SUSTAINABLECORN.ORG
CROPS, CLIMATE, CULTURE AND CHANGE

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Semi-Annual CSCAP Advisory Board Meeting

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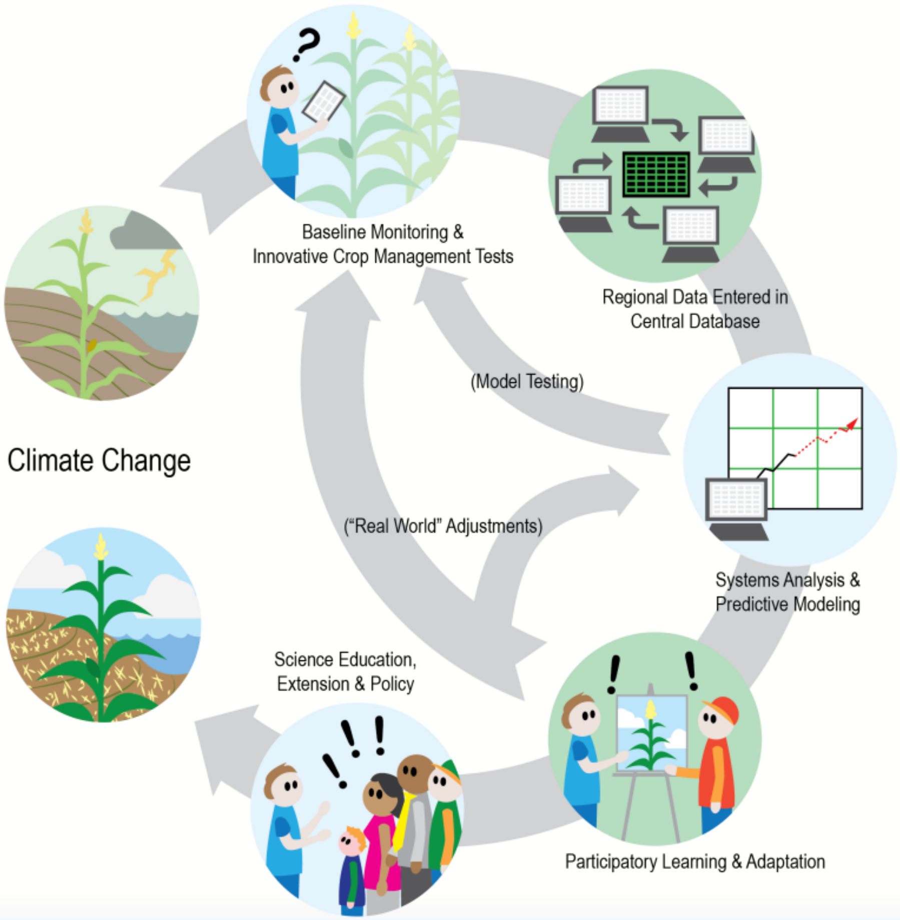
CSCAP Objectives

