Welcome

USDA ARS National Program 216

Agricultural System Competitiveness & Sustainability

2013-2017 Retrospective Review Panel Discussion

April 16, 2018

Photo credit: Edwin Remsberg and USDA-SARE

Agenda

- **11:00 – 11:30: Introductions and Background**
  - Introductions of on-site and remote attendees
  - Today's Approach
  - ARS 5-Year Research Cycle
  - Overview of NP216 Action Plan Components
- **11:30 – 12:00: Component 1 Review**
  - ENHANCING THE YIELDS OF FOOD, FEED, FIBER, AND FEEDSTOCK PRODUCTION SYSTEMS
- **12:00 – 12:15:** (Lunch prep/break)
- **12:15 – 12:45: Component 2 Review**
  - ENHANCING PRODUCTION SYSTEM ECONOMICS VIABILITY
- **12:45 – 1:15: Component 3 Review**
  - PRODUCTION SYSTEM EFFECTS ON NATURAL RESOURCES
- **1:15 – 1:30: Break**
- **1:30 – 2:00: Component 4 Review**
  - INTEGRATION OF SUSTAINABILITY GOALS
- **2:00 – 2:30: Final Discussion with all Attendees / Participants**
- **2:30 – 4:00: Panel Only Discussion and planning for Critique development and delivery**

2013-2017 NP216

Retrospective Review

Approach

1. Examples of accomplishments for each Component will be provided and summarized

2. A time for questions and discussion will follow each Component overview

3. The examples and conversations are designed to help the panel members review the success or deficiencies of the overall national program

5 Year Research Cycle

National Programs in ARS are Mission Driven

- Keep Producers In Business
- Enhance Natural Resources Base
- Problem-solving Science

Assessment

Input

Planning

Implementation

RELEVANCE • PERFORMANCE • RESULTS •

NATIONAL PROGRAMS

AGRICULTURAL RESEARCH SERVICE

NP216 Action Plan Mission
2013-2017

Provide farmers with management practices, decision aides, and information needed to

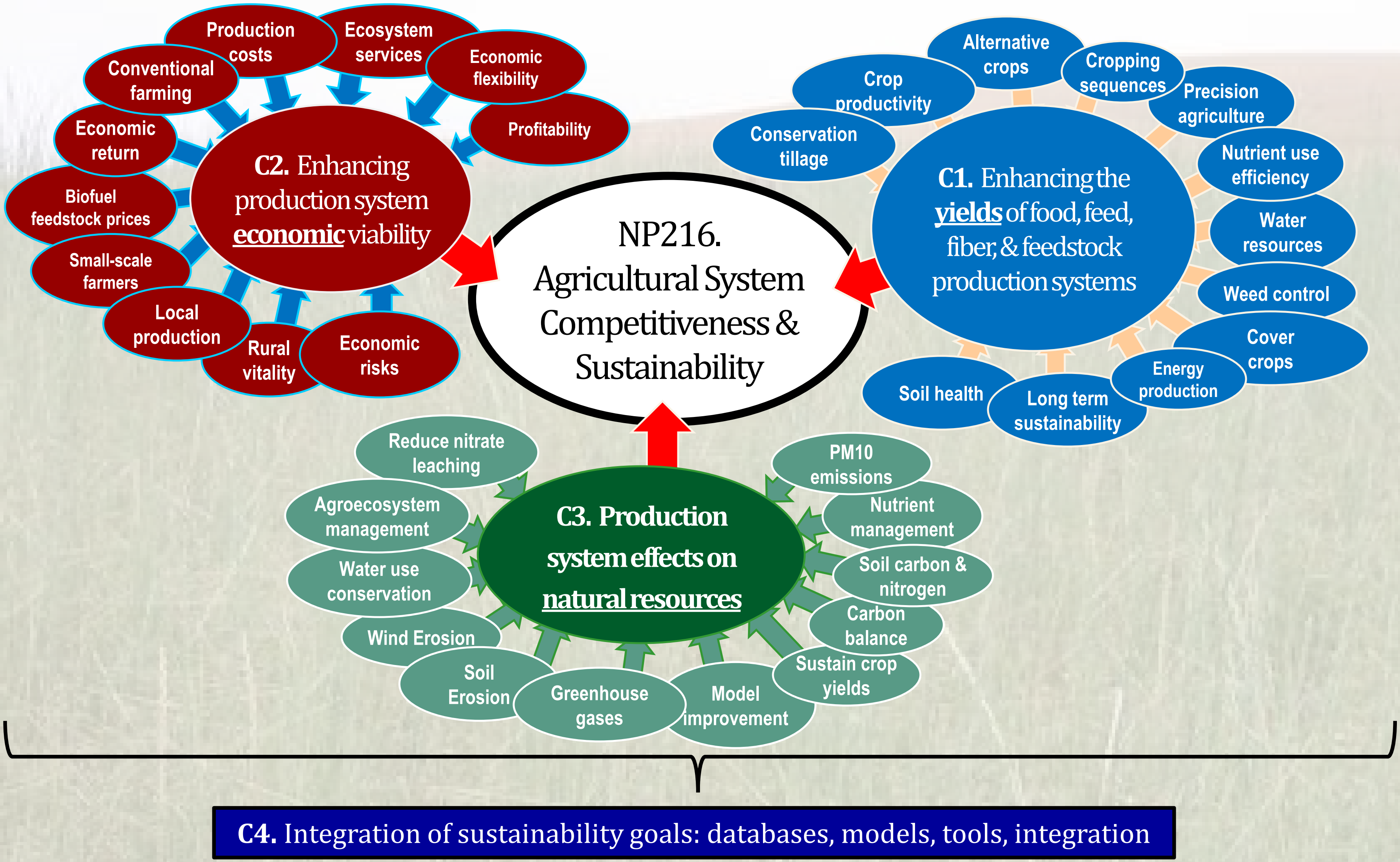
> *"move farming systems along a trajectory toward greater sustainability on each of the four goals":*

1. Satisfy human, food, feed and fiber needs, and contribute to biofuel needs
2. Sustain the economic viability of agriculture
3. Enhance environmental quality and the resource base
4. Enhance the quality of life for farmers, farm workers, and society as a whole.

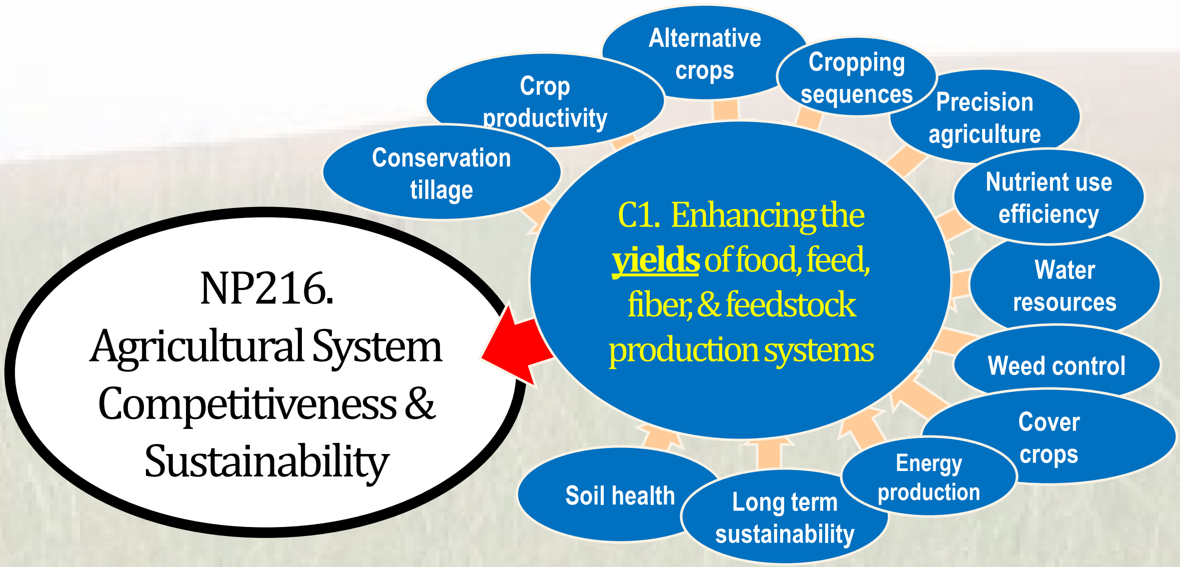
2013-2017 Action Plan Components

- Component 1. Enhancing the yields of food, feed, fiber, & feedstock production systems
- Component 2. Enhancing production system economic viability
- Component 3. Production system effects on natural resources
- Component 4. Integration of sustainability goals
- *Component 5. NEW: Closing the yield gap through: Genetics × Environment × Management (G × E × M)*

*Vision: Help producers develop **integrated solutions** that solve their problems related to **productivity**, **profitability**, and **natural resource** stewardship*



C5: Closing the yield gap through interactions of genetics x environment x management (G x E x M) This component is being developed as a direction for new projects moving into NP216 from other ARS National Programs. GxExM will become a focus for NP216 during the five year cycle of research starting 2017.



Foci:

- To understand underlying agroecological principles for development of technologies
- To develop production strategies to produce the food, feed, fiber, and feedstock needed by society

Problem 1A:

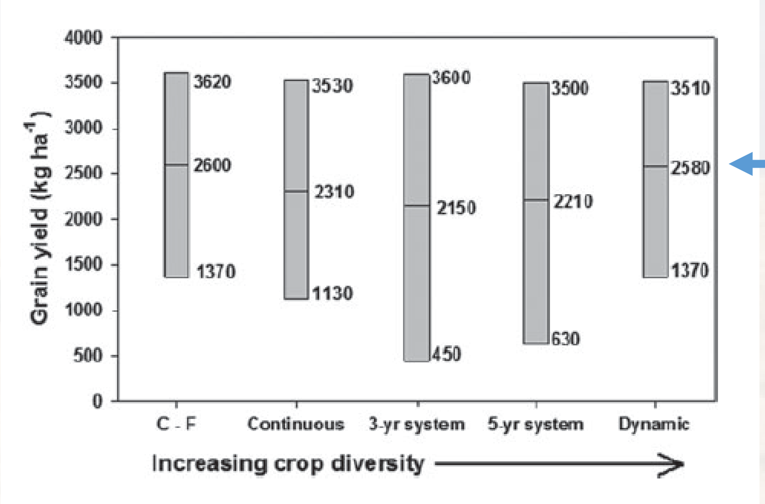
Crop Production Systems

Crop production in most regions is dominated by one, or at most a few crops, with additional minor crops grown to meet market demands

Knowledge and technology are needed for improved and diversified agronomic crop production systems to increase yield, reduce input costs, break weed and disease cycles, reduce economic and environmental risk, and distribute labor and equipment use over the cropping cycle

Diverse agricultural systems are more complex, but more productive and stable

- To improve the resilience of agricultural systems, ARS scientists in Mandan, North Dakota examined the role of biodiversity in the management of agricultural systems.
- These complex systems require more management but can be more resilient than conventional systems.



FINDINGS AND IMPACT:

- Use of complex, adaptable cropping systems (Dynamic) increased spring wheat yield by 10-20%.
- Increasing system complexity by adding livestock decreased overwintering costs by up to 32%.

Sanderson, M.A., Archer, D.W., Hendrickson, J.R., Kronberg, S.L., Liebig, M.A., Nichols, K.A., Schmer, M.R., Tanaka, D.L., Aguilar, J. 2013. Diversification and ecosystem services for conservation agriculture: Outcomes from pastures and integrated crop-livestock systems. Renew. Agric. Food Sys. 28(2):129-144.

Improving Weed Control and Soil Conservation in Cotton Fields

- Benefits of conservation systems are numerous; Conservation tillage, after being widely adopted in the past few decades (Fig. 1), however, is now threatened by the development of herbicide-resistant weeds. Currently, there are 153 herbicide resistant weeds in the U.S.

- ARS scientists evaluated integrating high residue cover crops, crop rotation, alternative row spacings, and conventional, glyphosate and glufosinate-based cotton production systems.

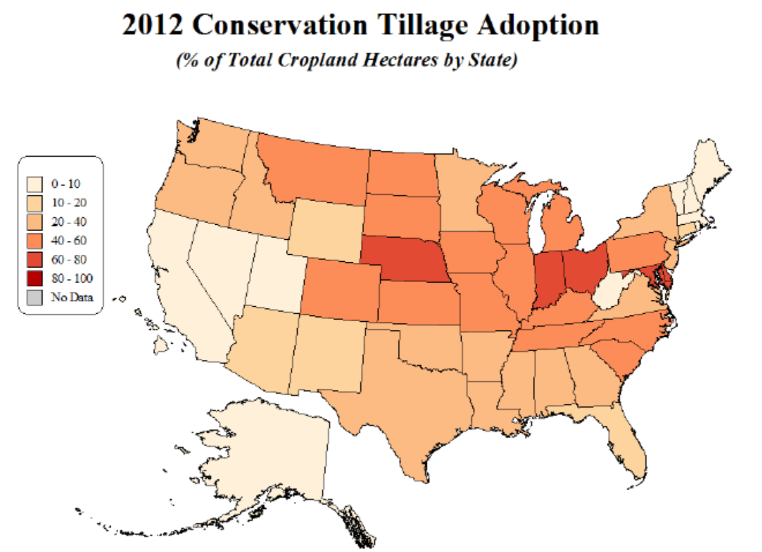


Figure 1. Conservation tillage ha in 2012 as a percentage of total cropland ha by state (USDA, 2015b).

