

Stanford University

Woods Institute for the Environment

Freshwater Initiative

An Overview of Three Strategic Collaboration Research Programs



WOODS INSTITUTE
FOR THE ENVIRONMENT
STANFORD UNIVERSITY

February 2010

Woods Institute for the Environment

Freshwater Initiative

Water presents one of the greatest sustainability challenges of this century. The demands upon that rigidly fixed supply of life's most indispensable compound are expanding. At the same time, climate change threatens the viability of existing water systems. Rising health standards drive changes in the definitions of acceptably clean and safe water supplies. And mounting concerns for environmental sustainability and ecosystem management are generating urgent new claims on this already scarce resource.

The Woods Institute for the Environment at Stanford University has launched a Freshwater Initiative consisting of three interrelated "strategic collaborations" research programs to address this sustainability challenge. Two of the strategic collaborations, the **Global Freshwater Initiative** and **Program on Water, Health and Development**, will address questions facing water managers throughout the world. The third strategic collaboration, the **Program on Water in the West**, will focus on solving water issues facing the western United States.

Stanford Expertise

Stanford has tremendous expertise in the water field, drawing on faculty in all seven schools at the university. The Woods Institute has supported an active research program on issues involving freshwater, primarily through its seed support of Environmental Venture Projects (EVP). Many of these EVPs have focused on freshwater issues that are at the heart of the new strategic collaborations. For example:

- One strategic collaboration on sustainable water supplies will build on a highly successful EVP that developed new modeling tools to improve urban water management in water-stressed India.
- Two EVPs, one working to reduce waterborne diseases in Africa and the other focused on arsenic poisoning from groundwater in Southeast Asia, will build a foundation for our new strategic collaboration on providing the developing world with higher quality water supplies that will improve public health.
- Another strategic collaboration will build upon several EVPs that have focused on issues in the western United States, including one directed at improving California water markets, and a new EVP on how to increase water recycling for agricultural production and ecosystem restoration in California and the West.

The new strategic collaborations are modeled after similar collaborations that the Woods Institute has successfully launched to address challenges in the areas of land use and the ocean – the Natural Capital Project, the Program on Food Security and the Environment, and the Center for Ocean Solutions. Like these existing strategic collaborations, the new freshwater research programs will share several key characteristics:

- *Focus on Solutions* - The programs will support and build on cutting-edge research.
- *Interdisciplinary Perspectives* - The programs will draw on expertise from around the university and beyond, including the Woods Institute's 46 fellows and more than 100 affiliated environmental faculty across Stanford.
- *External Collaboration* - The programs will work closely with decision makers and leaders from government, business and NGOs.
- *Training the Next Generation of Leaders* - The programs will help train new leaders to solve future freshwater challenges.

By providing a common home to the three strategic collaborations, the Woods Institute will ensure integration and coordination among the programs. We expect that the three programs will jointly work on a number of overlapping issues.

Three Strategic Collaborations

Short synopses of each of the research programs follow below.

Initiative I: Global Freshwater Initiative

Principal Investigators:

Steven Gorelick, Environmental Earth System Science
Barton Thompson Jr., Law School and Woods Institute
Scott Rozelle, Freeman Spogli Institute for International Studies and Woods Institute

Estimated Budget:

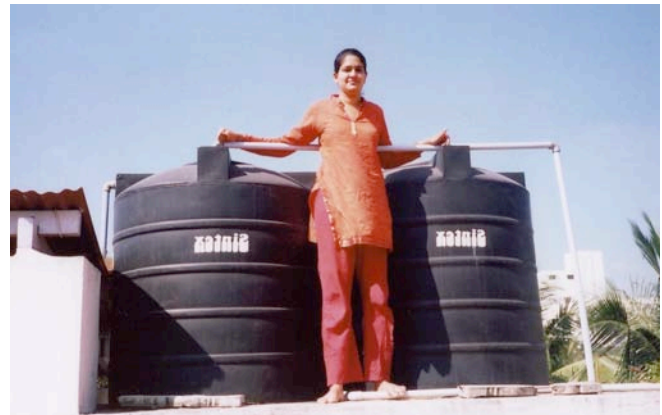
\$8.8 million over 5 years

Changes in human and natural systems will drive serious threats to freshwater resources in the 21st century. An overarching challenge will be to create water systems that can sustain human wellbeing and natural ecosystems in the presence of rapid environmental and socioeconomic change. Solutions are likely to rely on modern engineering and information technologies, combined with effective planning, policies and institutions.

