



Naturbaserte løsninger (NBS) for å sikre mot flom og skred

EC-H2020 Innovation action 'PHUSICOS'

Anders Solheim, NGI



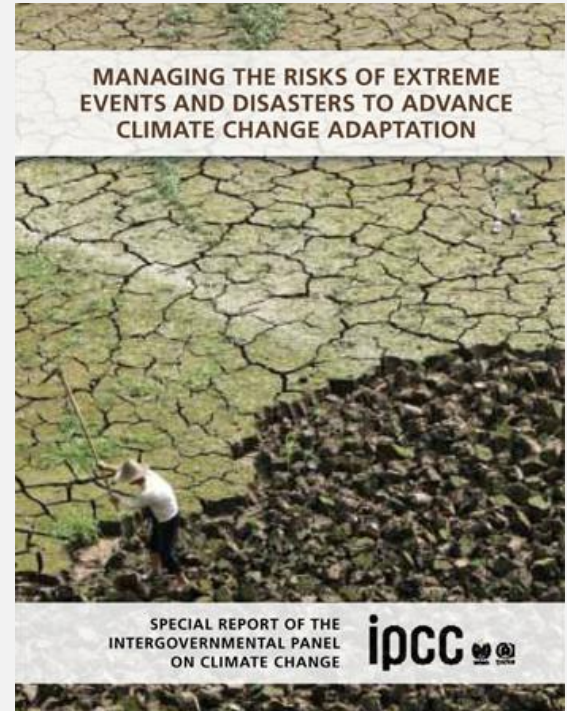
Nature-based solutions definition

- Solutions "**inspired and supported by nature**, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (EU, 2015)
- More than blue and green infrastructure, also includes sustainable management of land and resources



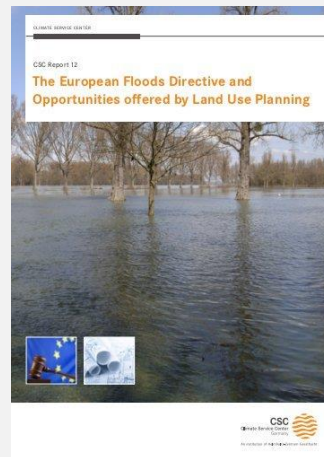
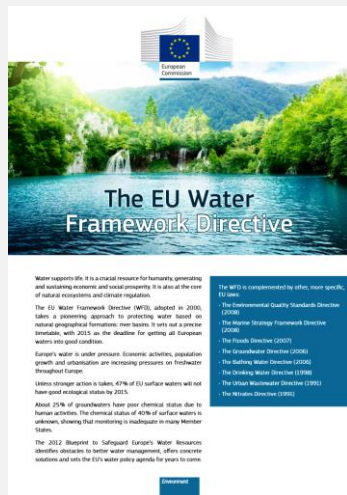
Natural hazard risks from extreme weather events

- Damage costs from extreme weather events (floods, droughts, landslides, storm surges) are very high, and increasing.
- Impact from climate change and other changes (land use change, demography) are likely to worsen the situation.
- Traditional engineering concepts are costly, take space, lack flexibility, and may have negative impact on ecosystems.
- Nature-based solutions are available on small-scale level, but need upscaling.