FINDINGS AND IMPACT:

High residue cover crops are increasingly being incorporated into integrated pest management recommendations for their weed suppressive characteristics.

Aulakh, J.S., Price, A.J., Enloe, S.F., van Santen, E., Wehtje, G., Patterson, M.G. 2012. Palmer amaranth management in glufosinate-resistant cotton: I. tillage system, cover crops and herbicide management. Weed Management and Herbicide Resistance Special Issue. Agronomy. 2:295-311.

Cereal rye as cover crops grown before corn can increase incidence of corn seedling root diseases, but timing is critical

- Cereal rye cover crops in corn-soybean rotations can significantly reduce erosion, decrease losses of N and P, and increase soil organic matter
- However, corn yields following cereal rye cover crops have been reduced during some years/some fields.
- One hypothesis is that cereal rye may be acting as a host for corn pathogens

FINDINGS AND IMPACT:

- Discovery that as the interval between rye termination and corn planting *increased*, the amount of radicle root rot and incidence of *Pythium* on the radicle *decreased*.

Corn seedling radicle showing root rot when planted **3 days** after terminating a rye cover crop with glyphosate.

Treatments	Time Interval (d)	Radicle root rot incidence (%)	***Pythium*** incidence (%)
No rye, control	No rye	58.3	0.0
Rye, 25 DBP	25	75.0	8.3
Rye, 14 DBP	14	72.2	22.2
Rye, 10 DBP	10	83.3	22.2
Rye, 3 DBP	3	91.7	61.1
Rye, 1 DAP	-1	100.0	75.0

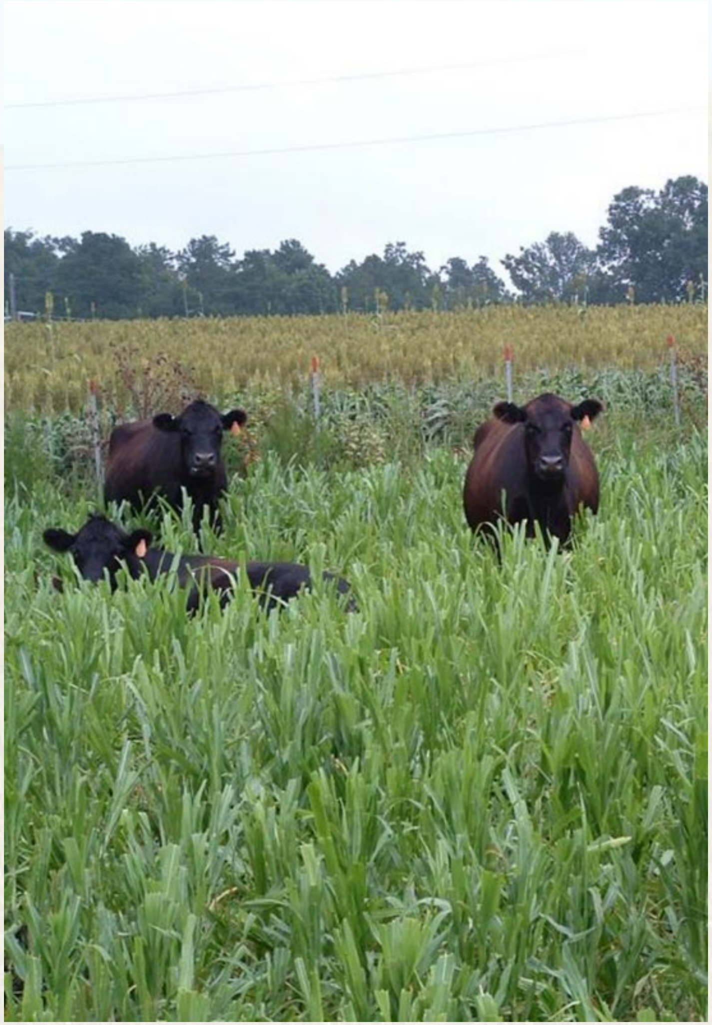
Bakker, M.G., J. Acharya, T.B. Moorman, A.E. Robertson, and T.C. Kaspar. 2016. The potential for cereal rye cover crops to host corn seedling pathogens. Phytopathology 106:591-601.

Problem 1B:

Integrated Crop-Livestock Systems

Incorporation of livestock and poultry into crop production systems uses forage and grain to produce high protein products (e.g. meat, eggs, dairy)…

Knowledge and technology for improved integrated crop – livestock production systems are needed



Sustainability of integrated crop-livestock systems

- ARS and collaborators from France, Brazil, Uruguay, Argentina, and Ohio State University provided a synthesis of integrated crop-livestock systems as an option for sustainable intensification of agriculture

FINDINGS AND IMPACT:

- These integrated systems provide better regulation of biogeochemical cycles and decreased effects on the air and water systems
- They also favor diverse habitats and trophic networks and provide greater flexibility for the whole system to cope with potential socio-economic and climate change induced hazards and crises.

Franzluebbers, A.J., Lemaire, G., Carvalho, P.C.F., Sulc, R.M., Dedieu, B. 2014. Toward agricultural sustainability through integrated crop-livestock systems: Environmental outcomes. *Agriculture, Ecosystems and Environment* Vol. 190, P. 1-3.

Integrated crop-livestock systems maintain soil quality

Information documenting the long-term impact of integrated crop-livestock systems on soil quality is lacking.

Nine years of detailed soil measurements found that:

=

FINDINGS AND IMPACT:

The findings are used to reassure farmers in the northern Great Plains that they can graze crop residue without negatively impacting the soil resource.

Liebig, M.A., Tanaka, D.L., Kronberg, S.L., Scholljegerdes, E.J., Karn, J.F. 2012. Integrated crops and livestock in central North Dakota, USA: Agroecosystem management to buffer soil change. Renew. Agric. Food Sys. 27(2):115-124.

Problem 1C:

Organic Production Systems

Certified organic production represents a growing component within agriculture

Knowledge and technology for providing nutrients, controlling weeds and other pests, and increasing yields are needed for improved, sustainable organic production systems

Water quality in organic grain cropping and pasture systems (2013-2015)

Evaluated water quality in organic vs. conventional [drainage systems]

FINDINGS AND IMPACT:

- Nitrate N loss to subsurface drainage from 2013-2015 for organic C-S-O/A-A rotation was 53% lower than for the conventional C-S rotation
- Subsurface drainage water nitrate N concentration still exceeded the 10 ppm drinking water standard 76% of the time for conventional C-S but only 26% of the time for the organic C-S-O/A-A rotation.

Nitrate-N Load (lb N/ac) in Drainage Water

Rotation	2013*	2014*	2015*	∑ 2013-2015*
Organic C-S-O/A-A	21.2	13.0	8.9	**43.1**
Conventional C-S	44.7	32.4	13.9	**91.0**
Organic Pasture	8.5	1.1	1.0	**10.6**

*Quantities significantly different among rotations

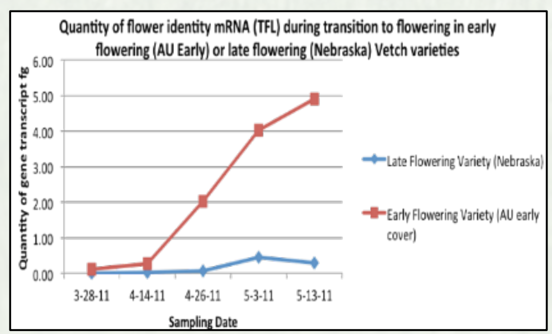
Cambardella, Cynthia. A., Delate, Kathleen, and Jaynes, Dan. B. 2015. Water quality in organic systems. Sustainable Agriculture Research 4(3):60-69. doi:10.5539/sar.v4n3p60

Genetic control of hairy vetch flowering time decoded for potentially improving varieties for use in organic farming.

- Winter cover crops reduce soil erosion, prevent loss of nutrients during the winter, and improve soil organic matter and soil health
- For no-till organic cropping systems, onset of flowering indicates earliest time cover crops can be mechanically terminated without herbicides or tillage

FINDINGS AND IMPACT:

- ARS Scientists in Beltsville MD identified five key flowering genes associated with initiation or inhibition of flowering that are regulated during transition from vegetative to flowering growth stages
- Earlier-flowering cover crops permit earlier spring planting of the next crop



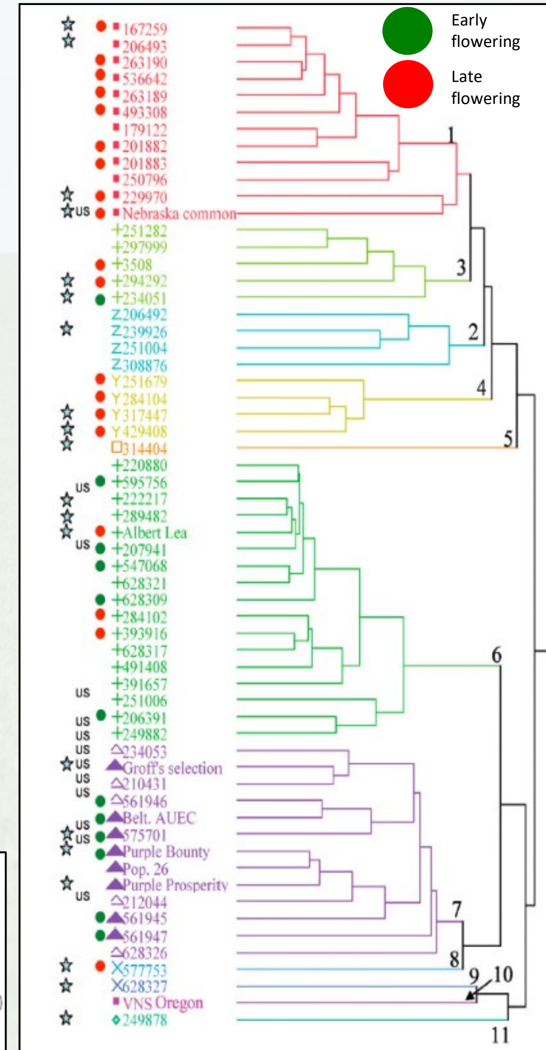
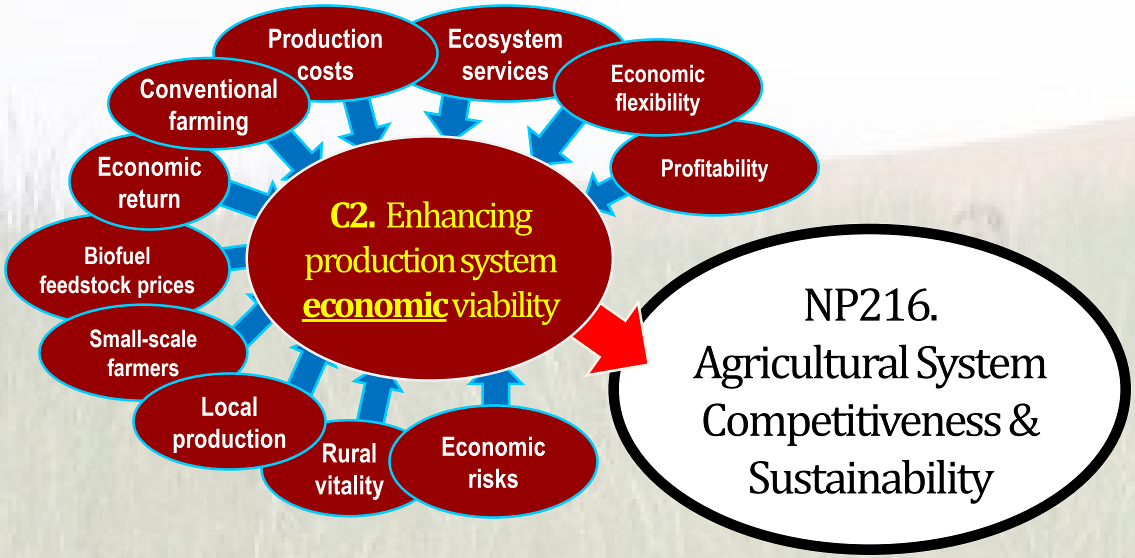


Fig. 1. Hierarchical clustering of worldwide *Vicia villosa* accessions based on amplified fragment length polymorphism (AFLP) marker analysis.

Maul J. E., S.B. Mirsky, S.E. Emche, T. Devine. 2011. Evaluating a core germplasm collection of the cover crop hairy vetch (*Vicia villosa* Roth) for use in sustainable farming systems. Crop Science 51:2615-2625.

