



NBS for hydro-meteo hazards and climate change adaptation

Process to NBS implementation and replication; PHUSICOS experience

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OPERANDUM summer school
30 August 2022

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 776681



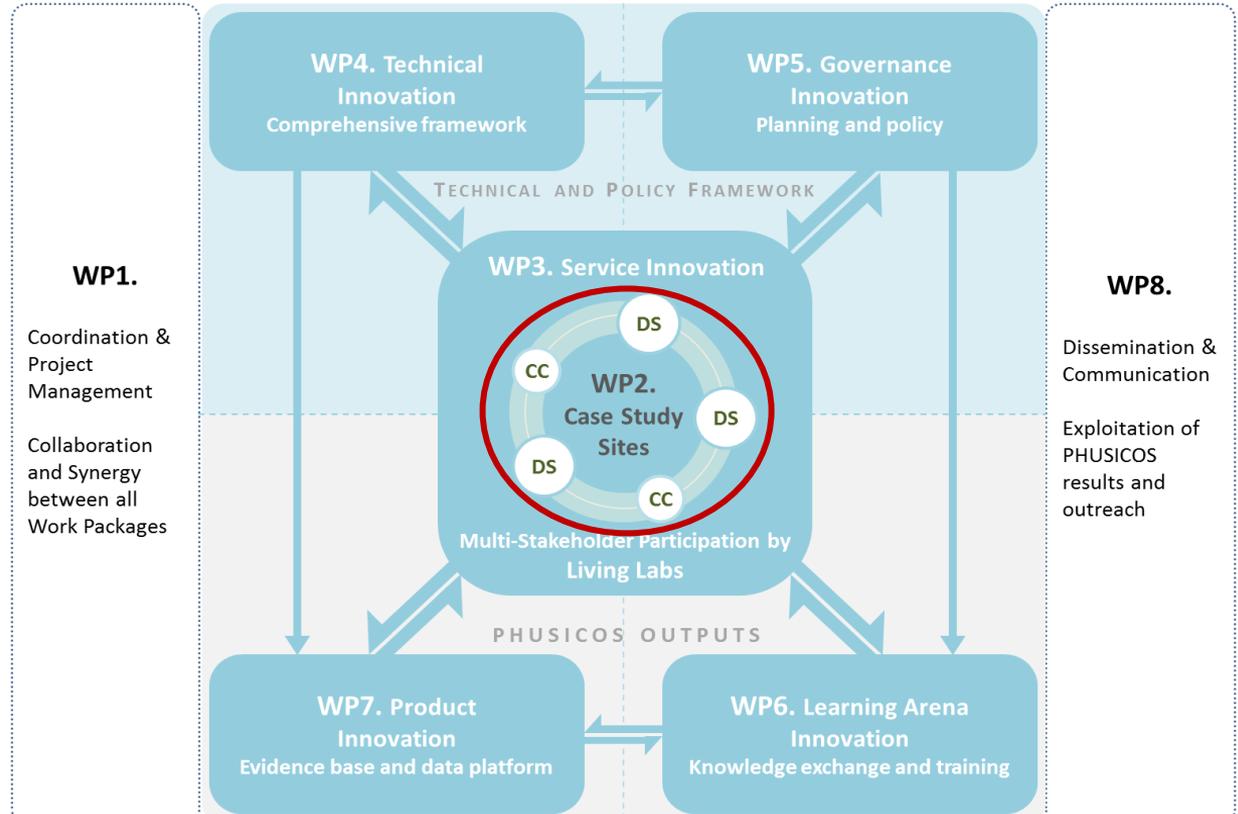
Outline

- PHUSICOS project (short)
- Implementation selection criteria
- Implementation examples case sites
- Barriers and enablers
- Presentation of case study, mountain region



PHUSICOS – a 5 year H2020 project on NBS (in mountainous rural areas)

- 5 years (2018-23), with budget of 10 mill. Euros.
- 15 partners from 7 countries. Coordinated by NGI
- Innovation Action: Funding is more focused on closer-to-the-market activities (demonstrating, up-scaling, etc.)
- 8 Work Packages centered around case studies, WP2



PHUSICOS NBS sites

PHUSICOS' NBS selection criteria:

- Risk reduction / Resilience;
- Technical feasibility;
- Co-benefits (Social, Ecological, Economic);
- Effectiveness;
- Efficiency;
- Potential negative impacts of NBS;
- Stakeholder involvement;
- Harmonization with other PHUSICOS WPs;
- Compliance with international and EU agreements and directives



Selection criteria - Funding

- At least 40% from other sources than PHUSICOS
 - Cash from private or public sponsors
 - In-kind in the form of hours spent, use of equipment, laboratory facilities, etc., etc.
- Maintenance costs can be included, with up to 15% of estimated cost, in its 2018 value.
- The 40% must be specified in the proposal, including sources of the funds.
- All costs to be covered by the project must be eligible in accordance with EU rules (Grant Agreement).



Selection criteria - Risk reduction and resilience

- Reducing risk and increase resilience regarding hydro-meteorological hazards is the key issue of PHUSICOS!
 - Human life and well-being
 - Ecological state
 - Social structure
 - Economic values
 - Critical infrastructure



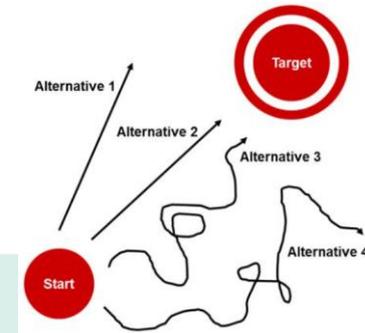
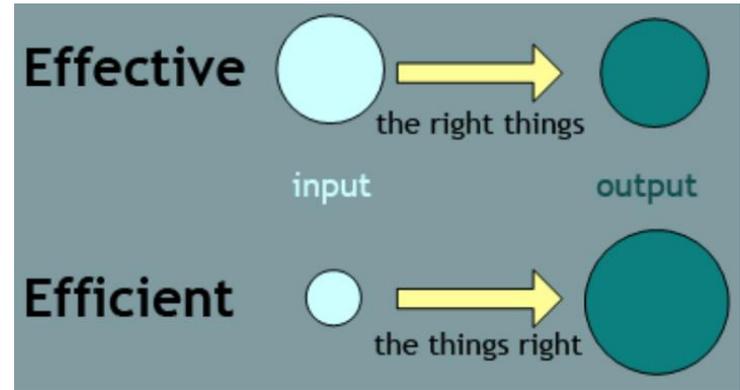
Selection criteria – Co-benefits

- **Ecological impacts:**
 - habitat restoration, enhancing biodiversity and ecosystem services (ESS) provisions
 - increased carbon storage capacity, such as increase in biomass.
- **Social impacts:**
 - provision of human well-being and health (e.g. stakeholder involvement to increase perception of safety)
 - improved quality of life and accessibility for recreation
- **Economic impacts:**
 - enhancing innovation capacity, e.g. new methods, concepts, etc.
 - increase in human capital for territorial growth (create jobs).



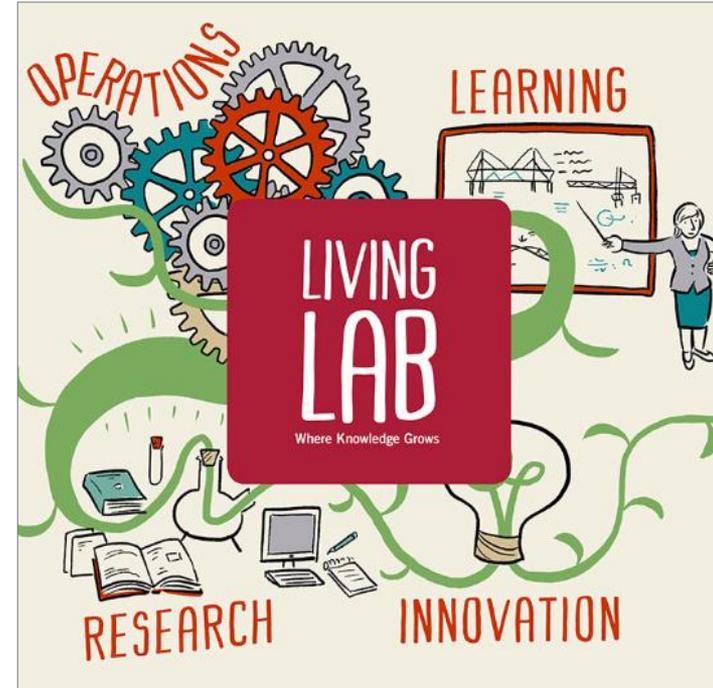
Selection criteria – Effectiveness (and efficiency)

- Effective vs. efficient:
 - Being effective is about doing the right things, while being efficient is about doing things right.
- The NBS should be effective over long time periods, and designed to withstand changing physical conditions.
- Need for maintenance must be described (and budgeted).