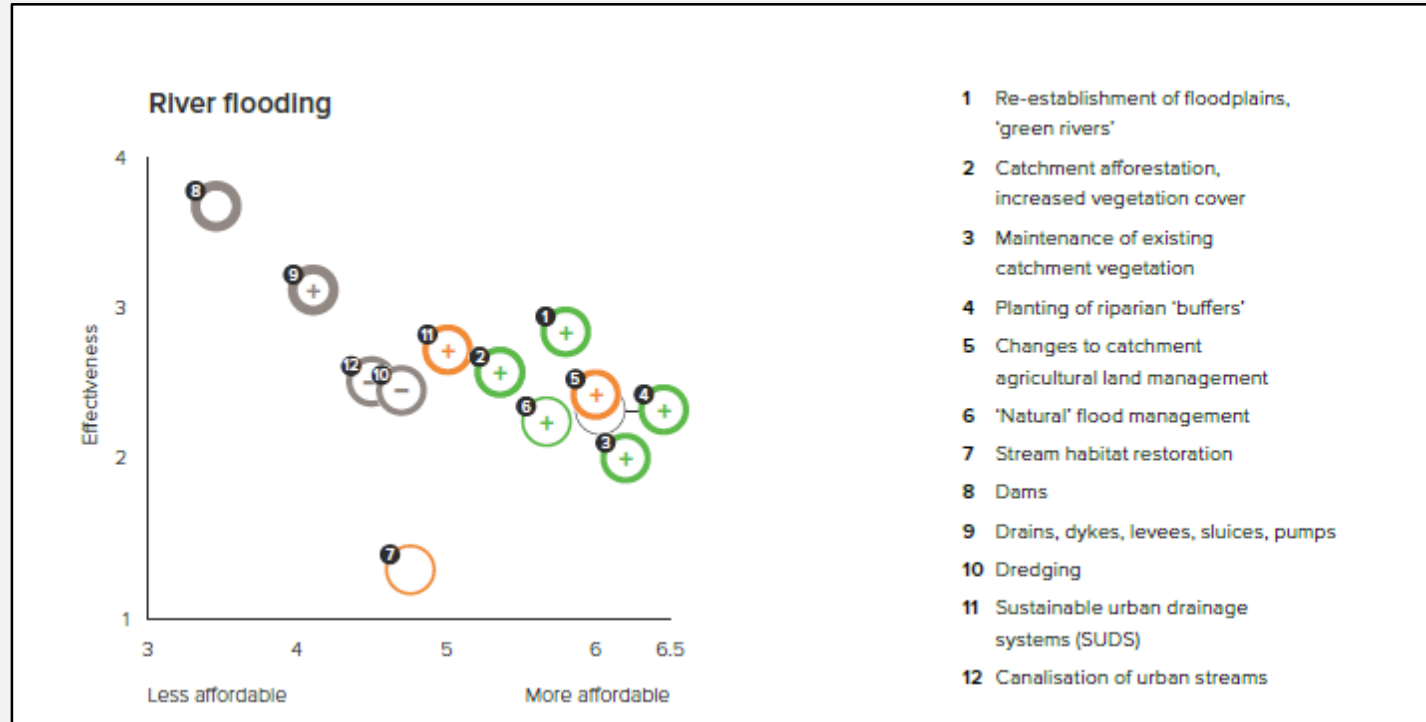


Nature-based solutions – co-benefits/expectations

- Contribute to green growth and citizen well-being
- Preserve and improve ecosystems (plants, fish stocks, etc.)
- Provide business opportunities
- Implement broader EU policies of Water Framework Directive, Floods Directive, UN's SDG's, and the Sendai Framework for DRR.



NBS versus traditional measures – an example from UK



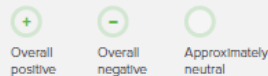
Category of option



Strength of evidence



Additional consequences









The Royal Society (2014). Resilience to extreme weather. The Royal Society Science Policy Centre report 02/14. London, UK.

Large and increasing attention for NBS in the EU

A community of practice on NBS

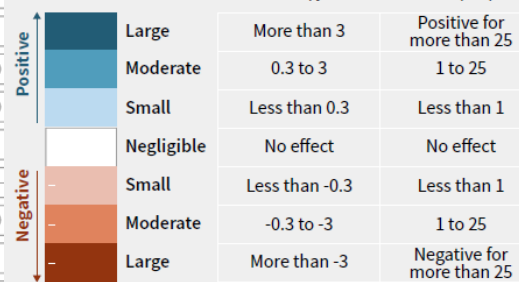


- ↗ 15 projects
- ↗ >150 mill. EURO

ThinkNature	CSA	SC5-10-2016	Establish science-policy-business-society interfaces to allow for continuous dialogue and interaction
NAIAD 	RIA	SC5-9-2016	Promote the uptake of ecosystem-based approaches for disaster risk reduction and climate change and the exploration of the concept of the insurance value of ecosystems
Nature4Cities Naturvation	RIA	SCC-03-2016	Enable the systemic integration of NBS into a sustainable urban planning, new governance, business, financing models and partnerships 
CONNECTING Nature Urban GreenUp UNALAB GrowGreen 	IA	SCC-02a-2016	To provide a robust, EU-wide evidence base and develop a European reference framework for nature-based solutions in cities (water and climate resilience) 
CLEVER Cities EdiCitNet URBiNAT proGfreg	IA	SCC-02b-2017	To provide a robust, EU-wide evidence base and develop a European reference framework for nature-based solutions in cities (inclusive urban regeneration) 
OPERANDUM RECONNECT Phusicos 	IA	SC5-08-2017	To provide evidence that NBS are flexible, multi-beneficial alternatives to traditional engineering to cope with extreme hydro meteorological events

IPCC Special Report, 2019.

