Integrated social-ecological and governance analysis of the water-energy-food-ecosystems Nexus in a mountain catchment in Northern Italy

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Questions? Comments?
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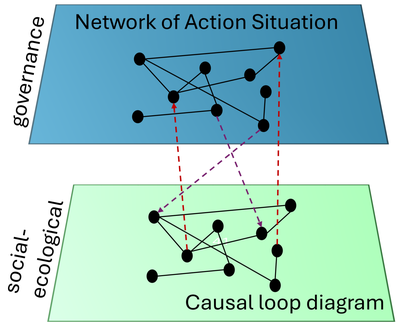
1 Introduction

- **The Alps are the "water towers"** of Northern Italy, contributing on average to 53% of the discharge in the River Po [1]
- Changes to the total and seasonal **availability of alpine water resources** induced by climate change cause **trade-offs** between water dependent sectors, which became evident in recent **water scarcity** and **drought** conditions;
- The **Water-Energy-Food-Ecosystems (WEFE) Nexus** approach has proven useful to understand how these sectors are intrinsically interconnected at **a biophysical** and **technological level**;
- The **governance** implications of WEFE interdependencies and the **institutional interlinkages between the sectors** have received, so far, less attention.

The objective of this study is to qualitatively assess water scarcity in terms of:

- **Interlinkages between social-ecological processes** across the WEFE sectors
- **Interconnections** between **sectoral venues of decision making** and policy formulation

2 Methodology



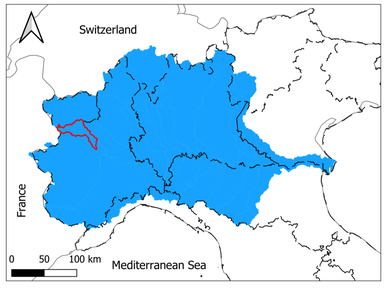
**Action Situation:* a venue of decision-making where social actors interact and produce an outcome [2]

Data source

- Stakeholder Interviews
- Observation of stakeholder meetings
- Regional policies, plans
- News' articles

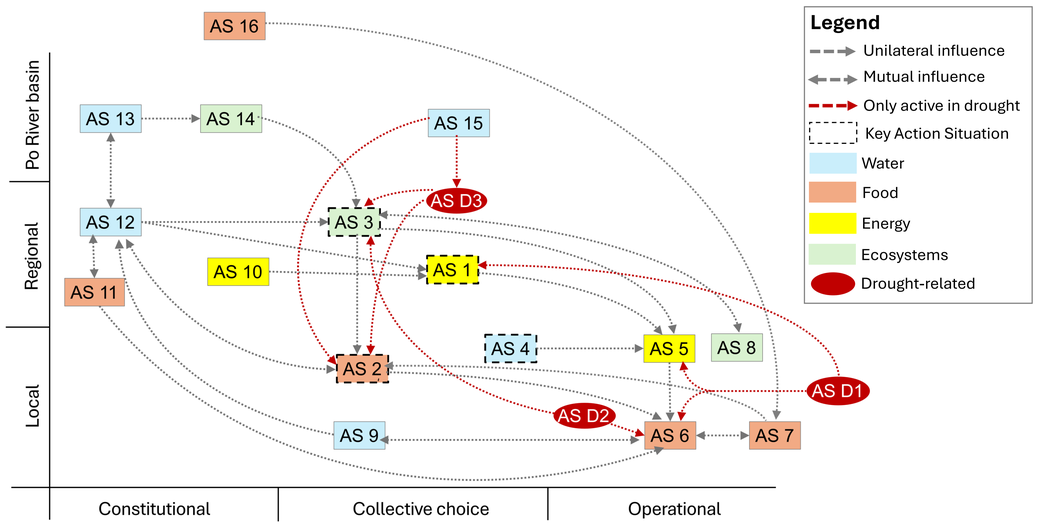
3 Case study

Torrente Orco catchment, River Po Basin, Northern Italy



- Large storage capacity in upstream hydropower reservoirs
- Large downstream withdrawals for irrigation (corn, grassland, cereals, soya)
- Frequent water scarcity conditions (granted concession vs available water)
- Water resources partly allocated outside the catchment

