A participatory monitoring network in the Andes

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The challenge

Monitoring: Is it possible?

• Uncertainties:
  • Knowledge about Andean hydrological processes;
  • Climate variability;
  • Extrapolation.

• Time limit to generate relevant information.

• Huge gap on hydrological monitoring, (a bit less in meteorological monitoring).
The challenge is ambitious

Traditional hydrometeorological monitoring

- **National scale** network.

- **Location** as a function of infrastructure and civil works (irrigation, hydroelectric plants, airports), and not related to watershed or ecosystem services management.

- Therefore, great gap in **high elevation zones** (most important areas for ecosystem services generation).

- Statistical process of **long data time series**, putting little attention on hydrological processes or their meaning.
Why to monitor?

Information needs

• Key factors for **hydrological ecosystem services** performance.

• **Evaluation** of human intervention and management **benefits**: avoid misunderstandings, optimise interventions.

• **Show balance** of investments.

• Indispensable input for **modelling and prediction** (model calibration).

• Allow **economic analysis** to study green infrastructure feasibility, and comparisons between grey and green investments.
How the hydrological response of degraded páramo change under restoration strategies in Antisana?

What are the hydrological impacts of human interventions in the humid páramos of Paute?

What is the hydrological response after pine forestation of the jalca in Chachapoyas?

What are the hydrological benefits of grassland restoration in the humid puna of Huaraz?

How water regulation change after cattle grazing exclusion in the puna of Huamantanga?

What is the impact of pine afforestation and infiltration trenches in the puna highlands of Tambobamba?

What is the hydrological impact of cultivation and overgrazing in the puna ecosystems of Cochabamba?
Institutional arrangement for participatory monitoring

1. Direct users of land and water.
   - **Commitment:** Security for equipment.
   - **Benefit:** Use information for decision making and improve local practices.

2. Local development institution.
   - **Commitment:** Logistics for data and information collection.
   - **Benefit:** Relevant information for development projects.

3. Research institution.
   - **Commitment:** Data processing and interpretation.
   - **Benefit:** Information research for their students and projects.

4. iMHEA network.
   - **Commitment:** Technical assistance, partnership, generate exchange mechanism.
   - **Benefit:** Several monitoring sites help provide a better idea of Andean hydrology. Decision making incidence.

How to monitor?

1. Direct users of land and water.
2. Local development institution.
3. Research institution.
4. iMHEA network.

Acosta, 2013.
“Trading” space for time

(i) Changes in time
“Trading” space for time

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(ii) Paired catchments
“Trading” space for time

(i) Changes in time

(ii) Paired catchments

(iii) Monitoring network
What is the baseline?

Identify a “witness” or “control”

- In time: BEFORE intervention.
  - Problem: Interventions and actions generally don’t wait.

- In space: SAMPLE region.
  - Problem: Identify representative catchments.

- Most robust:
What scale?

The one that offers the information you need

- Spatial:
  Plot – microcatchment – catchment.
  - Too micro: risk of using variables that do not reflect the benefits.
  - Too macro: intervention impacts may be diluted, mixed or hard to separate.

- Temporal:
  Instantaneous – hourly – daily – monthly – annually …
  - Each question has its own time scale, some within days, others use years of data.
  - How much time do we have to monitor to find answers to our relevant questions?
Paired catchments

A powerful tool for mountain ecosystems

- Microcatchments (0.2 to 10 km²)
- Precipitation – Streamflow

Céleri et al., 2013.
Precipitation: At least 2 tipping bucket rain gauges (res. 0.254 mm or better).
Streamflow: Pressure transducers (res. 0.1 cm) at an interval of 5 to 15 min.
iMHEA partners

- Regional coordination:

- Local stakeholders:

- Scientific advisors:

De Bièvre, 2015.
The natural hydrological regime:
As expected, we found an extraordinary wide spectrum of responses among Andean catchments.
PAUTE, Ecuador

HUARAZ, Perú

TIQUIPAYA, Bolivia

Photographs: Junior Gil Ríos, Boris Ochoa Tocachi
The hydrological regime

Páramo

Jalca

Puna

Ochoa-Tocachi et al., 2016.
SEASONALITY / ASYMMETRY / DROUGHT & FLOODING

TAMBOBAMBA, Perú

Photographs: Boris Ochoa Tocachi
Land-use change impacts: Similarly, impacts are highly diverse, but most commonly result in increased streamflow variability and a decline in catchment regulation capacity and water yield.
CONSERVED / DEGRADED STATUS COMPARISONS

Photographs: Luis Acosta
Catchment comparisons

Buytaert et al., 2007; Ochoa-Tocachi, 2013.
Other information sources?

Complementing information from different sources help enrich knowledge
Complementing information
Supporting investment: For example, under compensations schemes for ES in Peru, the network starts providing quantitative information on hydrological benefits of green infrastructure.
• **Harvested volume** from 25/12/2014 until 27/04/2015: 209118 to 365072 m³/km²

Ochoa-Tocachi, 2015.
Regional analysis

What is the hydrological response to grassland restoration and overgrazing in puna ecosystems in Huaraz?

What is the benefit of grassland closure on water regulation in the puna of Huamantanga?

What is the hydrological impact of cultivation and overgrazing in puna ecosystems of Cochabamba?

Ochoa-Tocachi, 2015.
Cattle grazing exclusion

Potential recovery volume: \(~ 43000 \, \text{m}^3/\text{km}^2\)
Comparison of different grey and green interventions

Cost curves

De Bièvre, 2014.
Final comments

• There is no fixed common solution.

• The network emerged from a local awareness of the need of information.

• “Low” entry threshold, accessible to local partners, ensuring quality through technical assistance and scientific advise.

• The participatory monitoring activities themselves have important local impacts.

• The network has generated relevant knowledge within short monitoring time periods (1 – 3 years).

• Mechanisms and opportunities to reflect, exchange experiences and feedback.
Some perspectives

• The rapidly growing and large database generated should be managed properly. These data need to be summarised in comprehensible indices.

• New questions, new technologies, new methods…

• Articulate/incorporate this monitoring generation to the national systems of hydrology and meterology.

• Draw regional conclusions about the hydrology of Andean ecosystems to support environmental policies and land use and management.

• Connection between the generated information and economic analyses.
Questions and discussion

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