Response options based on land management		Mitigation	Adaptation	Desertification	Land Degradation	Food Security	Cost
Agriculture	Increased food productivity	L	M	L	M	H	—
	Agro-forestry	M	M	M	M	L	●●
	Improved cropland management	M	L	L	L	L	●●
	Improved livestock management	M	L	L	L	L	●●
	Agricultural diversification	L	L	L	M	L	●
	Improved grazing land management	M	L	L	L	L	—
	Integrated water management	L	L	L	L	L	●●
	Reduced grassland conversion to cropland	L	—	L	L	L	●
Forests	Forest management	M	L	L	L	L	●●
	Reduced deforestation and forest degradation	H	L	L	L	L	●●
Soils	Increased soil organic carbon content	H	L	M	M	L	●●
	Reduced soil erosion	↔ L	L	M	M	L	●●
	Reduced soil salinization	—	L	L	L	L	●●
	Reduced soil compaction	—	L	—	L	L	●
Other ecosystems	Fire management	M	M	M	M	L	●
	Reduced landslides and natural hazards	L	L	L	L	L	—
	Reduced pollution including acidification	↔ M	M	L	L	L	—
	Restoration & reduced conversion of coastal wetlands	M	L	M	M	L	↔ —
Restoration & reduced conversion of peatlands	M	—	na	M	L	●	



Confidence level
Indicates confidence in the estimate of magnitude category.

H High confidence
M Medium confidence
L Low confidence

Cost range
See technical caption for cost ranges in US\$ tCO₂e⁻¹ or US\$ ha⁻¹.

●●● High cost
●● Medium cost
● Low cost
— no data

(IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems, 2019)

Mountains amplify risks - challenges

- ↗ The impacts of extreme hydro-meteorological events in mountain areas often affect entire river basins (flooding and landslides)
- ↗ Extreme weather events trigger rapid-moving mass gravity flows
- ↗ Managing water issues can help manage landslide and debris flow hazards downstream.
- ↗ Mountainous regions do not receive same attention as urban areas, and
- ↗ Norway is a country with large rural, mountain areas!



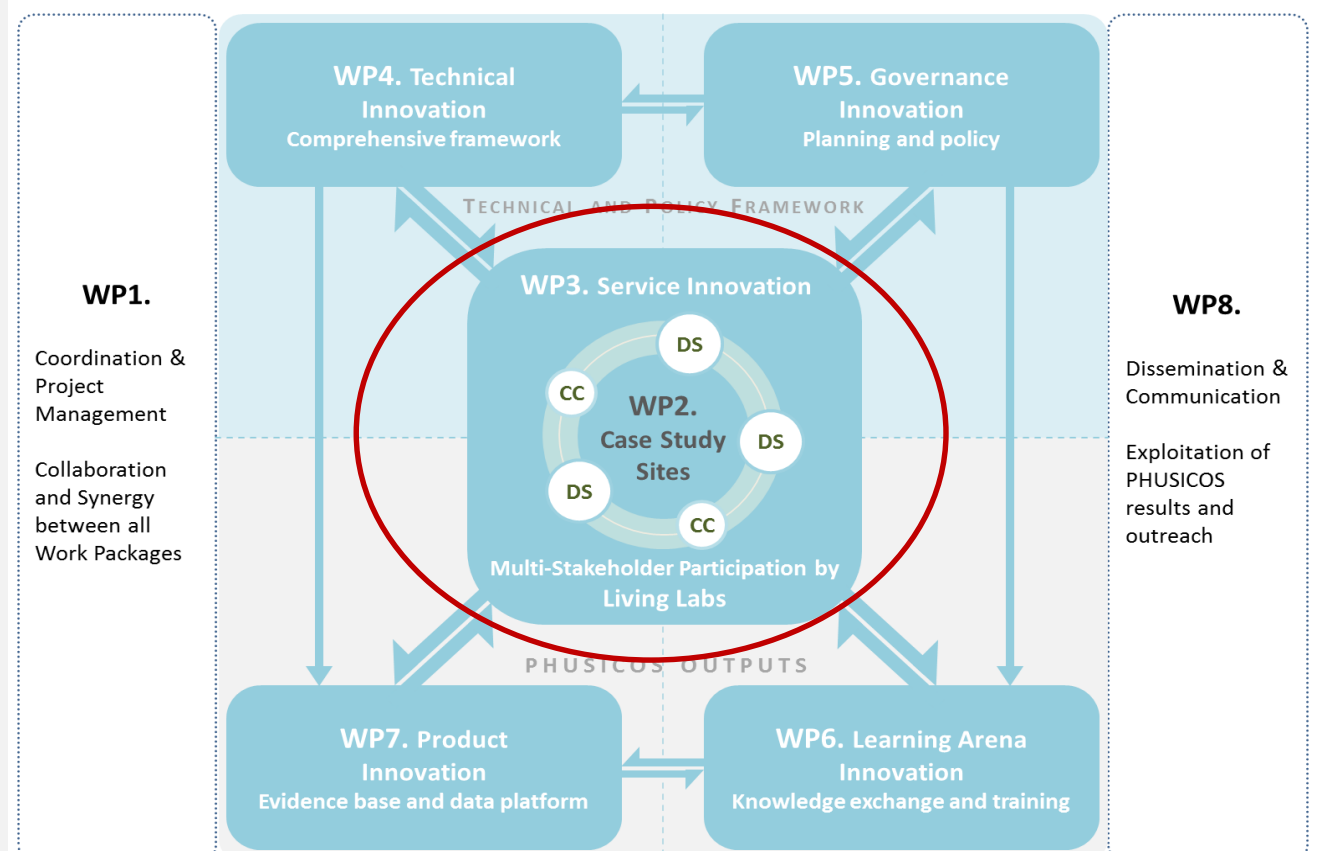
Illustration: The Norwegian Water Resources and Energy Directorate