Selection criteria - Participatory process

- The Living Lab approach (WP3)
 - Evaluation on how the LL approach is being applied, from planning through implementation.
 - Important to also describe the continued participatory process after proposal.
 - Tailored to the local context at each case
 - Much experience among the Isar and Kaunertal site groups.
- **Plus harmonization with other WPs**
 - Partly covered by previous points
 - To show how the various WPs are important for each of the cases.



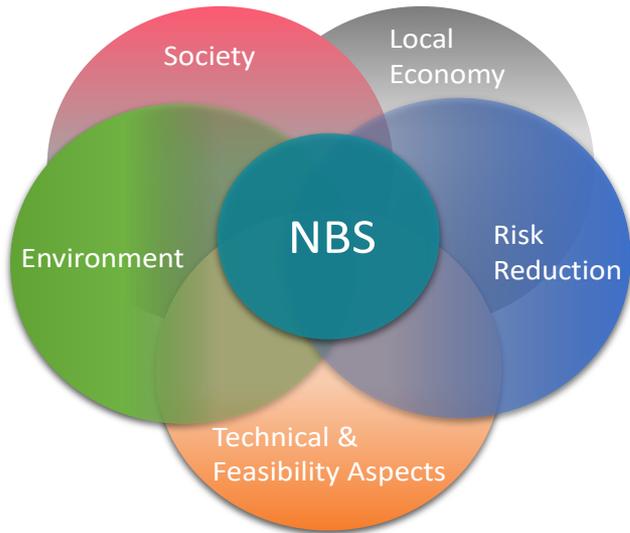
Additional criterion

- How the proposed NBS help to fulfill
 - The UN development goals
 - Sendai declaration of DRR, 2015-2030:
 1. Understanding disaster risk
 2. Strengthening disaster risk governance to manage disaster risk
 3. Investing in disaster risk reduction for resilience
 4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction



NBS performance assessment framework

The Framework Tool is based on the assessment of distinctive Indicators, making up a Framework Tool Matrix



AMBIT	CRITERION
Risk Reduction	Hazard
	Exposure
	Vulnerability
Technical & Feasibility Aspects	Technical Feasibility
	Economic Feasibility
Environment	Water
	Soil
	Vegetation
	Landscape (Green Infrastructure)
	Biodiversity
Society	Quality of life
	Community Involvement and Governance
	Landscape and Heritage
Local Economy	Revitalization of Marginal Areas
	Local Economy Reinforcement, including New Job Opportunities

https://phusicos.eu/wp-content/uploads/2019/05/D4.1_Task4.1_UNINA_14052019_Final_withAppendicies.pdf



PHUSICOS NBS

Approved; Various stages of implementation (10)

Proposed & approved but cancelled (3)

Proposed but declined (1)

• Total 18 proposed
• 14 to be implemented

Site	Proposal	Hazard	Type intervention	Status
Gudbrandsdalen, Norway	G1: Jorekstad	Flooding	-Use of floodplain; receded green barrier	Approved, but cancelled
Gudbrandsdalen, Norway	G2: Skjåk	Flooding/torrents	Living Lab process	Approved,
Gudbrandsdalen, Norway	G3: Øyer	Flooding / debris flows	Vegetation, check dam, retention basin	Under implementation
Gudbrandsdalen, Norway	G4: Skurdalsåa	Flooding	Retention high in catchment	Approved,
Serchio River Basin, Italy	SRB-A: Canals by Lake Massaciuccoli	Erosion, run-off, pollution, flooding	Vegetated buffer strips	<u>Implemented</u>
Serchio River Basin, Italy	SRB-B: Canals by Lake Massaciuccoli	Erosion, run-off, pollution, flooding	Vegetated buffer strips	<u>Implemented</u>
Serchio River Basin, Italy	SRB-C: Dam by Lake Massaciuccoli	Erosion, run-off, pollution, flooding	Vegetated basin	Approved,
Serchio River Basin, Italy	SRB-D: NBS Lab	N/A	Educational	<u>Implemented</u>
Serchio River Basin, Italy	SRB-E: Canal system	Flooding	Improve hydraulic capacity	<u>Implemented</u>
Pyrenees, Spain	P1: Santa Elena	Erosion, rockfall, instability	Vegetated terraces	Approved
Pyrenees, France	P2: Socques	Torrents	check dams	Cancelled
Pyrenees, France	P3: Artouste	Rockfall	Wood structures to prevent release and acceleration	Approved
Pyrenees, France	P4: Bastan River	Flooding, torrents	Change of river long & tranverse profile; allow more room for floods	Cancelled
Pyrenees, France	P5: Capet Forest	Snow avalanches	Afforestation in release area	<u>Implemented</u>
Pyrenees, Spain	P6: Port Ainé	Flooding, instability	Re-vegetation, erosion control	Declined
Pyrenees, Spain	Erill-La Vall	Debris flows	Erosion control, wooden gabions, vegetation	Approved
CC - Isar River, Germany	Educational	Flooding	Flood plain restoration	<u>Implemented</u>
CC - Kaunertal, Austria	Revegetation	Erosion, landslides	Microbe-assisted revegetation	Under implementation

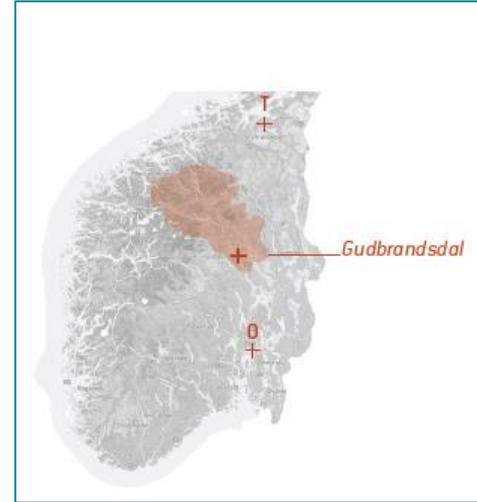


Stakeholders various NBS projects

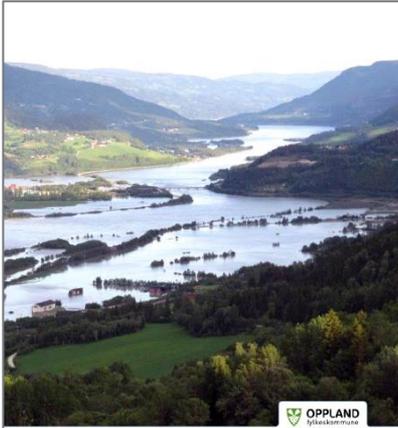
Site	Hazard	Affected	Stakeholders
Jorekstad (Norway)	Floods, erosion	Agricultural area, sports arena	Farmers, municipality, NGOs, citizens
Øyer (Norway)	Floods, debris flows	New housing area	Municipality, house owners
Serchio river (Italy)	Erosion, pollution, run-off, flooding	Agricultural area, lake pollution	Farmers, municipality, region
Capet forest (Pyr.)	Snow avalanche	National park	Tourism, NGOs, forestry
St. Elena/Artouste (Pyr.)	Rock fall, erosion	Infrastructure (road)	Travellers, local communities
Erill la Vall (Pyr.)	Debris flows	Village, nature	Municipality, citizens, NGOs