Component 1 Review

Questions & Discussion



Foci:

To understand the economic factors affecting production system profitability

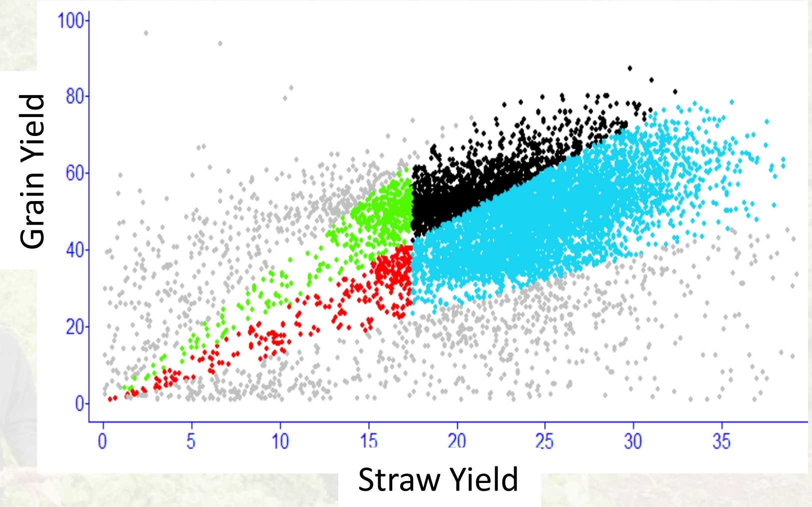
To develop appropriate strategies for profitable food, feed, fiber, and feedstock production

Problem 2A:

Farm-Scale Economics

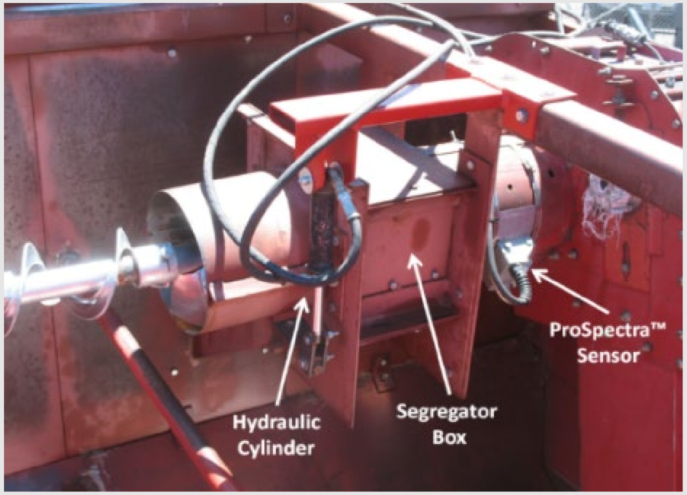
Volatile commodity prices and increasing input costs represent economic challenges for producers

Understanding the factors affecting farm-scale profitability and developing strategies for optimizing producer income are needed



System for Segregating Hard Red Wheat by Protein Content Rewards Growers

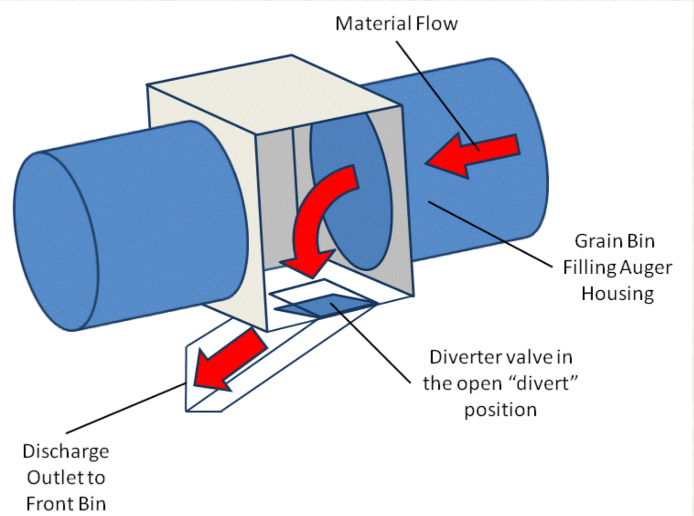
- Grain segregation in the harvesting process may have the ability to capture high protein grain within fields.



ProSpectra sensor, segregator box, and hydraulic cylinder of the grain segregator mounted on the grain bin-filling auger in the bulk tank of a Case IH 1470 combine.

<u>FINDINGS AND IMPACT:</u>

- Segregating grain *can increase net returns* to over $9.00/acre compared to bulking (depending on year)



Net returns from segregating dark northern spring wheat by protein concentration during harvest. Long, D.S., J.D. McCallum, C. Martin, and S. Capalbo. 2016. Agronomy Journal. 108:1503-1513.

Assessing Environmental Stress in Wheat to Improve Precision Agriculture

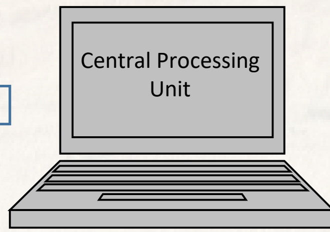
- Multi-sensor system for measuring grain yield, grain protein, and straw yield on the combine developed

FINDINGS AND IMPACT:

- Producers can identify specific regions within fields where grain yield was impacted by early- or late-season stress

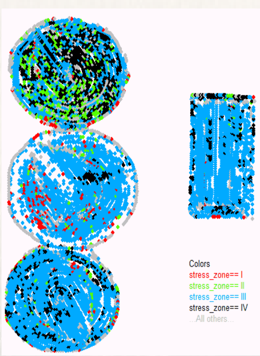
INPUTS

Yield monitor Protein sensorCrop height (lidar)



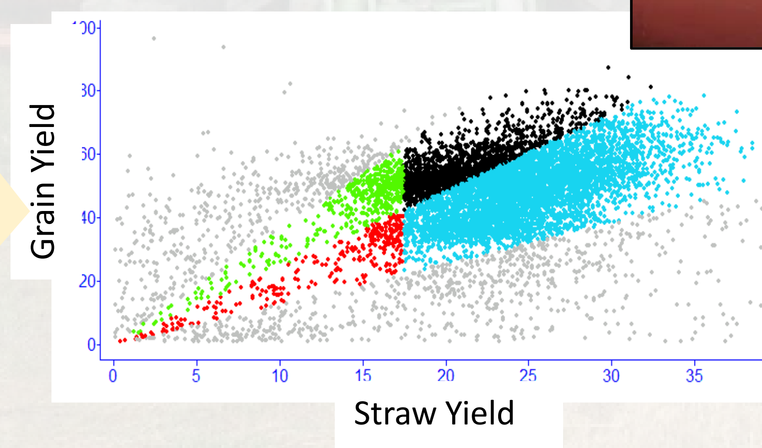
OUTPUTS

Harvest Index
Straw to grain ratio
and more



Map of four stress categories.

Scatter plot between grain- & straw-yield identifies four stress categories: **early in season (green)**, **late in season (blue)**, **both (red)**, or **little stress (black) [See Coapland et al. 1996]**



On-combine, multi-sensor data collection for post-harvest assessment of environmental stress in wheat. Long, D.S., and J.D. McCallum. 2015. Precision Agriculture. 16:492-504.

Long-term evaluation of cover crop biomass production and nitrogen accumulation in high-input, tillage-intensive production systems

- Long-term research examined cover crop performance across years during variable winter climatic conditions

- Cover crop biomass production and nitrogen accumulation were evaluated

FINDINGS AND IMPACT:

- Rye and legume-rye produced 25% more cover crop biomass than mustard and the legume-rye accumulated 35% more nitrogen

- Developed ecologically-based soil and pest management strategies that enhance soil health, nutrient cycling, and profitability

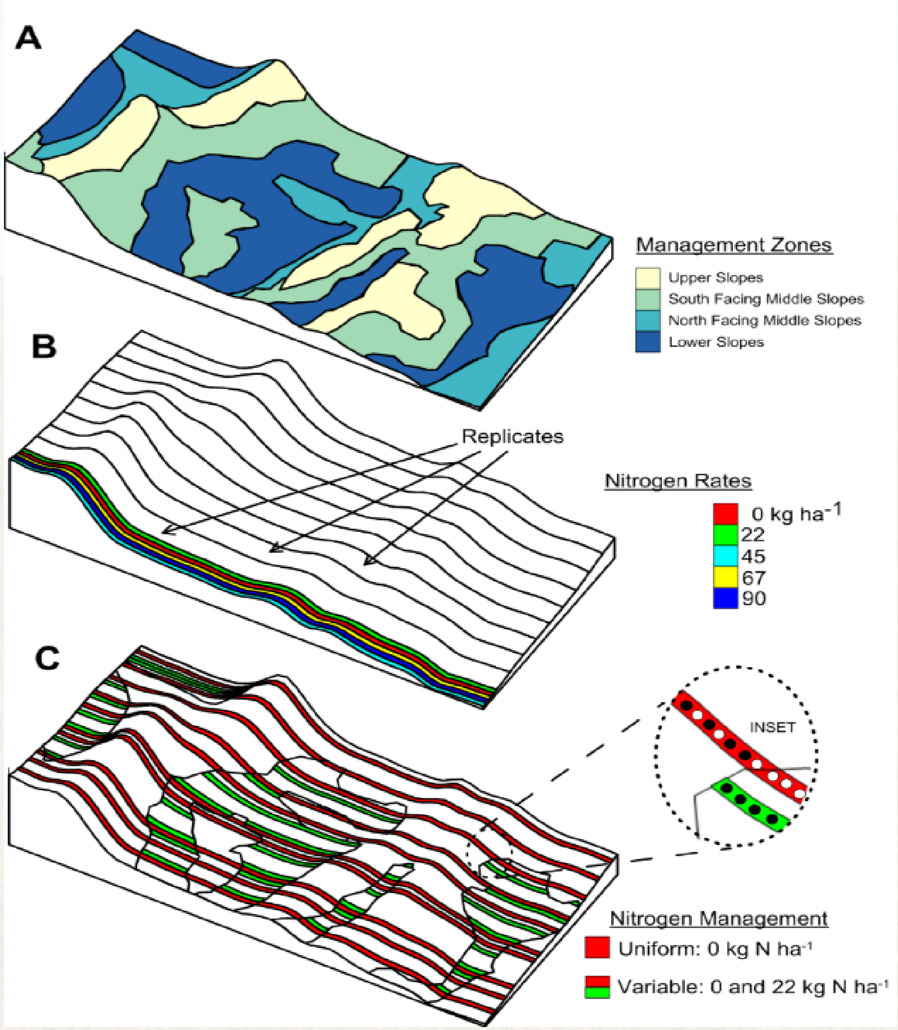
Brennan E.B., N.S. Boyd, R.F. Smith. 2013. Winter cover crop seeding rate and variety affects during eight years of organic vegetables: III. Cover crop residue quality and nitrogen mineralization. Agron. J. 105:171-182.

Terrain-based variable nitrogen management found unprofitable in dryland wheat production systems

Investigated in 8 farm fields in northern Montana

Basis:

- conventional N recommendations,
- terrain-based zones, and
- average Portland prices for hard red spring wheat



FINDINGS AND IMPACT:

Variable N management was not more profitable than uniform N management; average net returns were up to $11/ac less

Would have been profitable in:

- years with large price spreads in fields, and
- growing seasons with above average yields

Net returns from variable-rate nitrogen management on dryland spring wheat in northern Montana. Long, D.S., J.D. Whitmus, R.E. Engel, and G.W. Brester. 2015. Agronomy Journal. 107:1055-1067.

Problem 2B:

Macro-economics

Agricultural production represents a significant component of the United States economy and makes a positive contribution to the country's balance of trade.

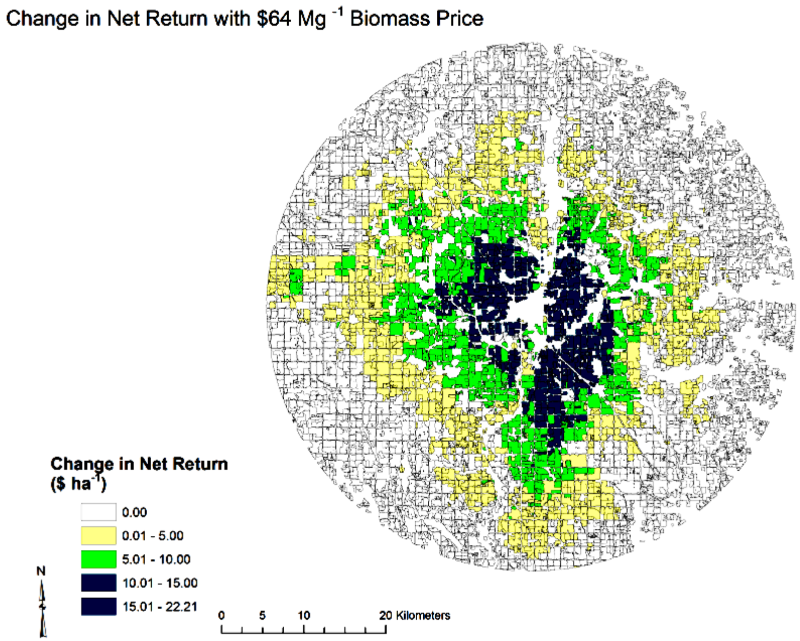
Strategies for optimizing the contribution of agricultural production to the United States economy are needed.

