Techno-ecological indicators

for a better description and management of water bodies in Norway

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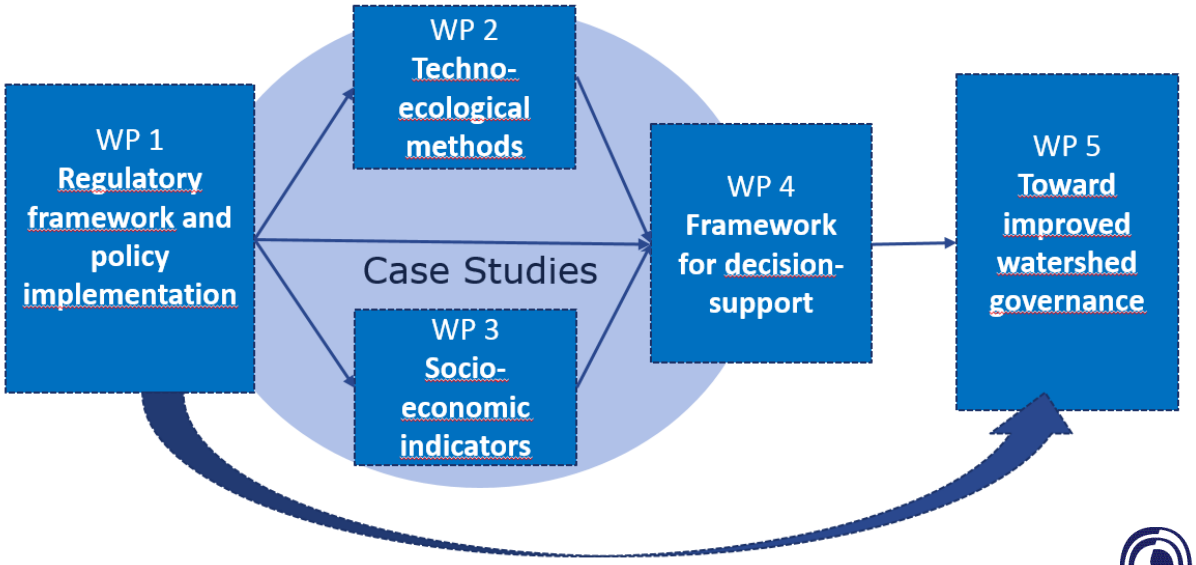
Project: SusWater

Sustainable governance of river basins with hydropower production (NFR, 2015-2018)



