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

2011 CSCAP Annual Report

Prepared for USDA, February 29, 2012

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2011 CSCAP Annual Report
Submitted Feb. 29, 2012
CSCAP-0005-2012

Cropping Systems Coordinated Agricultural Project (CSCAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems
USDA-NIFA Award No. 2011-68002-30190
USDA Award Date: March 1, 2011
Project Director: Dr. Lois Wright Morton, Iowa State University

Institutions: Iowa State University; Lincoln University; Michigan State University; The Ohio State University; Purdue University; South Dakota State University; University of Illinois; University of Minnesota; University of Missouri; University of Wisconsin; and USDA ARS – Columbus, Ohio.

Attached you will find the year one (2011-2012) annual report for the Climate and Corn-based Cropping Systems CAP (CSCAP). The CSCAP team has accomplished much and is anticipating year two as together we seek to address the societal challenge of better managing corn-based cropping systems for their carbon, nitrogen and water footprints under changing long-term weather conditions. We are a work-in-progress and encourage you to follow us on our Web site, www.sustainablecorn.org.

If you have questions or comments related to our project, do not hesitate to contact us.

Sincerely,

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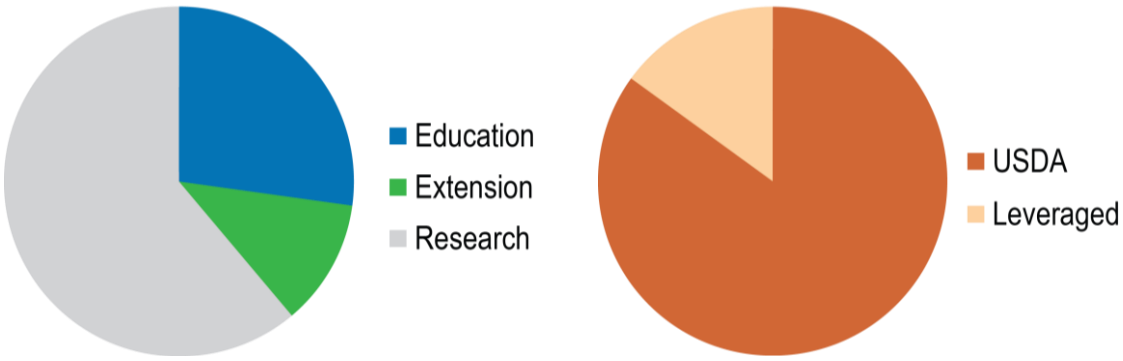
CHANGES IN REPORTING STRUCTURE

The original proposal for the Cropping Systems Coordinated Agricultural Project (CSCAP) team was organized around 5 Objectives with specific tasks and goals per Objective. The team discovered some complexities with this organization in year one, and a slight restructuring allowed more natural combinations to accomplish outcomes and helped the Objective Leaders to provide greater focus and authority over the tasks and goals their team members were working toward. The changes from the original proposal include the following:

- Life Cycle Analysis has been moved from Objective 4 to Objective 3.
- Objective 5 only represents the team's extension efforts now instead of extension and education.
- Objective 6 is new and represents the team's educational efforts.

The team annual report follows this reorganized structure.

YEAR ONE FUNDING SNAPSHOT



Year One Funding by Activity (above left); Year One Funding by Source (above right)

See *Appendix G, page 89* for more information.

Cropping Systems Coordinated Agricultural Project (CSCAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems

USDA-NIFA Award No. 2011-68002-30190

Project Director: Dr. Lois Wright Morton, Iowa State University

YEAR ONE ANNUAL REPORT: 2011

Prepared by CSCAP operations team:
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Iowa State University, Department of Sociology, 317 East Hall, Ames, Iowa 50011.
February 2012.

PROJECT OVERVIEW

Climate scientists widely agree the global climate is changing as evidenced by temperature, precipitation and seasonality shifts. It is unclear though how global and discrete localized changes will impact crop production and many are concerned about the potential detrimental effects to U.S. agriculture. The U.S. Midwest's rich natural resource base makes it one of the most productive agricultural areas in the world. Scientists and policy makers are placing great importance on ensuring the resilience of corn-based cropping systems to meet global market needs and sustain U.S. agricultural production. **This project seeks to investigate the complex carbon, nitrogen and water cycles in managing corn-based cropping systems to increase efficiency and productivity while simultaneously decreasing the environmental footprint under extreme and variable long-term weather conditions.**

The Climate and Corn-based Cropping Systems CAP (CSCAP) was funded by the U.S. Department of Agriculture National Institute of Food and Agriculture (USDA-NIFA) in March 2011. This project currently supports 136 scientists, graduate students, and topic-based specialists across 19 disciplines researching the environmental, economic and social impacts of long-term weather variability on corn-based cropping systems. The goal of the project is to connect field scale production research, evaluative and predictive modeling, and socioeconomic research of farmer beliefs and behaviors regarding climate change to interactive applications that include extension farmer outreach, graduate student training and development, and high school science teacher education.

The project envisions a region-wide coordinated functional network developing science-based knowledge that addresses climate mitigation and adaptation, informs policy development, and guides on-farm, watershed level and public decision making in corn-based cropping systems. Accomplishing this vision requires multiple disciplines to connect and learn from each other in new ways. This transdisciplinary approach enables the project team to link foundational sciences and systems in new ways so as to ask new questions, discover new patterns and create new science.

The CSCAP team is comprised of 10 institutions strategically located across nine upper Midwestern states. The research network includes 26 agricultural test sites and approximately 8,000 farmers providing real-world data for systems analysis and modeling. These data will in turn be used by 20 dedicated extension educators to provide learning opportunities for watershed-level farmer groups and by the education team in developing modules for high school science teachers.

The CSCAP has six 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.

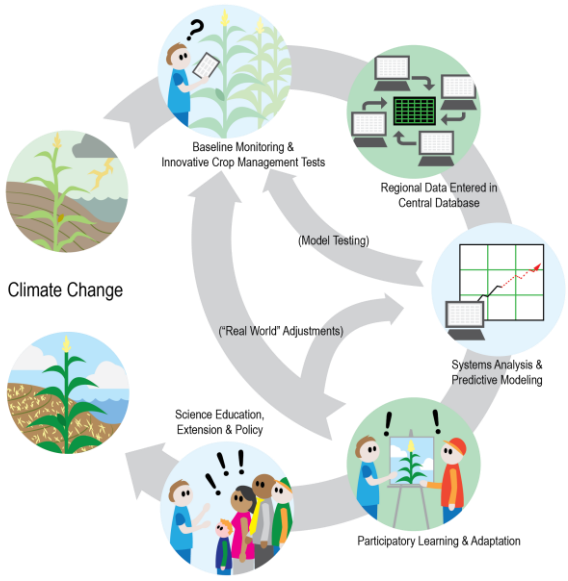

Fig 1 – Climate Change, Mitigation and Adaptation in Corn-based Cropping Systems Project Flowchart. This flow chart conceptualizes the multi-directional connections among project objectives.

(Above) The CSCAP team at the annual conference in Chicago, November 2011.

DEVELOPMENTAL PROGRESS

Executive Summary

In year one, the CSCAP established a personnel and organizational structure necessary to carry out the everyday operations for a large team, equip team members with needed information and resources, and bring about greater efficiency and use of members' time. The efforts by the Operation Team in developing communication tools, conducting team meetings and establishing project standards has built team confidence and allowed for transdisciplinary work to begin. Scientists are beginning to move beyond their individual disciplines to learn from one other and create new knowledge. The CSCAP has laid the foundation for scientists of many disciplines to build trust and negotiate how data will be collected, analyzed and reported in this project.

(Clockwise from top left) Joe Lauer discusses research trials with Rob Anex, Lori Abendroth, Thierno Diallo and Rashid Rafique at the University of Wisconsin's Arlington Agricultural Research Station; Project director Lois Wright Morton presents at the CSCAP 2011 annual conference in Chicago; Javed Iqbal and Felix Heitkamp discuss findings at the annual conference poster session; Conference attendees meet in small groups during the conference

Team Outcomes/Impacts – Year One

In the project's first year, the CSCAP established a large, transdisciplinary team. The 136-person team includes 50 principal investigators (PIs), 35 graduate students, 20 extension educators, 25 research specialists, 1 education specialist and 5 operations staff (including project management, accounting and communications). See *Appendix A, page 55* for team personnel listing. An external advisory board was established to ensure stakeholder involvement and integration of high-level expertise into the project. This 19-member board provides counsel and recommendations and acts as a network to engage important stakeholder groups. See *Appendix B, page 67* for advisory board member listing.

A transdisciplinary project integrates the knowledge of many specializations to make a quantum leap beyond disciplinary sciences to create new collaborative knowledge, leading to new understanding of difficult and complex problems.

In order to meet the CSCAP's goals and timelines, an early priority was the development of a comprehensive, simple and effective communication and organizational framework for the team. Thirteen topically-based e-mail distribution lists were created to allow for targeted, direct communication with project personnel. Monthly team and leadership conference calls with detailed agendas engage researchers and provide opportunities for building and strengthening transdisciplinary exchanges. Following each meeting, team members receive concise communication summarizing the discussion and follow-up action items. In addition to established monthly meetings, team leaders in year one convened their respective teams for more than 65 separate meetings via phone, video or in-person to accomplish objective-specific issues.

For Web-based internal project communication, the CSCAP team elected to utilize a password-protected Google site. This approach supports effective inter-team management and communication by centralizing all project information and resources to one accessible location for CSCAP team members. The internal site also acts as the interface to access the project's central database which houses data from all research locations. The internal site hosts all team and objective-specific documents, allowing members to easily log-in, upload, review and revise documents without having to search through personal files or e-mails. Using the site as a centralized repository ensures all team members are accessing the same file versions and information. Site usage statistics for the past five months show high use among CSCAP team members with 7,127 page views and 1,402 site visits.

Because the CSCAP is a large, transdisciplinary project, an early priority was establishing and agreeing upon guidelines for how research data and findings are published and shared. A publication committee was initiated to propose guidelines and a mechanism for sharing, documenting and publishing team products. Publication guidelines were created for 10 types of team products including research and extension publications, presentations and educational programs (See *Appendix C, page 68*). Over the course of the first year, these guidelines were vigorously debated among members.

At the November 2011 face-to-face meeting, the guidelines received consensus by all members.

The team evaluator in conjunction with the project director developed a project baseline assessment survey (see *Appendix E, page 75*) with 16 categorical questions, each with up to 11 sub categorical questions, to collect members' prior multi- and transdisciplinary connections, beliefs and attitudes about climate change and agriculture, and expectations and perceptions about the work of the team. Throughout October and November 2011, 121 team personnel completed the online survey (86 percent response rate). This survey will be administered again in project years three and five to document change over time in members' beliefs and activities in support of transdisciplinary work. An overall team evaluation plan (see *Appendix D, page 74*) was developed by the evaluator and project director with input from the project leadership team.

In the first year, researchers reconstructed the project's milestones with added structure, detail and clearly defined benchmarks. These milestones provide a project roadmap and mechanism for all team members to evaluate individual objectives and whole team progress toward and accomplishment of goals. Lastly, a comprehensive research directive was begun by the team so as to articulate foundational disciplinary and multidisciplinary research questions and hypotheses the project will address. This is a living document that the team will expand and refine as the research progresses.

Team Outputs – Year One

Two in-person CSCAP meetings occurred in year one. In early spring 2011, nearly all PIs attended the first meeting to begin the work of the project. Of greatest urgency was developing standardized protocols for gathering field data before the fast-approaching growing season, laying the groundwork for developing the farmer survey instrument for the social and economic research, and obtaining support from Extension Directors in participating states to build the network of extension educators. In November, a full-team meeting provided 75 CSCAP personnel, 10 advisory board members and eight invited guests opportunities to evaluate accomplishments toward year one milestones, discuss adjustments needed for year two, and strengthen relationships among the project team.

Project management personnel visited nine of 10 participating institutions to ensure consistency in field research, meet personnel and address project concerns or questions. Personnel spent an estimated month of time traveling to the various sites in total; this effort significantly strengthened the collaborative relationships which allowed for quicker team building and trust.

The project developed a signature look and identity. Promotional and resource materials, including a one page description and two postcards (see *Appendix H, page 90*) for use at meetings and field days, were created to raise public awareness and understanding of the project. An external public Web site (www.sustainablecorn.org)

was created at the start of the project and is currently in version "2.0" with more changes planned for the second year. The site features: team personnel; project descriptions, goals and progress; graduate student posters from the annual conference; project-related videos and other relevant resources. Site usage statistics from Oct. 18, 2011 (when data were first tracked) to Jan. 31, 2012 show 620 unique visitors viewing 3,947 pages over 1,349 visits to the external Web site.

Team Milestones and Deliverables
See specific objectives.

Broad Impacts
The CSCAP team actively engaged three of the USDA newly funded climate projects associated with corn cropping systems to find synergies and complementary goals and activities. These were the 1) Purdue University-led project, "Useful to Useable" (U2U) which aims to improve the resiliency and profitability of farms in the North Central Region amid variable climates through the development and dissemination of decision support tools, resource materials and training; 2) University of Nebraska-led extension project which will help extension specialists provide science-based climate information and resources, including on-demand web resources and decision-making tools, to animal agricultural producers and 3) Cornell University-led project which will provide an analysis of the current and long-term costs and benefits of various greenhouse gas policy incentives for corn producers and policymakers.

Lois Wright Morton and Ray Arritt have been invited to co-author sections in the US 2013 National Climate Assessment report under preparation nationally. Wright Morton is a co-author of the Agriculture chapter (Agriculture is a Socio-Ecological System, Adaptation Strategies, and Foundation for Climate Ready Agriculture) and the Rural Communities chapter. Arritt is a co-author of the Climate chapter. Also as a result of the CSCAP project, Dr. Wright Morton is chair of the Climate Task Force Communications subcommittee for the 25x25 Alliance, a national voluntary association of agricultural organizations with a goal of providing 25 percent of U.S. energy needs from agriculture and forestry by 2025.

See each objective for specific broad impacts associated with team work.

Training
See each objective for specific details.

Collaborations and "Integrated" Knowledge Developed
In year one, the project built collaborative partnerships with many groups and climate-related projects across the country. The CSCAP Project Manager and Project Director regularly talk with two USDA CAP climate projects (pine and wheat) as well as three corn-related USDA standard grant climate projects to coordinate and seek ways to learn from each other and integrate across agendas. Significant accomplishments due to these

relationships include an expanded capacity to more than double the number of farmers and HUC6 regions surveyed, sharing of assessment instruments used by CAP team evaluators, and exchanges of knowledge of Web-based tools for organization. External interest in the CSCAP standard field data collection protocols is high; and a number of organizations and groups are seeking ways to collaborate with various components of the project team. Leading agribusiness and stakeholder groups have signed on as advisory board representatives. Seven letters of support have been written at the request of groups of scientists submitting USDA and SARE directed proposals. External groups representing specific clientele bases impacted by project findings have been in conversation with CSCAP, including the 25x25 Alliance, the National Defense Fund and the National Fertilizer Institute.

Due to the importance of expanding the influence of the project, CSCAP sought and continues to seek additional resources to expand on cooperative research opportunities that would help accomplish the full vision of the project. With the initial USDA award, the project was able to leverage additional funds and improve funding for existing research goals, thereby strengthening important areas that were inadequately funded (i.e., IPM). To supplement the team's pest management effort, a proposal for $263,000 was submitted to and awarded by the United Soybean Board. This award increased the project expertise and capacity to address disease, insects and pests by adding 13 principal investigators, three graduate students and one research staff to the team. This funding widens the scope of CSCAP's original proposal and offers more data from the project experimental field sites for project analyses. Scientists included have expertise in plant pathology, entomology and weed science and represent eight of the 10 CSCAP institutions.

A CSCAP partnership with the "Useful to Usable (U2U)" standard USDA climate project based at Purdue University allowed resources to be pooled and an expansion of each team's farmer survey. The CSCAP-U2U partnership acquired an additional $51,400 from Iowa Agriculture and Home Economics Experiment Station, Purdue Agriculture, and the Natural Resources Conservation Service (NRCS) in Iowa which enabled the survey to expand beyond the initial goal of 8,000 farmers in four states, to a stratified random sample survey of nearly 20,000 farmers across 22 HUC6 watersheds in 10 upper Midwest states.

CSCAP has also laid the groundwork for future partnerships with the other climate CAPs. Specifically, with the "Regional Approaches to Climate Change in Pacific Northwest Agriculture" CAP project (Wheat CAP). After meeting with the Wheat CAP project director, both projects agreed to consult on social science research and extension activities to seek opportunities in adding value to both projects.

Team Plan-of-Work for Year Two

The overall goal of the project for year two is to strengthen the transdisciplinary focus and increase opportunities for collaborative work as researchers work toward meeting

year two project objectives and milestones. The CSCAP team will hold a year two annual meeting in Wooster, Ohio in August 2012. The meeting, themed "Strengthening Transdisciplinary Research," will include discussions about how all team members can better integrate their work and expertise, opportunities for graduate students to present their hypotheses and findings, a tour of the project field experiments at OARDC – Wooster, a participating farmer panel and time for objective-based workgroup meetings.

The project team will engage the advisory board at an interim meeting in March and the annual meeting in August 2012. This dialogue draws upon board members' expertise and provides the CSCAP with valuable feedback from important stakeholders.

The public external Web site will continue to be developed and will begin to reflect the research, extension and education programming being generated by the project.

The project will continue to foster partnerships with external groups and organizations to extend the vision of the CSCAP.

REPORT FOR OBJECTIVES 1 & 2
Standardized Methodologies & Network of Experimental Trials

Executive Summary

Investigators: Lal (lead), Helmers (lead), Kladivko (lead), Lauer (lead), Scharf (lead), Arritt, Bowling, Castellano, Cruse, Dick, Fausey, Frankenberger, Herzmann, Kravchenko, Nafziger, Nkongolo, Owens, Sawyer, Strock, Villamil

Integrated Pest Management (IPM) Investigators: Mueller (lead), Bradley, Chilvers, Davis, Eastburn, Esker, Gardiner, Gassmann, Leandro, Malvick, Michel, O'Neal, Robertson, Tylka, Wise, Yang

See *Appendix A, pages 55-66,* for Objective 1 and 2 PI contact information.

Objective 1: Develop standardized methodologies and perform baseline monitoring of carbon, nitrogen, and water footprints at agricultural test sites across the Midwest.
Objective 2: Evaluate how crop management practices impact carbon, nitrogen and water footprints at test sites.

Objectives 1 and 2 address the overall project's goal of acquiring an expanse of field research data centered around current and novel management practices. These practices have the potential to increase the resiliency of corn-based cropping systems to a changing climate while also mitigating the carbon (C), nitrogen (N) and water footprints.

The creation of standardized protocols for measuring C, N, water and other variables is a crucial first step in establishing sound, reputable science and generating a dataset that is highly functional and usable among many scientists. Protocols carried out identically among CSCAP research sites allows for seamless data entry into the CSCAP central database and provides a consistent set of data for systems analysis and predictive modeling (see Objective 3 section for more detail on systems analysis and predictive modeling). Data collection, entry, analysis and modeling are time-intensive activities necessitating the methods used to collect the data are uniform across field and lab personnel. This gives data users greater confidence when accessing and using the data. In analysis and modeling, a certain number of assumptions need to be made concerning agricultural cropping systems due to the massive number of variables possible. A set of standard protocols allows for real-time, tested data to drive the models with fewer necessary assumptions.

CSCAP researchers established and implemented standardized methodologies for measuring soil organic carbon (SOC), total nitrogen, soil physical properties, water quality and volume, greenhouse gas (nitrous oxide [N_2O], carbon dioxide [CO_2], and methane [CH_4]), crop biomass, C and N in biomass and grain, insect and disease pressure, and grain yield. These protocols provide the structure in collecting baseline site data and seasonal measurements for every research site over the next five years.

An expansive field research network was established in all project states, except South Dakota, and includes 26 field sites. Specific sites vary on exact treatments employed due to varying site capacities. Every site includes a corn-soybean rotation or continuous corn plot acting as a comparative baseline. Treatments employed across the research network include extended crop rotations (wheat), cover crops integrated into corn-soybean systems, tillage management, drainage water management, nitrogen management, and landscape. Within the network, a minimum of two research sites exist with the same treatment combinations. Following data collection of all outlined variables needed per site, scientists organize their data into a consistent structure and submit to the team's central database.

To aid the assessment of C and N footprints associated with corn-based cropping systems, researchers are measuring greenhouse gas (GHG) emissions in 18 of 26 research sites. Agricultural GHG emissions come from several sources with the largest due to soil management and fertility operations. Measuring GHG emissions in agricultural systems can be complex due to a range of variables, including cropping systems, soil variables (type and drainage), landscape characteristics and local climate.

Equipment necessary for collecting the required data was purchased, installed and used including photoacoustic spectrometers (PAS), soil moisture meters, weather stations and various tools needed to collect soil and agronomic data. Formal equipment training has occurred through project-wide events held in-person at the November annual meeting and through live, Web-based video. Discussions via phone and e-mail between colleagues have also addressed questions on protocol methodologies and procedures. Graduate students at each institution received individual training by PIs or research specialists from their institution.