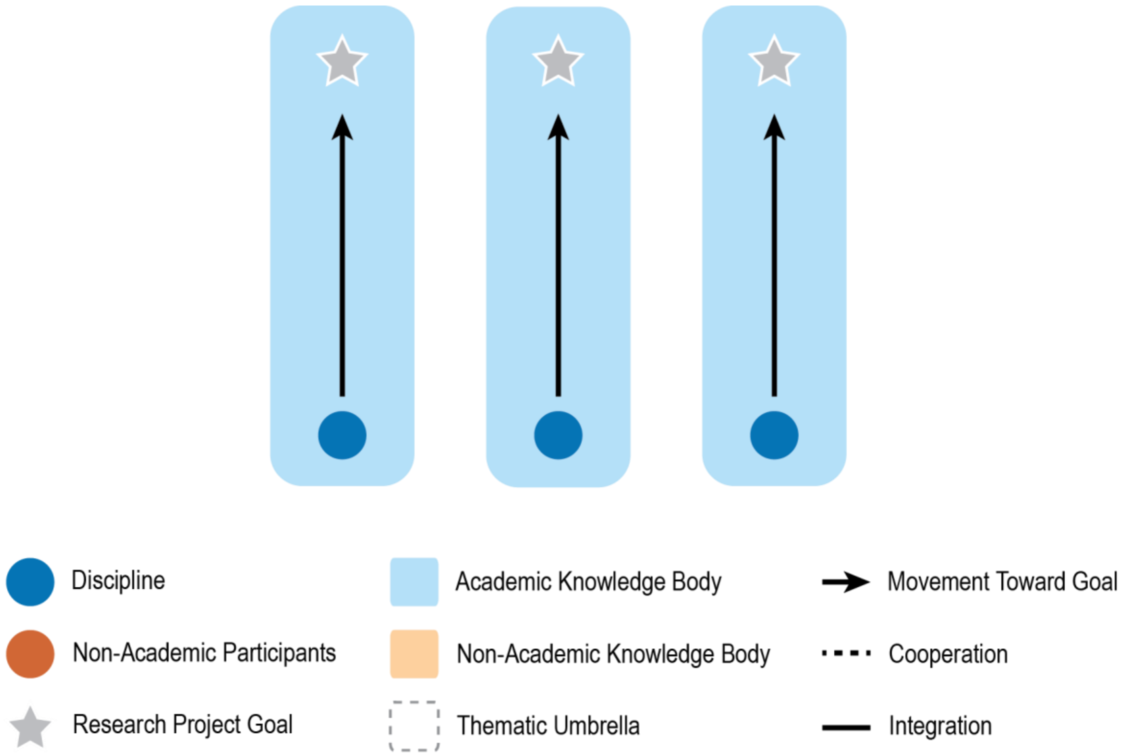


1. Develop standardized methodologies and perform baseline monitoring of carbon, nitrogen and water footprints at agricultural test sites across the Midwest.
2. Evaluate how crop management practices impact carbon, nitrogen and water footprints at test sites.
3. Apply models to research data and climate scenarios to identify impacts and outcomes that could affect the sustainability and economic vitality of corn-based cropping systems.
4. Gain knowledge of farmer beliefs and concerns about climate change, attitudes toward adaptive and mitigative strategies and practices, and decision support needs to inform the development of tools and practices that support long-term sustainability of crop production.
5. Promote extension, outreach and stakeholder learning and participation across all aspects of the program.
6. Train the next generation of scientists, develop science education curricula and promote learning opportunities for high school teachers and students.

Integration of Science

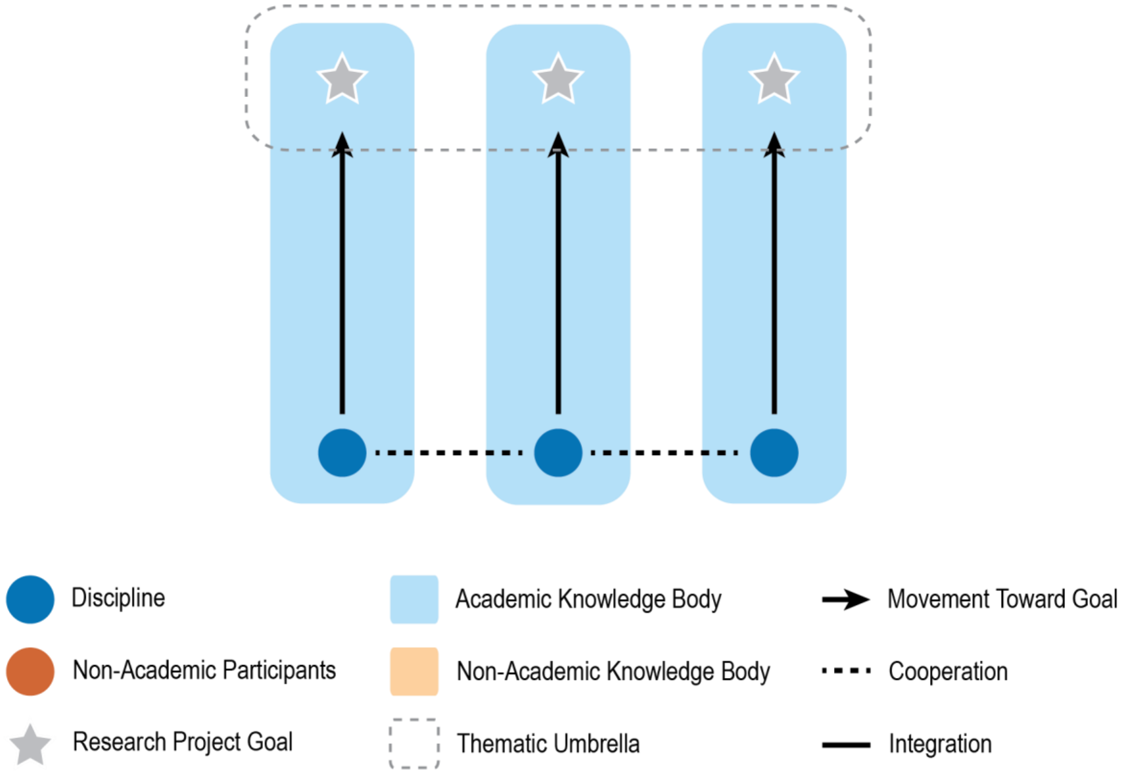
- Addressing complex, difficult problems
- Creating new knowledge (a.k.a. science)
- What processes and structures are needed to answer questions and find solutions?