NINA
Norsk institutt for naturforskning

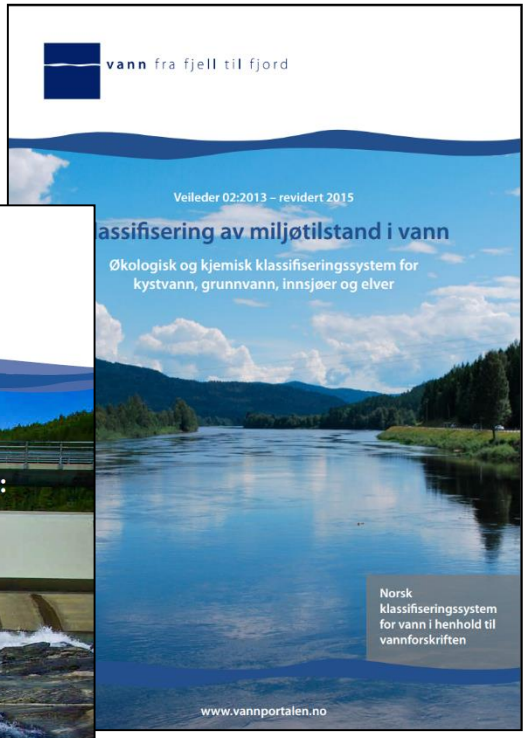
NIVA

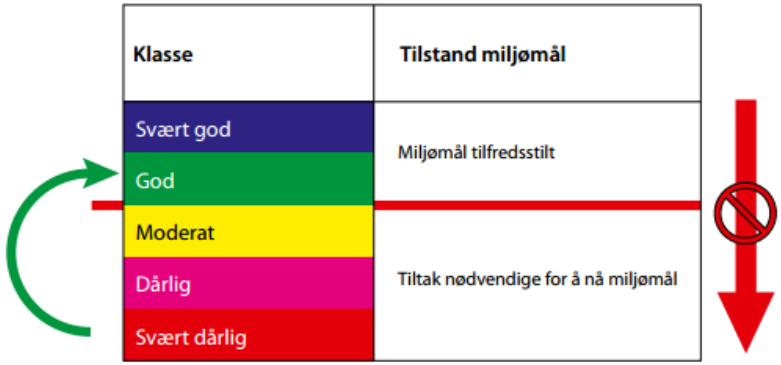
NTNU
100 skapende år

SINTEF

http://www.cedren.no/Prosjekter/SusWater

Context





EU Water Framework Directive (WFD);
Vannforskriften

River basin aspects to be considered

(grouped according to the «Sustainability» and «Ecosystem Service» frameworks)

Economical dimension

- Power plant, electrical installations
- Power lines
- Development of population, building of houses
- *Cabins*
- *Roads, trails*
- *Boat spots*
- *River structures, weirs*
- *Regulated reservoirs / flood safety*

- Enterprises and employment
- Service offers, communal economy
- Social conditions
- [Tourism]

Provision of work/liveli-hood

Industry & Services

Infra-structure

Land-based production

Biotic resources

Abiotic resources

Ecosystem processes, habitats

Culture & Education

Health & recreation

- Outdoor activities, hunting, fishing (many different types)
- Health conditions
- *Aesthetics*

Socio-cultural dimension

- Cultural heritage
- Cultural environment
- Sami cultural traditions
- *Education / research for schools and families*

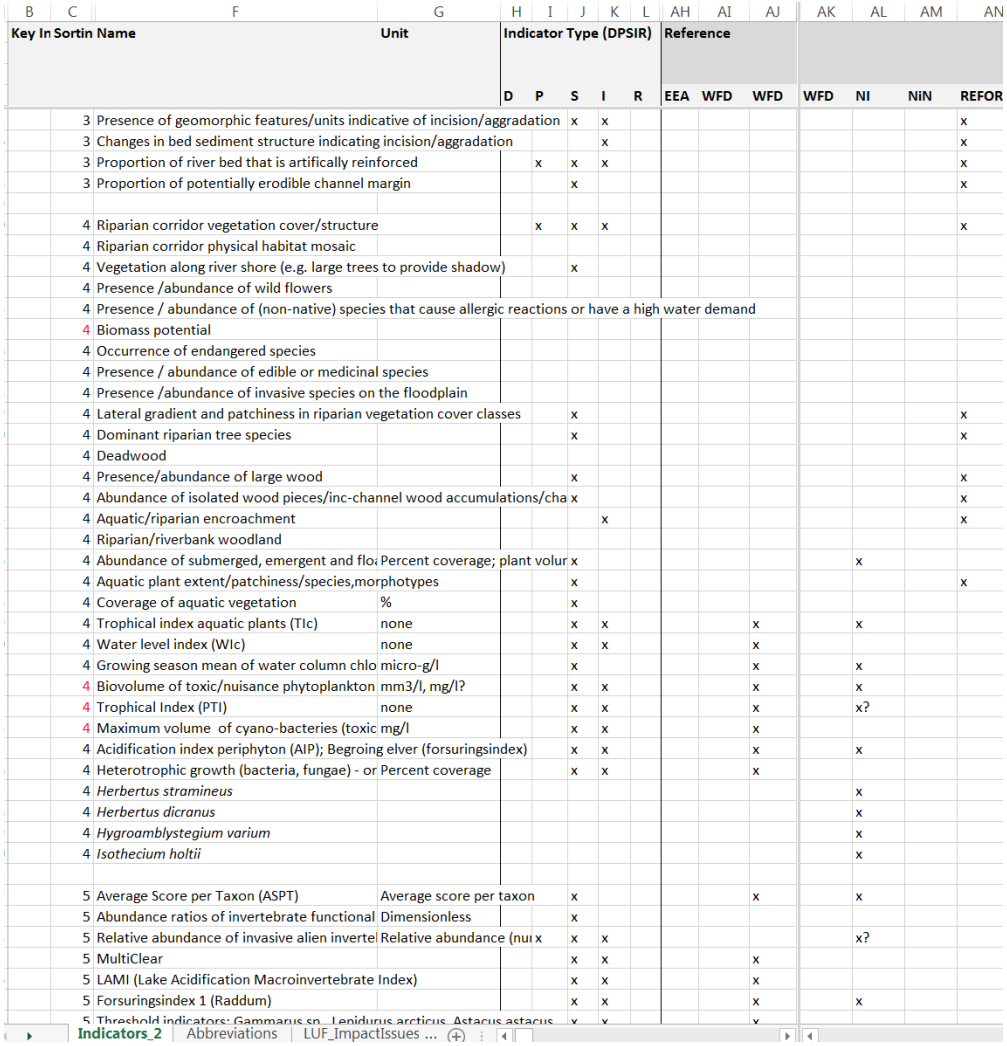
- Erosion / sediment transport
- Land slides
- Landscape and INON areas
- « Biodiversity » (incl nature types, fish/birds/mammals, ..)
- *Nuisance growth of aquatic vegetation; Salmon parasites*
- Marine conditions

