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Environmental flows and sustainable management in Norwegian regulated rivers.

Aim of my PhD

Develop an innovative **model framework** for assessing **environmental impacts** in regulated rivers, devise **mitigation measures** and their **effect** on the **future system**.

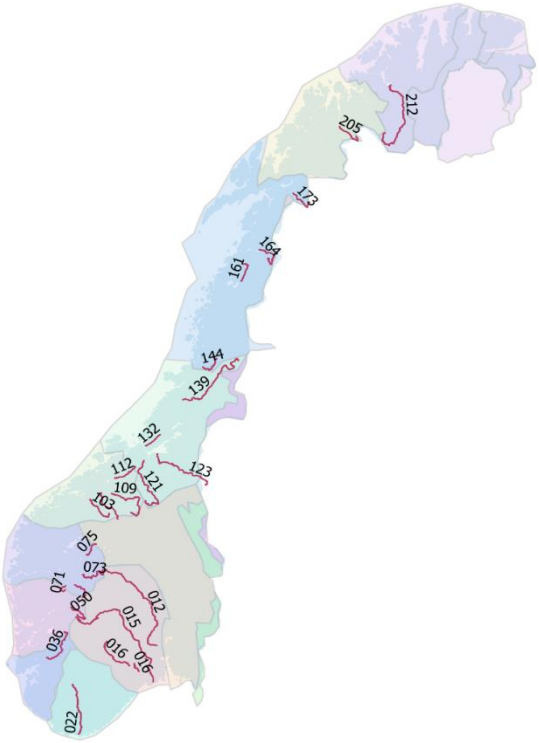
Context and content:

- Several regulated rivers needs **environmental flow** measures.
- The current practice for **e-flow** can mostly be categorized as **hydrological methods**.
- E-flow: “The water flows required to **sustain freshwater ecosystems** and the **human livelihoods** that depend on these ecosystems”.
- **There is a need for a consistent methodology to assess the e-flow in an easy and cost-effective way.**

Context and **content:**

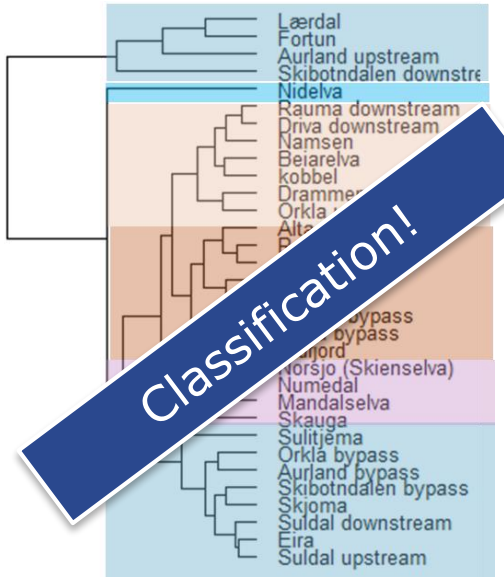
1. A **classification** of the hydrological alterations produced by river regulation.

Context and **content:**



River	Number
Drammen	12
Numedal	15
Skienselva	16
Mandalselva	22
Suldal	36
Eidfjord	50
Nærøydalselva	71
Aurland	72
Lærdal	73
Fortundalselva	75
Rauma	103
Eira	104
Driva	109
Surna	112
Orkla	121
Nidelva	123
Skauga	132
Namsen	139
Åelva (Åbjøra)	144
Beiarelva	161
Sulitjelmavassdraget r	164
Kobbelva	167
Skjoma	173
Skibotnelva	205
Alta	212

0 100 200 300 km



Context and **content:**

2. To develop an **integrated method** to asses e-flows in regulated rivers.

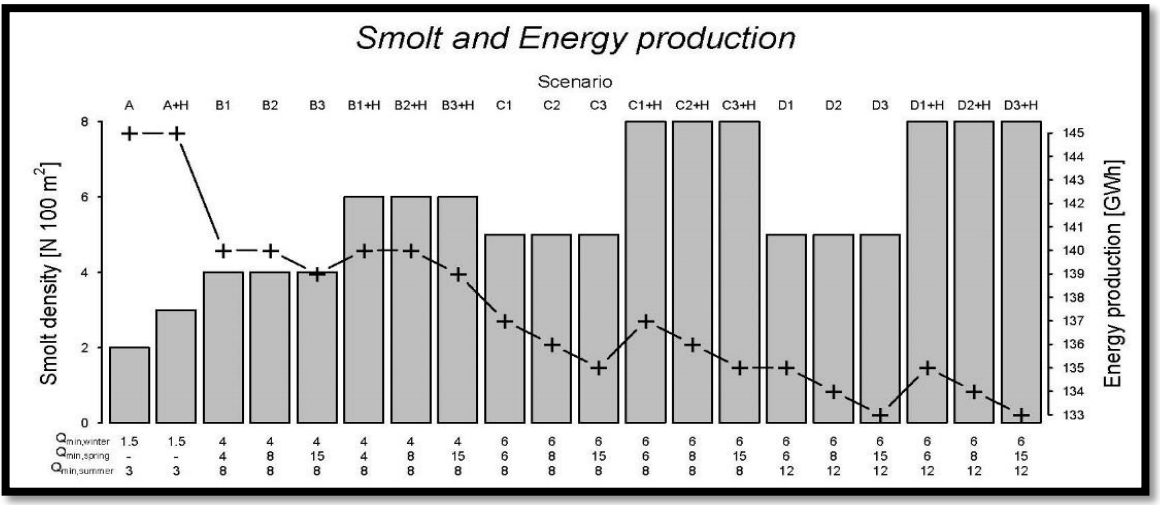
"**Integrative method**" that includes models of:

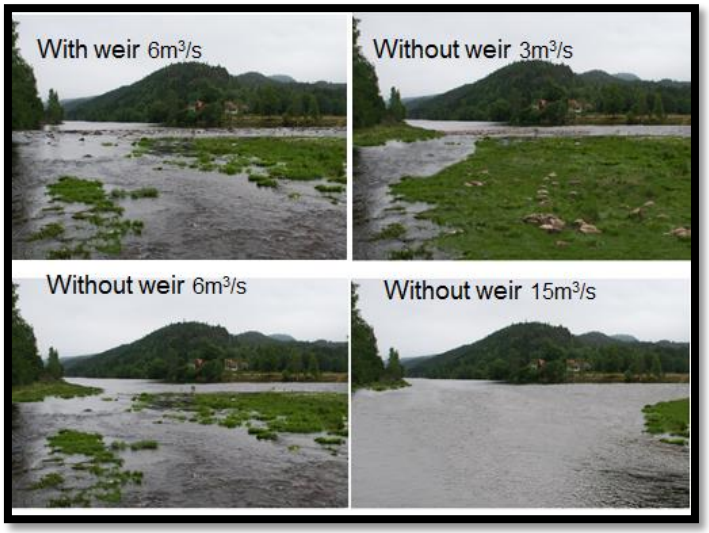
- hydrology
- hydraulics
- ecosystem services
- mitigation cost

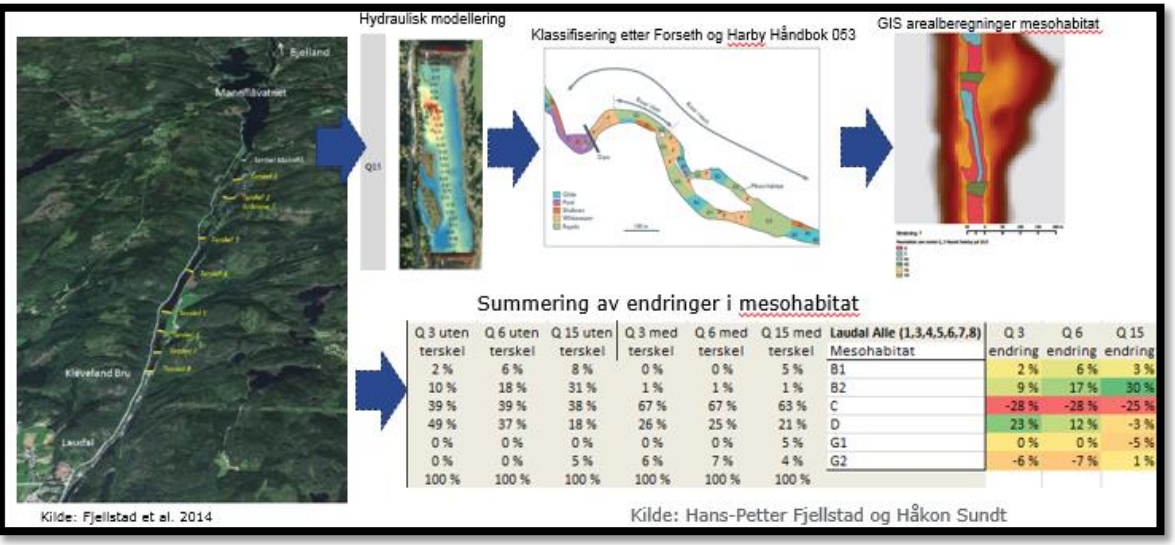
Into a **decision support system** for finding balanced **e-flows**.

Context and **content:**

"Integrative method" in Mandalselva







Kilde: Fjellstad et al. 2014

Kilde: Hans-Petter Fjellstad og Håkon Sundt

Context and **content:**

"Integrative method" in Mandalselva

3. To prove the **potential applicability** of the integrated method and generalize it.

Ljungan River in Sweden!