To supplement the team's pest management effort, a proposal for $263,000 was submitted to and awarded by the United Soybean Board. This award allowed the addition of 13 principal investigators, three graduate students and one research staff to the team. This funding widens the scope of CSCAP's original proposal and offers more data for project analyses. Scientists included have expertise in plant pathology, entomology, and weed science and represent eight of the ten CSCAP institutions.

(Clockwise from top left) Drainage water management equipment at Iowa State University's Gilmore City field sites; The University of Wisconsin's Arlington Agricultural Research Station; Purdue University's Phillip Owens collects soil cores; Javed Iqbal tests PAS equipment in the field

Team Outcomes/Impacts – Year One

In the first year, CSCAP PIs established standardized methodologies for measuring soil organic carbon (SOC), total nitrogen, soil physical properties, water quality and volume, greenhouse gas (GHG), crop biomass, C and N in biomass and grain, insect and disease pressure, and grain yield. Team PIs worked collectively to communicate and evaluate different potential methodologies, debate each methodology's advantages and disadvantages, make adaptations, and reach a consensus. Researchers also documented the procedures behind the collection of each data variable including the frequency of measurement and proper units, and communicated these to all team members conducting field research. Development of standardized protocols was time sensitive and intense, with much of the work occurring within the first three months of the award date so as to implement in the 2011 growing season. Following the growing season, these protocols were re-evaluated and codified in November 2011 to assure consistent, uniform data were

being collected. During the project first year, Objective 1 and 2 team members invested considerable time and energy to successfully accomplish this milestone.

A comprehensive research network was established by utilizing existing experimental designs as well as developing new research sites. PIs reviewed many existing research sites that were brought forward as potential, useable sites and selected those that aligned with the specific goals of the CSCAP. New sites were established to complement these existing sites and provide a comprehensive set of treatments and data for the CSCAP network. This combination of previously established and newly developed research sites is configured with unified equipment and methodologies and in some cases allows data prior to 2011 to be incorporated into the project.

Greenhouse gas emissions have traditionally been measured utilizing gas chromatograph (GC) technology which required field sampling and laboratory analysis. This method of collection requires substantial logistical and technical resources that can limit its use across a project of this scope. Infrared photoacoustic spectroscopy (PAS) techniques collect flux measurements in the field with limited technical resources. This technology enables researchers without chromatography expertise to collect GHG data quickly and easily while in the field. The CSCAP project uses both methods to maximize GHG monitoring among a large group of researchers with diverse expertise. Project participants began using new technologies in year one, including six project-funded photoacoustic spectrometers (PAS).

Working with researchers from the USDA GraceNet greenhouse gas monitoring network, CSCAP researchers tested the suitability of PAS for measurement of N_2O and CO_2 fluxes from the soil surface by comparing measurements of N_2O and CO_2 flux and concentration between GC and PAS. Initial results indicate GC and PAS measure National Institute of Standards and Technology (NIST)-certified gas standard concentrations with similar accuracy and precision. Moreover, PAS and GC measurements of N_2O and CO_2 concentrations and fluxes are comparable and typically within five percent of each other.

Due to the project's transdisciplinary approach, the team has refined and incorporated greater detail and depth to the research questions and has included expected hypotheses that can be tested. All field research being conducted is captured in these research questions with detail regarding different scales (one state response as well as collective CSCAP research network) and is intimately connected to the overall project goals in addressing N, C and water footprints under a changing climate.

Team Outputs – Year One

Standardized research protocols were created as a result of numerous meetings over the phone and in person, as well as the review of various drafts by PIs. Standardized protocols dictating methodology, procedures and data collection of soil, agronomic, GHG and pests across all differing soils, environments and historical procedures employed is a

significant accomplishment for the team. At the end of year one, each protocol was individually re-evaluated, revised and finalized with minor changes for years two through five.

Table 1. The CSCAP research network includes 26 individual research sites. Each site has a unique site code for recognition in the central database. The lead PI per site is noted although several sites have a group of PIs working in a collaborative nature and across institutions in some instances.

No.	Lead PI	Institution	Site Code	Nearest City	County	State
1	Nafziger/ Villamil	U. of Illinois	NWREC	Monmouth	Warren	IL
2	Nafziger/ Villamil	U. of Illinois	ORR	Perry	Pike	IL
3	Kladivko	Purdue U.	SEPAC	Butlerville	Jennings	IN
4	Kladivko	Purdue U.	DPAC	Farmland	Randolph	IN
5	Sawyer	Iowa State U.	ISUAG	Boone	Boone	IA
6	Helmers	Iowa State U.	GILMORE	Gilmore City	Pocahontas	IA
7	Helmers	Iowa State U.	SERF	Crawfordsville	Washington	IA
8	Kravchenko	Michigan State U.	MASON	East Lansing	Ingham	MI
9	Kravchenko	Michigan State U.	KELLOGG	Hickory Corners	Barry	MI
10	Strock	U. of Minnesota	SWROC.B	Tracy	Redwood	MN
11	Strock	U. of Minnesota	SWROC.G	Tracy	Redwood	MN
12	Strock	U. of Minnesota	SWROC.P	Tracy	Redwood	MN
13	Scharf	U. of Missouri	BRADFORD.A	Columbia	Boone	MO
14	Scharf	U. of Missouri	BRADFORD.B1	Columbia	Boone	MO
15	Scharf	U. of Missouri	BRADFORD.B2	Columba	Boone	MO
16	Scharf	U. of Missouri	BRADFORD.C	Columbia	Boone	MO
17	Nkongolo	Lincoln U.	FREEMAN	Jefferson City	Callaway	MO
18	Fausey	USDA-ARS, OH	STJOHNS	St. Johns	Auglaize	OH
19	Fausey	USDA-ARS, OH	NEAW	Coshocton	Coshocton	OH
20	Lal	The Ohio State U.	WATERMAN	Columbus	Franklin	OH
21	Dick	The Ohio State U.	WOOSTER.LTR	Wooster	Wayne	OH
22	Dick	The Ohio State U.	WOOSTER.CC	Wooster	Wayne	OH
23	Dick	The Ohio State U.	HOYTVILLE.LTR	Custar	Wood	OH
24	Lauer	U. of Wisconsin	ARLINGTON	Arlington	Columbia	WI
25	Lauer	U. of Wisconsin	LANCASTER	Lancaster	Grant	WI
26	Lauer	U. of Wisconsin	MARSHFIELD	Marshfield	Marathon	WI

Data were collected across the research network encompassing 80 variables on a site-specific basis spanning agronomic, soil quality and health, greenhouse gas (GHG), integrated pest management (IPM), water quality and volume, and climatic data; see Table 2. In 2011, GHG emissions were not measured in all 18 of 26 sites due to the setup and establishment of certain treatments which did not allow measurements to begin until year two.

Table 2. The CSCAP research network (n=26 sites) is collecting numerous measurements across several types of treatments. Each site within the network has unique space, equipment, and personnel capacities and as such, contains only a subset of the seven potential treatments (corn-soybean, extended rotations, etc.) and varies on the measurements taken based on whether they are identified as priority or optional. The values within the Table represent the estimated total number of plots within the research network that are measuring each data type (agronomic, soil quality & health, etc.) per treatment. For example, the sites with extended rotations will report 720 plot values for grain yield encompassing yields for wheat, corn, and soybean. This table captures the strength of the CSCAP network as it demonstrates the team's collective nature and the high number of measurements occurring every year.

		Corn-Soybean	Extended Rotations	Cover Crops	Tillage Mngt	Drainage Water Mngt	Nitrogen Mngt	Landscape
Agronomic	Plant Population	257	192	122	100	45	72	42
	Plant Biomass	338	168	234	160	50	136	72
	Plant Biomass C & N	298	168	234	160	50	136	72
	Grain yield & moisture	600	720	284	216	90	144	84
	Grain total C & N	590	480	284	216	90	128	84
	Canopy N-sensing	36	0	40	32	12	48	0
	Stalk nitrate	68	0	37	34	18	16	15
Soil Quality & Health	Bulk Density	135	121	73	58	19	40	21
	Water Retention	115	121	57	42	19	8	15
	Soil Moisture	190	122	109	78	50	48	33
	Soil Texture	139	121	73	58	31	48	21
	Penetration Resistance	28	0	4	18	6	0	0
	Soil pH & CEC	278	242	146	116	62	96	42
	Soil Organic C & Total N	278	242	146	116	62	96	42
	Soil Nitrate	119	121	57	42	31	16	15
	Aggregate Stability	48	0	24	26	6	8	12
	Infiltration Rate	48	0	16	26	6	8	0
	Organic matter (fractionation & particulate)	88	0	40	52	12	16	24

GHG	Greenhouse Gas (CO_2, CH_4, N_2O)	117	97	60	46	31	16	12
Pest Pressure	Foliar Disease	119	261	56	28	0	0	0
	Soil plant pathogens	49	87	28	14	0	0	0
	Weed seedbank	49	87	28	14	0	0	0
	Soil insect population	109	97	61	38	31	40	21
	Above-ground insect population	49	87	28	14	0	0	0
Water Quality & Volume	Tile drainage volume	31	0	0	6	31	8	0
	Water quality	31	0	5	8	31	8	3
	Water runoff rate	0	0	5	2	0	0	3
	Time to runoff	0	0	5	2	0	0	3

Researchers installed or updated weather stations to provide site-specific and complementary data to nearby stations managed by the National Climate Data Center's Daily Climate Cooperative. Collectively, weather data available for team use includes precipitation, air temperature, relative humidity, solar radiation, and wind speed and direction.

Principal investigators hired and trained new employees including graduate students and research specialists to support CSCAP activities. Researchers participated in monthly team meetings and as-needed objective-based meetings to connect with other project participants and coordinate efforts among all aspects of the project.

Team Milestones and Deliverables

All milestones were met for the Objective 1 and 2 team in year one. Key milestones include the development of standardized protocols for use across all research sites for collecting measurements for greenhouse gas, crop biomass, C and N in biomass and grain, disease and insect ratings, water drainage measurements, and grain yield. Identification of nearby national weather stations occurred as well as formatting of weather and metadata.

The team established, expanded and implemented a larger functional network of research sites than expected at the project onset. A questionnaire was sent out to all researchers to provide a uniform set of metadata per research site. This information, along with details provided by the protocols regarding treatments and data collected, provided the initial entries and structure to the spreadsheets and central database. All research sites collected their specific data variables successfully this first year and are still processing many of the soil and water samples in the laboratory. See *Appendix F, pages 84 and 85,* for a full list of project milestones for year one.

Broad Impacts
With CSCAP research sites located across the Midwest, the project's standardized methodologies are yielding reliable, accurate and comparable data from areas with different soils, rainfall patterns, temperature regimes, solar radiation, length of growing season and overall yield potential. The comprehensive dataset will allow researchers to apply cross-region comparisons and analyses.

The standardized protocols developed by CSCAP in year one will be significant for future field research. The scientific community has already shown considerable interest in the protocols and inquired when they will be publically available.

The development of these standardized protocols required a substantial time investment for negotiation among PIs to work through various possible methodologies and arrive at approaches everyone felt confident and comfortable with in regards to scientific accuracy and rigor.

As previously mentioned, the project has acquired additional funding to support its directives in year one. CSCAP has and will continue to seek additional funds and resources to accomplish the full vision of the project. Due to fiscal year 2012 USDA budget directives, one CSCAP partner site, the USDA-ARS North Appalachian Experimental Watershed Lab in Coshocton, OH, was closed late in 2011. The CSCAP has partnered with The Ohio State University and the USDA-ARS Soil Drainage Research Unit at Columbus, OH to allow the planned research to continue.

Training
See *Appendix A, pages 55-66,* for a complete listing of graduate students with responsibilities in Objective 1 and 2 teams. Twenty-two graduate students have duties that partially or fully fall within Objective 1 and 2 efforts. Of these 22 graduate students, three are supported through the additional funding supplied by the United Soybean Board. Twenty-two research specialists support the work of these objectives.

Collaborations and "Integrated" Knowledge Developed
Supplemental funding from the United Soybean Board allowed for additional principal investigators, graduate students and research specialists to join the project and expand research relative to integrated pest management. This support addresses the gap which existed and offers greater detail regarding the system response to the treatments.

Team Plan-of-Work for Year Two
The team will publish the standardized protocols and post to the external Web site after acceptance. CSCAP scientists will communicate and promote these protocols to others outside the project to build consensus among other researchers in using these as the new standards for measuring carbon, nitrogen and water in corn-based cropping systems.

Researchers will continue to collect soil, agronomic, water, GHG and IPM data from the established field sites. Select research sites were initiated in 2011 and not able to collect the complete set of measurements; in 2012, all sites will collect stated measurements. The PAS equipment was not available for all sites in 2011 due to timing and need to conduct rigorous measurements as described previously. Researchers received live, video-based PAS equipment training in February 2012.

Primary research data from 2011 will be completely uploaded, cleaned and managed through the central database. Feedback regarding the database functionality will further refine the database for year two data upload.

Researchers will continue to refine research questions and hypotheses and begin to link foundational disciplinary research questions (i.e., SOC, GHG, IPM, social-economic) to other team research questions via formal and informal communications. For the Objective 1 and 2 teams, this connection is particularly important to successfully connect with the systems analysis and predictive modeling team (Objective 3).

The 2012 CSCAP annual conference in Ohio will include a field day at the Wooster research sites. Presentations by PIs and graduate students will highlight work conducted on location as well as others through plot demonstrations, equipment demonstrations, and poster board presentations.

The project will begin to extend the progress and findings of Objectives 1 and 2 through the external Web site with descriptive images, videos and publications.

REPORT FOR OBJECTIVE 3
Systems Analysis & Predictive Modeling

Executive Summary

Investigators: Anex (lead), Arritt (lead), Abendroth, Basso, Bowling, Castellano, Gassman, Herzmann, Kling, Miguez, O'Neal, Owens

See *Appendix A, pages 55-66,* for Objective 3 PI contact information.

Objective 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.

Objective 3 addresses the overall project's goal of utilizing the field research data in a suite of local, regional, and national scale models that examine current and predicted implications of the project management practices on C, N and water under different climate conditions. These findings will build knowledge and assist in evaluating cropping system management practices based on adaptation and mitigation capacities.

Objective 3 PIs are charged with the task of combining data gathered from field research with public climate data and applying physical, climate, social and economic models to address current and predicted changes in climate. Objective 3 involves the development of an analysis infrastructure and the use of that infrastructure to provide insight into and evaluate the impacts and outcomes that will likely affect the sustainability and economic vitality of corn-based cropping systems. The analysis infrastructure includes a database system to manage experimental data and a variety of physical and economic models capable of analyzing impacts at multiple scales.

Climate scientists agree that global changes are present now and will continue, but there is great uncertainty regarding the impact these global changes have on local and regional cropping systems. Scientists also agree that there is no single best climate model either for the globe or for a region (such as the Midwest), so that it is necessary to consider a suite of climate scenarios to represent the expected range of plausible future climates.

To assess the sustainability and economic vitality of Midwestern corn-based cropping systems, researchers are analyzing the ability of current and novel practices to meet environmental and economic goals under future climate scenarios. Analysis using predictive models can extrapolate experimental data both in time and space in order to quantify the performance of different cropping systems and management practices in meeting multiple objectives and to help understand the trade-offs among objectives both today and under future climate scenarios.

In the first year, Objective 3 members made significant progress: collaborating with Objective 1 and 2 researchers regarding experimental designs implemented to ensure

modeling needs were met, creating the framework for the CSCAP team database, implementing Phase I of the database, identifying sources for climate model projections, developing a framework for collaboration across research units, categorizing the capacity of specific models used, identifying and assembling public data sets for C, N and water, and beginning preliminary analysis and modeling using pre-existing site data.

A large undertaking for the first year was the creation of the CSCAP database. A committee of CSCAP researchers across Objectives 1, 2 and 3 worked to develop a framework, build a central database to store, manage, and provide data that already have an existing construct of metadata, climatic, carbon, nitrogen, water and other variables needed for model input. The database structure brings about a consistent format for all primary, secondary and climatic data.

Researchers began collecting, enhancing and combining process models, historical data and climate projections with data from field trials 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.

In addition to process models, life cycle assessment (LCA) data are being collected for the full range of agricultural processes and inputs. These data represent all of the "upstream" impacts associated with the manufacture of materials such as fuel, pesticides and fertilizers.

Team Outcomes/Impact – Year One

Creating a transdisciplinary team begins within and among similar disciplines and then extends outward. The Objective 3 team began this process by first determining the goals of individual research units and the strengths of their respective models in addressing the impacts of corn production in multiple dimensions, but with particular emphasis on economics and the C, N and water cycles. Figure 2 provides the integrated analysis framework with connectivity among units reflecting information flow among modeling teams.

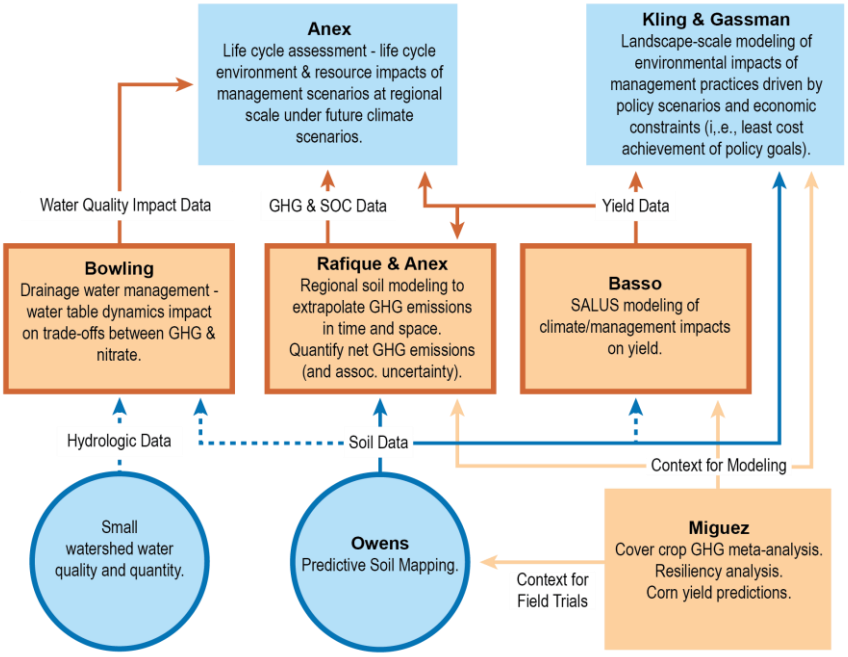

Fig 2. CSCAP Integrated Systems Analysis Framework and Connectivity. This flow chart conceptualizes data connections among systems analysis researchers.

Three relational spreadsheets were developed to encompass the complexity of the field research network using unique site identifiers and coding systems. These spreadsheets serve as the foundational framework for the central database design and development. The spreadsheets include site metadata, 55 treatments within five main categories, and 80 types of collected data within six main categories. Although consistent, standardized protocols were developed by the Objective 1 team, slight variations exist in the specific treatments or data collected due to differing capacities across the 26 research sites. The organizational framework of the database forces uniformity and mechanization in data entry while simultaneously allowing for flexibility inherent across the research network.

The management of metadata as well as primary, secondary and climate data from our multi-institution and transdisciplinary research team is a critical component of ensuring success in meeting project goals. The ubiquitous presence of the Internet helps bridge the distance between geographically dispersed researchers and research sites by providing a platform to build collaborative tools for team access. Google has provided leadership in Internet-based collaboration, and this project is taking advantage of freely offered tools including Google Docs (collaboratively edited spreadsheets and work documents), Google Sites (internal wikis), and e-mail forums.

The management of project research data consists of a hybrid use of Google collaboration tools along with traditional relational database software such as PostgreSQL. See Figure 3 for the CSCAP central database design and capabilities. Through the use of web service interfaces, these data repositories are automatically synced limiting issues with data versioning and allowing data providers and data users to manipulate data through customized interfaces. Most project data is redundantly stored within the Google Cloud and at the project relational database at Iowa State University. A built-in feature to the Google Cloud is data versioning, which allows oversight of what data is changing when and by whom allowing data changes to be rolled back if necessary. A database committee evaluated beta versions of Web-based forms prior to whole team release to ensure compatibility and ease of entry for all team members.

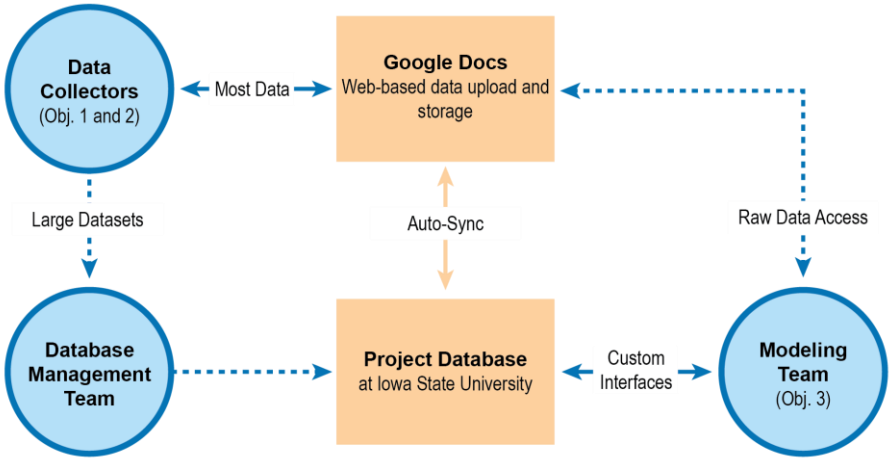

Fig 3. CSCAP Database Design and Capabilities. This flow chart conceptualizes how CSCAP researchers access and store shared data.