- Natural resources (Agricultural and forest resources); *e.g. timber along the river; sheep near mountain streams*
- *Aquaculture*
- [Tourism], [Hunting, fishing]

Environmental dimension

- «Hydrology» (river discharge, floods, reservoirs, ice, ground water, local climate, …)
- Water quality / pollution
- Freshwater resources
- Minerals and sediment resources

List of potential relevant indicators (selection)



Key	In	Sortin	Name	Unit	Indicator Type (DPSIR)					Reference			WFD	NI	NiN	REFOR
					D	P	S	I	R	EEA	WFD	WFD				
		3	Presence of geomorphic features/units indicative of incision/aggradation				x	x								x
		3	Changes in bed sediment structure indicating incision/aggradation					x								x
		3	Proportion of river bed that is artifically reinforced			x	x	x								x
		3	Proportion of potentially erodible channel margin				x									x
		4	Riparian corridor vegetation cover/structure			x	x	x								x
		4	Riparian corridor physical habitat mosaic													
		4	Vegetation along river shore (e.g. large trees to provide shadow)				x									
		4	Presence /abundance of wild flowers													
		4	Presence / abundance of (non-native) species that cause allergic reactions or have a high water demand													
		4	Biomass potential													
		4	Occurrence of endangered species													
		4	Presence / abundance of edible or medicinal species													
		4	Presence /abundance of invasive species on the floodplain													
		4	Lateral gradient and patchiness in riparian vegetation cover classes				x									x
		4	Dominant riparian tree species				x									x
		4	Deadwood													
		4	Presence/abundance of large wood				x									x
		4	Abundance of isolated wood pieces/inc-channel wood accumulations/cha				x									x
		4	Aquatic/riparian encroachment					x								x
		4	Riparian/riverbank woodland													
		4	Abundance of submerged, emergent and flo	Percent coverage; plant volur			x							x		
		4	Aquatic plant extent/patchiness/species,mor	phytotypes			x									x
		4	Coverage of aquatic vegetation	%			x									
		4	Trophical index aquatic plants (TIc)	none			x	x				x		x		
		4	Water level index (WIc)	none			x	x				x				
		4	Growing season mean of water column chlo	micro-g/l			x					x		x		
		4	Biovolume of toxic/nuisance phytoplankton	mm3/l, mg/l?			x	x				x		x		
		4	Trophical Index (PTI)	none			x	x				x		x?		
		4	Maximum volume of cyano-bacteries (toxic	mg/l			x	x				x				
		4	Acidification index periphyton (AIP); Begroing	elver (forsuringsindex)			x	x				x		x		
		4	Heterotrophic growth (bacteria, fungae) - or	Percent coverage			x	x				x				
		4	*Herbertus stramineus*											x		
		4	*Herbertus dicranus*											x		
		4	*Hygroamblystegium varium*											x		
		4	*Isothecium holtii*											x		
		5	Average Score per Taxon (ASPT)	Average score per taxon			x					x		x		
		5	Abundance ratios of invertebrate functional	Dimensionless			x									
		5	Relative abundance of invasive alien inverte	Relative abundance (nu	x		x	x						x?		
		5	MultiClear				x	x				x				
		5	LAMI (Lake Acidification Macroinvertebrate	Index)			x	x				x				
		5	Forsuringsindex 1 (Raddum)				x	x				x		x		
		5	Threshold indicators: Gammarus sp., Lepidurus arcticus, Astacus astacus				x	x				x				

