

The Effects of Hydropower Plants on River Ecosystem Services

Environmental valuations needed for the implementation of the Energy Strategy 2050



Evidence-based Policy-making 2017, Case study 1

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Energy strategy 2050

Swiss Federal Office of Energy (SFOE) plans to increase hydropower production from 36'300 to 38'600 GWh by 2050

- modernizing and expanding existing hydropower plants
- constructing new ones



<https://progrss.com/sustainability/20170523/switzerland-energy-strategy-2050/>



Benefits of hydropower plants

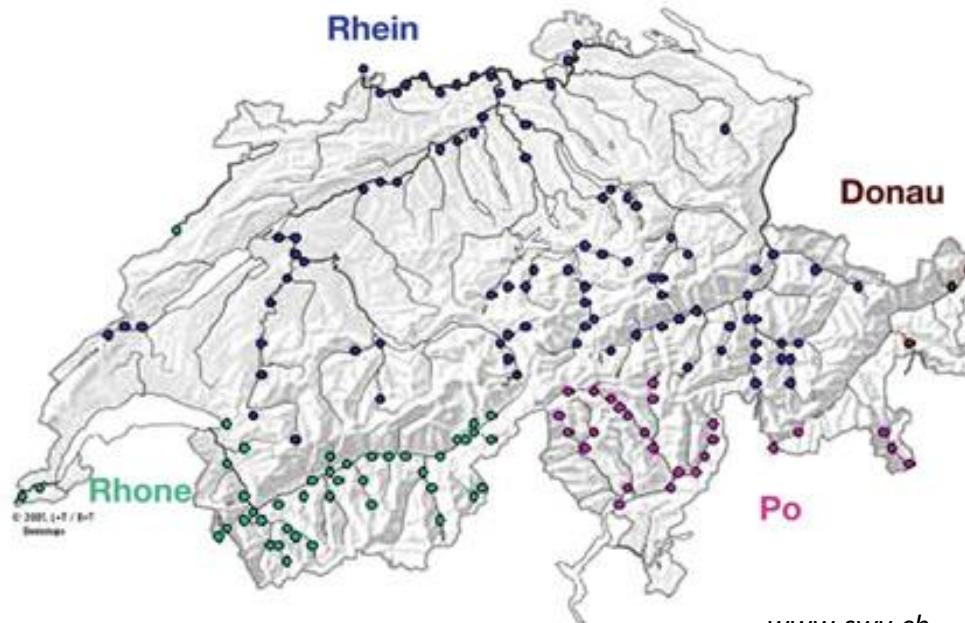
- Renewable energy source
- Domestic energy source
- Clean fuel source (no pollution)
- Fast from zero to max output (= Backup power)
- Recreational opportunities
- diverse benefits e.g. flood control, irrigation, and water supply

<https://www.energy.gov/eere/water/benefits-hydropower>



Hydropower in Switzerland

- 56% of today's energy production
- 97% of electricity production from renewable sources





Ecologic and socio-economic issue

- Only **10%** of the water bodies are **still intact / undisturbed**
- Undisturbed rivers provide ecosystem services
- The **increase in hydropower production** will result in a loss or reduction of the services provided by intact rivers