Valley of Gudbrandsdalen, Norway



Valley of Gudbrandsdalen, Norway



Lågenplanen

Regional plan for Gudbrandsdalslågen med sidevassdrag

- Tiltak for å redusere flom- og skredskader

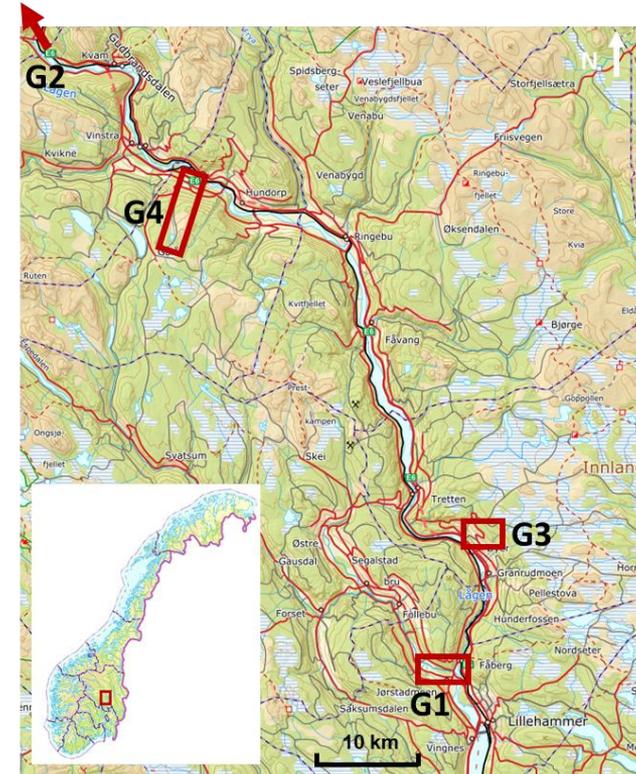


<https://innlandetfylke.no/tjenester/plan-statistikk-og-folkehelse/regionale-planer/>



Valley of Gudbrandsdalen, Norway

- G1: Jorekstad – case study Bologna summer school
- G2: Skjåk - Living Lab process and interest in using traditional water ways for flood retention
- G3: Øyer - flood and erosion control
- G4: Skurdalsåa - flood retention



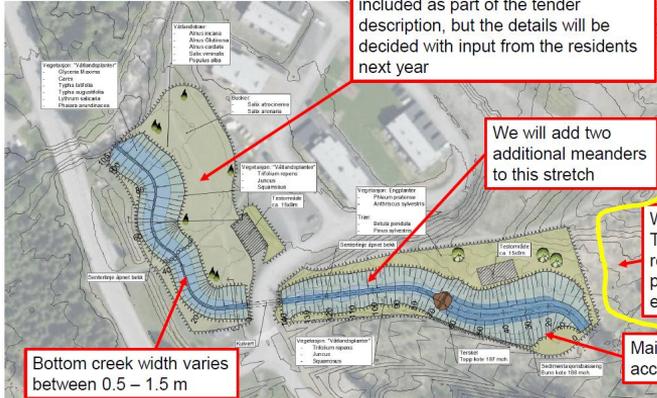
Gudbrandsdalen: Øyer, flood control

G3: Øyer, flood / erosion control:

- Previous gravel pit, to be developed into an area for family housing.
- Measure consists of re-opening creek, revegetation, constructing a sedimentation basin in the creek and establishment of blue-green park area with ponds, for flood retention.
- Vegetation species from southern climate (south Norway);
- Planted in two fenced plots to test the growth;
- effectiveness of these species will be tested out as erosion protection measures



Overview



Benches and playgrounds will be included as part of the tender description, but the details will be decided with input from the residents next year

We will add two additional meanders to this stretch

We will demarcate areas of Trodalsbekken that must remain undisturbed to preserve the natural environment.

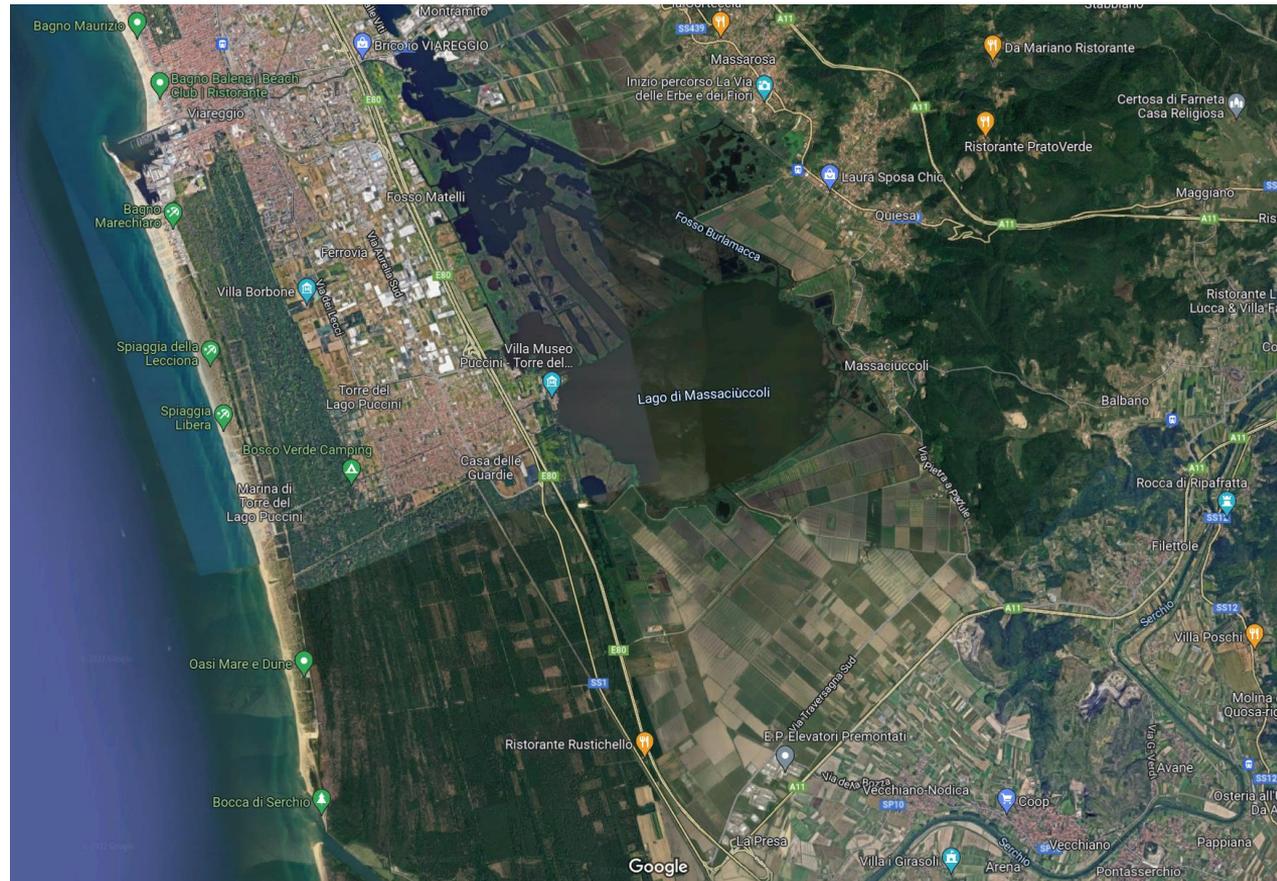
Bottom creek width varies between 0.5 – 1.5 m