Disciplinary



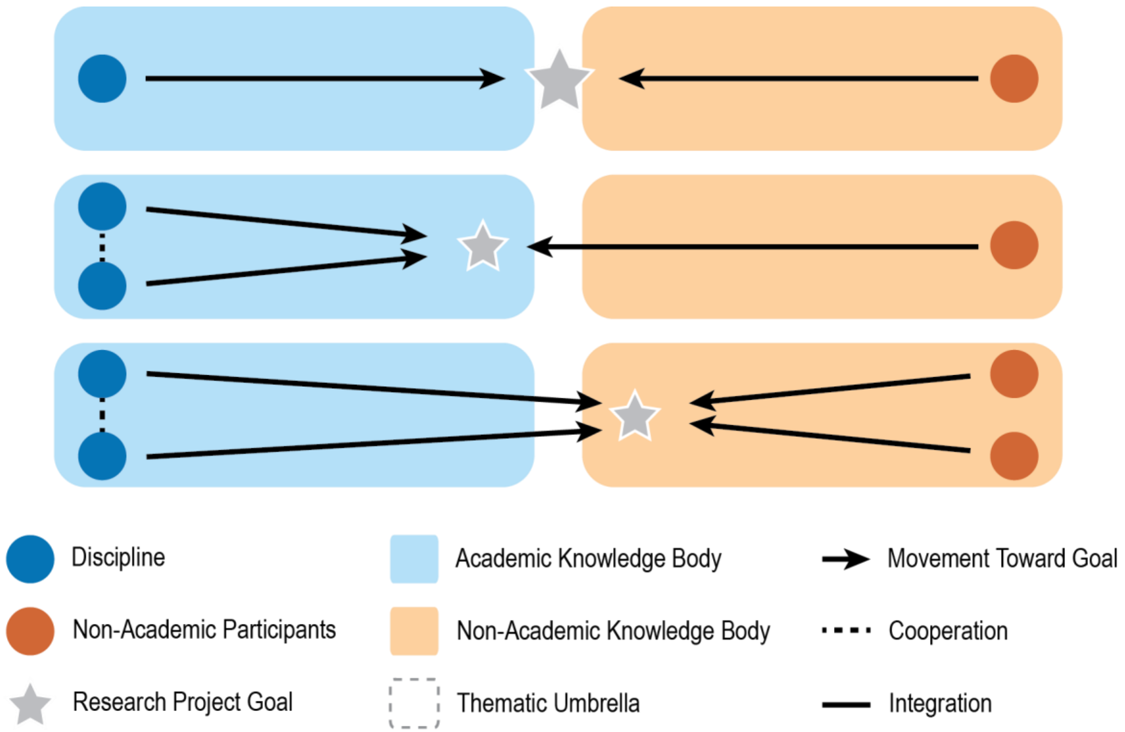
Tress, Tress, & Fry 2004

Multidisciplinary



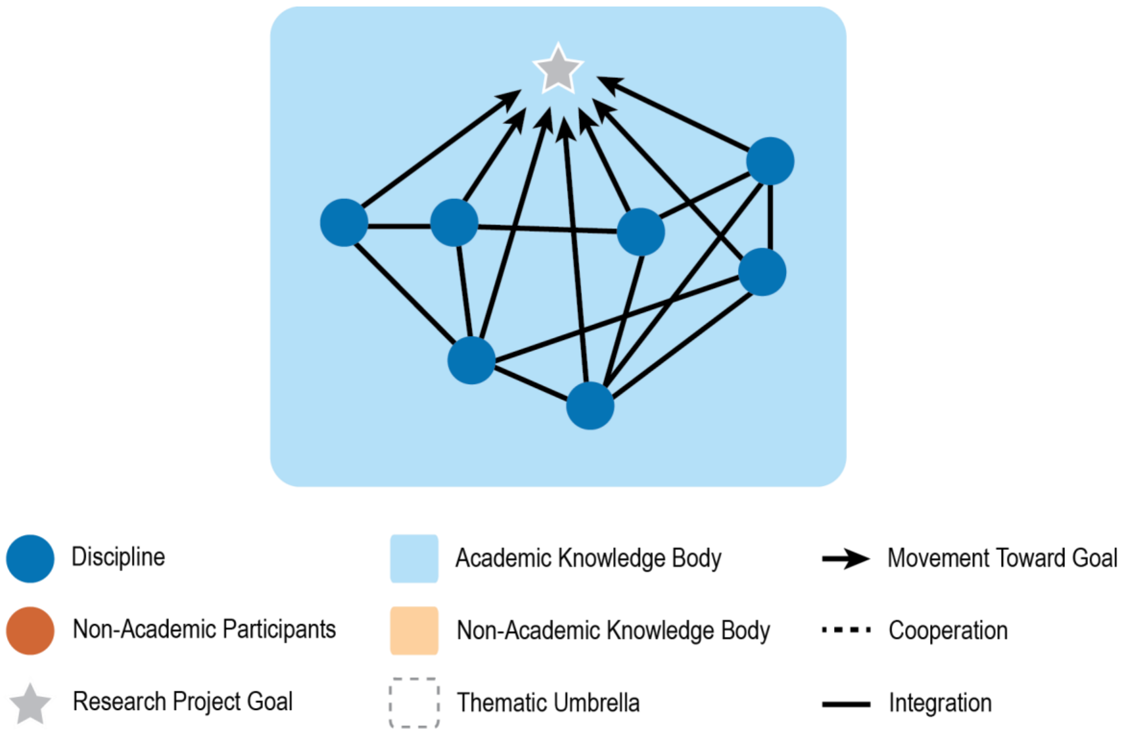
Tress, Tress, & Fry 2004

Participatory



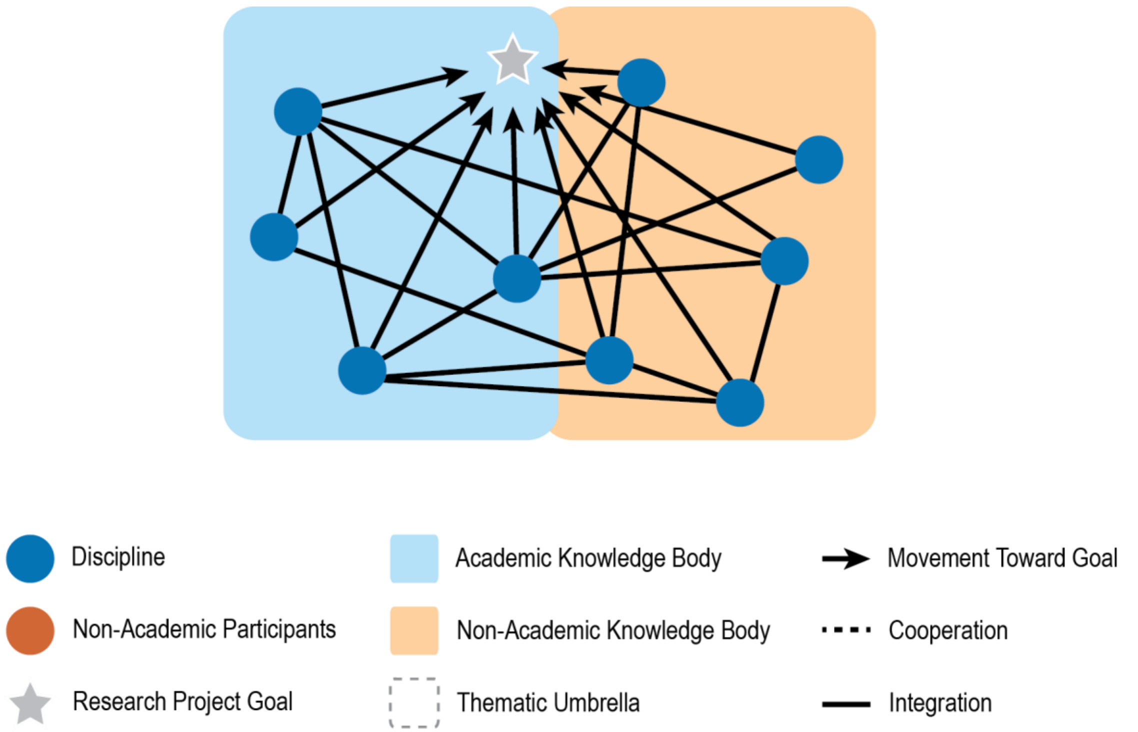
Tress, Tress, & Fry 2004

Interdisciplinary



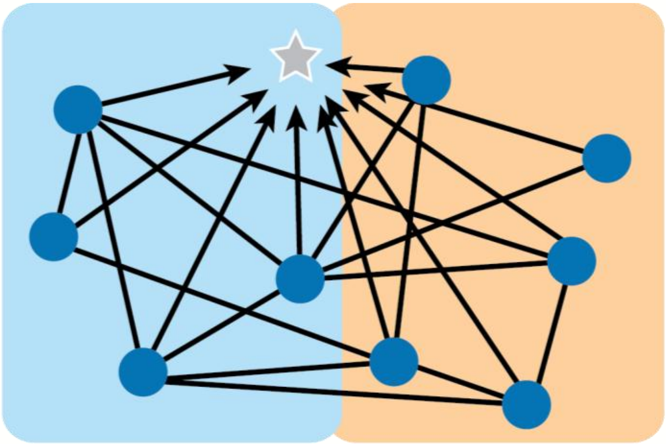
Tress, Tress, & Fry 2004

Transdisciplinary



Tress, Tress, & Fry 2004

A Work-in-progress



Becoming a transdisciplinary project that integrates the knowledge of many specializations to make a quantum leap beyond disciplinary sciences to create new collaborative knowledge which leads to a new understanding of difficult and complex problems

Research Questions & Hypotheses

Research Questions:

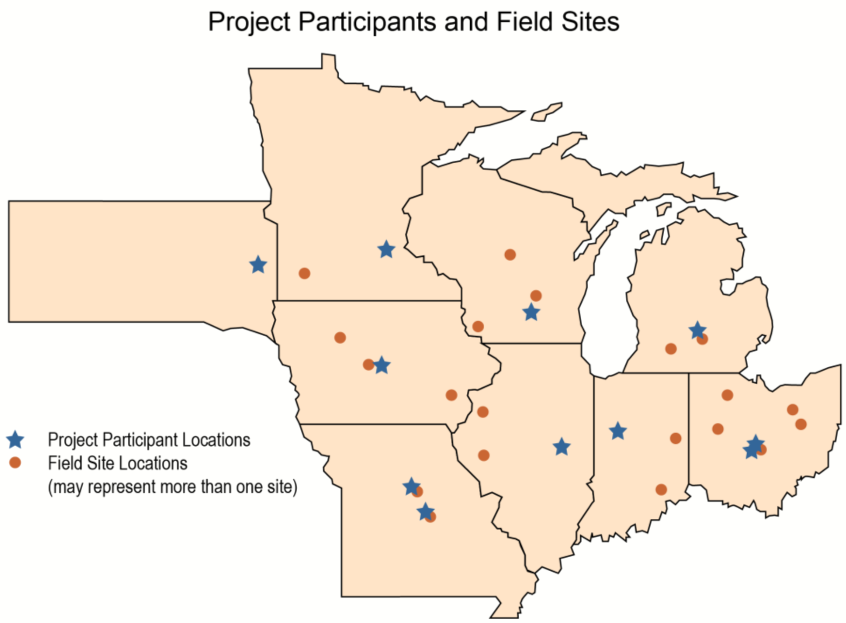
- Help investigators avoid distractions, diversions and the “all-about” project by working toward supporting a specific, arguable thesis.

Hypotheses:

- Give insight into the proposed research question
- Are measurable and testable
- Are developed directly from the science and experiences of the researcher
- Should be concise
- Have a well-founded rationale

Objectives 1 & 2

- **Topic Area: Tillage System, Extended Rotations, Cover Crops, Nitrogen Sensing, Controlled Drainage, Greenhouse Gases, and Integrated Pest Management**



- **AS PER PROPOSAL:** *Develop standardized methodologies for estimating C, N, and water footprints of corn production in the region and perform baseline monitoring in eight states to evaluate the impacts of a suite of crop management practices, including no-till, extended crop rotations, drainage water management, cover crops, and canopy N-sensors.*

Objectives 1 & 2

- **RQ 1. How do tillage management systems impact the greenhouse gas footprint of corn production systems?**
- **RQ 2. How do extended rotations impact the greenhouse gas footprint of corn production systems?**
- **RQ 3. How do winter cover crops impact the greenhouse gas footprint of corn production systems?**
- **RQ 4. How does sensor-based nitrogen (N) fertilizer management impact the greenhouse gas footprint of corn production systems?**
- **RQ 5. How do cover cropping, tillage, and sensor-based N management interact in their impacts on the greenhouse gas footprint of corn production systems?**
- **RQ 6. How does drainage impact the greenhouse gas footprint of corn production systems?**
- **RQ 7. How does drainage water management impact the greenhouse gas footprint of corn production systems?**

Objectives 1 & 2

- **RQ 8. How does sensor-based N management affect the resiliency of corn production to changing climate?**
- **RQ 9. How does tillage affect the resiliency of corn production to changing climate through alterations in carbon, nitrogen, and water in the soil?**
- **RQ 10. How do extended rotations affect resiliency of corn production through alterations in carbon, nitrogen, and water in the soil?**
- **RQ 11. How does drainage affect the resiliency of corn production through alterations in carbon, nitrogen, and water in the soil?**
- **RQ 12. How does drainage water management affect the resiliency of corn production through alterations in carbon, nitrogen, and water in the soil?**
- **RQ 13. How do winter cover crops affect the resiliency of corn production through alterations in carbon, nitrogen, and water in the soil?**

Objectives 1 & 2 / IPM

- **RQ 14. Will corn and soybean diseases be affected by climate and management practices evaluated in the CS-Corn project?**
- **RQ 15. How do weeds affect greenhouse gas emission measurements? (Davis graduate student)**
- **RQ 16. Will seed treatments help soybean production be more resilient to climatic fluctuations? (Zaworski)**
- **RQ 17. Will production practices such as Drainage Water Management (DWM) and cover crops increase root rot diseases of soybean? (Han)**
- **RQ 18. How does the cultural practice of cover cropping affect arthropods? (Dunbar)**
- **RQ 19. How does the cultural practice of crop rotation affect pests? (Dunbar)**
- **RQ 20. How does variation in climate across a broad geographical area affect pest management inputs and key pests? (Dunbar)**

Objective 3

- **Topic Area: Systems Analysis and Predictive Modeling**
- **AS PER PROPOSAL:** *Apply climate information to physical models to synthesize results from field tests and extend them to predict responses to climate and economic scenarios*. *We will combine process models, historical data, and climate projections with data from Objectives 1 and 2 to calibrate biophysical models at ever-larger scales: field, farm, and landscape. These models will be used to perform "what if" experiments about observed climate variability and projected climate change. Finally, we will develop a landscape-scale modeling system that integrates economic land use models with detailed biophysical models and projections from climate models. This modeling framework will be used to determine the optimal targeting of cover crops, drainage management, and other conservation practices within a corn-based cropping system under a variety of possible environmental goals.*

