PHUSICOS

According to nature

Deliverable D2.1

Procedures for distribution of funds and tenders

Work Package 2– Case study sites: large scale demonstrator sites and supporting concept cases

Deliverable Work Package Leader: NGI

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Project information

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Summary

PHUSICOS, meaning 'According to nature' in Greek (φυσικός), is a four-year Innovation Action project that started in May 2018 and is funded by the European Union's Horizon 2020 research and innovation programme under Grant agreement No. 776681. PHUSICOS consists of 8 work packages (WPs), of which WP2, 'Case study sites', is the core of the project. This report is the first delivery, D2.1, of WP2.

Nearly 50% of the total budget allocated from the European Commission (EC) is for the implementation of Nature Based Solutions (NBSs) in three demonstrator sites and two concept case sites. This report describes shortly the five case sites and the problems they are facing with regards to natural hazards and the NBS solutions they are starting out with in a process with stakeholder involvement in order to reach NBS implementation in accordance with local interests and needs.

The report defines the selection criteria, which largely follows the key performance parameters described in the PHUSICOS proposal. The selection criteria should also be aligned with the NBS evaluation framework to be developed under Task 4.1 of WP4, and the report demonstrates the relationship between the initial selection criteria and the WP4 performance evaluation criteria.

As the case study sites will have to procure goods and services, short descriptions of the relevant counties' regulations for public procurement are included in the report, as well as the EC regulations of 'best value procurement'. However, correct procurement, as well as ensuring that all costs are eligible, is the responsibility of the site owners.

Finally, the report briefly describes the selection process, which is done by the 15 members of the Steering Committee, and the distribution of the EC funds, which cannot be used until the NBSs are approved by the Steering Committee. A template for the NBS proposal, which should not exceed 10 pages, is included as an appendix in the report.

Contents

Appendices

1 Introduction

The project EC H2020 project *'PHUSICOS – According to nature'* (Grant Agreement number 776681), is a project under call **SC5-08-2017: Large-scale demonstrators on nature-based solutions for hydro-meteorological risk reduction**. PHUSICOS (https://phusicos.eu) is a four-year Innovation Action project with the aim of demonstrating how nature-based / nature-inspired solutions (NBSs) reduce the risk from extreme weather events in rural mountain landscapes. The project started in May 2018 and the project consortium comprises 15 partner organizations from 7 countries (Norway, Germany, Austria, Italy, France, Spain, and Andorra).

The overarching objective of PHUSICOS – 'According to nature' is to demonstrate that nature-based and nature-inspired solutions for reducing the impact of extreme weather events in rural mountain landscapes, are technically viable, socially acceptable, cost-effective and implementable at the regional scale. To achieve this objective and bridge the knowledge gap on NBSs and their efficiency in reducing risk due to hydro-meteorological hazards (flooding, erosion, landslides, etc.), PHUSICOS intends to implement NBSs at several European sites. Three main case study sites (Serchio River Basin in Italy, The Pyrenees in Spain-France-Andorra, and the Valley of Gudbrandsdalen in Norway) have been selected as large-scale demonstrator sites for implementation of the NBSs. The three sites meet the two essential criteria of (1) illustrating the potential for up-scaling and mainstreaming NBSs throughout Europe, and (2) accomplishing this within the timeframe of PHUSICOS. These three demonstrator sites each have four key features:

(i) they are representative of hydro-meteorological hazards, vegetation, topography and infrastructure throughout rural and mountainous regions in Europe such that tested NBSs can be replicated in other regions;
(ii) they have guaranteed external financing and are currently in the process of implementing DRR measures;
(iii) they are open to broader implementation of NBSs through the application of the PHUSICOS key innovation actions; and
(iv) they include end-user participation to ensure the long-term implementation of NBSs after the completion of PHUSICOS.

In addition to these three demonstrator sites, PHUSICOS will test specific challenging aspects of NBSs in two small-scale complementary concept cases (the Kaunertal Valley in Austria and the Isar River Basin in Germany). The lessons learned from these concept cases will also benefit the demonstrator sites at a large scale, particularly through a study of their transferability. In particular experiences from the Isar case, which acts as learning example, can be of great value to all the other cases.

PHUSICOS will demonstrate that the benefits of NBSs are inclusive by increasing the ecological, social and economic resilience of local communities. Nature-based and nature-inspired solutions also include sustainable management and responsible use of land, water and natural resources. PHUSICOS addresses this broad definition of nature-based solutions through five innovation actions:

- Engaging a diverse range of stakeholders through a Living Labs approach, a stakeholder participation methodology, with service innovation at the demonstrator sites and concept cases.
- Designing a comprehensive framework for comparative analysis and monitoring to evaluate the performance of various NBSs through the lens of technical innovation to assess the benefits and costs using different performance assessment tools.
- Exploring ways to enhance the inclusiveness, fairness and effectiveness of the co-design and implementation of NBSs in the context of governance innovation.
- Creating a knowledge co-generation platform using learning arena innovation, including the use of social-ecological simulation approaches (also referred to as serious gaming).
- Establishing a comprehensive state-of-the-art evidence-base and data platform concerning NBSs through product innovation, providing a set of tools and best practices.

However, the project also acknowledges that NBSs are not always the best solution. Grey measures and NBSs do not always cover the same spectrum of response. For some problems, 'grey' measures may be the most feasible and most effective measure. In other cases, hybrid solutions may be the best alternative, where NBSs are complementary to grey infrastructure. There will be examples of this in PHUSICUS, such as the combination of a diversion pipeline and NBSs in the Serchio River Basin (Chapter 2.3). Grey measures and NBSs.

PHUSICOS is organized in eight work packages, where the demonstrator and concept case sites, organized in WP2, form the core of the project (Figure 1.1). This document, which is a deliverable under WP2 of the project, describes the procedures regarding the selection, funding and implementation of the various measures to be co-funded through PHUSICOS. The evaluation criteria are set in close coordination with WP4, which is developing a comprehensive framework for assessing the performance of the NBSs.

As the implementation of the various NBSs will involve purchasing goods and services on a commercial basis, the document also briefly covers the various relevant national procurement regulations, as well as the EC regulations, which all must be followed.

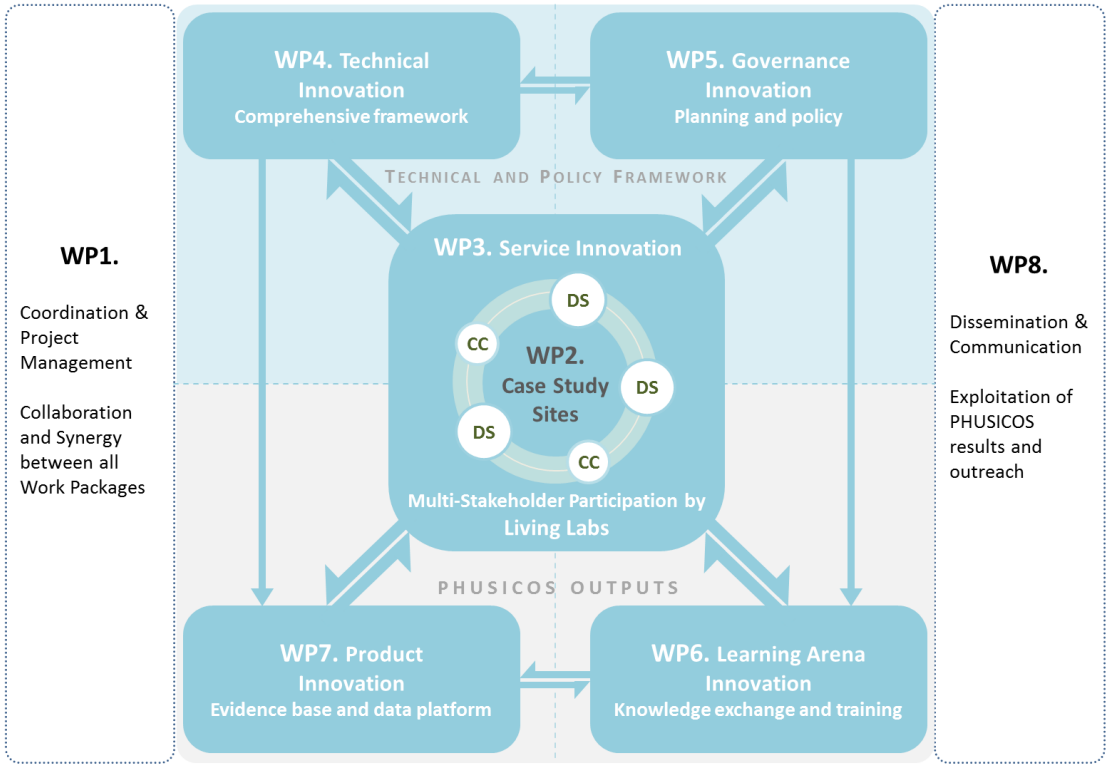

Figure 1.1 PHUSICOS work plan and project structure, including all work packages (WPs). (DS=demonstrator site; CC=concept case).

2 Demonstrator and concept case sites

The PHUSICOS case study sites (Figure 2.1) have been selected to represent a broad range of temporal stages with regards to the implementation of NBSs. They have also been selected because they represent a broad variation in problems, as well as environmental and societal conditions. Table 2.1 lists key aspects for each site, including size, NBSs to be included and impacts. Some sites are more mature (e.g. green infrastructure projects have already been implemented and supporting NBSs are planned), while some of the demonstrator sites are currently in the stages of planning and detailed design of DRR (Disaster Risk Reduction) mitigation measures with implementation starting in 2019. The conditions of the five NBS sites in different countries allows a comparison of implementation, green infrastructure, technical innovation, participatory processes, sustainable management practices, governance and policy mechanisms. The implementation of NBSs at the case study sites, with end-user partner participation at the demonstrator sites, is one of the key aspects of the PHUSICOS project. It is also an aim that the tested NBSs can be replicated in other regions and countries.

The following descriptions of the demonstrator and concept case sites are taken from the PHUSICOS proposal (DoA). As all the site responsible agencies have worked on further planning of NBSs in their sites since the proposal was prepared, some sites may already have progressed further, and have specific measures planned to be accompanied by local stakeholder participation process. This will most likely be a continuous process through most of the PHUSICOS life span, and therefore, any description will be a 'snapshot' of the situation at one specific time in the project.

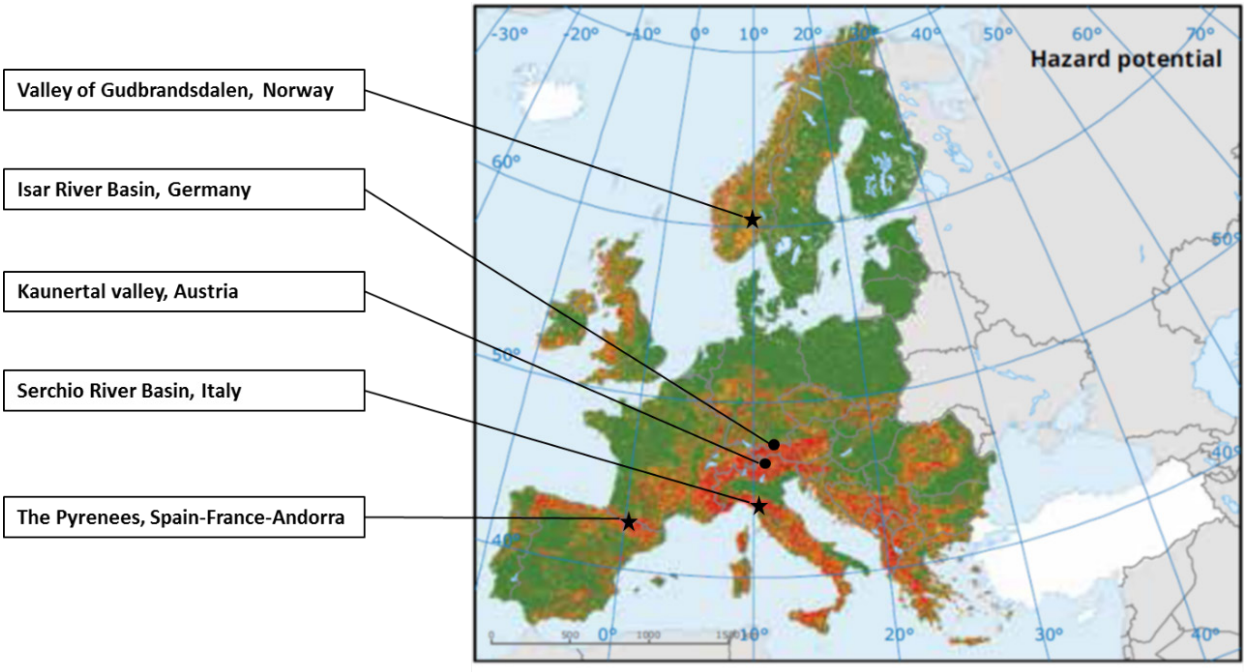

Figure 2.1 Location of the 3 large scale demonstrator sites (stars) and the 2 concept cases (closed circles).