Crop Residue Supply for Bioenergy

- Transportation costs commonly result in residue harvest being concentrated near a biorefinery, concentrating environmental impacts near the facility as well

FINDINGS AND IMPACT:

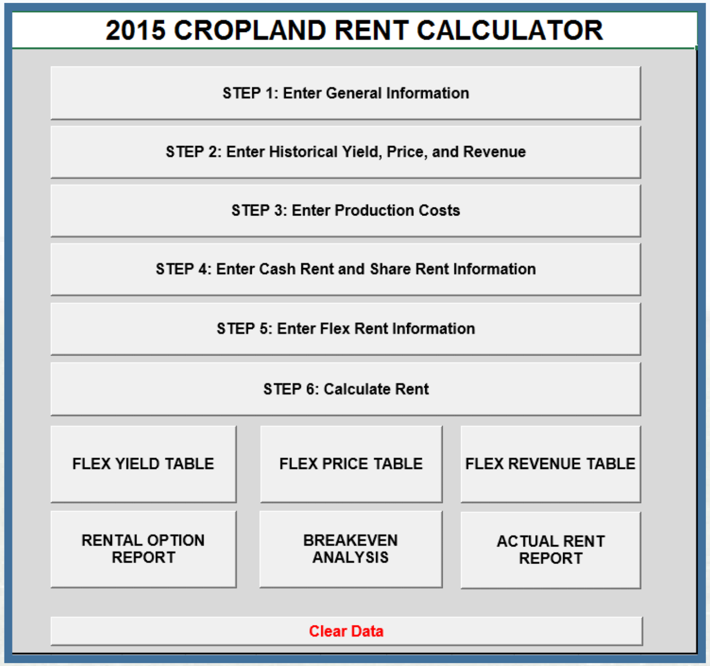
- Farmers could begin to profitably deliver corn stover at prices *above $53 per ton*
- Findings indicate that most profitable tillage and crop rotation practices shift in response to increasing biomass price with producers shifting from a corn-soybean rotation toward continuous corn



Archer, D.W., Johnson, J.M. 2012. Evaluating local crop residue biomass supply: Economic and environmental impacts. BioEnergy Research. 5:699-712

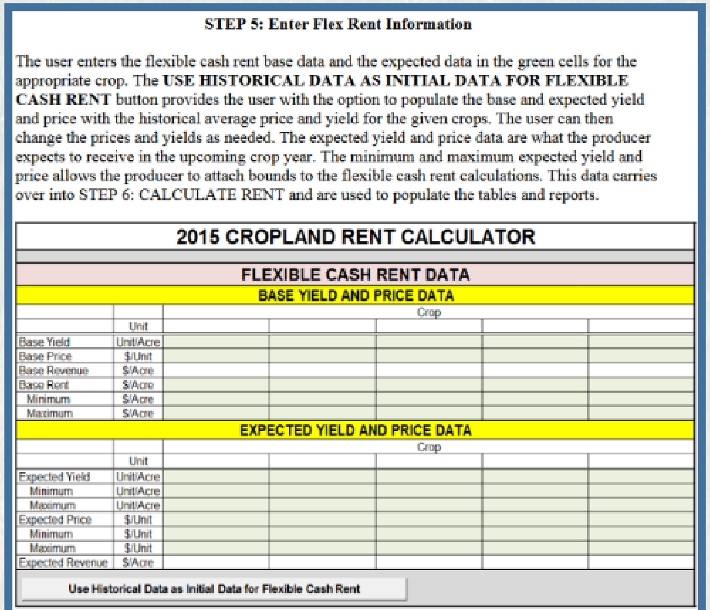
Decision aid for comparing rental agreements

Cropland Rental Tool (CROPRENT) is a excel-based decision tool developed for comparing different cropland lease agreements, including flexible cash rents, for up to five crops and/or management systems.



FINDINGS AND IMPACT:

Flexible cash rents allows rents to vary from year-to-year based on changes in price, yield, or revenue, allowing tenants and landowners to share in the risk associated with volatile commodity prices and uncertain yields.



STEP 5: Enter Flex Rent Information

The user enters the flexible cash rent base data and the expected data in the green cells for the appropriate crop. The **USE HISTORICAL DATA AS INITIAL DATA FOR FLEXIBLE CASH RENT** button provides the user with the option to populate the base and expected yield and price with the historical average price and yield for the given crops. The user can then change the prices and yields as needed. The expected yield and price data are what the producer expects to receive in the upcoming crop year. The minimum and maximum expected yield and price allows the producer to attach bounds to the flexible cash rent calculations. This data carries over into STEP 6: CALCULATE RENT and are used to populate the tables and reports.

2015 CROPLAND RENT CALCULATOR

FLEXIBLE CASH RENT DATA

BASE YIELD AND PRICE DATA

	Unit	Crop				
Base Yield	Unit/Acre					
Base Price	$/Unit					
Base Revenue	$/Acre					
Base Rent	$/Acre					
Minimum	$/Acre					
Maximum	$/Acre					

EXPECTED YIELD AND PRICE DATA

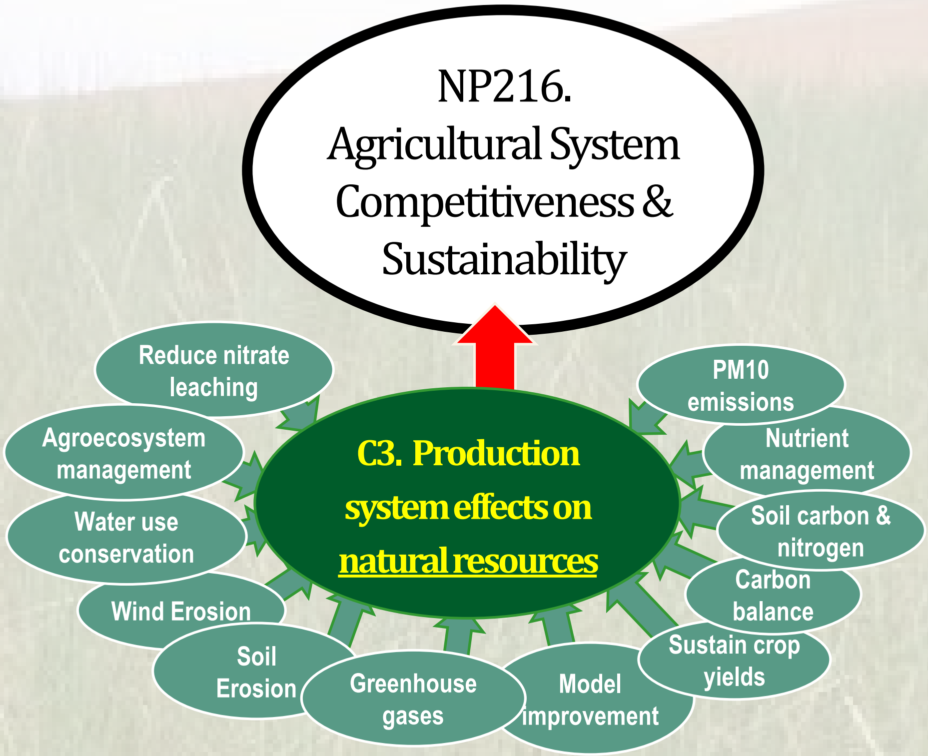
	Unit	Crop				
Expected Yield	Unit/Acre					
Minimum	Unit/Acre					
Maximum	Unit/Acre					
Expected Price	$/Unit					
Minimum	$/Unit					
Maximum	$/Unit					
Expected Revenue	$/Acre					

Use Historical Data as Initial Data for Flexible Cash Rent

CROPRENT is downloadable for free, with the accompanying User Manual, from: http://www.cottoninc.com/fiber/AgriculturalDisciplines/AgriculturalEconomics/Cotton-Farming-Decision-Aids

Component 2 Review

Questions & Discussion



Foci:

To understand the physical, chemical, and biological processes in production systems, and

To develop strategies for meeting air, water, and soil quality expectations of society

Problem 3A:

Air Quality

Agricultural production systems interact with the atmosphere affecting air quality

Management practices that maintain or improve air quality are needed

Grazing sheep during fallow reduces greenhouse gas emissions while maintaining crop yields

- Investigated managed sheep grazing in rotations with different crop rotations

<u>FINDINGS AND IMPACT:</u>

- Sheep grazing increased soil organic C and total N in spring wheat-pea/barley-fallow rotation compared with tillage and herbicide application for weed control

- Sheep grazing had no effect on crop yield compared with tillage and herbicide application

Barsotti, J.L., Sainju, U.M., Lenssen, A.W., Miller, Z.J., Hatfield, P.G. 2016. Sheep grazing enhances coarse relative to microbial organic carbon in dryland cropping systems. Sustainable Agriculture Research. 5(2):1-14. doi:10.5539/sar.v5n2p1

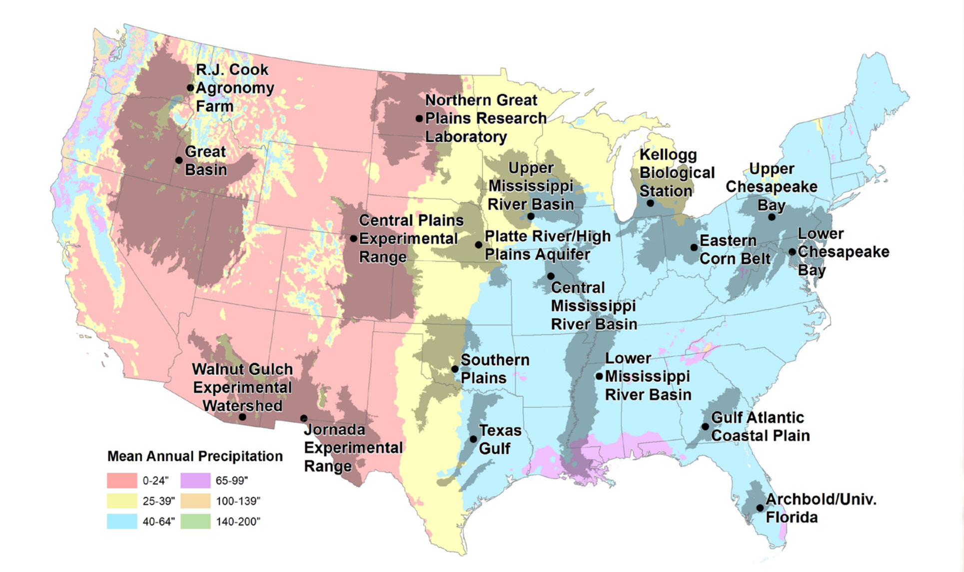
Long Term Agricultural Research (LTAR) Network rangeland wind erosion research leads to improved models and calibrations for more effective management

- Rangeland wind erosion causes: losses of productivity, highway fatalities, health problems & abrasive damage

- ARS coordinated research & modeling efforts for wind erosion at 9 LTAR network locations.

<u>FINDINGS AND IMPACT:</u>

- Outcomes will help develop new models to assess current land management, land use, and rangeland wind erosion, providing insights needed to reduce wind erosion problem.



Webb, NP, Galloza, MS, Zobeck, MS, and Herrick, JE. 2016. Threshold wind velocity dynamics as a driver of aeolian sediment mass flux. *Aeolian Research* Vol. 20, P 45–58. https://doi.org/10.1016/j.aeolia.2015.11.006

Problem 3B:

Water Quality

Agricultural production systems affect surface and ground water resources

In many regions production is dependent on irrigation

Management practices that maintain water quality and optimize water use efficiency are needed

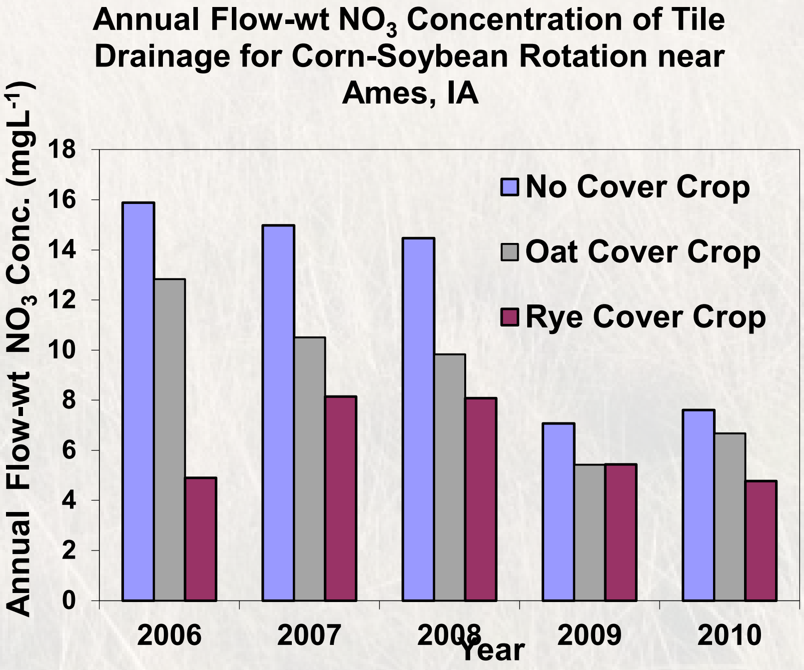
Oat and rye cover crops substantially reduce nitrate losses in drainage water

- ARS scientists in Ames, Iowa, showed that a winter cover crop reduced the concentration of nitrate in drainage water

FINDINGS AND IMPACT:

- Oats reduced nitrate concentrations by 26%
- Rye reduced nitrate concentrations by 46%

Kaspar, T.C., D.B. Jaynes, T.B. Parkin, T.B. Moorman, and J.W. Singer. 2012. Effectiveness of oat and rye cover crops in reducing nitrate losses in drainage water. Agric. Water Manage. 110:25-33.