Indicators_2 | Abbreviations | LUF_ImpactIssues ...

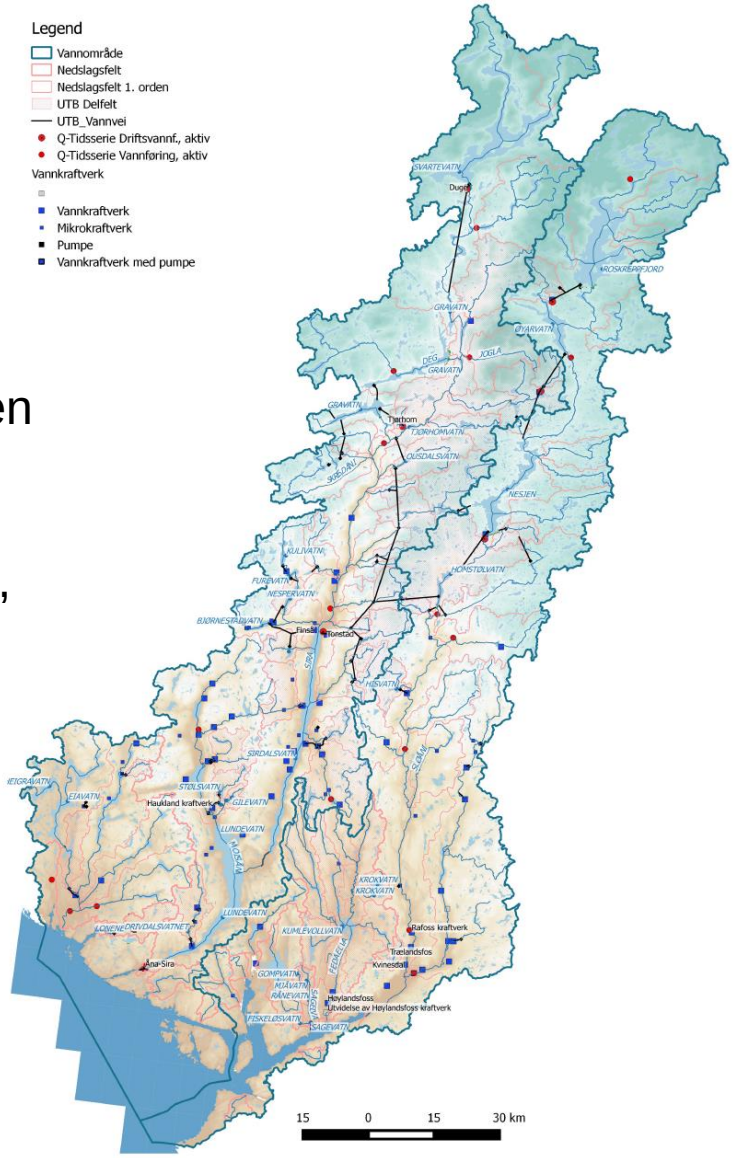
After review (laws, guidelines, project reports, papers, …):

> 240 potential indikators only for physical conditions and ecology!