Table 2.1 Overview of the demonstrator sites and the concept cases with main risks, potential NBSs and phase of implementation of NBS and potential impacts of NBSs.

Characteristics	Pyreneees	Gudbrandsdalen	Serchio	Kaunertal	Isar
Type of PHUSICOS case study site	Demonstration	Demonstration	Demonstration	Concept	Concept
Size of river basin (km²)	10,000	12,678	1,565	64	8,962
Size of PHUSICOS focus (km²)	70	50	114	5	2,838
Hydro-meteorological risks	Flooding, landslides and debris flow	Flooding, landslides and debris flow	Extreme drought and flooding	Landslides, rock fall and debris fall	Flooding Erosion/ Incision
Potential NBSs to be implemented	Land use and landscape management (forest), natural	Adapted policy, knowledge learning arena, afforestation,	Restoration and re-vegetation, retention basins,	Microbe-assisted vegetation cover to	Post analysis of restoration using

Characteristics	Pyreneees	Gudbrandsdalen	Serchio	Kaunertal	Isar
	material for protection works, monitoring	forest management, retention basins, remote sensing monitoring	governance and land use management	minimize erosion (experimental)	green, blue and hybrid solutions
Phase of implementation of NBSs	Ongoing projects since 2010, new projects planned for next funding cycle	Regional Master Plan ratified in 2017 with projects identified for implementation by 2022	Detailed design completed with construction planned 2018-2021	Pilot scale study to follow time lines of PHUSICOS project	Mature site, restoration between 1997 and 2011
Impacts of NBS	Local restoration to reduce erosion during flooding and improve sediment retention, improve land use for stabilization, adequate forest management to decrease rock falls	Reduction in damages to infrastructure, buildings and farmland due to heavy rainfall while safeguarding and preserving biodiversity	Increase the retention and decrease soil erosion debris flow	Pioneer knowledge to establish bacteria-assisted vegetation cover to increase slope stability in areas of glacier retreat above the treeline	Extraction of success factors to be shared with other PHUSICOS sites
PHUSICOS End-user partner	Working Community of the Pyrenees (CTP)	Oppland County Authority (Oppland)	Serchio River Basin Authority (ADBS)	*	*
Relevant Innovation WPs	WP3-WP7	WP3-WP7	WP3-WP7	WP3, WP4 & WP7	WP3-WP5

** No end-user partner in PHUSICOS Consortium; however, key stakeholders have already agreed to participate at this site.*

2.1 Demonstrator site Pyrenees, Spain and France

The Pyrenees experienced severe floods in 2013 (Figure 2.2), but in the Pyrenees as well as other European mountains, studies have indicated that landslides and subsequent flooding have decreased in places where forest has conquered past grasslands, especially in the highest part of pastures (Galop et al., 2011, Fuchs et al., 2015, Houet et al., 2015). In some cases, reforestation has demonstrated its usefulness to cope with hydro-climatic extreme events by reducing the hazard intensity. However, this positive impact is very local and more importantly it does not include the broader implications of socio-economic impact of land abandonment and downsizing of pastures. Demonstration and monitoring of reforestation in relevant environments is needed to understand the implications of tree species, drainage systems, and agro-pastoral practices. The Consortium Pyrenees Working Community (CTP) is reaching out to local communities in these most vulnerable natural areas to engage them in meaningful dialogue to co-design strategies, funding schemes, monitoring systems, services and policies related to various NBSs. Proposed demonstrations will be realized in collaboration with planned work of municipalities and project proposals that receive funding from the Operational

Program for Territorial Cooperation Spain-France-Andorra (POCTEFA) program for 2014-2020 which focuses on "*Promoting the protection, development and sustainable use of local resources*" and "*Promoting adaptation to climate change and risk prevention and management*." One of the goals is to propose land use changes as a tool for stabilizing the entire river basin and valleys, with the support of local communities.

Figure 2.2 Photos from Bareges in the Pyrenees after the flood in June 2013.

Objectives

One objective of this demonstration site is to set up and implement an appropriate Land Use and Climate Change (LUCC) model based on Houet et al. (2015) in order to identify the places where hazard and risk have increased/decreased between 20th and 21st century, and to propose adapted strategies. In particular, vegetation types that have decreased the risk level related to landslides and/or floods will be proposed as new NBSs. NBSs are planned for two particular cases, the cross-border road between Laruns (France) and Biescas (Spain), and in the Cauterets valley (France).

Natural hazard challenge and needs unmet

In European mountains, the main past land change trajectory is reforestation due to land abandonment or downsizing (Fuchs et al. 2015, Houet et al 2015). This trend is confirmed with regional spatially explicit and scenario-based Land Use and Climate Change projections (Stürck et al., 2015; Vacquié et al., 2015) although they exhibit various intensity of reforestation at finer scale. In some cases, reforestation has demonstrated its usefulness to cope with hydro-climatic extreme events by reducing the hazard intensity. However, such actions could be considered as incomplete to be proposed as NBS since the scale is generally very local and the actions' perimeter restricted to technical aspects with no consideration for local communities´ feedback.

In the two focus areas, main natural hazards problems include snow avalanches, rockfall, debris slides and torrential floods. Various measures, including reforestation, forest management, wooden retaining structures formed by local wood, terracing and various blocking structures constructed from local materials.

Current NBSs and unsolved problems

LUCC data are available from past projects in the Cauterets valley. Spontaneous reforestation due to abandoned grasslands could lead to disputable effects on landslide hazards needing further controlled demonstration in relevant environments. Landslides have decreased in places where forest conquered past grasslands, especially in the highest part of pastures. Project interventions will propose land use changes as a tool for stabilizing the other parts of the valleys, taking into account the willingness of local communities. Still problems arise frequently in the two selected focus areas.

NBS development to fill knowledge gaps

- Preparing hazard susceptibility maps from past and current LUCC data over the area for risk identification;
- Select NBSs such as the ones listed above, plan, design and implement them.
- Selection of NBS monitoring objects (tree species, drainage systems, agropastoral practices) and monitoring method (UAV, remote sensing, in situ sensors);
- Impact/risk maps taking into account the reduction of risks offered by the selected NBS;
- Develop with stakeholders the conditions of a plan that should implement the identified NBS, positive/negative aspects, funding issues, actors, future services.

Co-Design of strategies, funding schemes, monitoring systems, services and policies related to various NBS.

Replicability and upscaling potential

- NBS analysis will identify change in hazard (landslide, rockfall, flash floods) susceptibility affecting the whole Pyrénées mountain domain conditioned by agropastoral and additional NBS changes
- Service/workflow development that is transferable to other mountainous regions like the Alps, Massif Central, or other mountain regions.

The identified NBSs will be specified and described to be implemented by SME's. This should boost the market of risk reduction in mountainous areas. This knowledge transfer will allow : i) appropriateness of technical aspects, ii) development of operational tools for risk assessment, and monitoring related impacts of the NBS, iii) collaboration between private-public actors to operate the NBS.

2.2 Demonstrator site Valley of Gudbrandsdalen, Norway

The long (230km) and narrow Valley of Gudbrandsdalen experiences a surplus of sediment and debris from its many side valleys. During recent years a number of severe weather events have triggered landslides and floods (Figure 2.3), subsequently causing considerable damage to agricultural land and destruction of infrastructure (Olsen et al., 2016). The traditional approach to reducing these risks has been the construction of grey

infrastructure to include dams and retention basins. However, the county administration wishes to implement NBSs to not only reduce the risk of flooding, but also to enhance ecosystem biodiversity, protect fish stocks and game population. The Oppland County Authority is leading the transition towards an NBS-based approach through their Regional Master Plan (RMP). The RMP includes the construction of new retention basins combined with biotope measures. Further to these efforts is a focus on the need to improve policy for land-use planning and increase knowledge capacity of local actors with regard to effective logging management and gravel outtake on riverbanks in side rivers. The Oppland County Authority is also at the forefront to foster cooperation between all stakeholders in the valley and the national authorities.

Figure 2.3 Photos from the Valley of Gudbrandsdalen, Norway after the flood in May 2013.

Objectives

At the core of the planned NBSs is an adapted policy for areal, forestry and land use planning including re-meandering, forest management and gravel outtake on riverbanks in side rivers. The effects of the changed planning and management will be monitored using innovative remote sensing exploiting Sentinel-1 and Sentinel-2 products in addition to UAV applications.

Natural hazard challenge and needs unmet

Climate predictions for the region foresee an increase in precipitation in the range of 10-30% with emission scenarios RCP4.5 and RCP8.5 respectively, until 2100 (Hanssen-Bauer et al., 2017). Hydro-meteorological risk reduction will only be possible with an increase of alternative solutions to grey infrastructure. NBSs will integrate needs to protect nature, fish stocks, game population and risk reduction of floods in adjacent areas.

In addition, the intensification of the usage of the valley floors for infrastructure, new buildings and farming as well as the decrease of forest areas have been identified as a conditioning factor (Olsen et al., 2016) that needs to be addressed in areal and land use planning during the demonstration project.

Current NBSs and unsolved problems

Only few NBSs, e.g. coconut mats for slope stability and re-meandering, have been implemented in addition to traditional measures such as catching dams and retention basins. Several long-term ecosystem monitoring programs have been ongoing in the region since the 1980ies and might serve as long-term impact measure. Parts of the region are protected nature reserves and NBSs are the only option to further decrease the risk of flash floods and landslides in these areas.

Within this project Oppland County Authority mainly targets the side valleys for NBSs implementation as these are identified as the main cause for the damage in past events.

NBS development to fill knowledge gaps

- Adjusted areal and land use planning policy and change of best practices in planning;
- Afforestation, forest densification/enrichment and adapted forest management with reduced impact logging techniques;
- Establishment of gravel outtakes on river banks in side valleys;
- Sediment deposition dams combined with biotope measures;
- Restoring of degraded ecosystems and re-meandering, re-vegetation of riverbanks;
- Economic, social and environmental comparison of traditional solutions and NBS;
- Monitoring of long-term economic costs of restoration and repairs beyond project horizon;
- Sharing of knowledge through multi-stakeholder engagement end-user workshops;
- Foster cooperation between all stakeholders in the valley and national authorities.

Replicability and upscaling potential

- Development of legal and institutional frameworks arising from NBS policy documents;
- Forestry and land use monitoring with Sentinel-1 and -2 products, development of long-term monitoring service.

2.3 Demonstrator site Serchio River Basin

The Serchio River Basin is defined as a basin of national interest according to Italian law and has been identified as 'river basin district' for implementation of the Water Framework Directive. The unique combination of challenges that are present include extreme drought and flooding, seismic risk as well as water pollution. The Massaciuccoli Lake is partly bordered by levees and has an area of about 12 km² with average depth of about 2m. The lake is surrounded by a marginal wetland, called Massaciuccoli Padule,

with a surface area of 15 km², which occasionally experiences strong drought conditions (Figure 2.4). To overcome this primary criticality, a diversion channel from the Serchio river allowing water to flow from the Filettole area to the basin of the lake (Figure 2.5), with a flow rate of about 3.0 m³/s, has been designed and funded by the Ministry of the Environment and the Protection of the Territory and the Sea (ATO 2010a, 2010b).