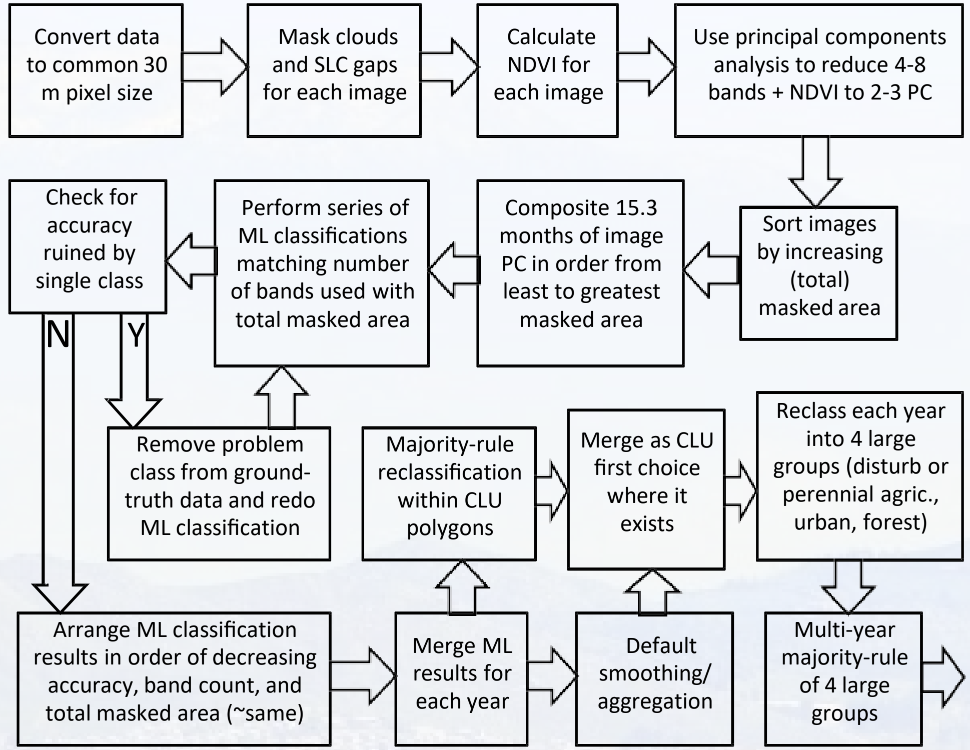


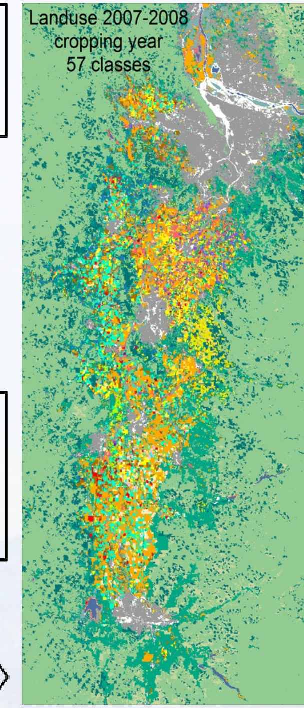
Stream and river water quality linked to land-use practices

- Assess how land use alters water quality of nearby streams and rivers for pollution monitoring and natural resource stewardship

- Tools needed to quantify how land use alters stream and river water quality over long time periods

- ARS scientists in Corvallis OR collected data over an 8-year period to define 56 land-use patterns of crops, forests and urban development that represented 99% of the area in the Willamette River Basin of western Oregon.





FINDINGS AND IMPACT:

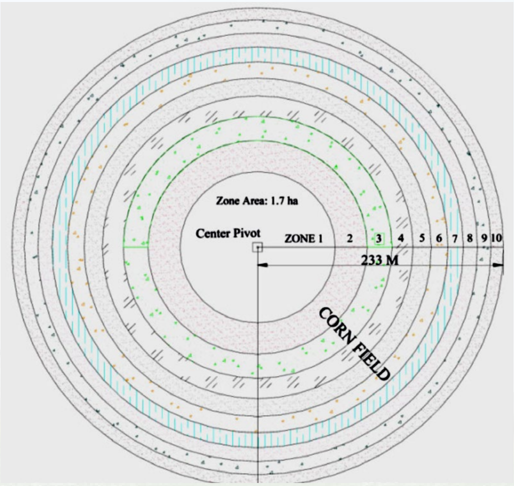
- When used with SWAT, data of *different land-use patterns can now be used to project the potential environmental consequences of land use patterns changing in response to market forces, policies and climate*.

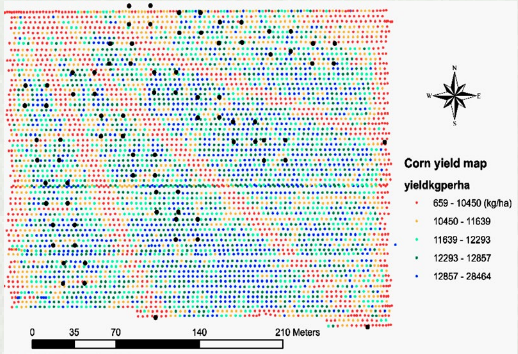
Mueller-Warrant, G.W., S.M. Griffith, G.W. Whittaker, G.M. Banowetz, W.F. Pfender, T.S. Garcia, and G. Giannico. 2012. Impact of land use patterns and agricultural practices on water quality in the Calapooia River Basin of western Oregon. J. Soil and Water Conservation 67(3):183-201.

Efficient water use in corn production

- Due to uncertainty in amount/timing of precipitation during cropping season, producers in the Mississippi Delta depend heavily on supplemental irrigation

- ARS scientists in Stoneville, MS evaluated at which growth stages of corn, irrigation water can be reduced- without affecting yield





FINDINGS AND IMPACT:

- Reducing water to 75% after milk stage did not affect yield. With additional tests, this information can help producers save money by reducing irrigation water at those growth stages in corn

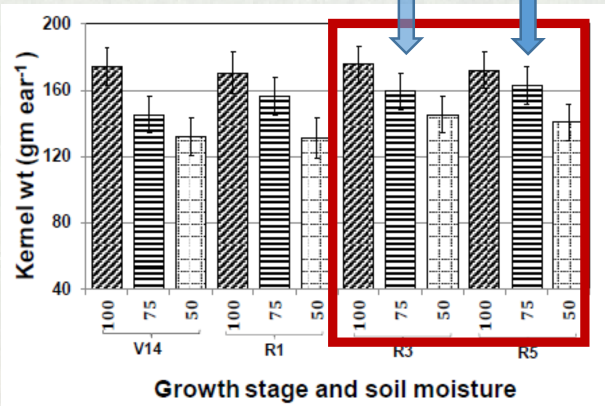


Figure 1. Corn kernel weight per ear in grams as influenced by soil moisture treatments (100 = 100% of field capacity (FC), 75 = 75% FC, 50 = 50% FC) at different growth stages (V14 = fourteen leaf stage, R1 = silk stage, R3 = milk stage and R5 = dent stage).

Sui, R., Fisher, D.K., Reddy, K.N. 2015. Yield response to variable rate irrigation in corn. Journal of Agricultural Science. Vol. 7:11-18.

Problem 3C:

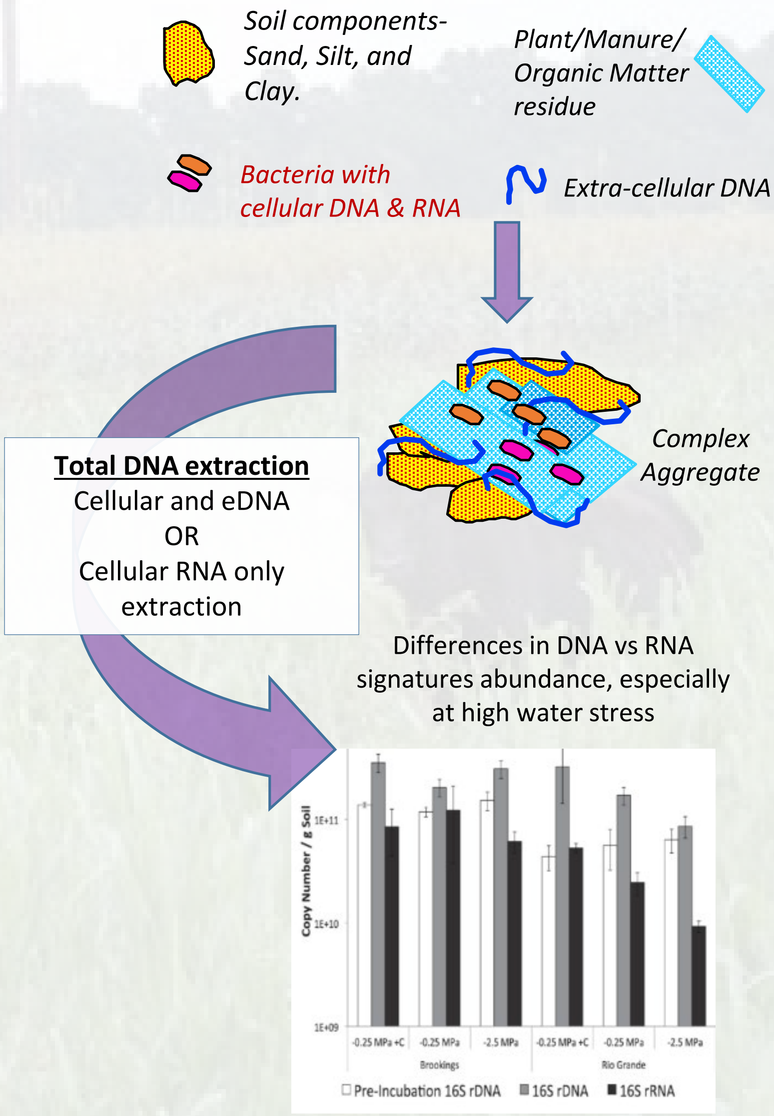
Soil Quality

Agricultural production systems affect soil physical, chemical, and biological properties

Management practices that maintain or improve soil quality are needed.

Molecular Biology Tools for Use in Assessment of Soil Health and Microbiomes

- ARS scientists in Beltsville, MD developed a suite of affordable molecular biology tools for use in soil health assessment
  - Bacterial / fungal community structure
  - Nematode abundance / pathogen potential
  - Functional gene abundance
  - Updated protocols for estimates of biologically active soil DNA and RNA
- Found significant differences in sizes and diversity of groups of soil organisms among long term cropping systems



FINDINGS AND IMPACT:

- Results aid farmers, extension agents and researchers exploring soil health and needing to assess sustainability of agroecosystems.

Kepler, R.M., Maul, J.E., Ugine, T.A., Cavigelli, M.A., Rehner, S.A. 2015. Community composition and population genetics of insect pathogenic fungi in the genus Metarhizium from soils of a long-term agricultural research system. Environmental Microbiology. doi:10.1111/1462-2920.12778.

Long-term reduced till with continuous cropping reduces soil carbon and nitrogen losses

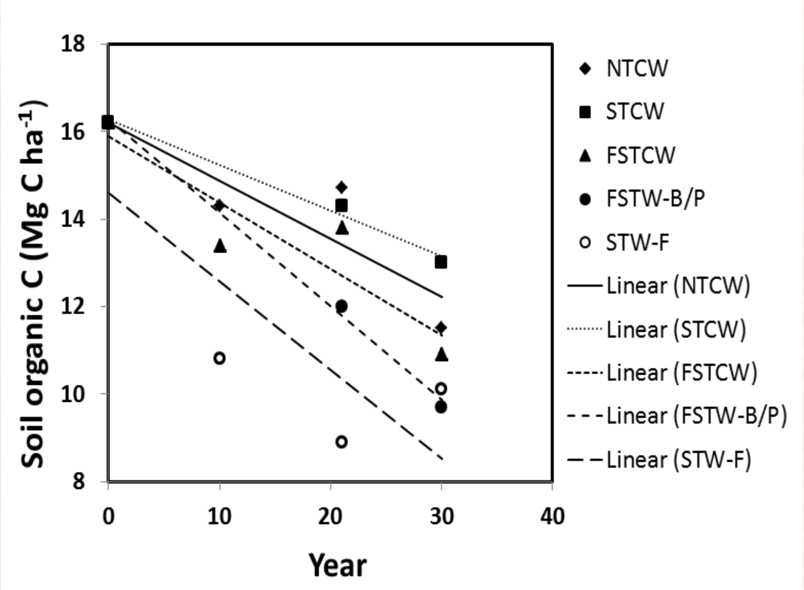
Investigated C and N losses associated with conventional and no till practices in wheat and impacts of residue vs. fertilizers

FINDINGS AND IMPACT:

- Continuous N fertilization reduced soil pH, Ca, and Mg, but greater crop residue returned to the soil increased P, K, Na, Zn, and CEC in reduced till continuous spring wheat compared to conventional till spring wheat-fallow.
- No-till continuous spring wheat reduced soil C and N *losses* by 10% compared with 30-35% losses with conventional till spring wheat-fallow after 30 years of converting grassland to cropland.
- Mean annualized spring wheat yield was 23-30% lower in conventional till spring wheat-fallow than reduced till continuous spring wheat.

Crop residue

Fallow



Sainju, U. M., B. A. Allen, T. Caesar-TonThat, and A. W. Lenssen. 2015. Dryland soil chemical properties and crop yields affected by long-term tillage and cropping sequence. SpringerPlus 4:230. DOI 10.1186/s40064-015-1122-4.

