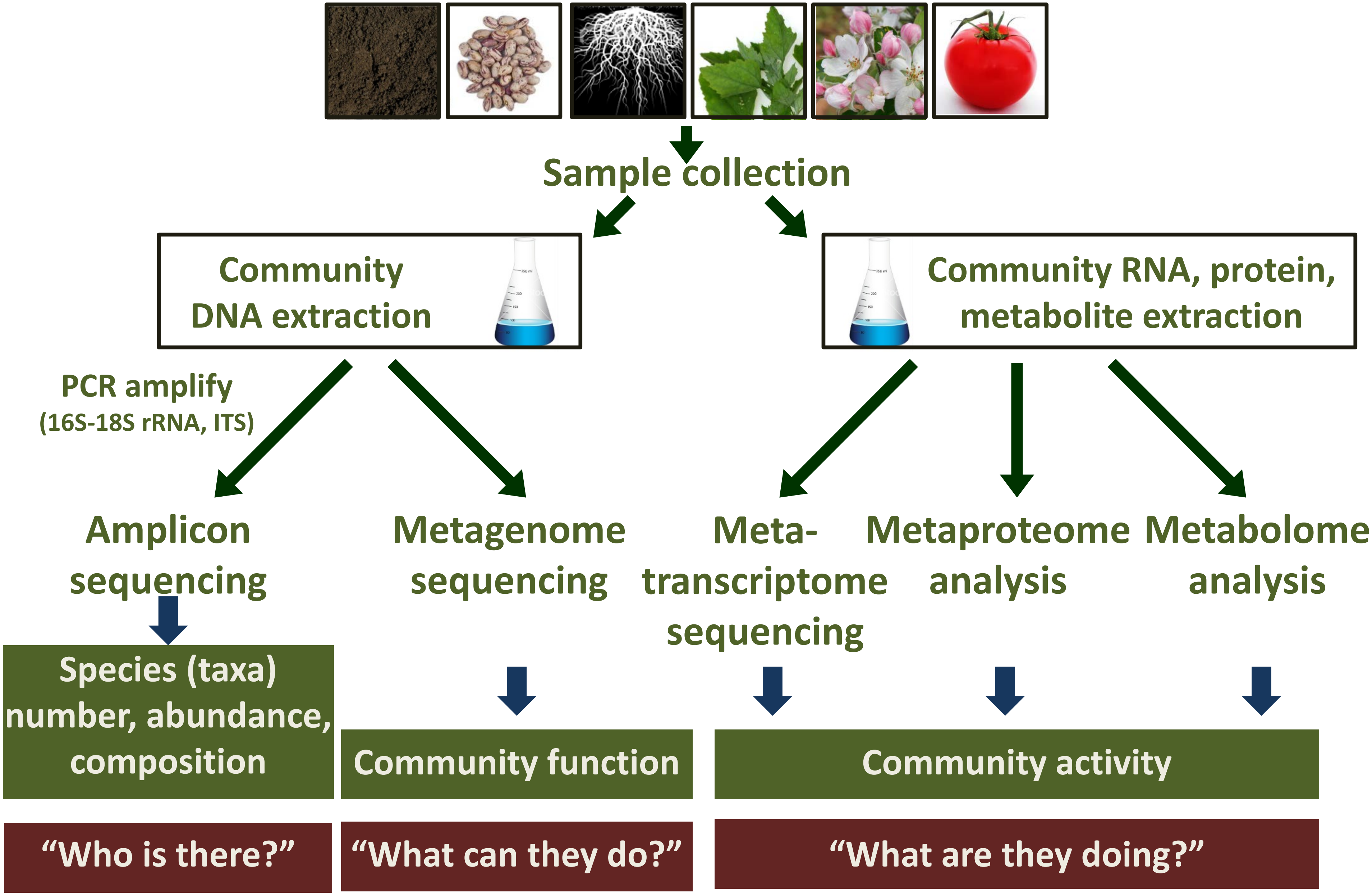
Why the Phytobiomes Initiative now?

- **Advances in metagenomics-enabling technologies**:
  - high-throughput sequencing
  - computational biology
  - other 'omics' technologies

- **Systems-level approaches**

- **Human Microbiome discoveries**
  - lessons learned
  - paradigm shifts
  - applications

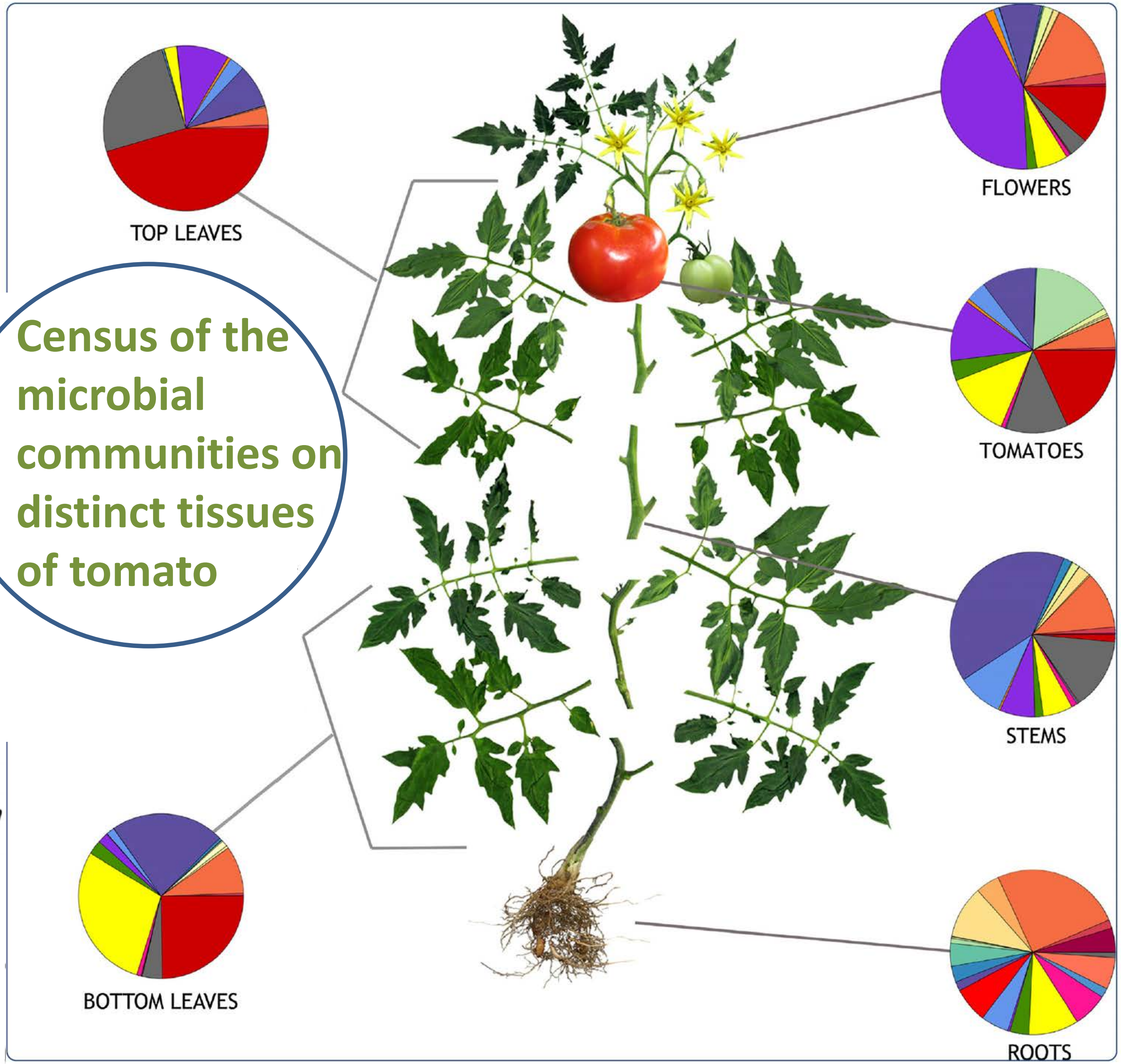
These advances are enabling us to assess the community composition, function, and activity of culturable and non-culturable organisms in the phytobiome


Sample collection
Community DNA extraction
Community RNA, protein, metabolite extraction
PCR amplify
(16S-18S rRNA, ITS)
Amplicon sequencing
Metagenome sequencing
Meta-transcriptome sequencing
Metaproteome analysis
Metabolome analysis
Species (taxa) number, abundance, composition
Community function
Community activity
“Who is there?”
“What can they do?”
“What are they doing?”

Who is there?

Bacterial communities

Census of the microbial communities on distinct tissues of tomato

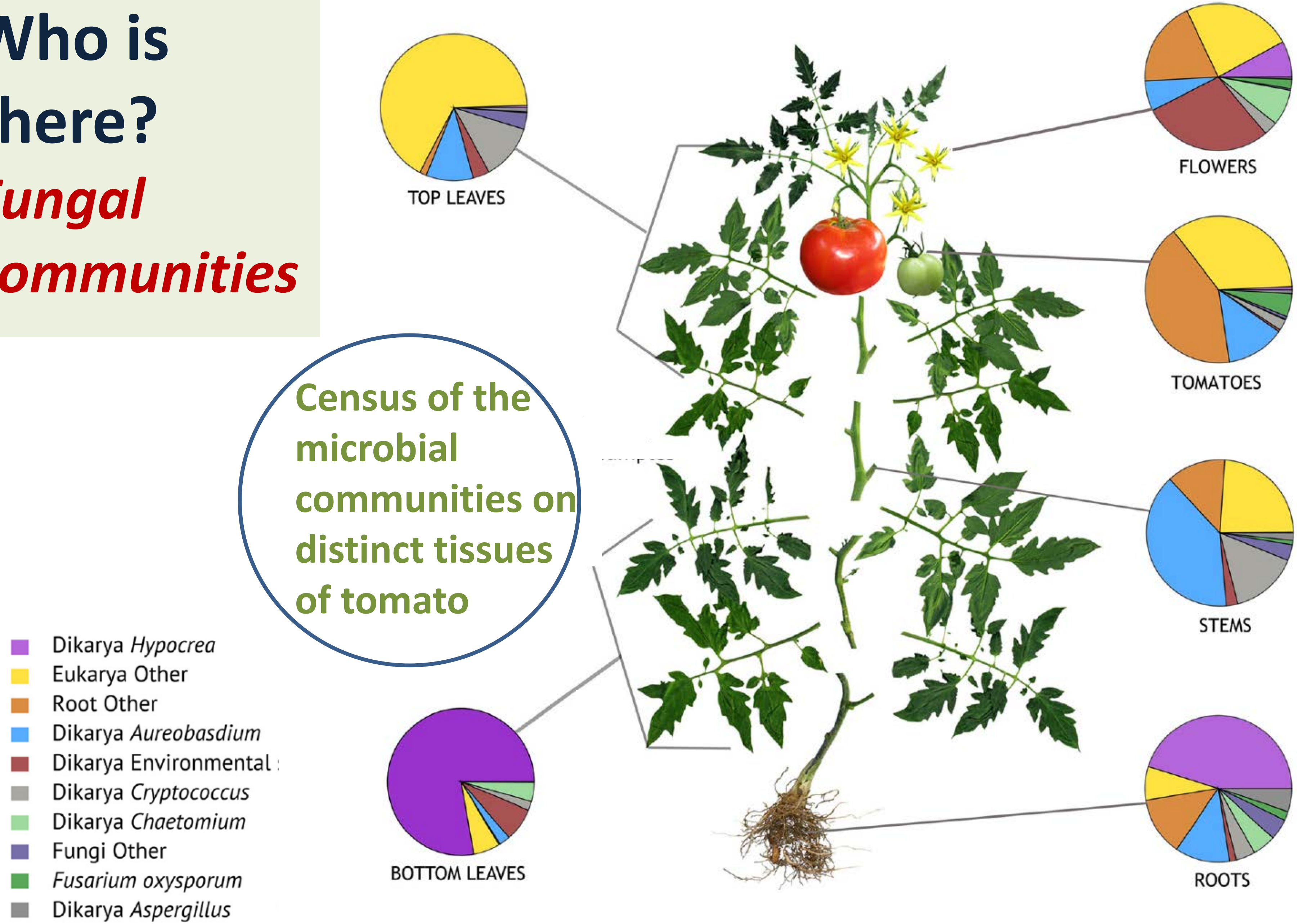


- Acidobacteriaceae_Gp1
- Actinomycetales_Frankineae
- Actinomycetales_Micrococcineae
- Actinomycetales_Propionibacterineae
- Bacteria_Other
- Comamonadaceae_*Acidivorax*
- Enterobacteriaceae_*Erwinia*
- Enterobacteriaceae_Other
- Flavobacteriaceae_*Chryseobacterium*
- Gemmatimonadaceae_*Gemmatimonas*
- Methylobacteriaceae_*Methylobacterium*
- Phyllobacteriaceae_*Mesorhizobium*
- Proteobacteria_Other
- Pseudomonadaceae_*Chryseomonas*
- Pseudomonadaceae_*Pseudomonas*
- Rhizobiaceae_*Agrobacterium*
- Rhizobiaceae_*Rhizobium*
- Rhizobiales_Other
- Sphingomonadaceae_Other
- Sphingomonadaceae_*Sphingobium*
- Sphingomonadaceae_*Sphingomonas*
- Xanthomonadaceae_*Xanthomonas*

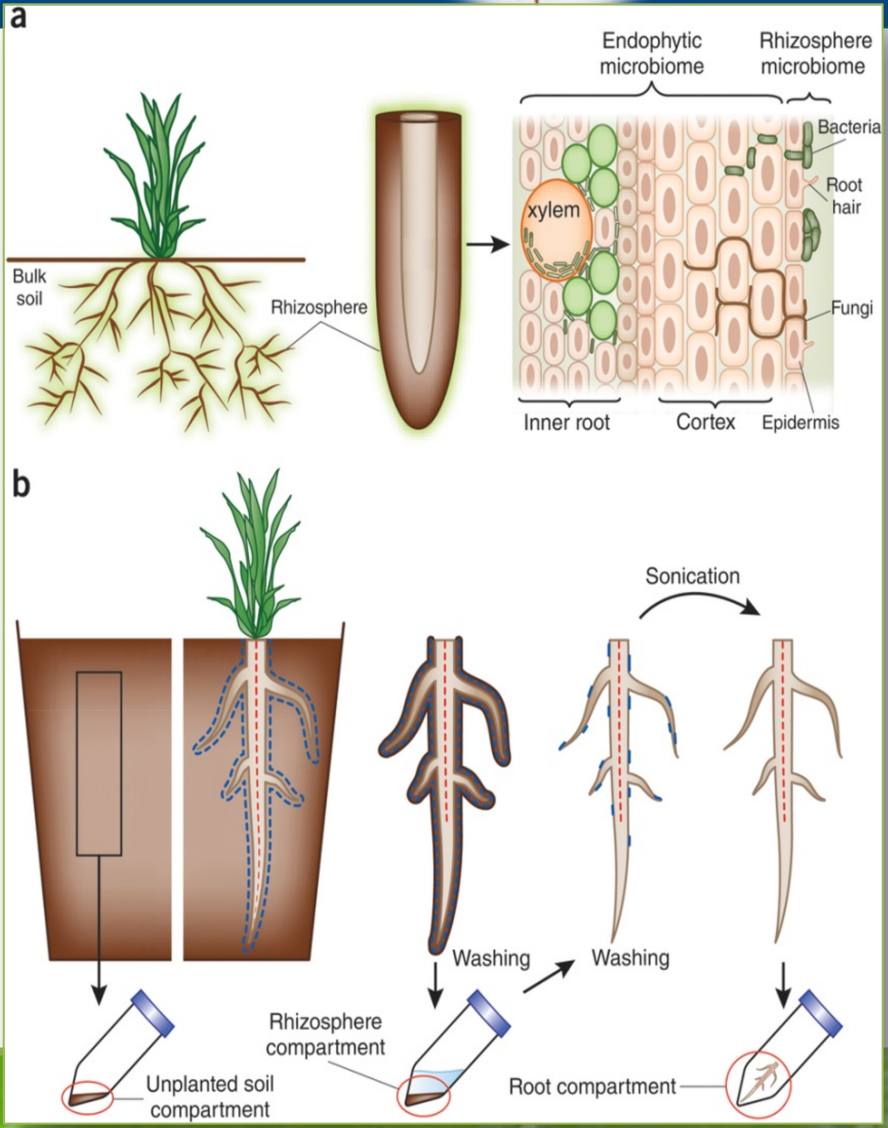
Ottesen et al 2013. BMC Microbiology

Who is there? *Fungal communities*

Census of the microbial communities on distinct tissues of tomato



Ottesen et al 2013 BMC Microbiology



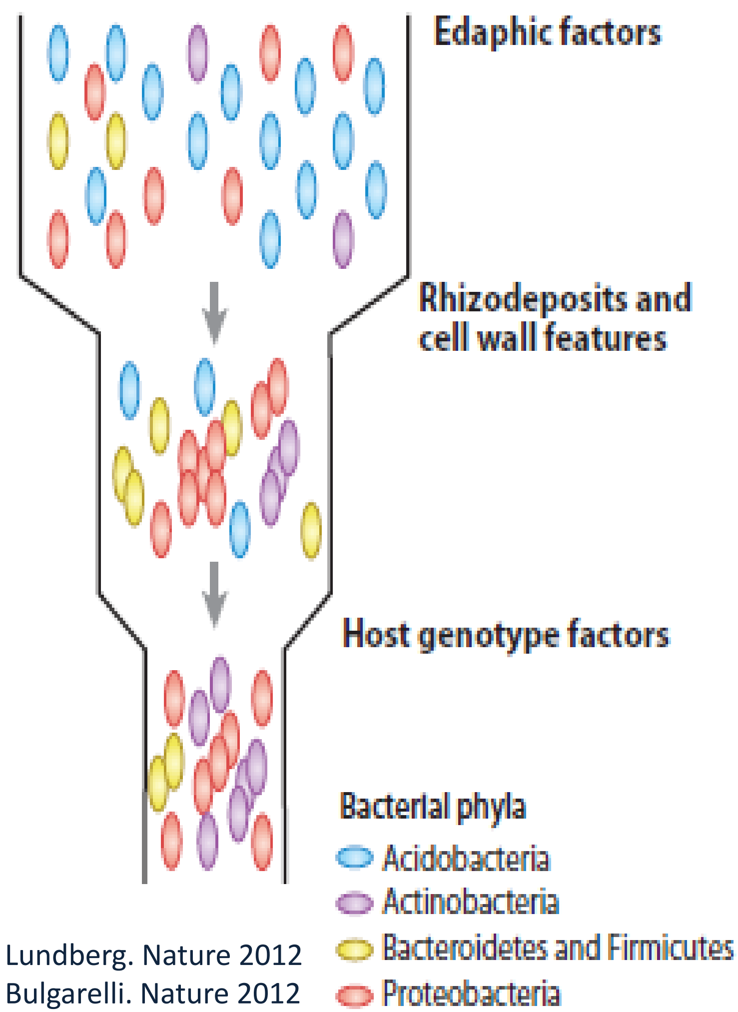
Is there a core rhizosphere microbiome?

- DNA from microbes in the soil, rhizosphere, and endophytic compartments
- amplicon sequencing

Lundberg et al, Nature 2012
Bulgarelli et al, Nature 2012
Hirsch et al, Nature Biotech 2012

What did they find?

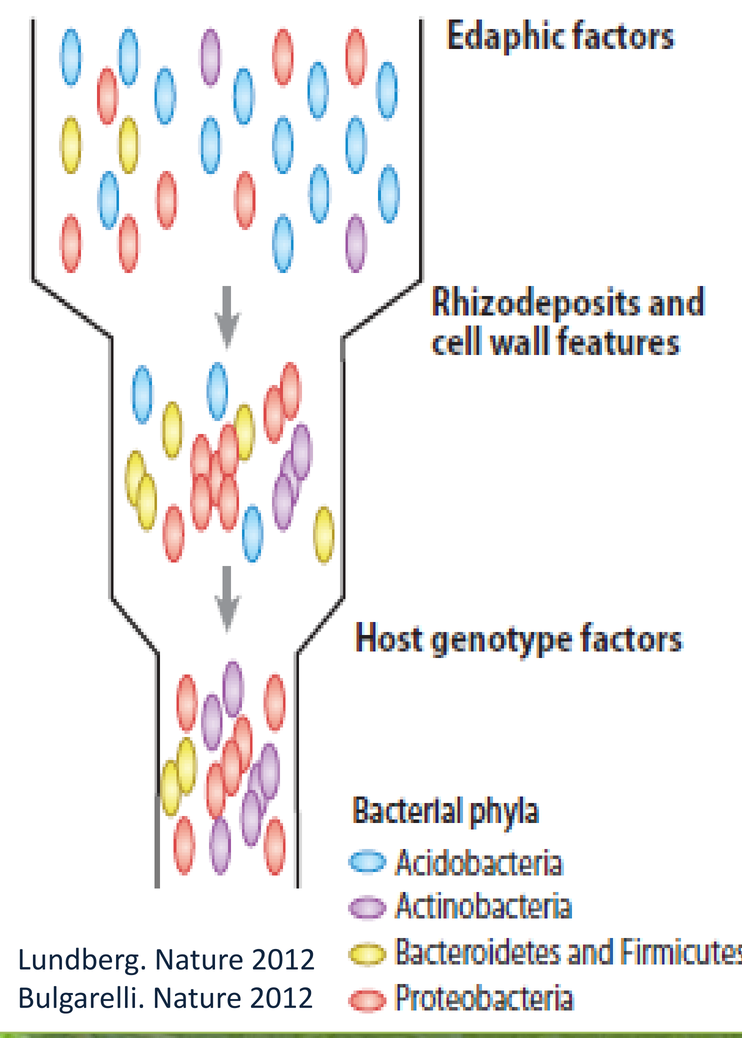
- Many microbes abundant in the soil were **NOT** found in the **endophytic** communities
- Endophytic communities in roots from different parts of the world were surprisingly **similar**
- **Host genotype** –dependent selection within the root corpus fine-tunes community profiles
- ***Bottom line:***
  - ***Communities are <u>not</u> a product of random assembly,***
  - ***may be predicted based on knowledge of the processes that drive their development***



Lundberg. Nature 2012
Bulgarelli. Nature 2012

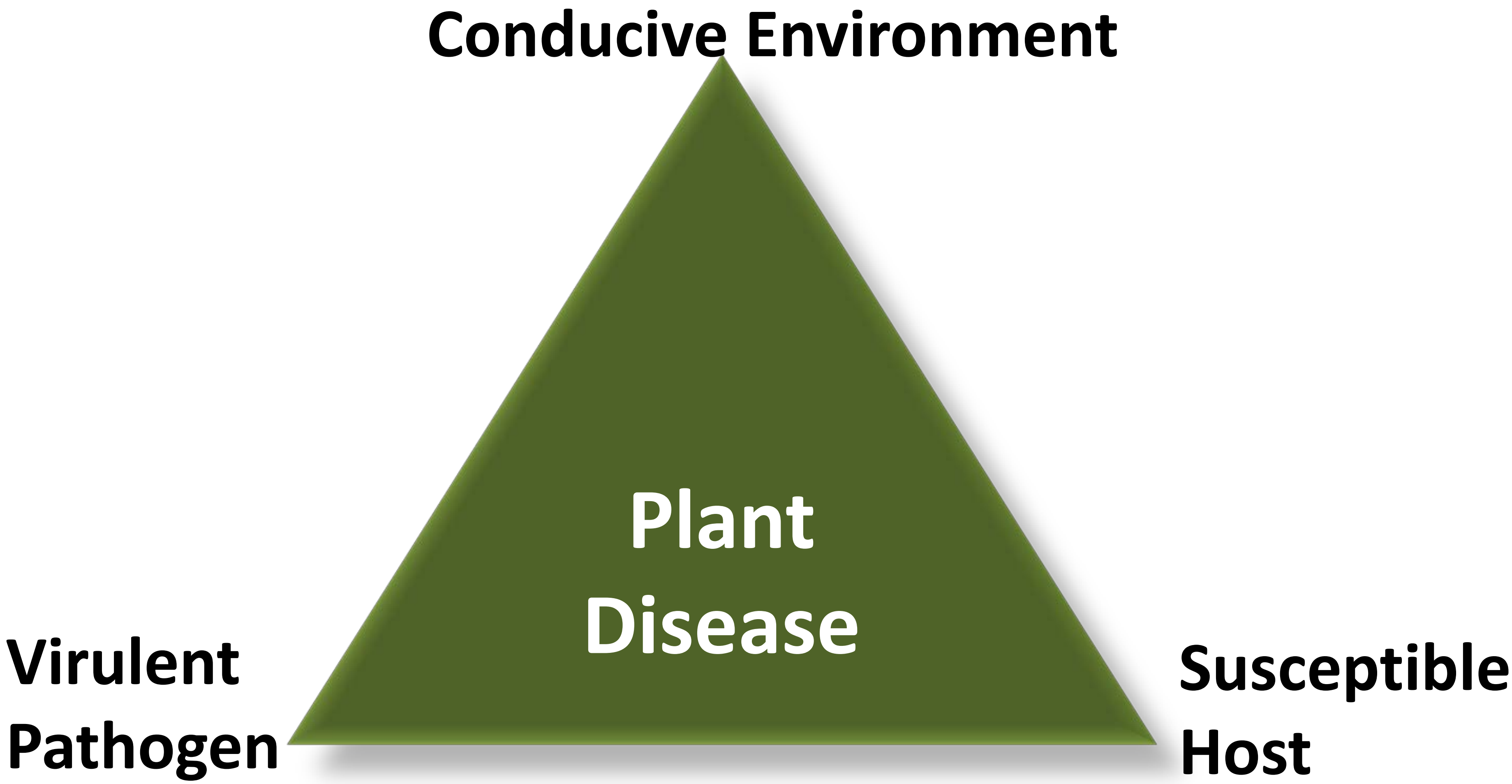
Phytobiomes Initiative

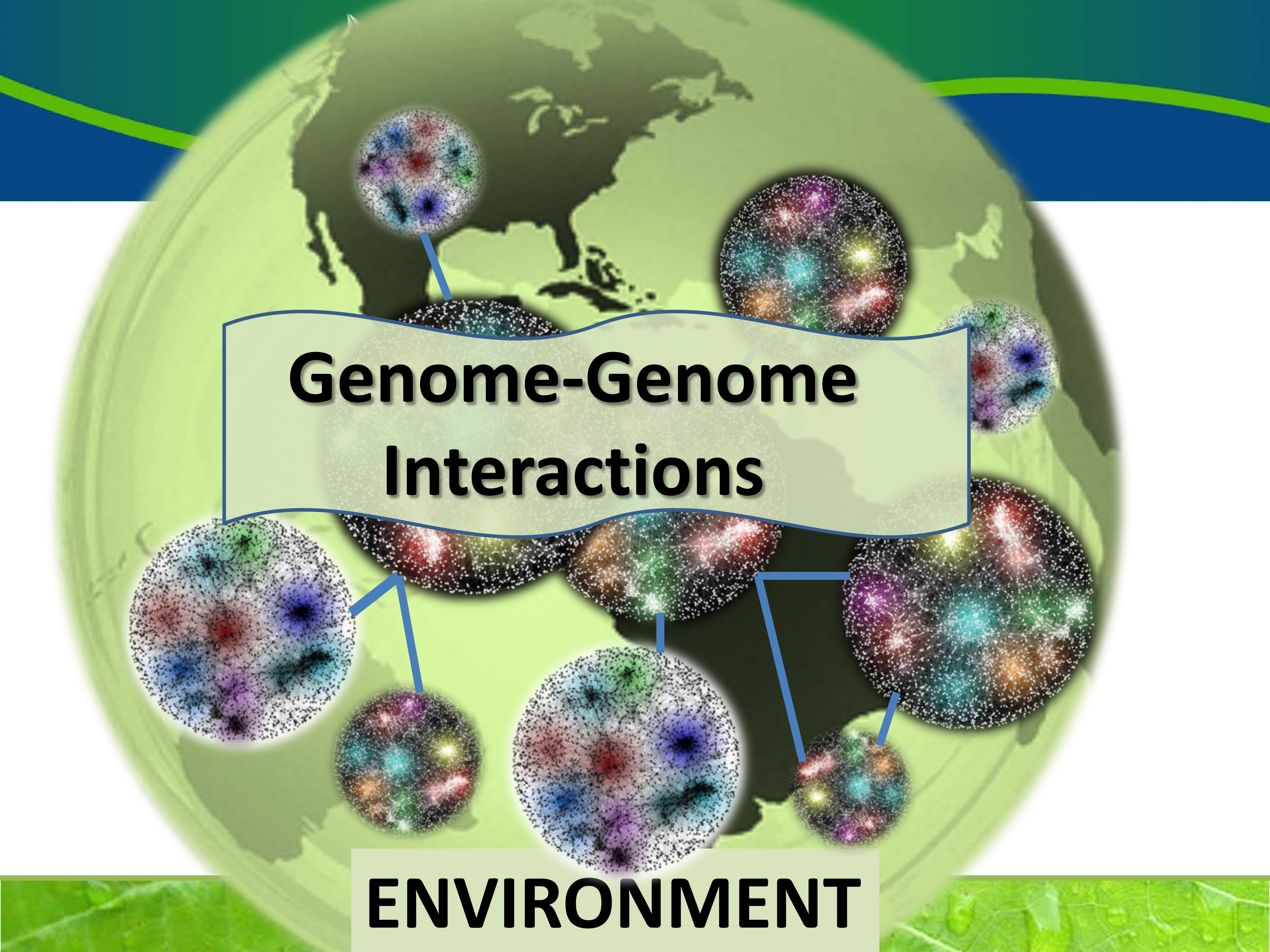
- Can we breed plants that select for a beneficial phytobiome?
- Have we inadvertently selected against plant traits that help support beneficial microbes by breeding for high yield under conditions of high inputs and soil tillage?



Lundberg. Nature 2012
Bulgarelli. Nature 2012

Phytobiomes Initiative




Genome-Genome
Interactions
ENVIRONMENT

Influence of disease on the microbiome?

- Extracted DNA from bacteria in the rhizosphere for:
  - Amplicon sequencing (Who is there?)
  - Analysis of functional genes via hybridization (What can they do?)