- We have to choose a limited number of key indicators which can be used for administrational tools.
- Some indicators can be defined in expert panels (e.g. for fish, biodiversity).
- For selected user interests we are asking the stakeholders.

Case areas

Vosso-Ostenfjorden river basin (Evanger-concession, BKK)



Selected local user interests that are affected by river regulation and were identified in interviews (WP3):

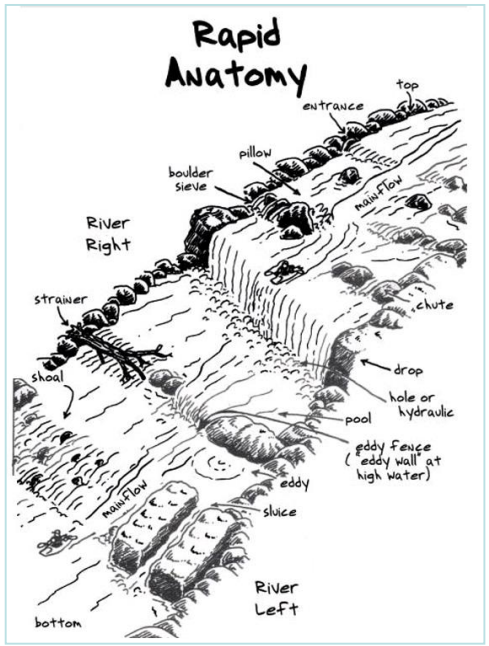
- Fishing (salmon; mountain lakes; fly-fishing)
- Rafting, padling
- Walking, cycling, skiing, hunting
- Bading / swimming
- Land use (sheep in the mountains)
- Aesthetics, educational activities