The team has evaluated climate sources of climate model data and has elected to use climate model results from the Coupled Model Intercomparison Project, phase 3 (CMIP3) which was the suite of climate models used for the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Although results are now becoming available from the next phase of that modeling effort (denoted CMIP5, to be used in the IPCC Fifth Assessment Report), there are two main reasons to use CMIP3 at the present time. First, CMIP3 projections and model performance have been extensively evaluated in the scientific literature, so that capabilities and limitations of the participating models are well known. Second, downscaled data sets based on the CMIP3 global model results already are available. This means researchers can leverage that work in the project (downscaling is not funded as part of this CAP), and work can begin sooner than if researchers had to wait for the newer model results to become available and to be downscaled. The project team presently is evaluating various downscaled CMIP3 data sets in terms of their physical realism and practical suitability

In support of the transdisciplinary emphasis of this project, the team has refined and deepened the research questions being investigated and formulated testable hypotheses regarding the coupled environmental and economic impacts of corn production under the management systems under study and likely future climate. All systems analysis and predictive modeling efforts are incorporated into these research questions which capture the impacts of corn production across multiple temporal and spatial scales to meet the overall project goals in understanding N, C and water footprints under a changing climate.

Researchers began examining possible collaborations with other climate-based agricultural projects, including: the "U2U" project based at Purdue University, the Conservation Innovation Grant (CIG) project addressing nitrous oxide mitigation protocols led by the Fertilizer Institute, and the Agricultural Model Intercomparison and Improvement Project (AgMIP), a multi-institutional and multi-national project to assess and improve crop models.

Team Outputs – Year One

Researchers assembled current and archived data, including those related to climate, weather, tillage and corn production. Investigators researched several sources of climate model output to find suitable data sets that can be adapted for uniform use in the project. A process was developed to provide historical climate data for a grid of locations covering the domain studied in this project. A great deal of data collection, processing and quality control was done to ensure representative data for the field sites back to at least 1951.

All previously published LCAs of corn were assembled and a meta-analysis was performed to determine to what extent there is commonality of method, data sources and assumed parameter values. The corn production LCA meta-analysis includes studies of corn production as a component of other processes, such as corn grain ethanol production. The meta-analysis will help guide the LCA process by defining current best practices and allowing the team to see clearly where improved data and standardized methods are needed.

Project investigators worked together to gather field site metadata for modeling use, including collecting specifications on treatments, measurements, and detailed site data for the long-term sites.

Researchers processed archived weather information from long-term sites in the area with near real-time data sources and local monitoring. This three-pronged approach will lead to a quality weather and climate dataset that can be used by the modelers.

Researchers collected literature and began modeling the impact of various factors, including cover crops, nitrogen, weather conditions and landscape positions and on maize yield and greenhouse gas emissions. They also began developing cost estimates

associated with alternative corn based cropping systems that generate GHG reductions, including cover crops and land retirement.

Investigators are researching sources for downscaled climate scenarios for use by the project's modelers. Downscaling is needed in order to disaggregate monthly data to obtain daily time steps, to transform large-scale climate information into more realistic representation of local scales.

Researchers began to develop soil carbon and greenhouse gas models of long-term experimental sites to allow for testing the modeling framework against data sets already in existence. Investigators used past data to begin testing various models, including EPIC and DayCENT.

Power analysis using previous research data was initiated. The systems analysis and predictive modeling scientists worked with all research PIs to specify research questions and hypotheses to be tested throughout the five year project. Investigators initiated a detailed statistical power analysis for assessing the number of replications and sub-samples needed at each site to detect statistically significant differences in soil carbon and GHG emissions. Through statistical power analysis, researchers can test how changes such as extending the duration of an experiment can add to the statistical power of the experiment thus strengthening the conclusions that can be drawn.

Working with collaborators from the USGS the soil carbon modeling team has incorporated the DayCENT soil carbon model in a state-of-the-art parameter estimation software tool that will allow for the automatic "tuning" of the DayCENT model parameters in order to match measured experimental data. This tool also allows CSCAP researchers to better understand the sensitivity of the DayCENT model performance to data quality, number of measurements and accuracy of assumed model parameter values. This is the first time that DayCENT has been subjected to parameter estimation analysis and promises to provide useful insights that will have impacts well beyond this project.

Principal investigators hired and trained new employees including graduate students and research specialists to support CSCAP activities. Researchers participated in monthly team meetings and as-needed objective-based meetings to connect with other project participants and coordinate efforts among all aspects of the project.

Team Milestones and Deliverables

All milestones were met for the Objective 3 team in year one. The team developed and conducted initial testing to ensure usability among all CSCAP members. The project also developed, calibrated and conducted analyses of corn-based production systems using models and life cycle analysis (LCA). Using the corn LCA meta-analysis, researchers have defined the LCA goal and scope as well as impact categories and data sources. See *Appendix F, page 86,* for a full list of project milestones for year one.

Broad Impacts
With CSCAP research sites located across the Midwest, Objective 3 researchers will have reliable, accurate and comparable data across different soils, rainfall patterns, temperature regimes, solar radiation, length of growing season, and overall yield potential to apply cross-region comparisons and analyses.

The CSCAP systems analysis team has begun the training of a new generation of scientists and engineers who can work across the agricultural, analysis and climate domains.

Training
See *Appendix A, pages 55-66,* for a complete listing of graduate students with responsibilities in the Objective 3 team. Seven graduate students have duties that partially or fully fall within Objective 3 efforts. Four research specialists support the work of this objective.

Collaborations and "Integrated" Knowledge Developed
Collaboration has begun with the CIG grant led by the Fertilizer Institute (TFI) developing nitrous oxide protocols for corn production in the Midwest. Anex is serving on the advisory panel for the project. Researchers have incorporated into our set of modeling scenarios cases to represent the N_2O protocols and will be able to test these scenarios using experimental data in future years. This provides an important verification component for the TFI team and also provides the CSCAP system analysis team with a highly policy-relevant context for a portion of its analysis.

Future collaborations may be possible with climate and modeling scientists from the "U2U" USDA standard grant project based at Purdue University. Data collaboration and sharing may increase the data available to CSCAP modelers and strengthen connections with related external research.

Researchers are exploring the best avenues for collaboration with the USDA funded project "New Tools and Incentives for Carbon, Nitrogen and Greenhouse Gas Accounting and Management in Corn Cropping Systems" led by Cornell University aimed at developing decision support tools for corn farmers. The CSCAP modeling team has on-going collaborations with Keith Paustian of Colorado State University who is a member of the Cornell team. There are significant complementarities among the environmental impact scenarios that will be analyzed under these two projects. Researchers are now working to determine how best to coordinate analysis efforts to leverage both project efforts and enable the team to analyze more cases and a wider geographic scope of corn production in the U.S.

Within the CSCAP, an early priority was building trust among researchers conducting field trials under Objectives 1 and 2, and systems analysis and predictive modeling researchers under Objective 3. Because these groups represent different ways of

approaching science and creating new knowledge, there was initially considerable unease among researchers about the use of primary data in models, citing credit for results and the assumptions and data underlying modeling results. Joint development of team publication guidelines has addressed some of these concerns.

Team Plan-of-Work for Year Two

In year two, Objective 3 of the CSCAP will perform statistical power analysis for each of the CSCAP field sites. This analysis will allow researchers to anticipate how certain the conclusions are likely to be at the end of five years at each site. Local variation in climate, soil type, and treatment variables mean that experiments at each site will have somewhat different statistical power. CSCAP researchers will quantify the likely impacts of this variation on the ability to generalize across sites. The team will also explore how much additional statistical power could be obtained by adding measurements, extending the duration or otherwise modifying experimental design in the future.

Researchers will strengthen connections between the Objective 1 and 2 teams conducting field trials and the Objective 3 team modeling and analyzing data. This will allow joint negotiation of assumptions and evaluation of experimental models.

Members will also continue strengthening their connections to one another as well to other team members. A series of conference calls are already in place for PIs and their graduate students to provide an overview of their research and modeling capabilities to allow learning among other researchers and eventually strengthen the crossover and collaboration possible.

Researchers will begin to fully utilize the central database: submit field data, verify data accuracy and quality, test data, revise forms to make data submission and access simple and seamless. Objective 3 members will be able to export data from this database in May-June allowing work to begin in earnest testing and evaluating their models against year-one data that will be extended during years two through five.

The next steps in database development include provisioning tools to allow entry and storage of high frequency data like GHG, making the data entry and storage routines more robust, and designing download interfaces for modelers to use. These all involve iterative processes by which data entry and download users can help guide the creation of these interfaces. An administrative aspect to data collection will be built as well, providing project managers a dashboard to audit the progression of data collection from our projects.

Researchers will be developing a landscape-scale modeling system that integrates economic land use models with detailed biophysical models and projects from regional 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.

Researchers will continue to refine research questions and hypotheses; begin to link foundational disciplinary research questions to other team research questions via formal and informal communications. For the Objective 3 team, this connection is particularly important to successfully build with the protocol standardization and field research teams (Objectives 1 and 2).

The project will begin to extend the progress and findings of Objective 3 through the external Web site with descriptive images, videos and publications.

REPORT FOR OBJECTIVE 4
Social & Economic Research

Executive Summary
Investigators: Arbuckle (lead), Tyndall, Wright Morton

See *Appendix A, pages 55-66,* for Objective 4 PI contact information.

Objective 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.

This objective focuses on farmer capacity and willingness to adopt management practices and strategies that lead to long-term sustainability and productivity of corn-based cropping systems under variable weather and long-term climate changes. This objective utilizes sociological and economic theories and methods to gather data on Midwestern farmers' beliefs, attitudes, and management strategies. It studies farmers' awareness of long-term weather patterns and the impacts they have on their adaptive and mitigative actions. Findings from this objective provide a feedback loop to the field trials and modeling objectives and a framework for developing tools for farmer decision-making, education curricula and science-based policies. The intent of Objective 4 is achieved primarily through survey research and participatory farm-level climate scenario analysis and economic assessment of cropping systems.

Year one outcomes included (1) the establishment of strong survey research partnerships with the USDA Purdue University-led grant, "Useful to Usable" (U2U) and the National Agricultural Statistics Service (NASS), (2) leveraging of project funds through buy-in from key agricultural stakeholders, (3) development of transdisciplinary research and extension partnerships across the CSCAP objectives, (4) improved extension educator capacity to engage farmers about adaptive and mitigative management options through I-Farm-facilitated interviews, (5) analysis of preliminary data leading to improved knowledge of farmer beliefs and concerns about climate change, and (6) initiation of a relationship with the USDA "Regional Approaches to Climate Change in Pacific Northwest Agriculture" CAP project.

Activities and outputs included weekly conference calls and several in-person meetings of the 10-investigator CSCAP-U2U survey team and extensive consultation with NASS that led to the development of an innovative survey research design, sampling approach, and questionnaire. Support from key stakeholders was manifested through $51,400 in additional survey funding. I-Farm-related outputs include 20 trained extension educators and materials that will facilitate interviews with farmers. A survey conducted jointly with CSCAP IPM researchers led to a technical report. Analysis of preliminary data on climate

change attitudes among farmers and agricultural educators resulted in two reports, a major regional meeting presentation, a Web-based video, and substantial media coverage.

(Above) Iowa State University sociologist J. Arbuckle discusses climate-related findings from the 2011 Iowa Farm and Rural Life Poll for Kansas State University's news media service.

Team Outcomes/Impacts – Year One

The primary Objective 4 outcome from year one was the building of a strong partnership with the USDA Purdue-led grant "Useful to Usable" (U2U) project team and the decision to co-fund and co-produce a farmer survey designed to meet both CSCAP and U2U goals. Although the two projects have distinctly different objectives, a common goal underlying the survey is to learn about the relationships between farmers' beliefs and concerns about climate change and their management practices to inform development of strategies that maintain and improve the resilience of corn and soybean production systems in the face of climate uncertainties in the Corn Belt. When each grant was awarded, USDA-NIFA instructed all CAP grants to explore opportunities to collaborate in ways that might leverage resources and generate complementarities. In May 2011, after several months of exploration and negotiation, the socioeconomic research teams from both projects determined that (1) the projects' research objectives overlapped significantly, and (2) by combining resources in a partnership, the geographic scope of survey research could be broadened and the sampling strategy improved to obtain results superior to those that would otherwise be attained.

Each project had proposed state-wide surveys of farmers in several states that overlapped. During the discussion process, it was discovered that NASS could draw farmer samples using watersheds as the sampling unit instead of the typical state-level unit. It was agreed that the watershed was a more logical sampling unit for the project because the impacts

of climate change are manifested ecologically and hydrologically rather than following political boundaries. By combining resources, the partnership allowed both projects to reach a larger number of farmers than both could reach separately and resulted in an innovative research design, sampling approach and survey instrument, which was sent to nearly 20,000 farmers in February 2012. Innovative aspects of the survey include (1) using the watershed as the sampling unit, which to the researchers' knowledge has never been done at this scale, (2) because NASS is conducting the survey, they will be able to populate the data set with data from the Census of Agriculture. This will be the first survey ever conducted that will be able to link complex attitudinal measures with the detailed agricultural enterprise data from the Census of Agriculture at this scale. The survey research process is presented in more detail in the *outputs* section, below.

A related outcome was the cultivation of commitment to the project among key agricultural stakeholders. Representative of this was the CSCAP-U2U leadership team's ability to secure financial commitments from the ISU College of Agriculture and Life Sciences, Purdue Agriculture, and Iowa USDA Natural Resources Conservation Service to help expand the reach of the survey effort. These agencies and organizations each provided about $17,000, which allowed the Objective 4 team to expand the survey area by six watersheds.

Another critically important outcome has been the development of strong working relationships across CSCAP objectives. Objective 4 integrates with all CSCAP project objectives, providing social science research-based understanding of farmer perspectives on climate change, weather variability, and adaptive and mitigative management. This information will inform all other project objectives – education, extension and outreach, biophysical field research, monitoring, and modeling of agricultural production systems – through feedback loops established between them. In year one, the feedback loops between CSCAP social-economic research (Objective 4) and extension programming (Objective 5) and Integrated Pest Management (IPM) (Objectives 1 and 2) were firmly established. Integration with Objective 5 consisted of shared graduate students, discussions on survey instrument development, I-Farm training of 20 project extension educators, and the development of outreach materials that extension educators can use with their farmer watershed groups to discuss long term weather patterns and implications for management decisions in corn-based cropping systems. Integration with the IPM component of Objective 1 and 2 consisted of a collaborative survey of Iowa agricultural educators.

New knowledge on Iowa farmer perceptions of climate change was generated through analysis of data on the 2011 Iowa Farm and Rural Life Poll. This information was used to guide the design and selection of items for the larger CSCAP regional survey instrument. These findings were disseminated through print, radio and Web media.

Finally, a partnership with the "Regional Approaches to Climate Change in Pacific Northwest Agriculture" CAP project (Wheat CAP) was initiated. CSCAP Objective 4

leadership met with Sanford Eigenbrode, director of that project and shared the completed CSCAP-U2U survey instrument. CSCAP and Wheat CAP agreed to consult on social science research and extension activities to seek opportunities to add value to both projects.

Team Outputs – Year One

The survey research design and survey instrument are the two major year one outputs. Social scientists from the CSCAP and U2U projects conducted weekly conference calls, exchanged frequent e-mail communications, and met multiple times in person over the course of 2011 as they developed the research design, devised the sampling strategy, and developed the survey instrument. The result of this effort is an innovative survey of farmers in 22 HUC6 watersheds across 10 Corn Belt states.

The CSCAP-U2U team worked closely with Iowa Agricultural Statistics and the National Agricultural Statistics Service to define the sample frame. Innovative aspects of the survey include (1) using the watershed as the sampling unit, which to our knowledge has never been done at this scale, (2) because NASS is conducting the survey, they will be able to populate our data set with data from the Census of Agriculture. This will be the first survey ever conducted that will be able to link complex attitudinal measures with the detailed agricultural enterprise data from the Census of Agriculture.

The potential survey area comprised 26 HUC6 watersheds located in what the USDA defines as "major crop areas" for corn and soybeans in the Corn Belt. Due to resource constraints, only 22 watersheds could be surveyed. Watershed selection criteria were developed to prioritize watersheds. It was decided to select the top ten watersheds in terms of corn and soybean production. The next five watersheds were selected based on acreage under irrigation. The final seven watersheds were selected based primarily on ecological grounds (e.g., watershed 070600, the so-called "Driftless Area," which was selected due to its uniquely sensitive geologic and ecological features). Figure 4 maps the watersheds that were surveyed.

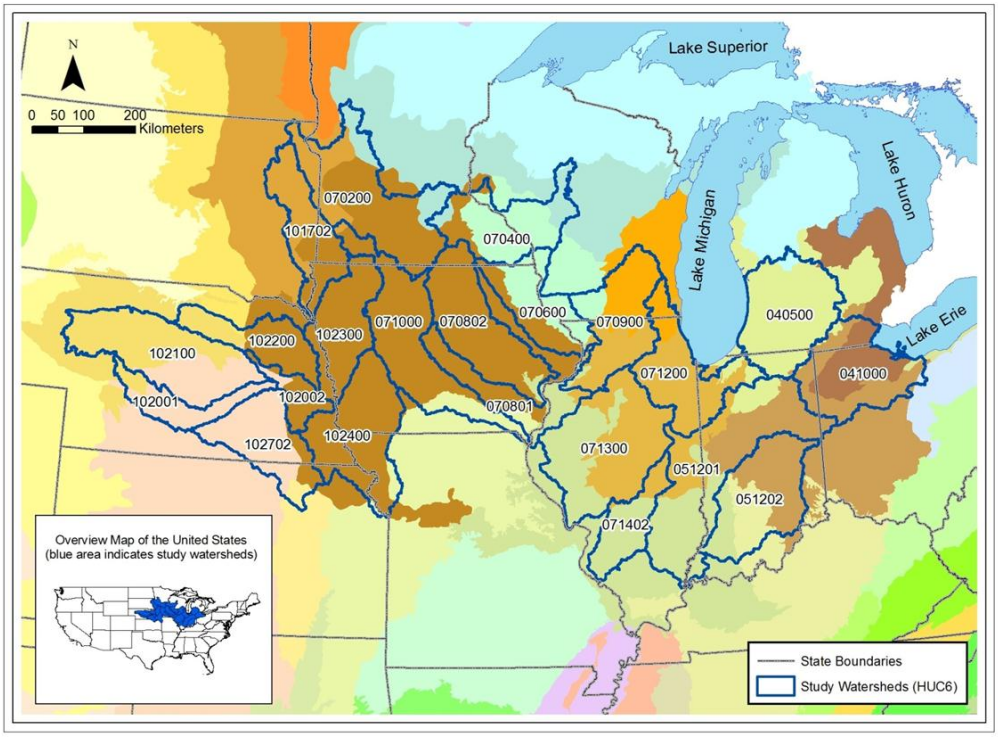

Fig 4 – Twenty-two HUC6 watersheds surveyed by CSCAP-U2U.

The group of 22 HUC6 watersheds that were used to stratify the farmer sample encompasses much of the nation's most productive cropland. The 22 watersheds contain 60 percent of total corn acres and 51 percent of total soybean acres in the US. Table 3 presents corn and soybean acreage by watershed.