Problem 3D:

Environmental Quality

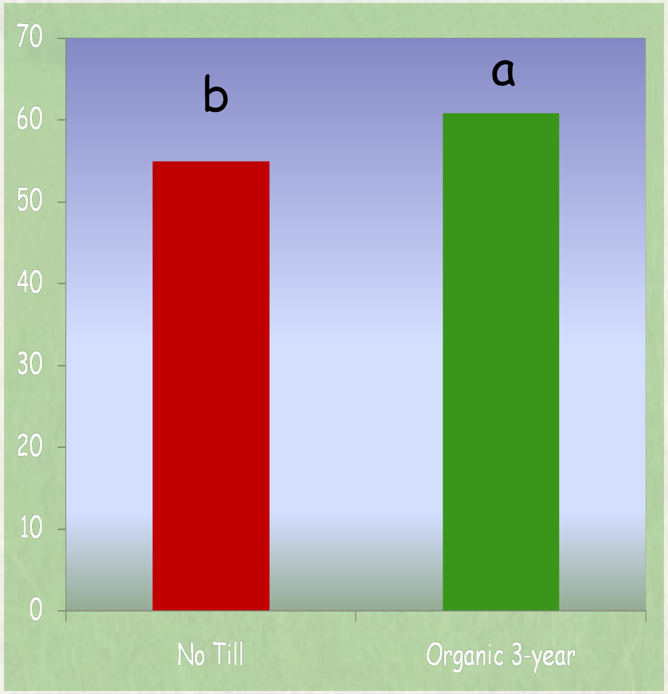
Changing management practices to reduce negative effects of production practices on the environment may have an unintended impact of shifting the negative outcomes to another part of the environment

Active research is needed that jointly addresses both land management and its effects on natural resources to ensure that agricultural production practices maintain or improve environmental quality

Organic cropping provides ecosystems services that rival no-till cropping

FINDINGS AND IMPACT:

Soil Organic Carbon (to a depth of 1m) in corn–rye–soybean–wheat/legume rotations was 11% greater in a manure-based organic, 3 year trial (a) compared to a no till system (b) after 11 years



System	Potentially mineralizable N	Frequency of manure application
CT	229 b	NA
NT	241 b	NA
Org2	**297 a**	**1 of 2 yrs**
Org3	**323 a**	**2 of 3 years**
Org6	**325 a**	**2 of 6 years**

Greenhouse gas emissions

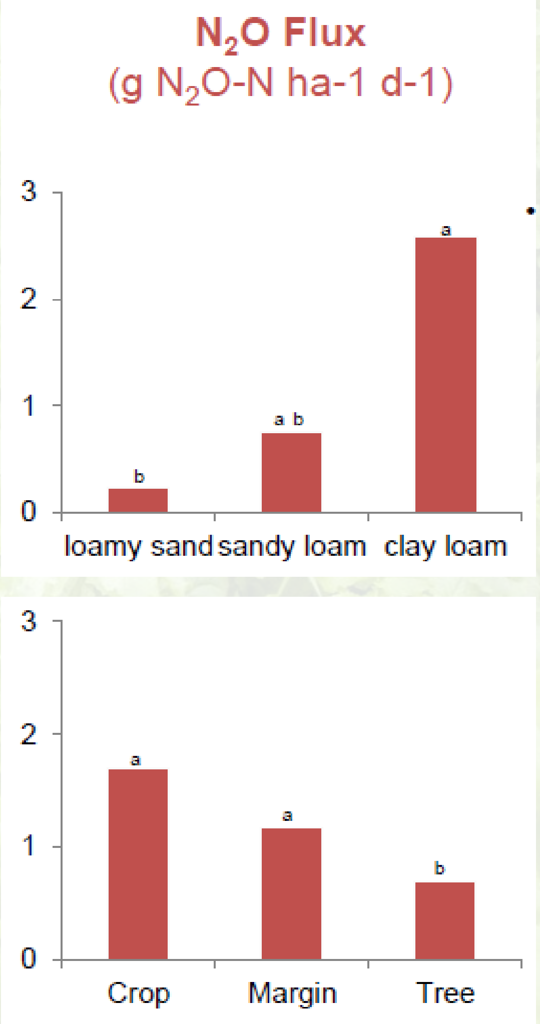
	$CO_{2\ eqvt}$ (kg CO_{2eqvt} ha^{-1} y^{-1})			
System	ΔSoil C	N_2O	Energy	GWP
No-Till	0 b	303 b	807	1110 b
Chisel Till	1080 a	406 ab	862	2348 a
Organic	**-1953 c**	**737 a**	**344**	**-872 c**

Cavigelli, M.A., S.B. Mirsky, J.R. Teasdale, J.T. Spargo, and J. Doran. 2013. Organic grain cropping systems to enhance ecosystem services. Renewable Agriculture and Food Systems 28: 145-159.

Agroforestry has potential to mitigate agricultural greenhouse gas emissions in the southeastern USA

Long term silvopasture experiments in North Carolina were initiated in 2007 by planting trees on marginal cropland. It has demonstrated a multi-disciplinary approach to conservation agriculture using a systems approach. Impacts on greenhouse gas emissions are notable.

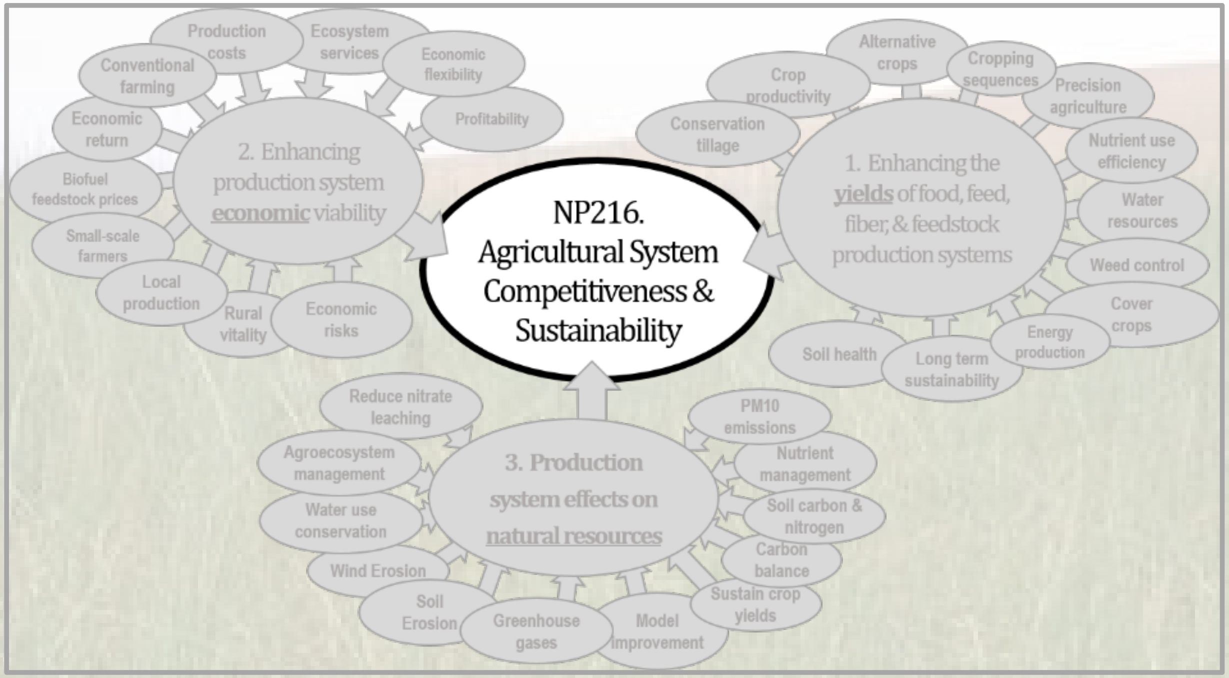
FINDINGS AND IMPACT:



Component 3 Review

Questions & Discussion

Vision: Help producers develop ***integrated solutions*** *that solve their problems related to productivity, profitability, and natural resource stewardship*



C4. Integration of sustainability goals: databases, models, tools, integration

Foci:

- To overcome problems related to the synthesis of data for assessments of sustainability at the farm/regional/or larger scales
- To develop databases and analytical tools for processing datasets, and to use or develop statistical methods, assessment tools, and simulation models - to synthesize results that farmers, ranchers, and other producers can use in organizing their operations to enhance their sustainability.

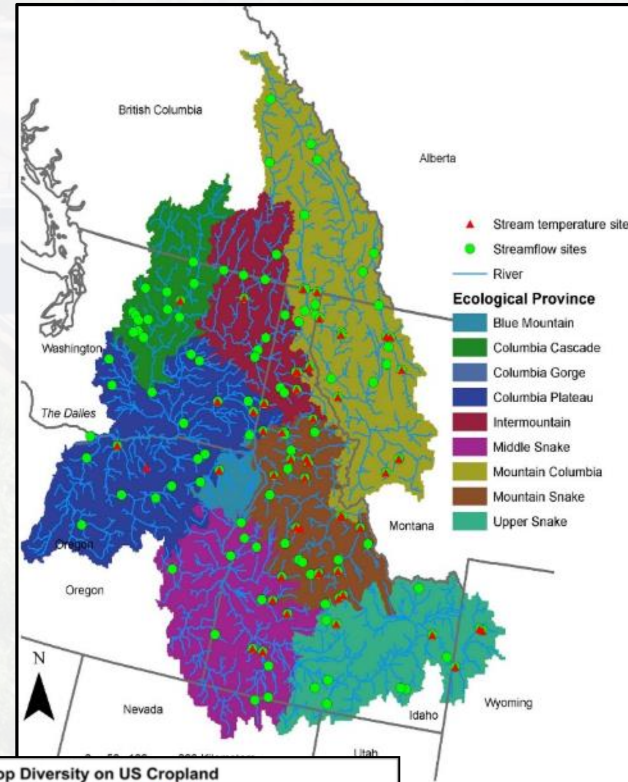
Problem 4A:

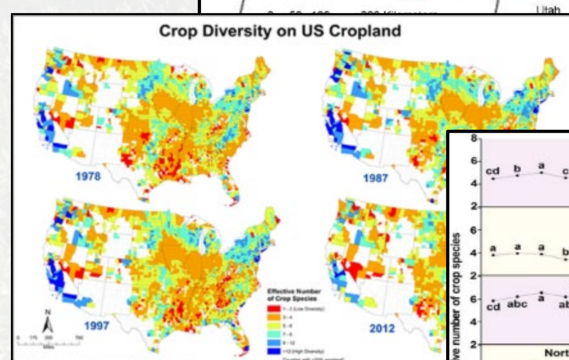
Database Development

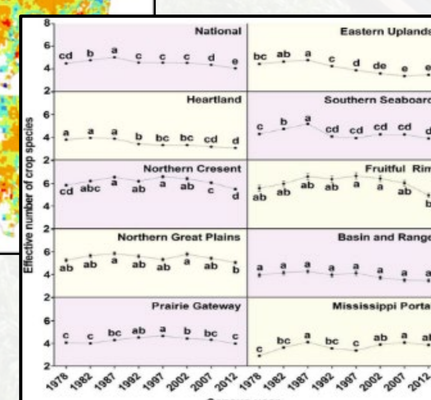
Agricultural production research is conducted at a large number of ARS locations, and at cooperating university and non-profit research organization

Comparison of results is often hampered by lack of access to data

Development of a database for storage and access is needed to integrate and validate research across locations, regions, and nationally.







Meta-data requirements for conservation agricultural systems research outlined

- No-till/conservation agricultural systems research has been studied for >50 years in countries around the world; however, few standards in methodology exist
- Scientists from Paraguay, Germany, Italy, and Brazil and ARS scientists at Raleigh, NC and Morris, MN outlined necessary standards of conservation / agroecosystems research.