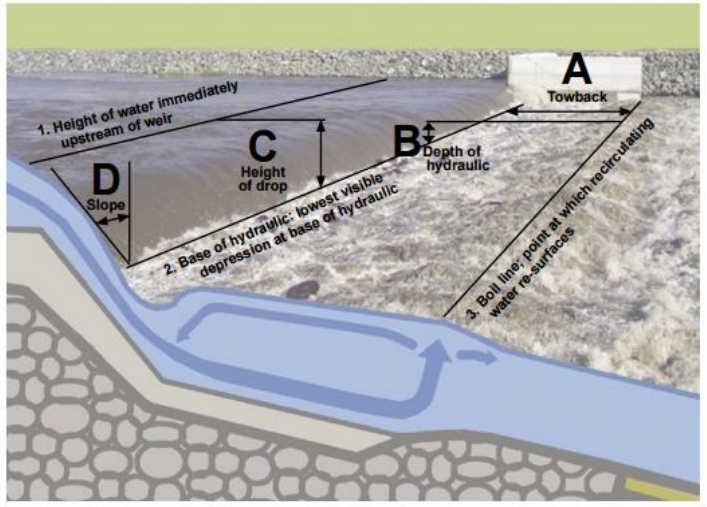
Sira-Kvina river basin

Example: Rafting

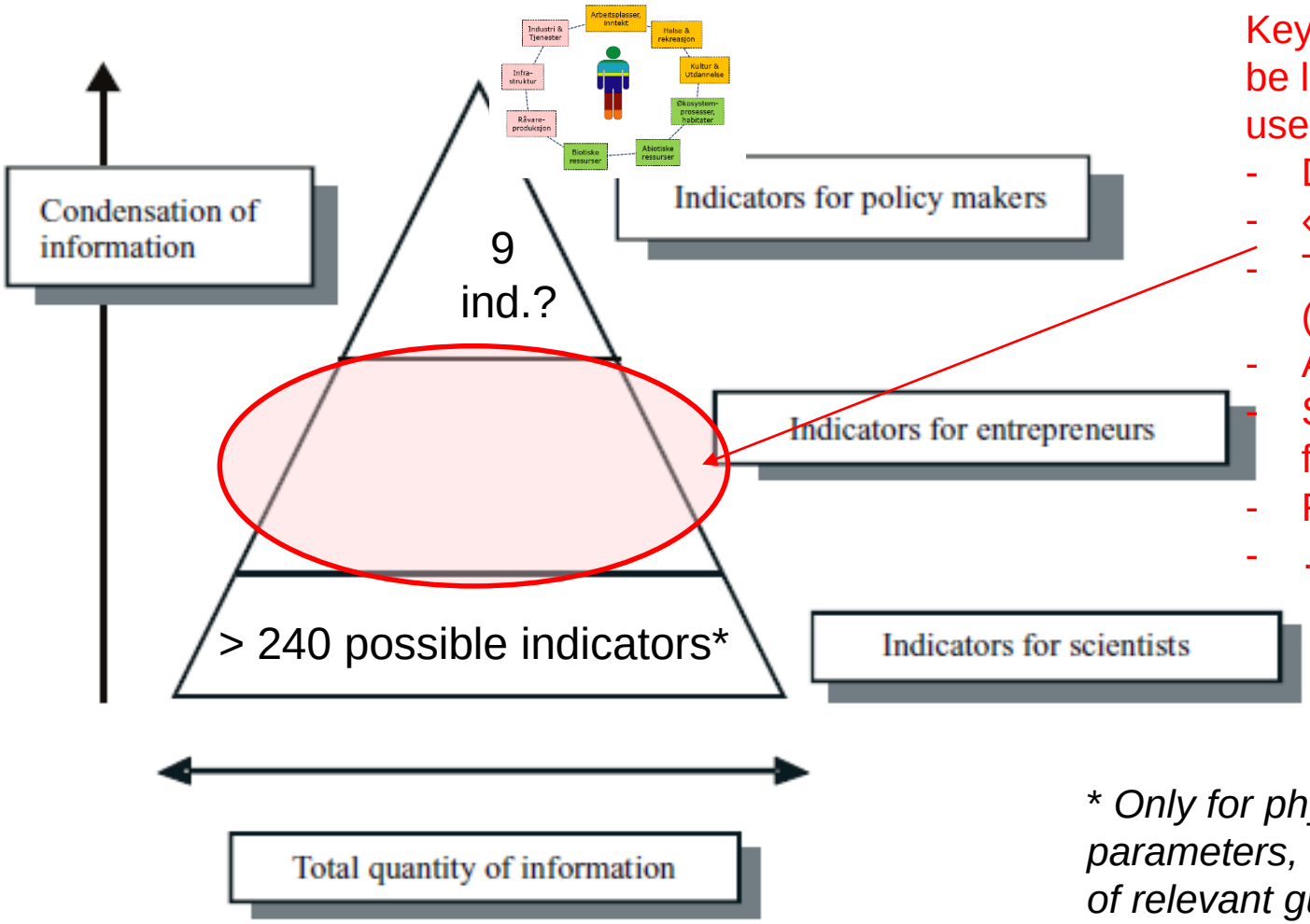
Key parameters:

- River type (slope, bankfull width, substrate, curvature; “rapid anatomy” ….);
- Discharge (seasonal distribution)
- Hydraulic structures in the river (e.g. weirs, large wood)
- Aesthetical aspects of the scenery; variation
- Accessibility





We have to choose some key indicators



Key indicators that can be linked to several user interests:

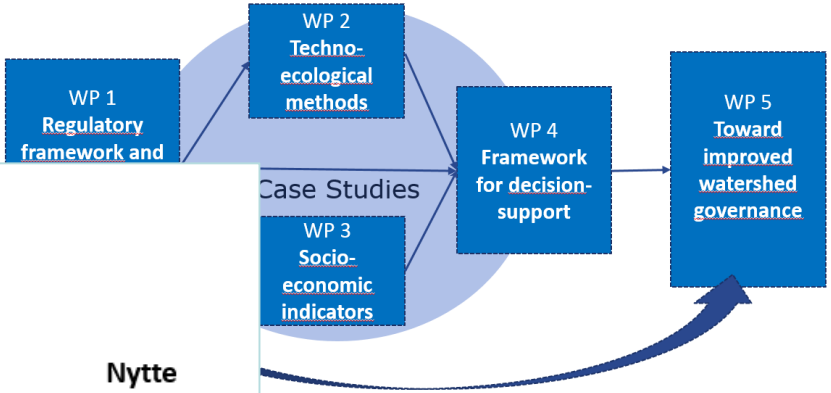
- Discharge
- «River type»
- Temperature (climate zone)
- Aquatic vegetation
- Shore- and floodplain vegetation
- Fish
- …

