

# STATE OF THE ART OF ECOSYSTEM SERVICES

BIENNIAL WATER FUNDS SUMMIT

BOGOTÁ, COLOMBIA

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## CHALLENGE: DESIGNING APPROPRIATE INTERVENTION BUNDLES IN DIFFERENT CONTEXTS

Bogotá, DC, Colombia



(Photo: Sheila Reedy)

Freeport, Texas, USA



(Photo: Wyman Meinzer)

(One-size does not fit all, see review of water funds: Bremer et al. 2016 *Ecosystem Services*)

On Tuesday afternoon, a group of us hiked through the rain and mist to see one of the sources of water for Bogotá: Los Tunjos Lagoon in the Sumapaz páramo (picture here on left). On the way, we got to see cattle exclusions that were installed on a farmer's land to help improve water quality.

Standing there in the mist and rain, we were thousands of miles away from where I have been working on water issues in Texas—literally and figuratively. The Brazos river in Texas ran dry in 2011, the main water users are big companies like The Dow Chemical Company, and the City of Houston.....there is very little agriculture.

The field trip to the páramo and this meeting sent a clear message to me....we all share water challenges but the solutions to our challenges are not one-size-fits-all, there's no silver bullet.

What I am going to try to show in the talk today, is how science — especially including social sciences and economics--can help us identify specific sets of interventions that fit different contexts....and how we can learn through sharing insights from other places.

## INTERVENTION BUNDLES

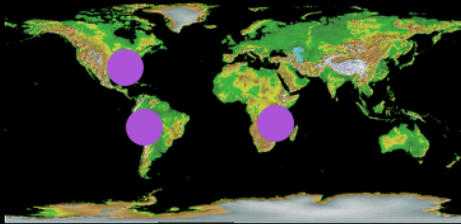
A small set of evidence-based interventions for a specific social-ecological system and context that when used together provide better outcomes than generic or individual interventions.

(Adapted from Institute for Healthcare Improvement 2012)

I've borrowed the concept of intervention bundles from healthcare practitioners...and here in the context of conservation and water management, I'll define it as: [see slide].

## THREE SCIENCE QUESTIONS

- WHAT IS GOING ON IN HUMAN-WATER SYSTEMS?
- HOW CAN WE IMPROVE THE SYSTEMS?
- DID WE SUCCEED?



## EXPLORING THE SCIENCE

- WHAT ARE THE TRENDS?
- WHAT ARE SOME EXAMPLES?
- WHAT SHOULD WE ASK NEXT?

To identify these intervention bundles, we need to ask three science questions [see slide]...

I am going to help us explore the science addressing these questions by giving an assessment of the trends; provide examples from water systems and funds in Texas, Peru, and Kenya; and propose some of the science questions I think we need to be asking next.

# WHAT IS GOING ON IN HUMAN-WATER SYSTEMS?

## Social-Ecological Systems

Governance  
Systems

Actors



Resources  
Systems

Resource  
Units

### Trends

- Modeling linking ecosystems, services, beneficiaries
- Building empirical evidence base for changes in services
- Emerging research on actors' behavior

(SES Systems: Ostrom 2009 *Science*, Leslie et al. 2015 *PNAS*)

So, it makes sense that before we can design appropriate interventions, we need to understand the system. The social-ecological systems framework has been helpful in conceptualizing human-water systems. Much of the science in the space has been on linking ecosystems to services, and their beneficiaries. And there are increasing efforts to make this empirically based. However, I'd say the big gap here is our understanding of governance systems and actors' behaviors.

# WHAT IS GOING ON IN HUMAN-WATER SYSTEMS?

## Example: Public Goods and Gender, Upper Tana, Nairobi, Kenya

- Theory:
  - Mix gender groups manage public goods better
  - Trust is important because hard to monitor
- Experimental Results (preliminary):
  - Communication: Mix gender groups contribute most
  - No Communication: All female groups contribute least
- Potential Implications:
  - Need to engage both genders
  - Provide monitoring/enforcement



The Nature Conservancy

Yuta Masuda et al. (In Preparation)

One place we're making an important advance in understanding actors' behavior is exciting new work on gender and public goods by Yuta Masuda, Carolina Castilla, and Wei Zhang in the upper Tana watershed outside of Nairobi, Kenya.

The basic idea is that involving men and women in the management of resources can lead to better outcomes.

Yuta and the team did some experiments to test this out and found evidence that in fact mixed gender groups do contribute more to the public good, but when people cannot communicate about their decisions, there are lower contributions, especially in all female groups.

What this suggests is that it is important to involve both genders and provide mechanisms for people to know what others in the community are doing.

## WHAT IS GOING ON IN HUMAN-WATER SYSTEMS?

### New Questions:

- What are actors doing?
- Why do actors behave as they do?
- How do actors' behaviors influence or get influenced by the ecosystem?

(Reddy et al. 2016 *Conservation Letters*, also see Morrison 2016 *Biological Conservation*)

So, what should be asking next?

I'd argue we need to better understand what people are doing, why, and how it relates to the ecosystem...in order to design better interventions and governance structures.