Healthy orange tree

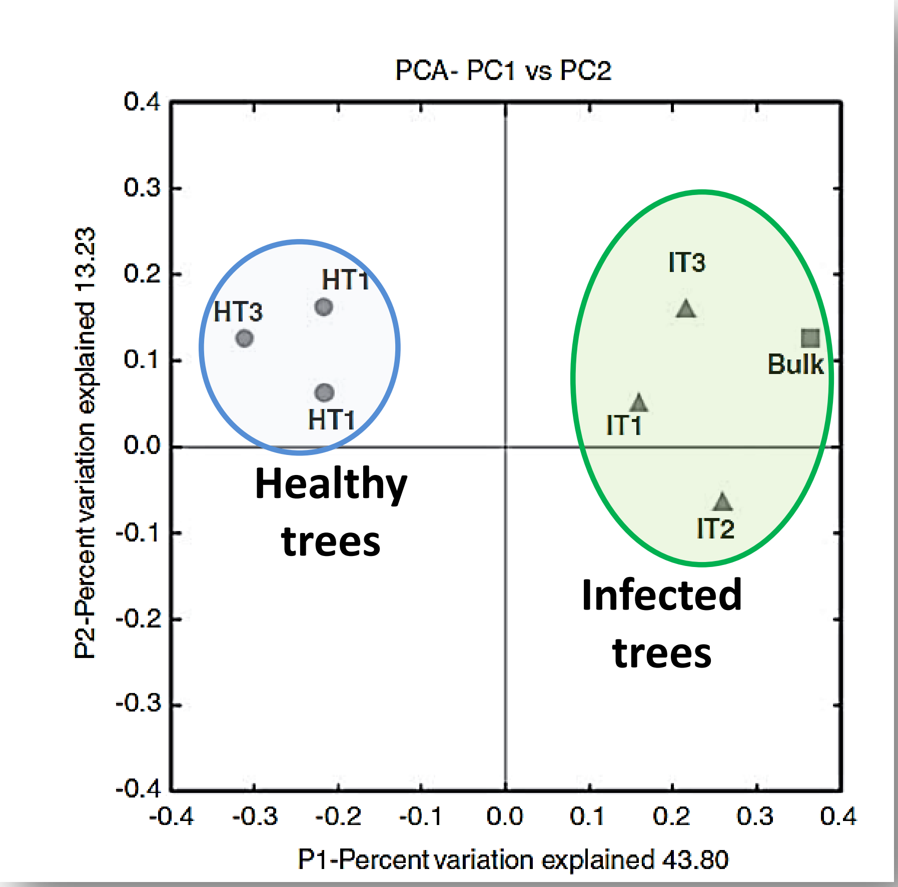
Tree with citrus greening (Huanglongbing)

Does the genome of the pathogen affect the genome response of the plant, and alter the genome content/function of the microbiome???

What did they find?

- Rhizosphere communities on infected trees were different from those on uninfected trees

→ Disease is associated with detectable shifts in the phytobiome



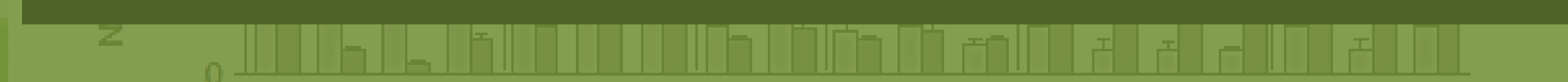
Trivedi et al. 2012. ISME J 6:363

Phytobiomes Initiative

Citrus greening is associated with:

- a shift away from use of easily degraded carbon

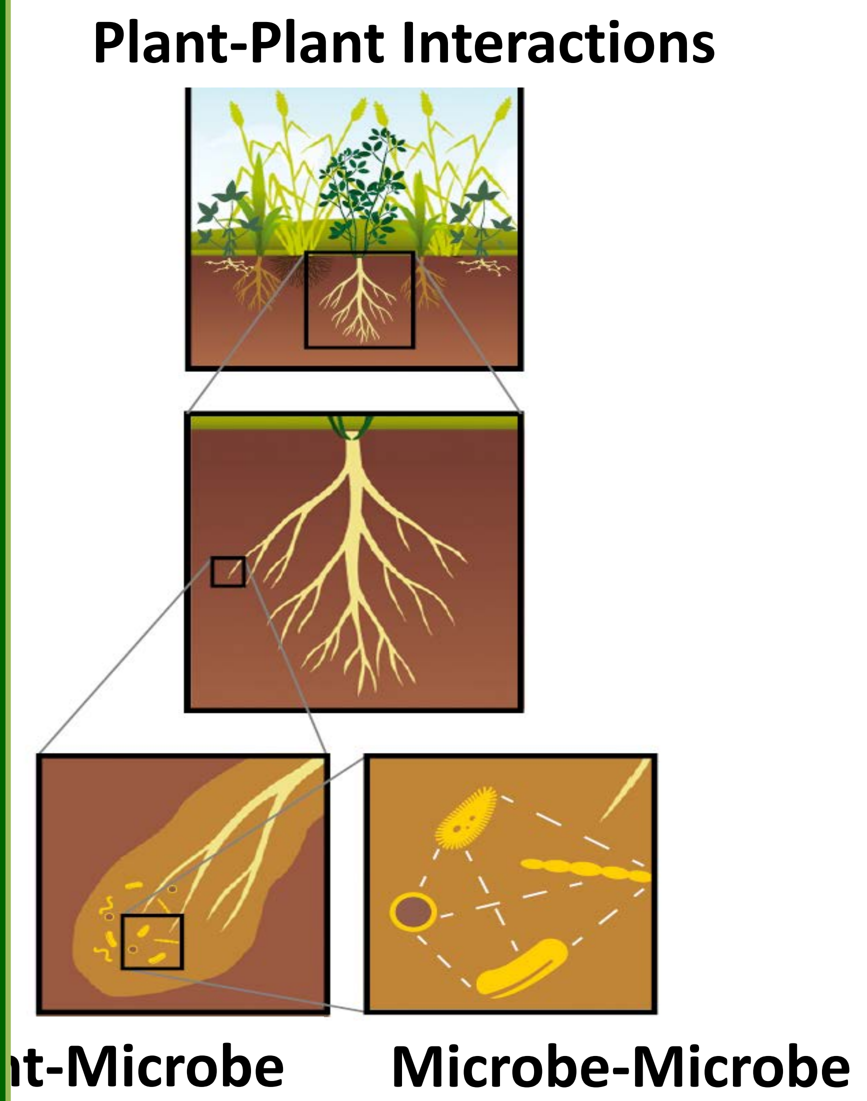
- **Phytobiomes studies may:**
  - → provide more precise insights into the mechanisms and consequences of disease (and resistance)
  - → identify microbial indicators of disease (and resistance) progress



Phytobiomes Initiative

- What factors most influence the phytobiome content/function or plant health?

- What functions that affect microbe-microbe interactions can be manipulated to improve soil health or control disease?

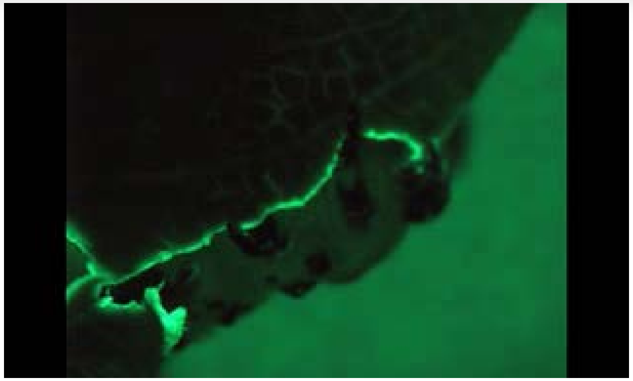


Insects and the Phytobiome?

Herbivore exploits orally secreted bacteria to suppress plant defenses PNAS 110:15728

Seung Ho Chung[a], Cristina Rosa[a], Erin D. Scully[b], Michelle Peiffer[a], John F. Tooker[a], Kelli Hoover[a], Dawn S. Luthe[c], and Gary W. Felton[a,1]

- **Bacteria** associated with the Colorado potato beetle manipulate plant defenses to facilitate beetle feeding



Deciphering the Rhizosphere Microbiome for Disease-Suppressive Bacteria

Rodrigo Mendes,[1*†] Marco Kruijt,[1*‡] Irene de Br
Johannes H. M. Schneider,[2] Yvette M. Piceno,[3]
Peter A. H. M. Bakker,[5] Jos M. Raaijmakers[1¶]

Unraveling plant–microbe interactions: can multi-species transcriptomics help? *Trends Biotech (2012) 30:177*

Beyond the Venn diagram: the hunt for a core microbiome Ashley Shad

The rhizosphere microbiome and plant health *Trends Plant Sci (2012) 17: 478*

Diffuse symbioses: roles of plant–plant, plant–microbe and microbe–microbe interactions in structuring microbiome *Mol Ecol (2014) 23:1571*

MATTHEW G. BAKKER,* DANIEL C. SCHLATTER,† LINDSEY OTTO-HANSON†
LINDA L. KINKEL†

Chemical Signaling Between Plants and Plant-Pathogenic Bacteria Annu Rev Phytopathol (*2014*) 51:17

Vittorio Venturi[1,*] and Clay Fuqua[2]

Functional soil micro
Laksmanan V[1], Selvar

A Synthetic Community Approach Reveals Plant Genotypes Affecting the Phyllosphere Microbiota

holt[1*]

The rhizosphere microbiota of plant invaders: an overview of recent advances in the microbiomics of invasive plants

*Vanessa C. Coats[1] and Mary E. Rumpho[2 *]* ***Frontiers Microbiol (2014) 5:1***

Many questions to address:

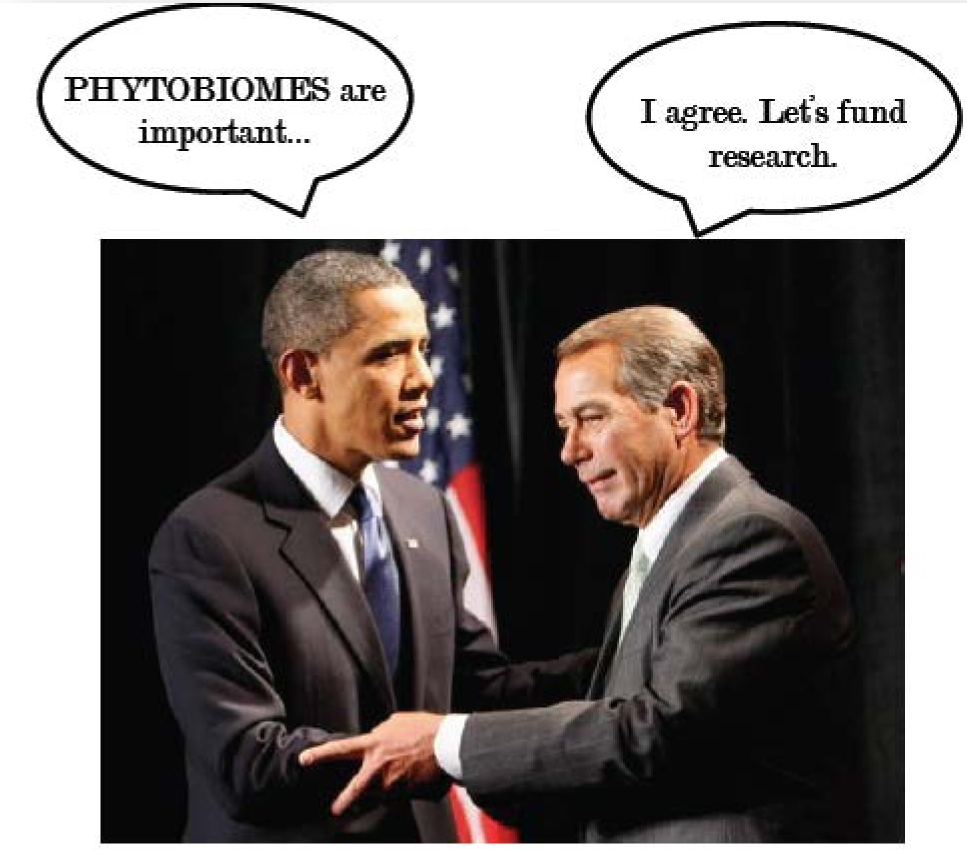
- How do phytobiomes affect plant disease, plant resistance or plant performance?
- How does the phytobiome influence plant tolerance to abiotic stresses?
- What useful organisms, genes and products can be mined from phytobiomes?
- Can phytobiomes be 'managed' to maintain soil health, or to rebuild depleted soils, in an environmentally sound manner?

By 2025, build a foundation to:

- Assess climatic impacts on crop-related phytobiomes
- Understand inter-relationships with nutrient uptake and their utilization
- Relate the phytobiome to its impacts on animal and human health and safety
- Safely and sustainably intensify production of food, feed and fiber
- Change the discovery paradigms for plant disease control, crop improvement, etc.

On the *Phytobiomes Initiative* near-horizon:

- **APS PPB Policy Fellowship for an early-career plant pathologist to work at a high level of government for 1 year.**
  - **Negotiating placement of the Fellow with OSTP**



**Supported by APS Council
and
APS Foundation**

On the *Phytobiomes Initiative* horizon:

- ***Phytobiomes 2015: Designing a New Paradigm for Crop Improvement: A Workshop, May 2015, Washington, D.C.***
  - **Bring together a broad community of scientists to establish current and future priorities in phytobiomes research**
  - **Forge interdisciplinary, interagency, international, and public-private collaborations**
  - **Translate phytobiomes knowledge to safe and sustainable crop production practices**

Phytobiomes Initiative

Seeking *Phytobiomes Initiative Partners:*

www.phytobiomes.org

Phytobiomes Initiative

Follow the Phytobiomes Initiative @Phytobiomes

SOIL RENAISSANCE

THE SAMUEL ROBERTS NOBLE FOUNDATION

IS-MPMI International Society for Molecular Plant-Microbe Interactions

What can you do?

- **Ask your local and national representatives to add $100 million/year in NEW funding to Phytobiomes Research!**

Let's get congress to agree to something!!!

Phytobiomes Initiative

Tweet Your Representative!

@SenBennetCo Let's double production of safe and nutritious food, feed and fiber #phytobiomes www.phytobiomes.com

Vision

Comprehensive knowledge of phytobiomes

New strategies for reducing: plant disease, environmental degradation, resistance to antimicrobials, non-renewable inputs, and impacts of weather extremes; and **for increasing:** food safety, soil health, human health, and the beneficial impacts of microbial communities. **Increased and more robust human, genetic and technological infrastructure**

Impact

increase in safe and healthy food, feed, and fiber

Farm Bill and Appropriations Update

ESS Meeting

October 2-3, 2014

Presentation Overview

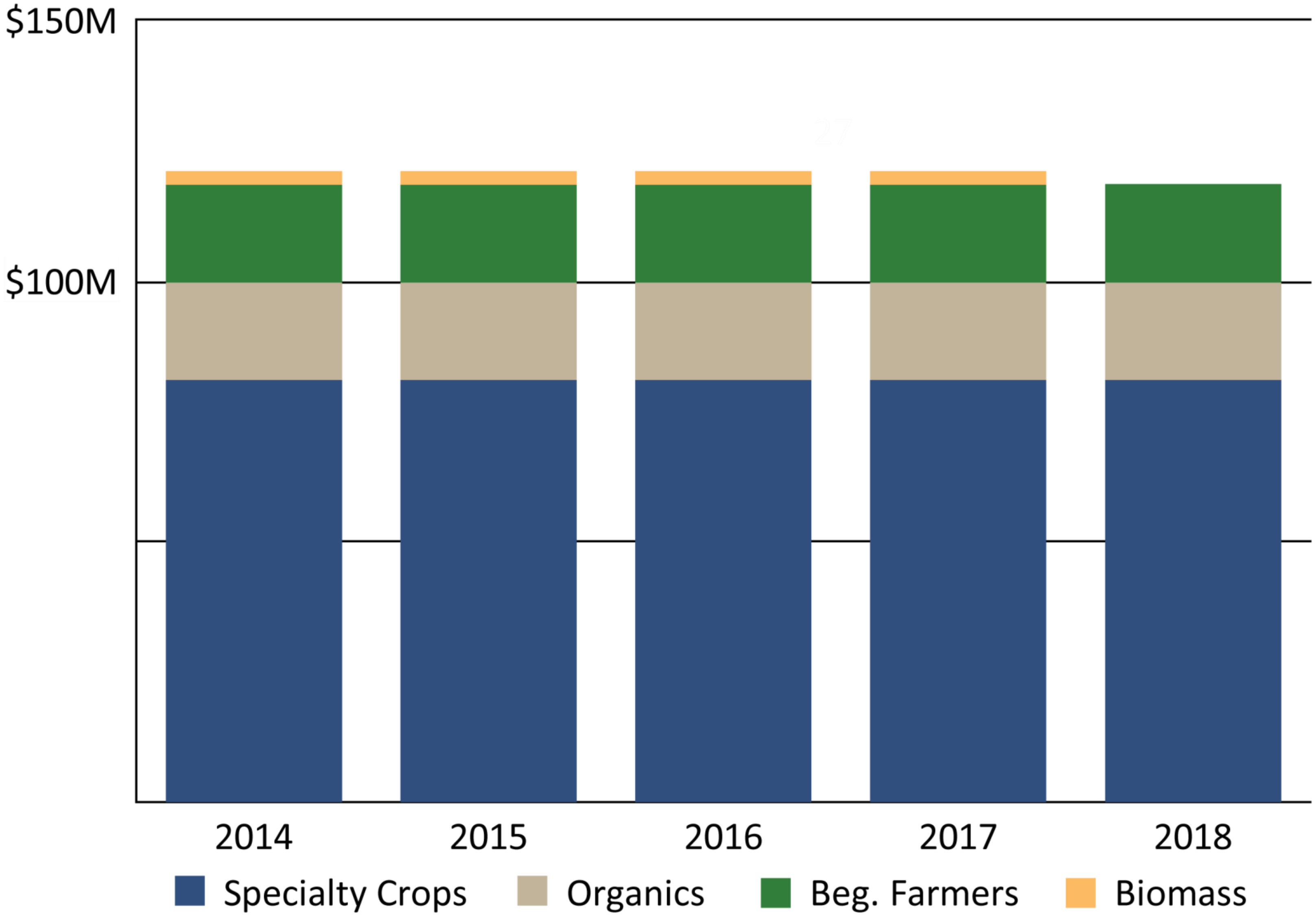
- CLP – Farm Bill Update
- BAC – Appropriations Update
- Election Analysis

Farm Bill Update

Farm Bill Finished (or is it)

- Agricultural Act of 2014 signed into law on February 7, 2014
- Most CLP proposals favorably considered
- Provides $689 M in mandatory spending in Title VII alone over 5 years (including Foundation for Food and Agriculture Research)
    - Provides permanent baseline for some programs (Specialty Crop Research Initiative)

2014 Farm Bill - NIFA Mandatory



Now in Implementation Phase

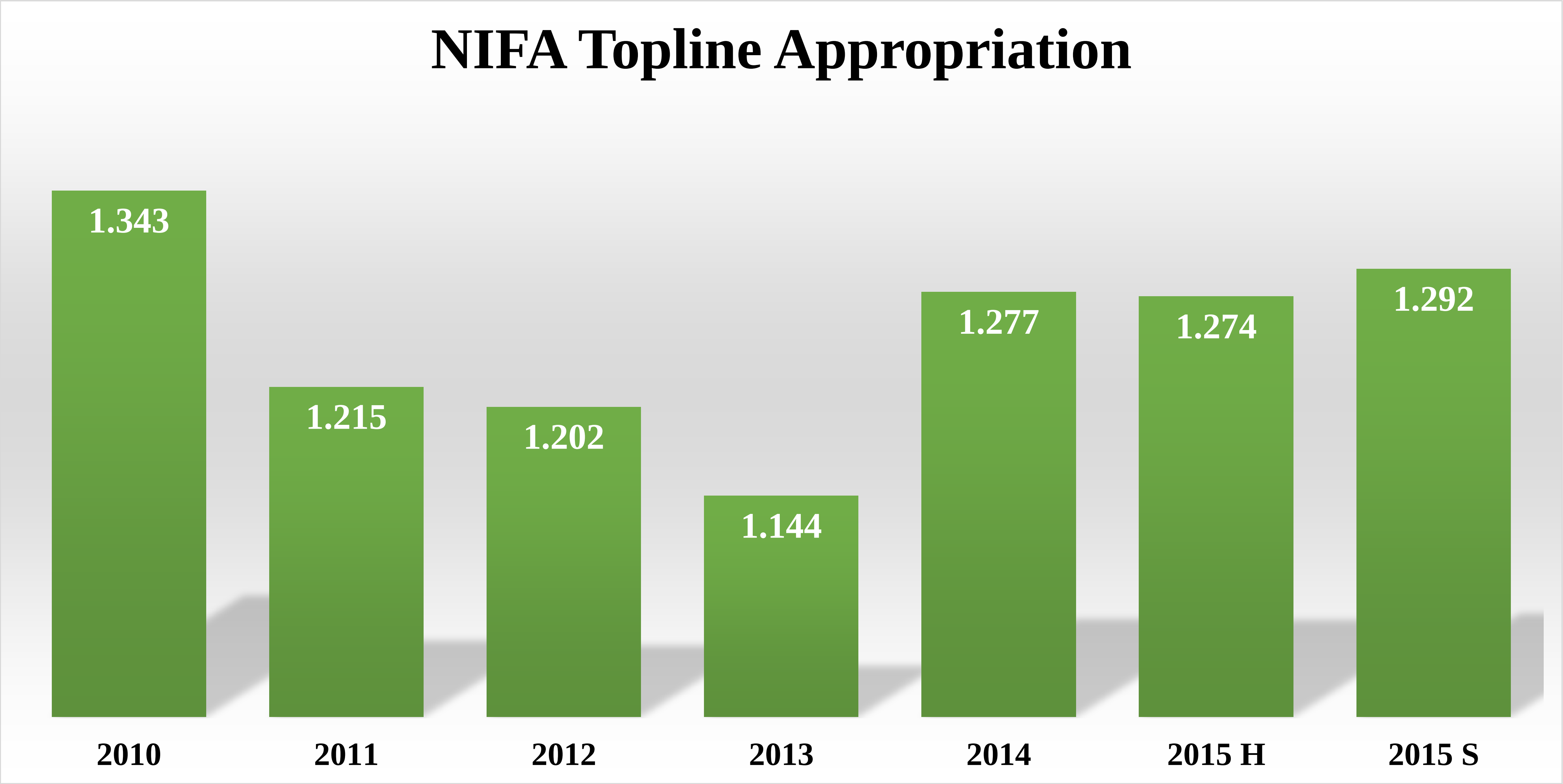
- $6 M for Farm Bill Education
    - $3 M for development of web-based decision aids
    - $3 M for extension for outreach and education
- USDA working through Title VII implementation
    - CSU addition, etc.
    - Farm Bill changes in Appropriations (CHMPS, Notwithstanding's, etc.)

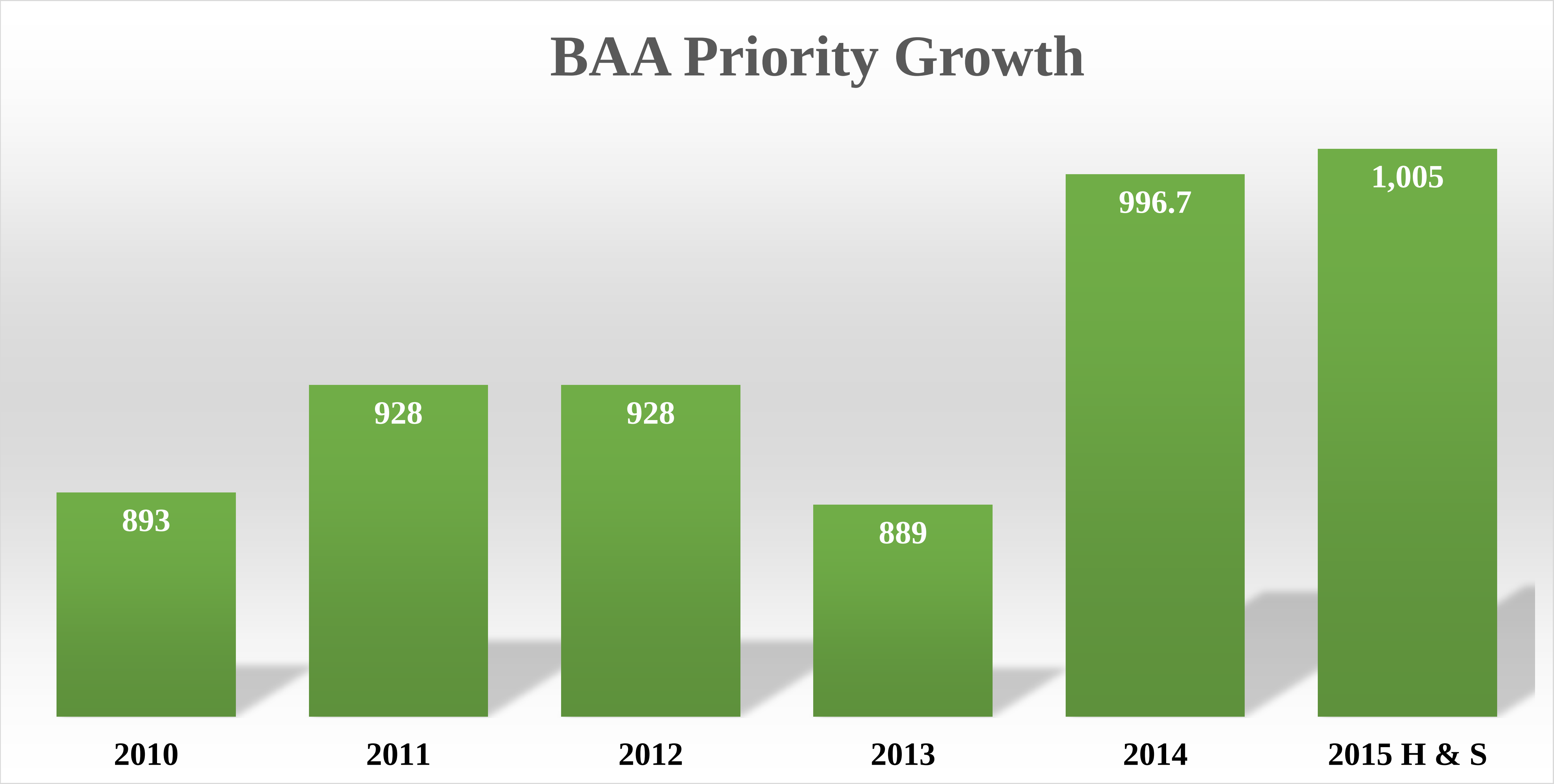
Other CLP Issues

- Child Nutrition Reauthorization – expires FY2015
  - Senate has had 2 hearings
  - Monitor Nutrition Education programs