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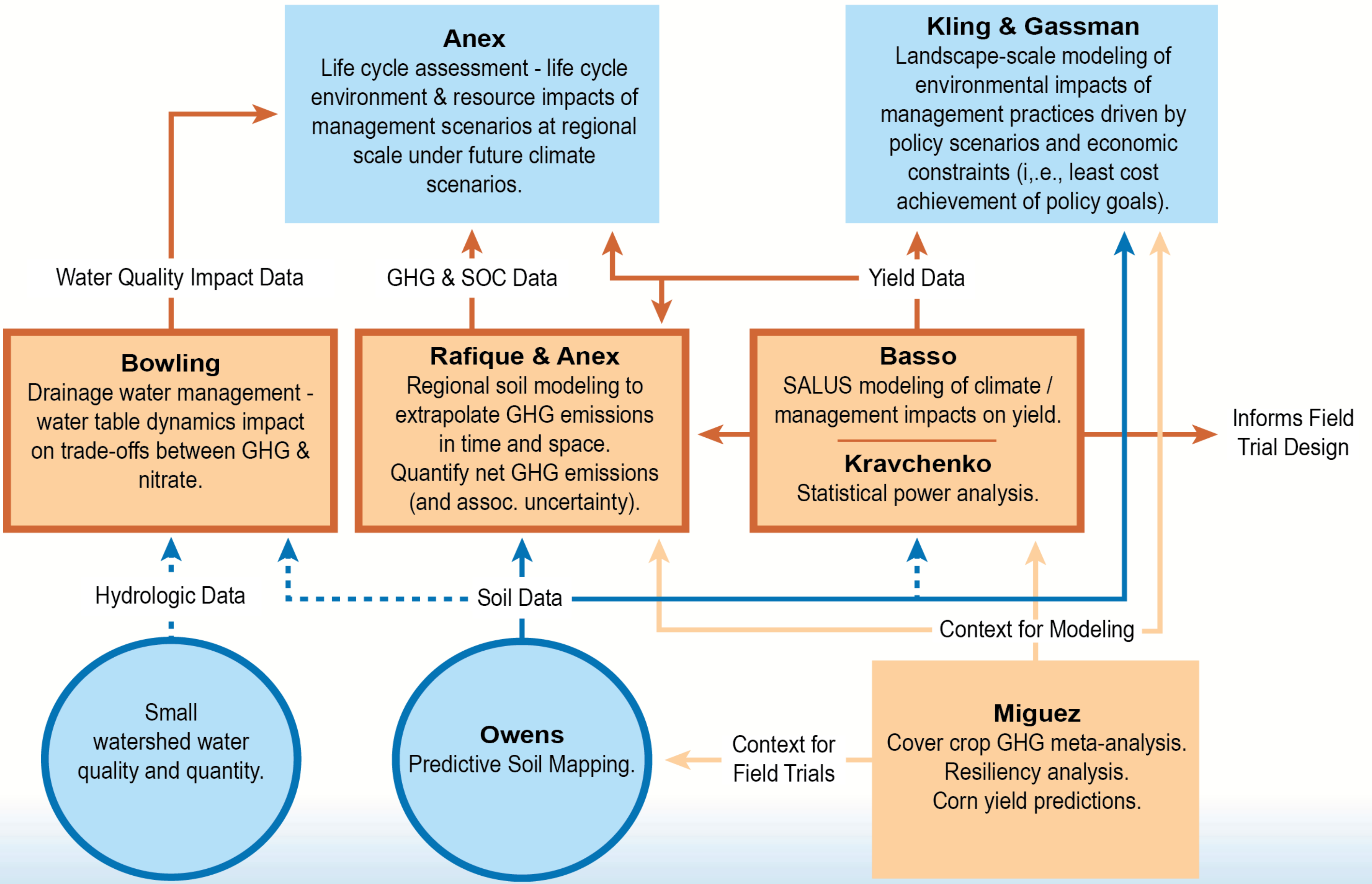
Objective 3



Predictive Soil Modeling: Owens

- **Task 1. Identify presently available soil datasets and maps at various scales.**
- **Task 2. Provide region wide gridded maps, from existing datasets, at 10 and 30 meter resolution for various soil properties (available water, carbon, soil depth, etc.).**
- **Task 3. Develop baseline soil property maps at fields where CAP projects are currently being conducted.**
- **Task 4. Provide improved quantitative estimates of soil properties at a regional scale for model input and projections.**
- **Task 5. Develop methods for upscaling field property measurements to provide soil data for regional scale models.**