The **Global Freshwater Initiative** will develop implementable strategies to promote the long-term viability of freshwater supplies for people and ecosystems threatened by climate change, shifts in land use, increasing population and decaying infrastructure.

In a selected set of regional investigations, Stanford researchers and local collaborators will work together to understand freshwater resource issues and build quantitative policy evaluation models that account for hydrologic processes and economic behavior. Through regional integrated models, the project will examine the efficacy of policy instruments aimed at reducing vulnerability and enhancing sustainability. The initiative also will conduct a variety of activities that cut across the regional investigations, including model-building workshops to generate a common analytic framework and an annual policy forum to compare water-resource sustainability strategies across regions.

Research activities will satisfy three strategic



criteria. First, researchers will work with stakeholders and regional collaborators to generate solution-oriented outcomes. Second, research will consider the combined effects of multiple stressors of water supply vulnerability. Third, the initiative will be global in scope but regional in focus. Regional investigations will represent a diverse set of problems involving water supply vulnerability.

The initiative will: 1) generate a set of policy evaluation models developed in conjunction with each regional investigation; 2) provide targeted analyses of viable policy interventions aimed at achieving freshwater sustainability; and 3) train the next generation of water resource experts. Initiative funds will support faculty, students, postdoctoral fellows and visiting scholars, as well as allow project members to travel to regional investigation sites to build strategic partnerships, collect data and construct regional integrated models.

Selected current research on this topic

- Global change and water resource vulnerability.
- Transition to sustainable water supplies in southern India.
- Land use and freshwater supply in Cambodia.

Initiative II: Program on Water, Health and Development

Principal Investigators:

Jenna Davis, Civil and Environmental Engineering and Woods Institute
Scott Fendorf, Environmental Earth System Science and Woods Institute

Estimated Budget:

\$2.73 million over 3 years

Among developing countries in Asia and Africa, 20 percent of the population has no improved water supply service and 50 percent lack access to basic sanitation services. The high cost of installing modern water and sewer networks means that efforts to expand access for these populations will rely principally on “non-networked” options, such as shared borewells and household latrines. A variety of reliable and low-cost, non-networked water and sanitation technologies exist, but their widespread use creates challenges for public and environmental health.

The **Program on Water, Health and Development** will address pressing research needs related to non-networked water supply and sanitation service delivery; enhance capacity within developing countries for sustainable water and wastewater management; establish long-term partnerships so that research is translated into practice; and offer unique training and learning opportunities for faculty and students at Stanford and partner institutions.

The proposed program will initiate activities in Cambodia, Mozambique and Tanzania as first-stage locations, because of the pressing need and the strong partnerships that exist between Stanford faculty and collaborators in these countries. In Cambodia, researchers will work with partners to identify approaches for serving non-networked populations at risk of arsenic poisoning. In Mozambique, researchers will evaluate the impacts of a policy experiment to legalize water resale to non-networked populations. In Tanzania, researchers will investigate the changes in household water management and hygiene needed to realize health benefits of government



investments in community borewells. In each case, multi-scale, multidisciplinary research is envisioned that has direct bearing on pressing environmental, health and economic development policy debates.

Research can only make “real world” impact, however, if it is linked to decision-making and policy formulation. The program research strategy is premised on the belief that creating partnerships, and not simply pursuing projects, is essential to having an impact on critical water and sanitation challenges in Asia and Africa. Initially, we will build upon existing networks between Stanford faculty and government agencies, international development agencies, NGOs and research institutions operating in Cambodia, Mozambique and Tanzania to link research, training and policy activities within each country. At the same time, the program will actively seek to disseminate research outputs across Asia and sub-Saharan Africa, where three quarters of those lacking access to improved water supply and basic sanitation live. Over time, the program will scale out to establish new country partnerships in both regions.

Selected current research on this topic

- Water, health and environment: Childhood survival in Tanzania.
- An integrative study of processes controlling arsenic release induced by land use in Asia.
- Water and development: Scaling local solutions.

