YEAR 5 TOP TEN ACCOMPLISHMENTS

"Our work is about understanding systems, specifically the carbon, nitrogen, water and human-social systems that underpin the management of corn-soybean production and their interactive responses to variable climate and weather conditions."

Lois Wright Morton, Project Director
Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems Coordinated Agricultural Project (2011–2016)

1

Completed advanced, cropping systems research using a diverse network of 35 experimental sites in the Midwest, measuring carbon, nitrogen, and water footprints. This expansive dataset will be made public post-project at the USDA National Agricultural Library.

2

Integration of 119 findings on carbon, nitrogen, water, stakeholders, climate, and pests led to workgroup-based recommendations: 59 synthesized recommendations, and 17 highly integrated concepts. These are the foundation for new knowledge creation and strengthening of the body of science in managing corn-based cropping systems for productivity and ecological integrity, with attention to soil and water resources under increasingly variable climate conditions. See reverse for some of the initial findings and recommendations.

3

Scientific findings have been reported in 154 refereed journal articles, 212 extension publications and 995 presentations to stakeholders; resulting in a total audience reach of 89,824 since the project began.

4

Next generation scientists, including postdocs, MS and PhD students, presented their research findings in Washington DC - through research summaries, posters and oral presentations - to USDA, partner agencies, and congressional staff. Their materials were shared via social media to extend their reach. To date, 133 undergraduate students, 86 graduate students (29% minority and 49% women), and 19 postdoctoral researchers (74% minority and 10% women) have been members of the team.

5

Professional development workshops trained science teachers and extension educators: 106 teachers in Iowa, Minnesota, Missouri, Ohio, and South Dakota were taught how to incorporate agriculture and climate change education in K-12 classrooms. Sixty extension educators were trained at an agriculture and climate symposium, co-funded by USDA SARE and presented at the National Assoc. of County Agricultural Educators meeting.

6

The team's database and infrastructure are being extended as project investigators develop new research teams such as the 2015 USDA-NIFA funded project, Transforming Drainage, led by Purdue University. The team's research database houses some of the most comprehensive systems-level data collected on Midwest agricultural systems.

7

Guidance for incorporating climate change education in Extension programs was developed for North Central land-grant university extension leadership and educators. The Climate Change and Agricultural Extension report, developed in collaboration with USDA's Useful to Usable project, includes social science research findings, recommendations and lessons learned when conveying climate science to farmers and other agriculture stakeholders. See http://store.extension.iastate.edu/Product/Climate-Change-and-Agricultural-Extension.

8

An additional $25 million in leveraged dollars has been obtained by the team to date, expanding the scope of research and reach of the initial USDA-NIFA investment in the region.

9

A legacy of educatonal publications and videos for agricultural stakeholders and educators have been made available via land-grant university Extension online stores, Midwest Regional Climate Centers, the National Council for Science and the Environment's website for K-12 educators. For an example, see http://store.extension.iastate.edu/Topic/Crops/Climate-and-Agriculture.

10

Our 43 co-PI scientists have expanded the research, outreach, scope and life of this project through their networks and partnerships. Partners include, but are not limited to: USDA's Midwest Climate Hub, Useful to Useable, PINEMAP, and REACCH, and others such as the North American Climate Smart Agriculture Alliance, United Soybean Board, AgMIP, NSF National Socio-Environmental Synthesis Center, and SARE.

Sustainable Corn CAP is a regional collaboration supported by USDA-NIFA Award No. 2011-68002-30190, "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems." The 11 institutions comprising the project team include: University of Illinois; Iowa State University; Lincoln University; Michigan State University; University of Minnesota; University of Missouri; The Ohio State University; Purdue University; South Dakota State University; University of Wisconsin; and USDA-ARS Columbus, Ohio. March 2016; Publication No. CSCAP-0188-2016.

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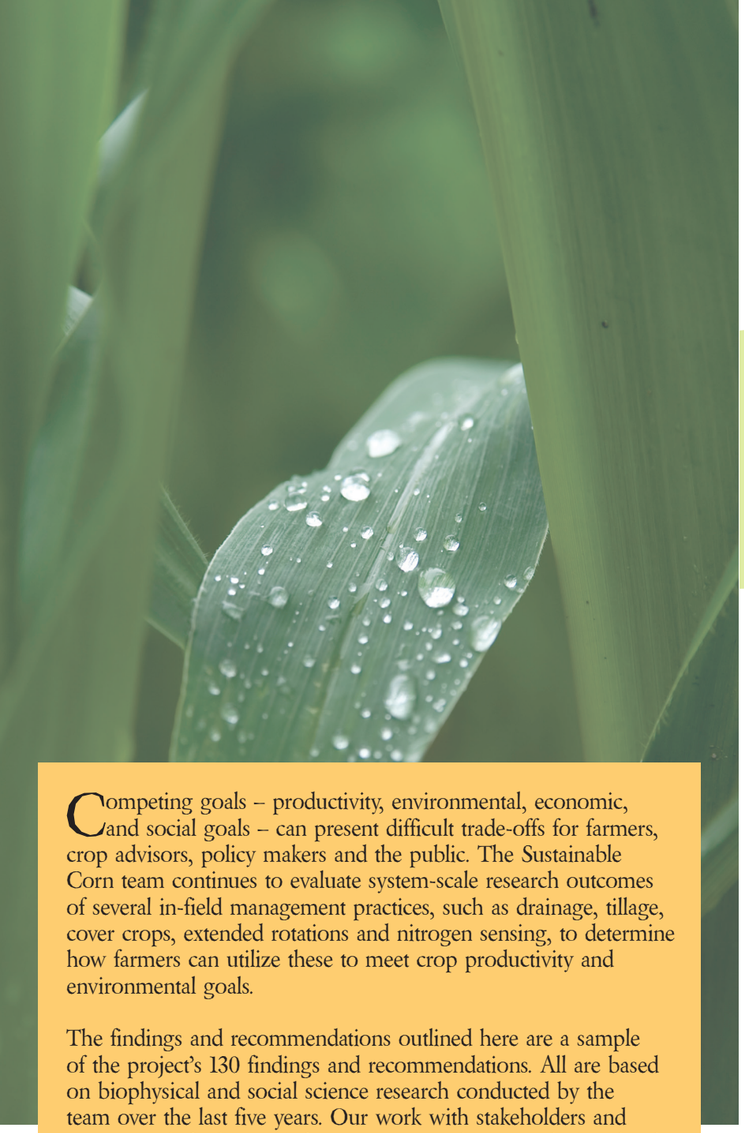