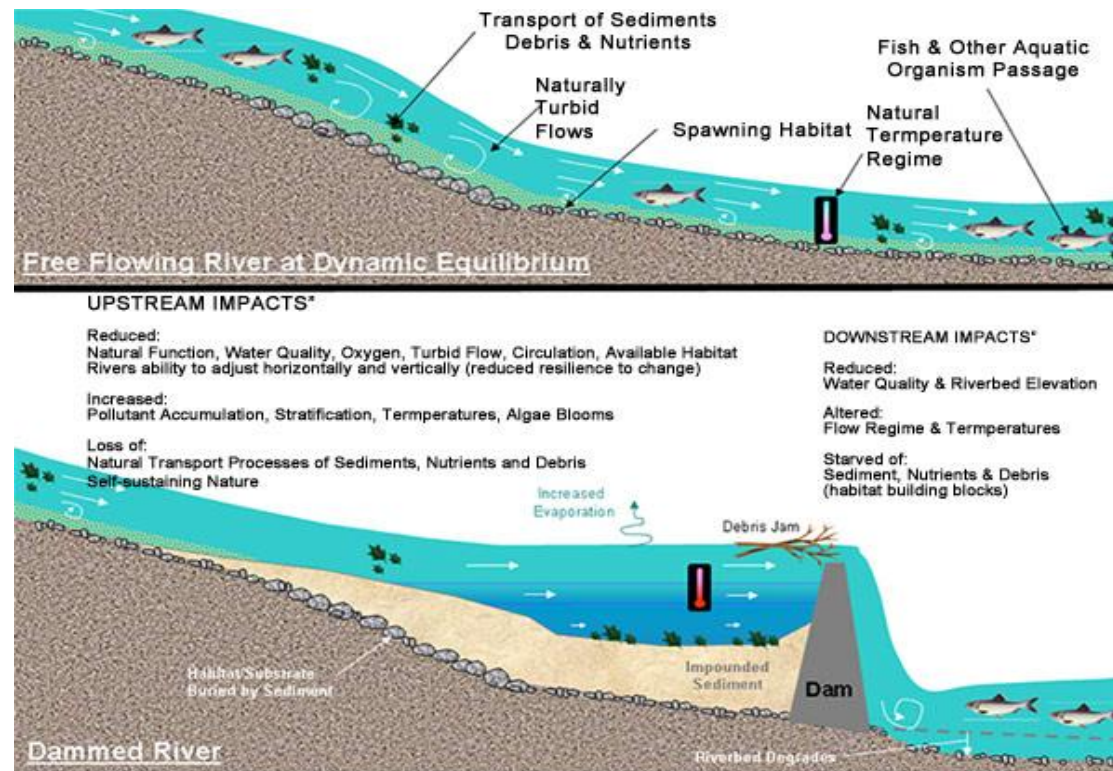


<https://whatisonthetable.wordpress.com/2013/05/17/so-what-are-the-causes-of-conflict/>

Ecologic and socio-economic issue

In Switzerland only 10% of natural river ecosystems left:

- Residual water flow
 - Hydropeaking
 - Fish migration
 - Bedload transport
- >> Biodiversity
- >> Water, air, soil quality





Ecologic and socio-economic issue

- Water protection law 2011: Reduction of negative impacts until 2030
 - 0.1 Rp/kWh \neq actual costs

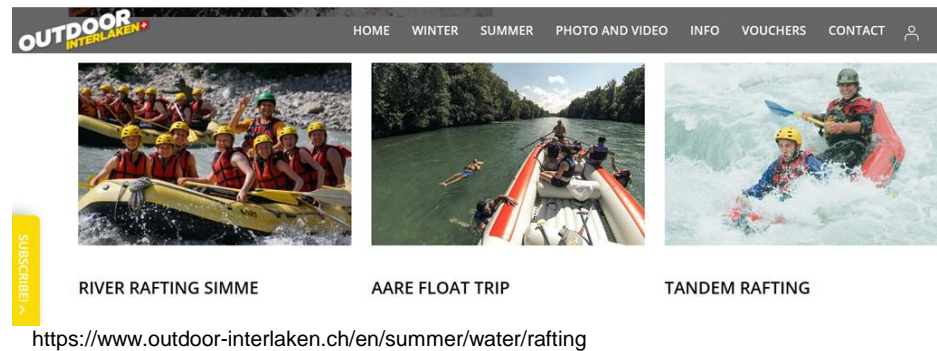


<https://www.bafu.admin.ch/bafu/de/home/themen/wasser/dossiers/strategische-gewaesserplanung-meilenstein-naturnahe-fluesse.html>

Ecologic and socio-economic issue

Potential stakeholders:

- Business community :
 - Fishing
 - Restaurants / hotels
 - Landowners
 - Water recycling
 - Outdoors activities:
swimming, kiting, yachting etc.
- Civilians : environmental scientist, taxpayers, NGOs (Acqua Viva, ProNatura)
- Government: Swiss Federal Offices (SFOE, FOEN), Politicians



veronicamust...
Sydney,
Australia

Reviewed August 4, 2017

Exquisite dining and excellent 5 star service

Every dish was a taste sensation and beautifully presented. Don't go past the Lobster bisque..The setting was superb overlooking the [river](#). In every way , it was a real dining experience. [More](#)