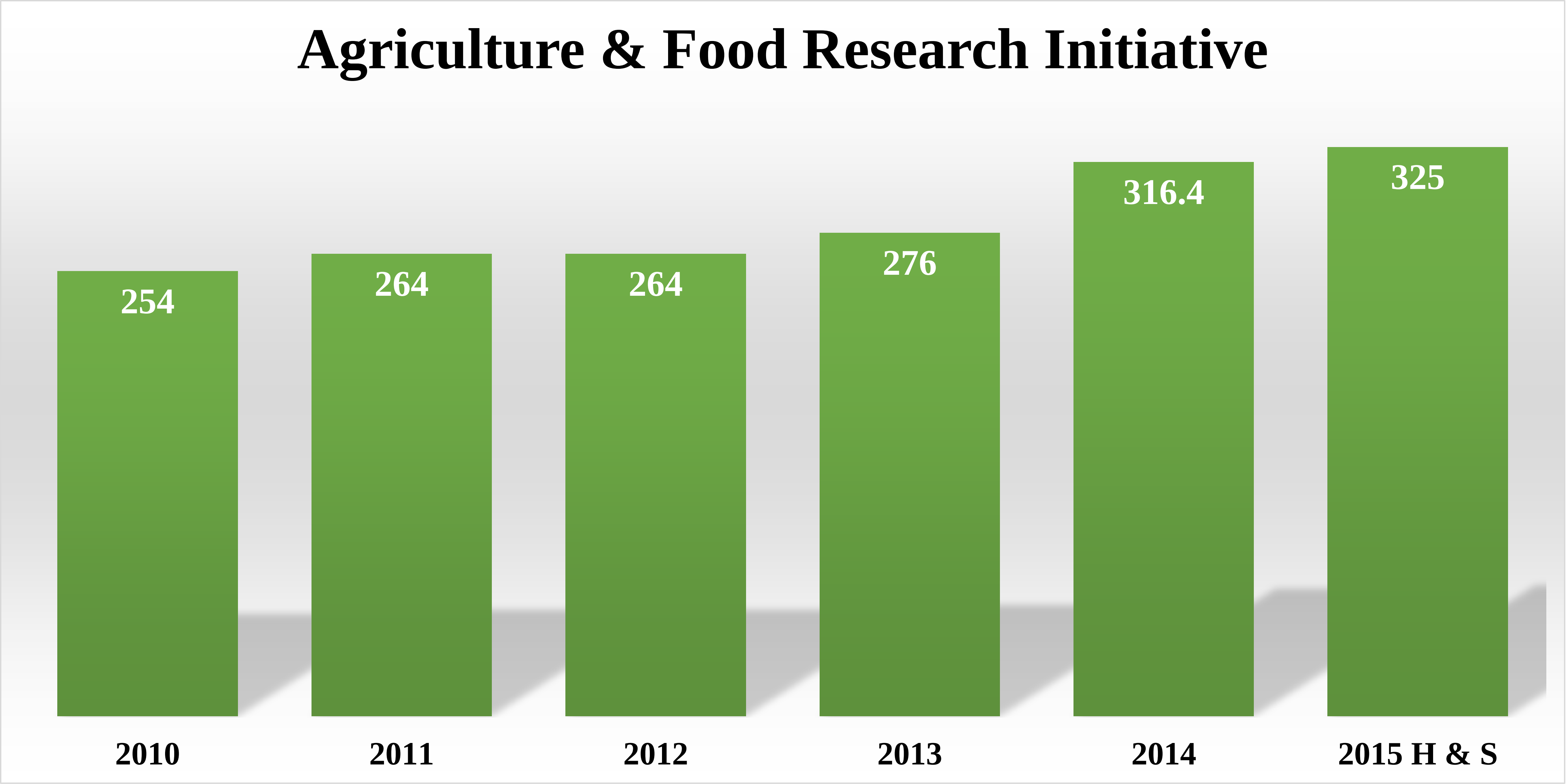

Appropriations Update

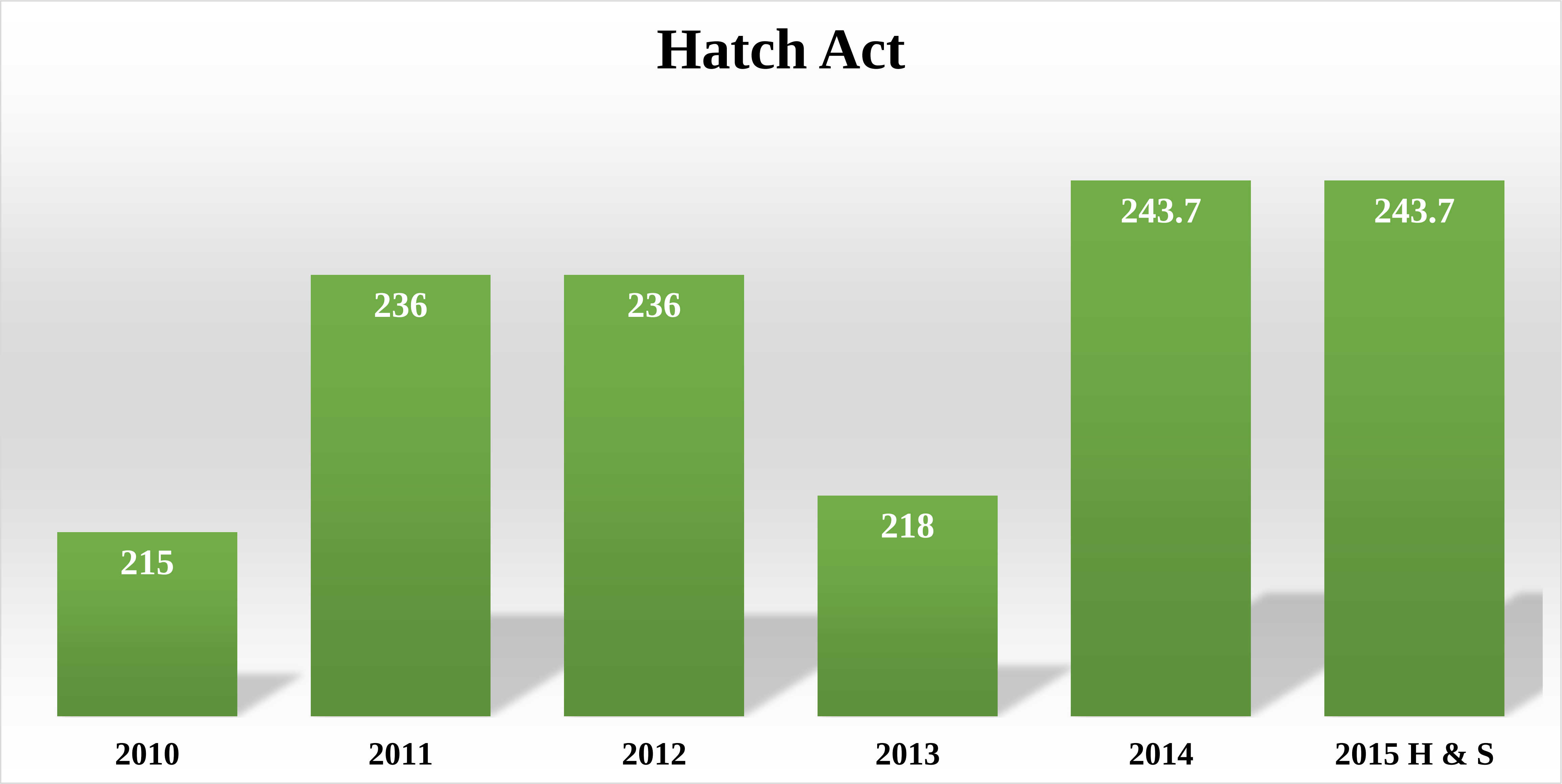
FY 2015 Appropriations Results		
	House	**Senate**
Reported	June 4	May 22
NIFA Topline	1.274 Billion	1.292 Billion
AFRI Increase	8.6 Million	8.6 Million

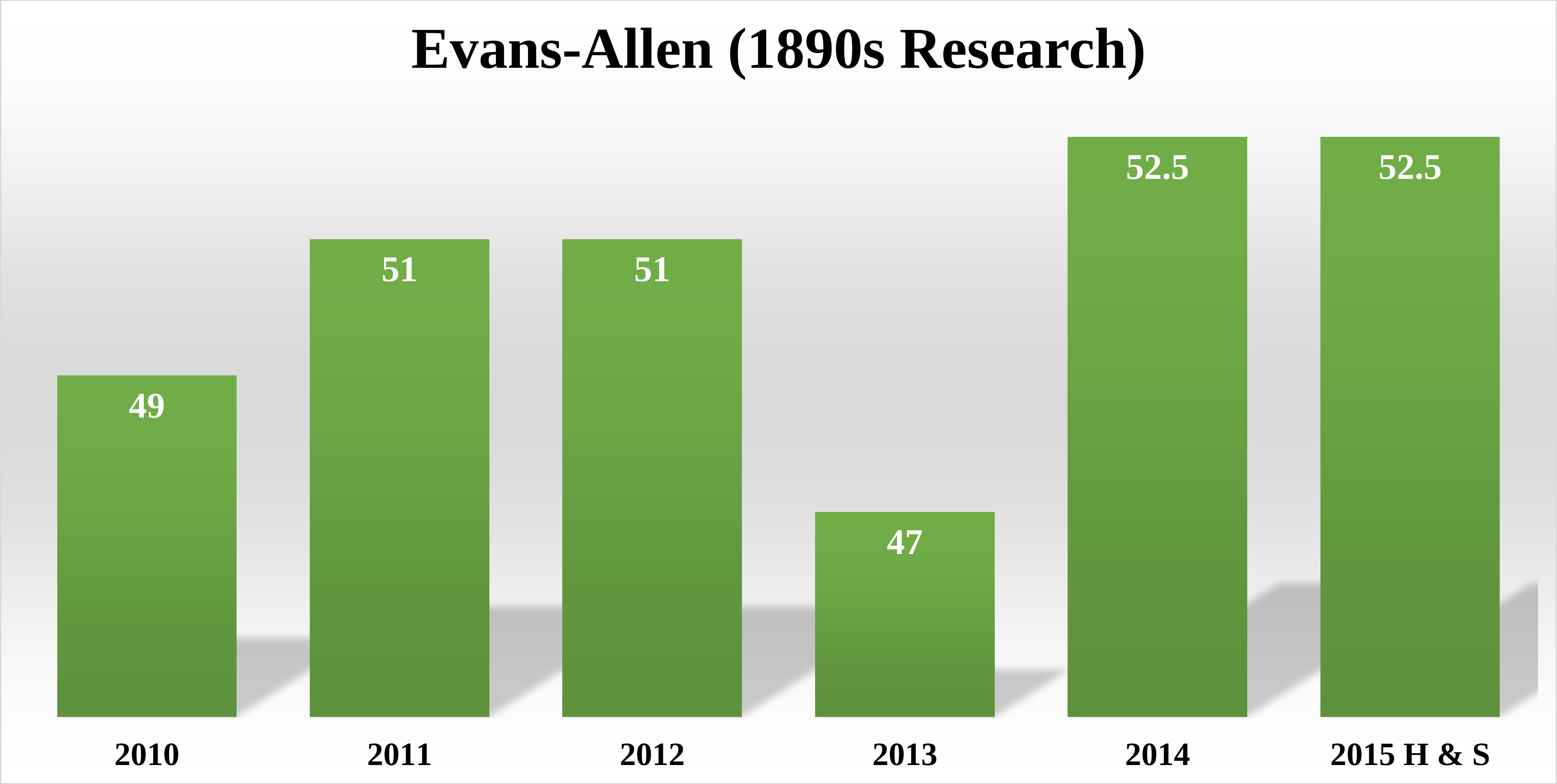

NIFA Topline Appropriation
1.343
1.215
1.202
1.144
1.277
1.274
1.292
2010
2011
2012
2013
2014
2015 H
2015 S
*($Billions)


BAA Priority Growth
893
928
928
889
996.7
1,005
2010
2011
2012
2013
2014
2015 H & S

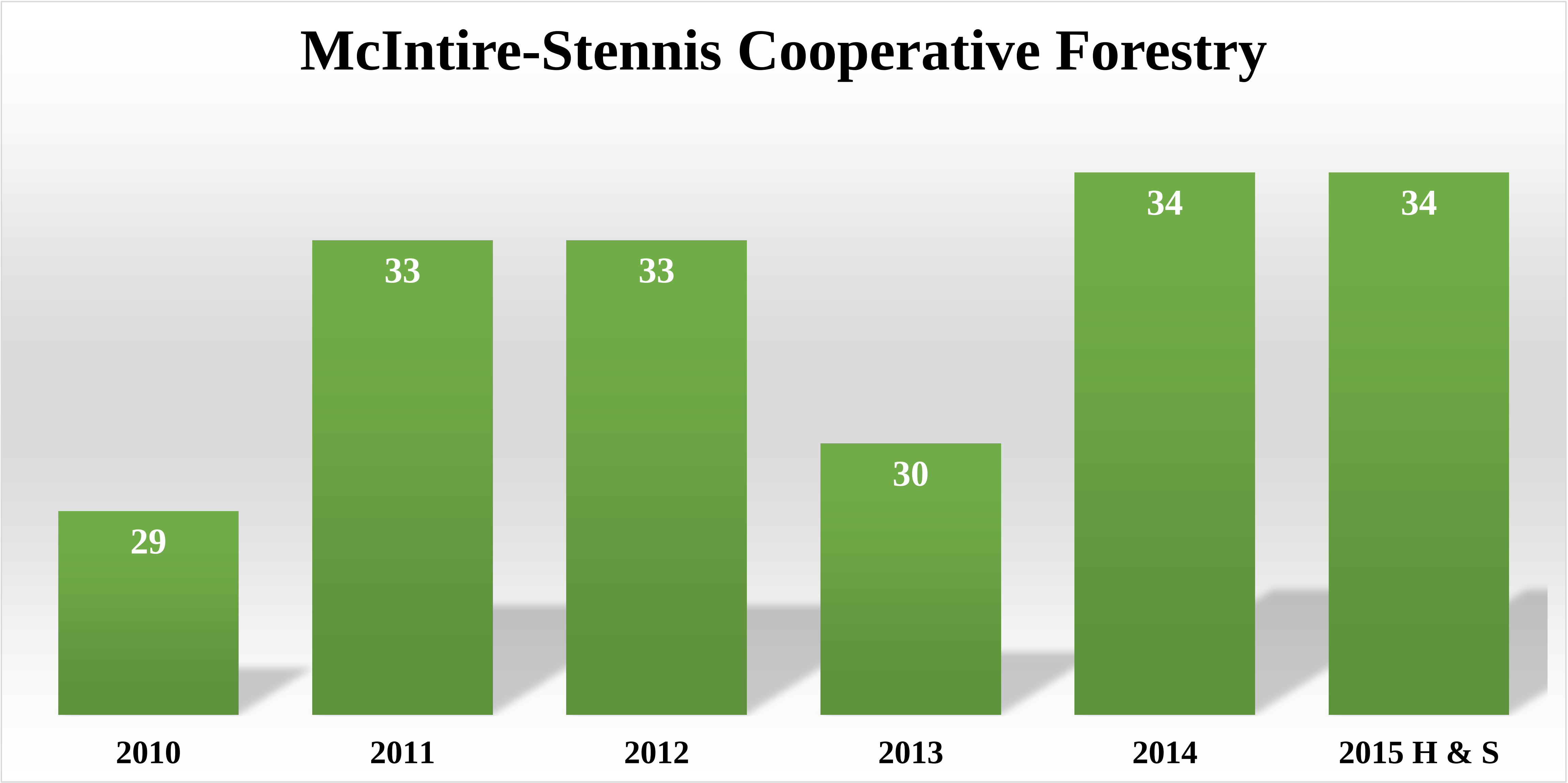
*($Millions)

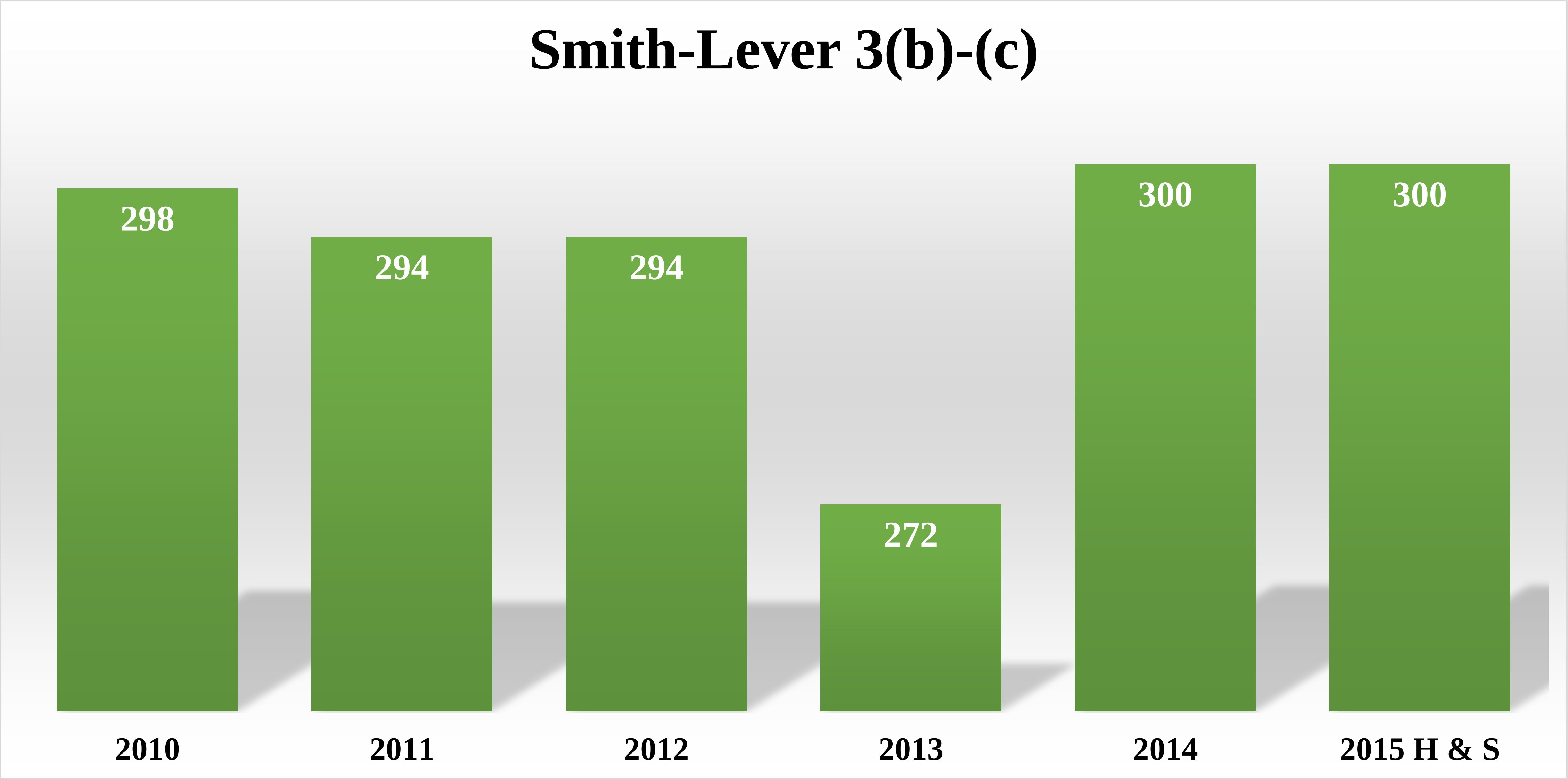

Agriculture & Food Research Initiative
254
264
264
276
316.4
325
2010
2011
2012
2013
2014
2015 H & S
*($Millions)


Hatch Act
215
236
236
218
243.7
243.7
2010
2011
2012
2013
2014
2015 H & S
*($Millions)

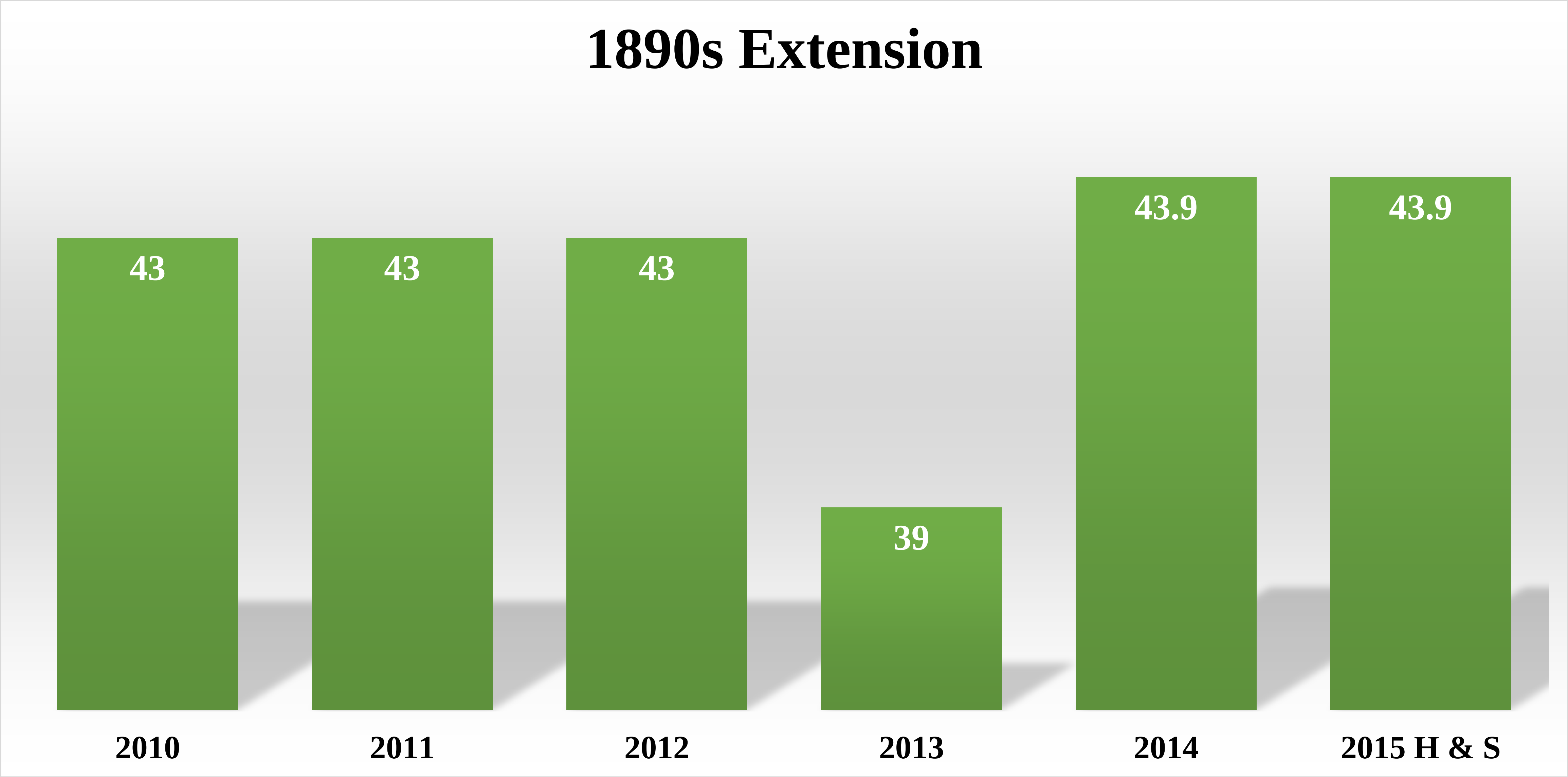

Evans-Allen (1890s Research)
49
51
51
47
52.5
52.5
2010
2011
2012
2013
2014
2015 H & S

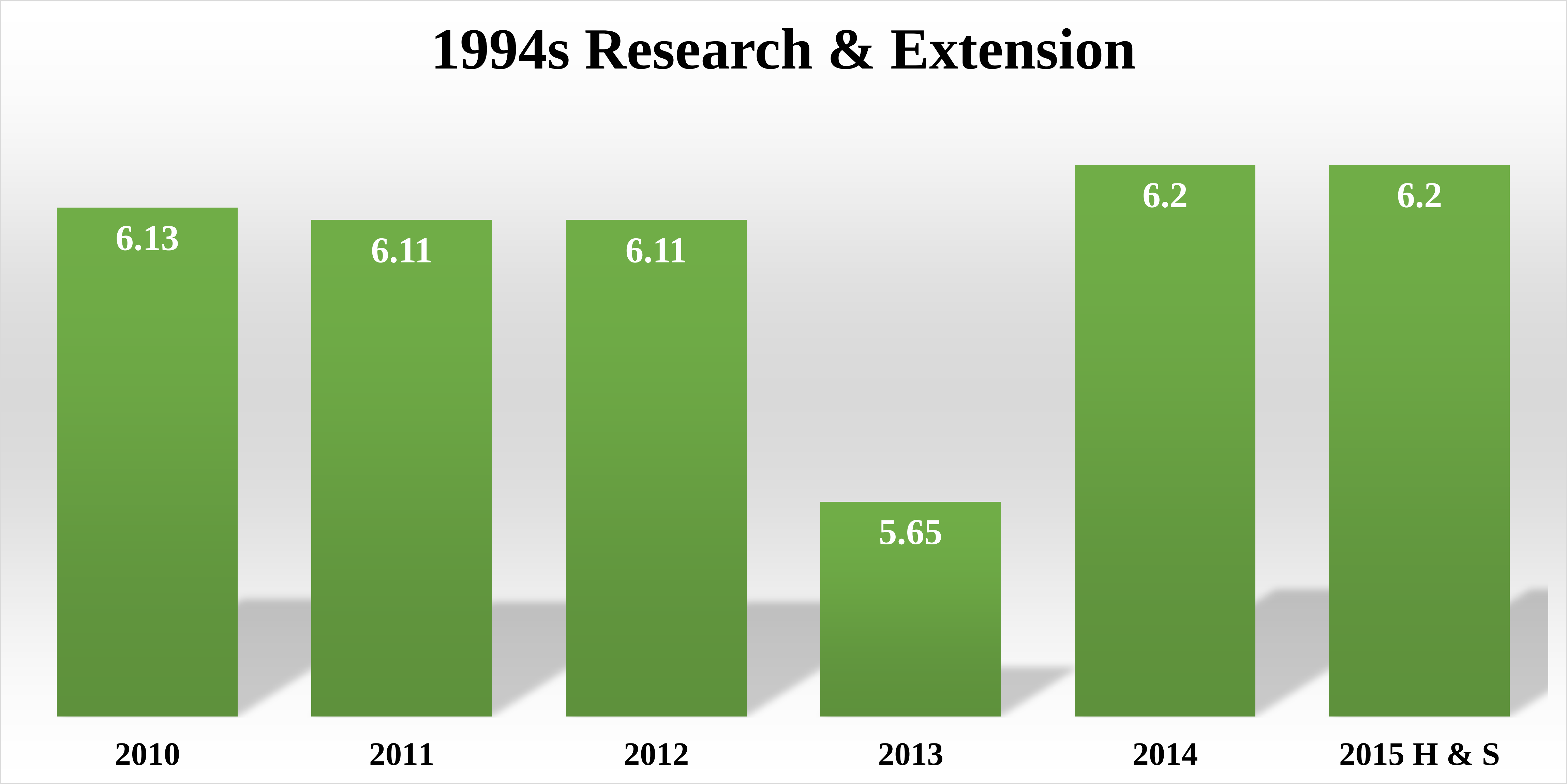
*($Millions)

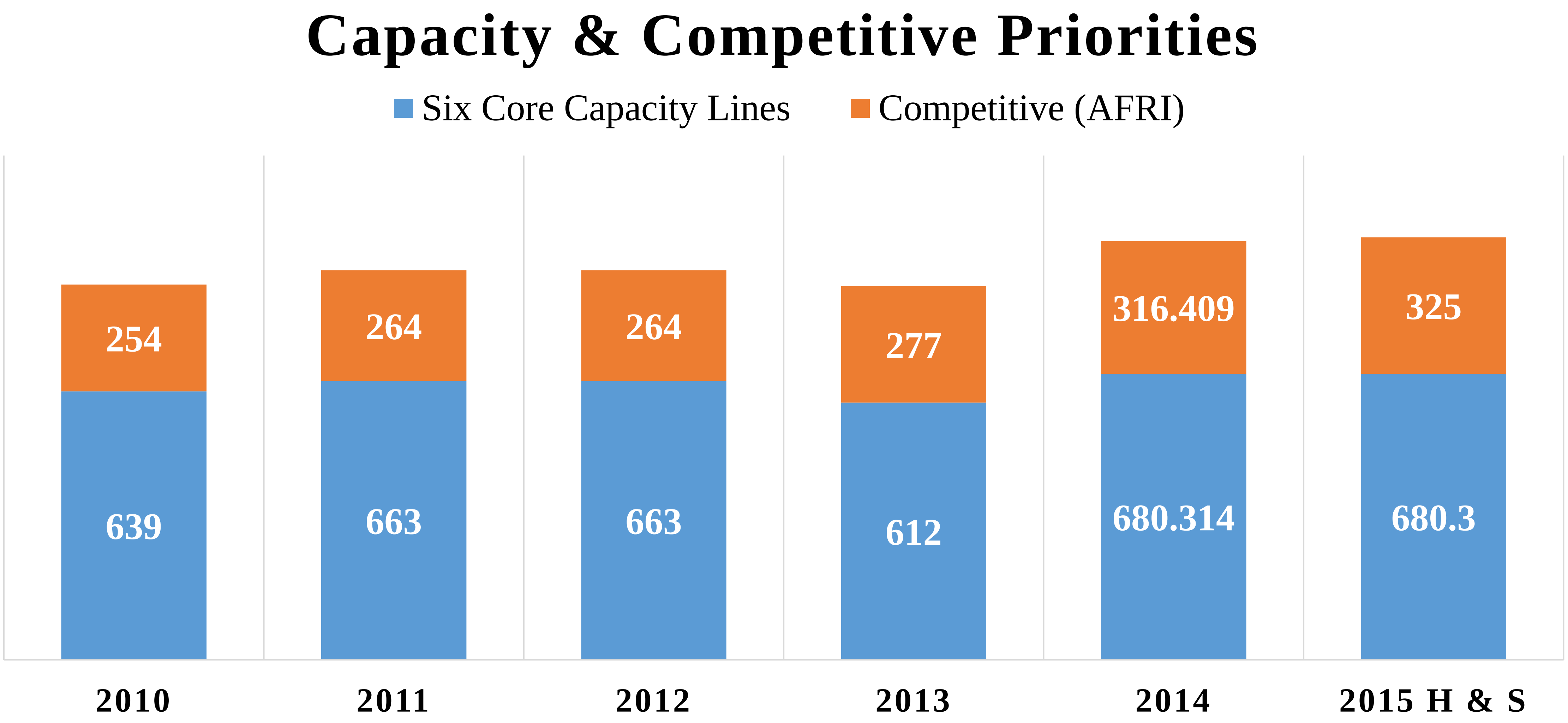

McIntire-Stennis Cooperative Forestry
29
33
33
30
34
34
2010
2011
2012
2013
2014
2015 H & S
*($Millions)


Smith-Lever 3(b)-(c)
298
294
294
272
300
300
2010
2011
2012
2013
2014
2015 H & S

*($Millions)

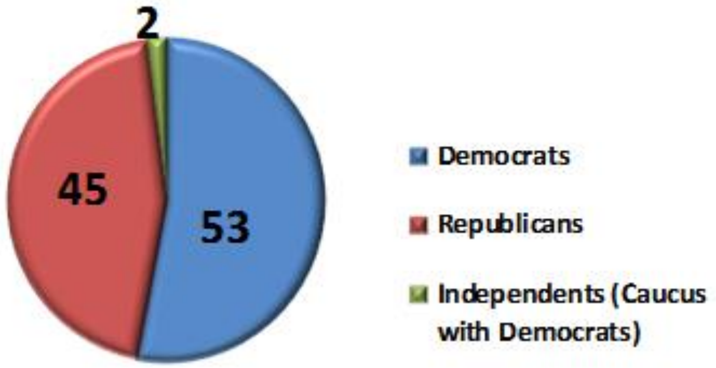

1890s Extension
43
43
43
39
43.9
43.9
2010
2011
2012
2013
2014
2015 H & S
*($Millions)


1994s Research & Extension
6.13
6.11
6.11
5.65
6.2
6.2
2010
2011
2012
2013
2014
2015 H & S
*($Millions)


Capacity & Competitive Priorities
Six Core Capacity Lines
Competitive (AFRI)
254
639
264
663
264
663
277
612
316.409
680.314
325
680.3
2010
2011
2012
2013
2014
2015 H & S

Election Analysis

Make-up of the House and Senate



SENATE

100 Members, 6 year terms (staggered – 1/3rd of the Senate up every 2 years)

Democrats hold a 55 to 45 majority

60 votes needed for cloture, to end a filibuster and pass legislation

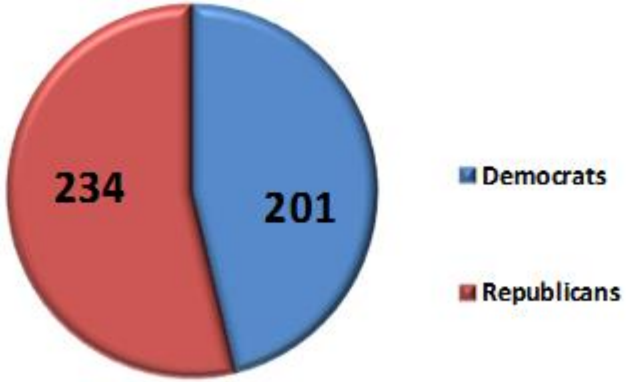
Vice President casts tie-breaking votes

U.S. HOUSE OF REPRESENTATIVES

435 Members, 2 year terms

Republicans have a 33 seat majority

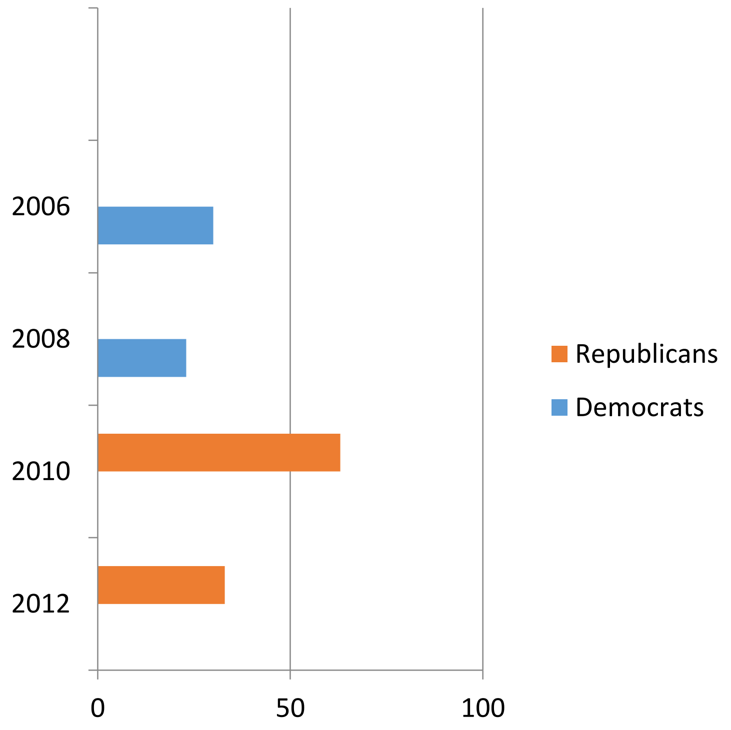
218 votes needed to pass legislation (50%)



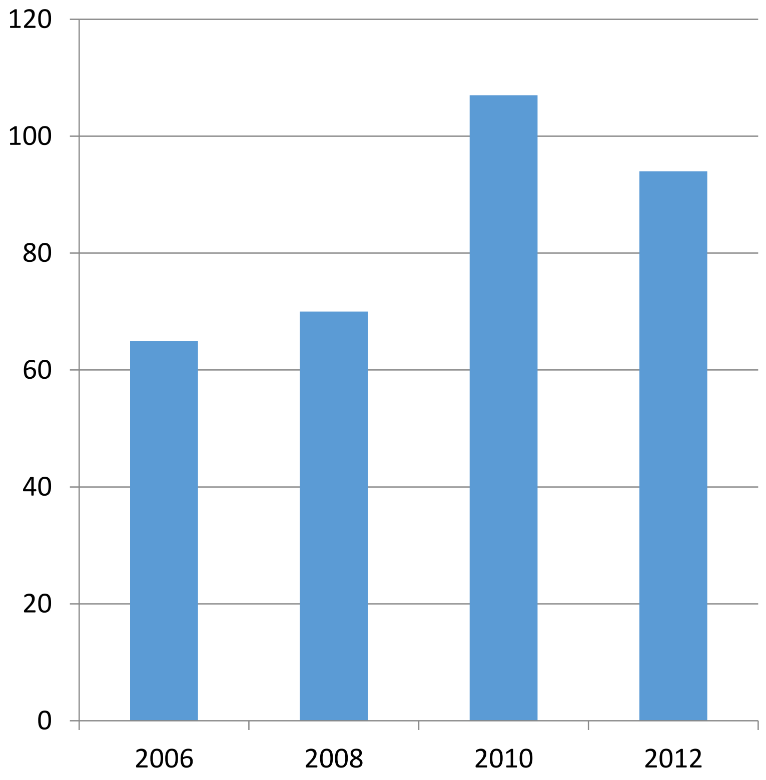
A Highly Volatile Electorate

From large swings to unprecedented numbers of freshman lawmakers, the Congress is a very unstable place.