Resiliency & Meta-Analysis: Miguez

- **RQ 1. How do cover crops influence greenhouse gas emissions of agroecosystems?**
- **RQ 2. How do cover crops influence the overall global warming potential of an agroecosystem?**
- **RQ 3. What are the biophysical mechanisms underlying gas flux changes in cover crop systems?**
- **RQ 4. What other environmental trade-offs (e.g. reduction in nitrate losses) should be considered in agroecosystems if cover crops increase GHG flux?**
- **RQ 5. Does increased diversity (cover crops, extended rotations) improve agricultural indicators in response to intense precipitation events?**
- **RQ 6. Does increased diversity improve: yield stability, soil erosion losses, soil organic carbon, and pest pressure?**
- **RQ 7. How are these indicators (yield stability, erosion, SOC, pest pressure) related to climate resilience?**

- Our goal is to simulate and predict the impact of climate on yield and the local environmental impacts of corn-based cropping systems in the Midwest USA using the SALUS model. Specifically, we will be examining the consequences of temperature, precipitation, and CO_2 changes on irrigated and rain fed corn-soybean rotations in the Midwest USA along with nutrient losses managed with no tillage and conventional tillage.

Soil Carbon & GHG Modeling: Rafique & Anex

- **RQ 1. What will be the net reduction in GHG fluxes due to the use of cover crop, extended rotation, and drainage water management treatments in corn based cropping system under projected future climates?**
- **RQ 2. What are the potential of cover crop, extended rotation and drainage water management treatments in sequestering more soil C in corn based cropping system under projected future climates?**
- **RQ 3. What is the minimum time required to observe the effects of cover crop, extended rotation and drainage water management on soil carbon changes?**
- **RQ 4. How can the DayCent model be calibrated for the extreme weather conditions and dry/wet periods?**
- **RQ 5. How do the potential of cover crop, extended rotation and drainage water management treatments vary over time and space in reducing GHG fluxes from the corn based cropping system of the Midwest?**
- **RQ 6. Was is the potential of the use of cover crop, extended rotation and drainage water management treatments over time and space in sequestering soil C in the corn-based cropping systems of the Midwest USA?**

Field Scale Hydrologic Modeling: Bowling

- **RQ 1. What is the sensitivity of water conservation and nitrate load reduction due to drainage water management (DWM) under observed and projected climate variability at the Davis Purdue Agricultural Center?**

- **RQ 2. What is the potential for water conservation and nitrate load reduction with DWM under projected climate conditions across the entire CSCAP region?**

- **RQ 3. What are the trade-offs between nitrate load reduction (due to reduced subsurface drainage) and greenhouse gas emissions (due to reducing soil conditions) in the subsurface drained agricultural lands of the US Corn Belt?**

Life Cycle Assessment: Anex

- **RQ 1. What are the life-cycle environmental and resource impacts of the alternative corn management systems under projected future climates?**
- **RQ 2. How should emissions/absorption of GHG that occur at different times be accounted for in assessing life cycle GWP?**
- **RQ 3. How do the net-energy, GWP, and eutrophication potential of corn grain based ethanol and gasoline compare for the corn management systems under consideration?**
- **RQ 4. What are the largest sources of GHG emissions, eutrophication potential, etc. over the full life cycle for the corn production systems under consideration?**
- **RQ 5. What trade-offs are inherent among the studied management systems in impact categories such as GWP and eutrophication potential?**
- **RQ 6. To what life cycle model assumptions are the net-energy, GWP, etc. of the corn production systems most sensitive?**
- **RQ 7. How do life cycle impacts of the corn management systems under study vary with geographic location and time (under projected future climates)?**

- **RQ 1. What is the least cost placement of cover crops and drainage management to achieve nutrient reduction goals in individual watersheds in the UMRB and in the entire watershed?**

- **RQ 2. How quickly does the cost rise as the nutrient reduction goals increase?**

- **RQ 3. What are the GHG effects of the cover crop and drainage management strategies?**

- **RQ 4. How does the optimal placement and cost change when crop prices increase? How do they change if/when there is a substantive market for corn stover?**

Objectives 4 & 5

- **Topic Area: Social-economic and Extension**
- **AS PER PROPOSAL:** *Gain knowledge of farmer beliefs and concerns about climate change, attitudes toward adaptive and mitigative strategies and practices, and decision support needs to inform the development and adoption of tools and practices that support long-term sustainability of crop production. Contribute to feedback loops between social science research, biophysical field research, monitoring, and modeling of agricultural production systems.*