The water supply through the diversion channel will be coupled with the implementation of several NBS techniques to mitigate the effects of climate change and at the same time increase biodiversity and improve the water quality of the lake. The Basin Authority will collaborate with stakeholders to develop the implementation of NBSs, including the maintenance and monitoring plans and explore planning strategies with the overall goal to develop an ecosystem-based management approach for hydrometeorological risk reduction in the area of the Massaciuccoli Lake. Subsequently, this will foster the implementation of a territorial management strategy for overcoming the challenging issues associated with drought and for mitigating floods and landslide risks.

Figure 2.4 Photos from the Serchio River Basin, Italy. On the left, Lake Massaciuccoli area during the flood of December 2009. On the right, Lake Massaciuccoli area during the drought of July 2017.

Objectives

The Serchio River Basin extends for about 1500 km^2. Its hydrological network includes the Serchio River, its tributaries and the Massaciuccoli Lake. The main objective of this demonstrator case is to both select and test the most appropriate NBSs solutions for the mitigation of hydrometeorological events (droughts, floods and landslides) in the Serchio River Basin, also contributing to the ecosystem restoration of the Massaciuccoli Lake and its surrounding areas through the improvement of the water quality and the safety condition of its banks.

The design of a diversion channel for reducing the drought risk in the Massaciuccoli Lake area will be integrated by applying the most appropriate NBSs to satisfy the needs of hydraulic risk mitigation, ecosystem restoration and improvement of water quality. Moreover, the use of multiple vegetation layers to reduce the risk of landslides and soil

erosion, through selection of appropriate native plant species will be tested in a selected area of the basin.

The selection and use of the most appropriate NBSs will contribute to the development of an ecosystem-based management approach for hydrometeorological risk reduction in the area of the Massaciuccoli Lake, fostering the implementation of a territorial management strategy for overcoming the serious issues associated with drought and mitigating floods and landslide risks.

Natural hazard challenge and needs unmet

The challenge consists in reducing the hydrometeorological risk, coupled with the sustainable management of the area, by combining different purposes such as hydraulic safety, achievement of water quality goals and environmental improvement.

The water supply through the diversion channel will be coupled with the implementation of several NBSs techniques, such as the renaturalisation of some areas that would lead to the increase in biodiversity and better management of the water resource during drought periods, improving the mitigation of climate change effects. Identified NBSs, even though able to implicate a localized effect, will improve the general conditions of the project (Trombardore et al., 2015).

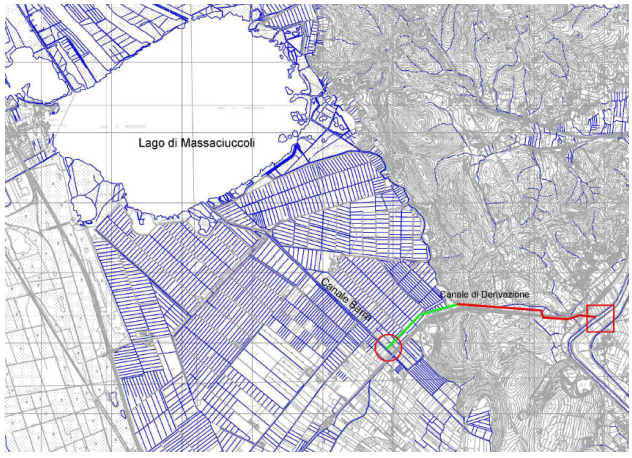

Figure 2.5 The planned diversion channel of the Serchio river basin (red, green).

Further issues are related to the flooding as a result of possible lake levees overflows and/or failures and the insufficiencies associated with the remediation network. These aspects are strongly interconnected with other critical aspects of the Lake area, such as the water deficit, the hydrogeological risk of subsidence due to land reclamation, the water quality problems and their eutrophication, the progressive salinization of lake waters. For mitigating the hydraulic and environmental risk in the Massaciuccoli Lake, it is thus necessary to recover adequate environmental conditions for the lake and its surrounding areas.

The suggested measures in the Serchio River Basin is thus an example of a combination of 'grey' solutions (the diversion channel, which is a pipeline), and the NBS's in the Lake Massachiuccoli area. Here, these two different approaches is meant to improve the performance of each other.

Current NBSs and unsolved problems

Examples of NBSs to be coupled with the diversion channel for mitigating the hydraulic and drought risk and improving the environmental condition of the Massaciuccoli Lake are:

- Restoration and re-vegetation of Fossa Nuova Channel Banks and Massaciuccoli Lake Banks;
- Restoration and re-vegetation of Serchio River Banks;
- Buffer strips to prevent eroded material leaving the fields surrounding Fossa Nuova Channels;
- Sediment capture ponds on the secondary hydraulic networks;
- Forest restoration by using multiple vegetation layers to reduce the risk of landslides and rain induced erosion, through selection of appropriate native plant species;
- Construction of retention basins to be activated in the case of high intensity events;
- Improvement of existing phytoremediation plants or creation of new ones.

The efficiency and effectiveness of the NBSs in mitigating hydrometeorological risk need further demonstration in relevant environments. If ad-hoc methods for the evaluation of root reinforcement have been developed, the effectiveness of the use of multiple vegetation layers to reduce the risk of landslides and the raindrop impact induced erosion need to be deeply analysed.

NBSs development to fill knowledge gaps

- Development of hazard and risk maps for risk identification, taking into account the proposed NBSs;
- Identification of appropriate monitoring tools for evaluating the effectiveness of the proposed NBSs;
- Development of NBSs implementation, maintenance and monitoring plans, by collaboration with stakeholders.
- Identification of funding lines for the realization of NBSs implementation, maintenance and monitoring plans.

Replicability and upscaling potential

- The NBS analysis will identify change in hazard (drought, landslide, flood) susceptibility affecting the area of the Massaciuccoli Lake and other selected areas of the Serchio River Basin;
- The NBS analysis will allow quantification of the environmental improvement of the area;

- The study will evaluate the effectiveness and cost benefit of NBSs, through the integration with the diversion channel and their duration over time; The study will allow the enhancement of NBSs implementation in similar catchments, in order to both reduce the related hydraulic and environmental risks and speed up the authorization processes.

2.4 Concept case site Kaunertal

Kaunertal Valley in western Austria is experiencing glacier retreat, and in the southern part of the valley the 'Gepatschferner' glacier is one of the fastest melting glaciers in Austria (Figure 2.6). This glacier retreat leaves unlithified sediments in steep lateral moraines exposed to erosion and subsequently rock fall, debris flows, and shallow landslides decreasing the slope stability in the proglacial. These sediment dynamics have negative effects on important infrastructure such as roads, settlements and the Gepatsch reservoir securing electricity availability for the region. The Kaunertal proglacial area will serve as a concept case where climatic changes such as the increase in frequency and severity of extreme events impose strong threats to the region. In an interdisciplinary effort between geomorphologists and ecologists, the stabilizing effect of vegetation and the growth-promoting effects of bacteria to specifically enhance plant traits that most strongly contribute to slope stability will be demonstrated (Figure 2.7). Local companies that established methods to revegetate steep slopes with 'hydro seeding' or 'spray cover' grasses on mountain pastures after the skiing season will be valuable partners to evaluate the feasibility of and implement the solution on the steep lateral moraines in the Kaunertal.

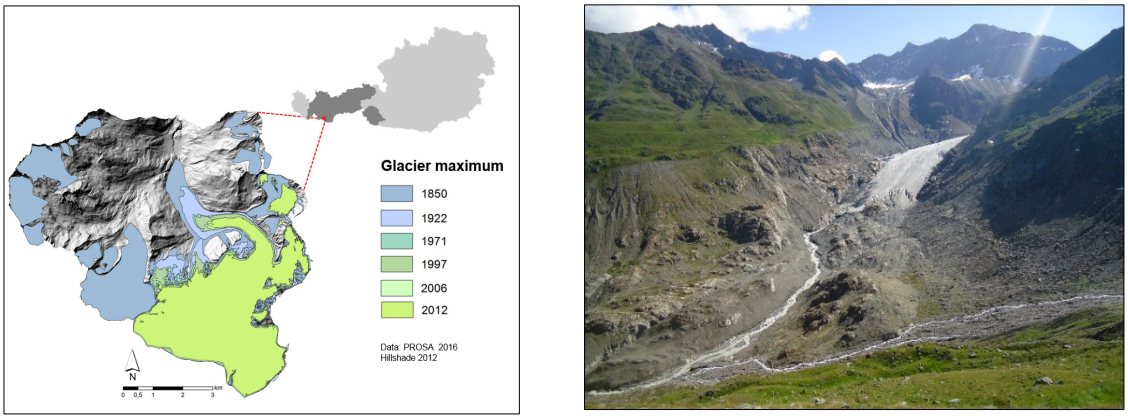

Figure 2.6 Glacier retreat in the Kaunertal Valley (64 km², 100-3536m.a.m.s.l.) since 1850 (left) and View of the Gepatschferner glacier and partly vegetated lateral moraines on both valley sides, with linear erosion features (right).

Figure 2.7 Laboratory experiments (left) and vegetation plots (right) to test bacteria-assisted vegetation cover to stabilise slopes in areas of glacier retreat above the timber line.

Objectives

The objectives of this concept case are to a) quantify sediment erosion in proglacial areas as a function of vegetation conditions, b) decipher erosion controls like glacier dynamics, connectivity conditions, and ground ice within the glacier forefield, c) identify naturally occurring plant species in the proglacial zone that decrease sediment erosion, and d) to identify bacterial strains that promote functionality of these plants. Only bacteria specific for the region are to be used. No new species are introduced.

The provision of seeds of suited plants along with bacterial strains that enhance the plants' ability to increase slope stability will be proposed as a new NBS. Experimental plots in the Kaunertal valley will serve as open labs to demonstrate NBS to school classes, students, and stakeholders. Firstly, cooperation ideas will be discussed with companies working on revegetating slopes.

Natural hazard challenge and needs unmet

Since the end of the Little Ice Age (LIA) around 1850 global warming has resulted in a still ongoing retreat of glaciers in the Alps. The Gepatschferner glacier in the Upper Kaunertal valley released more than 6 km² of terrain since its maximum ice extent at the mid of the 19th century. With a current retreat rate of around 110 m a^{-1} unlithified sediments of steep lateral moraines and other deposits are exposed to erosion (Baewert and Morche, 2014).

Proglacial sediment output impacts on both natural and anthropogenic systems down-stream of the glacier zone (Lane et al., 2017). Sediments modify channel morphology, flow dynamics, habitat evolution and element concentration, and even govern the fate of sediment-associated detrimental pollutants. They can have negative effects on important infrastructure such as roads, settlements and reservoir lakes. Snow melt and heavy convective rainstorms during the summer cause dramatic geomorphological changes in the proglacial zone, frequently triggering debris flows and outburst floods from the glacier (Baewert and Morche, 2014). Erosion and sediment output from the

forefields sum up to a sediment load of 167 000 t a^{-1} exported by the Fagge river and draining into the Gepatsch reservoir (Tschada & Hofer, 1990).

Only in recent years it has been acknowledged that vegetation cover may play an important role in the sediment connectivity of land units (Corenblit et al., 2009). The Kaunertal valley offers different vegetation succession phases from the glacier margin to the reservoir together with a highly dynamic environment. These circumstances provide optimal conditions to research the effects of vegetation on sediment erosion.