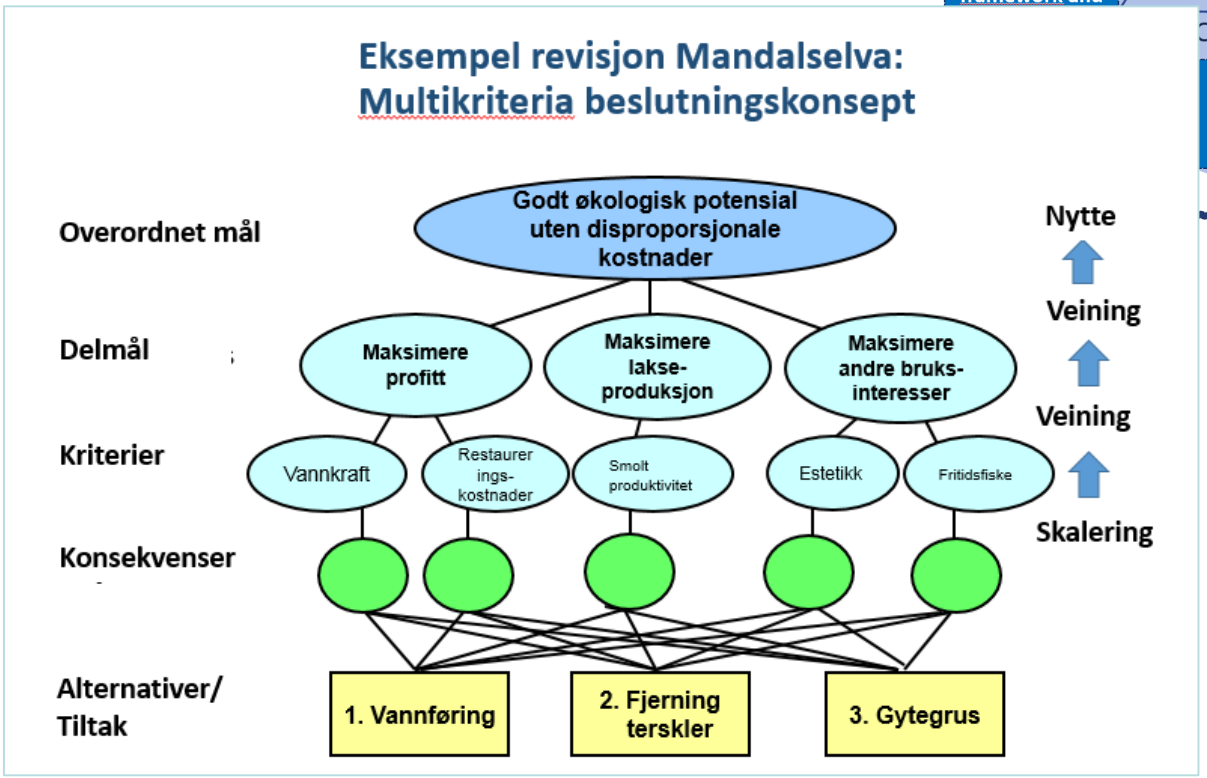
** Only for physical or ecological parameters, based on a review of relevant guidelines, EU projects and papers*

Relationships between indicators. From Braat 1991, in Helming et al. 2008.

Implementation and further use

WP 4: Include additional «user interest packages» into multi-criteria decition support tools





Further use: NVE?

Example for multi-criteria decision support tool (B. Köhler, NINA)





Centre for environmental design of renewable energy - CEDREN

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100 skapende år

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