Context and **content:**

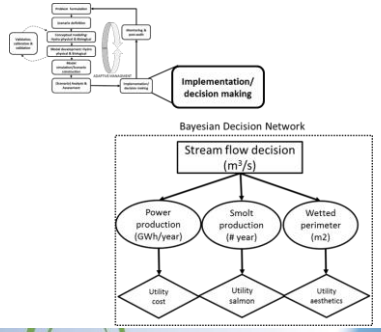
"Integrative method" in Mandalselva and Ljungan

4. To write a **technical report** about the **methods** used and their **effectiveness.**

Context and **content:**

"Integrative method" in Ljungan

5. To test the implementation of the **MCDA** as a tool to help in e-flow management.



Is it innovative?

- Very few studies combine models as:

  Hydro-physical + Individual Based Model + Hydropower production

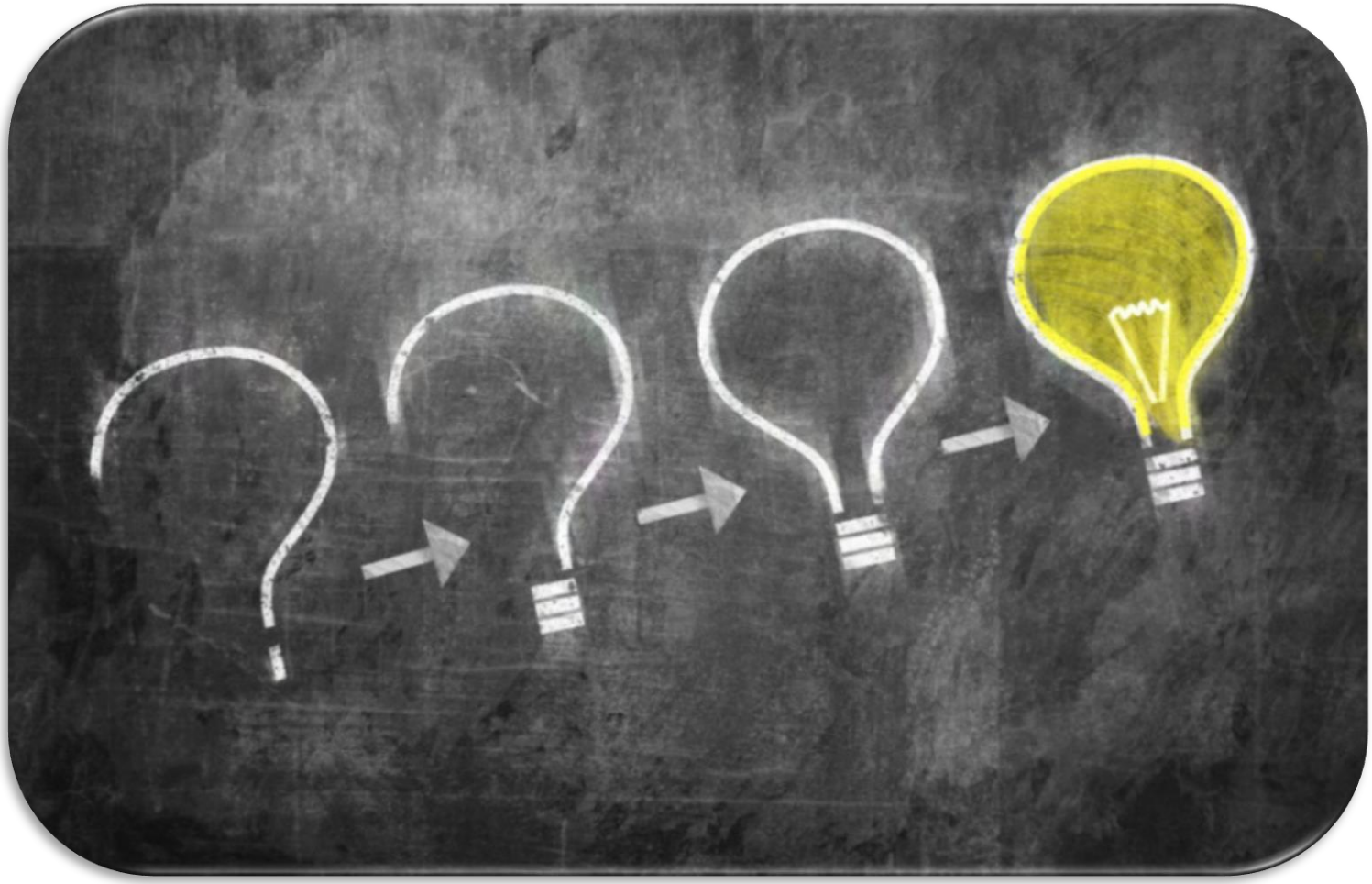
- Very few combine the previous with consideration of social benefits.

- No previous study in Norway has used an **Integrative method** in a real water management project before.

How can it be used?

- The **integrative method** could be applied into other regulated rivers.
- The thechnical report could be used as a **guideline**.
- It will help in **water management** decision and in the **re-licensing** process.

Thanks for your attention!







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