Current NBSs and unsolved problems

The ongoing vegetation succession further away from the glacier stabilizes lateral moraines and other glacial deposits (Corenblit et al., 2009). Thus, slope stability is increased by plant communities featuring specific below- and above-ground traits. However, the pioneer plants need time and some geomorphic stability to populate the steep slopes. Especially in proglacial areas that were uncovered from ice only during the past centuries to decades, earth surface processes operate at accelerated rates, not allowing pioneer plants to develop that quickly and at sufficient density to reduce erosion. Therefore, it is aspired to support succession in the proglacial zone by understanding the potential natural vegetation and how to enhance their preferable traits taking advantage of bacteria that promote plant growth.

NBSs development to fill knowledge gaps

Slope protection in pristine Alpine regions should be based on naturally occurring plant species in order to avoid changes in local plant communities and biological invasions. Plant growth-promoting bacteria favour plant health and stress tolerance by supplying nutrients, stimulating the plants' metabolism, and enhancing root and vegetative development (Perez-Montano et al., 2014). Below- and above-ground plant traits are tightly associated to the plants' potential to increase slope stability (Burylo et al., 2012). Consequently, bacterial strains can be brought into action to boost the slope protective features of natural vegetation. However, the exploitation of beneficial plant-bacteria interactions has so far been restricted to crop plant species, thus its implementation as NBS in Alpine regions is pending and its acceptance by stakeholders needs to be assessed.

In this regard the concept case plans to:

- Identify plant species and species compositions that decrease erosion;
- Identify bacterial strains (only bacteria already existing in the area) that support traits of naturally occurring Alpine plant species that decrease erosion (Figure 2.7);
- Provide seeds of suited plant species enriched with bacterial strains that enhance desired functions of plants (decrease of erosion);
- Provide bacterial communities that accelerate the increase of plant cover in glacier forefields in an unspecific manner;
- Perform an analysis of acceptance and legal conditions to evaluate the feasibility of the NBS;

- Establish experimental plots in the Kaunertal valley that will serve as open labs to demonstrate the NBS to school classes, students, and other interested stakeholders.

Replicability and upscaling potential

- Seed mix enriched with bacteria can be utilized in anthropogenically used areas;
- Seed mix enriched with bacteria is commercially utilisable;
- The open lab established in the Kaunertal valley can be used to inform and train colleagues, which facilitates the replicability of the case study;
- Procedure to identify most suited plant species and bacterial strains is transferable to other locations;

Knowledge and awareness on thermal erosion due to ground ice melt affecting sediment erosion. Its quantification can be used to correct future estimations in proglacial settings.

2.5 Concept case site Isar

The Isar river is one of the main affluents of the Danube, sources in the Alps, and crosses the Bavarian capital Munich. Heavy rain events in the Alps in the years of 1999, 2005 and 2013 led to major floods. For example, in June 2013 flood damage costs amounted to € 1.3 billion in Bavaria, Germany (BSUV, 2014). To limit the flood risk to housing areas, hydraulic regulation began and the riverbed was canalized. However, grey infrastructure caused accelerated river incision, which resulted in major risks for biodiversity and cultural buildings such as bridges. Therefore, during the last two decades, the state of Bavaria in cooperation with city governments and other relevant stakeholders implemented a wide range of local NBSs, e.g. restoration measures (Figure 2.8). These succeeded to decrease flood risks and the river incision rate, ameliorate recreational quality and improve the ecological status of the river course and its floodplains according to the Water Framework Directive (Directive 2000/60/EC) as well as Natura 2000 (Ballon et al., 2005), achieving the first German award for river development ('Gewässerentwicklungspreis') in 2007. The post-analysis of this concept case will provide a good practice framework of a successfully implemented flood risk management plan and related river restoration, enabling to identify the key factors relevant to the other PHUSICOS case study sites. Efforts to reduce hydro-meteorological risks by NBSs continue, as for example there is an increasing awareness for the necessity of measures on a broader landscape scale such as improved forest management practices in the upstream mountain catchment areas.

Figure 2.8 The Isar river during (left) and after (right) the hydro-morphological restoration. Today's near-natural landscape raises awareness on the usefulness of NBSs both for DRR and recreational purposes (Pictures: Zingraff-Hamed 2011 and 2015).

Objectives

The objective of this concept case is to provide a good practice framework based on the description and in-depth ex-post-analysis of a successfully implemented flood risk management plan and related river restoration at the Isar river. During the last two decades, the state of Bavaria in cooperation with city governments and other relevant stakeholders who prepared the ground for later action in a living lab approach, has implemented a wide range of local restoration measures. The integral flood protection strategy for Bavaria was implemented between 1999–2013 and considered as a good practice to follow (Grambow et al., 2015). The intended ex-post-analysis shall thus identify key factors being relevant to the remaining living lab procedures at demonstrator and concept case sites, and catalyse a fruitful know-how exchange in terms of territorial cohesion amongst stakeholders, offering an opportunity to elaborate innovative solutions for questions still unsolved (see below) at the Isar river as well.

Natural hazard challenges

Alpine rivers are subject to flash floods caused by summer major rain events in the Alps and snow melting. According to the record of the Bavarian Water Agency, Isar discharge in Munich can vary from 8 to 1.050 $m^3.s\text{-}1$ (http://www.hnd.bayern.de). Climate change is further likely to increase the summer precipitations in Alpine areas by 25% (DKRZ, 2017).

Current NBSs and unsolved problems

Nature-based solutions (NBSs) directed to decrease flood risks have been: increasing the water retention capacity; improvement of the morphological processes; reestablishment of the longitudinal and lateral continuity; replacement of steep embankments secured with concrete slabs and paving by flat sloping banks and naturally developing

banks; amelioration of flood runoff, and the construction of water-side sealed embankments (Binder, 2010). As the applied living lab approach was reported to have been one of the key success factors for the realization of these measures (Mahida, 2013), these projects may serve as NBS good practices for the other demonstrator and concept case study sites of PHUSICOS (e.g. by "look-and-learn"-visits).

Nevertheless, there is room for further development. Open questions of relevance to the Isar case consist, for instance in the issue of ecological improvements (e.g. fish species refuge in the context of flood events) (Zingraff-Hamed et al., 2018). Further measures, such as the Mountain Forest Initiative (Bergwald-Offensive; http://www.bergwald-offensive.de/start/) by the forest authorities, with a focus on forest restoration and changes in silvicultural practices may contribute to reduce natural hazards and flood risks downstream. However, their impact and interactions with instream measures remain difficult to quantify.

NBSs development to fill knowledge gaps

- Ex-post analysis of long-term living lab experience at Isar river with focus on stakeholder composition; institutional structures; obstacles and challenges; applied tools and approaches; development over time;
- Extraction of key success factors for the establishment and successful operational work of living labs in the context of NBS and mountain areas;
- Identification of good practice schemes relevant to NBS planning; governance strategies; funding; monitoring systems; services and enabling policies;
- Gap analysis: identification of current stakeholder perceptions and possible intervention/ capacity-building demands related to future NBS action which might call for an improved cross-institutional exchange (interface water / forestry / agriculture).

Replicability and upscaling potential

- The intended in-depth ex-post analysis of a) the long-term living lab experience and b) implemented river restoration measures at Isar river case study site offers the opportunity of up-scaling in two directions:
- Upscaling of identified good practices towards the remaining PHUSICOS case study sites is intended to be reached by establishing a fruitful know-how exchange between stakeholders and living labs of the involved demonstrator and concept cases (e.g. by "look-and-learn"-visits; joint capacity-building; data exchange platform).
- Upscaling within the Isar watershed is also likely to be fostered by reflecting hitherto implementation action from an outsider perspective of other European mountain areas (PHUSICOS partners).

The replicability and usefulness of Isar river experiences for remaining case study sites is intended to be achieved by building out a strong interface between the concept case study (WP 2) and living lab approach of the project (WP3).

3 Procurement – national regulations

A significant part of the PHUSICOS grant is set aside for the implementation of the accepted NBSs. As a part of this, procurement of services and products will be necessary. As the entities responsible for the sites are all public, all procurement must follow the national laws and regulations in the country or region where the procurement takes place, as well as the regulations set by the EC.

In PHUSICOS, the three demonstrator sites will all buy goods and/or services, whereas the responsible entities behind the two concept case sites have proposed to carry out most of the proposed work themselves, without a tendering process. However, as purchasing goods and services is not fully excluded in the concept case sites, the following paragraphs briefly describe the regulations which apply to all five countries, Norway, Italy, Spain, Austria and Germany, as well as the EC rules.

It is important to note however, that each of the 'site owners' has the responsibility to ensure that all procurement is performed properly and follows all relevant laws and regulations.

3.1 Norway

Public procurement in Norway is regulated by the law 'Lov om offentlige anskaffelser (Anskaffelsesloven); LOV-2016-12-16-103 from 01.01.2017 and LOV-2016-06-17-71 from 01.01.2017). This law operates with a set of threshold values, over which different sets of rules apply. For procurement below NOK 100 000,- (ca. Euro 10 000) no public announcement or competition is necessary. For procurement between NOK 100 000,- and 1.1 mill., open competition between at least three contractors is required. For procurement above NOK 1.3 mill., the competition should be open within the European Economic Area (EEA, comprising all EFTA and EU countries). For contracts related to building- and construction, the thresholds are NOK 44 mill., and NOK 51 mill. (for the competition within EEA).

In addition to the financial threshold values and the requirements of announcement and open competition, other requirements, relevant for PHUSICOS, were introduced in 2017:

- The procurement should reduce negative environmental impact and promote climate-friendly solutions.
- Life cycle costs of the procured product or service must be considered.
- The contractor must have routines to assess that basic human rights are considered at all levels of the procurement, and that procured products are manufactured under acceptable working conditions.

For procurement over NOK 1.1 mill., the selection must be based on either lowest price, lowest cost, including life cycle costs, or best relation between price, cost and quality, where the quality parameter is of non-economic character, such as delivery conditions, customer satisfaction, etc.

3.2 Italy

The legislation to be followed regarding works contracts, services and supplies as a public administration is the "Codice dei contratti pubblici" – Decreto legislativo 18 aprile 2016, n. 50, issued in implementation of the directives 2014/23/EU, 2014/24/EU and 2014/25 / EU, supplemented by the Implementing *Regolamento attuativo D.P.R. 5 ottobre 2010, n. 207* and numerous guidelines issued by the ANAC - National Anti-Corruption Authority. These are all national regulatory documents, which need to be compliant with EU legislation.

The district basin authority for the Serchio River Basin (ADBS), which has the legal status of a non-economic public body, follows more specific procedures. To meet its needs, the ADBS normally uses the e-procurement procedures available on the Acquistinretepa website, such as the e-market (MEPA), the system of agreements and framework agreements, the dynamic acquisition systems. It can also make use of the Telematic Purchasing System of the Tuscany START Region, which allows open, restricted and negotiated tenders to be awarded for the supply of supplies, services, public works and design using entirely electronic means. Further regulation is contained in the Statuto dell'Ente, adopted by interministerial decree 52 of 26 February 2018, which also regulates internal regulations for the negotiation activity, to date, currently being prepared. All these are more internal regulations, but which also needs to be compliant with national regulations.

In summary, the EU regulations are the overarching ones, but different entities may have their internal regulations which regulate their functioning (including public procurement) in greater detail, but always in compliance with EU (and, therefore, National) regulations.

3.3 Spain

Spain has a new public procurement law, which entered into effect on 9. March 2018, and transposes into Spanish law the Directives of the European Parliament and Council 2014/23/EU and 2014/24/EU, of 26.February 2014. All procurement under PHUSICOS will be governed by the new law, the LCSP (Ley de Contratos del Sector Publico) (https://www.lexology.com/library/detail.aspx?g=0e21e439-f2cf-4221-beda-8ff8c5278bc9).

Main features of the new law are:

1. The subjective scope of the LCSP is extended to include political parties, trade unions, business and professional organizations, as well as foundations and associations linked to any of the above.
2. The LCSP defines two new contract types, works concession contracts and services concession contracts. The spectrum of public sector contracts encompasses Works contracts; Works concession contracts; Services concession contracts; Supply contracts; Services contracts; and Mixed procurement contracts.