Table 3 - Corn and soybean acres in study area, by watershed

HUC6	States	Corn Acres	Soy Acres	Total Corn and Soy Acres
040500	IN, MI	1,529,373	916,934	2,446,307
041000	IN, MI, OH	1,856,381	2,169,249	4,025,630
051201	IL, IN, OH	4,806,502	3,749,567	8,556,069
051202	IN	1,861,888	1,459,580	3,321,468
070200	IA, MN, SD	4,055,702	2,831,711	6,887,413
070400	MN, WI	1,557,723	732,667	2,290,390
070600	IA, IL, MN, WI	1,677,120	597,210	2,274,330
070801	IA, IL, MN	2,596,654	1,448,143	4,044,797
070802	IA, MN	3,855,398	2,165,340	6,020,738
070900	IL, WI	2,803,785	978,312	3,782,097
071000	IA, MN	3,604,682	2,384,479	5,989,161
071200	IL, IN, WI	2,400,181	1,286,490	3,686,671

071300	IL	4,928,392	2,726,205	7,654,597
071402	IL	1,296,547	1,140,668	2,437,215
101702	IA, MN, NE, SD	1,830,339	1,268,891	3,099,230
102001	NE	1,140,440	244,006	1,384,446
102002	NE	655,254	498,904	1,154,158
102100	NE	1,126,117	268,748	1,394,865
102200	NE	1,414,211	847,193	2,261,404
102300	IA, MN, NE	2,411,256	1,742,198	4,153,454
102400	IA, KS, MO, NE	2,346,397	2,063,866	4,410,263
102702	KS, NE	2,040,545	1,159,301	3,199,846
Watershed Totals		51,794,887	32,679,662	84,474,549
US Totals		86,248,542	63,915,821	150,164,363
Percent of US Totals		60%	51%	56%

Sources: 2007 Census of Agriculture Vol 1, Part 52; 2007 Census of Agriculture Watersheds Vol. 2, Part 6

The survey instrument itself represents a major output. Following the months-long development process, the 12-page survey was tested with dozens of farmers and reviewed by numerous extension and agricultural professionals in Iowa, Indiana and Nebraska to ensure that wording and content would be easily understood by respondents. Upon completion of the survey instrument, the team submitted the methodology, instrument, and documentation to the ISU Institutional Review Board (IRB) for quality assurance and protection of human subjects. Upon ISU IRB review and approval, the survey formatting was finalized, sent to printing and prepared for mailing in February 2012. The methodology uses the Dillman three-step mail survey process; preparation and printing included materials for three mailings per subject and the development of a cover letter, final survey, follow-up post card, and third mailing cover letter. NASS has drawn the stratified random sample and sent out the mailing as part of their subcontract agreement.

Another key output was the procurement of additional funding to help expand the reach of the survey effort. The financial commitments from the ISU College of Agriculture and Life Sciences, Purdue Agriculture, and Iowa USDA Natural Resources Conservation Service totaled $51,400.

Integration with the IPM component of Objective 1and 2 consisted of a collaborative survey of Iowa agricultural educators. This cross-disciplinary effort surveyed 125 agricultural educators to better understand their beliefs about climate change and perceived need for climate-related curricula. The survey was completed by attendees of the annual Iowa Association of Agricultural Educators (IAAE) summer conference and results were analyzed and compiled in a report titled “Climate Change in the Classroom: A Survey of Iowa Agricultural Educators,” (CSCAP-0001-2011-IA).

An I-Farm training session for the 20 CSCAP extension educators was conducted in November 2011 to increase capacity to conduct I-Farm-facilitated interviews with farmers across the study area. An Adobe connect follow-up webinar training took place on Dec. 20, 2011. The extension educators will use I-Farm as a data gathering tool and an educational opportunity to increase farmer knowledge and inspire learning about connections between management practices, climate variability, soil erosion; nutrient runoff, and atmospheric, economic and environmental impacts. User-friendly materials and guides to help facilitate those interviews were also developed and distributed to extension educators.

Analysis of data on Iowa farmer perceptions of climate change was published in the 2011 Iowa Farm and Rural Life Poll Summary Report. The data were also presented at a major regional extension conference and disseminated through radio, print, and web media. In addition, analyses and findings resulted in a journal manuscript, "Farmer beliefs and concerns about climate change and attitudes toward adaptation and mitigation" that is currently under review for the journal *Climatic Change*.

Other year one outputs included the development of position descriptions and recruitment of graduate students to support of the plan of work. Team members participated in the monthly leadership and team conference calls, as well as within and across objective subgroup planning and coordination meetings.

Team Milestones and Deliverables

All milestones were met for the Objective 4 team in year one. The team developed a farmer mail survey instrument which was sent to a stratified, random sample of nearly 20,000 farmers in February 2012. Researchers began coordinating with the CSCAP extension component to ensure application of social-economic research. See *Appendix F, pages 87,* for a full list of project milestones for year one.

Broad Impacts

The survey partnership between the CSCAP and U2U brought 10 CSCAP and U2U researchers and graduate students together under a common goal. This year-long and continuing process began in early 2011, and has taken significant time, funds and dedication. Through this partnership, the CSCAP and U2U teams committed to share findings with important implications for development of effective extension and educational materials and programming and decision support tools. This is a great demonstration of the synergies that are possible among USDA-funded projects, linking and leveraging them to accomplish far more together than either could alone.

The survey methodology utilizes a design that is a random sample of farmers stratified by HUC6 watersheds. This unique approach sets a new standard for social survey research applied to natural resource management. Researchers will gain a better understanding of farmer perceptions of climate change, how they see climate change affecting their

agricultural operations, and their willingness to adopt adaptive or mitigative cropping practices. The data set will enable researchers to conduct multilevel modeling and spatial analyses that nest farmers within watersheds and bring watershed-level biophysical and climatic data into modeling of attitudes and behaviors. The addition of data from the Census of Agriculture will create a set of farmer data that is unparalleled in its socioeconomic, social-psychological, and geographic scope.

The CSCAP-U2U search for additional funding for survey implementation resulted in not only increased financial support, but also increased project visibility. This generated considerable excitement from NRCS and experiment station directors across the region and will benefit the project in upcoming years.

Training

See *Appendix A, pages 55-66,* for a complete listing of graduate students with responsibilities in the Objective 4 team. Three graduate students are at least in part dedicated to this objective; all are funded through external sources. In addition, one research staff supports the work of this objective and is funded by non-CSCAP supplemental dollars (~$5,000). Two additional CSCAP-funded graduate students will be added in year two.

Collaborations and "Integrated" Knowledge Developed

Because of the interconnected nature of this project, researchers working under this objective collaborate closely with systems analysis and predictive modeling investigators for the LCA model construction. Researchers also work closely with the CSCAP extension team to connect farm management practices and farmer response to climate change, and to provide extension educator orientation and professional development. Researchers have begun to develop publications extension educators can use with their farmer stakeholders.

This objective has forged a close partnership with the U2U climate project based at Purdue University. This collaboration benefits both groups by offering an opportunity to pool resources for common goals. The collaborative group's co-PIs are comprised of two sociologists (Arbuckle, ISU; Haigh, University of Nebraska), a natural resource economist (Tyndall, ISU), a natural resource social scientist (Prokopy, Purdue), a landscape ecologist (Knoot, ISU), and a water resources scientist (Knutson, University of Nebraska). PhD students working on the project are from sociology (McGuire, ISU) and natural resource management (Saylor, Purdue).

The CSCAP-U2U partnership with the Regional Approaches to Climate Change in Pacific Northwest Agriculture CAP project will provide opportunities for research and extension collaboration between these regional projects.

Team Plan-of-Work for Year Two

The Objective 4 year two plan of work includes farmer survey data management, entry, cleaning and analysis in preparation for hypotheses testing. I-Farm interviews will be initiated. Initial results of analyses will be presented at conferences and manuscripts will be prepared and submitted to journals. Contributions to the development of extension materials and programming will be initiated.

The survey data will be ready for analysis in summer 2012. In year one, co-PIs and social-economic graduate students developed their research questions and hypotheses. In year two, analysis will begin and preparation of journal manuscripts as well as one MS thesis and one PhD dissertation will commence. Two new PhD-level graduate students will start work on the project. One will support survey data analysis and will be skilled in multi-level modeling and spatial analysis. The second will coordinate the I-Farm interviews with farmers and analyze the data collected through those interviews. Investigators and students will conduct presentations and submit posters of CSCAP survey findings at conferences, including the Rural Sociological Society, *International Symposium on Society and Resource Management* (ISSRM) and American Sociological Association (ASA); as well as webinars for CSCAP team extension educators.

Investigators and extension educators will begin conducting one-on-one interviews using I-Farm, a Web-based model that allows farmers to analyze the biophysical and financial characteristics of their current operations and compare them to land-use scenarios that simulate various adaptive and mitigative practices. This approach will provide real-farm platforms for structured climate- and agriculture-related discussions between extension educators and producers. This information will help gauge farmer willingness and capacity to adopt alternative cropping practices.

Insight gained from both the survey data analysis and I-Farm interviews will help inform the project's extension and education activities. Integration with Objective 5 will intensify in year two as investigators and graduate students from both objectives begin to develop extension materials and programming. Interaction with Objectives 1, 2 and 3 will also ramp up as Objective 4 findings are communicated to the other objectives. Interaction with Objective 3 will be especially important as data on farmer use of and attitudes toward key practices and strategies will be useful to assess the validity of modeling assumptions.

The project's external Web site will continue to develop its section on social and economic research. A paper on the survey methodology and instrument will be written, co-authored and published by CSCAP-U2U team in 2012.

The CSCAP's year two annual meeting in the summer of 2012 will increase connections and understandings among biophysical and social scientists as they create new knowledge and explore joint research questions.

REPORT FOR OBJECTIVE 5
Extension

Executive Summary
Investigators: Benning (lead), Arbuckle, Ingels, Moore, Todey, Wright Morton

See *Appendix A, pages 55-66,* for Objective 5 PI contact information.

Objective 5: Promote extension, outreach and stakeholder learning and participation across all aspects of the program.

The project's extension directive promotes participatory exchange of climate and agricultural knowledge among farmers, extension educators and the project team. An expansive network of established and newly initiated farmer groups serves as the structure for evaluating the crop management practices being tested across the CSCAP field research sites. Extension professionals in Objective 5 are experienced in testing new technologies, strategies and group techniques to encourage farmer learning and implementation of appropriate adaptive management approaches.

In the first year, the CSCAP extension team worked closely with Extension Agriculture and Natural Resource (ANR) Directors across the 10 Land Grant University (LGU) institutions involved with this project to identify extension educators with an interest and ability to dedicate time to the CSCAP. Initially, the project budgeted approximately $22,000 per institution to hire and support extension educators committed to building strong connections among the work of the project and their LGU institutions. The CSCAP goal is to build upon the current capacity of the upper Midwest Extension system to communicate and promote programming efforts in climate and agricultural science. Although the goal was the addition of 10 extension educators (one from each project LGU) to the CSCAP, the objective team was pleasantly surprised to find high levels of receptiveness to partnering with the project and currently has 20 extension educators who will actively work with farmer audiences in their state.

In November 2011, a project orientation and training session on agriculture and climate was held for newly recruited CSCAP extension educators, sponsored co-jointly with the USDA Heartland Regional Water Coordination Initiative "Water and Climate Conference." The water cycle and nitrogen management are central concerns for both the Heartland project and the CSCAP. Issues of agricultural water quality are "natural" ways to start educator and farmer conversations about effects of long-term weather changes and their implications for the water, nitrogen and carbon cycles. Partnering with the Heartland Regional Water Coordination Initiative was advantageous in year one since several extension educators were already attending the conference. This maximized their time rather than requiring back-to-back attendance of this meeting and the CSCAP annual

meeting. In year two, extension educators will attend the CSCAP project-wide meeting in Wooster, Ohio.

Throughout year one there has been considerable extension educator skepticism of climate science and climate change's effects to agriculture. The Objective 5 extension team has encouraged questions, seeking to convey that scientists and educators are learning together with a goal of encouraging open-minded dialogues regarding what is known, what is not known, certainty and uncertainty, and perceptions of risk. The team has built trust and support among extension educators by sharing project resources, concerns about and strategies for the transfer of climate science and agricultural practices to farmers. Extension educators have already identified 70 potential key farmer leaders and group members for their state-based watershed groups.

The extension team meets via conference call and webinars monthly. These meetings are used to identify partners and resources for extension educators to create learning opportunities for their farmer groups. They are also used as professional development opportunities for the extension educators to learn more about climate and other sciences the project is engaged in. A series of statewide and within-state regional publications featuring climate data are being developed for extension educators to use with farmers.

An important element of the extension activities will be farmer participation in the flow of information among the various objectives of the research project. The I-FARM participatory assessment activity serves as a catalyst for farmer-led watershed groups to engage in the development of adaptive and mitigative strategies (see Objective 4, social-economic research for more details).

(Above) Farmer group members discuss targeting water quality improvement practices.

Team Outcomes/Impacts – Year One

Extension administrators in nine states (10 Land Grant Universities) agreed to programmatically dedicate 20 extension educators to partner with the project and work with 200 producers on climate change and its implications to corn-based cropping systems.

The extension team built a number of partnerships in year one, including with the USDA Heartland Regional Water Coordination Initiative in planning the "Water and Climate Conference" which allowed initial CSCAP training and orientation to extension educators. As a result, extension educators were able to hear trusted scientists, engage in dialogue with colleagues, and gain an overall understanding of climate science and potential impacts to agriculture. This conference prepared them to undertake project work and more systematically integrate climate science into existing and future extension programs with farmers and stakeholders in their state.

As a result of extension team monthly webinars, extension educators have become more confident in developing farmer presentation strategies to start the climate dialogue. Further, as the extension educators work with CSCAP extension leadership team to plan webinar topics on cropping systems and recent climate research as well as prepare farmer publications, educators have shown increased willingness to add climate topics to existing winter meetings and summer field day events to increase farmer exposure to climate information.

In year one, project social-economic scientists strongly connected to the extension component of the project, viewing the implementation of the farmer survey as providing critical data for developing recommendations and applying management strategies that empower Midwest farmers with the necessary information and tools. As a result of the in-project social-economic research relationships, the extension team connected to the USDA U2U project which is developing decision support tools for managing corn systems (and co-funding research with the CSCAP, see Objective 4) and explored opportunities to use the CSCAP extension educators and participating farmers to test and evaluate their decision support tools. Jamie Benning, the CSCAP Objective 5 extension leader, has been asked to serve and accepted the role of advisory board member to the U2U project.

Ongoing communication and information exchanges with the Pacific NW Wheat CAP have led to a joint proposal to develop an eXtension site on cropping systems and climate plus supporting materials. A gap currently exists within eXtension regarding climatic information relative to row-crop production systems of cereal grains. A significant amount of synergy occurs between the wheat and corn CAPs allowing the teams to combine efforts and address this gap with the information and resources generated by the projects. The tentative name for this expected Community of Practice is "Row-Crop Production and Climate."

Team Outputs – Year One

The Extension team meets monthly via telephone and communicates regularly via e-mail. The extension educators review and discuss the external Web site and have begun to provide input on the structure and content of the site so as to make it a useable reference to their farmer stakeholders.

The project produced 81 draft region-specific climate publications which are being used to engage State Climatologists with extension educators as they finalize these education tools for farmers within their states. These publications support the work of CSCAP and U2U and will interact with a NOAA multi-agency effort on the National Climate Assessment. The product addresses current climate-related trends impacting agriculture in each state. These may be expanded into a national impacts database through collaboration with NOAA. Using some data processed for systems analysis researchers, investigators produced thousands of draft climate-related graphs to be included in CSCAP extension materials. These are being evaluated and will be a year two product.

Extension educators have begun to develop watershed based groups and have identified almost 70 potential key farmer leaders that will participate in the project. The goal is 200 participating farmers across the region. As farmers are enrolled to participate in the project, they take a baseline assessment survey of their attitudes, beliefs and practices related to climate and conservation practices. A second assessment will occur early in year five of the project and will be compared to this baseline to document change or lack of change in perceptions and behaviors. CSCAP participating farmers, with support from their extension educator, will select their own field trial experiments and collect soil samples and agronomic data based on Objective 1 protocols as a baseline of their biophysical conditions.

An important part of the project's extension efforts is farmer participation in the I-FARM participatory assessment activity which is a combination research and education tool. The I-FARM activity allows farmers to help the CSCAP research team gain an in-depth understanding of the practical economic and sociocultural feasibility of potential climate-related mitigation and adaptation practices. Ongoing discussions with farmer groups assess strategies as they are developed and provide feedback to continually inform the design and improvement of practices, policies and programs, including future education and extension programming for regional implementation.

Team Milestones and Deliverables

All milestones were met for the Objective 5 team in year one. Extension milestones include engaging producers in learning, experimenting with and adopting approaches that may lead to long-term reductions in greenhouse gas fluxes and nitrogen and water use in corn production systems. Extension educators are beginning to facilitate participatory exchanges with farmers and form farmer-led watershed groups. See *Appendix F, page 87*, for a full list of project milestones for year one.

Broad Impacts
As result of a new partnership, Jamie Benning, the CSCAP Objective 5 extension leader, will serve as an advisory board member to the U2U project. This is providing a direct link between the U2U-developed farmer decision tools with opportunities for CSCAP extension educators and farmers to pilot test these tools and strengthen the regional Extension system plans of work associated with row crops and climate science.

Garnering widespread support in the team's efforts to programmatically strengthen the Land Grant University's focus on climate education within agriculture represents a significant shift to increase attention on this issue relative to past efforts. This programming emphasis is expected to grow in the future with the CSCAP uniquely able to lead and serve as an example.

As the extension team has worked to develop climate training materials and messages that appeal to farmer and stakeholder audiences, the impact of climate on the water cycle has resonated well with extension educators. They feel that farmers can best incorporate climate science into their decision making process as it relates to increases and decreases in rainfall, soil moisture, relative humidity, etc.; all factors that influence cropping systems on a daily basis. The team is focusing their messages on informing farmers of the potential risks associated with weather fluctuation and crop production risk management strategies rather than "big picture" climate issues. Identification of these topic-based approaches signals progress by communicating information outward in a way that can be positively received and implemented.

Training
See *Appendix A, pages 55-66,* for a complete listing of graduate students with responsibilities in Objective 5 team. Three graduate students are at least in part dedicated to this objective; all which are funded through external sources. Twenty extension educators are working with the CSCAP.

Collaborations and "Integrated" Knowledge Developed
Collaboration has occurred with the U2U climate-based agricultural project based at Purdue University, particularly in regards to project extension activities.

These activities also have a strong tie to the social and economic research objectives of the project. Scientists will evaluate how CSCAP research fits within the social and economic constructs of Midwest farmers. Extension personnel will communicate this research and help develop a feedback loop to transfer this knowledge among researchers, other extension educators and stakeholders.

Team Plan-of-Work for Year Two
The CSCAP annual convening in August 2012 will focus on strengthening transdisciplinary research and connecting the extension educators to the overall project as it. This will be their first opportunity to meet face-to-face with other members of CSCAP.

After the project meeting, they will have a greater understanding of the research occurring, project resources and the ability to better connect local producers with CSCAP field research and analyses.

The CSCAP 2012 annual conference will feature an interactive farmer panel and other opportunities for the research team to interact with and learn from farmers. This will help researchers better understand farmer ideas and concerns about climate; carbon sequestration; excess water, flooding and drought; and nitrogen loss to air and water. Extension personnel will also present initial, aggregated I-FARM findings from meetings held in the summer with individual farmers where they evaluate specific management practices on their fields.

By year two, the project plans to be working with about 200 participating farmers. A feedback loop will begin to develop among farmers, extension personnel, social and economic researchers, and field trial scientists. Extension educators will meet with their farmer groups prior to, during and after the growing season to evaluate and discuss results of their own field experiments and data on water, carbon and nitrogen within their watershed and consider alternative adaptation strategies.

In the second year, the project will strengthen its connections to the U2U project. U2U will begin developing farmer support decision tools based on analyses of the CSCAP-U2U socioeconomic survey responses. Farmer groups will test the decision support tools as they are developed.

The CSCAP external public Web site will continue to develop its “Farmers and Industry” section, and will develop a dedicated “Extension” section.

REPORT FOR OBJECTIVE 6
Education

Executive Summary
Investigators: Moore (lead), Benning, Colletti, Lekies, Miller, Nkongolo, Todey

See *Appendix A, pages 55-66,* for Objective 6 PI contact information.

Objective 6: Train the next generation of scientists, develop science education curricula and promote learning opportunities for high school teachers and students.

The education directive of the CSCAP has two over-arching goals: 1) train the next generation of scientists in disciplinary and transdisciplinary science and 2) develop curricula and learning opportunities to create capacity building for science educators regarding climate and agriculture and the social-economic-ecological relationships. This objective team is developing focused-educational approaches and creating interactive environments as well as purposeful training that will mentor and further career development for project graduate students. The project's multi-pronged approach utilizes place-based education at multiple levels (9-12, undergraduate, graduate, extension and stakeholders) to increase learning and foster a new generation of scientists, farmers, entrepreneurs and citizens. Deliberate cross-over among PIs in Objectives 5 and 6 ensure educational strategies, tools and materials are fully utilized across all of these audiences.

In the project's first year, the education team built camaraderie among project graduate students by connecting the students in various capacities including a special session at the CSCAP annual conference for graduate students and key leaders, a graduate student e-mail distribution list, and the opportunity to join team teleconferences.

CSCAP graduate students gain unique experiences and learning opportunities from this project by working outside their single discipline and institution and connecting to a much larger network of scientists, project staff and graduate students. Many CSCAP graduate students will work with these same individuals as colleagues in the future; this project is positioned to raise-up a new type of scientist and innovative ways to approach complex challenges. Specifically, in year one, the process of developing the next generation of scientists involved training graduate students within their own discipline – this helped establish each as an expert within his or her own field before expanding beyond to other disciplines. Graduate students were involved in the final stages of developing and implementing standardized protocols for measuring soil organic carbon (SOC), total nitrogen, water quality and volume, greenhouse gases and agronomic indicators. Major professors and research specialists invested significant time in training each graduate student on the proper methodologies, equipment operation and expectations of being on the CSCAP team. In conjunction with their objective team and their major professors, graduate students participated in the construction of research

questions and hypotheses which guide their individual research and serve an important role in the larger transdisciplinary team effort.

