

**SECTORAL APPLICATIONS RESEARCH PROGRAM (SARP)  
PROJECT ANNUAL REPORT TEMPLATE**

**PROJECT TITLE: Risk perception, Institutions, and Water Conservation:  
Enhancing Agricultural Adaptation to Future Water Scarcity in Central Arizona**

**INVESTIGATORS:**

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**NOAA GRANT NUMBER:** NA11OAR4310123

**PROJECT YEARS:** 09/01/2011 - 08/31/2013

**TIME PERIOD ADDRESSED BY REPORT:** 09/01/2011 - 05/31/2012

**PRELIMINARY MATERIALS**

**A. Research project objective.**

The objective of this project is to help farmers maximize opportunities to enhance their flexibility in face of climatic stress while also investing in the resilience of the broader social-ecological system on which farmers depend. Specifically, we will evaluate the ways in which water resource institutions affect Central Arizona farmers' capacities to individually adapt to drought risk, as well as their participation in efforts to enhance broader system resilience in face of increasing water scarcity.

**B. Stakeholders and decision makers** with whom you are working (*in bulleted form*).

- Farmer associations (Arizona Agribusiness Council; Arizona Cotton Growers Association)
- Irrigation districts in Phoenix and Pinal Active Management Areas

- Irrigation districts of Safford, Arizona
- University of Arizona Cooperative Extension
- Decision Center for a Desert City at Arizona State University

**C. Approach** including methodological framework, models used, theory developed and tested, project monitoring and evaluation criteria. Include a description of the key **beneficiaries** of the anticipated findings of this project (e.g., decision makers in a particular sector/level of government, researchers, private sector, science and resource management agencies). *(Limit of one page)*

We are employing a social-ecological systems framework, as elaborated by Anderies et al. 2004) to identify, describe and evaluate the role of institutions in structuring the position of the irrigated agriculture community in relation to the threat of future water scarcity associated with changing climatic and hydrological conditions (and changing economic and demographic factors). We are evaluating the *robustness/vulnerability* tradeoffs associated with three decades of water institutional developments designed to enhance stability in water supplies in urbanizing central Arizona. The modeling and institutional analysis will allow us to explore the institutional conditions under which farmers are most likely to make specific decisions about their water use, water technology and cropping strategies, and the conditions in which they would find information about climate changes useful. These institutional arrangements have enhanced the robustness of the agricultural sector to inter-annual climatic variability and associated variability in water supplies, but may enhance systemic vulnerability to emerging threats to surface water availability. We are also assessing the role of agriculture in adaptation as one of “private provisioning of public adaptation goods”; and thus are exploring the possible institutional arrangements that either facilitate or inhibit such provisioning.

Our methods and approach include: 1) institutional analysis of water institutions as associated with irrigated agriculture, and of agricultural institutions associated with farm-level decision-making; 2) expert interviews (irrigation district managers, farmers, farm associations, water managers, climate experts) and farm-level survey to assess perception of risk, attitudes concerning attachment to place and abilities to plan, learn and organize, use of climate services and perceptions of primary stressors on agricultural water use and decision-making; 3) student-run research workshops (Fall 2011, Fall 2012) in which graduate students collaborate in developing in-depth analysis of one aspect of project and 4) development of a dynamic systems model designed to test robustness-vulnerability tradeoffs and alternative institutional scenarios with agriculture and water community.

The broader benefit for this region will be to lay the foundation for a new process of collaboration and engagement among farmers and water managers with the common interest of managing individual vulnerabilities to enhance system resilience. Outcomes will be judged as successful if the results are incorporated into

Extension planning / programs and if a discussion of new institutional designs are initiated among urban water planners to improve the participation of the agricultural sector.

**D. Matching funds/activities** descriptions, including in-kind, used in this project.

We have acquired supplemental funding from the NSF-Funded Decision Center for the Desert City, Arizona State University. This funding supports an additional graduate research assistant, and provides supplemental support for fieldwork and stakeholder engagement. This funding has also permitted the incorporation of an additional co-PI: Dr. Rimjhim Aggarwal.