House Seats Gained 2006-2012

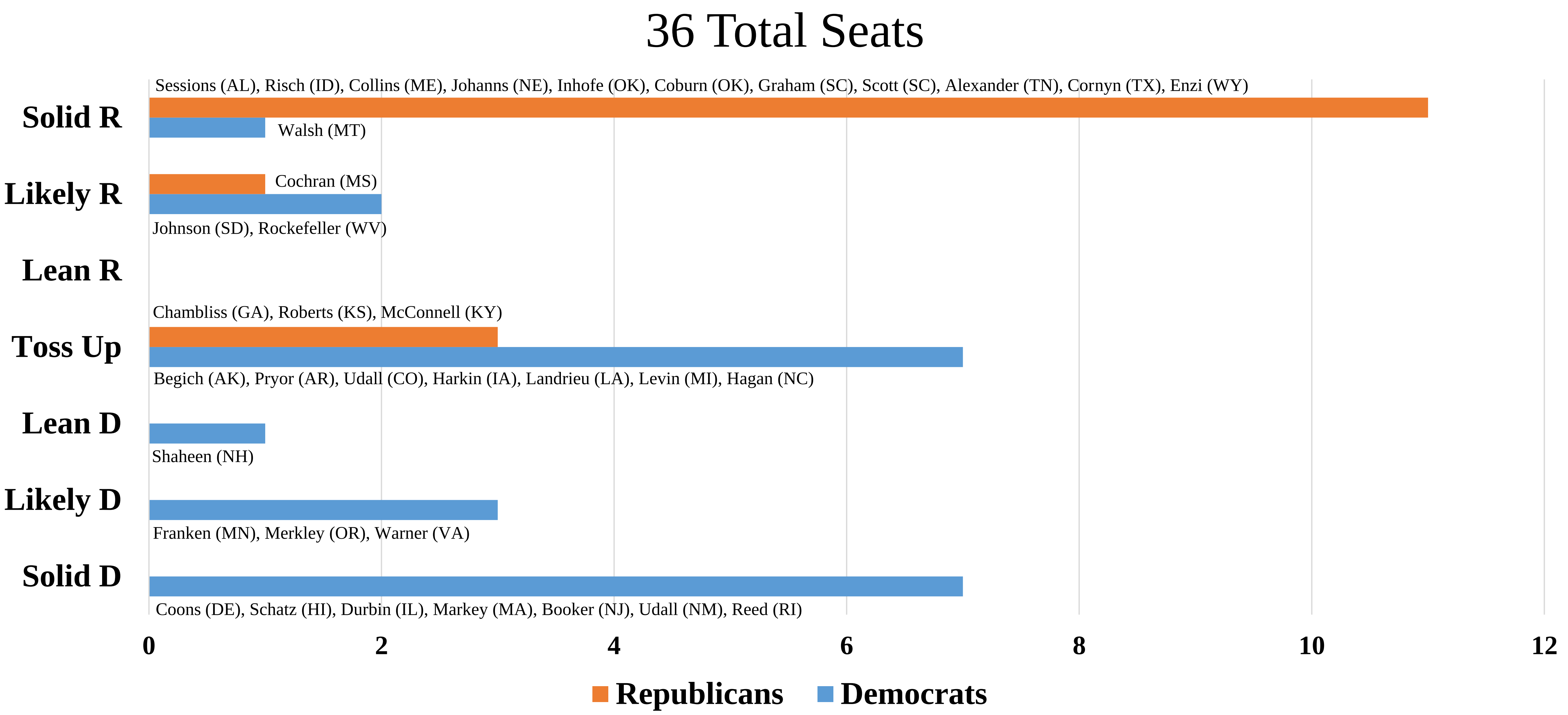


Number of Freshmen by Election Year 2006 – 2012



2014 Senate Race Vulnerabilities

Breakdown of all Senate seats by *Cook Political Report* Rating



Challenges Ahead

- Number of Lines
- Sequestration vs. Budgetary Outlines
- Capacity vs. Competitive
- The “Farm-Damily”
- Reconciliation in 2015?
- Return of Sequestration?

Questions?

The FAO International Treaty (IT) on Plant Genetic Resources for Food and Agriculture and other international agreements

Peter Bretting
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What are plant genetic resources (PGR)?
Seeds, fruits, cuttings, pollen, and more--the raw material for crop breeding that underpins food security, and plant research.

The US National Plant Germplasm System provides much PGR, but more is needed

The IT and the Convention on Biological Diversity (CBD)

- The IT is a legally-binding Treaty under the UN Food and Agriculture Organization.
- The objectives of the IT are:
  - the conservation and sustainable use of PGRFA (Plant Genetic Resources for Food and Agriculture) and
  - the fair and equitable sharing of the benefits arising out of their use.
  - The IT is in harmony with the CBD, and <u>focused on sustainable agriculture and food security.</u>

- The CBD is a legally-binding Convention.
- The objectives of the CBD are:
  - the conservation of biological diversity
  - the sustainable use of its components and
  - the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The IT and the CBD

- The IT:
  - 130+ nations are Parties to it; in force since June 2004.
  - The US signed (2002) but has not yet ratified it.
  - The Executive Branch transmitted the IT to the Senate to seek its advice and consent to ratification in 2008. [It is pending in the Senate].

- The CBD:
  - 190+ nations are Parties to it; in force since Dec. 1993.
  - The US signed (1993) but has not yet ratified it.

The IT and the CBD

- The IT:
  - Nations have sovereign rights over “their” PGRFA and in exercise of those rights Parties agree to:
  - Establish a multilateral system (MLS) for benefit-sharing, and facilitated access to certain PGRFA for crop genetic improvement for food security.
  - Provisions for PGRFA in International Agricultural Research Centers (e.g., CIMMYT, IRRI)

- The CBD:
  - Nations have sovereign rights over their natural resources.
  - Emphasizes contractual (bilateral) arrangements.
  - “Prior informed consent” can be required by a nation, and “benefit sharing” takes place via “mutually agreed terms” regarding access to germplasm.

The IT and the CBD

- IT's scope includes all PGRFA. The MLS includes:
  - PGRFA of 64 food and feed crops key to food security; more crops may be included in the future.
  - Held in ex situ collections by national governments (e.g., US National Plant Germplasm System), in the public domain; or held by IARCs; or
  - Donated or made available by private entities.

- CBD's scope and coverage:
  - Most genetic resources under national jurisdiction exchanged internationally post-29 Dec. 1993.
  - Depending on a nation's interpretation, the CBD's access and benefit-sharing regime might Include major crops not covered by the IT MLS such as soybean, tomato, cotton, peanuts.

The IT and the CBD

- Benefit-sharing under the IT:
  - In a broad sense, benefit-sharing under the IT will come from nations who are obliged to conserve PGRFA and make them available for research and breeding.
  - In a narrow sense, benefit-sharing will flow from individual PGRFA transactions via the Standard Material Transfer Agreement (SMTA) which details obligations of recipients and the providers. Funds do not flow back directly to the country of origin: they are invested in projects supporting farmers in developing countries who conserve crop diversity in their fields, and assisting farmers and breeders globally.

- Benefit-sharing under the CBD:
  - Negotiated by providers and recipients (e.g., in contracts for exchanging genetic resources); in some cases national governments are involved.
  - In many nations, will be guided by the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits Arising from their Utilization, which will come into force this month.
  - National implementation procedures are under development, and will be key to the Nagoya Protocol's effects.

The IT and the CBD

- Germplasm access and exchange under the IT:
  - Via the SMTA, which includes conditions for end use (excludes non-food and non-feed), conservation, management of IPRs, and benefit-sharing upon commercialization.

- Germplasm access and exchange under the CBD:
  - Variable terms, negotiated by parties to individual contracts.
  - National implementation of the Nagoya Protocol might affect those terms, and might not be tailored to the needs of agriculture, involving problematic requirements.

Effects of IT and CBD on US PGR users

- IT:
  - Has not affected use of PGRFA acquired pre-IT, nor of domestic US PGRFA.
  - Use of PGRFA acquired internationally post-IT has been affected by terms and conditions of SMTA.
  - In some cases, the IT's SMTA has facilitated international access to PGRFA for U. S. public-sector researchers, genebanks, etc., but in other cases it has not.
- CBD :
  - Generally has not affected use of PGRFA acquired pre-CBD, nor of domestic US PGRFA.
  - Use of PGRFA acquired internationally post-CBD affected by terms and conditions of exchange consistent with U. S. law.
  - Effects of the Nagoya Protocol will be determined by its implementation.
  - Since 1993, access to genetic resources internationally has become increasingly problematic.

Effects of the US ratifying and becoming a Party to the IT

- US PGRFA users, both public and private-sector, would have guaranteed access to PGRFA from other nations and IARCs: if needed, international law would be a tool for asserting that right.
- Terms of access specified by the SMTA.
- US government obliged to provide PGRFA access to non-US users essentially via current NPGS practices, but accompanied by the SMTA.
- Terms of access to NPGS PGRFA would not change for US users.

Effects of the US ratifying and becoming a Party to the IT

- Thus, if the US were a Party to the IT, the NPGS would incur additional obligations for reporting, information-sharing and curation, but it is already fulfilling nearly all of those. <u>Other public and private-sector PGRFA users would incur no additional obligations.</u>
- As a Party, the US government could effectively represent US germplasm users at the IT's Governing Body, advance US priorities and interests, and strive to improve some aspects of the IT and the SMTA.

Draft Background on the SMTA

Monsanto supports the International Treaty on Plant Genetic Resources for Food and Agriculture (IT) in principle and is seeking means to actively engage in its access and benefits sharing provisions. Specifically, we view the multilateral system (MLS) as a valuable source of plant genetic resources for food and agriculture (PGRFA). Monsanto's plant breeding efforts would benefit if access to MLS material was allowed under acceptable terms. In return, Monsanto would be able to contribute to the fair and equitable sharing of benefits by means that include furthering the conservation and sustainable use of PGRFA in general.

Plant breeders have delivered proven benefits to human kind through acquiring, using and creating new combinations (diversity) of PGRFA, which provided improved food security and economic growth globally. Plant breeders working in industry advance and improve germplasm using the best available techniques fit for purpose in highly competitive markets. Commercial breeding programs use PGRFA that range from unimproved, "pre-bred" material[1] whose characteristics are poorly known to more advanced, better characterized, higher value "improved" material. It is generally understood that the value of unimproved germplasm is much lower than improved material. The investment risk of advancing from unimproved PGRFA to improved, commercial germplasm is much higher due to the low probability of any return and higher cost due to the increased time it takes to develop commercial material. Much of the cost and time involves eliminating the undesired genetic load contained in unimproved PGRFA. The majority of material in the MLS would be characterized by company breeders as having lower commercial potential (unimproved) without significant, costly and prolonged investments in making improvements[2]. Nevertheless, the MLS represents an important additional source of diversity for research and long-term crop improvement programs globally. This additional diversity is important considering the current need to adapt to climate change and new threats confronting farmers.

The IT established a multilateral system for facilitated access to PGRFA that uses a standard material transfer agreement (SMTA). Attractive features of the SMTA include its administrative simplicity, low-cost access to genetic resources and provisions for maintaining the PGRFA for research and breeding at the discretion of the developer. However, the SMTA also creates challenges for many companies, particularly those that use patents to protect intellectual property. Some companies have adopted a policy of SMTA-avoidance as a matter of necessity because:

1. Patenting plant breeding inventions triggers costly compliance measures. Because patenting inventions involving PGRFA are standard practice for some companies and since patents are considered to be a restriction triggering mandatory monetary benefits sharing, MLS material must be tracked in perpetuity within commercial breeding programs in order to comply with the IT.
2. The definition of PGRFA is unrealistic given commercial breeding practices. In theory, this necessitates the tracking of every gene contained in every accession obtained from the MLS in every cross to comply with the literal terms of the SMTA. In practice, tracking every accession

[1] The term "pre-bred" refers to raw accessions that may include wild relatives, landraces and other unimproved materials

[2] Maintaining a private source of quality germplasm is an additional cost to companies.

in perpetuity regardless of whether the material is present or confers any commercial value is cost prohibitive for a breeding program and possibly technically impossible[3].

3. Payment rates are unreasonably high and put the original user (payer) at a competitive disadvantage, while secondary accession (from an initially commercialized cultivar) is unrestricted and free. In effect, this does not promote use and early adoption of PGRFA, but the converse. Many products are available in multiple countries. A patent enforced in one country affords no protection in another where patents cannot be obtained. The commercial restriction triggering payment does not restrict access in markets where a patent cannot be acquired. Thus, a developer making mandatory payments has no protection in other markets where competitors will have free access without encumbrance by either a patent or SMTA.

Currently, many technologically-based seed companies that use patents to protect their intellectual property view the SMTA as impeding breeding programs globally and achieving the goals of the IT. The treatment of patents on plant inventions as a restriction that triggers monetary benefits sharing discriminates against innovation-driven, technology companies that are committed to complying with agreements into which they have entered. For the reasons given above, the SMTA requires signatories to track individual genes and every accession in a breeding program in perpetuity, which is excessively costly, if not impossible. Importantly, the demonstrable value and probability of benefit from breeding with unimproved MLS materials is insufficient for some companies to incur the monetary risks associated with using them in commercial plant breeding programs.

Because of the above considerations, a large and important pool of PGRFA is not available to a significant portion of the private sector. The current SMTA-defined value sharing proposition is unacceptable to many companies, and negatively affects benefits returned to society in the form of improved seed and the flow of funds into the IT derived from access and sustainable use. This situation also has negative consequences on food security, economic development and sustainable use of PGRFA. It is hoped that the Governing Body of the IT will consider these and other points as they examine new approaches to enhance benefits sharing. Simple modifications could improve the SMTA and facilitate plant breeding broadly, positively impact the conservation and sustainable use of PGRFA while also ensuring the fair and equitable sharing of benefits derived from their utilization.

---

[3] The SMTA definition of PGRFA as a functional unit of heredity does not appropriately reflect that fact that genetic material's actual and potential value may be beneficial, neutral or detrimental to the commercial value of the progeny. A PGRFA may be present in a commercial material's lineage, but its contribution to the commercial value is negligible and the cost of removing it is prohibitive.

Access to Germplasm for Breeding

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

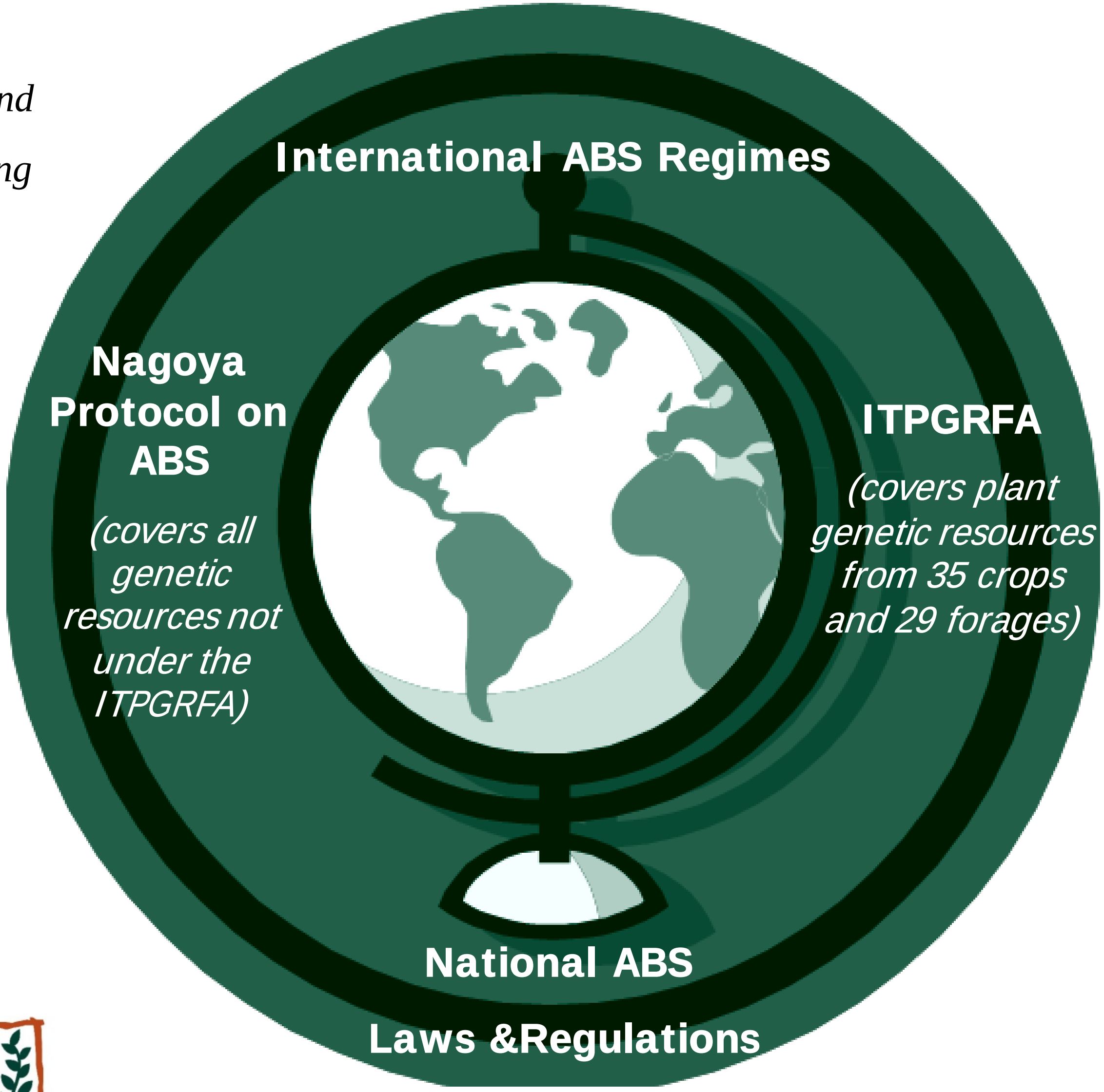
13 June 2014

Tom Nickson

MONSANTO
imagine™

ABS – The Big Picture

ABS: Access and Benefits Sharing



MONSANTO imagine™

ITPGRFA - Basics

- Adopted by Parties November 2001 as a specialized global system for the management and exchange of plant genetic resources
- Entered into force June 2004
- Much of the world's germplasm is controlled under the ITPGRFA
- Currently 131 Contracting Parties :

Australia	Brazil	Canada
India	Japan	Costa Rica
Uruguay	Paraguay	All Europe

- The US is signatory, but has not completed the ratification process
- Notable other Non-Parties:

Argentina, China, Mexico, Russia & Ukraine

MONSANTO imagine™

Structure of the ITPGRFA

Organization of the ITPGRFA includes:

- General provisions on conservation and sustainable use – pursuing appropriate policies (developing country focused), international cooperation, supporting research e.g., "expand the use of local and locally adapted crops;
- Farmers' Rights – saved seed endorsed (as allowed by National Law – Parties must take measures to promote and protect Farmers' Rights and may allow farmer saved seed for breeding, exchange, sale, etc.);
- Multilateral System of Access and Benefits Sharing, which limits scope to Annex I "crops" – 35 food crops and 29 forages, describes rules for access and forms of benefit sharing, and proposes the Standard Material Transfer Agreement (SMTA);
- Supporting Components – the global plan of action, networks, information systems and cooperation involving *ex-situ* collections including non-Annex I crops held by IARCs of the CG system;
- Financial Provisions – strategy to fund conservation and sustainable use of PGRFA including voluntary contributions; and
- Institutional Provisions – authority of the Governing Body.

MONSANTO imagine™

ITPGRFA Pro’s & Con’s




- **ASTA supports ratification of the ITPGRFA since US would provide leadership and stability needed by ASTA members**

Pro’s	Con’s
Contains most of the world’s plant genetic resources	MLS contains only 64 crops and needs to be include many more
Administratively simple with low transaction costs for access	Compliance requires expensive tracking and tracing.
Provides legal certainty important internationally	Mandatory monetary payments on patented materials are high, can extend in perpetuity and are not necessarily used to improve commercial breeding
Recognized in the Nagoya Protocol	

ABS & Plant Breeding

- **Why does this matter?**
  - **Access to germplasm globally has been affected by the international conversation on ABS**
    - **It is expected that developed countries must pay a fair and equitable share of the benefits they derived from the utilization of genetic resources to the (original) providers.**
  - **The seed sector needs Contracting Parties that will advocate for reasonable rules and terms within the Governing Body of the ITPGRFA**
    - **The US government recognizes the benefits commercial breeding delivers, the value of intellectual property rights in development and the importance of global, facilitated access to plant genetic resources.**
  - **The impact of Nagoya on breeding and commercial seed sales globally is uncertain, and the ITPGRFA provides protection for the seed sector**

MONSANTO imagine™

Academic perspective on Germplasm Treaty

Scott Jackson
University of Georgia

- Research focus: use of Crop Wild Relatives (CWRs)
  - To increase diversity in breeding programs
  - Source of genes for climate adaptation
- Germplasm exchange is key to research
  - Pigeonpea and chickpea seeds from India

Challenges with SMTA

6.7 In the case that the **Recipient commercializes** a **Product** that is a **Plant Genetic Resource for Food and Agriculture** and that incorporates **Material** as referred to in Article 3 of **this Agreement**, and where such **Product** is not **available without restriction** to others for further research and breeding, the **Recipient** shall pay a fixed percentage of the **Sales** of the **commercialized Product** into the mechanism established by the **Governing Body** for this purpose, in accordance with *Annex 2* to **this Agreement**.

6.11 The **Recipient** may opt as per *Annex 4*, as an alternative to payments under Article 6.7, for the following system of payments:

6.10 A **Recipient** who obtains intellectual property rights on any **Products** developed from the **Material** or its components, obtained from the **Multilateral System**, and assigns such intellectual property rights to a third party, shall transfer the benefit-sharing obligations of **this Agreement** to that third party.

b) The period of validity of the option shall be ten years renewable in accordance with *Annex 3* to **this Agreement**;

c) The payments shall be based on the **Sales** of any **Products** and of the sales of any other products that are **Plant Genetic Resources for Food and Agriculture** belonging to the same crop, as set out in Annex 1 to the **Treaty**, to which the **Material** referred to in *Annex 1* to **this Agreement** belongs;

d) The payments to be made are independent of whether or not the **Product** is **available without restriction**;

e) The rates of payment and other terms and conditions applicable to this option, including the discounted rates are set out in *Annex 3* to **this Agreement**;

DivSeek: a Digital Seed Bank

Meetings sponsored by the Global Crop Diversity Trust in Colombia, Thailand, USA and Germany to discuss how to better use CWRs and genomic tools to explore crop genebanks.

Premise: Vast collections of germplasm, well curated, but not well described. How do we find the variation we need to solve current and future problems?

Digital Seed Bank:
Sequence the > 7M accessions in ~1750 collections

The International Center for Tropical Agriculture in Colombia holds 65,000 crop samples from 141 countries.

Feeding the future

We must mine the biodiversity in seed banks to help to overcome food shortages, urge **Susan McCouch** and colleagues.

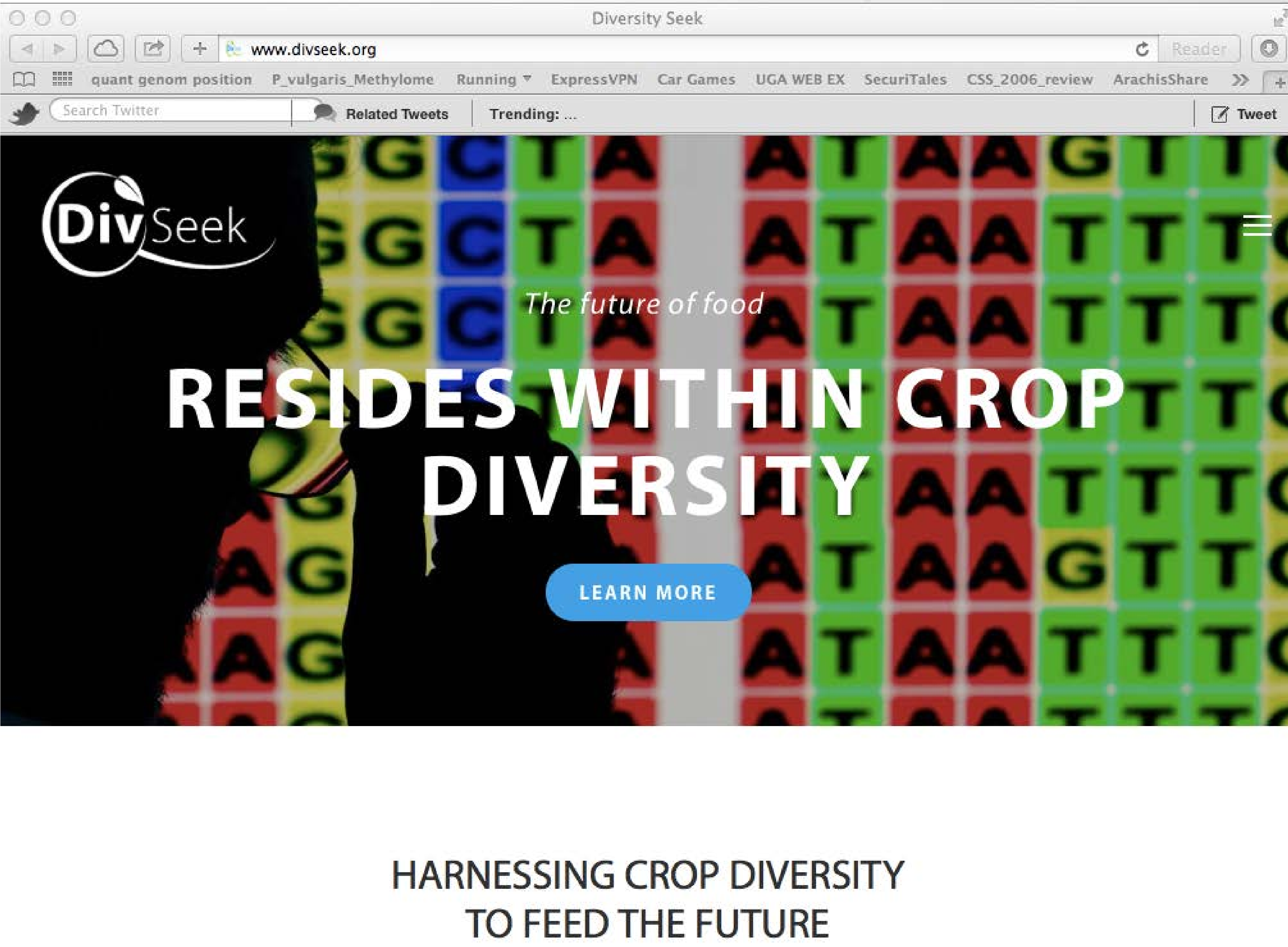
Humanity depends on fewer than a dozen of the approximately 300,000 species of flowering plants for 80% of its caloric intake. And we capitalize on only a fraction of the genetic diversity that resides within each of these species. This is not enough to support our food system in the future. Food availability must double in the next 25 years to keep pace with population and income growth around the world. Already, food-production systems are precarious in the face of intensifying demand, climate change, soil degradation and water and land shortages.