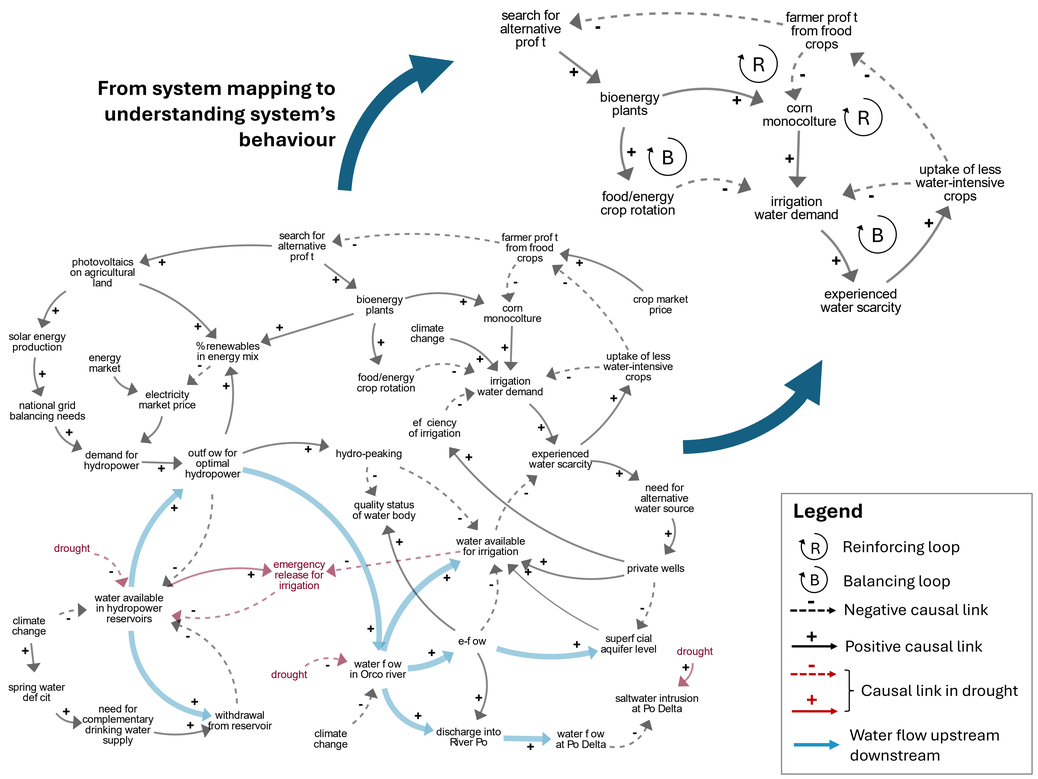
4.1 Results: governance interconnections



AS	Name of Action Situation
AS1	Renewal of large hydropower concession
AS2	Renewal of irrigation concessions
AS3	Update to regional e-flow regulation
AS4	New drinking water supply concession
AS5	Reservoir operation
AS6	Irrigation at farm level
AS7	Crop pattern at farm level
AS8	E-flow experimentation by water users
AS9	Groundwater withdrawal concession
AS10	Energy and Environmental Plan
AS11	Rural Development Plan
AS12	Water Protection Plan
AS13	River Po Basin Water Balance Plan
AS14	E-flow Directive
AS15	Permanent water scarcity observatory of the Po River Basin
AS16	Common Agricultural Policy
AS D1	Coordination dialogue energy-agriculture
AS D2	Water allocation plan between irrigation districts
AS D3	Guidelines for drought management

4.2 Results: social-ecological interlinkages

From system mapping to understanding system's behaviour



4.3 Results

Examples **of interplay** between **governance** and **social-ecological** processes:

- **Setting requirements on social-ecological processes**
  e.g., AS 3 → e-flow; AS 9 → efficiency of irrigation;
  AS 16 → corn monocolture.
- **Monitoring for decision making**
  e.g., water flow in Orco river, → AS D3, AS 5;
  saltwater intrusion Po Delta → AS 15;
  good status of water body → AS 8, AS 3.

5 Conclusions

- **Droughts** reinforces uptake of decision making at operational level into higher hierchical levels (AS D1 → AS 1; AS D2 → AS 3)
- **Multi-purpose use of hydropower reservoirs** is enabled by informal agreements at the operational level (AS 4, AS 5, AS D1)
- Need to further support **transformation of local agriculture** to a more profitable and climate-resilient sector.
- Risk of **over-reliance on existing hydropower reservoirs**?

References

[1] Vivoli, D. and Weingartner, R., 2004. 'The hydrological significance of mountains: from regional to global scale'. Hydrology and Earth System Sciences 8(6), pp. 1 016–1 029

[2] McGinnis, M.D., 2011. An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework. Policy Stud. J. 39, 169–183. https://doi.org/10.1111/j.1541-0072.2010.00401.x

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