Agriculture, Resources, and the Environment

III. Sustainable Management of Nutrients and Water in Agricultural Landscapes

Summary
This initiative involves close engagement with farmer groups and other key agricultural stakeholders to address critical issues of nutrient flows and water use in California agriculture. The primary aims are to identify and quantify the key biogeochemical cycles that drive the flow of agriculturally applied nutrients through the agroecosystem and beyond, quantify the environmental impacts of those flows, identify the socioeconomic and agronomic factors that shape the use of agricultural inputs, and identify and communicate best management practices for improving on-farm efficiency and minimizing off-farm impacts. Several of the projects in this initiative are likely to follow an ecosystem assessment framework, modeled after the Millenium Ecosystem Assessment and other global efforts. Using such a framework involves compiling and synthesizing existing scientific knowledge on a topic and maintaining close engagement with stakeholders in order to ensure that products resulting from the assessment can achieve maximal decision making and policy impact.

Problem statement/ Baseline
Many of the most pressing environmental and economic sustainability challenges faced by California agriculture in the 21st century stem directly from the dynamics of nutrient flows and water use on our farms. In the case of nitrogen, a highly mobile nutrient, large amounts "leak" from the system and cause eutrophication and anaerobic dead zones in rivers, pollution of estuaries and coastal areas, nitrate contamination of groundwater, and high fluxes of nitrous oxide, a potent greenhouse gas. However, the exact location, extent, and severity of these environmental impacts and how they are related to one another and to on-farm nitrogen use are only partially documented, and the feasibility of ameliorating them is poorly understood. Similar concerns apply to phosphorus, which additionally is facing the potential for production to decline and/or become significantly more expensive in coming decades.[i] In the case of water, a series of drought years has heightened already existing political tensions between agricultural, environmental, and urban water users for an increasingly scarce resource, and some farmers are fallowing their fields for lack of irrigation water. Concurrently, some areas of the San Joaquin Valley are becoming unfit for crop production due to excess salinity, a problem closely tied to irrigation and nutrient applications.

Structural issues/ Broad drivers shaping change
- The general public as well as farmers and ranchers have little awareness of the landscape-scale problems associated with fluxes of nitrogen and other agricultural nutrients.
- Until recently, farmers have had few incentives to increase nutrient use efficiency because of low costs of energy, inorganic nitrogen fertilizer, and irrigation water.

Strategic opportunity

- Recent spikes in fuel prices and fertilizer costs have heightened farmers' interest in increasing their nutrient use efficiency for economic reasons.
- Recent changes in methods of regulating water quality of agricultural runoff have also heightened farmers' interests in nutrient use efficiency, for regulatory reasons.
- A continuing drought and new environmental water flow regulations for the Bay Delta region are increasing concerns among farmers, the general public, and policymakers about water use issues in agriculture.
- The creation of ASI has provided an institutional hub for interdisciplinary, stakeholder-oriented research and outreach.

Desired outcomes

- The capacity of UC researchers and UCCE staff to conduct multidisciplinary research and large-scale ecosystem assessments is increased.
- Key research and information gaps will be identified and will provide the basis for a research and communication plan on nutrient flows.
- A broad array of stakeholders, ranging from farmers and ranchers to fertilizer manufacturers and policy makers, will better understand nutrient flow dynamics, how they affect other natural resources, and best management practices for improving on-farm efficiency and minimizing negative off-farm impacts. Adding salinity
- Agricultural water users will have better information resources for choosing from an array of best management practices for water use efficiency.

Key Partners

- Producers (farmers, ranchers, dairies) as represented by approximately 30 commodity groups
- Input suppliers: fertilizer industry groups
- Irrigation districts
- UCCE
- Certified crop advisors
- Policy makers and regulators: and CA Dept of Food and Agriculture and Fertilizer Research and Education Program
- Environmental and agricultural NGOs: Roots of Change, Sustainable Conservation, etc.
- Packard Foundation

Activities

TOPICS:

- California Nitrogen Assessment. Conduct pilot statewide assessment of nitrogen fluxes, based on internationally accepted ecosystem assessment methodology, foster interdisciplinary research teams with junior faculty, build and implement a strategic communications plan to engage with the farming community, extensionists, policy makers, and the general public.

- Longterm Research on Agricultural Systems (LTRAS). Entering 17th year of research at the Russell Ranch facility on long term agricultural plots to understand relationships between sustainability and external inputs (N, P, water, energy) by assessing trends in yield, profitability, efficiency in use of limited resources, and environmental impacts, such as N losses.
- Ecosystem Assessment of Greenhouse Gas Emissions in CA Agriculture. Conduct research and outreach on GHG emissions from agriculture and food industries in CA, using a large-scale ecosystem assessment framework and building on work already completed on N_2O in the nitrogen assessment and other work in the Climate Footprinting Initiative. Preliminary work on carbon being done in California Agroecosystem Planning Project.
- Life Cycle Assessment of Water Use in Agriculture. Build on life cycle assessment capacity developed by ASI in the Climate Footprinting Initiative to address water use and soil salinity issues.

Resources needed for 5 years

Total need: $4.5 million

- Nitrogen Assessment = $1.5 M
- Research grants for 1 new ecosystem assessment on GHG and/or water = $1 M
- Russell Ranch facility support and projects @ $400,000 per year = $2 M

- *Additional SAREP/ASI staffing (using extramural funds) dedicated to ARE @ $60K for 5 years = $300K [part of all initiatives]*

Current extramural grants: $2.6 M
$1.5 million (N assessment)
$180,000* per year (Dean's Office support for Russell Ranch)
$200,000 CA Agroecosystem Planning Project

Additional need: $1.9 million or more, pending possible Dean's Office budget cuts

**Subject to further budget cuts.*

[i] Cordell, D., Drangert, J.O., and White, S. 2009. The story of phosphorus: global food security and food for thought. *Global Environmental Change* doi:10.1016/j.gloenvcha.2008.10.009.