REACCH and the REACCH legacy

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REACCH is one of more than 30 projects funded by the U.S. Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA) and its Climate Variability and Change Program, which is designed to address the problems anticipated for agriculture across the nation due to changing climates. NIFA's programs are part of a broader effort across the USDA that includes activities within the Agricultural Research Service (ARS), the U.S. Forest Service (USFS), the Risk Management Agency (RMA), the Animal Plant Health Inspection Service (APHIS), the Long-Term Agroecosystem Research (LTAR) Network, and the newly established USDA Climate Hubs. As NIFA Director Sonny Ramaswamy noted in a visit to the Palouse this past summer, this emphasis acknowledges that climate change is one of several "wicked" problems facing agriculture and food production at home and across the globe. The USDA is committed to leading efforts to mitigate and adapt to climate change, drought, and extreme weather in agriculture and forestry. As outlined by Director Ramaswamy (see page 2 of this report) and USDA Secretary Tom Vilsack, these efforts will include addressing six challenges. This, our fourth annual report, shows how REACCH and its partners are addressing these six challenges and laying the groundwork for continuing to address them into the coming decades.

IMPACT

The REACCH project is taking an unprecedented, coordinated, and integrated approach to supporting Pacific Northwest cereal production. Although our research, education, and extension efforts address topics ranging from nitrogen use efficiency to insect pest management, all is done in the context of the whole production system. In this respect, the project aligns with the integrating approach that farmers use to manage their operations. The project will end in 2016, but its influence will continue over the time scales relevant to long-term sustainability of agriculture in our region.

1. Building tools to identify and predict climate change impacts. Climate scientists in REACCH, at all three of our land-grant partners, have built detailed downscaled climate models based on the latest global models and are capable of projecting conditions at a 2.5-mile grid size. These in turn are being used to project responses of our current cereal cropping systems in terms of yield. Collaborative efforts across REACCH are allowing downscaled climate models to be coupled with cropping system models to anticipate changes in potential yields under different types of production systems. Using data available from the National Agricultural Statistics Service, we have generated dynamic maps of production systems (agroecological classifications) that show how yields vary over time, in part in response to climate. This is an invaluable baseline for detecting changes over the long term. These and other survey data being generated by REACCH are being cataloged and stored so that they can be readily accessed to reveal responses as climate changes in the Pacific Northwest (PNW).

2. Projecting how and where climate change may affect pests. Ongoing work in REACCH is using the downscaled climate models described in item 1 to project changes in the suitability of cereal pests, including the cereal leaf beetle (see the Year 3 annual report), aphids, and weeds such as downy brome and pathogens (see the Year 3 annual report, https://www.reacchpna.org/whatsnew/reports/). The models can also generate current degree-day models for phenology of pests and weeds, which will be incorporated into decision support tools for producers. Current and historical sampling data, coupled with climate information, can inform these projections.

3. Addressing uncertainties in methodologies. Climate change and variability present significant challenges because projected trends indicate that agriculture could be strongly affected, but the variability in climate projections is necessarily high. At each level, from selection of emission scenarios to selection of climate models and downscaling approaches and assessing how systems respond to climatic variables, there is inherent uncertainty. Our approach in REACCH is to ensure that this uncertainty is accounted for fairly in the science and in our discussions and communications to stakeholders. As climate science pertaining to the PNW advances, our team is on the front lines.

4. Increasing understanding of climate dynamics and uncertainties for policy and planning. Our project is engaged in activities designed to inform policy that could improve agriculture's resilience to climate change in the PNW.

5. Reducing the use of energy, nitrogen fertilizer, and water and increasing carbon sequestration through resilient agriculture and forest production systems. A principal theme of REACCH is continuing the long-standing effort by scientists in our region to help producers preserve soil carbon and improve the efficient use of fertilizers. Team members are documenting the effects of tillage practices on carbon in soils, on emissions of CO_2 and N_2O from production systems, and on the presence of nitrate in subsurface water.

6. Developing usable information and effective communication. Our project depends on excellent communication with the public and with stakeholders and on producing information that is useful. Although much of the science concerns trends and projections well into the 21st century, we are also producing information on current production practices and the management of pests and diseases that is useful today. Our outlets include online information, publications, informational videos, and webinars.

REACCH is a large Coordinated Agricultural Project (CAP), with $20 million in funding over five years. Unlike other NIFA projects, CAPs are charged with addressing the complexity of climate change as it affects entire agricultural systems, and they are

unprecedented in their integrative scope. Each of our scientists and students is contributing to one or more of the six challenges listed here, but all of us are also working in the broader context of a fully integrated project (Figure 1). We can all locate our work within this framework and articulate the connections and synthesis in which we are engaged. Our students are exposed to different aspects of the work through collaborative cross-disciplinary projects.

The other two NIFA CAPs are Sustainable Corn, led by Iowa State University, and PINEMAP, led by the University of Florida. Since their inception in 2011, the CAPs have worked closely to collaborate with and support one another to ensure that all three projects are successful. For an overview of what the three CAPs have accomplished see Eigenbrode et al. in the November/December 2014 issue of the *Journal of Soil and Water Conservation*.

Although motivated by a long-term vision of sustainable agricultural production, NIFA's CAPs and smaller climate projects are not in themselves long-term efforts; funding for REACCH will end during 2016. Toward the longer-term goals, REACCH is establishing the requisite collaborative frameworks, cyberinfrastructure, long-term experiments, conceptual framework, and capacity for continued efforts in the region. In our final two years as a project, partnerships with ongoing and beginning efforts addressing climate change and other threats to the sustainability of cereal production in our region will be critical. To reflect that emphasis, a special section of this annual report contains reports from many of these key partners. Representatives of these projects will participate in the fourth annual meeting of the REACCH project in March 2015 to delineate these collaborative efforts.

The REACCH project will help ensure that future generations in our region will have sustainable agricultural systems. Photo by Jillian Blume.

Figure 1. *REACCH conceptual framework and logic model.*