Maintenance vehicle access will be here

Status early July 2022



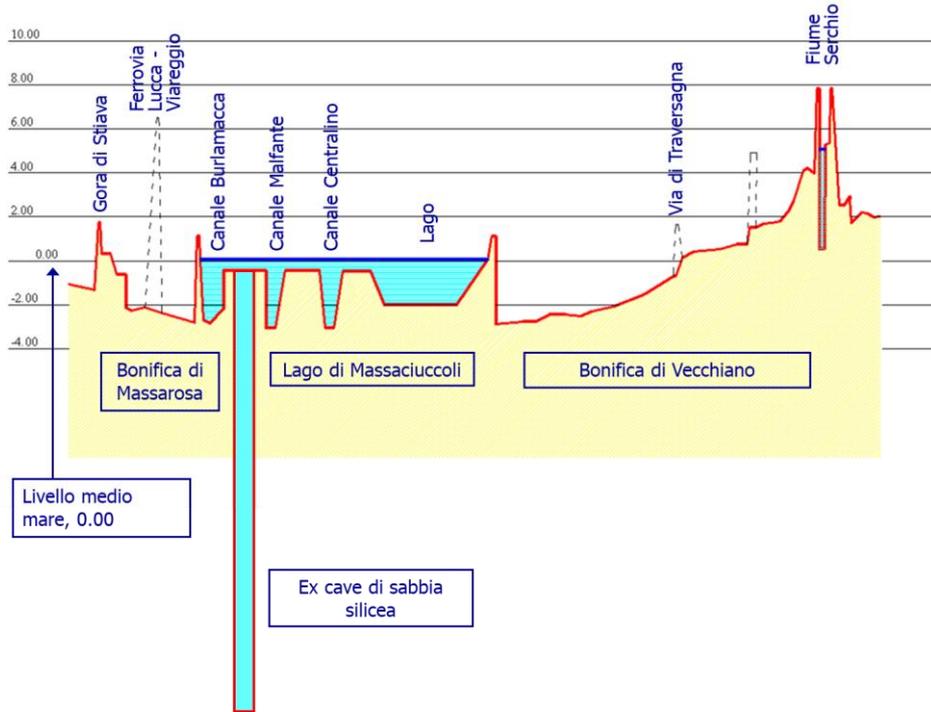
Serchio River Basin – Lake Massaciuccoli, Italy



- Lake is in very poor state. Inflow of seawater when lake level is low
- Transfer water from the Serchio River in dry seasons: decrease salinity and maintain lake level
- Prevent runoff of soil, nutrients and pesticides from farmland through NBS
- NBS also for flood control



PHUSICOS case – Serchio River / Lake Massaciucoli

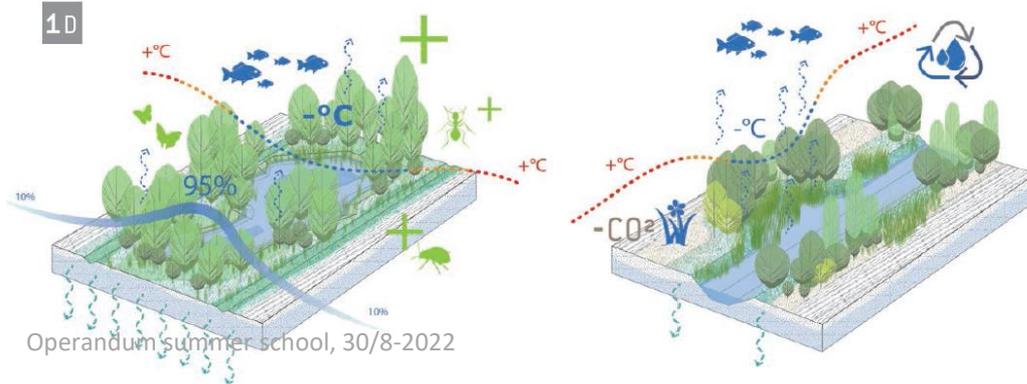
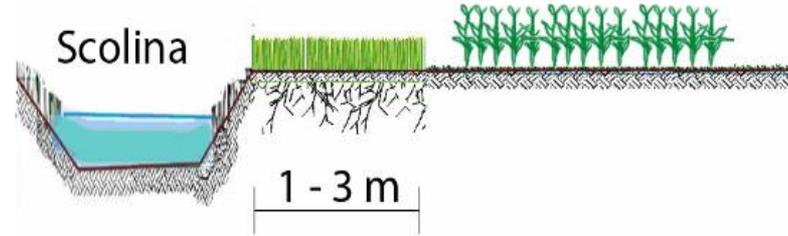


NBS measures

- Establish vegetation buffer strips along channels
- Establish a sedimentation basin
- Modify canal cross sections to increase their efficiency
- Change crops in parts of the fields



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
- ecologically valuable areas for specific species



M19-M36: Serchio River Basin, Italy - 2

Total for Serchio River Basin:

- Most progressing as planned! High potential for upscaling. Much interest and publicity, locally and regionally!

Barriere verdi per la salute del Massaciuccoli

Massaciuccoli



È una delle soluzioni individuate per mitigare il rischio idrogeologico legato all'erosione ma anche per abbattere gli inquinanti legati alle colture

MASSACCIUCCOLI. — Si chiamano *buffer strips* e sono barriere verdi, nel senso di aree vegetate, da collocare ai margini dei campi per contrastare a riparo pressoché zero erosione costiera e

emissione di inquinanti nelle acque del lago di Massaciuccoli. È questa una delle soluzioni green per mitigare il rischio idrogeologico e migliorare la qualità dell'acqua individuate nel corso di un sopralluogo, il primo, per verificare l'avvio dei lavori previsti dal progetto *Phusicos*, according to nature.

Finanziato dall'Unione Europea con 1 milione e 422mila euro, all'interno del più ampio programma quadro *Horizon 2020*, il progetto nasce con l'obiettivo di dimostrare l'efficacia di soluzioni basate sulla natura nel mitigare il rischio idrogeologico, nel migliorare la qualità della risorsa idrica e i delicati sistemi ambientali del comprensorio del Lago di Massaciuccoli tra le province di Lucca e Pisa.

Nella sostanza con l'attuazione di tale progetto si mira a dimostrare come interventi di tipo naturalistico, come le *buffer strips*, possano essere altamente efficaci per evitare che le acque dilavanti dalle coltivazioni nei terreni circostanti il lago di Massaciuccoli arrivino al lago cariche di sostanze inquinanti, quali ad esempio nitrati e fosfati.

Le *buffer strips* sono essenzialmente aree vegetate inserite ai margini dei campi coltivati al fine di limitare l'erosione del suolo e migliorare la qualità dell'acqua. Tali misure si inseriscono, quindi, perfettamente, nell'attuale tessuto territoriale del lago. Un approccio naturale e di basso impatto ambientale e paragonato finalizzato a incrementare la resilienza del territorio, favorendo la biodiversità e fruibilità delle aree naturali.

LEGGI DI TOSCANA
SOTTILEGGIO, 15 APRILE 2021
SULLA REGIONE

PRIMA PAGINA | CRONACA | POLITICA | ECONOMIA | CULTURA | WELFARE | WELFARE

Massaciuccoli più sicuro: al via EU Phusicos

Finanzia con 1,4 milioni di euro il progetto

Un progetto green da 1,4 milioni di euro che vede in prima linea l'autorità di Bacino

Soluzioni green per mitigare il rischio idrogeologico e migliorare la qualità dell'acqua. Si tratta del progetto *Phusicos*, secondo la relazione "Erosione del suolo in Europa con i modelli e gli interventi" dell'Unione europea. Il progetto è finanziato dall'Unione europea e vede in prima linea l'autorità di Bacino del Lago di Massaciuccoli. Il progetto mira a dimostrare l'efficacia di soluzioni basate sulla natura (NBS) nel mitigare il rischio idrogeologico, nel migliorare la qualità della risorsa idrica e i delicati sistemi ambientali del comprensorio del Lago di Massaciuccoli.