Nature-based solutions for reduction of landslide hazard

- ↗ Lack of adequate proof-of-concept for the ability of NBSs to mitigate the risk of hydro-meteorological events in sensitive rural and mountainous regions is a challenge.
- ↗ 'Nature-Based Solutions and Re-Naturing Cities' listed over **300 potential measures** that could be applied when constructing NBSs; however, only 50 measures were specifically related to DRR and **only one addressed the risk in mountainous regions and landslide hazards** (Sutherland et al., 2014).
- ↗ There is a significant potential for innovation in this area.
- ↗ Often the NBS for landslide hazard mitigation should be combined with “grey” mitigation measures to be effective.

PHUSICOS – a 4 year H2020 project on NBS (in rural areas)

- Eight Work Packages centered around case studies
- 15 partners from 7 countries. Coordinated by NGI
- 4 years (2018-22) with budget of 10 mill. Euros
- Innovation Action: Funding is more focused on closer-to-the-market activities (prototyping, testing, demonstrating, piloting, scaling-up)



PHUSICOS Case study sites

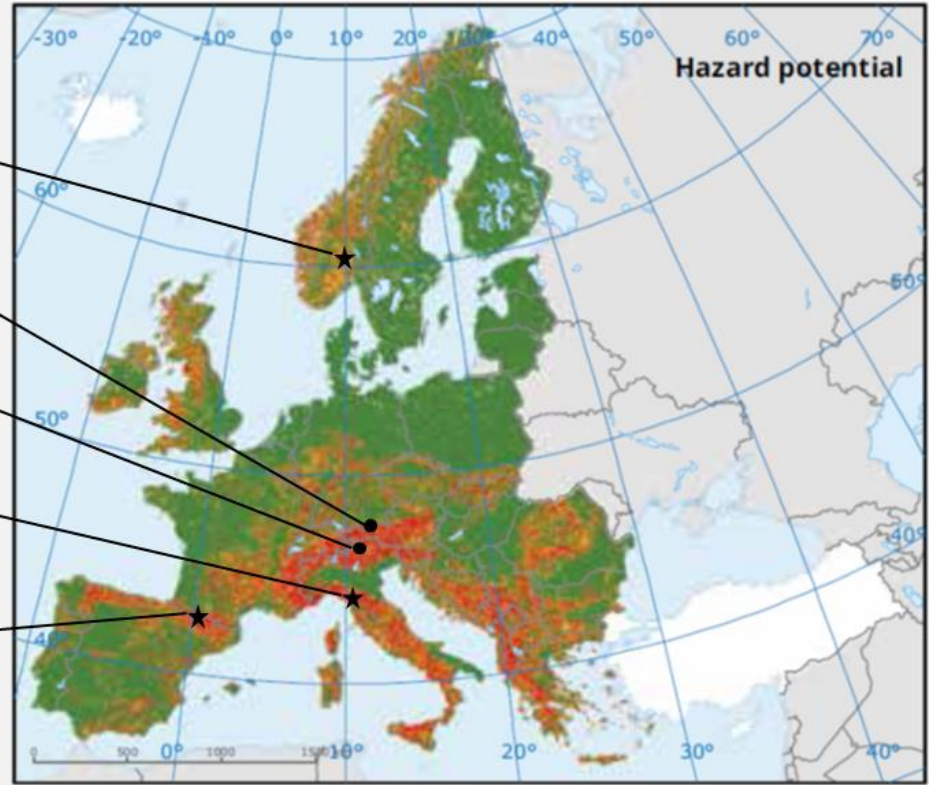
Valley of Gudbrandsdalen, Norway
Flooding, landslides and debris flows