Initiative III: Program on Water in the West

Principal Investigators:

David Kennedy, Lane Center for the American West and Woods Institute
Dick Luthy, Civil and Environmental Engineering and Woods Institute

Estimated Budget:

\$7.8 million over five years

The American West faces an urgently mounting water crisis. Its water regimes are largely the products of archaic political and institutional structures, 19th-century scientific assumptions and 20th-century engineering technologies. Challenges for managing water use arise from the age-old competition between agricultural and urban users, but also from aging water infrastructure, population growth, climate change and maintaining healthy aquatic ecosystems.

The mission of the **Program on Water in the West** is to find and demonstrate solutions to the region's water challenges that are efficient, equitable, sustainable and politically viable. The initial five-year program will focus on two major challenges and opportunities: 1) design and promote integrated monitoring and management policies for groundwater resources, including groundwater banking; and 2) design and promote adoption of non-potable water reuse and energy-efficient reuse systems for irrigation and for restoration of valuable aquatic and riparian ecosystems.

At the program's outset, researchers will undertake a special project to define metrics for success for each of its initiatives and their constituent projects. The research team will develop logical causal models for achieving results and define measurable outcomes. This initial step is necessary to ensure that research outcomes can be effectively applied for improving water use and management in the West.

To address the first challenge, researchers will focus on the institutional challenges facing the sustainable and coordinated management of groundwater and surface water. Although ground- and surface water are hydrologically connected, few western states effectively integrate them. Some, like California, ignore the hydrological interconnection entirely. This has led in much of the West to declining groundwater tables, adverse impacts on surface streams and the inability to use aquifer space to store surface supplies. Researchers will

develop and recommend new systematic and politically viable approaches for improving and integrating groundwater and surface water management; develop recommendations for groundwater-banking legal and policy changes; and develop new technologies to effectively monitor and manage groundwater banks.

In the program's second research component, researchers will investigate how to develop superior processes for water treatment and reuse. Given the finite supply of water in the region, reclamation and reutilization offer some of the most promising avenues for extracting optimal value from a scarce resource. Researchers will focus on contaminants of emerging concern for non-potable water reuse as part of an ongoing study of irrigation and groundwater recharge in Monterey County, California, and on the construction and operation of an experimental biofuelled treatment plant on the Stanford campus. Longer-term objectives include building on the Monterey study to develop reliable metrics of water purity for various uses, including potability, habitat maintenance and crop and landscape irrigation; and assessing the scalability of the experimental Stanford installation to neighborhoods and cities. Special consideration will be given to establishing a gradient of water safety standards and to the



development of energy-efficient distributed systems.

Program research will be guided by two principles: 1) thinking about the region as a whole; and 2) systematically integrating institutional analyses of the historical, legal, political and economic dimensions of western water issues with cutting-edge science and the promotion of innovative technologies. The goal is to generate new knowledge that will produce more efficient,

sustainable and equitable utilization of the West's limited water resources, and thereby promote the entire region's continuing vitality.

The **Program on Water in the West** is a partnership with Stanford's Bill Lane Center for the American West and includes a multidisciplinary team of engineers, biologists, hydrologists, historians, economists, and legal and policy experts.

Selected current research on this topic

- Decision-making in recycled water project implementation: Asymmetry in scientific knowledge and political economy.
- A forensic study of unstable nitrification at the Palo Alto water quality control plant.
- An economic incentives model for California water markets.
- High-rate microbial production of nitrous oxide for energy generation.
- Comprehensive studies of aquifer depletion and salinization.

Funding Opportunities

The Woods Institute is providing each of the strategic collaborations with a small amount of start-up funds that will permit them to begin initial work. We are now seeking long-term funding for each of the strategic collaborations, and for the general support (outreach, communications, administrative) that the Woods Institute needs to effectively assist the collaborations. Funding also is needed to support new faculty positions in the freshwater area and to support graduate students working with the various programs.

Learn more about Stanford's freshwater research at: woods.stanford.edu

For more information:

Jeffrey Koseff
Woods Institute for the Environment
Stanford University
Y2E2 Building
473 Via Ortega - 4205
Stanford, California 94305
Phone: 650.736.8668
Email: koseff@stanford.edu