A nine-week course for graduate students on climate education was developed in response to the listening and work session that occurred at the CSCAP annual meeting. This weekly seminar is offered to all students in March 2012, at the beginning of the project's second year. Graduate students voiced their desire and interest to learn about climate science as many have never had undergraduate or graduate courses related to weather or climate. The seminar will encourage critical thinking and questioning and apply to their own disciplinary science while encouraging exchanges that lead to transdisciplinary exploration.

Staff was hired to lead development of high school (grades 9-12) science teacher modules, summer camps and internships. Meetings between the CSCAP education specialist and a teacher subgroup (2 science teachers and 1 economics/social studies teacher) have provided a feedback loop regarding interests and needs for the classroom and as an initial testing ground for modules.

The objective team began identifying possible curriculum to use for meeting team goals in addition to materials that will be produced from research efforts by members of Objectives 1 through 4. They also reviewed teaching materials, tools and Web sites related to climate change education that can serve as foundational materials for climate science and agriculture curriculum. The team has begun creating and planning for upcoming CSCAP-related short courses, workshops and conferences in year two.

(Above) Joe Colletti, senior associate dean of Iowa State University's College of Agriculture and Life Sciences, speaks with graduate students at the CSCAP 2011 annual conference in Chicago.

Team Outcomes/Impacts – Year One

Graduate student involvement relative to the research, extension and education efforts of the team are critical in achieving overall team goals and represent a CSCAP objective of raising up the next generation of climate and agricultural scientists. Thirty-five graduate students have been recruited by individual PIs and hired across the participating institutions for inclusion in all of the project's various directives.

Graduate students were significantly involved in the team's November annual meeting. Prior to the meeting, many students did not grasp the size and complexity of the CSCAP team. Over the course of the meeting, a change in connectivity and team unity occurred, especially among the graduate student subcomponent. Nearly every graduate student presented a poster describing his or her research methodologies in a 2-hour poster session that allowed other project and advisory board members to discuss and ask questions. Beyond the CSCAP annual meeting, some students also attended professional society meetings or institutionally-based meetings to learn and/or present initial findings from their CSCAP research project. Presentations are included in *Appendix H, page 90*.

The project developed the structure and focus of a Web-based seminar titled "The Science of Climate Change" for CSCAP graduate students to participate in. Twenty students are enrolled for the half-semester online seminar beginning March 2012. The seminar will be led from Iowa State University and streamed out to other participating institutions through Blackboard or corresponding technology.

The appointment of a graduate student to the Leadership Team provides additional opportunities for graduate students interested in learning about the complexity and decision-making associated with teams similar in scope to the CSCAP. Involvement also creates two-way communication between the graduate students and the leadership team to ensure an environment conducive to growth. In year one, a two-step process was created for graduate students to apply for the appointment, followed by their peers voting to place one of the nominees on the team. The election occurred at the end of year one with the appointee to begin at the start of year two.

Mark Hamsher, a high school science teacher and corn producer in Ohio, joined the CSCAP advisory board. For the last five years he served as a teacher-mentor for STEM graduate fellows at OSU participating in their NSF GK-12 place-based education project on the headwaters of the Sugar Creek Watershed.

Team Outputs – Year One

Much of the output for the first year was project preparatory work and not direct output. This is due to the CSCAP team's need to meet certain objective goals before being able to fully address others. Principal investigators recruited, hired and trained individuals for research specialist and graduate student openings in support of CSCAP educational activities.

Graduate students participated in a student-centered learning session at the November annual meeting and discussed convergence and transdisciplinary science. The students also had a separate dinner the first night of the conference to meet others and build connections across institutions. The goal of this and other sessions is designed to increase the student's sense of their individual science learning experiences and build a cohort community of scholars cross-trained in both climate and agriculture, to expand the student's professional network, and to further strengthen interactions among project participants.

The curriculum goals for the Web-based March 2012 seminar "Science of Climate Change" are to develop an overall awareness of climate change, its possible causes and how people may develop strategies to cope with these changes. Students will participate in weekly Web-based discussions related to climate change and agriculture. The seminar is offered to CSCAP graduate students free of charge with a nominal book cost, but graduate credit (1 credit) is available for those choosing to pay course tuition and fees.

Education scientists participated in monthly team meetings, leadership meetings and as-needed objective-based meetings to connect with other project participants and coordinate efforts among all aspects of the project.

Project personnel are working with three educators in Ohio to develop climate education modules. The first module underway includes a course outline for a year-long environmental studies class focusing on phenology. The second module is focusing on food production, safety and economics.

At Iowa State University, CSCAP personnel worked with the "Science with Practice" program staff to identify students for climate change related internships. Investigators also started planning for a summer workshop for young people interested in climate change science.

Team Milestones and Deliverables

All milestones were met for the Objective 6 team in year one. This project established milestones related to capacity building for subsequent project years with emphasis placed on student and staff recruitment and the development of educational frameworks for 9-12, undergraduate and graduate opportunities. Graduate students are engaging in team research and receiving transdisciplinary training in agricultural and climate-based science. Beginning in March 2012, the CSCAP distance education graduate course will be offered to graduate students. Researchers are also developing educational approaches focused on grades 9-12 and climate-related short courses for college credit. The phenology module is finished except for some final edits by the three expert science teachers who are the advisors to the modules construction. One of the science teachers is enrolled to take the online course from Iowa.

The Ohio State University, Iowa State University and Lincoln University planned for their undergraduate courses to be offered during the summer of 2012. The Ohio State University had one undergraduate intern working on the Sugar Creek Farmer Partner participation with the extension (I-FARM) component. See *Appendix F, page 88*, for a full list of project milestones for year one.

Broad Impacts

Although year one was only the initial step, graduate students have already gained valuable experiences as members of this transdisciplinary research project. A primary goal of CSCAP is the production of well-trained, "next generation" scientists across disciplines with the skills and experiences to face the challenges posed to agriculture. By engaging graduate students and encouraging transdisciplinary interaction, the project is emphasizing the importance of working across disciplines and collaboration to help solve scientific challenges.

Training

See *Appendix A, pages 55-66*, for a complete listing of graduate students with responsibilities in the Objective 6 team. One graduate student is at least in part dedicated to this objective. This graduate student is funded through external sources. An education specialist supports the work of this objective.

Collaborations and "Integrated" Knowledge Developed

One of the CSCAP's mechanisms for integration is through the graduate students. A key goal is to connect each student to work being done in multiple objectives to encourage transdisciplinary development. The annual meeting provided beginning opportunities for them to build relationships, trust and comfort. This has since resulted in increased communication through the graduate e-mail distribution list.

In the fall of 2011, the CSCAP pre-assessment baseline survey of all team members found "younger respondents are more optimistic than senior counterparts about the contribution of the collaboration in terms of their work quality and quantity. Younger respondents are also more likely to trust the CAP team and believe that CAP team members are open minded about considering research perspectives from disciplines other than their own." CSCAP graduate students have shown a strong interest in exploring the connections among project disciplines. This exploration is expected to evolve into a dialogue in future years where disciplines and perspectives begin to inform the research occurring by CSCAP personnel and emphasizes the graduate students' role in forming the CSCAP into a truly transdisciplinary project.

Team Plan-of-Work for Year Two

In year two, investigators will begin the Web-based graduate student seminar. This will emphasize graduate student involvement and development of a transdisciplinary approach. The students will continue to play a key role in the progression of the project by helping shape CSCAP dialogue and interaction.

CSCAP "Climate Discovery" modules will be developed at The Ohio State University (OSU) in coordination with South Dakota State University. The addition of climate discovery modules to an existing OSU grant offers an opportunity to pilot test the modules and provides a curriculum application beyond the life of this project. Climate Discovery modules will follow the national science content standards and will be aligned with individual state science requirements. There will also be a career development aspect to these modules. The audience includes the project network universities' secondary agriculture and science education curriculum, which currently focuses on water quality, watersheds, and the effects of different land management practices on water and soil quality. The end-use application will be secondary science and agriculture students and instructors as well as FFA chapters. Over this project's life we anticipate that these models will impact 3,000 students and 80 educators throughout CSCAP's nine states. These modules will be posted to eXtension for national delivery via the internet, making the potential impact even greater.

A two-week short course will be developed for college credit at The Ohio State University, South Dakota State University and Lincoln University/Iowa State University and transfer the curricula to other states in the network. The focus will be on climate change research in agriculture based on coupling natural and social systems. By year two, 20 students in each state are anticipated to attend these courses, with numbers growing as the short courses are rolled out to the other states. Iowa State and Lincoln University will jointly develop their short course targeted for minority students in the network.

Additional undergraduate students will be sought across CSCAP institutions for internships. Undergraduate students participating in internships at The Ohio State University will be engaged in field research related to corn systems and climate change and will play a role in the project's 2012 annual meeting in Wooster, Ohio. Iowa State University will build on its Science with Practice Program (http://www.ageds.iastate.edu/SWP/) and The Ohio State University on its summer intern program ORIP (http://www.oardc.ohio-state.edu/orip/secondary.asp?id=222) and extend these programs to the other universities and co-investigators associated with the project. The purpose is to provide opportunities for college students to learn and work experientially with faculty and staff in university research settings. This program will give students hands-on knowledge about research in agriculture and climate change. The faculty member is expected to provide a strong mentor-mentee environment and develop with the student a signed agreement outlining purpose, goals, and learning expectations. Targeted recruitment will occur at 1890 universities for summer interns. Twenty-one summer interns per year are budgeted (assuming a 50:50 match).

Graduate students will have a time set aside at the 2012 annual meeting to discuss how to further develop into transdisciplinary scientists. Select graduate students will also present initial research findings to the CSCAP team for feedback and discussion. A poster

symposium will allow every graduate student to prepare and present a poster detailing initial data and conclusions.

A separate education section will be developed on the external Web site and will target high school science teachers with agriculture- and climate-based educational resources. The Web site will include teaching modules specific to agriculture, corn-based cropping systems and their interaction with climate. Additional linkages will be made between and to other climate education projects.

CONCLUDING STATEMENT

The CSCAP team reached or surpassed all year one project goals and is entering year two on-target. It has been a highly productive year in developing the team framework, relationships, and initial research efforts to launch into subsequent years' work. The assembled CSCAP team includes 136 scientists, graduate students and topic-based specialists across 19 disciplines.

A research network of 26 field sites across 8 states has been established with an expansive network of 55 treatments and 80 types of measurements collected to measure the carbon (C), nitrogen (N) and water footprints of corn-based cropping systems. These treatments include a suite of management practices, including extended crop rotations, cover crops integrated into corn-soybean systems, tillage, drainage water management, nitrogen application timing and landscape position. Standardized methodologies and metrics have been created and implemented to assure uniform, standardized methodologies are used for gathering field data across the 26 sites on soil organic carbon, total nitrogen, soil physical properties, water quality and volume, greenhouse gas, crop biomass, C and N in biomass and grain, insect and disease pressure and grain yields.

The team's centralized database has been developed including the framework and Web-based repository that stores and manages research data from the field research network, farmer survey, and secondary data sets on climate and metadata for analyses and synthesis.

A stratified, random sample survey of nearly 20,000 farmers in the top 22 corn-producing HUC6 watersheds in the upper Midwest was sent in February 2012. The methodology and instrument was developed to assess farmers' social and economic beliefs, concerns and management practices.

Extension partnerships among 10 Land Grant Universities and 20 dedicated extension educators occurred. The climate science and agriculture extension plans of work were established and strengthened through the recruitment and orientation of extension educators who will establish bridges and create learning opportunities between the project team and more than 200 participating farmers.

The next generation scientists were recruited and trained with 35 graduate students performing research, extension and education work across all project objectives. Steps to develop an education curriculum were initiated with the recruitment of staff to work with high school science teachers to create science and agriculture modules for classroom, outdoor camps and informal learning experiences.

Project management developed mechanisms for internal and external communication. Collaborative tools, guidelines and standards were created for team use and housed on the CSCAP internal Web site. An external Web site was developed and content added for communicating team progress to the public (www.sustainablecorn.org).

Finally, the team leveraged dollars and personnel resources totaling more than $731,000. Collaborations and partnerships with other USDA projects were built and leveraged project dollars were obtained as additional funds to support research, extension and education.

APPENDIX & SUPPLEMENTAL MATERIALS

Appendix A: Team Roster

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
OPERATIONS Principal Investigator	✓	✓	✓	✓	✓	✓	Lois Wright Morton Iowa State University	Proj. Dir./ Professor Sociology	lwmorton@iastate.edu 515.294.2843
OPERATIONS Principal Investigator	✓	✓	✓	✓	✓	✓	Lori J. Abendroth Iowa State University	Project Manager Sociology	labend@iastate.edu 515.294.5692
OPERATIONS							Adam Bartelt* Iowa State University	Comm. Specialist Sociology	abartelt@iastate.edu 515.294.7380
OPERATIONS							Corene M. Bregendahl Iowa State University	Evaluator Leopold Center	
OPERATIONS							Roxanne Clemens* Iowa State University	Research Coordinator College of Ag & Life Sci.	
OPERATIONS							Lori Oh Iowa State University	Accountant Sociology	lorioh@iastate.edu 515.294.0477
ANEX Principal Investigator		✓	✓				Robert P. Anex, Jr. University of Wisconsin	Professor Ag and Biosystems Engin.	anex@wisc.edu 608.890.3839
ANEX		✓					Shashi Dhungel University of Wisconsin	PhD Grad Student Ag and Biosystems Engin.	
ANEX		✓					Lei Gu University of Wisconsin	PhD Graduate Student Ag and Biosystems Engin.	
ANEX		✓					Ao Li University of Wisconsin	PhD Graduate Student Ag and Biosystems Engin.	
ANEX		✓					Rashid Rafique University of Wisconsin	Post-Doctoral Researcher Ag and Biosystems Engin.	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
ARBUCKLE Principal Investigator			✓	✓	✓		J. Gordon Arbuckle, Jr. Iowa State University	Assistant Professor Sociology	arbuckle@iastate.edu 515.294.1497
ARRITT Principal Investigator		✓					Raymond W. Arritt Iowa State University	Professor Agronomy	rwarritt@iastate.edu 424.242.0329
BASSO Principal Investigator		✓					Bruno Basso Michigan State University	Associate Professor Crop Systems, Forestry, Env. Sci.	brunobasso1@gmail.com 3932.0437.1042
BENNING Principal Investigator			✓	✓	✓		Jamie L. Benning Iowa State University	Ext. Program Specialist & Ext. State Climate Ed Sociology	benning@iastate.edu 515.294.6038
BOWLING Principal Investigator	✓	✓					Laura Bowling Purdue University	Associate Professor Agronomy	bowling@purdue.edu 765.494.8051
BRADLEY Principal Investigator						✓	Kevin Bradley* University of Missouri	Associate Professor Plant Sciences	BradleyKe@missouri.edu 573.882.4039
CASTELLANO Principal Investigator	✓	✓					Michael Castellano Iowa State University	Assistant Professor Agronomy	castelmj@iastate.edu 515.294.3963
CASTELLANO	✓	✓					Javed Iqbal* Iowa State University	Post-Doctoral Researcher & GHG Measurement Coord. Agronomy	
CASTELLANO	✓						David Mitchell Iowa State University	MS Graduate Student Agronomy	
CHILVERS Principal Investigator						✓	Martin I. Chilvers* Michigan State University	Assistant Professor Plant Pathology	chilvers@msu.edu 517.353.9967
CRUSE Principal Investigator	✓						Richard M. Cruse Iowa State University	Professor & Dir. of Iowa Water Center Agronomy	rmc@iastate.edu 515.294.7850
CRUSE	✓						Scott Lee Iowa State University	PhD Graduate Student Ag & Biosystems Engin.	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
DAVIS Principal Investigator						✓	Vince Davis* University of Wisconsin	Assistant Professor Agronomy	vmdavis@wisc.edu 608.262.1392
DICK Principal Investigator	✓						Warren A. Dick The Ohio State University	Professor Environment & Natural Resources	dick.5@osu.edu 330.263.3877
DICK	✓						Brittany Campbell The Ohio State University	MS Graduate Student Environment & Natural Resources	
DICK	✓						Liming Chen The Ohio State University	Post-Doctoral Researcher Environment & Natural Resources	
DICK	✓						Clayton Dygert The Ohio State University	Research Specialist Environment & Natural Resources	
DICK	✓						Jessy Manifold The Ohio State University	MS Graduate Student Environment & Natural Resources	
EASTBURN Principal Investigator						✓	Darin M. Eastburn* University of Illinois	Associate Professor Plant Pathology	eastburn@illinois.edu 217.244.9632
ESKER Principal Investigator						✓	Paul Esker* University of Wisconsin	Assistant Professor Plant Pathology	pde@plantpath.wisc.edu 608.890.1999
EXTENSION				✓			Sarah Becker Lincoln University	Ext. State Climate Ed Extension	
EXTENSION				✓			Ross Behrends Minnesota	Ext. State Climate Ed Heron Lake Watershed District	
EXTENSION				✓			Robert Bellm University of Illinois	Ext. State Climate Ed Extension	
EXTENSION				✓			Dennis Bowman University of Illinois	Ext. State Climate Ed Extension	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
EXTENSION				✓			Laura Edwards South Dakota State University	Ext. State Climate Ed Extension	
EXTENSION				✓			Charles Ellis University of Missouri	Ext. State Climate Ed Extension	
EXTENSION				✓			Doug Goodrich Minnesota	Ext. State Climate Ed Redwood-Cotton Rivers Control Area	
EXTENSION				✓			Sanjun Gu Lincoln University	Ext. State Climate Ed Extension	
EXTENSION				✓			Russ Higgins University of Illinois	Ext. State Climate Ed Extension	
EXTENSION				✓			Richard Hoormann University of Missouri	Ext. State Climate Ed Extension	
EXTENSION				✓			Jon Neufelder Purdue University	Ext. State Climate Ed Extension	
EXTENSION				✓			Bryan Overstreet Purdue University	Ext. State Climate Ed Extension	
EXTENSION				✓			Angie Peltier University of Illinois	Ext. State Climate Ed Extension	
EXTENSION				✓			Hans Schmitz Purdue University	Ext. State Climate Ed Extension	
EXTENSION				✓			Michael Tarka Lincoln University	Ext. State Climate Ed Extension	
EXTENSION				✓			Marilyn Thelen Michigan State University	Ext. State Climate Ed MSU Extension	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
EXTENSION				✓			Jan Voit Minnesota	Ext. State Climate Ed Heron Lake Watershed District	
EXTENSION				✓			Shawn Wohnoutka Minnesota	Ext. State Climate Ed Redwood-Cotton Rivers Control Area	
EXTENSION				✓			Richard Wolkowski University of Wisconsin	Ext. State Climate Ed Extension	
FAUSEY Principal Investigator	✓						Norman R. Fausey USDA ARS – OH	Research Leader & Supervisory Soil Scientist USDA-ARS	norm.fausey@ars.usda.gov 614.292.9806
FAUSEY	✓						James Buxton USDA ARS – OH	ARS Hydrological Technician USDA-ARS	
FAUSEY	✓						Sarah Hess USDA ARS – OH	Hydrologic Technician USDA-ARS	
FRANKENBERGER Principal Investigator	✓						Jane Frankenberger Purdue University	Professor Ag & Biological Engin.	frankenb@purdue.edu 765.494.1194
FRANKENBERGER/ BOWLING	✓						Kyle Brooks Purdue University	MS Graduate Student Ag & Biological Engin.	
GARDINER Principal Investigator						✓	Mary Gardiner* The Ohio State University	Assistant Professor Entomology	gardiner.29@osu.edu 330.263.3643
GASSMAN Principal Investigator		✓					Philip W. Gassman Iowa State University	Associate Scientist Center for Ag & Rural Development	pwgassma@iastate.edu 515.294.6313
GASSMANN Principal Investigator	✓					✓	Aaron J. Gassmann Iowa State University	Assistant Professor Entomology	aaronjg@iastate.edu 515.294.7623
GASSMANN	✓					✓	Michael W. Dunbar Iowa State University	PhD Graduate Student Entomology	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
HELMERS Principal Investigator	✓						Matthew J. Helmers Iowa State University	Associate Professor Ag & Biosystems Engin.	mhelmers@iastate.edu 515.294.6717
HELMERS	✓						Reid Christianson* Iowa State University	Ext. Program Specialist Ag & Biosystems Engin.	
HELMERS	✓						Ryan J. Goeken Iowa State University	MS Graduate Student Ag & Biosystems Engin.	
HELMERS	✓						Carl Pederson* Iowa State University	Research Staff Ag & Biosystems Engin.	
HELMERS	✓						Xiaobo Zhou* Iowa State University	Research Staff Ag & Biosystems Engin.	
HERZMANN Principal Investigator	✓	✓					Daryl Herzmann Iowa State University	Assistant Scientist Agronomy	akrherz@iastate.edu 515.294.5978
INGELS Principal Investigator			✓	✓			Chad G. Ingels Iowa State University	Ext. Program Specialist Sociology	ingels@iastate.edu 563.425.3233
KLADIVKO Principal Investigator	✓						Eileen J. Kladivko Purdue University	Professor Agronomy	Kladivko@purdue.edu 765.494.6372
KLADIVKO	✓						Jason Cavadini Purdue University	MS Graduate Student Agronomy	
KLADIVKO	✓						Kaylissa Horton* Purdue University	MS Graduate Student Agronomy	
KLING Principal Investigator		✓					Catherine L. Kling Iowa State University	Professor Center for Ag & Rural Development/Economics	ckling@iastate.edu 515.294.5767
KLING		✓					Adriana Valcu Iowa State University	PhD Graduate Student Economics	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
KRAVCHENKO Principal Investigator	✓	✓					Alexandra Kravchenko Michigan State University	Associate Professor Crop & Soil Sciences	kravche1@msu.edu 517.355.0271 ext. 1241
KRAVCHENKO	✓	✓					Melissa Erickson Michigan State University	MS Graduate Student Crop & Soil Sciences	
KRAVCHENKO	✓	✓					Wakene Negassa Chewaka Michigan State University	Post-Doctoral Researcher Crop & Soil Sciences	
KRAVCHENKO	✓						Richard Price Michigan State University	Research Staff Crop & Soil Sciences	
LAL Principal Investigator	✓						Rattan Lal The Ohio State University	Professor School of Envir. & Nat. Resources	lal.1@osu.edu 614.292.9069
LAL	✓						Theresa Colson* The Ohio State University	Prog. Coordinator School of Env. & Nat. Resources	
LAL	✓						Felix Heitkamp The Ohio State University	Visiting Scholar School of Env. & Nat. Resources	
LAL	✓						Sandeep Kumar The Ohio State University	Post-Doctoral Researcher School of Envir. & Nat. Resources	
LAUER Principal Investigator	✓						Joseph G. Lauer University of Wisconsin	Professor Agronomy	jglauer@wisc.edu 608.263.7438
LAUER	✓						Thierno Diallo University of Wisconsin	Research Specialist Agronomy	
LAUER	✓						Maciek Kazula University of Wisconsin	PhD Graduate Student Agronomy	
LEANDRO Principal Investigator						✓	Leonor F.S. Leandro* Iowa State University	Assistant Professor Plant Pathology & Microbiology	lleandro@iastate.edu 515.294.8855