Isar River Basin, Germany
Flooding and erosion

Kaunertal Valley, Austria
Landslides, rockfall and debris flows

Serchio River Basin, Italy
Extreme drought and flooding

The Pyrenees, Spain-France-Andorra
Landslides, rock falls and flash floods



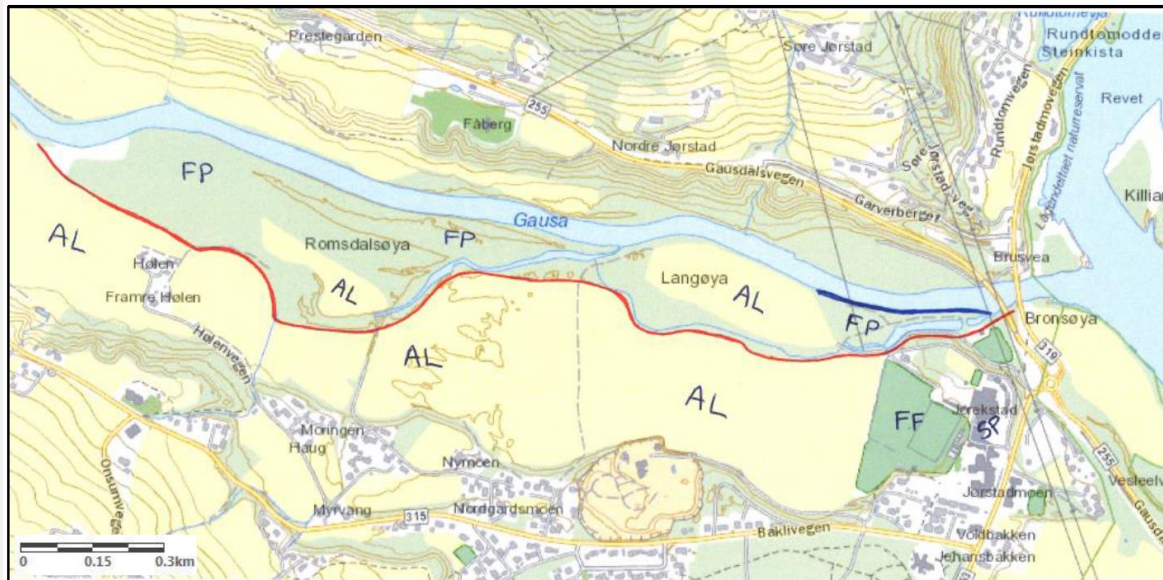
Valley of Gudbrandsdalen, Norway



Photos: from Heidi Eriksen and Turid Wulff Knutsen at Oppland County



PHUSICOS case – Jorekstad flood protection



Red line: The proposed receded barrier

Blue line: Existing flood prevention measure / erosion protection of the Gausa riverbank, to be removed.