Lucca in Diretta

Facebook, Twitter, YouTube icons

Massaciuccoli più sicuro, via ai lavori del progetto Phusicos

Soluzioni green per mitigare il rischio idrogeologico e migliorare la qualità dell'acqua

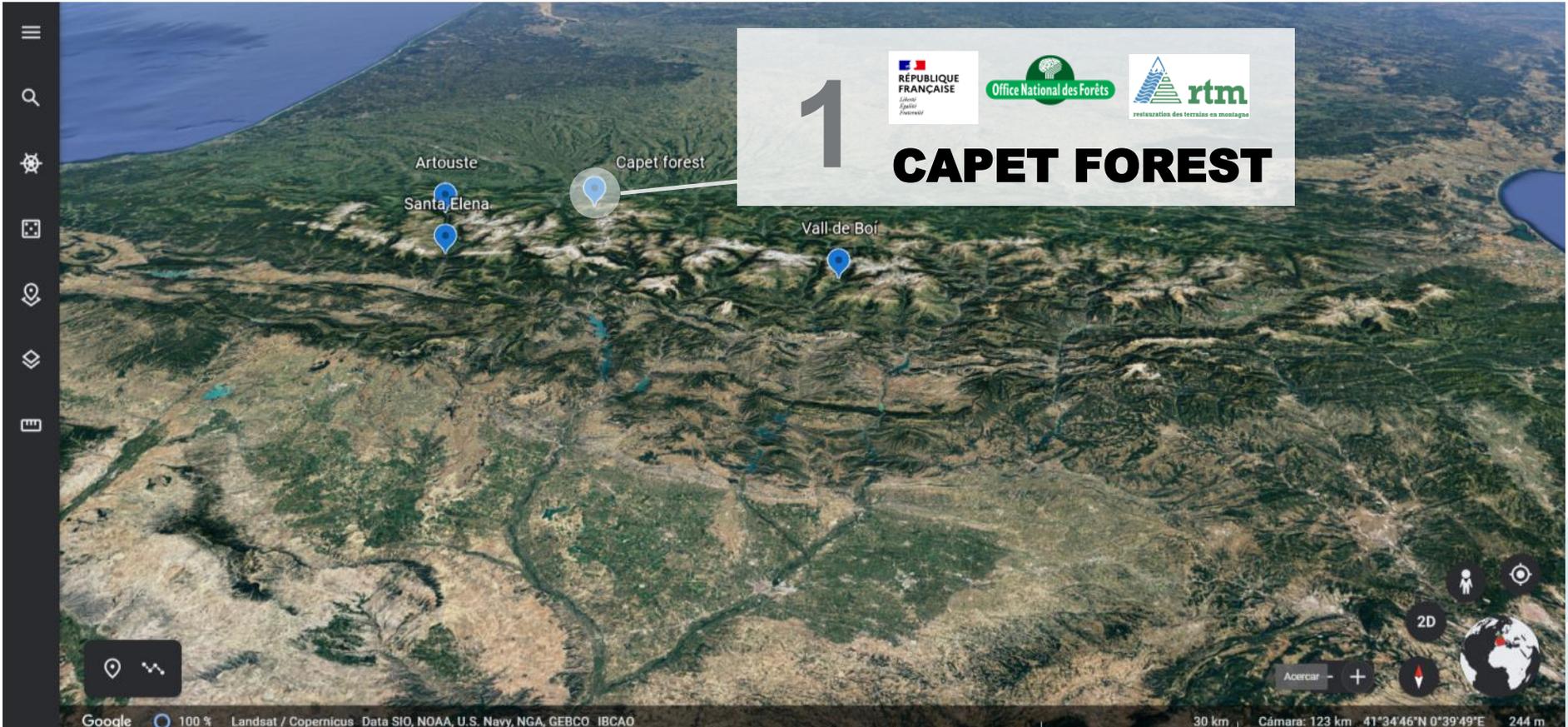
05 Febbraio 2021 - 11:58 | Commenti | Stampa | Invia notizia | 0 mila

Più informazioni su: [agricoltori](#), [autorità di bacino](#), [interventi green](#), [lago di massaciuccoli](#), [massaciuccoli](#), [progetto eu phusicos](#), [vechiano](#), [massarosa](#), [versilia](#)



Massaciuccoli più sicuro. Soluzioni green per mitigare il rischio idrogeologico e migliorare la qualità dell'acqua.





1

CAPET FOREST



Artouste
Santa Elena

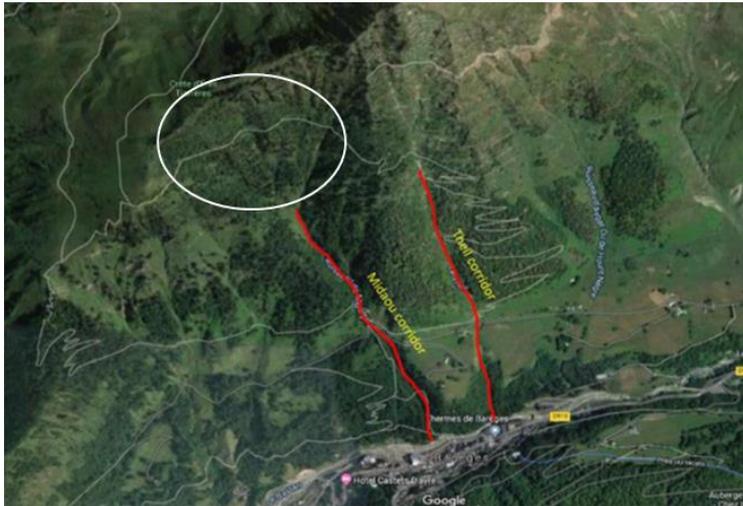
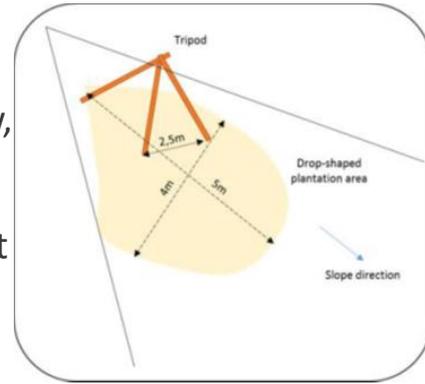
Capet forest

Vall de Boi



Pyrenees, Capet Forest: snow avalanches

- Frequent avalanches threats w/ evacuations of the village Baréges.
- Existing snow fences some times too low, and require heavy maintenance.
- PHUSICOS measure is afforestation in release area; altitude adapted local plant species, protected by tripods.
- Complete summer 2022.