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
LEKIES Principal Investigator					✓		Kristi Lekies The Ohio State University	Assistant Professor Environment & Natural Resources	lekies.1@cfaes.osu.edu 614.688.3537
MALVICK Principal Investigator						✓	Dean Malvick* University of Minnesota	Associate Professor Plant Pathology	dmalvick@umn.edu 612.625.5282
MICHEL Principal Investigator						✓	Andrew P. Michel* The Ohio State University	Assistant Professor Entomology	michel.70@osu.edu 330.263.3730
MIGUEZ Principal Investigator		✓					Fernando E. Miguez Iowa State University	Assistant Professor Agronomy	femiguez@iastate.edu 515.294.5980
MIGUEZ		✓					Andrea Basche Iowa State University	PhD Graduate Student Agronomy	
MIGUEZ	✓						Laila Puntel* Iowa State University	MS Graduate Student Agronomy	
MILLER Principal Investigator					✓		William Wade Miller Iowa State University	Professor Ag Ed & Studies	wwmiller@iastate.edu 515.294.0895
MILLER					✓		Matthew J. Shultz* Iowa State University	PhD Graduate Student Ag Ed & Studies	
MOORE Principal Investigator				✓	✓		Richard H. Moore The Ohio State University	Professor & Asst. Dir. School of Env. & Nat. Res.	moore.11@osu.edu 330.202.3538
MOORE				✓	✓		Rachel Hintz The Ohio State University	Ed Development Spec. School of Envir. & Nat. Resources	
MOORE				✓			Deana Hudgins The Ohio State University	Ext. State Climate Ed School of Env. & Nat. Res.	
MUELLER Principal Investigator	✓					✓	Daren S. Mueller Iowa State University	Assistant Professor Plant Pathology & Microbiology	dsmuelle@iastate.edu 515.460.8000

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
MUELLER						✓	Nathan Bestor* Iowa State University	IPM Assistant Coordinator Plant Pathology & Microbiology	
MUELLER/TYLKA						✓	Edward Zaworski* Iowa State University	MS Graduate Student Plant Pathology & Microbiology	
NAFZIGER Principal Investigator	✓						Emerson D. Nafziger University of Illinois	Professor Crop Sciences	ednaf@illinois.edu 217.333.9658
NAFZIGER/ VILLAMIL	✓						Chang Hoon Lee University of Illinois	Visiting Scholar Crop Sciences	
NAFZIGER/ VILLAMIL	✓						Shin-yi Lee Marzano University of Illinois	Research Staff Crop Sciences	
NAFZIGER/ VILLAMIL	✓						Stacy Zuber University of Illinois	MS Graduate Student Crop Sciences	
NKONGOLO Principal Investigator	✓						Nsalambi Nkongolo Lincoln University	Associate Prof. & GIS Lab Mgr. Ag & Environment	nkongolo@lincolnu.edu 573.681.5397
NKONGOLO	✓						Samuel Haruna Lincoln University	MS Graduate Student Ag & Environment	
NKONGOLO	✓						Brandon Mebruer Lincoln University	MS Graduate Student Ag & Environment	
NKONGOLO	✓						Stephanie Sale* Lincoln University	MS Graduate Student Ag & Environment	
NKONGOLO	✓						Kent Schmidt Lincoln University	Research Technician Ag & Environment	
NKONGOLO	✓						Jason Williams Lincoln University	MS Graduate Student Ag & Environment	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
ONEAL Principal Investigator	✓	✓				✓	Matthew O'Neal Iowa State University	Associate Professor Entomology	oneal@iastate.edu 515.294.8622
OWENS Principal Investigator	✓	✓					Phillip Owens Purdue University	Associate Professor Agronomy	prowens@purdue.edu 765.494.0247
OWENS	✓	✓					Jenette Goodman Purdue University	PhD Graduate Student Agronomy	
ROBERTSON Principal Investigator						✓	Alison Robertson* Iowa State University	Associate Professor Plant Pathology & Microbiology	alisonr@iastate.edu 515.294.6708
SAWYER Principal Investigator	✓						John E. Sawyer Iowa State University	Professor Agronomy	jsawyer@iastate.edu 515.294.7078
SAWYER	✓						Dan Barker* Iowa State University	Assistant Scientist Agronomy	
SAWYER	✓						Jose Pantoja Iowa State University	PhD Graduate Student Agronomy	
SCHARF Principal Investigator	✓						Peter Scharf University of Missouri	Professor Plant Sciences	ScharfP@missouri.edu 573.882.0777
SCHARF	✓						David Kleinsorge University of Missouri	Research Specialist Plant Sciences	
SCHARF	✓						Larry Mueller University of Missouri	Research Specialist Plant Sciences	
STROCK Principal Investigator	✓						Jeffrey S. Strock University of Minnesota	Associate Professor Dept. of Soil, Water, & Climate	jstrock@umn.edu 507.752.5064
STROCK	✓						Mark Coulter University of Minnesota	Assistant Scientist Dept. of Soil, Water, & Climate	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
STROCK	✓						Paulo Pagliari University of Minnesota	Research Associate Dept. of Soil, Water, & Climate	
TODEY Principal Investigator			✓	✓	✓		Dennis Todey South Dakota State University	Assoc. Professor & State Climatologist Ag Engineering	dennis.todey@sdstate.edu 605.688.5678
TODEY				✓			Trenton G. Ellis South Dakota State University	PhD Graduate Student Sociology & Rural Studies	
TODEY				✓			Erin L. Seldat South Dakota State University	PhD Graduate Student Sociology & Rural Studies	
TYLKA Principal Investigator						✓	Gregory L. Tylka* Iowa State University	Professor Plant Pathology & Microbiology	gltylka@iastate.edu 515.294.3021
TYNDALL Principal Investigator			✓	✓			John Tyndall Iowa State University	Assistant Professor Nat. Resource Ecology & Mngt	jtyndall@iastate.edu 515.294.4912
TYNDALL/ ARBUCKLE			✓				Tricia Knoot* Iowa State University	Post-Doctoral Researcher Nat. Resource Ecology & Mngt	
VILLAMIL Principal Investigator	✓						Maria B. Villamil University of Illinois	Assistant Professor Crop Sciences	villamil@illinois.edu 217.333.4690
WISE Principal Investigator						✓	Kiersten Wise* Purdue University	Assistant Professor Botany & Plant Pathology	kawise@purdue.edu 765.496.2170
WRIGHT MORTON			✓				Jonathan M. Hobbs* Iowa State University	PhD Graduate Student Statistics	
WRIGHT MORTON			✓				Jean M. McGuire* Iowa State University	PhD Graduate Student Sociology	
WRIGHT MORTON			✓				Benjamin B. Shin* Iowa State University	MS Graduate Student Sociology	

Research Group	OBJ 1&2	OBJ 3	OBJ 4	OBJ 5	OBJ 6	IPM	Name/ Org.	Position/ Dept.	E-mail/ Phone
WRIGHT MORTON				✓			Adam Wilke* Iowa State University	MS Graduate Student Sociology	
YANG Principal Investigator						✓	X.B. Yang* Iowa State University	Professor Plant Pathology & Microbiology	xbyang@iastate.edu 515.294.8826

** denotes personnel actively engaged in the project, but not funded through CSCAP's USDA grant funds.*

Appendix B: Advisory Board Roster

Name	Organization	Position
Arlen Leholm	North Central Regional Assoc. of Ag Exp. Station Directors	Executive Director
Arnel Hallauer	National Academy of Sciences	Member
David Wright	Iowa Soybean Board & NC Soybean Research Program	Director of Research
Gary Mast	Nat. Assoc. of Conservation Districts	Producer
Howard M. Brown	GROWMARK	Manager of Agronomy Services
James B. Gulliford	Soil & Water Conservation	CEO; former EPA director of Region VI & national EPA program director
Jerry L. Hatfield	Agricultural Research Service, National Lab. for Agric. & Environ.	Director
Joe Colletti	Iowa State University, College of Ag. & Life Sci.	Sr. Assoc. Dean of CALS & Assoc. Director of Expt. Stations
John Kadyszewski	Winrock International, Ecosystem Services	Director of Winrock's American Carbon Registry
Leonard (Kris) Krishtalka	University of Kansas, Biodiversity Institute	Director
Mark Hamsher	Ohio Educational System	High School Science Teacher
Norman Widman	National Resource Conservation Service, Ecological Sciences Division	National Agronomist
Paul Helgeson	Gold'n Plump (GNP)	Sustainability Manager
Pradip K. Das	Monsanto	Technology Lead, IFS
Reagan M. Waskom	Colorado Water Institute	Director
Robin Shepard	North Central Cooperative Extension Association	Executive Director
Thomas C. Dorr	U.S. Grains Council	CEO
Richard Sloan	Iowa Producer in Lime Creek Watershed	Producer

Appendix C: Publication Guidelines

CSCAP Team Publication Guidelines

Confirmed at Annual Meeting, November 2011

OVERVIEW

Developed by the CSCAP Publications Committee: *Lois Wright Morton, Eileen Kladivko, Dennis Todey, Cathy Kling, and Lori Abendroth*.

Guidelines developed for research, extension, and education publications developed by CSCAP faculty, staff, and students. Recommendations for proper citation, credit, and acknowledgement vary based on type of publication and complexity. Recommendations are given for each category of publication; exceptions and variations are possible but should be brought to the committee prior to publication for verification.

These guidelines apply to publications derived from CSCAP data secured on a password protected central database. One exception to these guidelines is the socio-economic survey data jointly funded and collected in conjunction with U2U, a USDA-NIFA standard climate grant. These survey data will be secured on the password protected site of each group and used under the same guidelines as stated in this document.

CATEGORIES

Refereed Journal Articles and Technical Reports

[1.] Using field/primary data from state level sites

- [a] List lead author and coauthor(s) as typically done per respective journal.
- [b] Include personnel only directly involved with field/primary research.
- [c] Include Acknowledgement option [1].

[2.] Combining field/primary data from 2 or more states' scope of work

- [a] List lead author and coauthor(s) as typically done per respective journal.
- [b] Include personnel only directly involved with field/primary research.
- [c] Include Acknowledgement option [1].

[3.] Using primary data for secondary analysis (e.g. modeling and/or survey analyses)

- [a] List lead author and coauthor(s) as typically done per respective journal.
- [b] Next, include PI's whose field research/primary data comprise the dataset used for analysis and/or modeling. Include PI names in alphabetical order. This may or may not include all PI's* on CSCAP dependent on which field sites/primary data are used in the paper.
  **PI needs to decide whether a staff or student should be listed instead of themselves based on time spent on respective dataset.*
- [c] Agreement form (page 6) must be initiated prior to publication by the first author with a copy submitted to the CSCAP operations team. It is recommended that secondary users initially consult with data owners prior to analysis for clear communication and agreement.

[d] Include Acknowledgement option [2].

Education and Extension Curricula & Publications
(Peer Review or Not Peer Review)

[1.] State-based publication

[a] List lead author and coauthor(s) as typically done.
[b] Include Acknowledgement option [3].
[c] Include Publication number as described on page 5.
[d] Include institution logo as primary logo at page header.
[e] Include the Sustainablecorn.org logo at the page footer.
[f] Include the USDA logo at the page footer.
[g] Include disclaimer on bottom of last page (see page 5).

[2.] Publication from 2 or more states' scope of work

[a] List lead author and coauthor(s) as typically done.
[b] Include Acknowledgement option [3].
[c] Include Publication number as described on page 5.
[d] Include multiple institution logos if desired.
[e] Include the Sustainablecorn.org logo as primary logo at page header or footer.
[f] Include the USDA logo at page header or footer.
[g] Include disclaimer on bottom of last page (see page 5).

Presentations: Field, Conferences, and Societal Meetings

[1.] Individual PI or state-based

[a] Use standardized PowerPoint (PPT) or poster template if possible, provided by CSCAP operations. If not using the standardized version, please adhere to points [d, e, f] listed here.
[b] List lead author and coauthor(s) as typically done.
[c] Include Acknowledgement [1] on last slide or bottom of poster.
[d] Include institution logo at the top left of poster or in the bottom left of PPT slide.
[e] Include the Sustainablecorn.org logo at the top right of poster or in the bottom right of PPT slide.
[f] Include the USDA logo at the top right of poster or in the bottom right of PPT slide.

[2.] Group presentations and/or using multi-state data in presentation

[a] Use standardized PowerPoint (PPT) or poster template if possible, provided by CSCAP operations. If not using the standardized version, please adhere to points [d, e, f] listed here.
[b] List lead author and coauthor(s) as typically done.
[c] Include Acknowledgement [1] on last slide or bottom of poster.
[d] Include multiple institution logos, if desired, at the top left of poster or in the bottom left of PPT slide.
[e] Include the Sustainablecorn.org logo at the top right of poster or in the bottom right of PPT slide.

[f] Include the USDA logo at the top right of poster or in the bottom right of PPT slide.

Theses and Dissertations

[1.] Research on individual component of CSCAP, within state scope of work.
- [a] List student and committee as typically done.
- [b] Include Acknowledgement option [1].
- [c] If part of the thesis or dissertation is published in a refereed journal, follow respective guidelines.

[2.] Research using CSCAP data for secondary analyses (e.g. modeling and/or survey analyses), within or across state's scope of work.
- [a] List student and committee as typically done.
- [b] In the Acknowledgement section or Materials & Methods, include PI's who conducted field research/survey collection that comprise the dataset used for analyses and/or modeling. Include PI names in alphabetical order. This may or may not include all PI's on CSCAP dependent on which primary data are used in paper.
- [c] Include Acknowledgement option [2].
- [d] If part of the thesis or dissertation is published in a refereed journal, follow respective guidelines.

Media: Videos, Web site, etc.

[1.] Individual PI
- [a] List presenter as typically done, by title and institution.
- [b] Include institution logo where appropriate.
- [c] Reference the funding source when speaking or at the bottom of webpages; e.g. use Acknowledgment [1].
- [d] Include the Sustainablecorn.org logo.
- [e] Include the USDA logo.

Acknowledgement Text

All publications will include a reference to the funding agencies* and scope of CSCAP in the Acknowledgements section. Insert one of the following text options based on type of publication.

**If funding beyond the USDA-NIFA grant was acquired, insert acknowledgement to additional agencies/sources next to or following the CSCAP reference.*

[1] This research is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190, "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems." Project Web site: sustainablecorn.org.

[If space exists, also include:]

Lois Wright Morton is Project Director of the Cropping Systems CAP. The 12 organizations comprising the project team include the following Land Grant

Universities and USDA Agricultural Research Service (ARS): Iowa State University; University of Illinois; Lincoln University; Michigan State University; The Ohio State University; Purdue University; University of Minnesota; University of Missouri; University of Wisconsin; USDA-ARS Columbus, Ohio; and South Dakota State University.

[2] This research is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190, "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems." The dataset used in this paper was derived from field research experiments conducted by *name 1, name 2, …, name X* (listed in alphabetical order) as part of the Cropping Systems CAP. Project Web site: sustainablecorn.org.

[If space exists, also include:]

Lois Wright Morton is Project Director of the Cropping Systems CAP. The 12 organizations comprising the project team include the following Land Grant Universities and USDA Agricultural Research Service (ARS): Iowa State University; University of Illinois; Lincoln University; Michigan State University; The Ohio State University; Purdue University; University of Minnesota; University of Missouri; University of Wisconsin; USDA-ARS Columbus, Ohio; and South Dakota State University.

[3] The information contained within this *[insert: publication/module/etc.]* is based on extensive scientific research conducted at sites across the Midwest. This regional collaborative project is supported by the USDA-NIFA, Award No. 2011-68002-30190, "Cropping Systems Coordinated Agricultural Project: Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems." Project Web site: sustainablecorn.org.

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Publication Number

Many of the publications produced by CSCAP personnel will have the capability and need for a reference number. Use the following structure and insert at the bottom of the last page of the publication. Contact CSCAP Publication Committee for what should be inserted for "Number of publication in system."

Publication numbers will be set as: CSCAP-Number of publication in system-Year-State or

Region. *Example, the first CSCAP publication is: CSCAP-0001-2011-IA*

Logos and Style

It is recommended that all affiliated publications and materials utilize standard publication guidelines whenever possible to remain consistent with the project's visual identity and style.

General guidelines:

- Font: Arial, 11 point
- Spacing: Single-spaced, paragraphs separated by line breaks
- Colors: Based primarily off those listed as part of the visual identity (orange and blue)

Logos are available in black/white or color. Use color logo for all print and web material when possible. Attain high resolution version of logos from CSCAP internal site.

Disclaimer for University Produced Materials

This is the most recent statement (as of 22 Nov 2011 via the USDA). You may use this or another version provided by your University. This is included here as a reference, if needed.

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Agreement for Publication

The Cropping Systems Coordinated Agricultural Project (CSCAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems is a multi-faceted, complex project aimed at answering questions important to researchers, policy makers, and citizens. To provide results and recommendations to others, we must work cooperatively in sharing and publishing data. Primary data, whether collected in field research plots, surveys, or landowner meetings, are needed for secondary analysis, e.g. crop, climate, and societal analyses and modeling.

Use of primary data must be authorized by the data owners prior to publication. A reasonable amount of time must be given to primary owners of data to publish in their respective journals. It is expected secondary users of the data will know their journal's stipulations regarding the disclosure of the dataset at time of publishing. This is an important clarification so that any published work on modeling does not unknowingly disqualify future publications

of the dataset from occurring.

It is the role of the data owner to assure the data is of highest quality with no known errors or changes expected to occur once it is uploaded to the team database. Secondary users may access and initially work with data contained in the database but must attain PI agreement prior to publication.

I have discussed this publication with all involved data owners and have followed the guidelines as stated in this document for my specific type of publication.

Title of Publication: _____

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Lead Author of Publication: _____ Date: _____

I agree to use of the data, which was collected by myself and/or my team, for use in the lead author's publication. My name, or someone on my team, will be included in the author list for this publication.

Data Owners: _____ Date: _____

_____ Date: _____

_____ Date: _____

Appendix D: Evaluation Plan Overview and Timeline

(MIXED) METHODS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Primary Data Collection					
Online survey of project PIs and participants (survey will also be administered on an individual basis as grad students/post docs leave and join the project)	✓				✓
Key informant interviews					
Team leaders		✓	✓	✓	✓
Project Director, Manager, Communications Specialist, Accountant		✓	✓	✓	✓
Listening session with graduate students @ annual conference		✓	✓	✓	✓
Conference call participant observation		✓	✓	✓	✓
Survey/interview of Extension educators					✓
Secondary Data Collection					
Media communications (radio, TV, print news stories)		✓	✓	✓	✓
Website statistics					
External Web site statistics		✓	✓	✓	✓
Internal Web site statistics		✓	✓	✓	✓
Publications					
Protocols	✓				
Products and publications		✓	✓	✓	✓
Quarterly report assessment		✓	✓	✓	✓
Milestones assessment		✓	✓	✓	✓
Assessment of external collaborators and partners (United Soybean Board, U2U, Midwest Corn Growers, etc.)		✓	✓	✓	✓
Deliverables	**Interim Report**	**Yr 2 Report**	**Interim Report**	**Interim Report**	**Project Report**

Appendix E: Team Evaluation Survey Results

1. Please indicate your role/position on the Corn-based Systems Coordinated Agriculture Project (CSCAP) team. (n=121)

PI or co-PI	34.7%
Professional and technical staff	19.0%
Graduate Student	18.2%
Advisory Board	9.1%
High school teacher	0.0%
Extension educator	10.7%
Other	8.3%

2. Please list your academic discipline(s) below. An academic discipline is defined as 1) A major or minor subject area of study offered at a university, or 2) an academic department with its own faculty and staff (e.g., agronomy, sociology, statistics, chemistry).