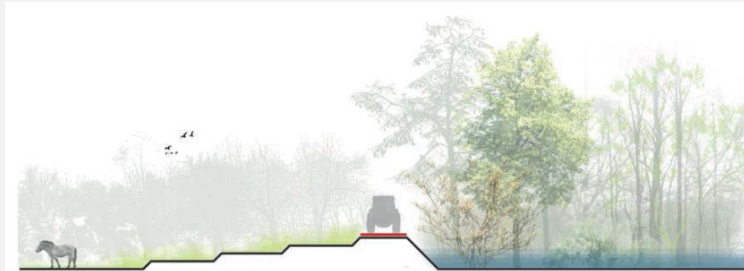
- Receded flood barrier to allow more space for flooding.
- Protects sport facilities and housing, as well as farmland.
- Avoid problems with sediment deposition and shallowing of main river Gudbrandsdalslågen
- Restore flood plane (FP) riparian vegetation, with several red-list species.
- Agricultural land (AL) inside the receded barrier is also flooded during extreme events today

Jorekstad, - design suggestions



Situation today. Red line: proposed barrier

Landscape architects' (AgenceTer, France) ideas for design.



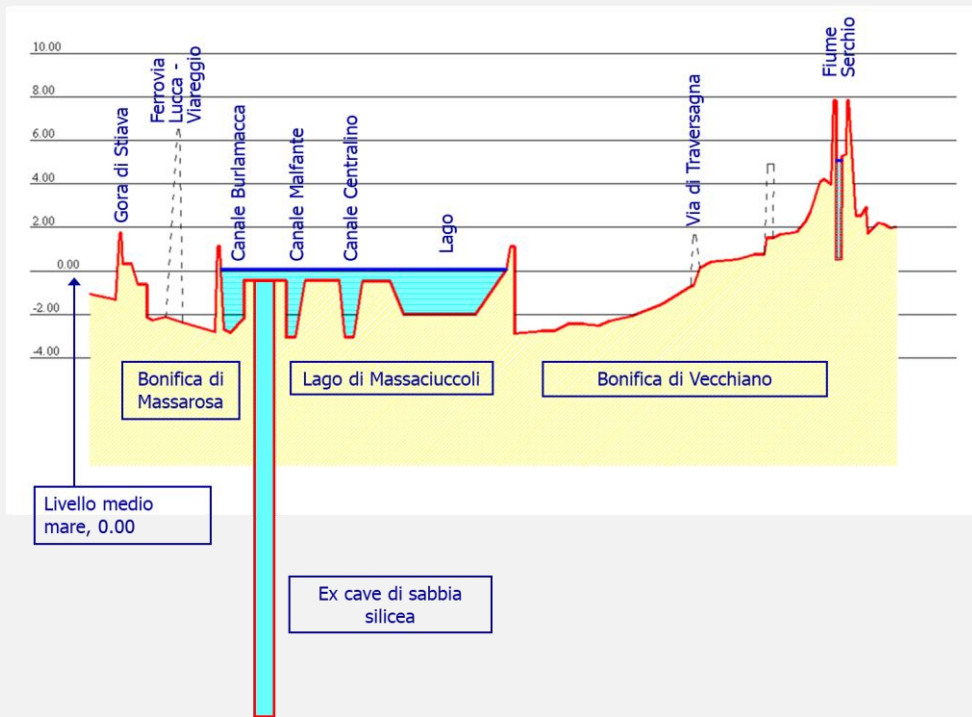
What lanscape architects can do!