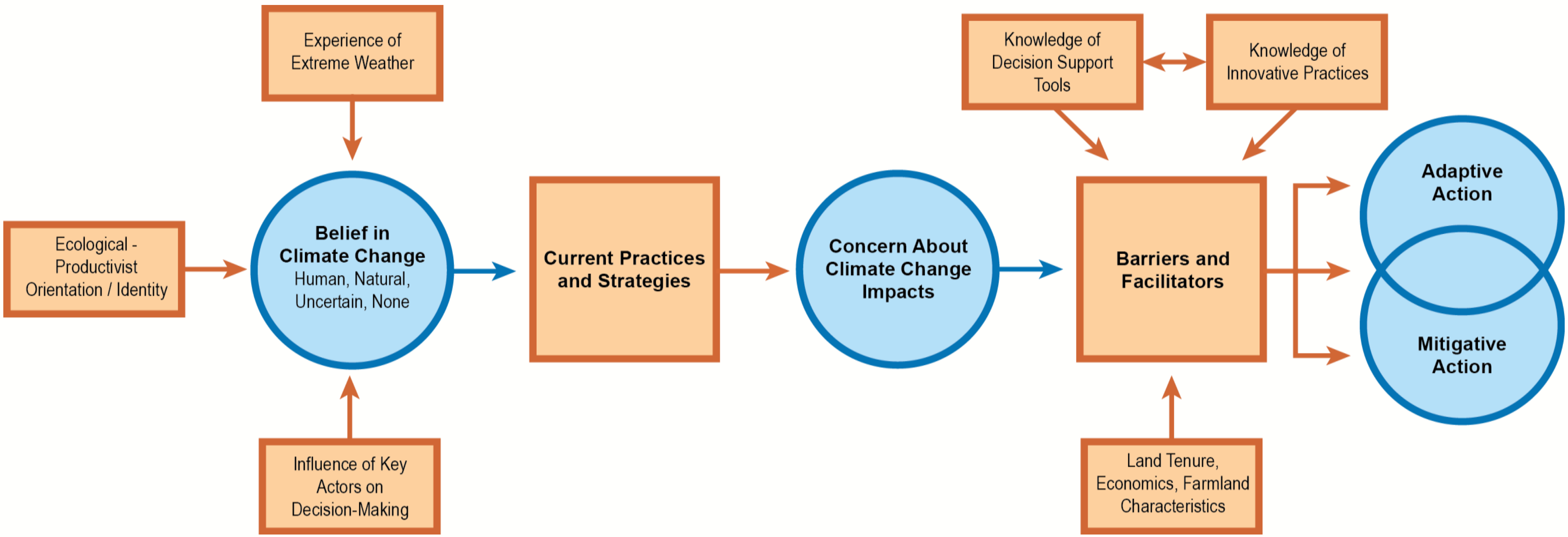
Specific to CSCAP

- **RQ 1. To what degree do farmers perceive climate change as a threat to their livelihoods, and how do those attitudes impact their willingness to adopt or otherwise support *adaptation* strategies and practices?**
- **RQ 2. To what degree do farmers implicate human activities as drivers of climate change, and how do those beliefs impact their willingness to adopt or otherwise support *mitigation* strategies?**
- **RQ 3. What weather-related decision tools do farmers employ, and how is use related to climate change preparedness/adaptive management?**
- **RQ 4. What other human dimensions factors (e.g., institutional, economic, or cultural influences, knowledge of practices/strategies) act as barriers to or facilitators of more resilient corn-based systems?**
- **RQ 5. How do climatological, meteorological, and biophysical factors shape farmer behavior toward climate change and potential adaptive and mitigative actions?**
- **RQ 6. How do farmers accommodate climate change in their decision making processes, and what tools and materials should be developed to help them establish more resilient systems?**
- **RQ 7. To what extent do farmer-led discussion groups in combination with the use of performance-based measures facilitate improvements in soil condition and reductions in soil and nutrient loss to proximate water bodies in corn-based cropping systems?**

Shared with U2U

- **RQ 8. To what extent is there a disconnect between scientific climate change information and subsequent response from farmers in developing agriculture risk management portfolios? What are the sources of these disconnects?**
- **RQ 9. How do scientific groups, such as climatologists, perceive long-term risks and benefits associated with climate change, and how does this differ from "layperson" or farmer groups? How does this contrast with perceptions of change anticipated in the next 2 or 5 years?**
- **RQ 10. What are sources of these differences in perception regarding the issue of climate change between these two groups?**
- **RQ 11. How does a farmer's individual identity influence farm management decisions under variable weather conditions?**
- **RQ 12. How does a farmer's social identity influence farm management decisions under variable weather conditions?**
- **RQ 13: How does a farmer's role identity influence farm management decisions under variable weather conditions?**

Objectives 4 & 5



Objective 6

- **Topic Area: Education**
- **AS PER PROPOSAL:** *Integrate education across all aspects of the CSCAP with focus on place-based education and outreach programs.*

Objective 6

- **RQ 1. Will the target audience of 9-12 high school students increase their content knowledge and understanding using the Grade Band 9-12 Educational "Climate Discovery" Modules developed by the project?**

- **RQ 2. Will teachers increase their content knowledge and awareness of environmental issues by participating in teacher training/classes developed by the project and/or using the Grade Band 9-12 Educational "Climate Discovery" Modules developed by the project?**

- **RQ 3. Will undergraduates/graduate students increase their content knowledge and awareness of environmental issues by participating in short courses developed by the project?**

- **RQ 4. Will undergraduates participating in research internships increase their content knowledge and awareness of environmental issues and awareness of careers in the field?**

- **RQ 5. How successful has the implementation of the overall project been in meeting its targeted goals of educational outreach?**

CSCAP Team – Nov. 2011