**E. Partners** with whom you are working (e.g., NOAA, other federal agencies, academia, nongovernmental organizations, private sector, etc.)

- University of Arizona Cooperative Extension Service
- The Decision Center for the Desert City
- The Australian Commonwealth Scientific and Research Organization

## **II. ACCOMPLISHMENTS**

### **A. Project timeline and tasks accomplished**

- Summer 2011-Winter 2012
  - 24 expert Interviews (30 participants total)
  - Literature review
  - Policy analysis
- Fall 2011
  - Workshop Course: Adaptation, Resilience and Transformation. Student participants prepared theoretical framework for project, interviewed stakeholders, evaluated institutional context and organized a Water-Climate Briefing for the Decision Center for a Desert City
  - Water Climate Briefing held on December 6, 2011 "*Cotton, Condos and Climate: Agriculture and Arizona's Water Future*". Over 30 participants from urban water, agricultural, research and practitioner communities. Student-facilitated discussion on agriculture's role in Arizona's water future
- Winter 2012
  - Poster Preparations/Presentations:
    - Bausch, J.C., J.P. Connors, C. Rubinos, H. Eakin, R. M. Aggarwal, and A. York. 2012. Agriculture around a desert city: Perspectives on decisions for water, land and livelihood. Poster presented at the January 13, 2012 CAPLTER 14th Annual Poster Symposium and All Scientist Meeting, Arizona State University, Tempe.



with relatively narrow view of agriculture in central Arizona water management

- Institutional context currently does not incentivize agricultural water conservation (to the contrary, farm sector is absorbing “excess” water from Colorado River); farmers are thus potentially receiving conflicting messages about need for water resource planning and their role in these efforts.
- Signals of environmental change are likely to be channeled through energy prices, infrastructure constraints, water prices, commodity prices.
- Climate services
  - All our interviews confirm that very few stakeholders in the agricultural sector within the Phoenix and Pinal AMAs are concerned with present or future water scarcity, climate variability or climatic change
  - No farmers or irrigation district managers seek or access any of the available climate services and products (material from CLIMAS, AZDroughtwatch.org; NDIS; or USDA).
  - No farmers or irrigation district managers report climate-related stressors on water availability despite current drought conditions
  - Outside of AMAs (Safford case study), concern re: water availability is acute. Water resources are scarce and over-allocated. Nevertheless, there too there is little evidence that climate services and products are used in interannual, intra-annual or longer term decision-making.

**B. Application of your findings to inform decision-making** and any highlights of communicating or translating science to decision makers (e.g. media events, presentations, briefings, representation on or input to decision making bodies, etc.).

- Water-Climate Briefing, Decision Center for a Desert City: “Cotton, Condos, and Climate: Agriculture and Arizona’s Water Future.” Student-led panel discussion of challenges and issues associated with farming and urban water futures in central Arizona. Event was attended by 30 + community members, and featured a panel of four local experts (irrigation district manager, farmer, farm association leader, water policy expert). See: <http://dcdc.asu.edu/outreach/waterclimate-briefings/>

Communication of research and development of engagement strategies is the central focus of the next 12 months of the project. In this respect we will be conducting a second student-run workshop course to develop strategies for engaging the farm community in adaptation and water concerns for Central Arizona and for communicating our research findings to the urban water management community and to the farm community. We also will be preparing our dynamic systems model as a tool for policy discussion and analysis. Our findings to date underscore this challenge: the farm community is effectively buffered from climatic stress and has negotiated very secure rights to water and land that do not make this

sector sensitive to climate-related stress on water supply or quality. Nevertheless, we feel it is important that the urban water planning and management sector understand the complexity of farm-level decision-making and associated institutional incentives. We are working with the Decision Center for the Desert City to develop and appropriate engagement strategy this year.