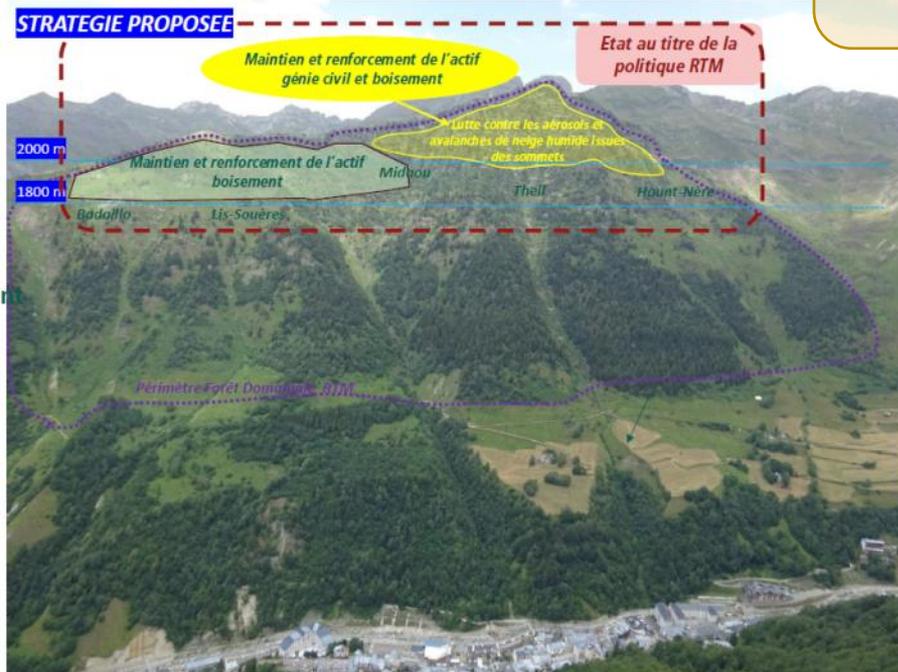


1 CAPET FOREST



Risk of avalanche

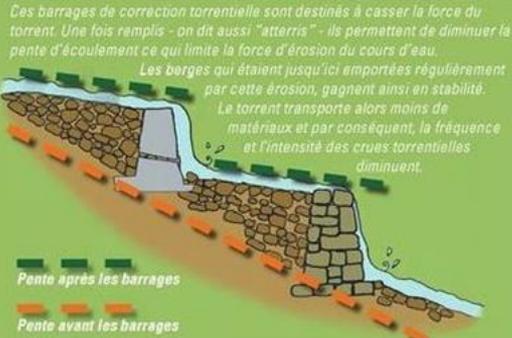
NBS: plant establishment and tripods



- Last planting campaign during late Spring 2022 (2.000 plants)
- Global strategy of protection planned by ONF-RTM: mixed works (grey + green), housing for workers for maintenance...
- Close coordination between ONF-RTM and Authorities (meeting, public event...)
- Monitoring post PHUSICOS may be reinforced



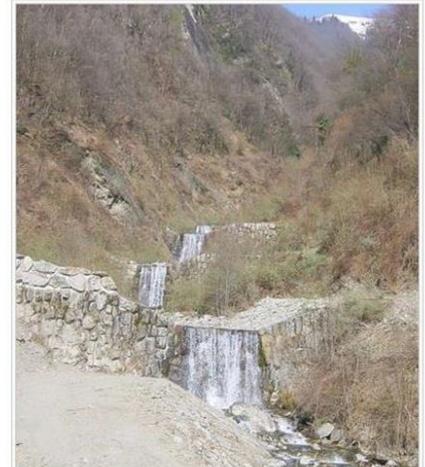
Check dams – hybrid solutions



- Combine traditional 'grey' techniques with the use of 'live' and local materials.
- Avoid long transport, concrete and other alien material; also consider emission reduction.



Le lit du torrent avant la construction des seuils



Cascade de seuils ayant stoppé l'érosion et permis la reconquête de la végétation



Barriers to uptake and implementation of NBS

1. Lack of political will and long-term commitment
2. Lack of sense of urgency among policymakers
3. Lack of public awareness and support
4. Risk aversion and resistance to change
5. Silo mentality
6. Misalignments between short-term plans and long-term goals
7. Lack of supportive policy and legal frameworks
8. Lack of design standards and guidelines for maintenance and monitoring
9. Lack of skilled knowledge brokers and training programs
10. Functionality and performance uncertainties
11. Perceived high cost
12. Lack of available financial resources
13. Lack of financial incentives
14. Property ownership complexities
15. Space constraints
- 16. Procurement challenges**
- 17. Other factors**

Sarabi et al. 2019 *Resources*, 8, 121.
Focus on urban settings

PHUSICOS: additional barriers and
experience from rural settings

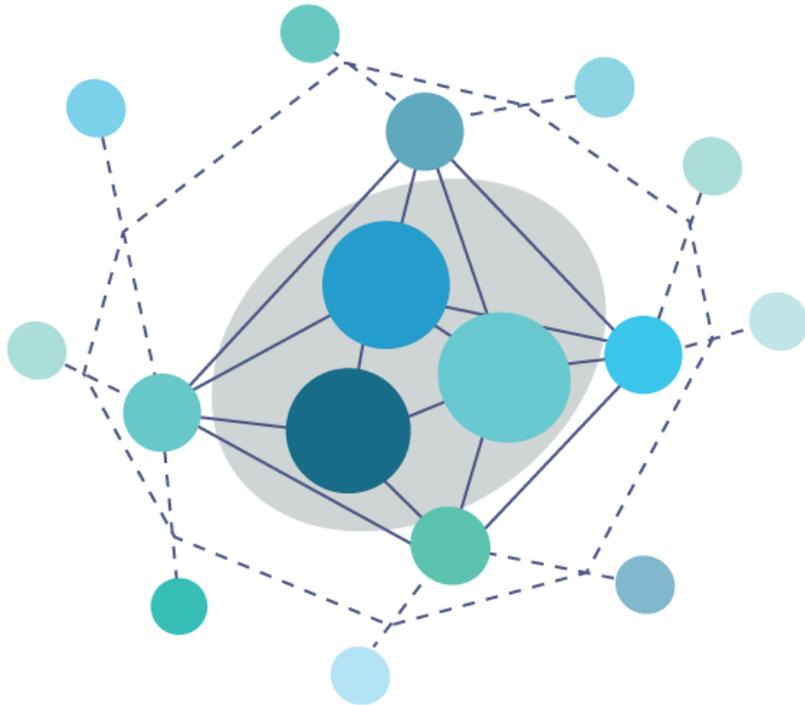


Barriers – experience receded green barrier

1. Lack of political will and long-term commitment
 2. **Lack of sense of urgency among policymakers**
 3. **Lack of public awareness and support**
 4. Risk aversion and resistance to change
 5. Silo mentality
 6. **Misalignments between short-term plans and long-term goals**
 7. Lack of supportive policy and legal frameworks
 8. Lack of design standards and guidelines for maintenance and monitoring
 9. Lack of skilled knowledge brokers and training programs
 10. **Functionality and performance uncertainties**
 11. **Perceived high cost**
 12. **Lack of available financial resources**
 13. **Lack of financial incentives**
 14. **Property ownership complexities**
 15. Space constraints
 16. **Procurement challenges**
 17. **Other factors**
- General skepticism to NBS, lack of knowledge
- Merging of two counties
- General skepticism to NBS, lack of knowledge
- Too little funding available
- Loss of agricultural land
- Complex, formal objections
- Loss of income from gravel removal



Polycentric governance as an enabler for NBS

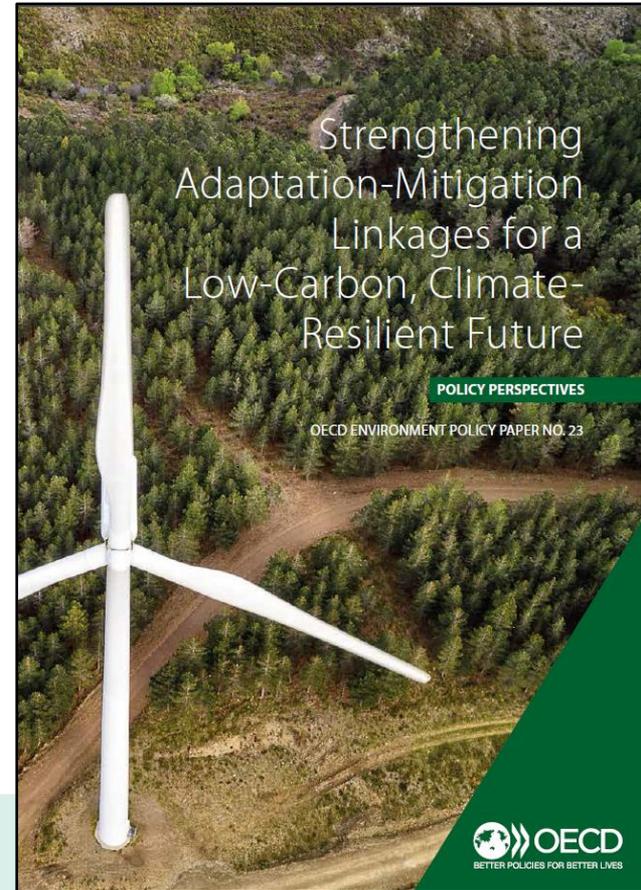


- Decisions are taken across different scales and sectors including collaboration with organisations outside public administrations
- I.e. stakeholder involvement at all levels in co-creation and co-design is important!

