Cost-effectiveness in water related ecosystem services conservation

Dr. Oscar Sarcinelli
IPE – Institute for Ecological Research

Prof. Dr. Ademar R. Romeiro
State University of Campinas - UNICAMP
1. The Cantareira Water Supply System

- The most important water supply system in Brazil:
  13 million beneficiaries;

- Drainage area:
  228,000 hectares;

- Structure:
  5 connected reservoirs;

- Priority area:
  Atlantic forest biodiversity conservation and water supply;
2. Land use, occupation and environmental impacts

**Land Use**
- 35% forest
- 54% pasture
- 12% eucalyptus

**Land Occupation**
- 55% of rivers without riparian forests

**Impacts on Water and Soil**
- Average annual erosion rate: 27 ton.hectare.year
- Average annual rivers Sedimentation rate: 1.2 ton.hectare.year

Source: IPE GeoLab
3. Regulation flow: The problem behind environmental impacts

Cantareira Water Supply System

18 abril 2010 - 99.6% capacidade

31 maio 2014 - <8.2% capacidade

Source: IPE GeoLab
4. No rain, no gain!

25% less rain
Jan/2011 to Nov/2014

118% less water provision
Jan/2011 to Nov/2014

Monthly average rain and its impact on water provision

5. Alternatives to increase Cantareira System resilience

- **Build new reservoirs:**
  US$ 286 millions;
  R$ 3,50 to US$ 1.00

- **Restore riparian forest:**
  21.5 thousand hectares:

- **Pasture management:**
  123 thousand hectares;

- **Combine forest and pasture management:**
  144.5 thousand hectares;
6. Research question?

Which intervention is more cost effective to promote water regulation flow and soil conservation in Cantareira Water Supply System?
7. Methods

7.1. Defining environmental indicator for water regulation ecosystem services

- **Soil Erosion**: when more water flows over soils, less water is stored in the soil and groundwater;
- **Sediment Delivery to Rivers and Reservoirs (Sed_Deliv)**: less capacity to store water;
- **Riparian Forest Recovery**: Enlarge water storage capacity and protect water quality;

7.2. Measure environmental benefits for all intervention alternatives

- **InVEST** – Integrated Valuation of Ecosystem Services and Trade-Off (Sediment Retention Model)
- High resolution LULC raster data (30m x 30m);
- USLE parameters adapted to local conditions (1:50.000);
7. Methods

7.3. Measure economic costs for each intervention alternatives

- Costs of “Voisin” pasture management implementation: US$ 881 per hectare
- Opportunity cost of riparian forest conservation: US$ 155 per hectare
- Costs of forest recovery (combined low costs models): US$ 7,715 per hectare

R$ 3.50 to US$ 1.00

7.4. Intervention cost-effectiveness analysis

- Total economic intervention costs / Total ecological benefits
## 8. Results

### Cost-effectiveness analysis

<table>
<thead>
<tr>
<th>Intervention scenarios</th>
<th>Intervention Cost</th>
<th>Sediments delivered to rivers</th>
<th>Cost-effectiveness ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US$ / hectare</td>
<td>Tons. hectare.year</td>
<td>US$ / Sed_Deliv</td>
</tr>
<tr>
<td>Baseline</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
</tr>
<tr>
<td>Riparian forest recovery</td>
<td>7,715</td>
<td>0.9</td>
<td>2,424</td>
</tr>
<tr>
<td>Pasture management</td>
<td>860</td>
<td>0.8</td>
<td>1,156</td>
</tr>
<tr>
<td>Riparian forest recovery and pasture management</td>
<td>7,040</td>
<td>0.6</td>
<td>1,880</td>
</tr>
</tbody>
</table>

R$ 3,50 to US$ 1.00

- ✓ Budget for Riparian Forest Recovery: US$ 166 millions
- ✓ Budget for Pasture Management: US$ 105,4 millions
- ✓ Budget for combined soil and water intervention practices: US$ 257 millions
8. Results

Baseline scenario
Source: Investigation results

Sed_Deliv: 1.2 tons/year

Pasture management scenario
Source: Investigation results

Sed_Deliv: 0.8 tons/year
9. Discussion

- Soil and water conservation are more cost-effective when investments are made in pasture management.

- Investment in the most conservationist scenario (i.e. combined intervention practices) is 11% less than to build a new reservoir and its ecological benefits for soil, water, biodiversity and system resilience are higher.

- A intervention program focused on pasture management could also improve cattle ranch productivity and rural families income in the region.

- Linking PES schemes with agricultural production could be used to incentivize pasture management in the Cantareira Water Supply System.
Thank you!

Oscar Sarcinelli
oscarsarcinelli@gmail.com