Diversity of dike sections



AgenceTer, France

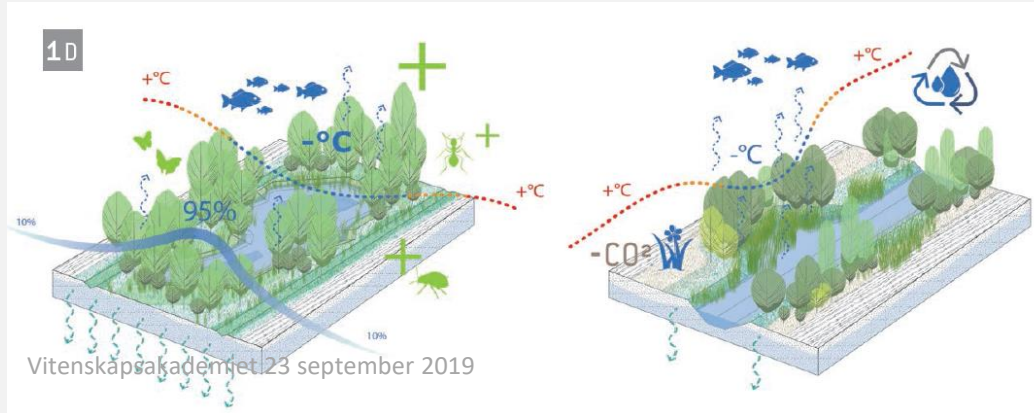
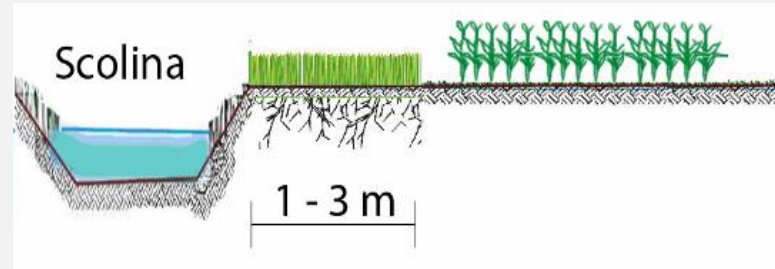
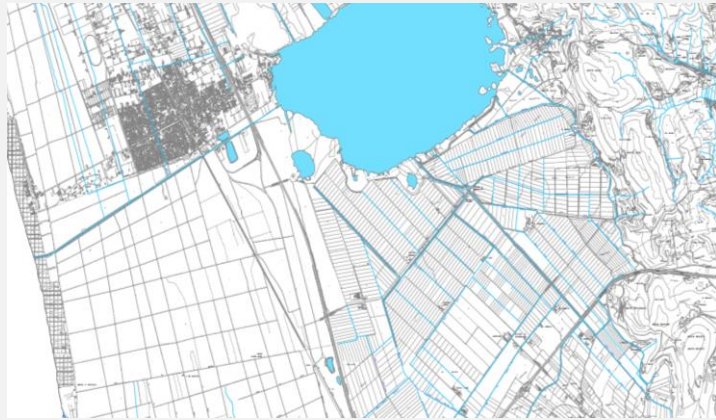
PHUSICOS case – Serchio River / Lake Massaciuccoli



- Transfer water from the Serchio during dry periods.
 - Decrease salinity in the lake and maintain water level
- Establish vegetation buffer strips along channels
- Change crops in parts of the fields
- Reforestation of landslide-prone slopes.



Measures to reduce runoff from fields, to canals and the lake

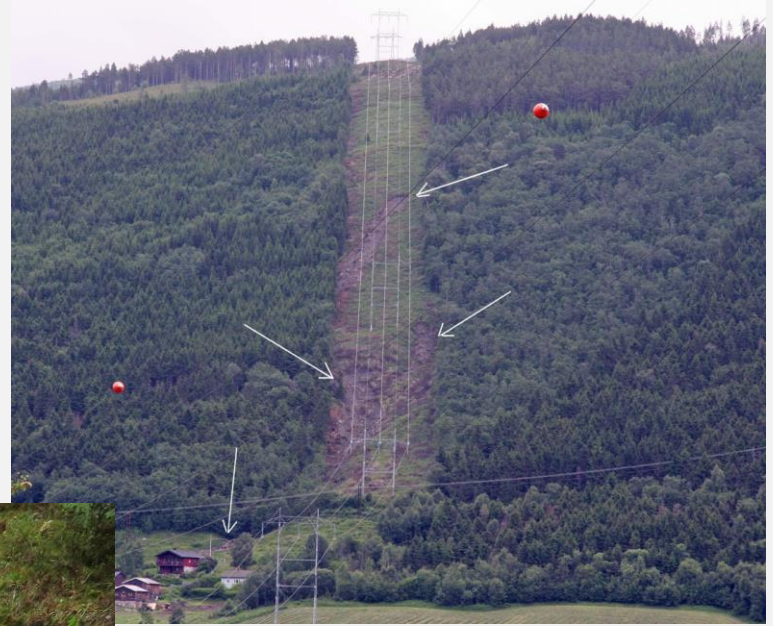


- natural water pockets within the engineered network
- possibilities for water buffering/ treatment on site
- ecological valuable areas for specific species

But NBS cannot solve all problems!



Effect of forest?



Clear cuts

Tractor roads (forestry)

NBSs to reduce risk from landslides and torrents – The Pyrenees



Biescas, Spain. Constructed in 1905



Torrent and erosion control

The Pyrenees; NBS against rockfall

Use of local wood, - no long transport or heavy machinery.