3. A streamlined open procedure may be used to award works, services and supply contracts that meet the following criteria:
   a) Their estimated value is lower than: (i) €2,000,000 in the case of works contracts; and (ii) €100,000 in the case of services or supply contracts; and
   b) The award criteria in the tender terms and conditions do not include a quantifiable to be made via a value judgement or, if so, that the weighting thereof does not exceed 25% of the total, except where the contract has considerations that are intellectual in nature – such as in the case of engineering or architectural services – in which case the weighting cannot exceed 45% of the total.
4. The LCSP includes a new procedure for awarding public contracts, called *asociación para la innovación*, or innovation partnership. The aim is to encourage the development of innovative products, services and works and their subsequent acquisition or engagement provided that they meet the levels of performance and maximum costs agreed between the contracting bodies and the participating entities.
5. LCSP has elements encouraging competition and support for SMEs so that they are able to access public contracts. This means that access to public procurement contracts will be opened up to a larger number of companies.
6. The LCSP includes new provisions for contract performance by public entities, previously known as *"medio propio"* (performance of public contracts by public sector entities), now referred to as *"encargos a medios propios"* or "performance by own resources", which follows the guidelines of the transposed EU procurement Directives, the requirements that those entities must meet have increased with the aim of preventing direct awards undermining free competition.
7. To enhance transparency, the LCSP makes it possible for contracting bodies to conduct market surveys and studies and to issue preliminary market consultations to economic operators active in those markets in order to prepare tenders properly and inform those operators of their plans and the requirements that they will have to meet to participate in the tender processes.

The law brings in measures aimed at safeguarding and guaranteeing free competition in public tender processes. There are several features of importance for PHUSICOS. In particular point 4, above, will be of interest to the PHUSICOS partners.

3.4 France

In France, Public Procurement is governed by *decret* No. 2016-360 of 25 March 2016, thus implementing *ordonnance* No. 2015-899 of 23 July 2015 which transposes into French law the European Directives of 2014 (2014/23 EU / 2014/24 / EU, 2014/23 / EU). This *decret* itself refers to more than thirty regulatory texts of French law.

It should be noted that as of April 1, 2019, all these texts will be gathered in the new "*Code de la Commande Publiques* (CCP)", resulting from *decret* No. 2018-1075 of December 3, 2018 applying *ordonnance* No. 2018 -1074 of November 26, 2018. Nevertheless, this change should be done "at constant right".

THRESHOLD	OBLIGATION
< € 25,000 **excl. tax**	The market can be negotiated without advertising or competition.
Between € 25,000 **excl. tax** and € 90,000 **excl. tax**	"Marché à *procédure adaptée* (MAPA)": the buyer freely determines the conditions of the procedure in accordance with the principles of the legislation on public procurement (freedom of access, equal treatment of candidates and transparency of procedures). Public contracts are placed in separate lots: the cumulative estimated value of all the lots is taken into account. Mandatory dematerialized procedure.
	Advertising: the buyer freely chooses the advertising criteria (example: buyer profile, BOAMP, specialized press, regional press, etc.)
Between € 90,000 **excl. tax** and € 144,000 **excl. tax** for supplies and services of a contract awarded by the State and its public institutions € 221,000 **excl. tax** for the supply and service of a contract awarded by local authorities and public health establishments € 443,000 **excl. tax** for supplies and services of a contract awarded by a procuring contracting entity engaged in network operator activity € 5,548,000 **excl. tax** for works, whatever the organization	"Marché à *procédure adaptée* (MAPA)": the buyer freely determines the conditions of the procedure in accordance with the principles of the legislation on public procurement (freedom of access, equal treatment of candidates and transparency of procedures). Public contracts are placed in separate lots: the cumulative estimated value of all the lots is taken into account. Mandatory dematerialized procedure.
	Advertising: a notice of contract must be published in the BOAMP or in a newspaper authorized to receive legal announcements (Jal). Optional: publication in the Official Journal of the European Union (JOUE).
> € 144,000 **excl. tax** for supplies and services of a contract awarded by the State and its public institutions > € 221,000 **excl. tax** for the supply and service of a contract awarded by local authorities and public health establishments > € 443,000 **excl. tax** for supplies and services of a contract awarded by a procuring contracting entity engaged in network operator activity > € 5,548,000 **excl. tax** for works, whatever the organization	*"Procédure formalisée"*, to choose: • Open or restricted invitation to tender • Competitive procedure with negotiation • Negotiated procedure with prior call for competition (only for contracting entities) • Competitive dialogue Mandatory dematerialized procedure.
	Advertising: a contract notice must be published in the BOAMP or a newspaper authorized to receive legal notices (Jal) as well as in the Official Journal of the European Union (OJEU).

Another cases giving rise to a negotiated procedure without a call for competition:

- In case of emergency and in unforeseeable circumstances that do not meet the deadlines (health hazards, fire hazard for example);
- When no admissible application has been submitted within the time limit;

- When the works, supplies or services can only be provided by one company: acquisition of a work of art, complementary delivery or similar services by the original supplier;
- For the supply of non-school books whose value is estimated at less than € 90,000 excl. tax excluding taxes;
- Where competitive bidding is impossible or unnecessary due to the low level of competition in the sector (if the need is below European thresholds);
- When the purchase concerns products made for research, experimentation, study or development purposes.

Case of social and specific services:
Regardless of the estimated value of the market, social service and specific service contracts may be awarded according to a "Marché à **procédure adaptée (MAPA)"**. These include services:

- Sanitary, social and health care
- Administrative, educational and cultural
- Hotel and catering
- Legal (administrative services of the courts)
- Related to the prison administration
- Postal

For this type of market, the advertising criteria are freely defined by the buyer, up to a threshold of € 750,000 excl. tax. Beyond this amount, advertising must be published in the Official Journal of the European Union (JOUE).

3.5 Austria

On 21. August, 2018, the procurement law reform package consisting of the Federal Procurement Act (BVergG 2018), a new Federal Law on the Granting of Concession Contracts (BVergG Concessions) and an amendment to the Federal Procurement Law for Defense and Security BVergG Defense and Security) came into force.

In general the BVergG 2018 regulates (for the University of Vienna) that for procurement below Euro 50.000 (100 000,- until the 31.12.2020 according to the *Schwellenwerteverordnung 2018*) no public announcement is necessary, despite there is a transnational interest for the contract, that should be awarded. For procurement between Euro 50.000,- (100.000,-) and Euro 221.000 an open competition (works, service and supply) with a national announcement must be applied. For building and constructions between 100.000 and 1.000.0000 Euro a competition between selected bidders is sufficient, above 1.000.000 an open procurement procedure is required.

For procurement above Euro 221.000 (works, service and supply) resp. 5.548 mill. Euro (building and constructions) the competition should be open within the announcement in the EU (TED). All Euro-Values are to understand without VAT.

Major innovations of the BVergG 2018 are:

- Mandatory SME friendly conception and implementation of procurement procedures
- Promotion of the best bidder principle
- Introduction of electronic allocation (e-assignment)
- Report to the site database (all contracts above 50.000 Euro)
- Deletion of the "proof of suitability" by a third party subject to a charge
- Easing the standardization
- Shortening the minimum deadlines

3.6 Germany

"Public procurement in Germany is regulated by the EU directives 2014/23/EU, 2014/24/EU and 2014/25 / EU, that have been transcripted into German law inducing a revision of the GWB (Gesetz gegen Wettbewerbsbeschränkungen –Act against Restraints of Competion) on 9. November 2017. For the federal state level, this has been ratified by the Bavarian Ministries by 1. January 2018 (Verwaltungsvorschrift zum öffentlichen Auftragswesen – VvöA; Andmistrative Regulation on Public Procurement). The Bavarian legislation differentiates between service and delivery contracts (Vergabe und Durchführung von Lieferungen und Leistungen durch Behörden der Staatsbauverwaltung des Freistaates Bayern - VHL Bayern) and building and planning contracts (Vergabe und Durchführung von Bauleistungen durch Behörden des Freistaates Bayern - VHB Bayern).

VHB law operates with a set of values, over which different sets of rules apply. For procurement below €10,000 (gross) no public announcement or competition is required but potential offering companies should be inventoried and offers should be compared. Procurement over €10,000 (gross) require an open competition published under www.auftraege.bayern.de or www.vergabe.bayern.de. Furthermore, for contracts over €50,000 (net), the attribution method should be agreed by the Bavarian government (Regierung / Landesbaudirektion Bayern). For contracts over €500,000 (net), the Bavarian government should agree with the duration of the open competition and with the awarding conditions. Structural engineering and street construction require further supervision by the Bavarian government.

VHL law also operates with a set of values, over which different sets of rules apply. For procurement below gross €1,000 no public announcement or competition is necessary but more than three offers should be compared. Exceptions are described in §8 of UVgO. For procurement between gross €1,000.01 and 220,999.99, a three months open competition should be published under www.auftraege.bayern.de or www.vergabe.bayern.de. For procurement over €221,000, the selection must be based on either lowest price, lowest cost, including life cycle costs, or best relation between price, cost and quality, i.e. comparable to EU's 'best value for money'.

In addition to the financial threshold values, the open competition and the awarding conditions, some major other requirements are:

- The offering company should employ disabled persons;
- The procurement should reduce negative environmental impact and the offering company offer environmental friendly solutions (Umweltrichtlinien Öffentliches Auftragswesen - öAUmwR);
- Anti-corruption policies have to be applied (Korruptionsbekämpfungsrichtlinie - KorruR)
- Child labour is unacceptable (Vermeidung des Erwerbs von Produkten aus ausbeuterischer Kinderarbeit - AllMBl. S. 322, StAnz. Nr. 20);
- The company also has to attest that it has no contact with Scientology- and other anti-constitutional organisations and agree on the declaration of data protection and data storage regulations (AllMBl. S. 701, StAnz. Nr. 44);
- The contractor must have routines to assess that basic human rights are considered at all levels of the procurement;
- Working conditions have to respect work law and no illegal worker should participate in the production process;
- Local resources should be preferred (§1 VOB/A);
- Only local and site-specific species should be used (§1 VOB/A)."

3.7 EU rules

All procurement of goods and services to be performed under the project must comply with the overall rules of the European Commission. However, the key principle here is that the process must be open and result in best value for money or, if appropriate, the lowest price. Commonly a combination between price and quality will give the best value. The beneficiary should demonstrate some level of tendering to ensure that best value is achieved, e.g. that at least three offers can be provided, or that a market survey has been performed.

The national regulations for procurement usually will have similar requirements, and the EC normally will accept the standard procedures in each country if they are properly used. The Commission will also normally accept commercial agreements already in place. However, it is of utmost importance that any conflict of interest is avoided, and that other principles stated in the Grant Agreement are followed, in particular GA articles 22 (Checks, reviews, audits and investigations), 23 (Evaluation of the impact of the action), 35 (Conflict of interest), 36 (Confidentiality), 38 (Visibility of funding), and 46 (Liability for damages). The beneficiaries must also ensure that these obligations apply to subcontractors.

The most common errors related to procurement comprise examples where the above regulations were not followed:

- Lack of evidence that procurement procedure was sound (best value for money, transparency and equal treatment).

- Where competitive tendering was not used, this was not sufficiently documented and justified.
- Participant's own normal practice not applied.
- Sub/contracting to a related party (conflict of interest).

4 Evaluation and selection of PHUSICOS measures

The proposed NBSs must comply with the project's definition of a nature-based solution, which aligns with the EU's Research & Innovation (R&I) agenda on 'Nature-Based Solutions' (EU, 2015). The agenda builds on a wealth of knowledge from previous EU Framework Programmes and policy initiatives to include green infrastructure, biodiversity and ecosystems, sustainable urban development, natural resources management, climate change mitigation and adaptation, and disaster risk reduction (DRR). In this context, nature-based solutions (NBSs) are defined as solutions that are "*inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience*" (EU, 2015). Since NBSs address a variety of societal challenges in sustainable ways, they are expected to contribute to green growth and citizen well-being, as well as provide business opportunities for positioning Europe as a driving force internationally (EU, 2015). Furthermore, NBSs contribute to the implementation of the broader EU policies of the Water Framework Directive (EC, 2000) and the Floods Directive (EC, 2007) as well as the UN's Sustainable Development Goals (UN, 2016). In addition, NBSs align well with several of the Sendai Framework for Disaster Risk Reduction's priorities.