Framing a protocol for no-till research

1. System description
2. Cropping and tillage history
3. Soil condition before the experiment
4. Soil fertility
5. Weed control
6. Planting/seeding equipment details
7. Soil moisture at seeding
8. Soil disturbance
9. Plant biomass produced
10. Insect and disease control
11. Nitrogen requirements
12. Crop rotation

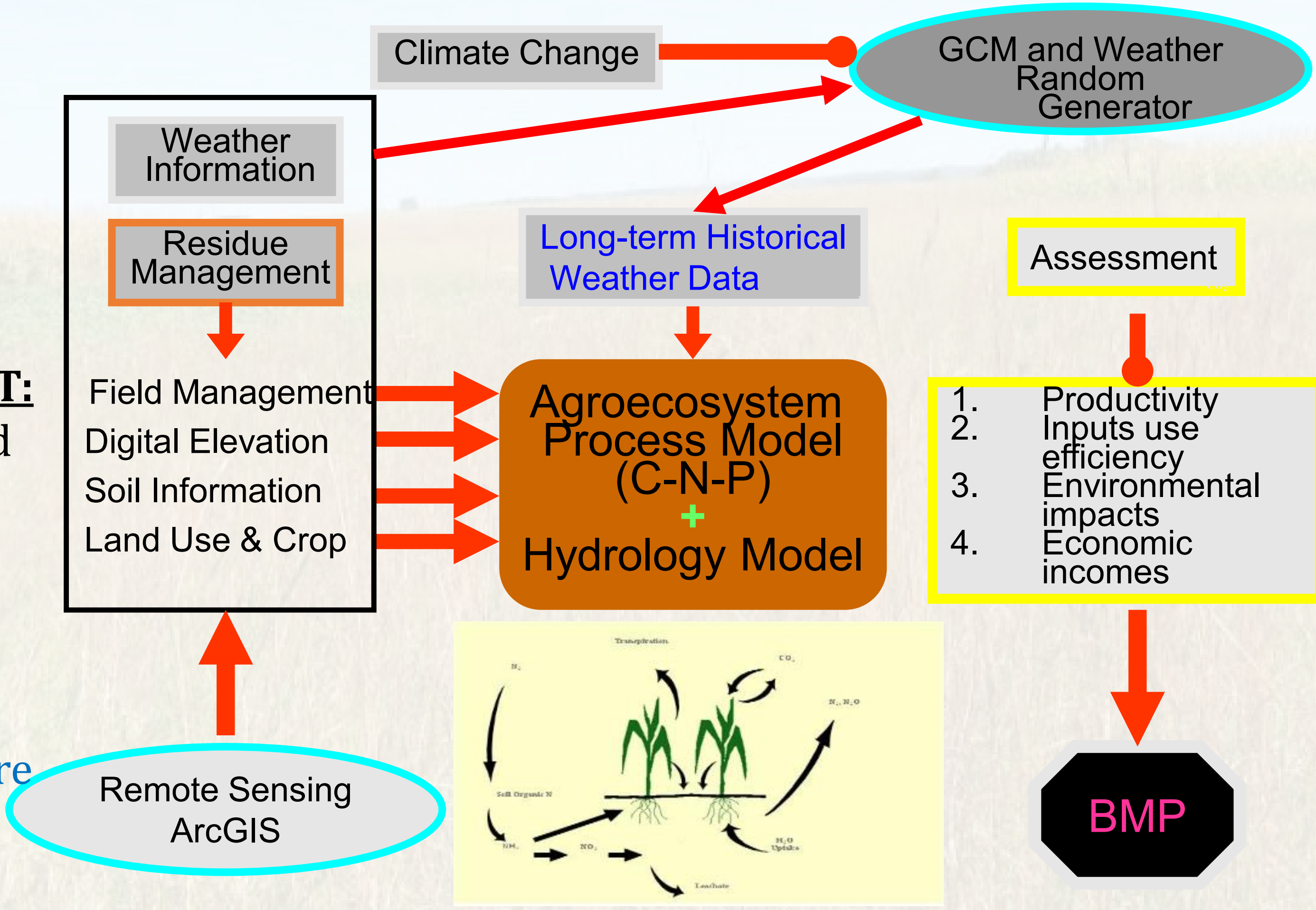
FINDINGS AND IMPACT:

- Standards in research methodologies in no-tillage/conservation agricultural systems will improve abilities to compare results from different researchers/ countries

Derpsch, R., Franzluebbers, A.J., Duiker, S.W., Reicosky, D.C., Koeller, K., Friedrich, T., Sturny, W.G., Sa´, J.C.M., Weiss, K. 2014. Why do we need to standardize no-tillage research? Soil and Tillage Research Vol. 137, P. 16-22.

Sustainable Nutrients & Water Management Technology – for addressing groundwater decline in the Mississippi Delta

- Research on yield gaps in southeastern crops is challenging, given the high variability in soil types, volatile weather, and biotic and abiotic stresses during the growing season



FINDINGS AND IMPACT:

- Models were developed that are used in conjunction with collected data to estimate and predict water utilization strategies and use future weather predictions to estimate crop nutrient use

Feng, G., Cobb, S., Abdo, Z., Fisher, D.K., Ouyang, Y., Adeli, A., Jenkins, J. 2016. Trend analysis and forecast of precipitation, reference evapotranspiration and rainfall deficit in the Blackland Prairie of Eastern Mississippi. *Journal of Applied Meteorology and Climatology* Vol. 55, P. 1425-1439. doi: 10.1175/JAMC-D-15-0265.1.

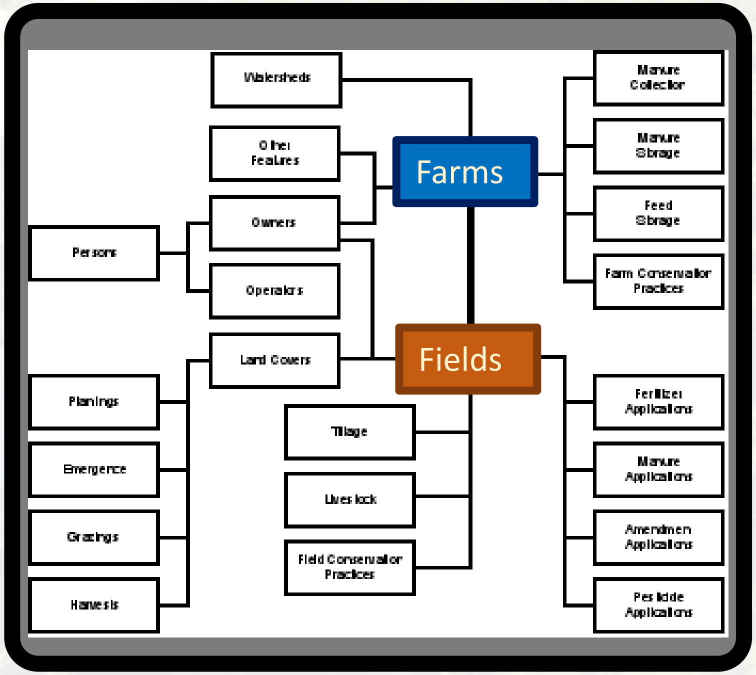
Problem 4B:

Synthesis and Modeling

Modern data collection methods are capable of generating very large datasets that are difficult to process for meaningful information

Methods and tools are needed to better understand underlying processes and responses to modern production practices

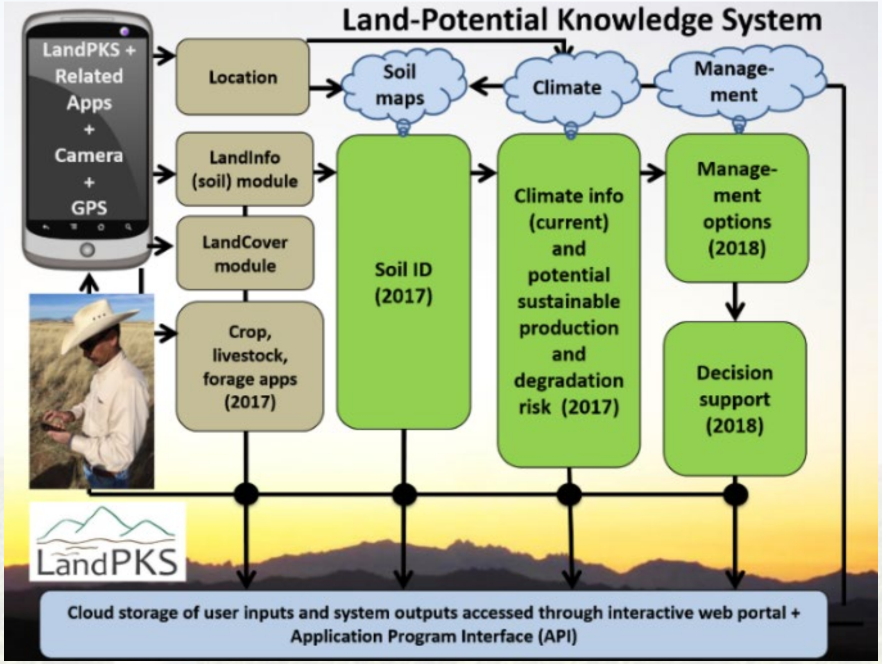
Tools include methods for processing, filtering, and incorporating these datasets into a common format, and statistical methods, assessment tools, and agronomic models to synthesize and compare results across locations



Platform and mobile apps developed for collecting and sharing G × E × M data

- ARS scientists in Las Cruces New Mexico, with support from USAID, NRCS other scientists, developed a "**Land-Potential Knowledge System**" (***LandPKS***) App.

- Optimal seed selection & management requires knowledge of soil, topography & climate for the location where germplasm & management systems were tested - and where they will be used.



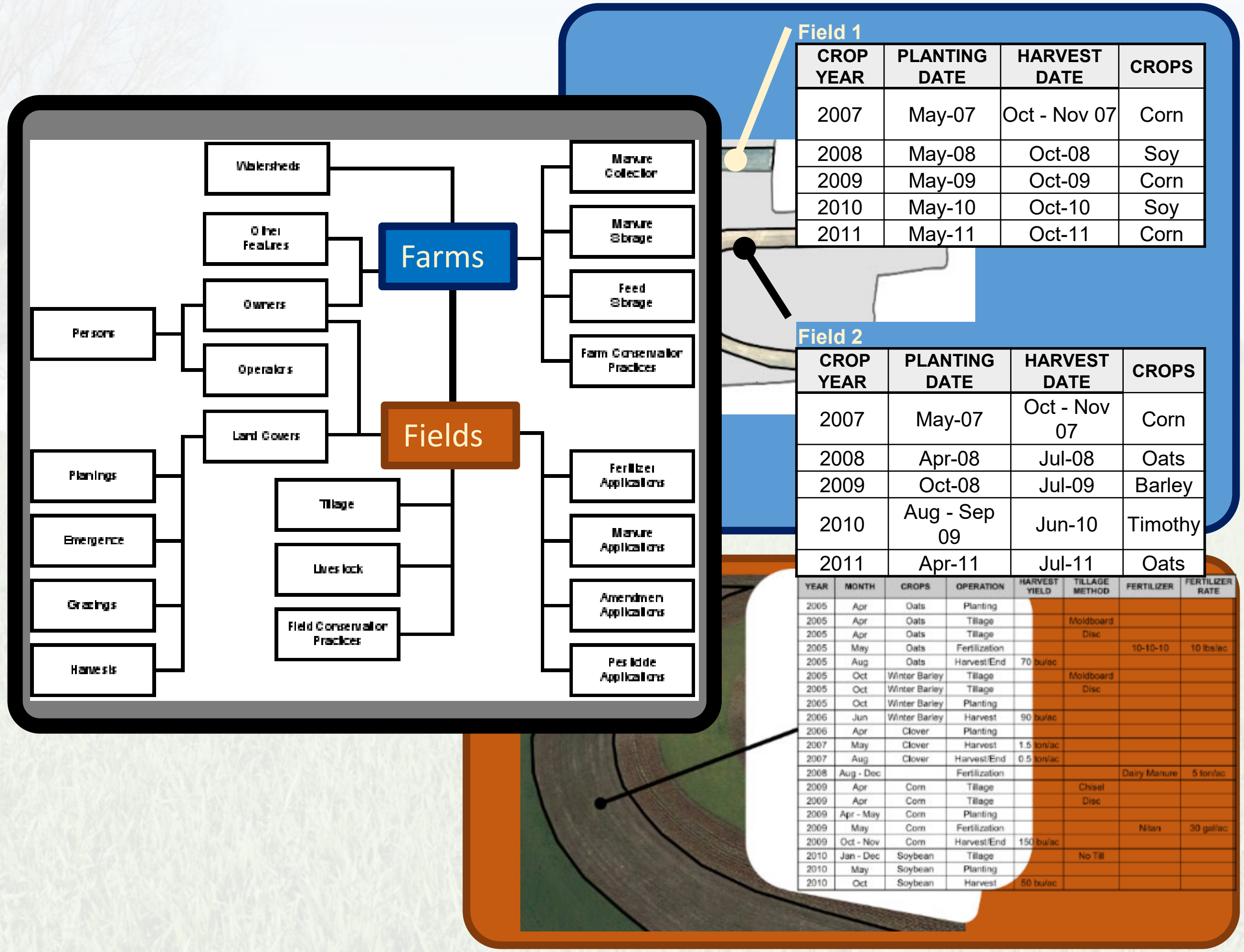
<u>FINDINGS AND IMPACT:</u>

- This App will help farmers in the US and globally sustainably intensify production systems.

Herrick, J.E., Karl, J.W., McCord, S.E., Buenemann, M., Riginos, C., Ganguli, A., Angerer, J., Brown, J., Kimiti, D., Saltzman, R., Beh, A., Bestelmeyer, B. 2017. Two New Mobile Apps for Rangeland Inventory and Monitoring by Landowners and Land Managers, Rangelands, Volume 39, Issue 2, April 2017, Pages 46-55, ISSN 0190-0528, https://doi.org/10.1016/j.rala.2016.12.003.

Long-term field management database

- ARS researchers in University Park, PA developed a framework for recording land management, water quality and related data



FINDINGS AND IMPACT:

- Database supports research to help farmers meet long-term production, land stewardship, and water quality goals

- Expected to help develop options for management that improve water quality.

Veith, T. L., J. E. Richards, S. C. Goslee, A. S. Collick, R. B. Bryant, D. A. Miller, B. W. Bills, A. R. Buda, R. L. Sebring, P. J. A. Kleinman. Navigating spatial and temporal complexity in developing a long-term land use database for an agricultural watershed. Journal of Soil & Water Conservation 70(5):288-296. 2015.