Farmers have saved the seeds of hundreds of crop species and hundreds of thousands of 'primitive' varieties (local domesticates called landraces), as well as the wild relatives of crop species and modern varieties no longer in use. These are stored in more than 1,700 gene banks worldwide. Maintaining the 11 international gene-bank collections alone costs about US$18 million a year.

The biodiversity stored in gene banks fuels advances in plant breeding, generates billions of dollars in profits, and saves many lives. For example, crossbreeding a single wild species of rice, *Oryza nivara*, which was found after screening more than 6,000 seed-bank accessions, has provided protection against grassy stunt virus disease in almost all tropical rice varieties in Asia for the past 36 years. During the green revolution, high-yielding rice and wheat varieties turned India into a net food exporter. By 1997, the world economy had accrued annual benefits of approximately $115 billion from the use of crop wild relatives[2] as sources of environmental resilience and resistance to pests and diseases.

The time is ripe for an effort to harness the full power of biodiversity to feed the world. Plant scientists must efficiently and systematically domesticate new crops and increase the productivity and sustainability of current crop-production systems.

Why does plant breeding need a boost? Because new, high-yielding seeds that are adapted for future conditions are a cornerstone of sustainable, intensified food production[3]. Since the mid-1990s, progress in conventional plant breeding has


Diversity Seek
www.divseek.org
Reader
quant genom position
P_vulgaris_Methylome
Running
ExpressVPN
Car Games
UGA WEB EX
SecuriTales
CSS_2006_review
ArachisShare
Search Twitter
Related Tweets
Trending: ...
Tweet
DivSeek
The future of food
RESIDES WITHIN CROP
DIVERSITY
LEARN MORE
HARNESSING CROP DIVERSITY
TO FEED THE FUTURE

DSB issues

- How does the SMTA apply to sequence information?
- If benefit is realized without use of seed, can compensation be expected?
- Goal is to have sequence tied to specific seeds/propagules.
- What about crops not in Annex 1?

ANNEX I

LIST OF CROPS COVERED UNDER THE MULTILATERAL SYSTEM

Food crops

Crop	Genus	Observations
Breadfruit	*Artocarpus*	Breadfruit only.
Asparagus	*Asparagus*	
Oat	*Avena*	
Beet	*Beta*	
Brassica complex	*Brassica* et al.	Genera included are: *Brassica, Armoracia, Barbarea, Camelina, Crambe, Diplotaxis, Eruca, Isatis, Lepidium, Raphanobrassica, Raphanus, Rorippa*, and *Sinapis*. This comprises oilseed and vegetable crops such as cabbage, rapeseed, mustard, cress, rocket, radish, and turnip. The species *Lepidium meyenii* (maca) is excluded.
Pigeon Pea	*Cajanus*	
Chickpea	*Cicer*	
Citrus	*Citrus*	Genera *Poncirus* and *Fortunella* are included as root stock.
Coconut	*Cocos*	
Major aroids	*Colocasia, Xanthosoma*	Major aroids include taro, cocoyam, dasheen and tannia.
Carrot	*Daucus*	
Yams	*Dioscorea*	
Finger Millet	*Eleusine*	
Strawberry	*Fragaria*	
Sunflower	*Helianthus*	
Barley	*Hordeum*	
Sweet Potato	*Ipomoea*	
Grass pea	*Lathyrus*	
Lentil	*Lens*	
Apple	*Malus*	
Cassava	*Manihot*	*Manihot esculenta* only.
Banana / Plantain	*Musa*	Except *Musa textilis.*
Rice	*Oryza*	
Pearl Millet	*Pennisetum*	
Beans	*Phaseolus*	Except *Phaseolus polyanthus.*
Pea	*Pisum*	
Rye	*Secale*	
Potato	*Solanum*	Section tuberosa included, except *Solanum phureja.*
Eggplant	*Solanum*	Section melongena included.
Sorghum	*Sorghum*	
Triticale	*Triticosecale*	
Wheat	*Triticum* et al.	Including *Agropyron, Elymus,* and *Secale*.
Faba Bean / Vetch	*Vicia*	
Cowpea et al.	*Vigna*	
Maize	*Zea*	Excluding *Zea perennis, Zea diploperennis*, and *Zea luxurians*.

Forages

Genera	Species
LEGUME FORAGES	
Astragalus	*chinensis, cicer, arenarius*
Canavalia	*ensiformis*
Coronilla	*varia*
Hedysarum	*coronarium*
Lathyrus	*cicera, ciliolatus, hirsutus, ochrus, odoratus, sativus*
Lespedeza	*cuneata, striata, stipulacea*
Lotus	*corniculatus, subbiflorus, uliginosus*
Lupinus	*albus, angustifolius, luteus*
Medicago	*arborea, falcata, sativa, scutellata, rigidula, truncatula*
Melilotus	*albus, officinalis*
Onobrychis	*viciifolia*
Ornithopus	*sativus*
Prosopis	*affinis, alba, chilensis, nigra, pallida*
Pueraria	*phaseoloides*
Trifolium	*alexandrinum, alpestre, ambiguum, angustifolium, arvense, agrocicerum, hybridum, incarnatum, pratense, repens, resupinatum, rueppellianum, semipilosum, subterraneum, vesiculosum*
GRASS FORAGES	
Andropogon	*gayanus*
Agropyron	*cristatum, desertorum*
Agrostis	*stolonifera, tenuis*
Alopecurus	*pratensis*
Arrhenatherum	*elatius*
Dactylis	*glomerata*
Festuca	*arundinacea, gigantea, heterophylla, ovina, pratensis, rubra*
Lolium	*hybridum, multiflorum, perenne, rigidum, temulentum*
Phalaris	*aquatica, arundinacea*
Phleum	*pratense*
Poa	*alpina, annua, pratensis*
Tripsacum	*laxum*
OTHER FORAGES	
Atriplex	*halimus, nummularia*
Salsola	*vermiculata*

US should be a signatory so that we can at least participate in discussions on changes in the Treaty and SMTA.

International Treaty

Ratification History

- Hearing in 2009
- Passed Senate Foreign Relations Committee in 2010
- On Senate calendar in December 2010. Adjourned before vote.

Senate Foreign Relations Committee

Robert	Menendez	DEM	NJ
Barbara	Boxer	DEM	CA
Benjamin	Cardin	DEM	MD
Jeanne	Shaheen	DEM	NH
Chris	Coons	DEM	DE
Richard	Durbin	DEM	IL
Tom	Udall	DEM	NM
Christopher	Murphy	DEM	CT
Tim	Kaine	DEM	VA
Edward	Markey	DEM	MA
Bob	Corker	REP	TN
Jim	Risch	REP	ID
Marco	Rubio	REP	FL
Ron	Johnson	REP	WI
Jeff	Flake	REP	AZ
John	McCain	REP	AZ
John	Barrasso	REP	WY
Rand	Paul	REP	KY

asta first–the seed®

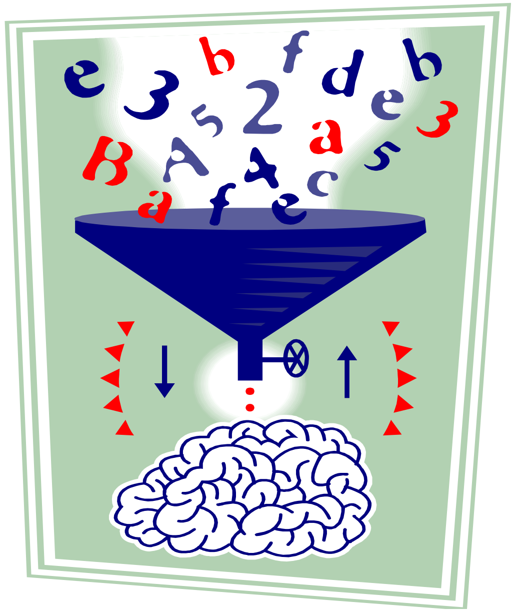
Open Science, Data and Publications

Sylvie Brouder
Professor And Wickersham Chair
Purdue University

Steven Daley-Laursen
Professor And Senior Research Executive
NAREEE Advisory Board, Open Data/Science Chair
University Of Idaho

Many Types of Data to be Managed by Universities

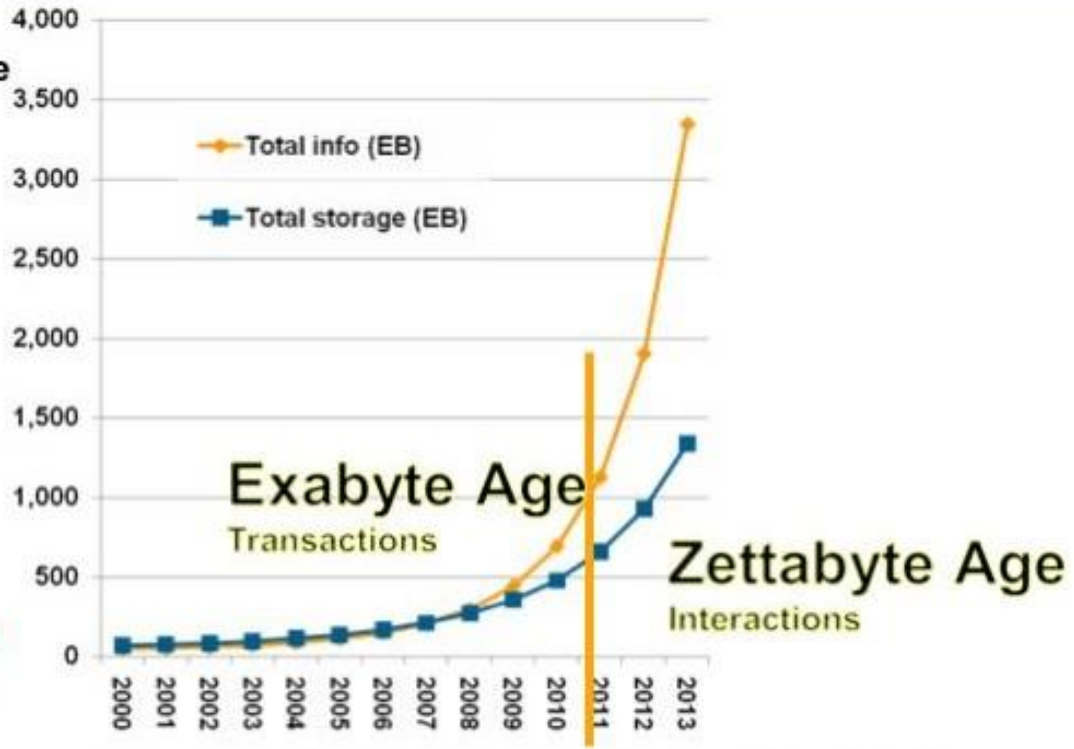
- **Research and Outreach Data & Computing**
- On-Line Teaching
- University Business Analytics
- Student Data



1. Data Explosion; Volume, Variety, Velocity

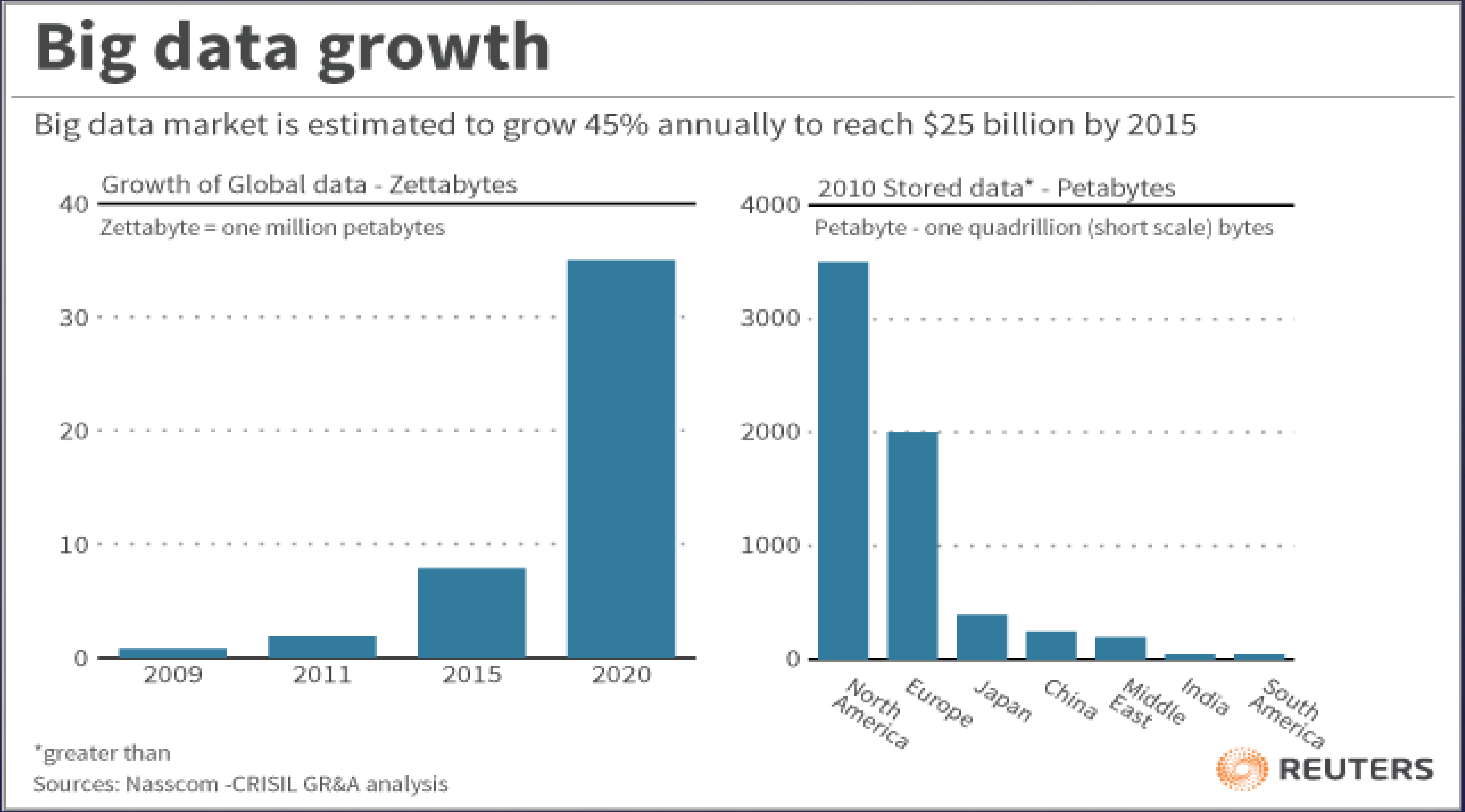
- More data has been created in the last three years than in all past 40,000 years.
- Almost all of this data has a location
- Business and government decision-makers must have a strategy for dealing with location based data

Technology Trend: (1) Sensor data and mobility apps are creating more data tagged with location. (2) Increasing number of apps are location-aware, so queries involve spatial dimension. High confidence that analytic apps will include who-what-when-**where** dimensions.



One Zettabyte (ZB) = 1,000,000,000,000,000,000,000 bytes = 10^{21} bytes.
Based on IDC and UC Berkeley data growth estimates.

TERADATA
Raising Intelligence



Reuters graphic/Catherine Trevethan 05/10/12

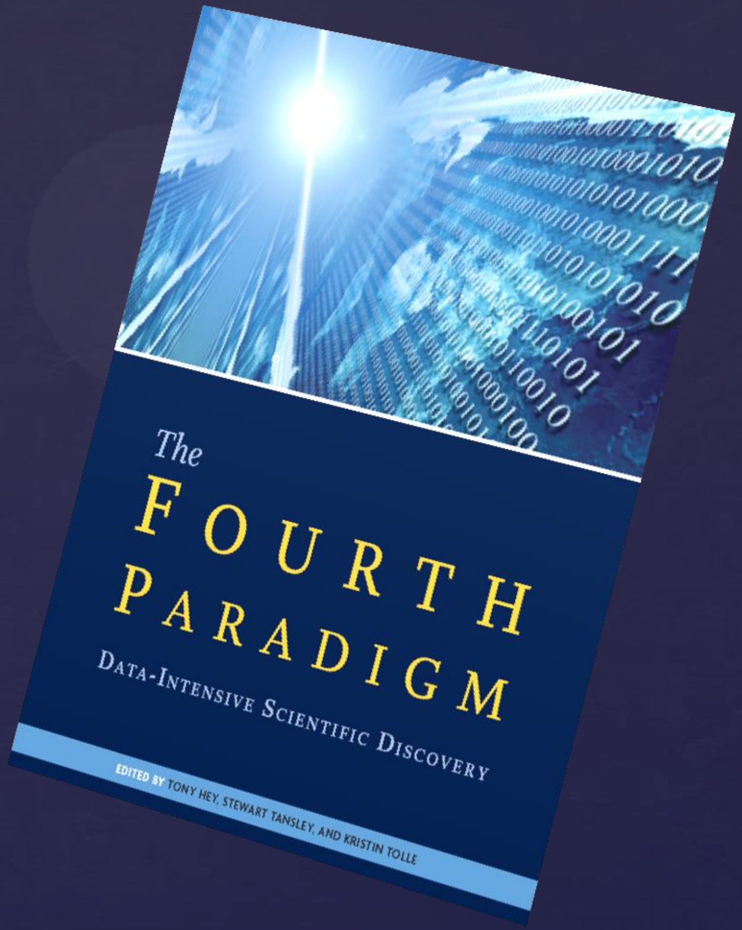
2. Science More Integrated, Computational, Data Intensive

"…data and software are redefining what it means to do science."

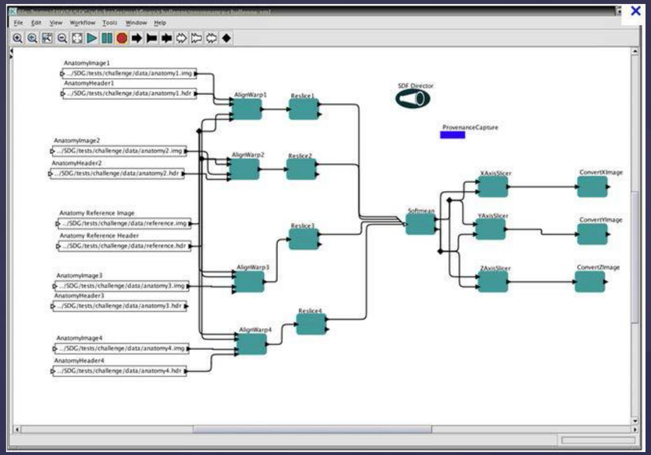
— **Bill Gates,** Chairman, Microsoft Corporation

"…greatest challenge for 21st-century science is responding to the new era of data-intensive science … a new paradigm beyond experimental and theoretical research and simulations of nature, requiring new tools, techniques, and ways of working."

— **Douglas Kell**, University of Manchester



Hey, Tansley, Hawley, Fourth Paradigm, http://research.microsoft.com/fourthparadigm/



"…everything about science is changing because of the impact of information technology. Experimental, theoretical, computational science are all being affected by the *data deluge*, and a fourth, ***data intensive science*** paradigm is emerging.

The goal is to have a world in which all of the science literature is online, all of the science data is online, and they interoperate with each other.

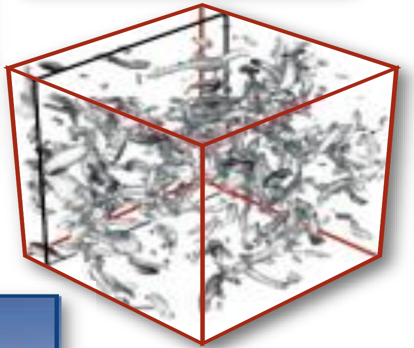
Lots of new tools are needed to make this happen."

- Jim Gray, Microsoft Research

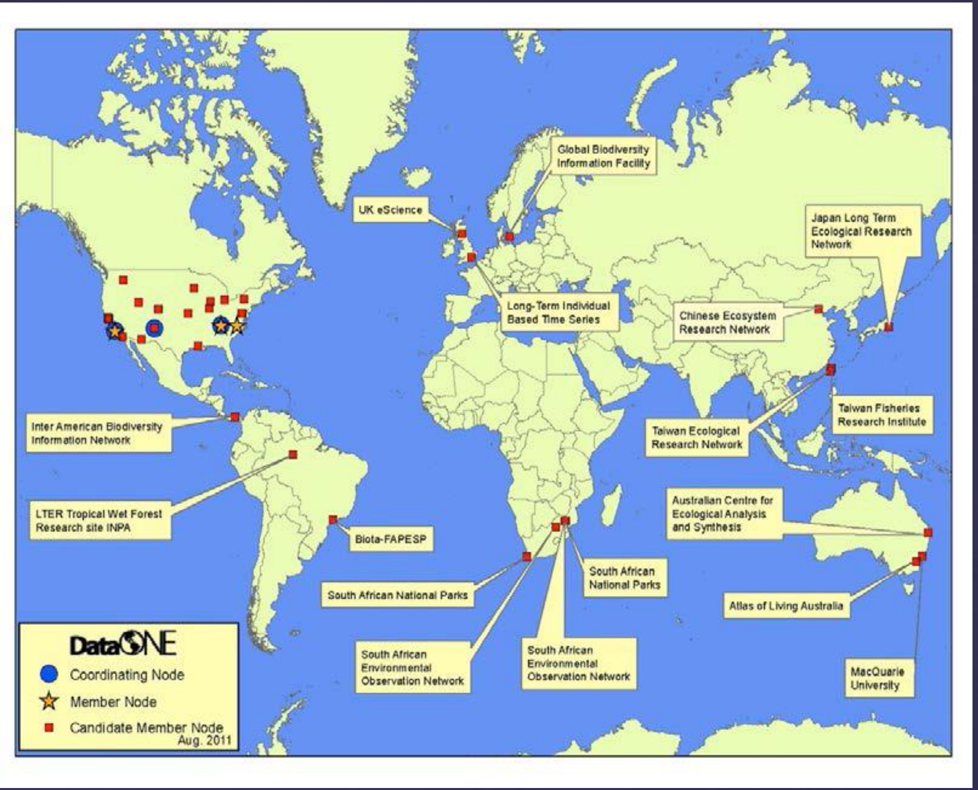
Science Paradigms

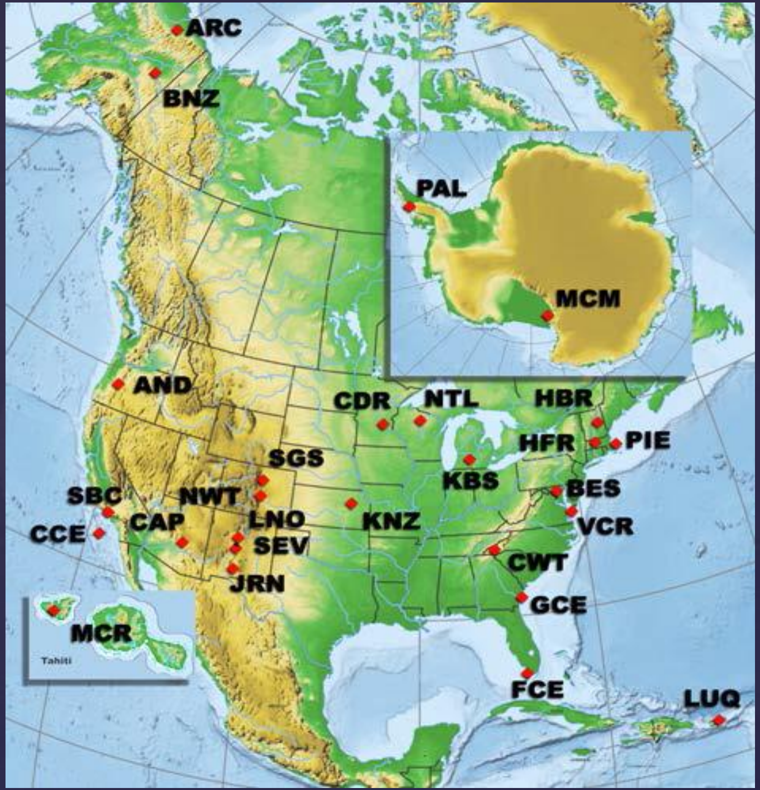
- Thousand years ago:
  science was **empirical**
  describing natural phenomena
- Last few hundred years:
  theoretical branch
  using models, generalizations
- Last few decades:
  a **computational** branch
  simulating complex phenomena
- Today: **data exploration** (eScience)
  unify theory, experiment, and simulation
  – Data captured by instruments
    or generated by simulator
  – Processed by software
  – Information/knowledge stored in computer
  – Scientist analyzes database/files
    using data management and statistics

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{4\pi G p}{3} - K\frac{c^2}{a^2}$$



* Image from *"The Fourth Paradigm: Data Intensive Scientific Discovery"*, Microsoft Research, 2009

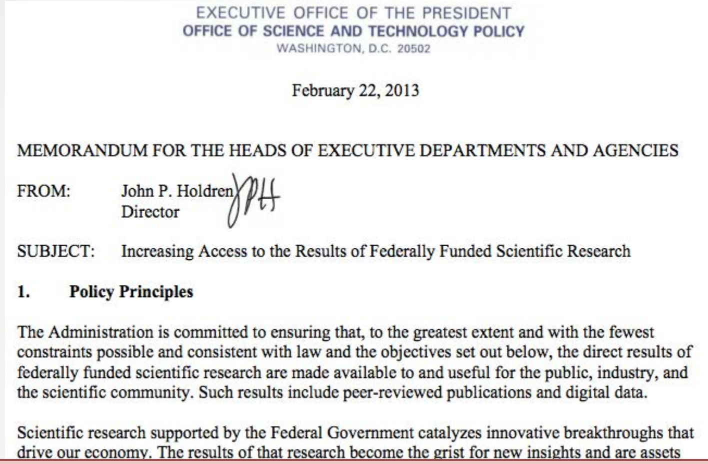




3. Scientists and issues are geographically spread.

4. Open Data/Science Mandates

...governments and funding agencies are requiring data accessibility and encouraging data intensive use...



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

February 22, 2013

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: John P. Holdren JPH
Director

SUBJECT: Increasing Access to the Results of Federally Funded Scientific Research

1. **Policy Principles**

The Administration is committed to ensuring that, to the greatest extent and with the fewest constraints possible and consistent with law and the objectives set out below, the direct results of federally funded scientific research are made available to and useful for the public, industry, and the scientific community. Such results include peer-reviewed publications and digital data.