**C. Planned methods to transfer** the information and lessons learned from this project.

We are working closely with University of Arizona Cooperative Extension to ensure the data and findings from this project are integrated into programing and strategic planning in the water conservation program of Extension. We are also collaborating with the Decision Center for the Desert City to find ways our results can work synergistically to enhance the revisions of the WaterSim model (water planning tool) to better represent the agricultural sector and to communicate the interests, motivations and needs of agriculture to urban water managers. We will conduct a participatory workshop with stakeholders this coming academic year to explore institutional scenarios; one result of that event will be to devise appropriate dissemination avenues (e.g., policy briefs, editorials, inputs into Active Management planning and adaptation plans).

**D. Significant deviations from proposed workplan**

The funding on the project was delayed from what we initially planned (start date of August 2011 rather than May 2011). Nevertheless, we leveraged DCDC funding to begin some of the qualitative analysis in the summer of 2011.

Our survey implementation has been delayed somewhat because of the difficulty in identifying an appropriate, publically available and reliable sampling frame. As a result, we have had very poor returns on our initial survey mailing despite aggressive efforts to inform the community of the survey and to disseminate it widely. We will be undertaking a renewed attempt at the survey mailing this month with the help of the Arizona Cotton Growers Association.

Given the difficulty in identifying a sampling frame, we decided to use a case-study of farmers outside of the AMAs as a comparison (rather than a randomized survey of non-AMA irrigation users). While the number of respondents is likely to be small, we hope it will be sufficient for comparison purposes.

We have benefited from the support of Dr. Rimjhim Aggarwal, who was not initially listed as a co-PI in the project. Dr. Tim Lant, one of the original Co-PIs is no longer at ASU and is not participating.

**E. Completed publications, white papers, or reports (with internet links if possible).**

Reports/ White Papers:

Marci Baranski, John Connors, Rafael Fernandez Alvarez, Mindy Kimball, Thomas Redd, Colin Kunzweiler, and Benjamin Warner. *Cotton, Condos and Climate: Institutions and Adaptation to Water Resource Change*. Adaptation, Resilience and Transformation Workshop Report. December 2012.

**III. GRAPHICS: PLEASE INCLUDE THE FOLLOWING GRAPHICS AS SEPARATE ATTACHMENTS TO YOUR REPORT**

See attached.

**IV. WEBSITE ADDRESS FOR FURTHER INFORMATION (IF APPLICABLE)**

Not applicable

**V. ADDITIONAL RELEVANT INFORMATION NOT COVERED UNDER THE ABOVE CATEGORIES**

None.

# Risk perception, Institutions, and Water Conservation: Enhancing Agricultural Adaptation to Future Water Scarcity in Central Arizona

Arizona State University (PI H. Eakin) and  
U of A Cooperative Extension (PI\_S. Waters)

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- Central Question: How do water institutions affect farmers' engagement with adaptation to future water scarcity in urban Central Arizona?
- Research Framework: Social Ecological System analysis / Institutional Analysis
  - Key research concepts: adaptive capacity, robustness-vulnerability trade offs, private provisioning of public adaptation goods
- Methods and Tools: institutional analysis, expert interviews, survey, dynamic system modeling, participatory workshops
- Preliminary Findings
  - Water institutions and infrastructure currently serve to buffer irrigated farm community from climatic variability and emerging stressors on water system. Little demand for and use of climate services and products.
  - Agricultural community faces contradictory institutional incentives and messages concerning need for water conservation (reduction in per-acre use of water)
  - Key decision-makers are irrigation district managers and water resource managers in urban context rather than individual farmers
  - Primary drivers of change in farm sector are exogenous to Central Arizona region: commodity prices, energy prices, federal regulations and farm policy
  - Signals of environmental change will be channeled through energy prices, infrastructure constraints, water prices rather than direct impacts on farm yields