Primary discipline *(frequency in parenthesis)*

Accounting
Administration
Ag. and Biosystems Engineering (2)
Agricultural Education (3)
Agricultural Climatology
Agricultural Engineering (5)
Agricultural Meteorology (3)
Agriculture
Agroecology
Agronomic, erosion and water quality
Agronomy (20)
Animal Science
Anthropology
Atmospheric dynamics
Biological Systems Engineering (2)
Business
Chemistry
Crop modeling
Crop Science (2)
Economics (2)
Education
Engineering
English
Entomology (3)
Environmental and Natural Resources (2)
Environmental Science (4)
Environmental Science and Wetland Ecology
Environmental Soil Science
Evolutionary Biology
Forestry Economics and Marketing (2)
Geography (Earth Science) Hydrology
Atmospheric Science
Geology (2)
Horticulture
Human development
Hydrology
Landscape ecology
Life cycle assessment
Natural Resources (2)
Pedology
Plant Pathology (10)
Plant Sciences
Professional Geography
Rural sociology
Secondary Biology
Sociology (6)
Soil Fertility
Soil Physics
Soil Science (12)
Soil Science, specifically soil and nutrient management
Sustainable Agriculture (2)
Water Resources
Watershed hydrology, stochastic simulation
Weed Science (2)

Secondary discipline (if any)

Ag Economics
Agricultural Engineering (2)
Agronomy (7)
Applied climate science
Biodiversity Science
Biological Systems Engineering (2)
Biometry
Chemistry
Civil engineering
Climatology
Commercial agriculture
Conservation Planning and Technical Standards
Corn Research
Crop Physiology (2)
Crop Science (2)
Cropping Systems
Ecology
Ecology and Evolutionary Biology (2)
Environmental Science (3)
Extension
Forest ecosystem management
Geography
Geology
Ground water
Hydraulics
Modeling
Natural Resources
Operations/Admin
Part-time Farmer
Plant pathology
Plant science
Population Genetics
Science Education
Sociology (2)
Soil Fertility
Soil Management
Soil Science (3)
Soil Sciences Biometry
Statistics
Sustainable Agriculture
Teacher Certification
Technology
Water Resources (2)

Third discipline (if any)

Agricultural meteorology
Agronomy
CIS
Crop modeling, statistics
Education
Geo-statistics
Hydrology
Insect Management
Integrate pest management
Landscape Ecology
Mycology
Plant ecology
Plant nutrition
Precipitation collection
Soil Fertility
Soil science
Statistics
Systems analysis
Waste Management
Water quality

3. On which CSCAP objective(s) are you working? (Choose all that apply.) (n=121)

Objective 1. Development of standardized methodologies for estimating C, N, and water footprints	21.5%
Objective 2. Performing field tests across 8 states; 21 baseline sites	43.8%
Objective 3. Application of models and scaling up to watershed levels	17.4%
Objective 4. Life cycle assessment and evaluation of willingness to adopt new systems	9.1%
Objective 5. Integration of education, extension, outreach, and stakeholder participation	33.1%
Whole project, all objectives	12.4%

4. The following are problems that some Corn Belt farmers have experienced over the past few years. How concerned are you about the following potential problems? (Make one selection on each line.) (n=121)

		Not Concerned	Slightly Concerned	Concerned	Very Concerned
a.	Increased flooding	5.8%	15.7%	52.1%	26.4%
b.	Longer dry periods and drought	4.1%	19.0%	50.4%	26.4%
c.	Increased weed pressure	11.6%	40.5%	37.2%	10.7%
d.	Increased insect pressure	9.9%	35.5%	43.0%	11.6%
e.	Higher incidence of crop disease	7.4%	31.4%	49.6%	11.6%
f.	More frequent extreme rains	5.0%	15.7%	43.8%	35.5%
g.	Higher incidence of saturated soils and ponded water	7.4%	25.6%	45.5%	21.5%
h.	Higher incidence of heat stress on crops and livestock	5.0%	29.8%	49.6%	15.7%
i.	Increased nitrogen leaching into nearby water bodies	5.0%	16.5%	42.1%	36.4%
j.	Increased soil loss (erosion)	4.1%	14.0%	42.1%	39.7%
k.	Increased nitrogen gas losses from soil leading to atmospheric pollutants and/or greenhouse gases	9.9%	32.2%	41.3%	16.5%

5. Please indicate your level of agreement with each of the following statements. (Make one selection on each line.) (n=121)

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a.	1 to 7 day weather forecasts are generally accurate	1.7%	14.0%	19.0%	58.7%	6.6%
b.	Monthly and/or seasonal weather forecasts are generally accurate	9.1%	25.6%	47.1%	17.4%	0.8%
c.	Extreme weather events in recent years have affected my long-term research goals	5.8%	13.2%	35.5%	35.5%	9.9%

6. People have different opinions about what makes a "good farmer." Please rate the following items in terms of their importance to what characteristics make a good farmer. (Make one selection on each line.) (n=121)
A good farmer is one who…

		Not Important at All	Slightly Important	Somewhat Important	Important	Very Important
a.	has the highest yields per acre ……..	9.1%	14.9%	35.5%	35.5%	5.0%
b.	is willing to try new practices and approaches	0.8%	2.5%	14.9%	51.2%	30.6%
c.	gets their crops planted first ……	34.7%	28.1%	24.8%	10.7%	1.7%
d.	considers the health of streams that run through or along their land to be their responsibility……	0.8%	2.5%	12.4%	47.9%	36.4%
e.	minimizes soil erosion ……	0.8%	0.8%	8.3%	43.0%	47.1%
f.	has the highest profit per acre ……	6.6%	9.1%	32.2%	34.7%	17.4%
g.	has the most up-to-date equipment ……	23.1%	32.2%	35.5%	7.4%	1.7%
h.	minimizes nutrient runoff into waterways ……	0.8%	3.3%	10.7%	40.5%	44.6%
i.	uses the latest seed and chemical technology	13.2%	26.4%	32.2%	23.1%	5.0%
j.	maximizes government payments ……	35.5%	29.8%	21.5%	11.6%	1.7%
k.	thinks beyond their own farm to the social and ecological health of their watershed …….	0.8%	5.0%	14.9%	37.2%	42.1%
l.	maintains or increases soil organic matter …..	0.8%	2.5%	16.5%	42.1%	38.0%
m.	minimizes the use of pesticides ……	8.3%	14.0%	24.0%	30.6%	23.1%
n.	manages for both profitability and minimization of environmental impact ……	0.8%	1.7%	7.4%	28.9%	61.2%
o.	scouts before spraying for insects/weeds/disease	0.8%	3.3%	11.6%	43.0%	41.3%
p.	manages farm operation to reduce income volatility ……	0.8%	1.7%	18.2%	57.0%	22.3%
q.	puts long-term conservation of farm resources before short-term profits ……	1.7%	5.0%	14.9%	40.5%	38.0%

7. **Organizations, agencies, and individuals can do a number of things to prepare for or address potential changes in climate. Please provide your opinions on the following statements. (Make one selection on each line.) (n=121)**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Farmers should take additional steps to protect farmland from the impacts of climate change	0.0%	0.0%	28.1%	55.4%	16.5%
b. University researchers should focus more on climate change research	0.0%	5.8%	33.1%	42.1%	19.0%
c. Youth educators should integrate climate change into their science curriculum	0.0%	4.1%	24.8%	45.5%	25.6%
d. University faculty should integrate climate science into their curriculum	0.0%	4.1%	23.1%	47.9%	24.8%
e. Funding agencies and organizations should direct more resources toward climate change research	1.7%	5.8%	34.7%	37.2%	20.7%
f. Seed companies should be developing crop varieties adapted to coming changes in weather patterns	0.0%	2.5%	23.1%	47.1%	27.3%
g. University Extension should help farmers to prepare for the impacts of climate change	0.0%	1.7%	15.7%	55.4%	27.3%
h. State and federal agencies should help farmers to prepare for the impacts of climate change	0.8%	2.5%	24.0%	53.7%	19.0%
i. Farm organizations (e.g., Farm Bureau, Corn Growers) should help farmers to prepare for the impacts of climate change	0.0%	1.7%	22.3%	55.4%	20.7%
j. Profitable markets for biomass should be developed to encourage planting of perennial crops (grasses, trees) on vulnerable land	1.7%	5.0%	22.3%	47.9%	23.1%
k. Profitable markets for carbon credits should be developed to encourage use of conservation tillage, cover crops, and other practices	6.6%	8.3%	24.0%	36.4%	24.8%
l. Profitable markets for small grains and other alternative crops should be developed to encourage diversified crop rotations	1.7%	5.0%	14.0%	46.3%	33.1%
m. Farmers should incorporate practices that reduce greenhouse gas emissions from their farming operation	1.7%	1.7%	30.6%	43.0%	23.1%

8. There is increasing discussion about climate change and its potential impacts. Please select the statement that best reflects your beliefs about climate change. (Choose only one.) (n=121)

a. Climate change is occurring, and it is caused mostly by natural changes in the environment	10.7%
b. Climate change is occurring, and it is caused mostly by human activities	50.4%
c. Climate change is occurring, and it is caused equally by natural changes in the environment and human activities	30.6%
d. Climate change is not occurring	0.0%
e. There is not sufficient evidence to know with certainty whether climate change is occurring or not	8.3%

9. Prior to January 2011 (the start of the CSCAP), how frequently did you do each of the following? (Make one selection on each line.) (n=121)

	Never	Once or twice a year	Quarterly	Monthly	Weekly
a. Read journals or publications outside your primary, secondary, or third disciplines (listed in response to Question #2)	12.4%	21.5%	19.8%	28.9%	17.4%
b. Attended meetings or conferences outside your primary, secondary, or third disciplines	38.8%	45.5%	12.4%	3.3%	0.0%
c. Participated in working groups or committees with the intent to learn from researchers in other disciplines	24.8%	40.5%	20.7%	12.4%	1.7%
d. Submitted grant proposals, other than the CSCAP, in partnership with colleagues or others outside your primary, secondary, or third disciplines	51.2%	36.4%	10.7%	1.7%	0.0%
e. Received grant funding awards, other than the CSCAP, in partnership with colleagues or others outside your primary, secondary, or third disciplines	57.0%	36.4%	6.6%	0.0%	0.0%
f. Obtained new insights into your own work through discussion with colleagues from other disciplines	10.7%	26.4%	23.1%	18.2%	21.5%
g. Modified your own work or research agenda as a result of discussions with colleagues from other disciplines	18.2%	32.2%	28.1%	18.2%	3.3%
h. Established links with colleagues from other disciplines that led to or may lead to future collaborative work	14.0%	47.1%	18.2%	14.9%	5.8%

10. Indicate the extent to which you agree with the following statements about the CSCAP team overall. (Make one selection on each line.) (n=121)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
a. The CSCAP team is accepting of new ideas	0.0%	1.7%	28.9%	29.8%	14.0%	25.6%
b. There is good communication among CSCAP team members	0.0%	5.8%	24.8%	36.4%	13.2%	19.8%
c. The CSCAP team is able to capitalize on the strengths of different researchers	0.0%	1.7%	23.1%	32.2%	22.3%	20.7%
d. The organization and structure of the CSCAP team is working well	0.0%	2.5%	21.5%	35.5%	15.7%	24.8%
e. The CSCAP team is able to accommodate the different working styles of team members	0.0%	1.7%	26.4%	32.2%	9.1%	30.6%
f. CSCAP team members are responsive to requests for information or action from other CSCAP team members	0.0%	3.3%	25.6%	29.8%	18.2%	23.1%

11. Indicate the extent to which you agree with the following statements about CSCAP outcomes. (Make one selection on each line.) (n=121)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
a. The CSCAP group meetings are productive	0.0%	4.1%	33.9%	22.3%	7.4%	32.2%
b. Overall CSCAP productivity (i.e., data, methodologies, modules, publications, and other products) is high	0.0%	0.8%	30.6%	26.4%	7.4%	34.7%
c. Overall quality of CSCAP data, methodologies, modules, publications, and other products is high	0.0%	1.7%	27.3%	28.9%	9.1%	33.1%
d. In general, the CSCAP has improved my research productivity (i.e., data, methodologies, modules, publications, and other products)	1.7%	10.7%	34.7%	22.3%	9.1%	21.5%
e. In general, the CSCAP has improved the quality of my research	0.8%	11.6%	34.7%	24.0%	8.3%	20.7%
f. Time spent on the CSCAP is well worth the effort in terms of returns I am receiving	0.0%	3.3%	30.6%	27.3%	18.2%	20.7%

12. Indicate the extent to which you agree with the following statements about your trust of the CSCAP team. (Make one selection on each line.) (n=121)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
a. I am comfortable showing limits or gaps in my knowledge to CSCAP team members	0.0%	1.7%	19.0%	44.6%	22.3%	12.4%
b. In general, I feel that I can trust the CSCAP team	0.0%	0.8%	22.3%	43.0%	18.2%	15.7%
c. In general, I find that CSCAP team members are open to constructive criticism	0.0%	2.5%	24.0%	28.9%	10.7%	33.9%
d. In general, I respect the CSCAP team members	0.0%	0.8%	14.0%	42.1%	31.4%	11.6%
e. I trust other CSCAP team members will not exploit or otherwise misappropriate ideas or information I share	0.0%	0.8%	17.4%	39.7%	23.1%	19.0%
f. I feel comfortable voicing my thoughts, knowledge, and opinions during CSCAP meetings and conference calls	0.0%	1.7%	22.3%	37.2%	22.3%	16.5%

Transdisciplinary science initiatives, such as the CSCAP, are different from interdisciplinary and/or multi-disciplinary initiatives in that they not only integrate two or more disciplinary perspectives, but also create novel conceptualizations, methodological approaches, analyses, and outcomes that move beyond individual disciplines.

13. Using the definition above, indicate the extent to which you agree with the following statements about transdisciplinary science. (Make one selection on each line.) (n=121)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
a. I describe myself as someone who strongly values transdisciplinary collaboration.....	0.0%	2.5%	7.4%	43.0%	43.8%	3.3%
b. Transdisciplinary research in the CSCAP stimulates me to change my thinking.....	0.0%	0.8%	30.6%	37.2%	15.7%	15.7%
c. I have changed the way I pursue research ideas because of my involvement in the transdisciplinary CSCAP	1.7%	13.2%	42.1%	19.0%	5.8%	18.2%
d. Transdisciplinary research has improved how I conduct research	0.0%	8.3%	29.8%	30.6%	14.9%	16.5%
e. CSCAP team members are open-minded about considering research perspectives from disciplines other than their own	0.0%	2.5%	22.3%	41.3%	6.6%	27.3%
f. I am optimistic that the transdisciplinary research of the CSCAP will lead to valuable scientific outcomes that would not occur without this kind of collaboration.....	0.0%	1.7%	16.5%	47.9%	26.4%	7.4%
g. Addressing issues through a transdisciplinary team approach results in better research, education, and outreach	0.0%	0.8%	14.9%	48.8%	31.4%	4.1%
h. Because of my involvement in transdisciplinary research, I have an increased understanding of what my own discipline brings to the collaboration.....	0.0%	3.3%	25.6%	40.5%	19.8%	10.7%
i. Generally speaking, I believe that the benefits of transdisciplinary scientific research outweigh the inconveniences and costs of such work	0.0%	2.5%	16.5%	50.4%	24.8%	5.8%
j. I am comfortable working in a transdisciplinary environment.....	0.0%	0.8%	11.6%	49.6%	33.1%	5.0%
k. Overall, I am pleased with the effort I have made to engage in transdisciplinary research for the CSCAP	0.8%	0.8%	32.2%	31.4%	21.5%	13.2%

14. What is the likelihood you will be able to achieve your Year 1 project milestones in the next four months? (Choose only one.) (n=121)

Very likely	22.3%
Likely	36.4%
Uncertain	14.9%
Unlikely	2.5%
Very unlikely	0.0%
Does not apply	24.0%

15. What is your gender? (n=121)

Female	27.3%
Male	72.7%

16. What is your age? (n=119) Range = 22-65 years $\bar{x}$ = 41.9 years St. Dev. = 12.6

Appendix F: Project Milestones

Task Name	Lead
Objective 1. Develop standardized methodologies and perform baseline monitoring of carbon, nitrogen, and water footprints at agricultural test sites across the Midwest.	
Develop written standard protocols and training for agronomic indicators	Lauer
Protocols developed for in-season measurements: plant population, biomass (dry matter) for all crops	
Protocols developed for harvest measurements: grain moisture, grain yield, and grain total C & N for all crops	
Develop written standard protocols and training for greenhouse gas data (CO2, N2O, and CH4)	Castellano
Protocol developed for GHG collection methodology	
Train team and students in PAS operation with written standard protocols.	
Sampling for data quality control.	
Check each PAS every 3 months for accuracy; recalibrate as necessary.	
Develop written standard protocols and training for soil data	Lal, Kladivko, Helmers
Protocols developed for baseline carbon, nitrogen, pH, CEC, and texture measurements.	
Protocol developed for baseline soil bulk density measurements.	
Protocol developed for baseline soil water retention measurements.	
Protocols developed for optional soil quality measurements of aggregation, penetration resistance, earthworms, and infiltration	
Protocols developed for soil moisture monitoring on selected plots.	
Protocols developed for soil nitrate sampling on selected plots.	
Develop written standard protocols and training for IPM measurements	Gassmann, Mueller, ONeal
Develop protocols, select graduate students, and train research farm cooperators.	
Develop written standard protocols and training for water and drainage measurements	Helmers
Protocols developed for measuring drainage flow and collection of nitrate concentrations in drainflow.	
Weather data using consistent protocols, formatting and metadata.	Herzmann, Arritt
Develop protocols for processing, quality control, and formatting of raw data into the central database.	
Begin the collection process for long term climate information from each of the field sites or from available data from nearby, long-term stations.	
Develop a process for raw data transmitted to the central database.	

Task Name	Lead
Objective 2. Develop & implement a functional network of monitoring sites. Evaluate how crop management practices impact carbon, nitrogen and water footprints at test sites.	
Select 21 sites for monitoring	Kladivko, Scharf, Lauer, Helmers
Finalize spreadsheet of regional sites, their characteristics and data to be collected	
Coordinate across 21 sites to ensure that corn, soybean, extended rotations, and cover crop treatment matrixes are represented in each region for Y1-Y5.	
Apply treatments to experimental plots ensuring consistent methodology used across the research network.	
Document site metadata, treatments, and data collected at each site through spreadsheet matrixes.	per specific topic
Develop spreadsheet of all plots and experiments using no-till.	Lauer, Nafziger
Develop spreadsheet of all plots and experiments using extended rotations with specification of crop (e.g., winter wheat, rye, oats, alfalfa).	Lauer, Nafziger
Develop spreadsheet of all plots and experiments using cover crops.	Kladivko
Develop a spreadsheet of all plots & experiments with drainage water management.	Helmers, Fausey
Develop spreadsheet of all plots and experiments using canopy N-sensors.	Scharf
Establish the capacity for and collect greenhouse data (CO2, N2O, and CH4)	Castellano
Equip locations with photoacoustic spectrometers (PAS) for GHG measurements at 18 sites.	
Hire full-time technician to receive, process & clean all raw GHG & ancillary soils data collected across network & to troubleshoot all measurement & equipment problems.	
Train team (including students) in operation and maintenance of PAS.	
Collect real-time data on gaseous fluxes weekly/fortnightly.	
All sites electronically transfer raw data to GHG manager for preparation into database.	
GHG manager process data and submit to database.	
Collect agronomic data using consistent protocols	Lauer
Collect agronomic indicator data (plant population, plant biomass, grain moisture & yield, grain total C & N).	
Transmit agronomic data to central database	
Collect soil data using consistent protocols	Lal, Kladivko, Helmers, Lauer, Scharf
Collect baseline measurements on all experimental plots	
Transmit baseline data to central database	
Collect integrated pest management (IPM) data using consistent protocols	Mueller, Gassmann, ONeal
Collect data during the season on pest abundance and use of pest management tactics	
Collect data from cover crops, post harvest	
Transmit IPM data to central database	
Collect water and drainage data using consistent protocols	Helmers
Measure tile drainage and water quality at drainage water management sites.	
Measure complete hydrologic budget at Coshocton, OH.	
Transmit water data to central database.	
Collect weather & climate data using consistent protocols, formatting & metadata	Herzmann, Arritt
Put in place weather instrumentation (if needed) at sites to collect: precipitation, air temperature, soil temperature, and solar radiation.	
Collect weather data across all network sites.	
Create web interface for project team to download collected weather and climate information.	