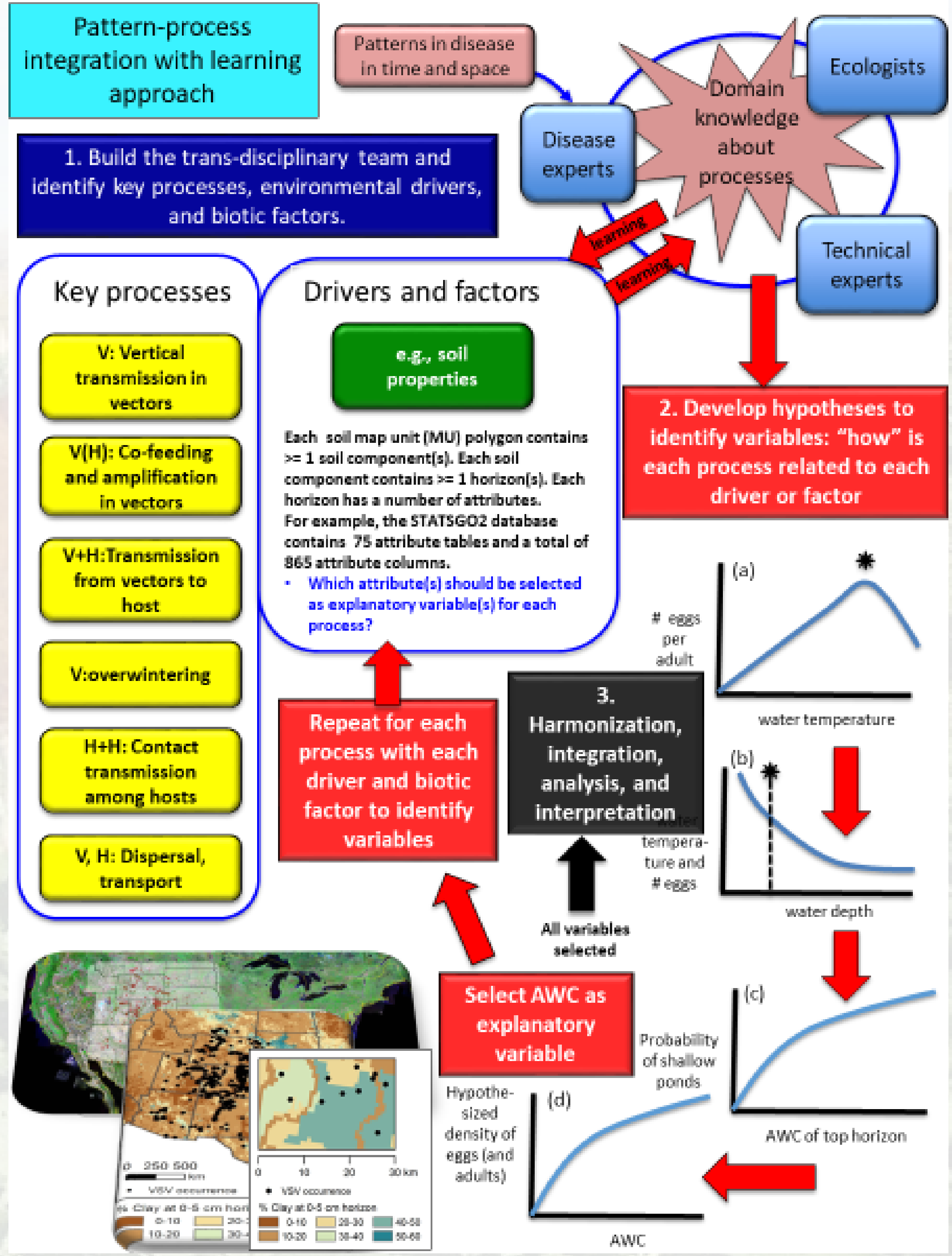
Geospatial databases and operational framework for predictive disease ecology

Vesicular stomatitis virus (VSV) [most common vesicular disease affecting livestock in the Americas] has expanded to ~250M acres between 2004 - 2016.

ARS scientists (Las Cruces), in collaboration with other ARS scientists and APHIS developed a spatially-resolved, iterative framework with human and machine learning to address this problem: a DATA CUBE.

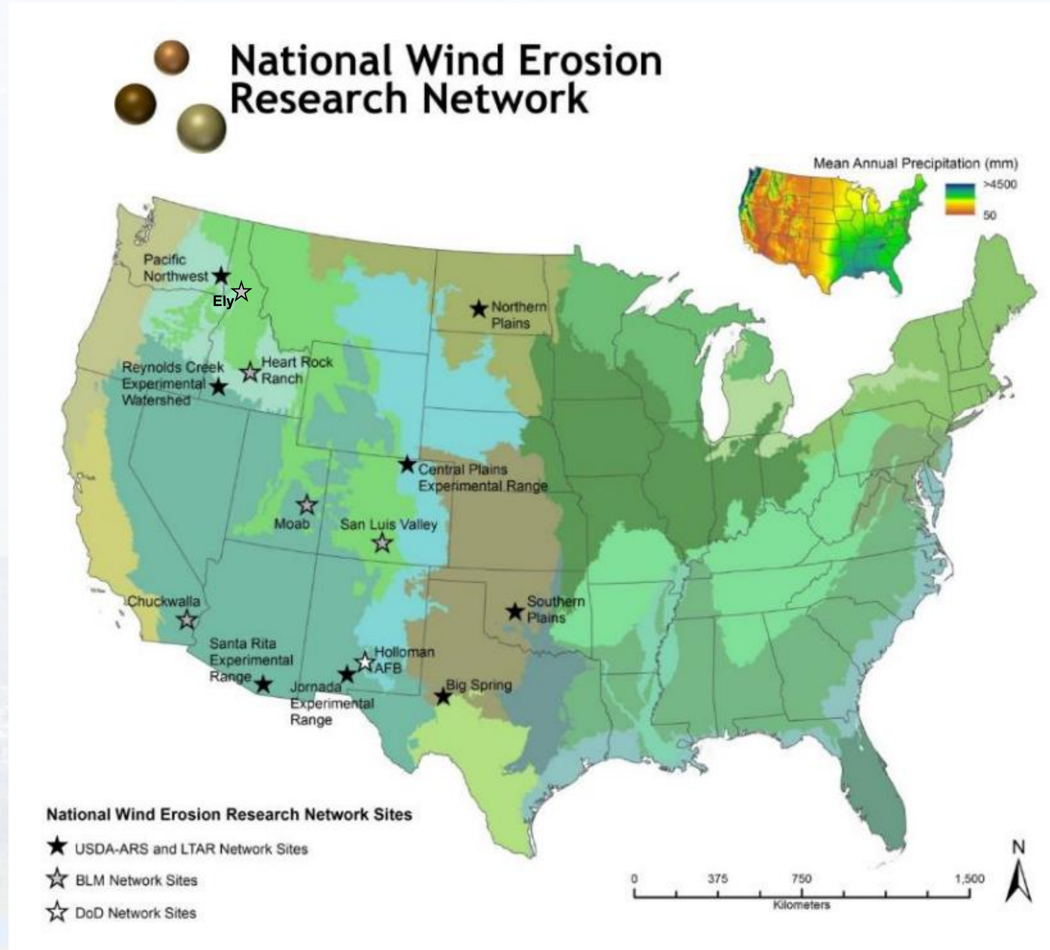
FINDINGS AND IMPACT:

New insights were discovered about the effects of drought, surface water, soil, and vegetation properties on host-vector relationships that contribute to variability in the spread of disease. The harmonized, spatially- and temporally resolved data cube can be used for other research questions in the geographic region of the analysis.



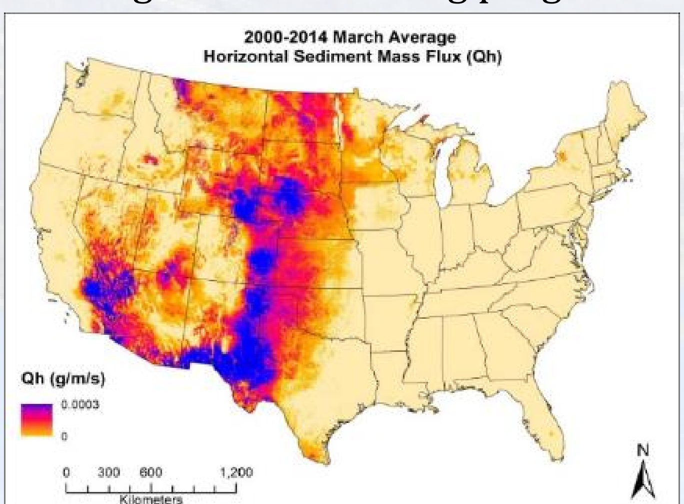
Long Term Agroecosystem Research (LTAR) Network
Rangeland Wind Erosion Research and Model Calibration

- A coordinated multi-partner *National Wind Erosion Research Network*
- 7 LTAR sites, 2 ARS labs and 5 BLM field offices (9 sites are operational)
- Basic and applied research into wind erosion and dust emission processes



<u>**FINDINGS AND IMPACT:**</u>

- **Developing wind erosion models to enhance national wind erosion monitoring and assessment programs**
- Integrating data and models with BLM and NRCS rangeland monitoring programs

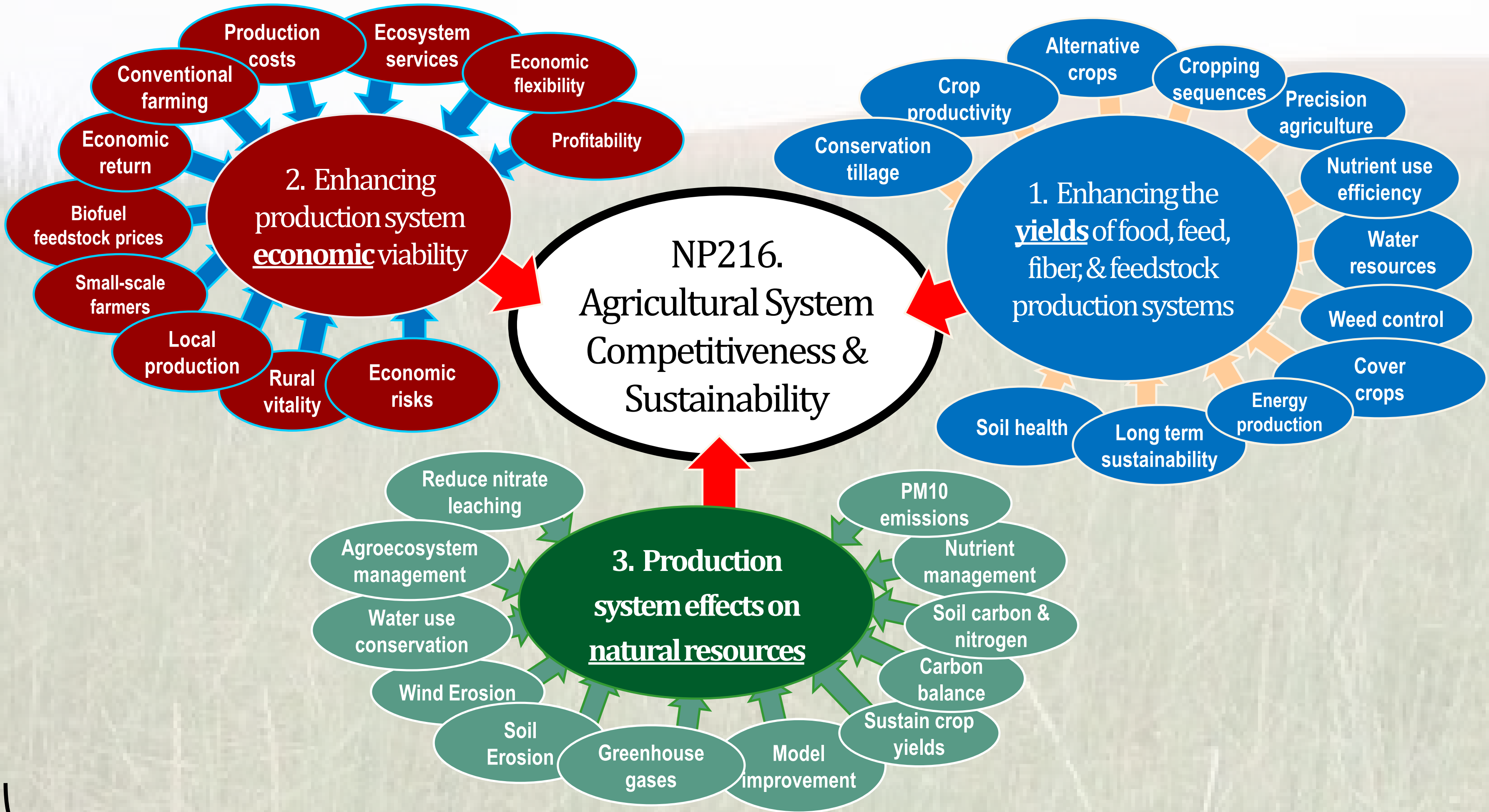


Webb, NP, Galloza, MS, Zobeck, MS, and Herrick, JE. 2016. Threshold wind velocity dynamics as a driver of aeolian sediment mass flux. *Aeolian Research* Vol. 20, P 45–58. https://doi.org/10.1016/j.aeolia.2015.11.006

Component 4 Review

Questions & Discussion

*Vision: Help producers develop **integrated solutions** that solve their problems related to **productivity**, **profitability**, and **natural resource** stewardship*



4. Integration of sustainability goals: databases, models, tools, integration

5: Closing the yield gap through interactions of genetics x environment x management (G x E x M) *This component is being **developed as a direction for new projects** moving into NP216 from other ARS National Programs. GxExM will become a focus for NP216 during the five year cycle of research **starting 2017.***

2013-2017 NP216

1. Summary Conversation

2. Panel Only Conversations