<https://www.tripadvisor.com/>

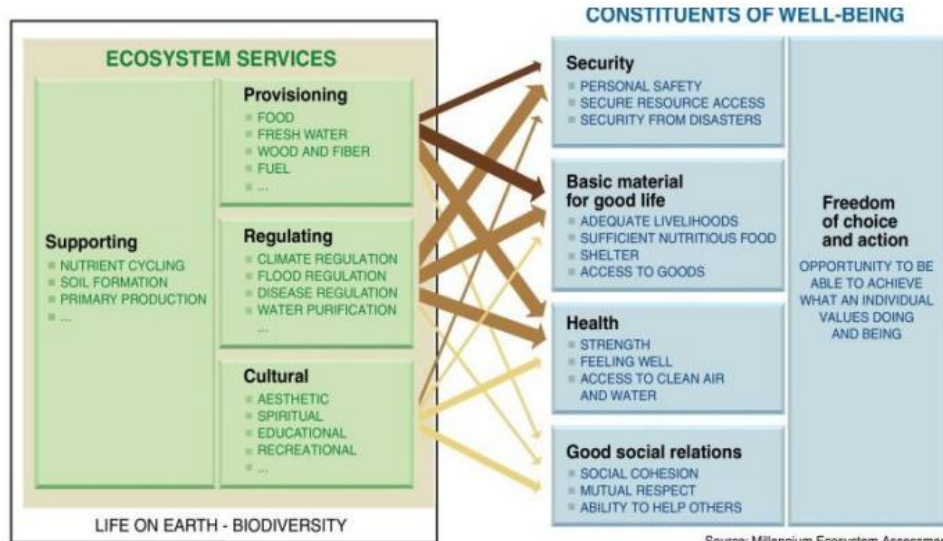
The Ecosystem service approach

Natural capital

Components of natural environment providing long-term stream of ecosystem services



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Source: Millennium Ecosystem Assessment

ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

Vermaat et al., 2013

Ecosystem services

Benefits obtained from ecosystem, increasing human well-being (MEA, 2005)



Environmental valuations

- Traditional approach: protect nature for the cause of its **own (intrinsic) value**

- **Ecosystem valuation**

- Assess and estimate **monetary value** for services provided by a river ecosystem



- **Total economic value** (summing the value of all benefits generated by an ecosystem in a given state)

- Possible to directly **compare benefits and negative effects of different options**

→ e.g. when building new hydropower plants

Case study from China - Valuation methods

Impact of three hydropower projects on river ecosystem services

- Identified 21 indicators
- Used different methods
- Compared total costs & benefits

Watershed services		Effect type	Method	Model explanation
Provisioning	Water supply	Irrigation benefit	Shadow price method	The shadow value is the increased production value from ensured farm land irrigated by hydropower plant.
	Hydroelectric power	Hydroelectric power generation	Market value method	The benefit of hydroelectric power generation is the multiplying product of the on-grid power tariff and its annual average quantity of hydroelectric power.
Regulating	Fluvial transport	Reservoir sedimentation	Project restoration method	The damage of reservoir sedimentation is valued as sedimentation removing cost.
Cultural	Aesthetic value/Tourism	Recreation and entertainment	Travel cost method	Travel costs to the tourist spot near the hydropower facility reflect the aesthetic value.
Supporting	Habitat	Biodiversity	Contingent valuation method	Stakeholders' willingness to pay for biodiversity could indicate the function value for habitat diversity for biota.

- Loss of biodiversity & water quality degradation were most important negative impacts
- Costs:Benefits ratio showed that negative impacts on river ecosystem services are too high to be neglected
- Considerable environmental cost not covered by existing water resource fee → need for new approaches (e.g. compensatory payments for ecosystem services)



Environmental valuations - potentials

- Illustrates that river ecosystems provide various services important for human well-being
- Focuses on the needs of stakeholder (the group of people who are affected by decisions)
 - Environmental valuations could potentially reach and inform **different stakeholder groups** along the decision-making process
- Makes is possible to compare effects of various sorts
- Creates values that people can relate to
- Based on scientific data
- Traceable and transparent instrument for decision making



Our opinion

- Remaining 10% intact water bodies in CH should be protected
- Holistic approach needed for sustainable development
 - River ecosystem valuations at different scales
- Important to also consider future needs of ecosystem service delivery (insurance value)
- Ecosystem services approach is a good way to make informed decisions on a complex issue
 - Helps policy-makers to identify priorities and trade-offs
- Higher risk when not taking into account environmental valuations



Potential barriers

- How can we give a value to nature?
 - Ethical/cultural/methodological considerations
 - Natural capital and future potentials
- Limiting point of view of some decision makers
 - Conflicting goals in energy production
 - Priority to urgent needs rather than future needs
 - Don't trust estimations for the future
 - Uninformed about ecosystem services approach and environmental valuations
 - Popularity is more important

However, ecosystem approach is trending today in some circles : published and ongoing research, debates



Role of the scientist

- Hearings in parliament for new legislations
e.g. representatives of Eawag were present for new water protection law
- Scientists are involved to investigate specific problems/questions
e.g. how much cold water can be returned into lakes/rivers without negative impacts

→ **Science has to deliver facts!**



Role of the scientist

- Conduct **impactful research**, not just publishable ones
- Conduct **sufficient research** to be **objective** and rely only on the scientific findings
- Extract **policy** and **practice implications** of research
- Tailor “**language**” and **medium of communication** to the targeted audience → **who** do we want to reach?
- Be **clear and simple** to avoid misinterpretations
- Actively **share findings** not only within scientific community but also in **politics and broader public**
- Actively **inform and collaborate** with various stakeholders



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Thank you for your attention



https://www.flickr.com/photos/bala_/3571279221/