Task Name	Lead
Objective 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. Develop and calibrate the central database while and ensuring usability for all CSCAP members.	
Build central database for sharing available data for this project.	Herzmann, Abendroth
Establish computer hardware needs for the centralized collection and storage of project databases.	
Inventory data to be collected.	
Establish metadata and practices.	
Build and support collaborative infrastructure around the collection of field data.	
Work with Obj 1 & 2 Teams to develop processes for standardized methodologies to be transmitted to the database.	
Apply pre-established open community-based standards including Federal Geospatial Data Committee (FGDC) metadata standards.	
Assemble metadata needed including historical data, climate, and landscape data.	
Work with Objective 1, 2, and 3 members to test data processes to database.	Herzmann, Abendroth
Conduct an initial dry run using pre-data from the sites.	
Establish systematic process and methods for data transmission for consistency.	
Establish preprocess data protocols (what modules are needed and from whom on what time schedule).	
Calibrate biophysical models at field, farm, and landscape scales.	Anex, Arritt
Assemble data needed to conduct "what if" experiments on observed climate variability, projected climate change, and economic land use models.	
Begin the development of corn life cycle assessment model(s)	Anex
Define LCA goal and scope.	
Specify allocation methods.	
Define impact categories and impact assessment methodology.	
Develop technology, management, and climate change analysis scenarios.	
Upscale experimental findings to larger scales through modeling	Anex, Kling
Pre-data from some sites used as "dry run" to calibrate upscale models.	
Identify and prepare data, processes, and models for hypotheses testing.	
Prepare data to examine different components of hydrological cycle with lysimeters, springs, runoff, weather, and other measurements.	
Perform review of carbon offset literature	Gassman, Kling

Task Name	Lead
Objective 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.	
Develop understanding of farmer awareness of climate change and willingness/capacity to undertake adaptive and mitigative action.	Arbuckle, Tyndall
Prepare and conduct farmer survey to assess social and economic impacts, climate change awareness and attitudes, and current and potential use of adaptive and mitigative practices.	
Use data from farmer survey to inform field research, modeling, extension, and education activities.	

Task Name	Lead
Objective 5. Promote extension, outreach and stakeholder learning and participation across all aspects of the program.	
Extension-facilitated participatory exchanges	Arbuckle, Tyndall, Benning, Ingels, Wright Morton
Develop specific interactive exchanges regarding team findings and producer acceptability.	
Engage advisory board in research, extension and education applications.	
Form farmer-led watershed groups	Benning, Ingels
Train team of project extension educators in 9 north central states to develop farmer-led watershed groups.	
Potential farmer leaders in watershed are identified.	
Incorporate I-FARM into extension component	Tyndall
Train team of project extension educators in 9 north central states to use I-FARM software.	
Producers/farmers are identified in each state to participate in I-FARM.	
Interact with USDA-funded Climate Change Mitigation & Adaptation in Agriculture (A3141) project U2U (Useful & Usable Decision Support Tools)	Arbuckle, Todey
Contact all USDA-funded A3141 projects associated with corn-based production systems	
Develop a communication plan for exchange and collaboration	
Connect project web sites and online materials for extension education and producers	

Task Name	Lead
Objective 6. Train the next generation of scientists, develop science education curricula and promote learning opportunities for high school teachers and students.	
Next generation of scientists are engaged in team research	Wright Morton
Undergraduates and graduate students are employed and trained by the team.	
Team PIs take responsibility for mentoring of graduate student(s)	
9-12 focused educational approaches	Moore
Develop climate discovery modules for in place NSF curriculum project	
Develop evaluation tools for these modules	
Climate short courses for college credit	Miller, Nkongolo, Todey
Develop a two-week short course for Ohio State University, South Dakota State University, Iowa State University, and Lincoln University	
Undergraduate internships	Moore, Miller, Nkongolo
ISU Science with Practice and OSU summer intern program will incorporate opportunities to work with co-investigators of this project	
Targeted recruitment at 1890 Lincoln University for summer interns with the project	
Distance Education Graduate Course	Miller
Develop education graduate course	
Pilot at ISU	

Appendix G: Year One Budget Overview

USDA Grant Fund Allocation

Direct Costs by Activity			
Education	$	850,742	(27 %)
Extension	$	365,060	(12 %)
Research	$	1,911,909	(61 %)
Total:	**$**	**3,127,711**	(100 %)

Total Costs		
Direct Costs	$	3,127,711
Indirect Costs	$	1,020,345
Total:	**$**	**4,148,056**

External Grants, Leveraged Dollars and Additional Institutional Support

United Soybean Board	$	80,285
Iowa Natural Resources Conservation Service	$	17,000
Iowa State Experiment Station	$	17,200
Purdue Agriculture	$	17,200
Institutional support (approx.)	$	~ 600,000
Total:	**$**	**~ 731,685**

Appendix H: Publications, Presentations and Supplemental Resources

** Denotes presenting author*

† Denotes presentation or abstract included on CD.

CSCAP 2011 Annual Conference Posters, by Objective

1. Wright Morton, Lois, Lori Abendroth, Adam Bartelt*, and Lori Oh. Climate and Corn Systems CAP: Overview and flowchart. Iowa State University. †
2. Moore, Richard H.*, Deana Hudgins, Warren Dick, Liming Chen, Clay Dygert, Rattan Lal, Sandeep Kumar, Atsunobu Kadono, Rachel Hintz, James Bonta, Lloyd Owens, Martin Shipitalo, Norman R. Fausey. CSCAP Activities in Ohio. The Ohio State University, USDA Agricultural Research Service.

Objectives 1 and 2

3. Iqbal, Javed* and Michael Castellano. Nitrous oxide and carbon dioxide measurement with photoacoustic spectroscopy. Iowa State University. †
4. Mebruer, Brandon*. Greenhouse gases emissions as affected by tillage and cropping system. Lincoln University. †
5. Sale, Stephanie* and Nsalambi Nkongolo. Monitoring greenhouse gases emission and soil thermal properties in corn and soybean fields from 2004 to 2006. Lincoln University. †
6. Kumar, Sandeep*, Atsunobu Kadono, Rattan Lal, and Warren Dick. Long-term tillage and cropping systems influences on soil hydraulic properties. The Ohio State University. †
7. Kadono, Atsunobo and Rattan Lal. Modeling of GHG flux from corn field under different land management in Central Ohio. The Ohio State University. ****presented by Sandeep Kumar*†
8. Heitkamp, Felix*, Hermann Jungkunst, and Rattan Lal. Strategies to reduce variation of greenhouse gas flux measurements on the field scale. The Ohio State University. †
9. Basche, Andrea* and Fernando Miguez. Protocol development for greenhouse gas analysis in corn systems with cover crops using the current literature. Iowa State University. †
10. Bonta, James* and Dave Barker. Effects of climate change on grass/legume growing season. USDA Agricultural Research Service. †
11. Brooks, Kyle*, Laura Bowling, Jane Frankenberger, and Eileen Kladivko. Improved flow measurement for drainage water management in Indiana. Purdue University. †
12. Helmers, Matthew, Xiaobo Zhou, Carl Pederson, and Ryan Goeken*. Iowa State University's Agricultural Drainage Water Research Site: Site characterization and past and present research. Iowa State University. †
13. Helmers, Matthew*, Xiaobo Zhou, Reid Christianson, Carl Pederson, and Greg Brenneman. Drainage water management in Iowa – Crawfordsville site. Iowa State University. †

14. Pagliari, Paulo* and Jeff Strock. Alternative statistical analysis options for unreplicated paired design experiments. University of Minnesota. †
15. Cavadini, Jason*, Kaylissa Horton*, and Eileen Kladivko. Standardized soil sampling protocols and their use on two Indiana CSCAP research sites. Purdue University. †
16. Cruse, Richard and Scott Lee*. Evaluation of crop management practices on soil infiltrability. Iowa State University. †
17. Haruna, Samuel*. Effects of tillage and cropping system on soil properties. Lincoln University. †
18. Williams, Jason*. Effect of tillage on corn and soybean growth and yield. Lincoln University. †
19. Lauer, Joe* and Emerson Nafziger. Extended rotations for Midwest U.S. cropping systems. University of Illinois, University of Wisconsin. †
20. Sawyer, John, Jose Pantoja*, and Dan Barker*. Nitrogen fertilization requirement and corn-soybean productivity in a rye cover cropping system. Iowa State University. †
21. Dunbar, Mike*, Aaron Gassmann and Matt O'Neal. Effects of cover crop and extended rotation on insect communities. Iowa State University. †

Objective 3

22. Goodman, Jenette*, Phillip Owens, and Eileen Kladivko. Methods for developing soil functional property maps for scaling to regional estimates. Purdue University. †
23. Rafique, Rashid*, Robert Anex, Sasha Kravchenko. Power analysis of soil measurements: soil carbon and greenhouse gases. University of Wisconsin, Michigan State University. †

Objective 4

24. Arbuckle, J. Gordon*, Tricia Knoot, John C. Tyndall. Corn belt farmers and climate change: Evaluating the socioeconomic acceptability of adaptive and mitigative cropping systems. Iowa State University. †

Objective 5

25. Miller, W. Wade and Jessica Peter*. Utilization of WebQuests to bridge the gap between research and information dissemination. Iowa State University. †

Objective 6

26. Wilke, Adam*, Jamie Benning, Chad Ingels, Daryl Herzmann, and Lois Wright Morton. Making climate change visible to farmers. Iowa State University. †
27. Benning, Jamie*, Chad Ingels, John Tyndall, J. Gordon Arbuckle, Richard Moore, and Lois Wright Morton. Extension-facilitated participatory exchanges and action with farmer-led watershed groups. Iowa State University, The Ohio State University. †

Publications, by Objective

Objectives 1 and 2

Scharf, P.C., D.K. Shannon, H.L. Palm, K.A. Sudduth, S.T. Drummond, N.R. Kitchen, L.J. Mueller, V.C. Hubbard, and L.F. Oliveira. 2011. Sensor-based nitrogen applications out-performed producer-chosen rates for corn in on-farm demonstrations. Agron. J. 103:1683-1691.

Objective 3

Basso B., L. Sartori, M. Bertocco, D. Cammarano, E.C. Martin and P.R. Grace. 2011. Economic and environmental evaluation of site-specific tillage in a maize crop in NE Italy. Available online 11 May 2011, DOI: 10.1016/j.eja.2011.04.002.

Objective 4

Arbuckle, J. Gordon Jr., Paul Lasley, and John Ferrell. 2011. Iowa Farm and Rural Life Poll: 2011 Summary Report. Extension Report PM3016. Ames, IA: Iowa State University Extension.

Arbuckle, J. Gordon Jr., Daren S. Mueller, and Adam Sisson. 2011. Climate Change in the Classroom: A Survey of Iowa Agricultural Educators. CSCAP-0001-2011, Iowa State University Extension Sociology, Ames, IA.

Olson, K.R. and L.W. Morton. 2012. The impacts of induced levee breaches on agricultural lands of the Ohio and Mississippi River Valleys. *Journal of Soil and Water Conservation.* 67(1):5A-10A.

Olson, K.R., M. Reed, LW. Morton. 2011. Multifunctional Mississippi River leveed bottomlands and settling basins: Sny Island Levee Drainage District. *Journal of Soil & Water Conservation*. July/August vol. 66:4:90A-96A.

Hu, Zhihua* and L.W. Morton. 2011. US Midwestern Residents Perceptions of Water Quality. *Water* 3:217-234.

Presentations, by Objective

Moore, Richard and Rattan Lal. 2012. Corn and climate change: a transdisciplinary approach to measurement and mitigation for U.S. corn belt cropping systems. The Ohio State University Environmental Science Graduate Program Seminar Series. Jan. 13, 2012.

Wright Morton, Lois. 2011. Climate Change, Mitigation & Adaptation in Corn-based Cropping Systems CAP. CSCAP Annual Conference. Chicago, IL. Nov. 8-10, 2011.†

Objectives 1 and 2

Dunbar, M. W., A. J. Gassmann, D. S. Mueller, and M. E. O'Neal. November 2011. Effect of cover crop and extended rotation on pest communities. 59th Annual Meeting of the Entomological Society of America. Reno, NV. General Session.†

Frankenberger, J.R. 2011. Limitations of drainage water management. Managing Water. Harvesting Results. America's Ag Water Management Summit. October 2011. Online at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/manage/?&cid=stelprdb1045701.

Ladoni Moslem, Juan Munoz-Robayo, Alexandra Kravchenko, and Sieglinde Snapp. 2011. Effects of Agricultural Management with and without Cover Crops On Soil Nitrate In Different Topographical Positions. ASA-CSSA-SSSA 2011 Annual Meetings. San Antonio, TX, USA.

Mitchell, David C., Michael J. Castellano, John E. Sawyer, Fernando Míguez and José L. Pantoja. 2012. Cover Crop and Nitrogen Fertilizer Effects on Nitrous Oxide Emissions from No-till Maize and Soybean. ISU Ecology and Evolutionary Biology Annual Spring Symposium. Jan. 28, 2012.

Mitchell, David C., Michael J. Castellano, John E. Sawyer, Fernando Miguez and José L. Pantoja. 2011. Nitrous Oxide Emissions From a No-till Corn-Soybean Rotation Comparing N Fertilization and Cover Cropping Treatments. ASA-CSSA-SSSA 2011 Annual Meetings. San Antonio, TX, USA. †

Mueller, Daren. 2012. ISU Integrated Pest Management Program: Where Research and Education Meet. Iowa State University Departmental Seminar. Ames, IA, USA.

Pagliari, Paulo and Jeffrey Strock. 2011. Analysis of Paired Design Approach Experiments Using a MIXED Model Approach. ASA-CSSA-SSSA 2011 Annual Meetings. San Antonio, TX, USA. Online at http://a-c-s.confex.com/crops/2011am/webprogram/Paper66245.html.

Pantoja, J.L., J.E. Sawyer, and D.W. Barker. 2011. Corn nitrogen fertilization in a rye cover cropping system. ASA-CSSA-SSSA 2011 Annual Meetings.

San Antonio, TX, USA. Online at http://a-c-s.confex.com/crops/2011am/webprogram/Paper65489.html.†

Sawyer, J.E. 10 March 2011. Nitrogen management with a rye cover cropping system. Iowa Learning Farm, Practical Farmers of Iowa, Clay county Extension, and Clay county NRCS, Spencer, IA.

Sawyer, J.E. 1 June 2011. Nitrogen rate management with a rye cover cropping system. Iowa Learning Farm, Practical Farmers of Iowa, Cover Crop Working Group field day, Rob Stout, Iowa Learning Farm cooperator cover crop demonstration site, West Chester, IA.

Sawyer, J.E. 17 June 2011. Nitrogen management with cover crops. Iowa Learning Farm, Practical Farmers of Iowa, Cover Crop Working Group field day, Jeff Joyce, Iowa Learning Farm cooperator cover crop demonstration site, Ruthven, IA.

Sawyer, J.E. 19 July 2011. Nitrogen management with cover crops. Iowa Learning Farm and Cover Crop Working Group field day, Ann Smeltzer Trust Farm, Gary and Dave Nelson site hosts, Otho, IA.

Sawyer, J.E. 1 Sept 2011. Nitrogen rate management with rye cover crop, nitrogen rate recommendations, and using active canopy sensors in corn production. Iowa Learning Farm Water Quality Field Day, Gilmore City, IA.

Sawyer, J.E. 14 Sept 2011. Nitrogen management with cover crops. Iowa Learning Farm, Practical Farmers of Iowa, Cover Crop Working Group field day, Competine Creek Watershed and Pekin High School FFA Field Day, Ruthven, IA.

Sawyer, J.E. 27 Sept 2011. Nitrogen fertilization in a rye cover cropping system. Iowa State University Crops Team Professional Development program, Ames, IA.

Sawyer, J.E. 27 Oct 2011. Nitrogen management with cover crops. Iowa Learning Farm, Practical Farmers of Iowa, Cover Crop Working Group field day, Gustafson Farms, Boone, IA.

Sawyer, J.E., J.L. Pantoja, and D.W. Barker. 2011. Effect of a rye cover crop and crop residue removal on corn nitrogen fertilization. *In:* B.A. Pringnitz (ed.). 23rd Integrated Crop Management Conference Proceedings (pp. 115-121). Iowa State University. Ames, IA. 144 p.

Sawyer, J.E. 2012. Nitrogen use in corn production, Iowa State Univ. Extension Crop Advantage Series, Morovia.

Sawyer, J.E. 6 Jan 2012. Nitrogen use in corn production, Iowa State Univ. Extension Crop Advantage Series, Burlington.

Sawyer, J.E. 26 Jan 2012. Nitrogen use in corn production, Iowa State Univ. Extension Crop Advantage Series, Iowa City.

Strock, J. 2011. Experimental field site presentation to soil scientists and engineers from the University of Saskatchewan and Agriculture and Agri-Food Canada.

Todey, D. Midwestern Climate Trends and Agriculture. 2011. Ag Horizons Meeting. Pierre, SD.

Todey, D. Midwestern Climate Trends and Agriculture. 2011. DTN Ag Summit. Chicago, IL.

Objective 3

Anex, Robert. 2011. Systems Evaluation Data and Tools. NIFA Sustainable Bioenergy Project Directors Meeting. Arlington, Virginia, October 24-26, 2011.

Anex, Rob. 2011. Objective 3 Team Progress Report. CSCAP Annual Conference. Chicago, IL. Nov. 8-10, 2011.†

Herzmann, Daryl. 2011. Data Management. CSCAP Annual Conference. Chicago, IL. Nov. 8-10, 2011.†

Munoz-Robayo Juan, Bruno Basso, Julie Winkler, Jeff Andresen, Alexandra Kravchenko, 2011. Climate Change Impact On Crop Yield in a Rotational System in Michigan. ASA-CSSA-SSSA 2011 Annual Meetings. San Antonio, TX, USA.

Objective 4

Arbuckle, J. Gordon Jr. 2011. Corn Belt Farmers & Climate Change: Evaluating the Socioeconomic Acceptability of Adaptation & Mitigation in Cropping Systems. CSCAP Annual Conference. Chicago, IL. Nov. 8-10, 2011. †

Arbuckle, J. Gordon Jr. 2011. Farmer Perspectives on Climate Change and Agriculture. Agricultural Decision Making with a Water and Climate Change Perspective Conference. Nebraska City, NE, November 1, 2011. †

Arbuckle, J. Gordon Jr. 2012. Farmer Perspectives on Climate Change and Agriculture. Department of Agronomy Seminar. Iowa State University. Ames, IA, January 19, 2012.

Wright Morton, Lois. 2011. Problem Solving Together. Iowa Water Conference. March 8, 2011. †

Wright Morton, Lois. 2011. Agricultural Producers' Management Decisions Under Perceptions of Uncertainty and Risk. Climate, Water and Ecosystems – Shaping the Great Plains. Oct. 13, 2011. Lincoln, NE. †

Wright Morton, Lois. 2011. Sustainability and Resilience Concepts Applied to Cultivated Ecosystems. 2011 BIGMAP Symposium: Co-existence, Choice and Sustainability for Crop Production. April 19, 2011. †

Objective 6

Todey, Dennis. 2011. Midwestern Climate Trends. Ag Summit 2011: Rebalancing Risk and Reward. Nov. 29-30, 2011. Chicago, IL.

Promotional Materials

SUSTAINABLECORN.ORG: Crops, Climate, Culture, and Change. Informational One-Pager. 2012. CSCAP-0002-2012.

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SUSTAINABLECORN.ORG: Crops, Climate, Culture, and Change. Field Day Postcard (Flowchart). 2012. CSCAP-0004-2012.

Press and News Releases

Arbuckle, J. Gordon, Jr. 2011. Iowa Farm and Rural Life Poll 2011 Results. Interview with Wallaces Farmer. Dec. 28, 2011. http://farmprogress.com/wallaces-farmer-story-nl13_3nl-iowa-farm-rural-life-poll-2011-results-9-55813

Arbuckle, J. Gordon, Jr. 2011. Two-thirds in Iowa Farm Poll say climate change is occurring. Interview with Brownfield Ag News. Dec. 19, 2011. http://brownfieldagnews.com/2011/12/19/iowa-farm-poll-two-thirds-say-climate-change-is-real/

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Iowa State University. 2011. Farmers Voice Opinions on Climate Change in 2011 Iowa Farm and Rural Life Poll. Press release. Retrieved from http://www.extension.iastate.edu/article/farmers-voice-opinions-2011-iowa-farm-rural-life-poll

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University of Minnesota. 2011. New research funding will show how climate change affects corn-based cropping systems. Press release. Retrieved from http://sustainablecorn.org/doc/news/2011/2011-02-18_minnesota-release.pdf

University of Missouri. 2011. MU scientist joins 5-year project studying climate change, corn production in Midwest. Press release. Retrieved from http://extension.missouri.edu/news/DisplayStory.aspx?N=1052

U.S. Department of Agriculture. 2011. NIFA Announces Grant to Study the Effects of Climate Change on Agricultural and Forest Production. Press release. Retrieved from http://sustainablecorn.org/doc/news/2011/2011-02-18_usda-release.pdf