Scientific research supported by the Federal Government catalyzes innovative breakthroughs that drive our economy. The results of that research become the grist for new insights and are assets

2-2013

OSTP Policy: “Increasing Access to the Results of Federally Funded Scientific Research” Requires a plan to support increased public access to the results of research (scholarly publications and science data) funded by the Federal Government

5-2013

OMB: “Open Data Policy—Managing Information as an Asset”

·May 9: WH Executive Order: “Making Open and Machine Readable the New Default for Government Information”

Why are data not reused? Real costs…

- **Too much work?** Lack of data workflow tools…
  - Diekmann interviews (J. Ag. & Food Info., 2012):

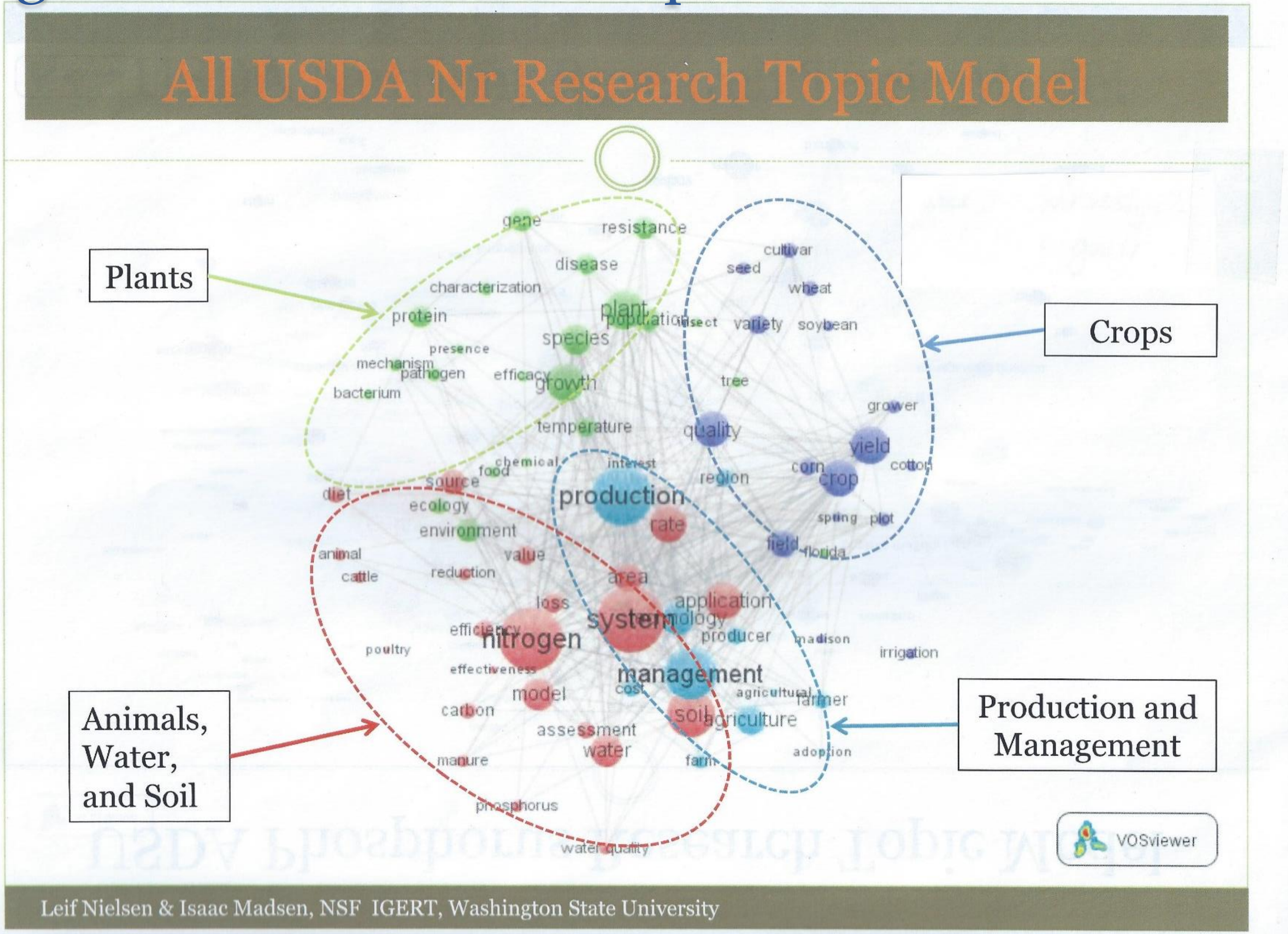
  "[Another group of scientists and I] were talking about, can we get our data and pull it together? They wanted that data, [but] ***it's the annotation that's really the hard part*** *[for] them [to be] able to make sense of it. I would be happy to give [out the data], but [then]* ***I have to explain whatever I did****."*

- **Too expensive?** > 80% of scientists surveyed in 2010 indicated that they did not have resources to make their data open access (Science. Feb. 2011)

Question of Money, Motivation, and Mechanics…

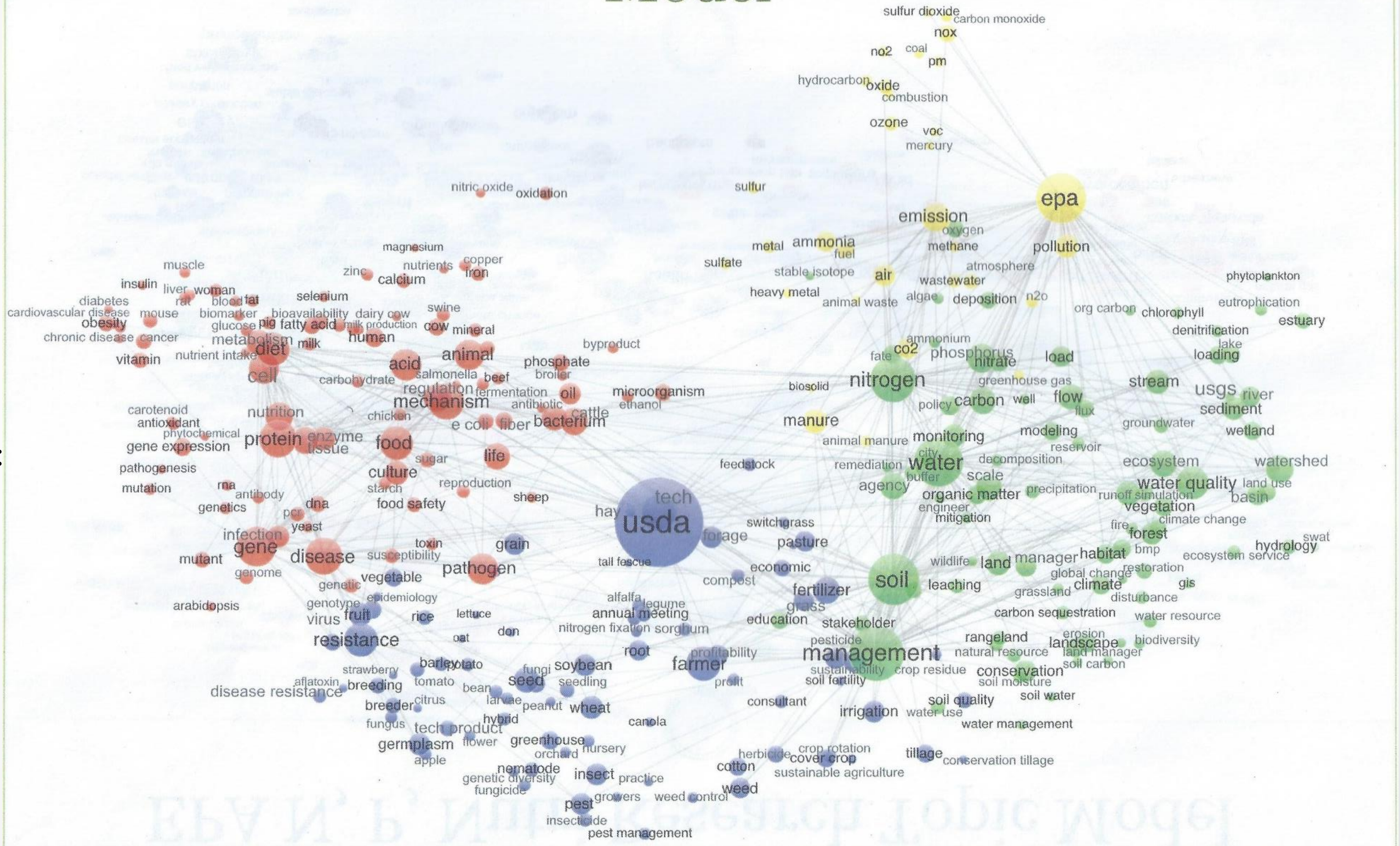
What do we know we know? Less than we could… Agricultural nutrients = pollutants

Topic model of funded research shows USDA has invested a lot BUT what does it all mean?



EPA, USDA, USGS N, P, Nutri Research Topic Model

Investment across 3 Agencies significant BUT can it be translated into useful knowledge for:
Management?
Policy?
Regulation?



Global Responsibility

Produce more food with fewer resources

- **Pilot commodity optimization program:** We collaborated with 15 large suppliers – representing 30% of our food and beverage sales in North America. By providing farmers with data and tools, they're able to develop plans to optimize fertilizer and tilling practices in corn and soy crop rotations. This saves money, reduces greenhouse gas (GHG) and, ultimately, delivers more sustainable products to our customers. The pilot commodity optimization program includes 2.5 million acres, with the potential to reduce GHG by 2.3 million metric tons (MMT).
- **Fertilizer optimization:** While our work on fertilizer optimization has been foundational, we are exploring opportunities to scale this and other pilots across food commodities. We are in the process of developing new relationships that could total 14 million acres, with the potential to reduce GHG by an estimated 7 MMT.

& Nutrition

Diversity & Inclusion

Leveraging our global scale

Related Links

WERF

Water Environment Research Foundation

Collaboration. Innovation. Results.

Learn about WERF | Search Research Publications & Tools

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About WERF

The Water Environment Research F
research organization dedicated to v
have developed a portfolio of more t

We are a nonprofit organization that
Our subscribers include wastewater
equipment companies, engineers an
subscribers. WERF takes a progress
subscribers, environmental professic
experts.

NATIONAL CORN GROWERS ASSOCIATION

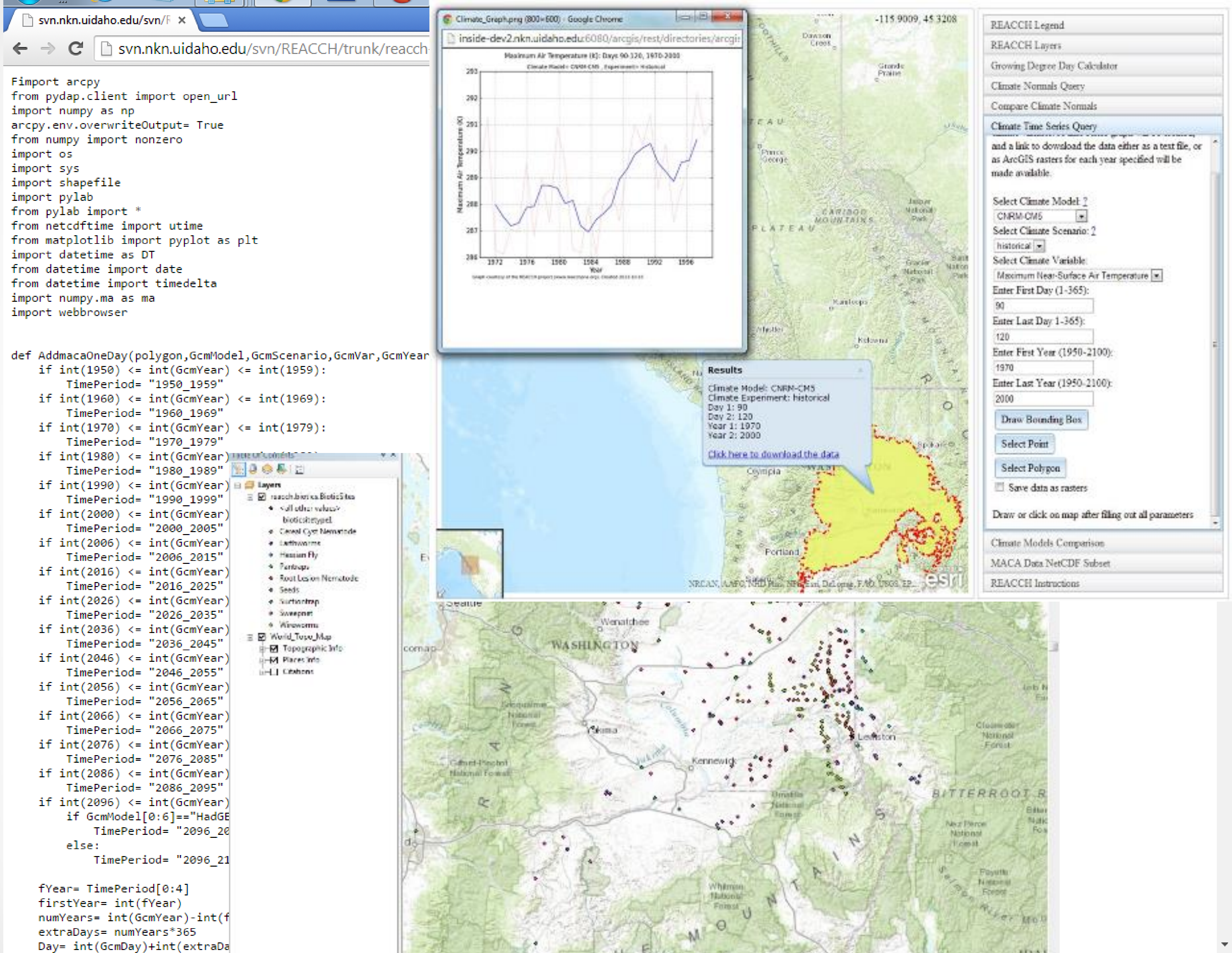
WERF

Water Environment Research Foundation

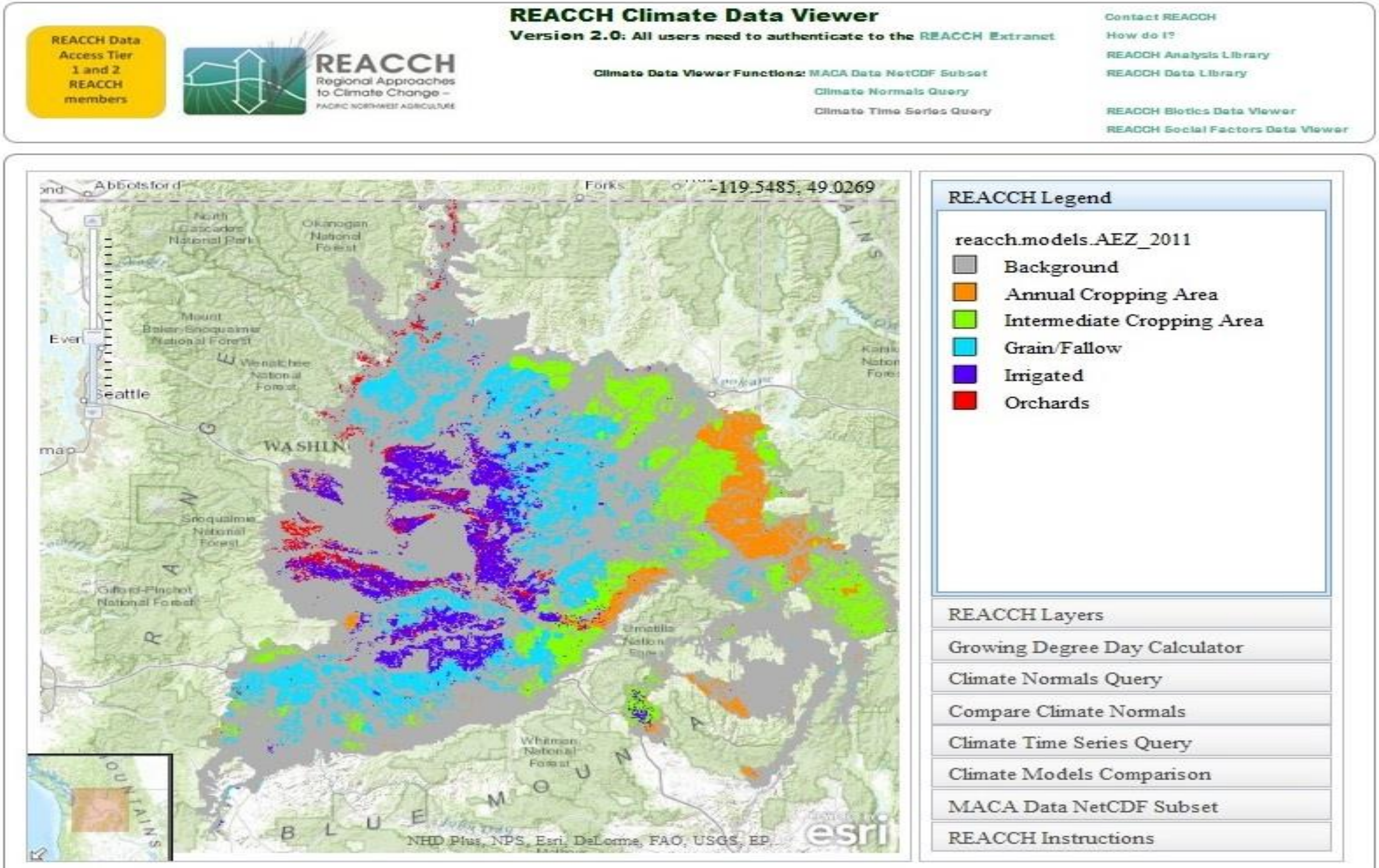
Collaboration. Innovation. Results.

Development of a National Agricultural BMP Database

The Water Environment Research Foundation (WERF), the National Corn Growers Association (NCGA), and the Missouri Corn Growers Association (MCGA) have partnered to undertake the development of a national Agricultural Best Management Practices (BMP) Database. The purpose of the Agricultural BMP Database is to develop a centralized repository of agricultural BMP performance studies to provide scientifically-based information on practices that reduce pollutant loading from agricultural sites. The database will include performance data and meta data that document the many field-based and practice-based variables that affect BMP performance. The long-term goal of the project is to provide agricultural advisors, planners, consultants and producers with information that enables them to better select systems of BMPs for their operations and to support improvements in agricultural BMP design and implementation.



svn.nkn.uidaho.edu/svn/R
svn.nkn.uidaho.edu/svn/REACCH/trunk/reacch
Fimport arcpy
from pydap.client import open_url
import numpy as np
arcpy.env.overwriteOutput= True
from numpy import nonzero
import os
import sys
import shapefile
import pylab
from pylab import *
from netcdftime import utime
from matplotlib import pyplot as plt
import datetime as DT
from datetime import date
from datetime import timedelta
import numpy.ma as ma
import webbrowser
def AddmacaOneDay(polygon,GcmModel,GcmScenario,GcmVar,GcmYear
if int(1950) <= int(GcmYear) <= int(1959):
TimePeriod= "1950_1959"
if int(1960) <= int(GcmYear) <= int(1969):
TimePeriod= "1960_1969"
if int(1970) <= int(GcmYear) <= int(1979):
TimePeriod= "1970_1979"
if int(1980) <= int(GcmYear)
TimePeriod= "1980_1989"
if int(1990) <= int(GcmYear)
TimePeriod= "1990_1999"
if int(2000) <= int(GcmYear)
TimePeriod= "2000_2005"
if int(2006) <= int(GcmYear)
TimePeriod= "2006_2015"
if int(2016) <= int(GcmYear)
TimePeriod= "2016_2025"
if int(2026) <= int(GcmYear)
TimePeriod= "2026_2035"
if int(2036) <= int(GcmYear)
TimePeriod= "2036_2045"
if int(2046) <= int(GcmYear)
TimePeriod= "2046_2055"
if int(2056) <= int(GcmYear)
TimePeriod= "2056_2065"
if int(2066) <= int(GcmYear)
TimePeriod= "2066_2075"
if int(2076) <= int(GcmYear)
TimePeriod= "2076_2085"
if int(2086) <= int(GcmYear)
TimePeriod= "2086_2095"
if int(2096) <= int(GcmYear)
if GcmModel[0:6]=="HadGE
TimePeriod= "2096_20
else:
TimePeriod= "2096_21
fYear= TimePeriod[0:4]
firstYear= int(fYear)
numYears= int(GcmYear)-int(f
extraDays= numYears*365
Day= int(GcmDay)+int(extraDa
Climate_Graph.png (800×600) - Google Chrome
inside-dev2.nkn.uidaho.edu:6080/arcgis/rest/directories/arcgis
Maximum Air Temperature (K): Days 90-120, 1970-2000
Maximum Air Temperature (K)
Year
Layers
World_Topo_Map
Topographic Info
Places Info
Results
Climate Model: CNRM-CM5
Climate Experiment: historical
Day 1: 90
Day 2: 120
Year 1: 1970
Year 2: 2000
Click here to download the data
-115.9009, 45.3208
REACCH Legend
REACCH Layers
Growing Degree Day Calculator
Climate Normals Query
Compare Climate Normals
Climate Time Series Query
and a link to download the data either as a text file, or as ArcGIS rasters for each year specified will be made available.
Select Climate Model: ?
CNRM-CM5
Select Climate Scenario: ?
historical
Select Climate Variable:
Maximum Near-Surface Air Temperature
Enter First Day (1-365):
90
Enter Last Day 1-365):
120
Enter First Year (1950-2100):
1970
Enter Last Year (1950-2100):
2000
Draw Bounding Box
Select Point
Select Polygon
Save data as rasters
Draw or click on map after filling out all parameters
Climate Models Comparison
MACA Data NetCDF Subset
REACCH Instructions
WASHINGTON
Wenatchee
Yakima
Kennewick
Lewiston
Portland
Olympia
Spokane
BITTERROOT R


REACCH Climate Data Viewer
Version 2.0: All users need to authenticate to the REACCH Extranet
REACCH Data Access Tier 1 and 2 REACCH members
REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE
Climate Data Viewer Functions: MACA Data NetCDF Subset
Climate Normals Query
Climate Time Series Query
Contact REACCH
How do I?
REACCH Analysis Library
REACCH Data Library
REACCH Biotics Data Viewer
REACCH Social Factors Data Viewer
-119.5485, 49.0269
Abbotsford
Forks
North Cascades National Park
Okanogan National Forest
Mount Baker-Snoqualmie National Forest
Wenatchee National Forest
Seattle
WASHIN
Snoqualmie National Forest
Gifford-Pinchot National Forest
Umatilla National Forest
Whitman National Forest
BLUE MOUNTAINS
NHD Plus, NPS, Esri, DeLorme, FAO, USGS, EP...
esri
REACCH Legend
reacch.models.AEZ_2011
Background
Annual Cropping Area
Intermediate Cropping Area
Grain/Fallow
Irrigated
Orchards
REACCH Layers
Growing Degree Day Calculator
Climate Normals Query
Compare Climate Normals
Climate Time Series Query
Climate Models Comparison
MACA Data NetCDF Subset
REACCH Instructions

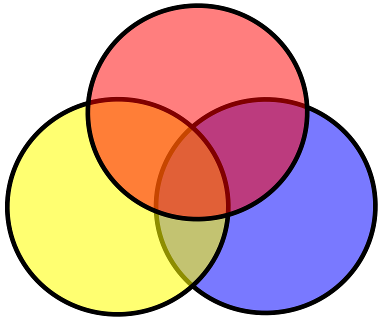
Climate Science

- Climate scientists from three Universities
- Multiple gridded downscaled climate scenarios for several hundred years for the entire US
- Code to perform dynamic, data-intensive analyses across multiple data sources
- Publish resulting dataset/metadata back to home base

Dickersin: Knowledge translation: From clinical research to practice decisions

The Medical Model

Evidence generation → Evidence Synthesis (systematic reviews) → Clinical policy (guidelines) → Evidence-based healthcare



Clinical trials, observational studies

Cochrane Collaboration, others

Professional Societies, others

Application of policy:
Evidence
Clinician expertise
Patient values

Knowledge translation

US government has 1.3 billion $$$ stockpile… Reduces symptoms by 17 hours (7 to 6.3 d), no effect on mortality

Comment / 1 Shares / Tweets / Stumble / Email   More +

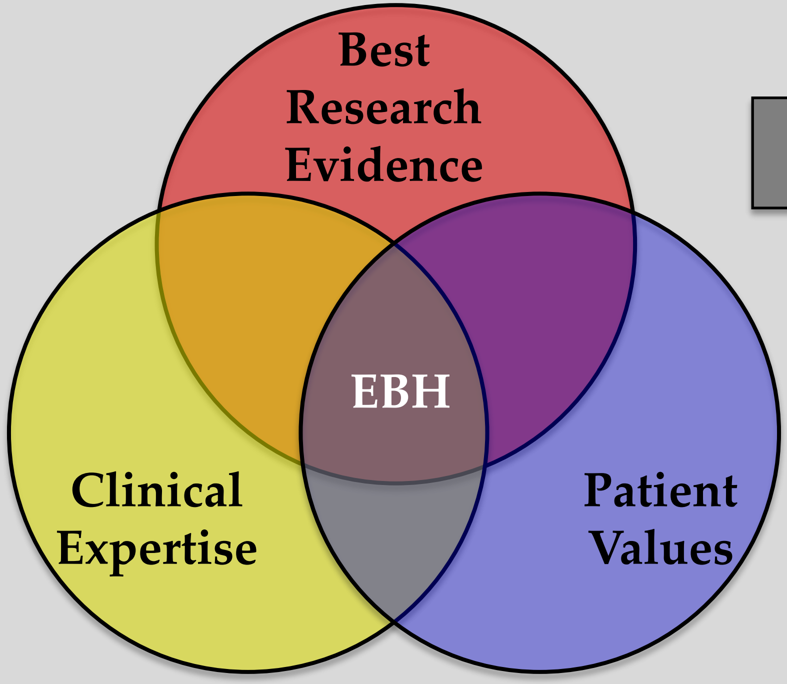
Tamiflu may have little effect in pandemic, study says

CBS EVENING NEWS

APRIL 10, 2014, 6:33 PM | A new study conducted by a worldwide medical research group challenges the assumption that antiviral medications like Tamiflu and Relenza offer significant help against the flu. The U.S. government has spent $1.3 billion stockpiling this class of drugs. Dr. Jon LaPook reports.

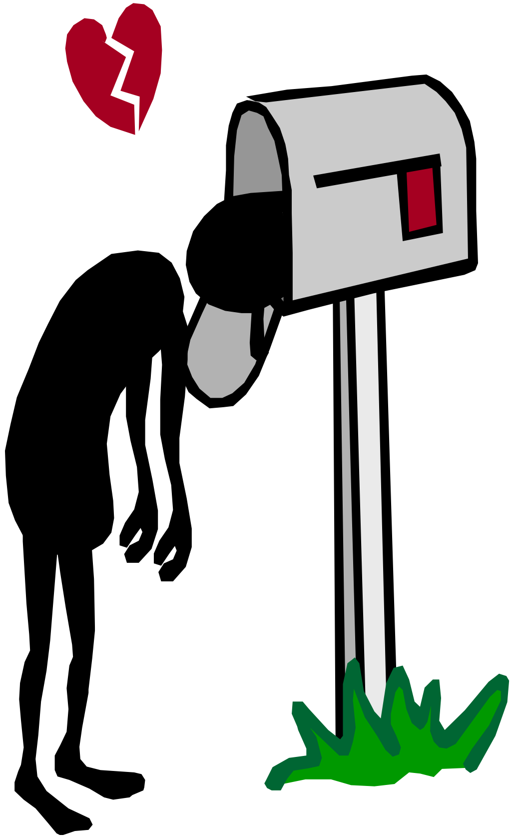
http://www.cbsnews.com/videos/tamiflu-may-have-little-effect-in-pandemic-study-says/

Evidence-Based Healthcare	Evidence-Based Agriculture
"The integration of best research evidence with clinical expertise and patient values"	"The integration of best research evidence with management expertise and stakeholder priorities?"



Sackett, 2000. Referenced in Dickersin, K. and M. Mayer. 2012. Understanding evidence-based healthcare: A foundation for action. US Cochrane Center. Available online at http://us.cochrane.org/understanding-evidence-based-healthcare-foundation-action

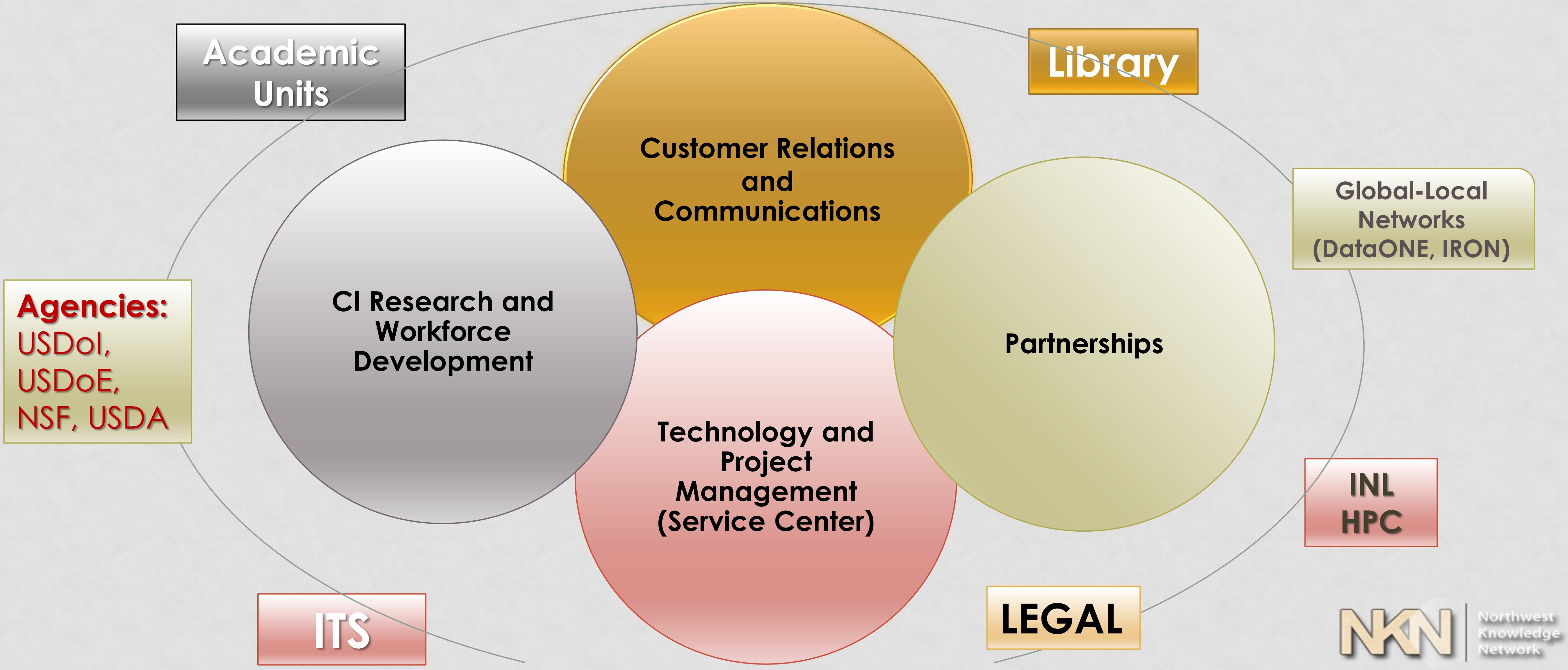
T. Scott Murrell, IPNI



I'm Lonely and Unsure

Who Else is Doing This That I Need to Connect with at My Campus???