4.1 Evaluation criteria

The parameters to be considered in the evaluation of the NBS proposals to be implemented at the case study sites are in line with the PHUSICOS project description and include the following:

- External funding;
- Risk reduction / Resilience;
- Technical feasibility;
- Co-benefits;
- Effectiveness;
- Efficiency;
- Potential negative impacts of NBS;
- Participatory process / stakeholder involvement;
- Harmonization with other PHUSICOS WPs;
- Compliance with international and EU agreements and directives.

Task 4.1 in Work Package 4 – 'Technical Innovation' is developing assessment tools for evaluating and verifying the performance of the project's NBSs. The protocol for evaluation of the proposed NBSs in WP2 should comply with the framework developed in WP4. However, several of the criteria in the WP4 framework address the monitoring

and evaluation of NBS measures that have been in operation for some time. Therefore a somewhat simplified protocol, with a semi-qualitative approach, is suggested for the initial evaluation to approve the selection of proposed NBSs (Table 4.1).

The WP2 assessment parameters roughly follow the ambit level of the WP4 framework. This is important as the assessment of the functionality of the NBSs should reflect the criteria for selection of measures to be funded. The comprehensive framework of WP4 furthermore includes a multi-level set of criteria, concepts, sub-criteria and around 90 indicators at the lowest level. These are included in Appendix B of the current report, as they provide a very useful checklist, both for proponents of NBSs, and for the Steering Committee members for a qualitative assessment of how the proposals meet the evaluation parameters. The ca. 90 indicators have a variable degree of relevance for the different NBSs. Some may not be relevant for some measures, and the indicators should therefore be considered carefully if used for assistance in the proposal writing or selection procedures of proposed NBSs.

Regarding the semi-qualitative evaluation aided by Table 4.1, it is up to each SC member to use the scoring scheme or not. It is meant as an aid for the assessment, but a SC member may choose to evaluate in a fully qualitative way. However, the parameters of Table 4.1 should all be assessed. We recommend that all low scores should be followed up with comments and recommendations for improvement. A total score of less than 45 when using the scoring sheet, would mean that the proposal needs significant improvement. These requirements do, however, not apply to a proposal for e.g. a learning visit to a site, an exhibition, hiring an external facilitator for the Living Lab process, or other measures, which are not physical mitigation measures *sensu stricto*. The following sub-chapters describe each of the WP2 parameters to be assessed for the evaluation of NBS proposals.

Table 4.1 Scoring scheme for proposed NBSs (left part) and how it relates to WP4's framework for NBS monitoring and evaluation (right part). The full WP4 framework is presented in Appendix B.

Evaluation of proposals					Task 4.1 - NBS evaluation
Parameter	**Weight**	**Score (Poor-good)**	**Result**	**Comments**	**Ambit (see App. B for full framework)**
External funding	2	0-5		Proponents must have relevant external funding (40%) for the proposed NBS (D2.1: Ch. 4.1.1)	N/A
Risk reduction / Resilience	3	0-5		All areas must be adressed; human life, economic value and ecological state (D2.1: Ch. 4.1.2).	Risk
Feasibility	2	0-5		The proposed NBS must be technically and economically feasible within the budget and the time frame of the project (D2.1: Ch. 4.1.3).	Technical and Feasibility Aspects
Co-benefits	3	0-5		The proposed NBS should provide environmental, societal and/or economical co-benefits. These are main factors in differentiating NBSs from from traditional 'gray' solutions (D2.1: Ch. 4.1.4)	Environment
					Society
					Economy
Effectiveness	2	0-5		NBSs must be effective over decades and under varying climate, including plans for maintenance. Assess also effectiveness vs. that of other 'grey' measures. (D2.1: Ch. 4.1.5).	Technical and Feasibility Aspects
Efficiency	1	0-5		The process towards NBS implementation should be efficient, and there should be congruity between costs (D2.1: Ch. 4.1.6)	Technical and Feasibility Aspects
Possible negative impact	3	-5-0		Identify and evaluate possible negative impacts of NBS (economy, society, ecology, resilience, etc.) (D2.1: Ch. 4.1.7)	Risk, Society, Environment, Economy
Participatory process	2	0-5		The intended stakeholder involvement / Living Lab process accompanying the NBS realization should be outlined here (D2.1: Ch. 4.1.8).	Society
Harmonization with other WPs	1	0-5		NBSs should receive input from and provide output to the other WPs (D2.1: Ch. 4.1.9).	All ambits
Compliance with international agreements and EU directives	1	0-5		NBS proposals should describe how they align with the UN SDGs, Sendai Framework, COP21 - Paris Agreement, EU directives, etc. (D2.1: Ch. 4.1.10)	All ambits
Total					

4.1.1 Funding

It is a requirement that the end-user of the case study site has the resources available to implement the proposed NBS action. For newly proposed NBSs at demonstrator sites, 60% of the costs of the action may be subcontracted through funds from PHUSICOS. The remaining 40% of the costs should be covered by other sources of funding. For the concept case sites, PHUSICOS may finance up to 100% of the costs of the proposed action. However, actions that have co-funding from other sources may be given priority if they satisfy the technical and societal criteria.

The 40% co-funding for the demonstrator sites may come from two principal categories:

- Cash contribution
- In-kind contribution

Cash contributions need no further explanation. If someone (local government, industry, or other) decides to allocate money to the project, this will count towards the 40% co-funding. In-kind contributions, on the other hand, can be in the form of working hours, equipment or materials, or other items, which will have to be appraised on a case-by-

case basis. The in-kind contributions can come from external entities, such as municipalities, companies or other organizations, as well as from the relevant partner organization (e.g. labour-hours that are not billed to the project).

All costs to be covered by the EC grant must comply with the rules for eligible costs, as stated in the Grant Agreement (Grant Agreement 776681 – PHUSICOS – H2020-SC5-2016-2017/H2020-SC5-2017-TwoStage, Article 6). In the implementation of the NBSs at the various case study sites, purchasing goods and services may be necessary. Such purchases must ensure the best value for money or, if appropriate, the lowest price. In doing so, the beneficiaries must avoid any conflict of interests (Grant Agreement, Article 35).

Best value for money must be documented according to institutional rules or within national and EU legislation on public procurement. Where competitive tendering is not used, documentation on alternative offers or market surveys can also be used to demonstrate best value. Best value will rarely be equivalent to lowest price, although this may also be the case. It is important that the combination of price and quality is carefully assessed.

The Grant Agreement (GA) describes the potential use of in-kind contributions by third parties. The beneficiaries may declare costs related to the payment of in-kind contributions as eligible (GA, Article 6.1 and 6.2), up to the third parties' costs for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services. The in-kind contributions may comprise services or goods free of charge to the beneficiary, or goods and services paid for to subcontractors by the beneficiary without using the project funding.

In the project, a subcontractor is an external entity, which is paid to do a specific job for the project or to deliver a specific goods. This is typically a private enterprise, such as a contractor, a consultancy or an engineering company, or representative of any other type of service one has to buy. Procurement from subcontractors has to follow the national regulations and laws for public procurement relevant in each case, as well as follow the EC rules for procurement (Chapter 3.6).

The cost for implementation of the proposed NBSs must be realistically estimated in its budget. This should comply with the project's funding rules (above), and the various sources of funding must be specified. It is important that the demonstrator sites clearly document that a minimum of 40% of the total cost is from sources outside of the project, and whether these are cash or in-kind contributions. There should be a clear plan for financing if the implementation phase goes over several fiscal years, and it must be clear that the responsible agency has the economic strength to support the costs. Furthermore, maintenance costs must be included if the NBSs need maintenance, as most measures do, to work properly over decades. Up to 15% of the estimated maintenance costs expected after the four years of the project, back-calculated to its 2018 value, may be included as a part of the 40% of the total costs, which have to come from other sources.

In summary, in order to propose a specific NBS, the demonstrator site that is requesting approval for implementing the NBS must demonstrate that at least 40% of the total cost of implementation comes from sources other than the EC grant. This external funding can be cash contributions from third parties or in-kind contributions. The ability to attract such funding and the level of external funding are important evaluation criteria when the proposed NBSs are to be approved for EC financing.

4.1.2 Risk reduction and resilience

The primary function of the NBSs to be implemented in PHUSICOS is that they must reduce the risk posed by hydro-meteorological hazards to the society and increase its resilience. The proposed NBSs must, therefore, demonstrate the ability to reduce impacts, mitigate harm, and ensure resilience regarding the human, ecological, social, and economic resources at risk. UNISDR (2017) defines resilience as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions.

The proposals of NBSs submitted for approval should briefly describe how risk from natural hazards is addressed with regard to protecting human life, economic values, ecological state and, if relevant, the social situation. In particular the resilience of any critical infrastructure will be considered important in the evaluation of the proposed NBSs.

4.1.3 Feasibility

The proposed NBSs must be technically and economically feasible. Key factors here are the time frame for implementing the measure(s), which has to be realistic, and the proposed budget. Costs for various parts and phases of the measure must be carefully estimated and included in the budget. Implementation should take place during the four years of PHUSICOS. It is also strongly recommended that the funds allocated for the demonstration sites are used for more than one measure.

4.1.4 Co-benefits

One of the key attractions of nature-based solutions is their multi-functionality and ability to provide several co-benefits in the same spatial area. The co-benefits may be ecological (e.g. enhancing biodiversity and improving carbon storage capacity), social (e.g. quality of life and improving accessibility for recreation) or economic (human capital, jobs). This is considered the most important aspect of NBSs relative to standard 'grey' solutions and is consequently weighted equally high as the ability to reduce risk (Table 4.1). Therefore, proposals will be evaluated with regard to such co-benefits, and in particular, but not limited to, the following aspects:

Ecological impacts related to enhancing biodiversity and ecosystem services (ESS) provisions

If and how the proposed NBSs will contribute to habitat restoration, improved biodiversity, and increase the sustainability of ecosystems. For example, one measure is the decreased spatial extent of areas exposed to flood risk due to the implemented NBSs. Preservation or restoration of fish stocks or endangered plant species may be other.

Ecological impacts related to increased carbon storage capacity

If and how the NBSs contribute to an increase in biomass (leaves, stems, trunk, roots and soil organic matter), with the additional biomass having the direct impact of enhancing carbon storage and sequestration subsequently reducing global greenhouse gas concentrations (Eklipse, 2017).

Social impacts related to user satisfaction, acceptance ad sense of ownership

If and how stakeholder involvement will improve user satisfaction and ultimately help build engaged communities for further replication and upscaling. Local community visits to the sites are an important part of this.

Social impacts related to improved quality of life and accessibility for recreation

If and how the implemented NBS's impact of reducing the risk of extreme weather events thus making these locations more available for recreation. The implementation of NBSs can, in addition to disaster risk reduction, contribute significantly to revitalization of marginal areas, providing new recreational services, increasing attractiveness of natural spaces and promoting the accessibility to areas and resources.

Economic impacts related to enhancing innovation capacity

If and how the actions of PHUSICOS will enable the efficient development, technical verification and dissemination of new NBSs by providing a structured methodology for testing and implementing new concepts, i.e. to what degree the availability of performance data, and the verification of solutions through demonstration sites, will be a substantial driver for de-risking new innovations, while at the same time improving the basis for risk-informed decisions by the authorities.

Economic impacts related to an increase in human capital for territorial growth

If and how the project can lead to new businesses and thereby supply jobs locally and/or regionally. One should consider the entire life span of the measures, including maintenance and, if relevant, decommissioning.