Competing goals – productivity, environmental, economic, and social goals – can present difficult trade-offs for farmers, crop advisors, policy makers and the public. The Sustainable Corn team continues to evaluate system-scale research outcomes of several in-field management practices, such as drainage, tillage, cover crops, extended rotations and nitrogen sensing, to determine how farmers can utilize these to meet crop productivity and environmental goals.

The findings and recommendations outlined here are a sample of the project's 130 findings and recommendations. All are based on biophysical and social science research conducted by the team over the last five years. Our work with stakeholders and our research findings reinforce one overarching conclusion: local adaptation of corn-based cropping systems to climate extremes will require farmers to experiment with practices and customize a suite of practices that work for their landscape and local climate.

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FINDINGS & RECOMMENDATIONS

CLIMATE

Mean precipitation is predicted to increase slightly, mostly in winter and spring. This is because the air is projected to warm, which can then hold more moisture.

Heavy rainfall events have increased significantly more than the annual or the seasonal totals have increased. This trend is predicted to continue and to strengthen over the next 30 years.

Over the past 60 years the Midwest has seen a slight warming, mostly in the cooler half of the year, which has allowed the hardiness zones to go northward.

WATER

Controlled drainage infrastructure can retain water in the soil profile and be beneficial in years when moisture stress occurs. Careful site selection and design are necessary to limit seepage from the system to improve the likelihood of increasing growing-season soil moisture.

Less benefit is achieved from controlled drainage infrastructure in areas where a substantial portion of total annual drain flow occurs in spring resulting in the need for drainage in order to complete field work.

In years with high daily temperatures and limited moisture, no-till systems will have a yield advantage relative to tilled systems.

NITROGEN

Controlled drainage can reduce offsite nitrate loss to surface water from drained cropland. The drainage systems do not reduce the nitrate concentration in tile drains; rather a reduction in nitrate loss is a result of reduced drain flow from the land.

Cover crops are effective for reducing nitrate and sediment losses from a variety of cropland landscapes. Models of extensive adoption of cover crops across the Corn Belt region confirm that wider cover crop adoption by producers in the study region would be of value.

GREENHOUSE GAS

To reduce nitrous oxide (a greenhouse gas) emissions in a corn-soybean system, replacement of corn with another crop, such as soybean or wheat, can achieve a greater reduction than what can be achieved solely through improved crop management practices.

Our cover crop and drainage experiments showed no consistent effect on nitrous oxide emissions from the soil surface. More research is needed.

CARBON

Losses and gains in soil organic carbon, soil nitrate, and soil water holding capacity are site specific. These changes reflect soil characteristics, position on the landscape, and tillage practices. For example, soil organic carbon in the root zone (0-20 cm) is eroded over time on slopes and summits, causing crop yields to go down in those locations.

When used as part of a long-term (3+ years) soil conservation strategy, no-till can be implemented without yield penalty compared to more aggressive tillage systems in a corn-soybean rotation, under most Corn Belt environments.

Cover crops can be added to increase organic matter inputs and aid in protection of soil organic carbon.

STAKEHOLDERS

Farmers' beliefs, attitudes, and concerns about climate change, as well as confidence in their capacity to cope and willingness to take adaptive and mitigative action, vary a great deal across the Corn Belt. Strategies in support of adaptive management are likely to be most successful when they align with local context and conditions and take differences among farmer perspectives into account.

Farmers are generally confident in their capacity to adapt to adverse weather. Highly confident farmers are less likely to have experienced negative impacts of extreme weather.

Farmers are pragmatic problem solvers. Our extension educators found farmers to be more receptive to exploring risk management solutions when discussions focused on the challenges associated with "increased weather variability and extremes" versus the topic of "climate change."

Farmers need more timely and accurate local weather and climate information as well as tools to make management decisions that effectively protect their economic, soil and water resources.

"When you're working with the soil, it's not like a light switch. You can't just change things and see immediate results. The soil needs time to transition. The conversion time of three or more years can pose difficult trade-offs for farmers."

an Iowa Farmer