BIG/OPEN DATA NETWORKS AND TEAMS



Enabling Data-Intensive Activity Dictates the Cooperators

- Quality data and metadata throughout lifecycle
- Data management policies
- Data/Pub cataloging, serving, application tool services
- Centralized IT, access to HPC, pipelines
- Research; Interoperability (TEK-BioP-Social) and Virtualization
- <u>Workforce development; domain and software</u>

= RESEARCH – LIBRARY – ITS – ACADEMICS –GCOUNSEL
REGIONAL-GLOBAL NETWORKS

Culture of short data “lifecycles” in agronomic research…

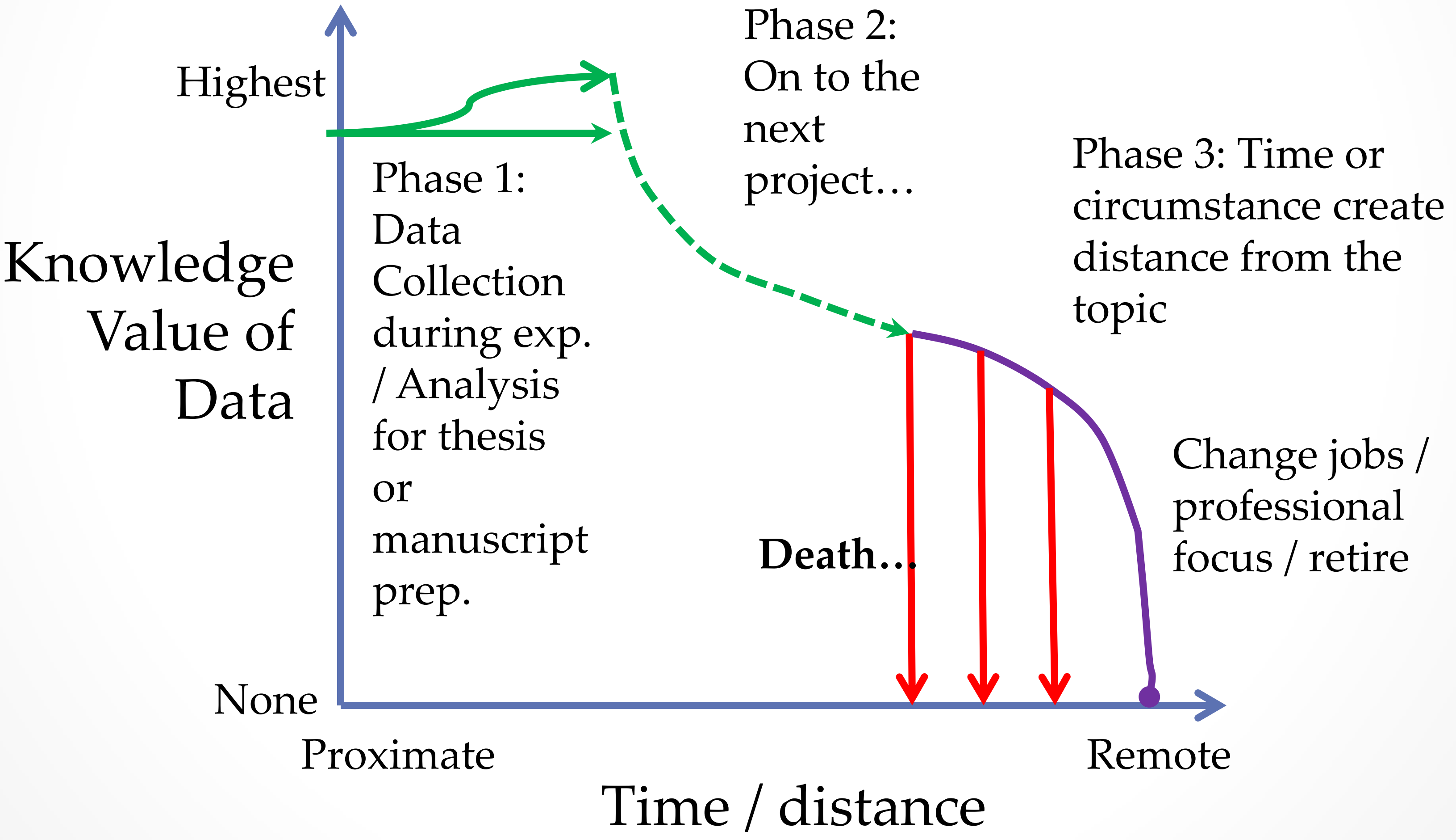
Business as usual in Agronomy / Applied Research… Data live and die within an individual PI lab

Data Dies

Data Created

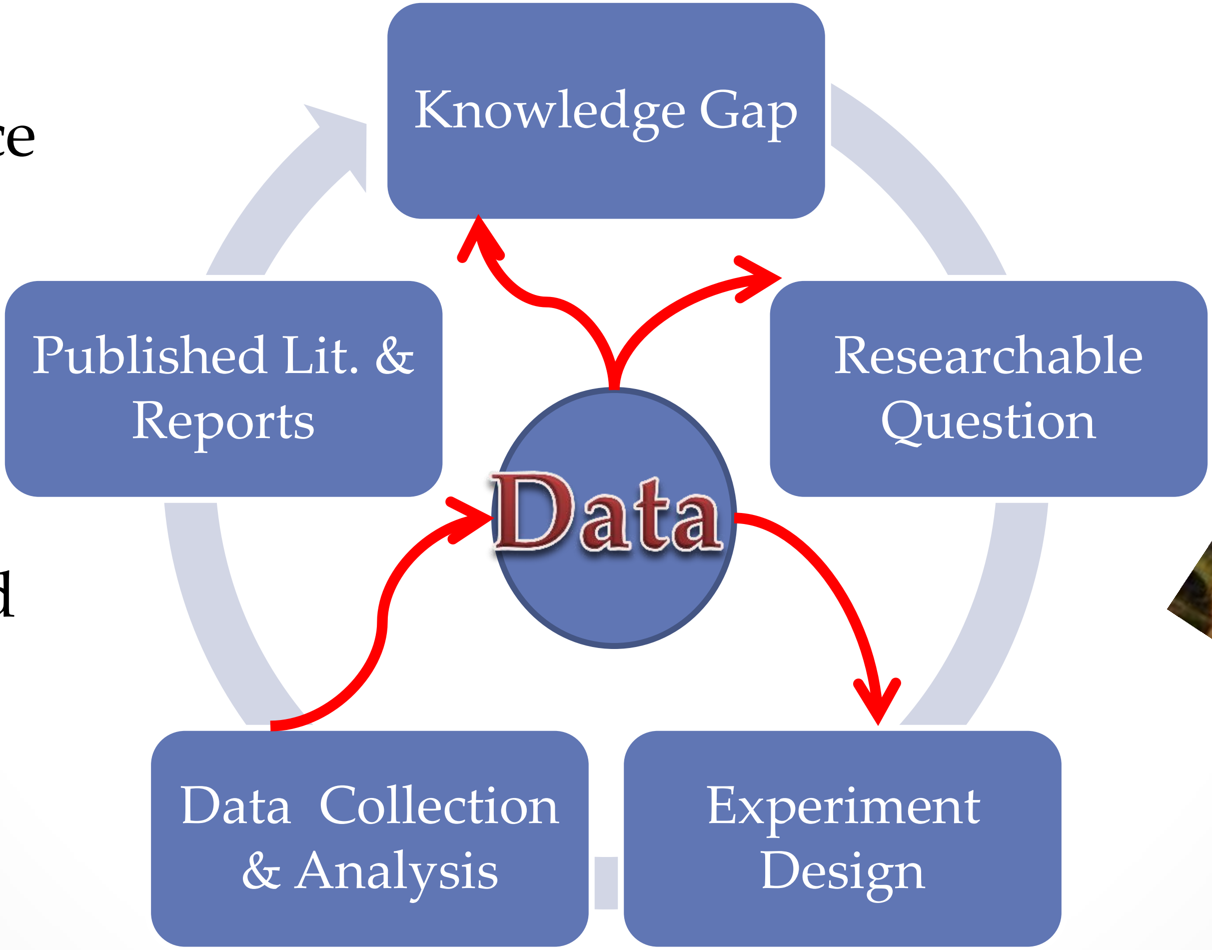
Data Conceived

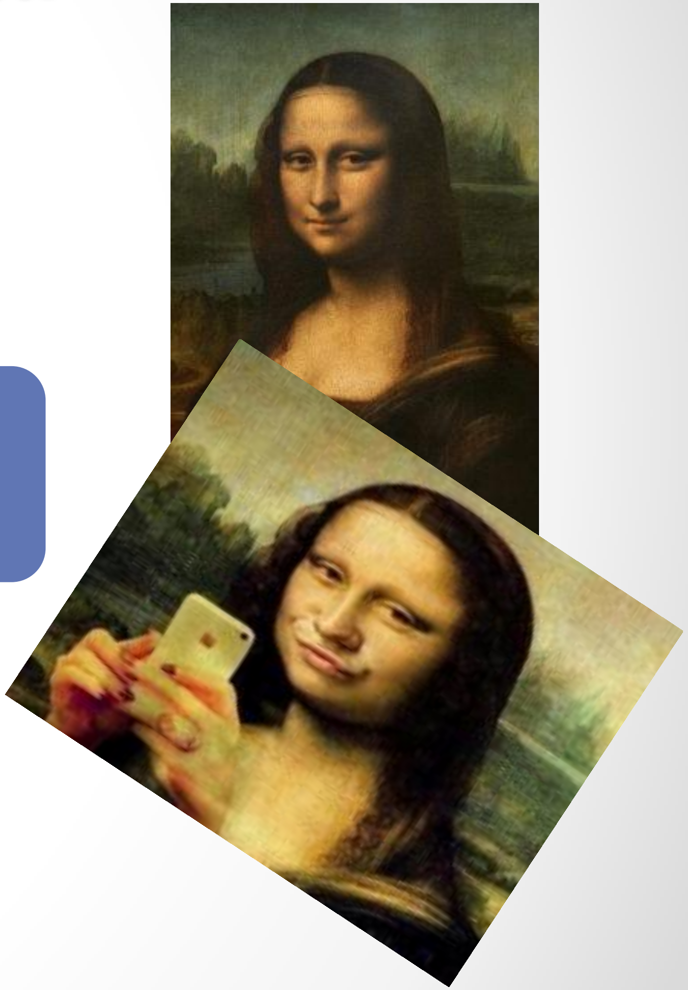
Precarious Nature of Typical Ag. Data Lifecycle: Scientifically proven that my ability to understand and find these data will erode extremely rapidly!



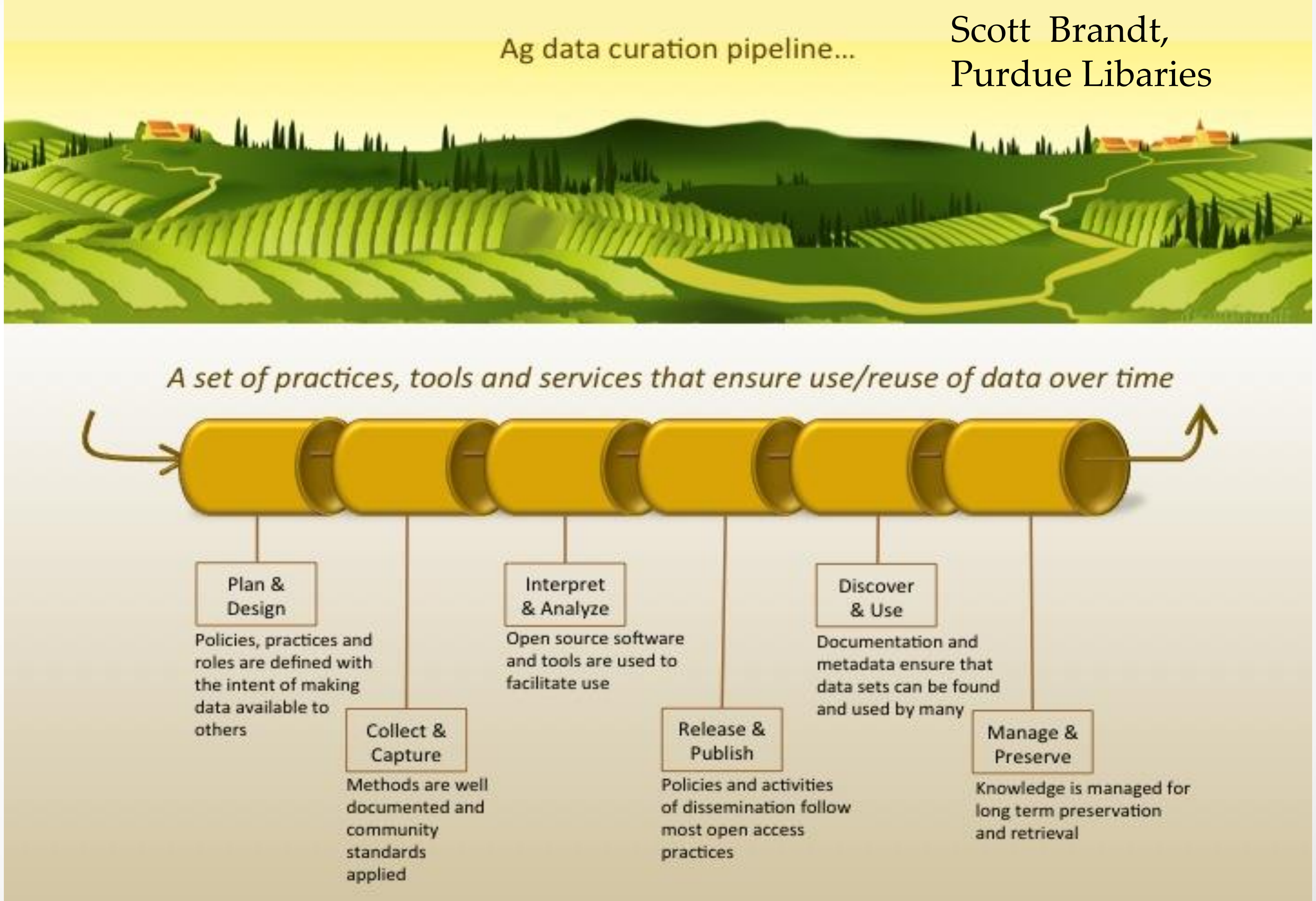
Applied research model with a longer data lifecycle … More “hands” on the data

Need someplace to put data w/ sufficient workflows & policies to ensure correct recognition and reuse

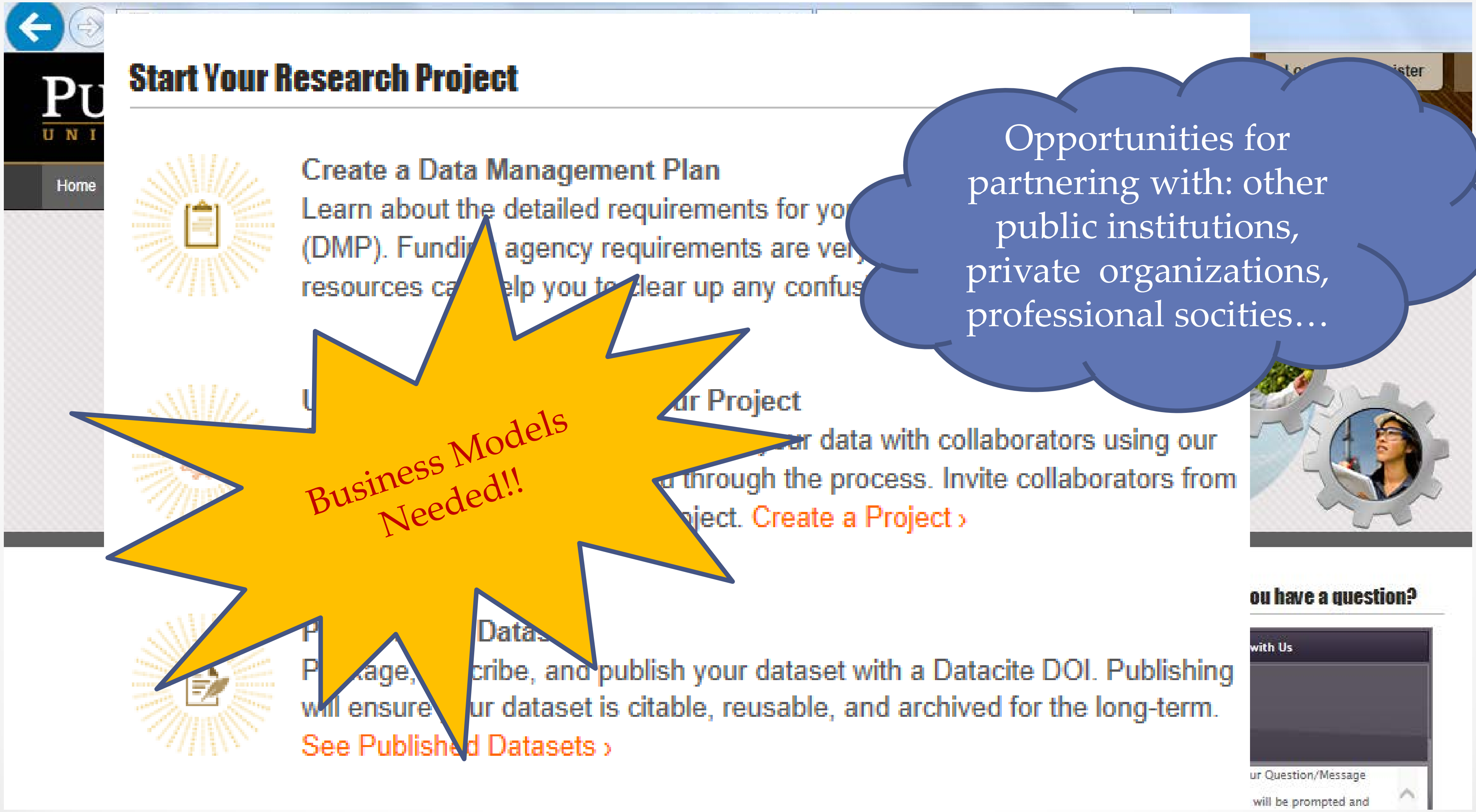




Why start w/ Libraries: Know how to organize & store so something can be discovered / accessed / used . They have the desired attributes for a data "destination"…



Purdue University Research Repository: What libraries are to books, PURR is to data (plus so much more!)



2010 to 2014

Northwest Knowledge Network

NORTHWEST KNOWLEDGE NETWORK

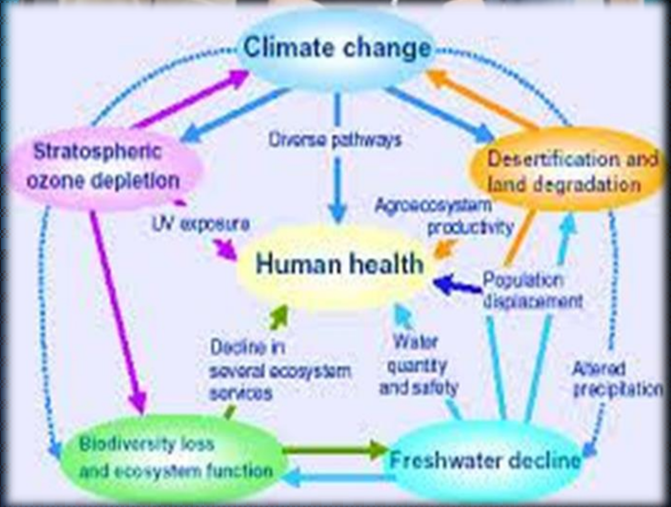
UNIVERSITY OF IDAHO AND COOPERATORS

www.northwestknowledge.net

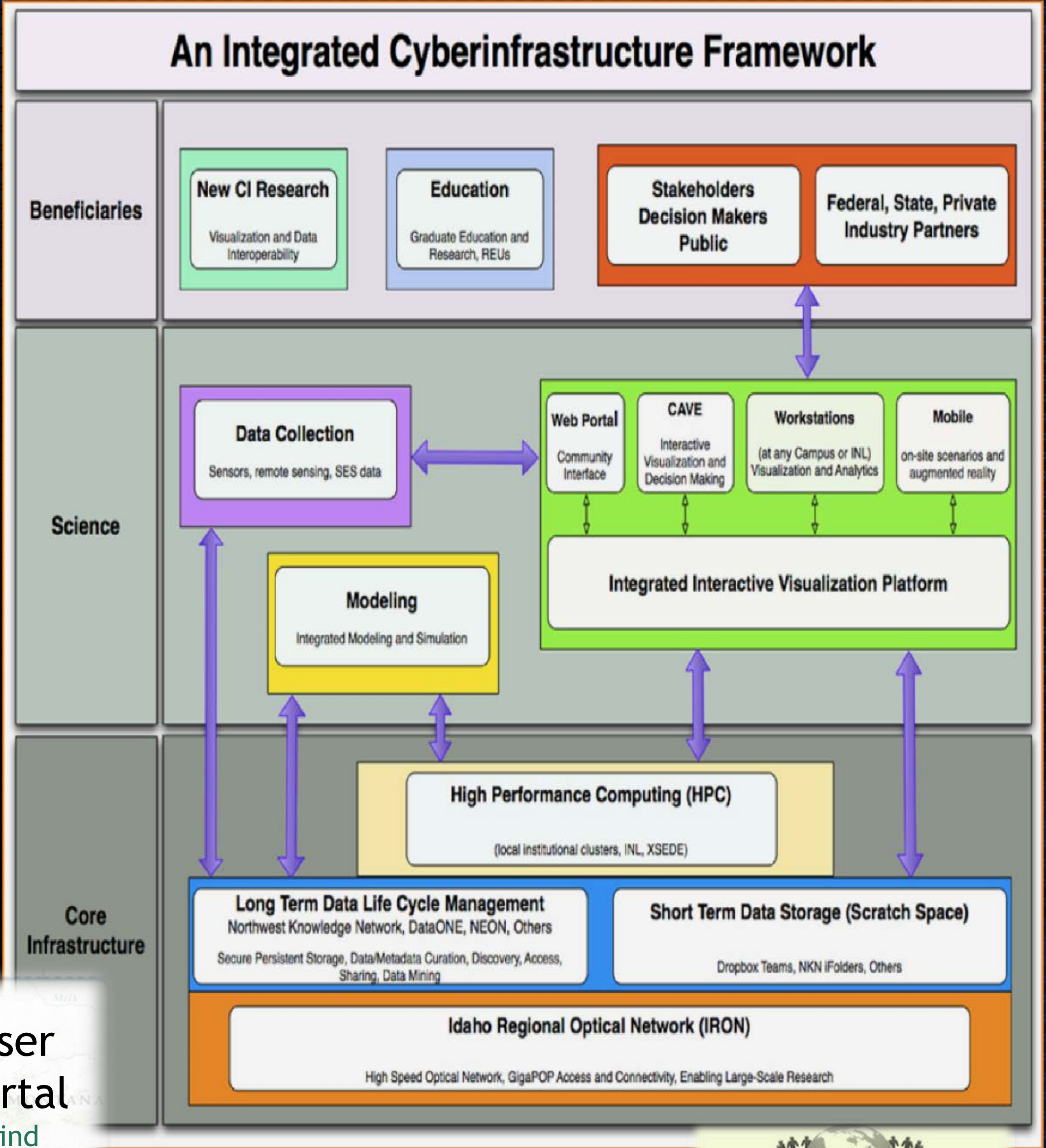
NKN Mission

Enable research teams to address complex societal problems by facilitating quality metadata, and the storage, discovery and dynamic analysis of data as long term , dependable assets.

Advance research and education in support of data intensive science.



User
Portal
Find
Upload
Collaborate



NKN Northwest Knowledge Network

Northwest Knowledge Network

- Lifecycle management for heterogeneous research data
  - Tiered, distributed data storage
  - Metadata Tools, Standards
  - Data discovery and retrieval
  - Data-centric researcher collaboration tools
  - Interoperability across scale, time, data discipline **(incl TEK, Social)**

- NKN Big Data Functions
  - ✓ Capture
  - ✓ Storage
  - ✓ Curation
  - ✓ Search
  - ✓ Sharing
  - Analysis
  - Visualization

- Collaborative regional data partnerships (NIFA USDA, NW CSC USDoI, INL USDoE, EPSCoR NSF, NW Climate Hub USDA, NW Forest Fire Science Center and Sustainable NW Dairies Center.

- Network of resources, services, and expertise
  - Policies, protocols, standards in support of effective data/metadata;
  - Systems admin, software development for data-intensive science;
  - Stable and enduring storage and access to data and metadata;
  - Hosting of virtual machines, applications, websites databases; and
  - Consulting/technical services for data and metadata management.
  - NSF DataONE, access to HPC and national high-speed data networks

The Next Phase: Online Data Observatory

- Enable investigators to visualize and intercompare heterogeneous datasets without struggling with file formats, unit conversion, subsetting, scales

- New research with existing data

- Important Components
  - Data representation/interoperability
  - New tools
  - Web service APIs

Case Study in Regional Data Management

- Startup venture; partner/institutional funding.
- Learned critical-minimal level of staffing hardware and software to sustain core services.
- Demand for services exceeding capacity. Venture ending.
- Established Service Center.
- Need dependable revenue flow for data services, and more sophisticated partnership between universities and federal government, on behalf of the PI's (the triangle of value propositions).

Seeking a Sustainable Fiscal Model

Northwest Knowledge Network FY2013 through FY2020 Budget Plan

	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
Revenue								
VP Funds	102,413	133,609	242,460	-	-	-	-	-
PI F&A Return	1,728	23,069	26,500	15,000	5,000	15,000	15,000	15,000
UI Central FA	-	-	-	-	-	-	-	-
Service Center	-	-	100,000	156,000	179,400	206,310	237,257	272,846
EPSCoR	39,720	78,727	172,631	164,154	84,284	-	-	-
USGS Grants	215,868	301,521	212,861	42,558	-	-	-	-
Misc Grants/Dept Funds	61,628	63,915	63,742	7,191	7,188	7,332	7,478	7,628
New Grant Funds	-	-	-	-	200,000	200,000	200,000	200,000
New Equipment Funding	-	-	-	-	-	100,000	100,000	100,000
Revenue Total	421,357	600,841	818,195	384,903	475,872	528,642	559,735	595,473
	-	-	-	-	-	-	-	-
Expense								
Payroll	402,116	563,468	798,734	785,220	788,737	804,328	820,229	836,450
Operating	19,058	18,861	46,017	38,517	38,517	38,517	38,120	38,517
Computer Equipment	-	89,203	45,000	40,000	40,000	140,000	180,000	180,000
Office Furniture/Equip	183	120	20,000	-	-	-	-	-
Expense Total	**421,357**	**671,651**	**909,751**	**863,737**	**867,254**	**982,845**	**1,038,349**	**1,054,967**
	-	-	-	-	-	-	-	-
Net FY Balance	-	(70,811)	(91,556)	**(478,834)**	**(391,383)**	**(454,204)**	**(478,614)**	**(459,494)**

Seeking a Sustainable Business Model via University-Agency Cooperation

Need activity-interaction on all three sides of a the value triangle; Federal agencies, PIs and universities must relate to each other.

- Agency require PI's to do DM planning; specific actions, costs, reporting;
- Agencies/Universities require PI's to dedicate direct costs for DM;
- Universities provide PI's with essential DM services or referrals;
- Universities/agencies convene national workshop on joint sustainable data management; cooperate on priorities, policies, protocols, costs.

USDA NAREEE Big/Open Data and Science

- USDA provide NAREEE with copy of USDA (OSTP) Open Data Plan
- USDA/NAREEE expand stakeholder involvement process, beyond scoping of individual REEE agencies
- ERS provide guidance on implementation of Open Data process
- USDA expand interagency collaboration on key topics like climate
- USDA place NAREEE representative on the OSTP Open Data Council

USDA NAREEE Big/Open Data and Science

- USDA provide glossary of terms, more definition(s) about what is required, preferred
- USDA provide basics on the value, best practices, benefits of managing Open/Big Data
- USDA gather input from universities re: their capacity for providing Open/Big data services
- USDA engage Capacity programs as a special case; get input from leaders
- USDA incentivize researcher for data preparation (offering scrubbing and other services)
- USDA provide guidance to universities on how Open and Big Data mandates will be enforced
- ARS conduct joint planning exercises with land grant universities leading data management
- USDA RFPs explicitly require data management activity and hold accountable
- USDA RFPs instruct PIs to include data management expenses in direct costs
- USDA work with smaller/medium sized universities to minimize negative economies of scale

The Case of Capacity Programs

Should Open Data mandate apply to Hatch, Smith-Lever, McIntire-Stennis, Evans-Allen, Animal Health, Renewable Resources (RREA), 1890, and Tribal?

A. $.5 billion in applied, regional and demonstration research programs and their data may be important;

B. Could be cumbersome, questionably effective and time consuming for data to be organized and called for from this community.

Capacity leaders need to provide input on whether to be included, and if so, how would they help design an approach that will work.

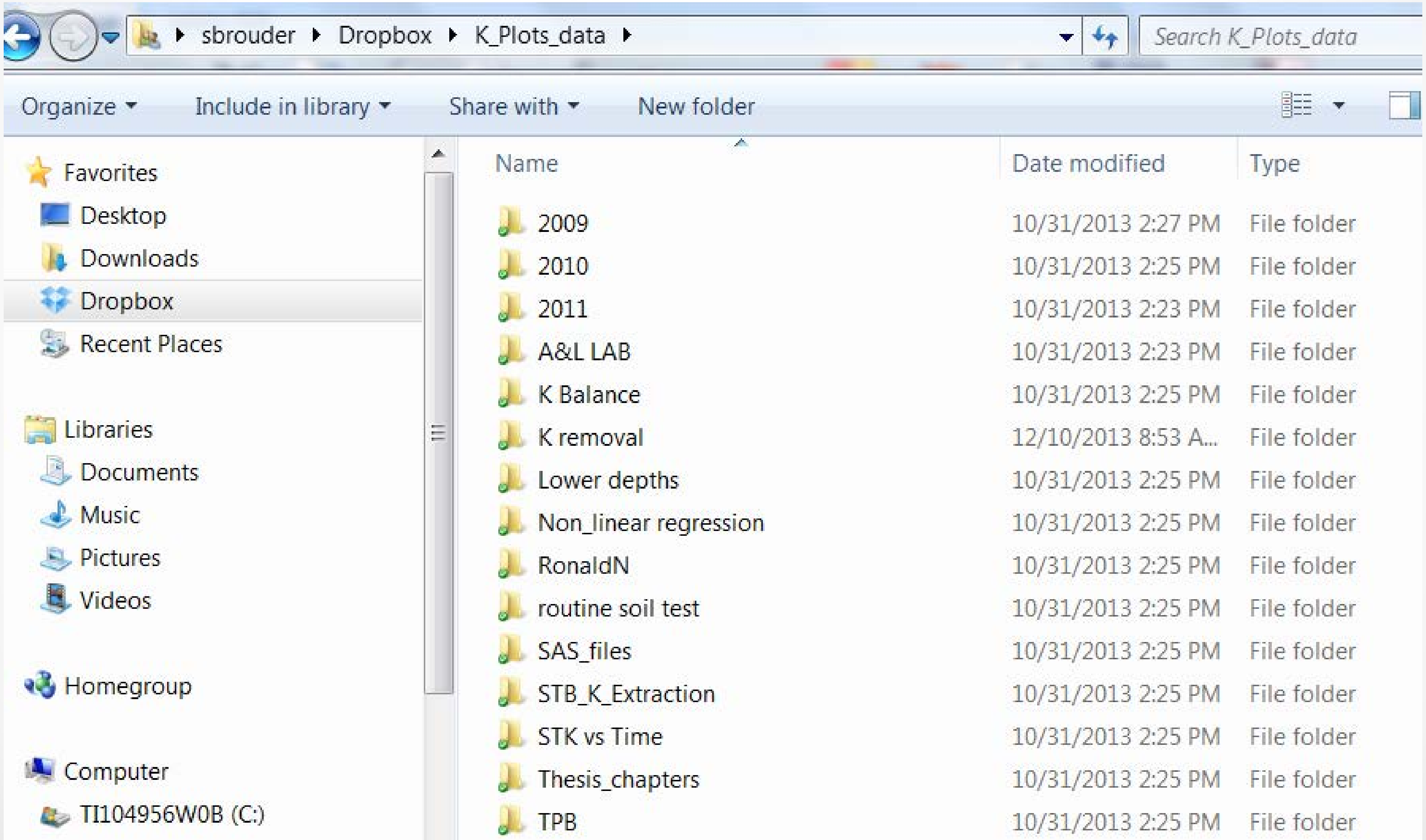
What is “big data” (vs “conventional”)?