4.1.5 Effectiveness

NBS proposals must demonstrate that the suggested solutions will be effective over long time periods (decades) and under varying physical conditions. In particular, they must be designed to withstand a changing climate, based on existing models for future scenarios regarding temperature and water supply (precipitation and snow melt).

Expected effectiveness can be extrapolated from examples from other areas using equivalent measures, or it can be estimated using best available knowledge, based on climate projections and the physical characteristics of the proposed measure. The need for maintenance in order to maintain effectiveness should be described in a way that is in accordance with estimated maintenance costs (Chapter 4.1.1). The essential message is that the NBSs must reduce risk and continue to do so over long time intervals.

Proponents should also assess the effectiveness of the proposed NBSs versus that of potential alternative 'grey' solutions, if any. Describe if and how potential less effectiveness is counterbalanced by other benefits.

4.1.6 Efficiency

In addition to demonstrating that the proposed NBSs are effective, proponents should also describe an efficient process from planning to implementation of the measures, and that there is congruity between the various project costs. The responsible agency must show its ability to support costs and maintaining the measure(s) over time, also after the four years of PHUSICOS.

4.1.7 Possible negative impacts

Identify if the proposed NBS may have any negative impacts (economy, society, ecology, resilience, or other). Evaluate these and if/how they may be counteracted by co-benefits.

4.1.8 Participatory process

The proposed NBSs are to be realized in accordance with local stakeholders through a Living Labs (LL) approach. Stakeholder participation in a fully transparent process is an important and overarching issue of PHUSICOS, and the proposals for NBSs to receive funding from the project will be carefully evaluated on how stakeholder participation is being carried out, both considering the past process, and where relevant, also the currently ongoing process, as well as the further planned process.

The LL approach is supported by WP3 – 'Service innovation: stakeholder participation through Living Labs', and has been described in Deliverable D3.1, 'Guiding Framework for Tailored Living Lab Establishment at Concept and Demonstrator Case Study Sites' (PHUSICOS D3.1, 2018).

In PHUSICOS, some of the case sites have already had contact with a range of key stakeholders, and the planning of various NBSs to be proposed has reached different stages. Therefore, the LLs will have different objectives and start at different phases of selection and implementation of the proposed NBSs. It is thus important that the individual LL processes will be tailored by the case site teams to the local context at each site, considering local needs and ambitions, physical conditions, and socio-cultural factors.

For some cases, it might be appropriate or even necessary, to hire an external 'neutral' facilitator for steering the intended participatory processes accompanying the NBSs´ realization. As this will have a cost, it will be possible to submit a short proposal only for this purpose, to avoid facilitating stakeholder involvement being a barrier against project progress. The same proposal template should be used, by filling in only the relevant parts and carefully explain the objectives.

Much experience can be gained from the Isar concept case site, which was subject to a comprehensive LL process until it was terminated in 2011.

4.1.9 Harmonisation with other PHUSICOS WPs

WP2, with the demonstrator and concept case sites, is the core of PHUSICOS (Figure 1.1), and therefore the proposals for NBSs to be funded through the project should demonstrate that they comply with the other work packages and provide the outputs and information required for achieving the scientific goals of PHUSICOS. This will also be part of the assessment and evaluation of the proposals.

WP3 - Service innovation: stakeholder participation through Living Labs

WP3 will support stakeholder participation through a Living Labs approach at the case study sites (PHUSICOS D3.1, 2018), with the intention of establishing a solid foundation, accepted by most stakeholders, for the NBSs to be implemented.

This is translated into the evaluation criterion on participatory process (Chapter 4.1.7). The process is meant to be performed under guidance of the WP3 team, and should be tailored for each individual case (Chapter 4.1.7).

WP4 Technical innovation to design a comprehensive framework

WP4 will design a comprehensive framework for assessment of NBSs in the context of natural hazard risk mitigation and ecosystem services monitoring, with the clear objective to strengthen the evidence regarding the effectiveness of NBSs.

The suggested NBSs must be suitable for monitoring according to the framework established in WP4. The evaluation criteria described in this document is aligned with the framework developed in Task 4.1 (PHUSICOS, 2018), but somewhat simplified (Table 4.1), as the WP4 framework is best suited to evaluate the NBSs after some time in operation. The NBS proposals should however, comply with the monitoring criteria developed in WP4.

WP5 Governance innovation for the design and implementation of nature-based solutions

WP5 will explore policy framework and financial instruments to enhance the effectiveness of the design and implementation of NBS in the context of governance innovation. This will include an analysis of EU policy for enabling NBS as implemented

by national, regional and local governments, and also instruments and initiatives on the part of the business community and non-governmental organizations.

In order to comply with the objectives of WP5, the NBS proposals should provide information on relevant governance systems, including directives and regulations at an international (EU), national or even regional or local scale, regarding designing, financing and implementing the NBSs. Although the delivery from Task 5.1 is scheduled as late as month 18 of the project, these questions should be treated to the extent possible in the proposals for NBSs to be funded by the project. As a help, the three main objectives of WP5 are as follows:

- Identify the hallmark characteristics of successful governance models for co-designing, financing and implementing NBSs.
- Characterise the institutional, legal, social and economic opportunities and barriers to NBS at the EU, national, regional and local scales, and suggest innovative new institutions, policies and instruments.
- Establish an international policy business forum for providing expertise on NBS funding and explore innovative ways to strengthen the science-policy-business nexus.

WP6 Learning arena innovation to encourage knowledge exchange

WP6 will facilitate closer collaboration between stakeholders using learning arena innovation to encourage knowledge exchange as well as training programmes for key stakeholder groups.

Although these programs are to be developed by WP6 throughout the duration of the project, the representatives from the case study sites are encouraged to include ideas or plans for how they may use the implemented measures to train different stakeholder groups at all levels, from decision makers and politicians, to school classes. Furthermore, a proper training programme, preferentially developed jointly with WP6, may also in itself qualify as a PHUSICOS NBS.

WP7 Product innovation to develop an evidence-base and data platform

WP7 aims to establish a comprehensive state-of-the-art evidence-base and data platform concerning NBSs related to extreme hydro-meteorological events in rural mountain landscapes.

The proposed NBSs should provide input to the inventory of NBSs to be created by WP7. This inventory is to include a description of the NBS, relevant documents as well as photographs and cartographic information. Proposals must include such information.

WP8 Dissemination and communication

WP8 is aimed at communicating and exploiting the results of the project to a wide audience to maximise project impact within the target audience groups of local

stakeholders, regional authorities, national and European policy makers, as well as public and private funding sources.

This activity is the responsibility of NGI, but it is important that the demonstrator case and concept case sites all provide relevant information as the process of planning, designing and implementing is proceeding, as well as during the continued life of the implemented measures. This comprises all aspects of the processes to be performed, such as the Living Labs process, stakeholder meetings, the procurement process, the establishment of measures, monitoring, maintenance, etc., and not the least about their performance when they are established.

4.1.10 Compliance with International agreements and EU policies.

International agreements include UN Sustainable Development Goals (SDGs), COP21 Paris Agreement, and the Sendai Framework for DRR, whereas the EU policies may include the Water Framework Directive and the Floods Directive. Other international laws and regulations may also be relevant, and can be included.

The UN Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice (https://www.un.org/sustainabledevelopment/sustainable-development-goals/). In particular SDGs 13 and 15, 'Climate Action' and 'Life on Land', respectively, are relevant and important for PHUSICOS

PHUSICOS represents an initiative that meet the goals of the COP21 Paris Agreement: nature-based and environment-friendly solutions are preferred to conventional mitigation measures to protect society form the risk associated with landslides, debris flows and floods in mountainous areas. Including national and regional climate action plans in PHUSICOS supports the broader conclusions of the COP21 Paris Agreement. Proponents are encouraged to explain how the suggested measure(s) help meeting the goals of COP21.

PHUSICOS supports the implementation of the Sendai Framework for Disaster Risk Reduction (https://www.unisdr.org/we/coordinate/sendai-framework). The four main priorities of the Framework are: i) *Understanding disaster risk*, ii) *Strengthening disaster risk governance to manage disaster risks,* 'iii) *Investing in disaster risk reduction for resilience*, and iv)*'Enhancing disaster preparedness for effective response and to build back better in recovery, rehabilitation and reconstruction*. In particular the former three of these are very relevant for PHUSICOS, and the proponents of NBSs to the project should describe how the measure complies with one or more of these priorities.

Proponents should also be familiar with important EU directives, such as the Water Framework Directive and the Floods directive, and explain how the proposed measure(s) comply with and support these important directives.

5 The selection process

The selection of the proposed NBSs to receive funding will be based on an evaluation of all the parameters described above. Proposals must therefore carefully address all these, following a template (Appendix A), before they are submitted to the project. The proposal, using the template, shall not exceed 10 pages, including budget, a map showing the NBSs´ locations, and all other figures, tables and references.

Evaluation and selection of the NBSs to be implemented will be done by the PHUSICOS Steering Committee (SC). The SC, which is chaired by the Project Coordinator (PC) and includes one representative from each partner, totalling 15, is the main decision making body in PHUSICOS. SC meetings will take place every six months throughout the duration of the PHUSICOS project and will be held in conjunction with annual meetings and the Stakeholder integration workshops. However, in order to speed up the selection process, commenting and voting for proposed NBSs can be done electronically, between SC meetings.

Implementing NBSs at the case study sites is the central activity of PHUSICOS as reflected in nearly 50% of the budget being dedicated to this. The SC is also responsible for managing these resources and for selecting which NBSs will be implemented. The SC will review NBS proposals and requests for funding as proposed by the end-users and partner(s) associated with the demonstrator or concept case sites. Approval of a proposed NBS for implementation at a given site will require agreement of the majority of the SC members, excluding the end-user partner and primary scientific contact partner for that site.

If a proposal is disapproved with a very small majority, or in case of equal votes for and against approval of a proposal, the proponents will get a possibility to revise and re-submit the proposal. This will be decided by the PC. If a revised and resubmitted proposal receives equal votes, the PC will have the final decision on the proposal. If a resubmitted proposal still is disapproved by the SC, then disapproval is the final decision.

The WP2 leader has responsibility for collecting the proposals, facilitating the presentation of the NBS proposals and leading the discussion with the SC. The final voting and the decision-making will, however, be led by the PC.

In summary, the process will include the following steps:

- Proponents submit their proposal, using the template (Appendix A), to the WP2 leader (anders.solheim@ngi.no).
- The WP 2 leader, in collaboration with the PC, performs an initial assessment of the proposal, and provide a short summary and recommendations to the SC.
- The proposal and the recommendation is reviewed by the SC members (except the member of the organization responsible for the proposal, with a relatively

short deadline (2-3 weeks) for evaluation, comments and a vote (yes or no). No response within the deadline is considered a 'yes'.

- The WP2 leader collects, comments, revises the recommendation, and sends the result to the proponents. This may be in the form of a go-ahead, with or without suggestions for improvements. In the case of rejection, reasons for this must be carefully explained. If relevant, suggestions for improvements and re-submission can also be given.
- The successful proponent may start spending the allocated funds, in accordance with the proposed budget.

6 Distribution of funds and reporting

6.1 Distribution of funds

The PHUSICOS project will be implemented over a period of 4 years, and involves 15 partners. The total budget amounts to **€ 9,633,000** and the **total requested EU contribution amounts to € 9,472,200**.

The costs are split over the following categories:

- Direct personnel costs: € 3,927,250
- Other direct costs: € 770,750 for travel (consortium partners, PHUSICOS external reference committee, Policy Business Forum), project events, project review meetings for coordinator and WP leaders, open access, dissemination costs and an audit
- Indirect costs: € 1,174,500
- Subcontracting: € 3,760,500 for implementing NBS at the demonstrator sites and concept cases (details in Section 4 under relevant partner)

As seen from the above, a substantial part, € 3,765,500, of the total PHUSICOS grant is allocated for the planning and implementation of the selected NBSs. The funds allocated for subcontracting are distributed according to Table 6.1.