# HOW CAN WE IMPROVE THE SYSTEM?

## Menu of Interventions

Approaches to Influence Actors' Decisions

Decisions Affecting Resource/Ecosystem

Promoting awareness and concern  
Providing incentives (economic, social, intrinsic)  
Using behavioral nudges

Land Use:  
Conservation/restoration  
Agricultural practices  
Water Use

(Reddy et al. 2016 *Conservation Letters*) (Calvache et al. 2012 TNC, Stavins and Olmstead 2008 *FEEM*)

### Trends

- Water Funds target land use; water markets/pricing target water use
- Evidence for approaches to influence actors' decisions limited
- Emerging integration of interventions

Once we have a better understanding of the system, we can start to ask, how can we improve the system....

Here we need to think about the menu of interventions as having two components--- the different approaches to influence actors' behavior and the different approaches to changing land use and water use.

In terms of trends, water funds have primarily targeted land use, while water markets/pricing have targeted water use.....in some places it may be important to integrate these approaches.

There also has been little science on how to influence actors despite the fact that many people agree that we need different approaches in different places, for instance here in Colombia in-kind payments are appropriate while in Brazil cash payments are appropriate.



## HOW CAN WE IMPROVE THE SYSTEM?

### Example: Intervention Bundle for Quantity, Dow, Freeport, Texas

Goal	Project	Evidence
Increase Supply	Management of water-hungry invasive plants	Not cost-effective, low water supply
	Municipal wastewater recycling in wetlands	Not cost-effective, high water-supply
Decrease Demand	Irrigation efficiency	Cost-effective, low water savings
	Municipal rebates for xeriscaping	Cost-effective, low water savings
Increase Value through Transfers	Floodplain restoration/reservoir reallocation (across time)	Cost-effective, medium water supplies
	Water trading (across users)	0-55% reduction in water price, small impact on shortages, economics losses



(Reddy et al. 2015 *Ecosystem Services*, Reddy et al. 2015 *Water Resources and Industry*)

In Texas with the Dow collaboration, we have done research to evaluate intervention bundles that could address quantity issues. We categorized these as interventions that increase supply, decrease demand, or increase value through transfers across time, space, and users.

The interventions ranged from nature-based solutions, like those used in water funds, to water trading or markets.

We found that some of these were cost-effective and delivered water quantity improvements (green), we are now exploring opportunities to advance these interventions through a multi-stakeholder mechanism, with help from TNC's water funds team.

## HOW CAN WE IMPROVE THE SYSTEM?

### New Questions:

- Considering actors and resources, what are the appropriate set of interventions for different contexts?
- How can we integrate interventions that address both quality & quantity goals?
- Can user fees pay a double dividend by reducing water use and funding source water conservation?

From this and other research, the emerging questions are:

What are the appropriate set of interventions?,

How can we integrate interventions that address land use and water use (such as water funds and water markets/pricing)?,

For example, can water user fees in water funds pay a double dividend by reducing water use and funding source water conservation?

## DID WE SUCCEED?

### Dash Board

- Water
- Habitat
- Return on Investment

### Trends

- Evidence for nature enhancing quality, emerging evidence on quantity
- Co-benefits articulated, not always quantified
- Return on investment analyses underway

Lastly, of course, we want to know if interventions succeeded, and if not....how to design them differently

Yesterday, we heard a great session on monitoring

Some take-aways from that session were that an increasing number of water funds are monitoring water outcomes [although fundraising for monitoring and planning for this upfront is still a challenge], but many are facing challenges in translating that into economic outcomes and understanding co-benefits.

We did however see some examples, including the presentation from Claudio Klemz on the Camboriú (Brazil) water fund.

## DID WE SUCCEED?

Example: Return on Investment Analysis (ROI), Lima Water Fund, Peru

Diversion-Infiltration System Restoration



(Photo: Natural Capital Project)

Grassland Restoration



(Photo: Walter Mvusi)

- >3X water availability
- ROI > 1 for upstream and downstream communities
- Restoration not viable without irrigation improvement in bundle

(Kroeger et al. 2016 TNC)

Here, I want to briefly share an example of another ROI analysis that is being led by Timm Kroeger.

Using simulation modeling, they analyzed the potential ROI for two land use interventions- restoration of antique water systems and restoration of the páramo.

They found that these interventions could increase water by 3 times and the return on investment was greater than one.

However, the ROI for the upstream community depended on having irrigation improvements (e.g., livelihood improvements) as part of the intervention bundle.

## HOW CAN WE IMPROVE THE SYSTEM?

### New Questions:

- How does ROI change when we consider multiple beneficiaries and co-benefits?
- How effective are different approaches for influencing actors?

As this research highlights, an important question is how does ROI change when we consider multiple beneficiaries and co-benefits? And, relatedly, how effective are different approaches for influencing actors. For example, what is the role of incentives, education, social networks?

## TAKE AWAYS

- Need to better use science to understand governance systems and actors
- Appropriate intervention bundles depend on social-ecological conditions
- Some interventions could pay double (e.g., user fees)
- Multiple interventions most successful
- Frontier is interventions that get triggered under new conditions (e.g., El Niño)



In sum, the key take-aways are:

- We need to better use science to understand...[see slide].
- I started this talk describing the water issues here in Bogotá and in Texas....

Bogotá, DC, Colombia



(Photo: Sheila Reddy)

Freeport, Texas, USA



(Photo: Wyman Meiner)

I started this talk describing the water issues in here Bogota and in Texas...this year they are both being impacted by El Niño, which has turned things on its head. For example, in Texas where a few years ago the river ran dry, it is now flooding and killing people. In contrast, Bogotá is having unusual water shortage problems. This only further underscores the need to design intervention bundles that fit specific systems, and the changing contexts experienced in those systems.