Most efficient for preventing release



SFI - KLIMA2050 Report on NBSs for landslides

- To be released very soon
- Gives background and introduction to the types of measures
- Refers to 'LaRiMiT', - a web based tool for decision makers to assess and choose the right mitigation measures, tailored to the local context.



From LaRiMiT

Live pole drain system, BC, 2003.

Live fascine structure (USA)

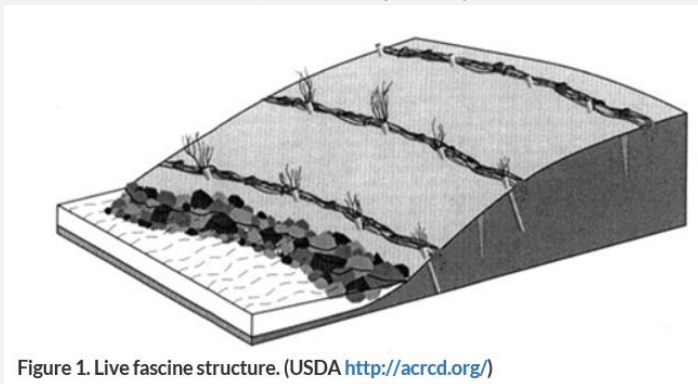
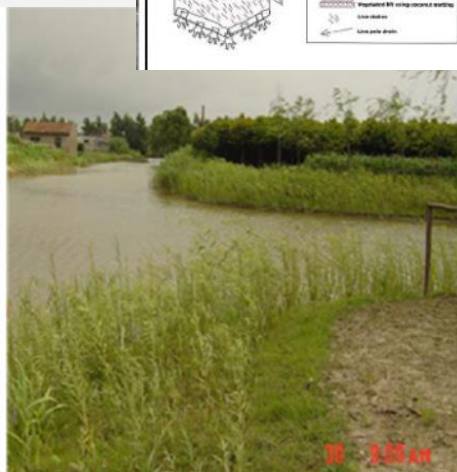
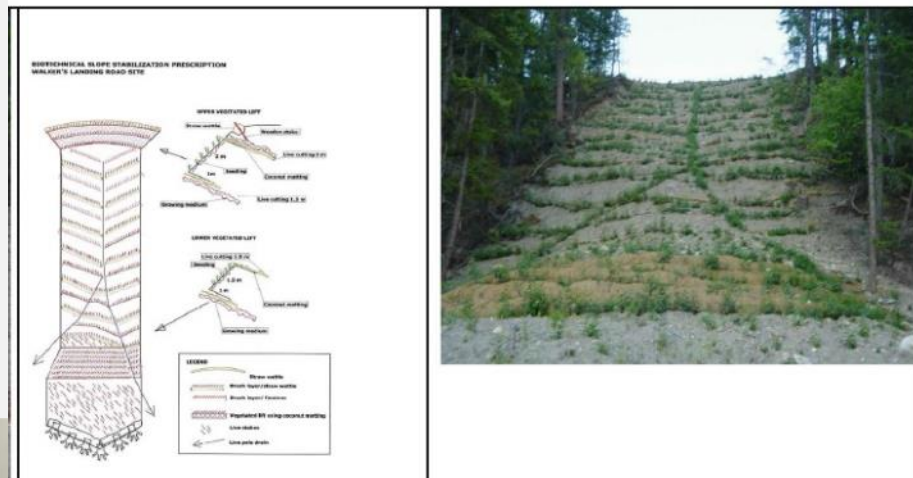


Figure 1. Live fascine structure. (USDA <http://acrcd.org/>)



Live staking structures, (Shanghai)

Figure 1. Live staking on the riverbanks of the Airport Town, Shanghai. In the left picture: 10 days after the installation, in the right picture: 140 days after the installation.

Stakeholder participation - Living Labs



- Co-creation and co-design creates an ownership to the measures.
- Important to establish enthusiasm among the citizens, as well as local and regional authorities and organizations.

Take-home lessons

- There is an increasing interest for NBS, as seen in several research calls from the EC.
- NBS can replace 'grey' structural measures in many areas and for many problems.
- However, NBS is certainly not the solution for all problems. Sometimes a grey, structural measure is necessary, and in many cases hybrid solutions might be the right way to go.
- NBS may take more space (=land) than grey structures. Local enthusiasm and sense of 'ownership' are important aspects of the NBS scheme.
- Much information on NBS (and other mitigation measures) can be found found at www.larimit.com

Thank you!

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