Ward & Barker (arXiv:1309.5821v1 [cs.DB] 20 Sep 2013)

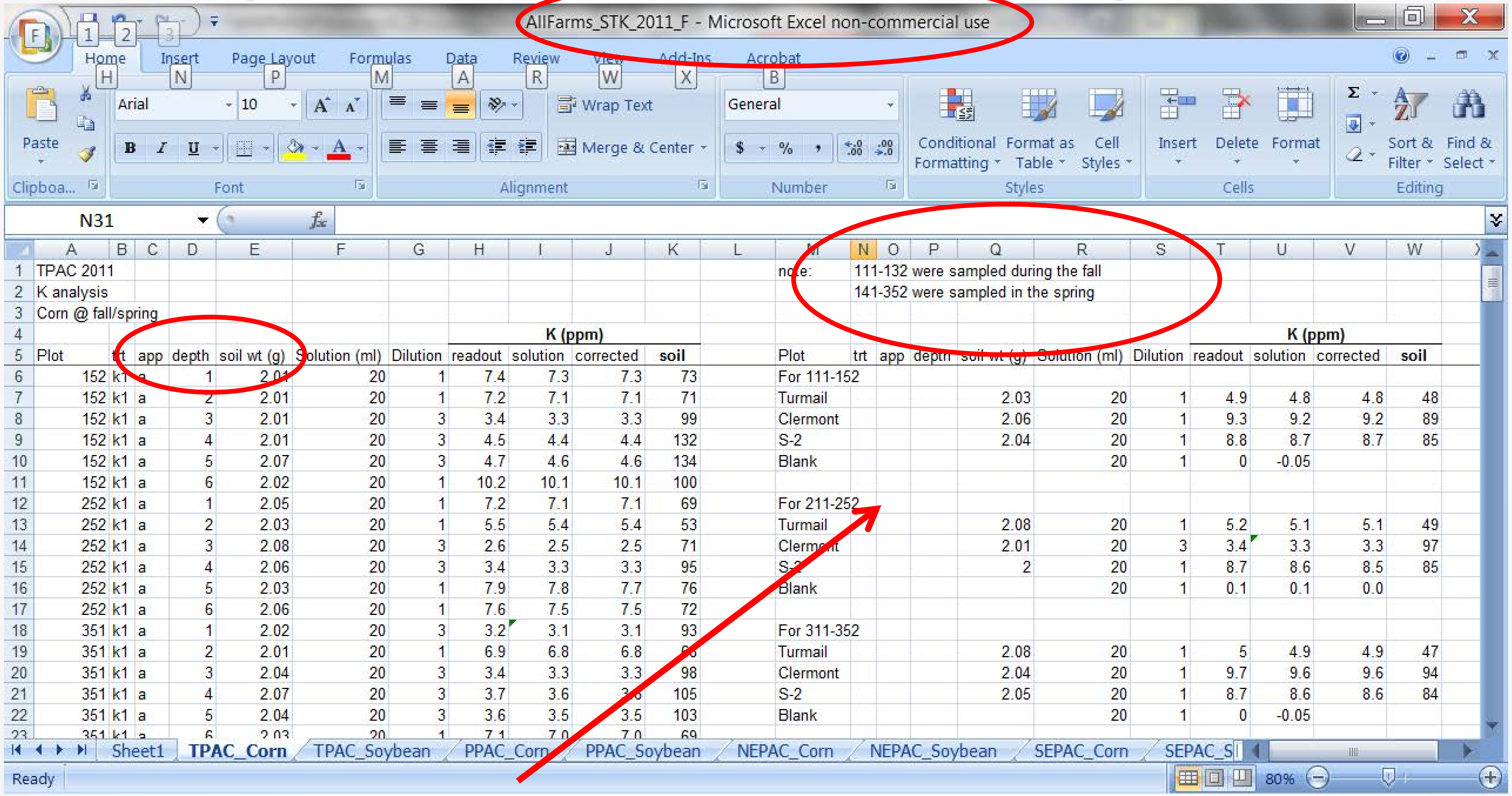
- Anecdotally: associated w/ data storage & analysis
- Gartner (2001): 3Vs ~ **Volume**, **velocity**, **variety**; (2012) **Veracity**
- Others: **Oracle** (structured w/ unstructured (e.g. social media)); **Intel** (generation of 300+ terabytes weekly); **Microsoft** (machine learning & artificial intelligence)
- Authors’ conclusions: Size, complexity, technologies to process sizeable/complex
- **SB conclusions: 3Cs ~ Stuff that is cumbersome, costly (time, storage, whatever) & confusing to deal with.**

Yesterday’s “big” is today’s “conventional” ~ once we figure it out, it isn’t big anymore… (Sonka, 2014 agrees w/ me on big data for ag.)

Status Quo: Taking a peek at data caretaking in AGRY… K Team Fellow (PhD student supported by Mosaic and PCS)



Today, I can tell you what this spreadsheet means but you can't understand all of it on your own…



TPAC 2011
K analysis
Corn @ fall/spring

note: 111-132 were sampled during the fall
141-352 were sampled in the spring

							K (ppm)			
Plot	trt	app	depth	soil wt (g)	Solution (ml)	Dilution	readout	solution	corrected	soil
152	k1	a	1	2.01	20	1	7.4	7.3	7.3	73
152	k1	a	2	2.01	20	1	7.2	7.1	7.1	71
152	k1	a	3	2.01	20	3	3.4	3.3	3.3	99
152	k1	a	4	2.01	20	3	4.5	4.4	4.4	132
152	k1	a	5	2.07	20	3	4.7	4.6	4.6	134
152	k1	a	6	2.02	20	1	10.2	10.1	10.1	100
252	k1	a	1	2.05	20	1	7.2	7.1	7.1	69
252	k1	a	2	2.03	20	1	5.5	5.4	5.4	53
252	k1	a	3	2.08	20	3	2.6	2.5	2.5	71
252	k1	a	4	2.06	20	3	3.4	3.3	3.3	95
252	k1	a	5	2.03	20	1	7.9	7.8	7.7	76
252	k1	a	6	2.06	20	1	7.6	7.5	7.5	72
351	k1	a	1	2.02	20	3	3.2	3.1	3.1	93
351	k1	a	2	2.01	20	1	6.9	6.8	6.8	[illegible]
351	k1	a	3	2.04	20	3	3.4	3.3	3.3	98
351	k1	a	4	2.07	20	3	3.7	3.6	3.6	105
351	k1	a	5	2.04	20	3	3.6	3.5	3.5	103
351	k1	a	6	2.03	20	1	7.1	7.0	7.0	69

							K (ppm)			
Plot	trt	app	depth	soil wt (g)	Solution (ml)	Dilution	readout	solution	corrected	soil
For 111-152										
Turmail				2.03	20	1	4.9	4.8	4.8	48
Clermont				2.06	20	1	9.3	9.2	9.2	89
S-2				2.04	20	1	8.8	8.7	8.7	85
Blank					20	1	0	-0.05		
For 211-252										
Turmail				2.08	20	1	5.2	5.1	5.1	49
Clermont				2.01	20	3	3.4	3.3	3.3	97
S-2				2	20	1	8.7	8.6	8.5	85
Blank					20	1	0.1	0.1	0.0	
For 311-352										
Turmail				2.08	20	1	5	4.9	4.9	47
Clermont				2.04	20	1	9.7	9.6	9.6	94
S-2				2.05	20	1	8.7	8.6	8.6	84
Blank					20	1	0	-0.05		

What is this???

Tomorrow, we may both be in the dark…

12 Core Data Competencies for Data Information Literacy (Carlson et al., 2011, Libraries and the Academy, 11(2), pp. 629-657)

- Introduction to databases & data formats
- Discovery & acquisition
- Data management & organization
- Data conversion & interoperability
- Quality Assurance
- Metadata
- Data curation & reuse
- Cultures of practice
- Data preservation
- Data analysis
- Data Visualization
- Ethics including citation of data

Blending different ag data streams at different ed. levels requires new skills & DIL curricula **("Library Sciences should be solicited to educate all…")**

Future farmer or ag. industry employee (BS level)

- Everyone needs environmental info. mgmt that teaches how data are produced/used ("data in my life")
- Array of educational trajectories are needed from most basic level to specific endpts.
- Future farm managers need data skills in context of business mgmt & systems analyses
- Be able to understand data from outside their degree & be able to ascertain data quality

Future consultant, CCA, policy maker, Agent, Ext. Specialist (MS, PhD level)

- Understand exp. design, statistics & probability (risk)
- Understand geospatial data
- Curricula should use open-source software & "workforce-available" statistical tools
- Be able to translate science into lay language w/ context
- CCA: Certificate in Ext. Prgm should cover 12 data competencies
- Capstone data experience
- Ext. Spec. competent in Systematic Reviews; data mgmt plans / repositories part of degree

Extension Delivery and Application

- Help producers, managers and policy makers with the application of data to scenario building, modeling, visualization….
- Pursue cooperative arrangements between industry, producers and universities on the collection, storage, access, use of data.
- Pursue RFPs with integrated Extension and Research in the data-intensive context.

Why are data not reused (FHF (Faculty Hrmph Factor))?

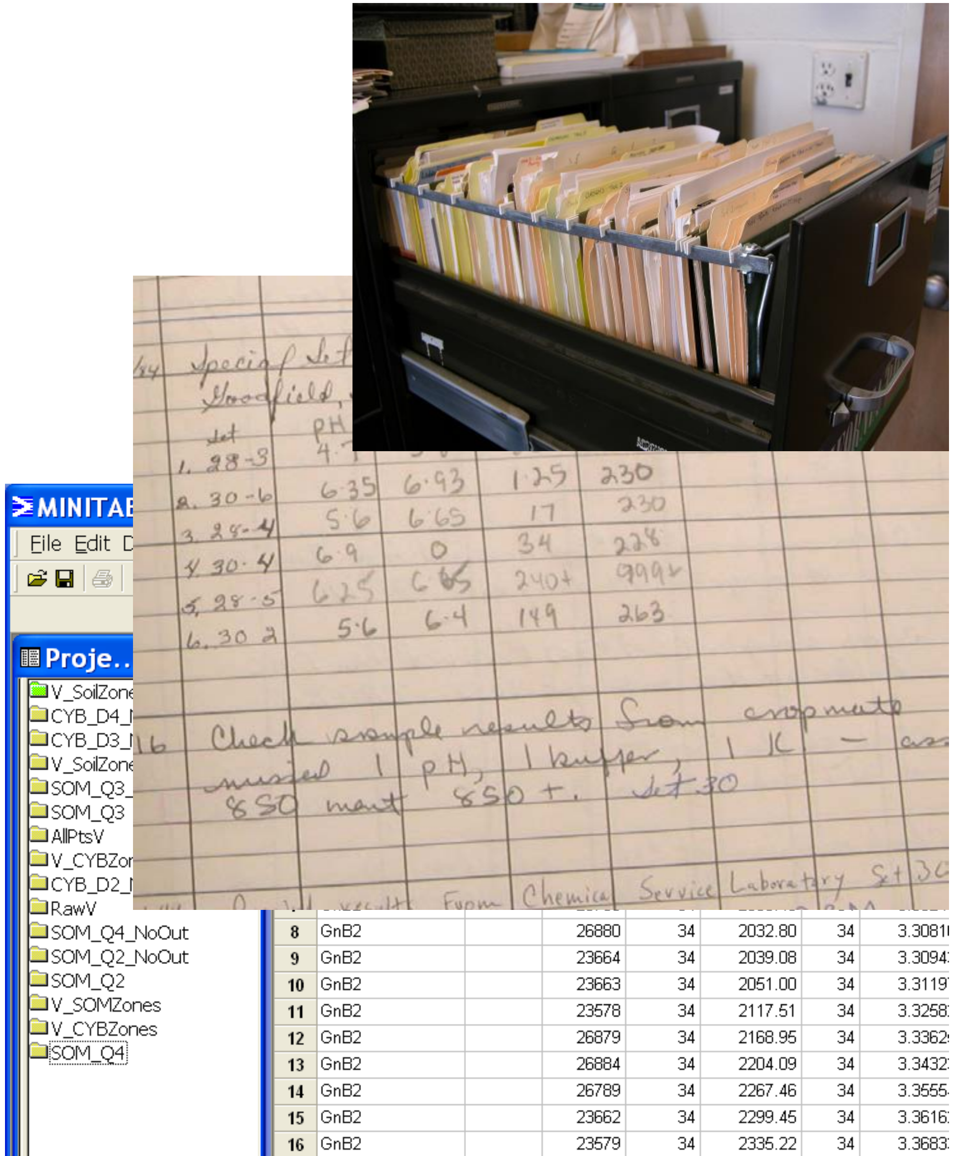
- **Not useful?** Question has changed… Hmmm: Yes & No
- **Not accessible?** Poor data hygiene…
  - Diekmann interviews (J. Ag. & Food Info., 2012):

*"The researcher wanted to reanalyze data from another figure and **I couldn't find it**. And I couldn't; **I lost it**. It was done on an old computer system and the **technician who did [it, had] moved on** and I wasn't able to find it."*

*"We have had a lot of problems in the past of losing data, or **just misplacing it**. And then we have to backtrack it and that's taken literally days or weeks to find where this data was stored. So it has been a real problem for us."*

Pressing technological challenges to informatics for all agronomic efforts concern data workflow…

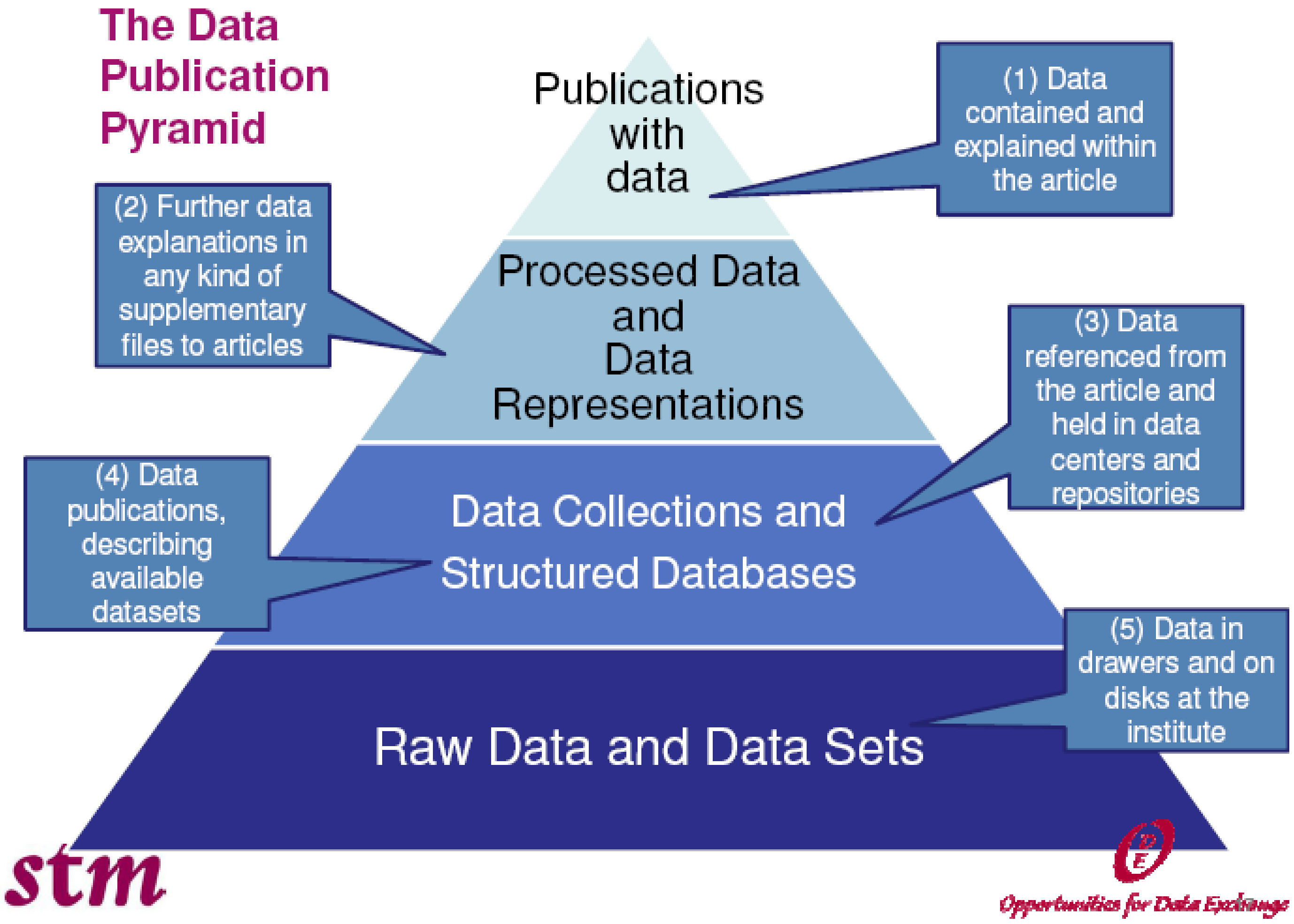
- Data dispersion
  - Take advantage of small datasets collected by many researchers (not everything is “BIG”)
- Data heterogeneity
  - Varied protocols reflecting local culture & variation in 1º purpose
- Data provenance
  - Need to track data through multi-step process of aggregation, modeling, analysis



ODE (Opportunities for Data Exchange) 2012 D6.1 Summary of the Studies, Thematic Publications & Recommendations ~

Manifestation of data can take 5 different forms…

Past
10 Yr
to
today



Stm=science, technical, medical publishing

Illustration 1: Data Publication Pyramid

http://www.alliancepermanentaccess.org/wp-content/uploads/downloads/2012/11/ODE-WP6-DEL-0001-1_0.pdf

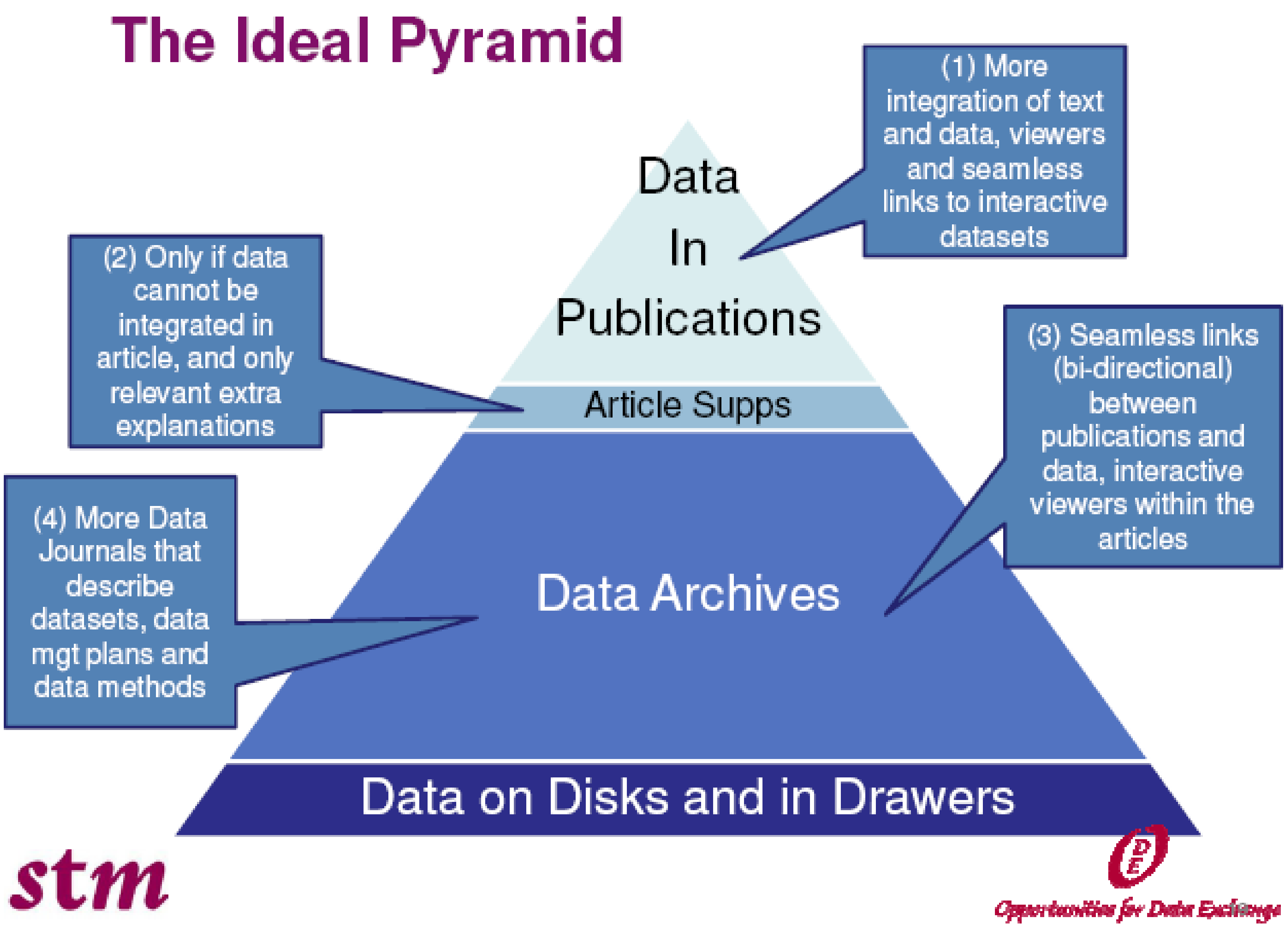


Illustration 3: The ideal Data Publication Pyramid

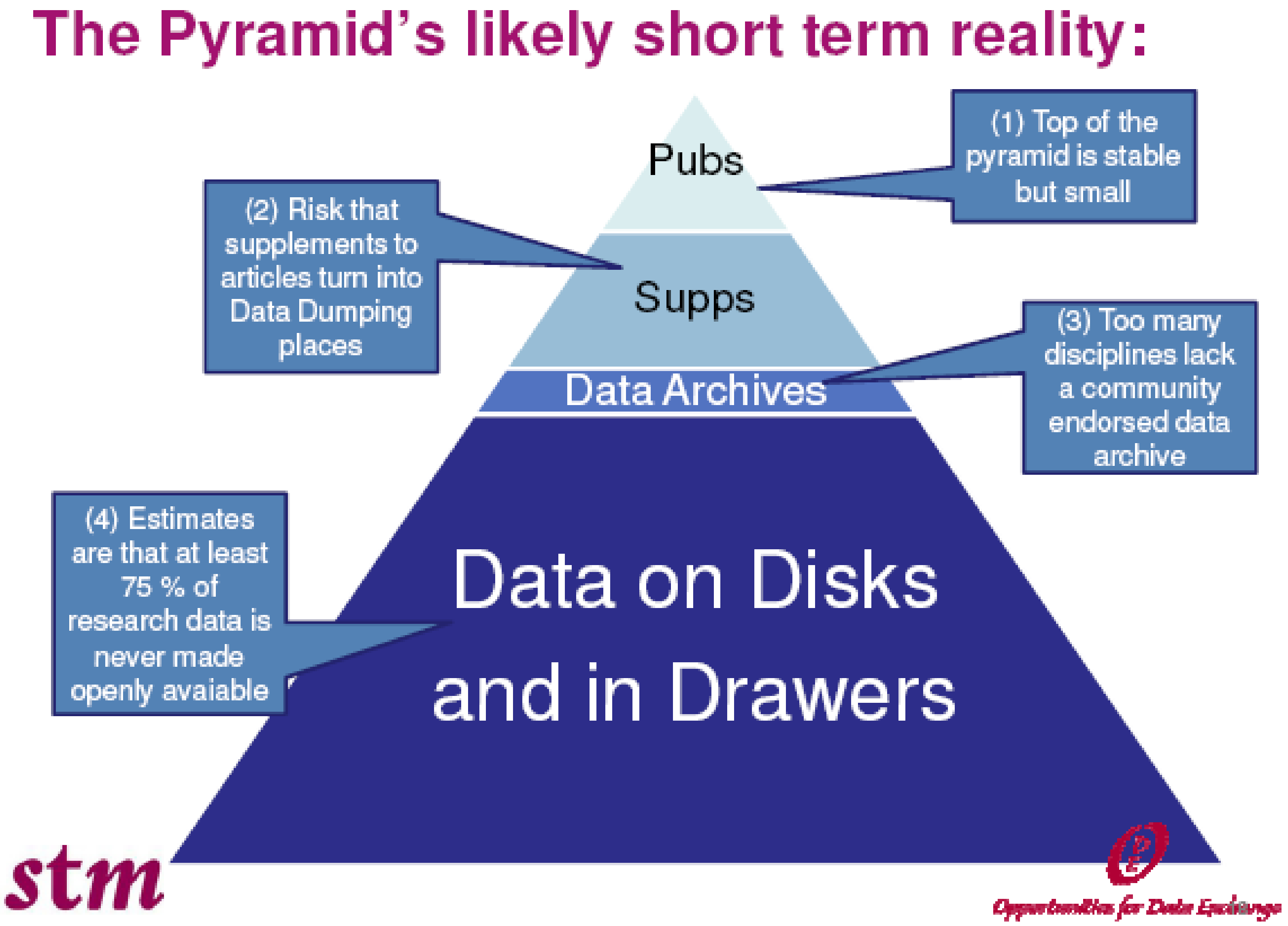


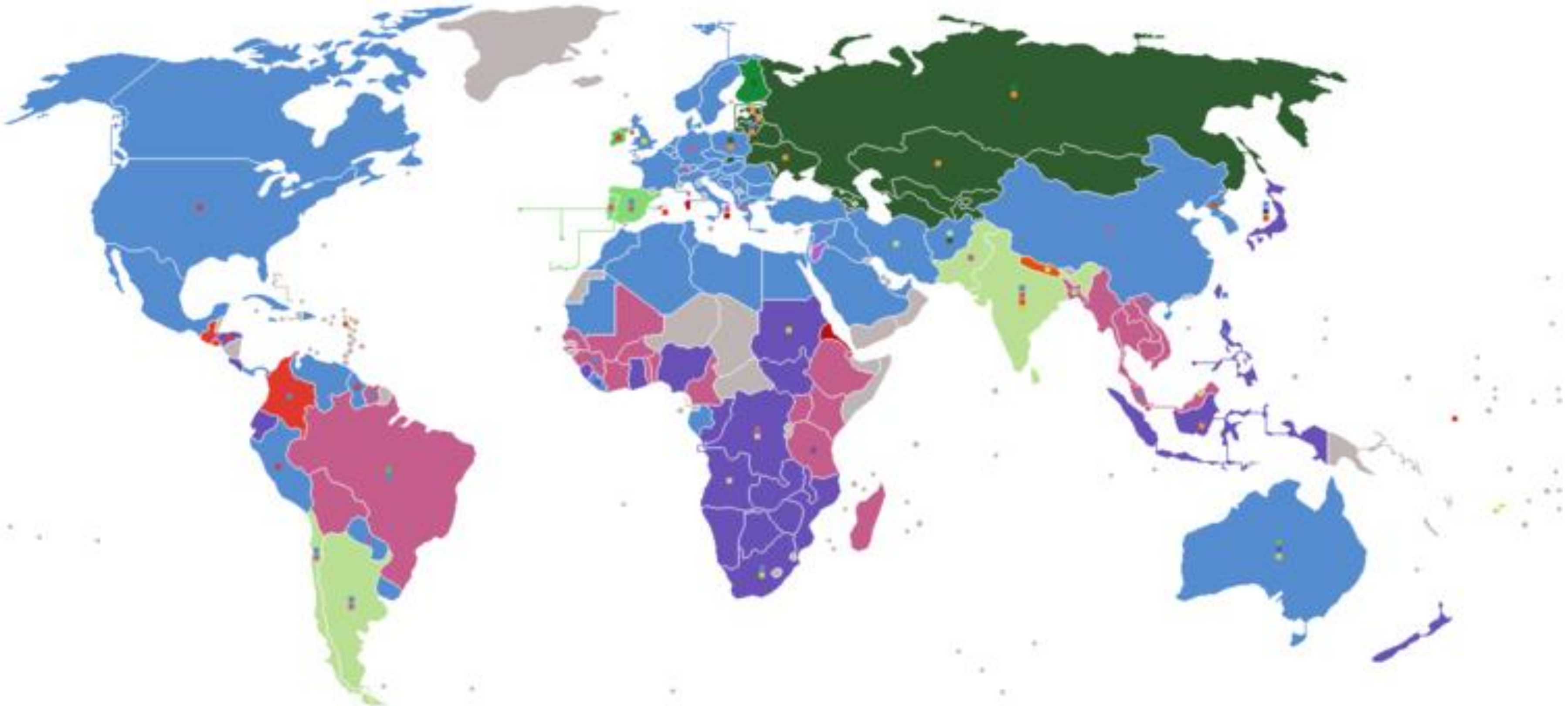
Illustration 2: The likely short term reality for the Data Publication Pyramid

Why Standards: What is "yield"…?

Is the width of a chariot at Pompeii the best determinant of gauge for railways?

Without standards you could not get "there" from "here"

Maps of Standards: World Rail Gauges



mm	1676	1668	1600	1524	1520	1435	1372	1067	1050	1000	950	914	762	750	610	600
ft in	5'6"	5'5.67"	5'3"	5'	4'11.8"	4'8.5"	4'6"	3'6"	3'5.3"	3'3.4"	3'1.4"	3'	2'6"	2'5.5"	2'	1'11.6"

http://oegeo.wordpress.com/2012/01/13/maps-of-standards/