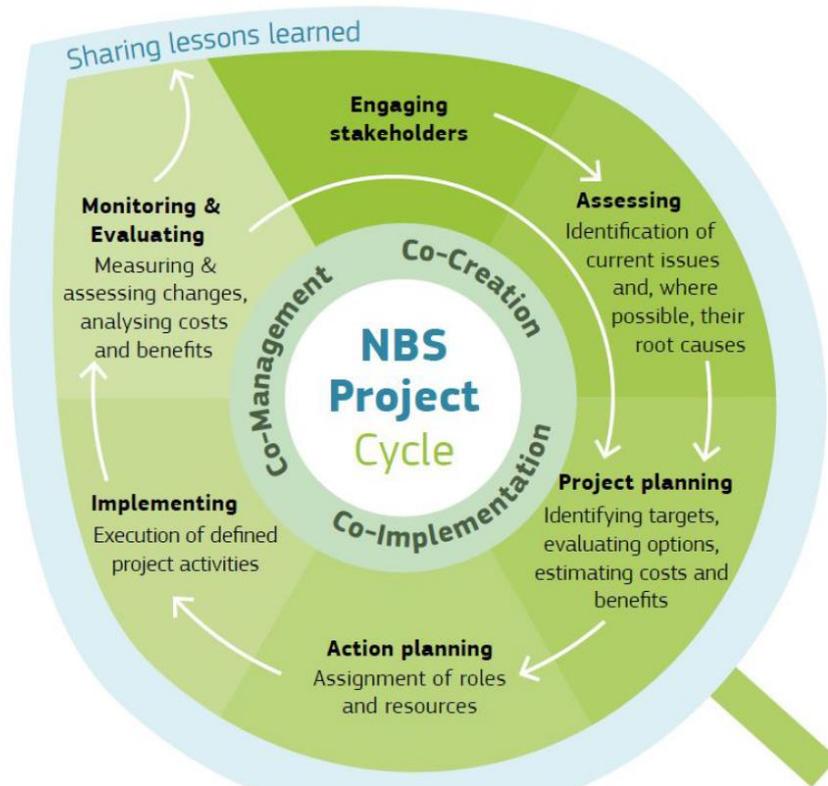


Integration of NBS into planning processes

- For example:
 - Criteria for infrastructure projects to include NbS evaluations at the planning stage
 - Adopt laws that require a portion of space dedicated to green infrastructure
- Norway's national planning guidelines for climate and energy planning and climate adaptation indicate that NBS should be assessed and justify if not selected



NBS Life Cycle



Stakeholder involvement from the beginning

- All levels in society
- Create 'ownership and enthusiasm
- Utilize local knowledge
- Identify local needs
- Align with local/regional policies
- Involve citizens in designing monitoring schemes and collect data
- Etc., etc.



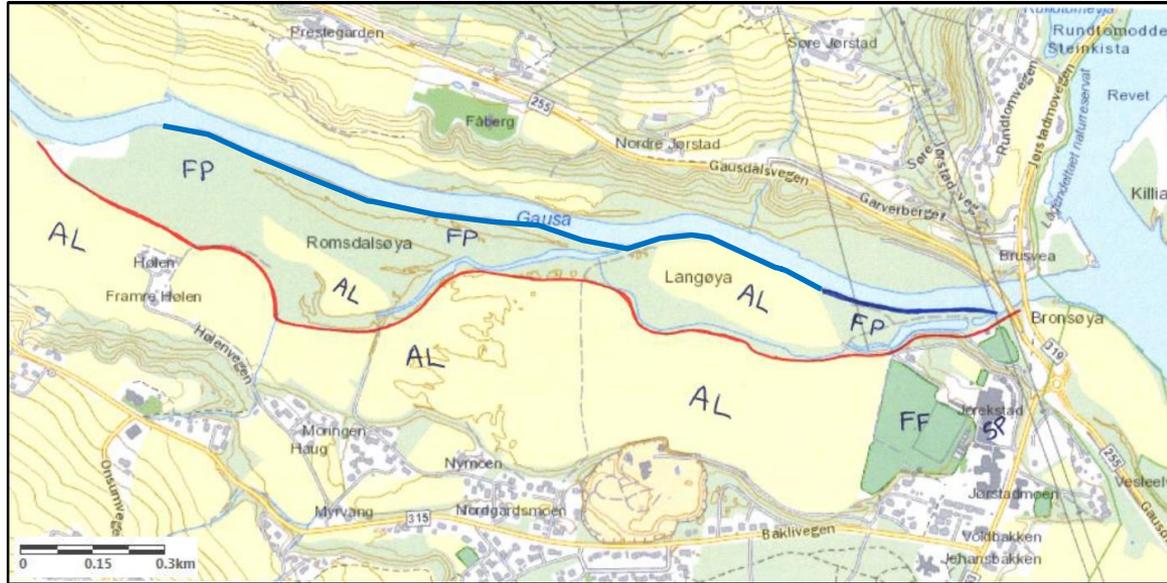
Lessons learned from the challenges

- Plan well ahead. Getting plans through to practical implementation takes more time than one possibly could think of.
- Procurement can be time consuming. Be as detailed as possible in the tender documents. Formal objections will lead to serious delays.
- Bring stakeholders into the process as early as possible, if possible from scratch; co-creation of the measures establishes 'ownership' and increased enthusiasm.
- Use their local knowledge wherever possible and show appreciation.
- Identify ambassadors for the project and work closely with them.
- Identify potentially 'problematic' stakeholders and plan strategies to handle these.
- If at all possible, choose public land for your NBSs.
- NBS take time to establish and become effective, thus plan and implement long-term monitoring programs to document NBS and improve knowledge regarding their uncertainties.



Case study mountain region – Jorekstad, Norway

(1/3)



Red line: Possible space for flooding in extreme cases

Blue line: Existing flood prevention measure / erosion protection of the Gausa riverbank

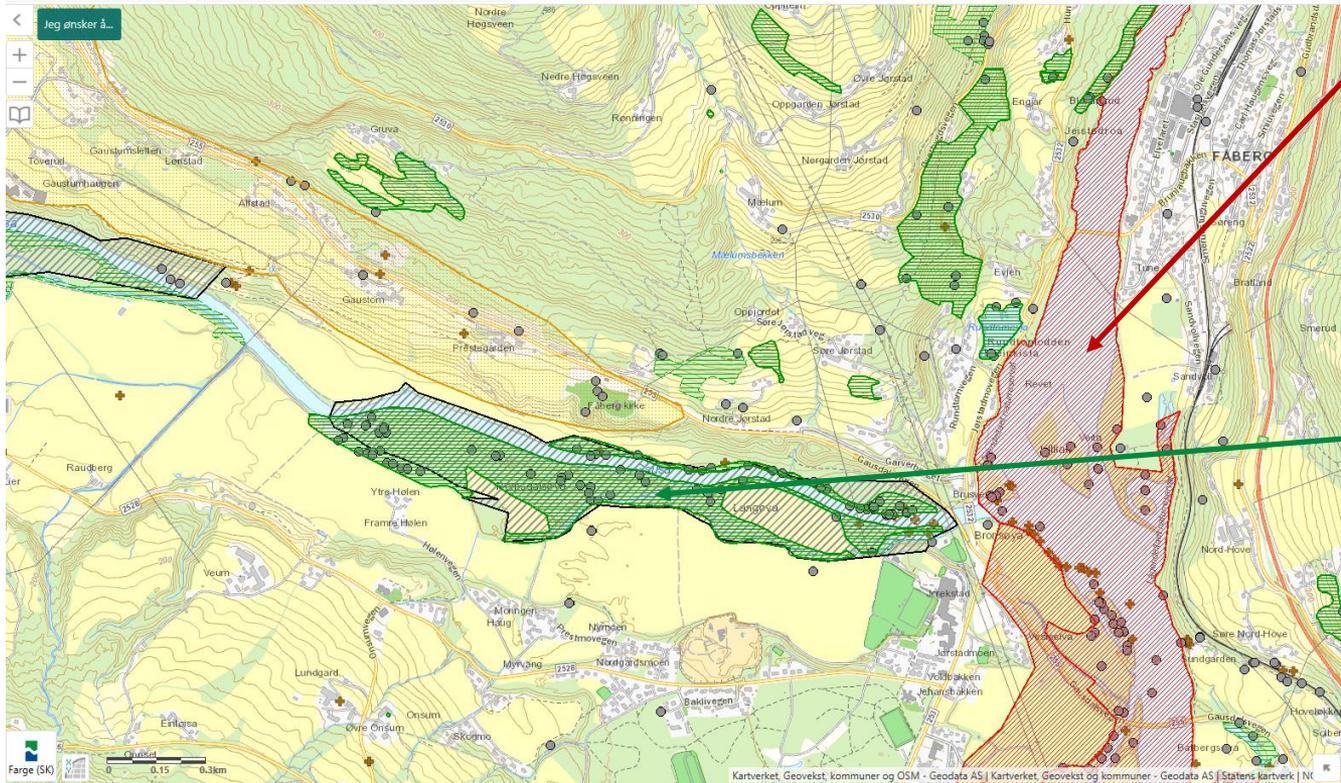
Action list:

- Restore flood plain (FP) riparian vegetation, with several red-list species.
- Reduce extreme event floods in agricultural land (AL)
- Protect sport facilities and housing, as well as farmland.
- Avoid problems with sediment deposition and shallowing of main river Gudbrandsdalslågen



Case study mountain region – Jorekstad, Norway

(2/3)



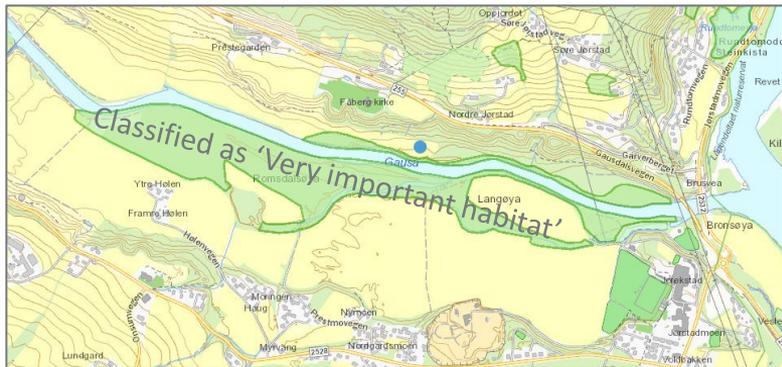
Protected area

Classified as an area with
“very important habitat”

<https://kart.naturbase.no/>



Case study mountain region – Jorekstad, Norway (3/3)



Aerial photographs: 2019 (after) versus 1967 (before) existing flood barrier. The flood barrier changed the riparian zone and some important species disappeared.



NGI



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This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 776681



Thank you!

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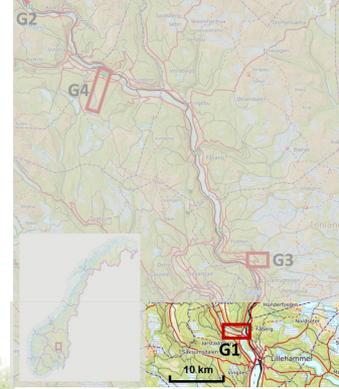
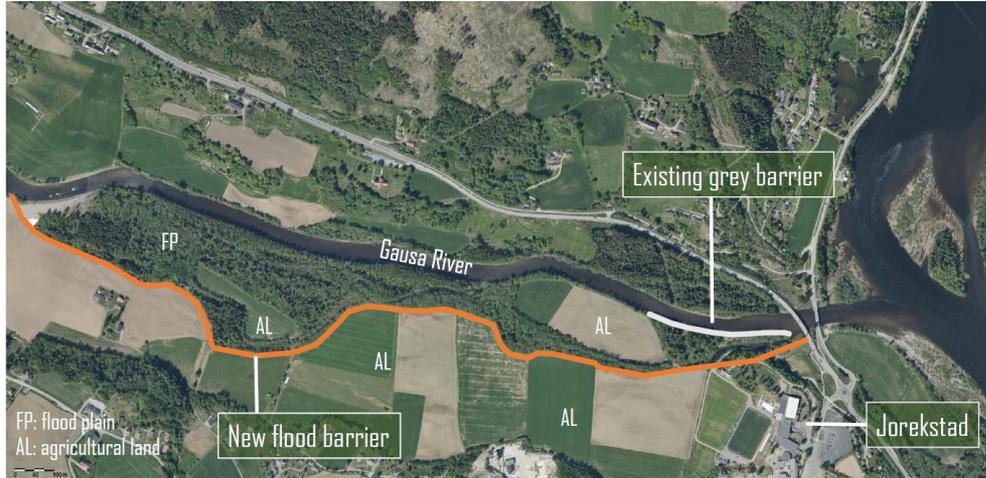
<https://phusicos.eu/>

 [@phusicos](https://twitter.com/phusicos)



Gudbrandsdalen: Jorekstad, flooding and erosion

G1: Receded green flood barrier to allow more space for flooding

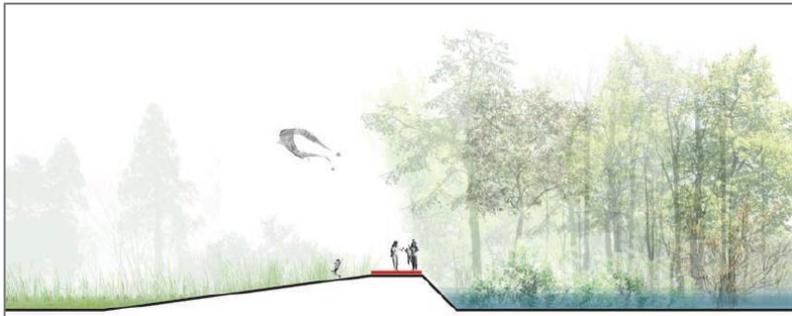
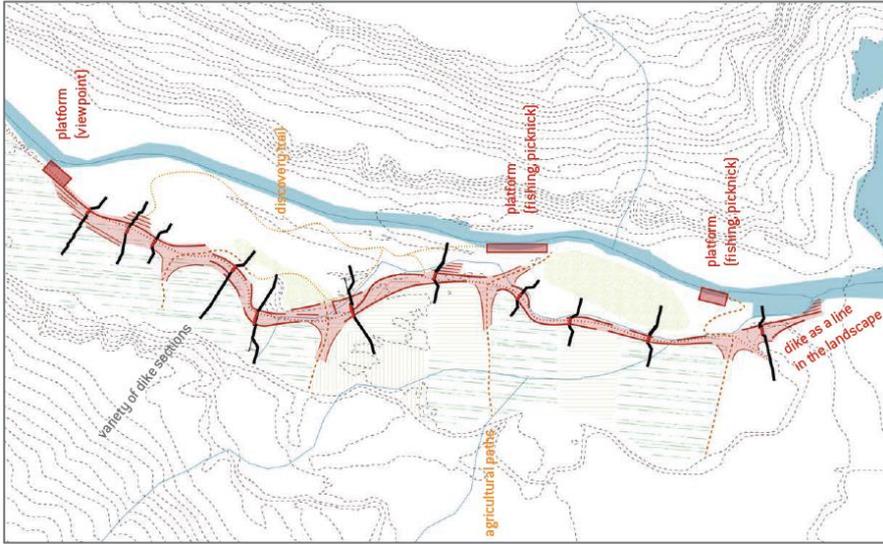


- Protects sport facilities and housing, as well as farmland.
- Avoid problems with sediment deposition and shallowing of main river Gudbrandsdalslågen
- Restore flood plain (FP) riparian vegetation, with several red-list species.



Confidence in the functionality of the solution (tested with models), however it was not implemented due to the barriers encountered (high costs for the municipality, land ownership, traditional thinking, lack of political will)

Jorekstad 'green' receded flood barrier



Jorekstad, - design suggestions



Situation today. Red line: proposed barrier

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