A detailed budget is required for all proposals. All costs to be covered by the project must be eligible according to EC rules. These are described in detail in the Grant Agreement.

Table 6.1 Funds allocated for subcontracting in PHUSICOS

Participant	Site	Amount (**kEuro**)
NGI	DS: Pyrenees	1 200
BRGM	*WP7*	*30.5*
Oppland	DS: Gudbrandsdalen	1 200
ADBS	DS: Serchio River Basin	1 200
TUM	CC: Isar	35
UNIVIE	CC: Kaunertal	30
PLUS	CC: Kaunertal	5
CREAF	DS: Pyrenees	60

The funds are distributed to the demonstration sites and concept case sites directly from the European Commission, but these funds may not be used until the proposed NBSs are approved by the SC. It is the responsibility of each fund-receiving partner that the allocated funds are used in accordance with EU rules for eligibility, which can be found in the Grant Agreement, as well as in the 'H2020 funding and tenders portal' (https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home), previously 'H2020 participant portal'.

6.2 Reporting

Once a proposal has been approved and funds can be used, a limited level of reporting will be required. The responsible agency is then requested to provide semi-annual short activity reports, which also must include a report on spent costs relative to the approved budget. This reporting will be requested by the WP2 lead, and coordinated with the reporting for the consortium meeting, to avoid double work. Deadline for WP2 reporting will therefore be roughly 2 weeks before each consortium meeting. These reports will also form part of the background for the annual PHUSICOS project progress reports to the European Commission. The reporting described here is additional to the standard financial reports required from all agencies receiving grants by the European Commission.

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Appendix A

Proposal to PHUSICOS

Start your proposal here. The proposal must not exceed 10 pages (Times New Roman, 12 point), including maps, figures, references and budget. Leave the blue help texts intact.

Title of the Proposal:
Site:
Proponent(s):

Description of the NBS (or other measure)

The proponents must describe the measure and, in general terns why they think it is worth funding. Details are to be described in the following chapters

Write here…

External funding (PHUSICOS D2.1; Chapter 4.1.1)

The proponent must document that at least 40% of the budget is from sources other than the EC grant to the project, in accordance with chapter 4.1.1

Write here…

Risk reduction / resilience (PHUSICOS D2.1; Chapter 4.1.2)

Address all relevant areas of risk: human life, economic values, ecological state, social situation, etc.

Write here…

Feasibility (PHUSICOS D2.1; Chapter 4.1.3)

Describe how the proposed NBS is technically and economically feasible within the time frame of the project and the economy described in the budget.

Write here…

Co-benefits (PHUSICOS D2.1; Chapter 4.1.4)

Describe how the NBS will provide environmental, societal and/or economical co-benefits.

Write here…

Effectiveness (PHUSICOS D2.1; Chapter 4.1.5)

Describe how the NBS will be effective and serve its purpose for time periods of relevant length. Include plan for maintenance if relevant. Assess also effectiveness vs. that of other 'grey' measures.

Write here…

Efficiency (PHUSICOS D2.1; Chapter 4.1.6)

The process towards NBS implementation should be efficient, and there should be congruity between costs

Write here…

Possible negative impacts (PHUSICOS D2.1; Chapter 4.1.7)

Identify and evaluate possible negative impacts of NBS (economy, society, ecology, resilience, etc.), and if/how co-benefits may counteract these.

Write here…

Participatory process (PHUSICOS D2.1; Chapter 4.1.8)

Describe how stakeholders have participated in the planning, design and implementation of the NBS through a Living Lab approach.

Write here…

Harmonization with other WPs (PHUSICOS D2.1; Chapter 4.1.9)

Describe how the NBS complies with other PHUSICOS WPs.

Write here…

Compliance with international agreements and EU directives (PHUSICOS D2.1; Chapter 4.1.10)

NBS proposals should describe how they align with the UN SDGs, Sendai Framework, COP21 - Paris Agreement, EU directives, etc.

Write here…

Other issues

Describe any other issues, which may not fit under the other headings, and is considered important by the proponents. This field can be used e.g. when applying for funds to hire external facilitator for the LL process, or other items.

Write here…

Budget

The budget must be detailed enough to demonstrate that the action is feasible (above). It should show the distribution between project funding from EC and external funds. It should also differentiate between labour (hours) and direct costs (travel costs, purchasing of services and goods, etc.) Estimated maintenance costs must be included if relevant.

Write here…

Appendix B

WP4 Assessment Framework Matrix (from WP4, T4.1)

AMBIT	CRITERION	CONCEPT	SUB - CRITERION	INDICATOR	METRIC	TIPOLOGY	DIRECTION	SOURCE	ASSESSMENT FACTOR
RISK REDUCTION	*Hazard*	Landslide Risk Resilience	Site response to Landslide phenomena based on susceptibility indicators: slope angle, pore water pressure, groundwater depth, soil properties, land use, land cover	Safety Factor	-	QT	-	M	
				Percentage of Occurred Landslide Area/ Risk Area	%	QT	-	S	
				Velocity of Occurred Landslides	m/s	QT	-	S	
		Flooding Risk Resilience	Site response to Flooding phenomena based on susceptibility indicators: land use cover, run-off coefficient, rainfall intensity and frequency and duration	Peak Flow	m^3/s	QT	-	M/LL	
				Peak Volume	m^3	QT	-	M/LL	
				Flooded Area	km^2	QT	-	M/GIS	
		Snow Avalanche Risk Resilience	Site response to Snow avalanche phenomena based on susceptibility indicators: topography, wind, temperature, snow thickness and duration	Snow Cover Map, Digital Terrain Model (DEM), Land Relief [To be integrated according to Living Labs]	-	QT		GIS/M/LL	
		Drought Risk Resilience	Site response to Drought phenomena based on susceptibility indicators: land use cover, temperature, antecedent dry period, rainfall	Standardized Precipitation Index (SPI)	-	QT		M	
				Effective Drought Index (EDI)	-	QT		M	
	Exposure	Exposed Areas	Potential Areas Exposed to Risks	Urban / Residential Areas	km^2		-		
				Productive Areas (agriculture, grazing)	km^2	QT	-	M/S	
				Natural Areas, Site of Community Importance SCI, Special Protection Areas SPA	km^2	QT	-	M/S	
		Potential Population Involved	Potential Population Exposed to Risks	Inhabitants	$nr./km^2$	QT	-	M/S	
				Other People (Workers, Tourists, Homeless)	$nr./km^2$	QT	-	M/S	
				Elderly, children, disabled	$nr./km^2$	QT	-	M/S	
		Potential Species Involved	Potential Species Exposed to Risks	Domestic and wild fauna (livestock and protected species)	$nr./km^2$	QT	-	M/S	
		Potential Buildings Involved	Potential Buildings Exposed to Risks	Housing	$nr./km^2$	QT	-	M/S	
				Agricultural and Industrial buildings	$nr./km^2$	QT	-	M/S	
				Strategic buildings (hospitals, schools, wastewater treatment plants,…)	$nr./km^2$	QT	-	M/S	
		Transportation Infrastructures	Potential Infrastructures Exposed to Risks	Roads	m/km^2	QT	-	M/S	
				Railways	m/km^2	QT	-	M/S	
				Lifelines (watermain, sewerage, pipeline,….)	m/km^2	QT	-	M/S	

	Vulnerability	Social - Population Density	Potential Population Vulnerable to Risks	Population	nr./km^2	QT	-	S	
		Economic	Potential Economic Effects due to Risks	Economic value of the productive activities vulnerable to risk (i.e. economic value of the fields, nr. workers)	€/km^2	QT	-	S	
		Physical Housing Infrastructure Density	Potential Infrastructures Vulnerable to Risks	Buildings	nr./km^2	QT	-	S	
		Physical Transportation Infrastructure Density		Transportation Infrastructures and Lifelines	m/km^2	QT	-	S	
TECHNICAL & FEASIBILITY ASPECTS	*Technical Feasibility (Affordability)*	Financial Assessment	Cost-Benefit Analysis of the Intervention	Initial costs	€	QT	-	M/S	
				Maintenance costs	€	QT	-	M/S	
				Replacement costs	€	QT	-	M/S	
				Avoided costs	€	QT	+	M/S	
				Payback Period	Year	QT	-	M/S	
		Landscape Coherence and Sustainable Use of Materials and Approaches	Application of Suitable Materials and Technologies	Material used coherence	Yes/No	QL		LL	
				Techniques used coherence	Yes/No	QL		LL	
ENVIRONMENT & ECOSYSTEMS	*Water*	Water Quality Resilience	Effects on the Water Quality	Extended Biotic Index (EBI)	-	S-QT		M/S	
				Fluvial Functionality Index (FFI)	-	S-QT		M/S	
				Physical parameters (temperature, PH, ...)	°	QT		M/S	
				Chemical Pollution Parameters (OD, BOD5, COD, NH4, NO2, Escherichia Coli, Total-Phosphorus T-P)	-	S-QT		M/S	
	Soil	Soil Physical Resilience	Soil Resistance to Erosion	Total predicted soil loss (RUSLE)	T ha^{-1} yr^{-1}	QT		M/S	
				Erodibility	mm^3 ha^{-1}	QT		S	
				Soil water holding capacity	semi-quantitative	S-QT		S	
		Soil Biological Resilience	Stability of the Soil Communities and Derived Environmental Services	Soil food-web stability	S parameter for stability	S-QT		S	
		Soil Chemical Resilience	Soil Fertility	Soil available nutrients and texture		S-QT		S	
				Soil structure		S-QT		S	
				Modelled C and N cycling	T ha^{-1} yr^{-1}	S-QT		S	
			Carbon Sequestration in Soil	Decomposition rate	% mass loss	QT		S	

		Belowground C Cycle		Modelled C content in the upper soil layers	T ha^{-1}	QT		S	
	Vegetation	Aboveground C Cycle	Forest Carbon Storage	Aboveground tree biomass	T ha^{-1}	QT		S	
			Forest Carbon Sequestration	Tree biomass stock change	T ha^{-1} yr^{-1}	QT		S	
		Spatial Forest Continuity	Structural Diversity	Woody vegetation cover by strata	%	QT		S/M	
				Non-woody vegetation (herb) cover	%	QT		S/M	
				Total vegetation cover	%	QT			
		Temporal Forest Continuity	Stages of Forest Stand Development	Number of diameter classes	#	QT		S	
				Tree regeneration	#	S-QT		S/M	
				Canopy gaps	Y/N	S-QT		S/M	
		Drought Risk	Moisture	Moisture index		QT		S/M	
		Fire Risk	Flammability	Flammability index		QT		S/M	
	Landscape (Green Infrastructure)	Green Infrastructure	Landscape connectivity	Hanski connectivity index	ha of potential habitat	QT		M	
			Mosaic Diversity	Abundance of ecotones/Shannon diversity	km/ha/ Shannon index	QT		M	
	Biodiversity	Functional Diversity	Soil Genetic Diversity (Microbial and Invertebrate)	Metagenomic map		QL		GIS/M	
			Soil Functional Diversity (Microbial and Invertebrate)	Abundance of functional groups		S-QT		S/M	
			Plant Functional Diversity	Diversity of functional groups	Shannon index	QT		S/M	
			Animal Functional Diversity	Diversity of functional groups	Shannon index	QT		S/M	
SOCIETY	*Quality of life*	Leisure and Connections Increasing	Recreational Opportunity	New Areas for recreational use and cultural events	km^2	QT	+	GIS	
				Different activities allowed in new recreational areas	nr.	QT	+	S	
				Average distance of natural resources from urban centres/train station/public transportation	km	QT	-	GIS	
			Sustainable Mobility	New pedestrian and cycling paths	km	QT	+	GIS	
				Sustainable transportation modes allowed	nr.	QT	+	S	
				New links between urban centres/activities	nr.	QT	+	GIS	

		Social Equity Benefits	Social Justice	Area easily accessible for people with disabilities	km²	QT	+	GIS	
				Rate of increase in properties incomes	%	QT	+	S	
		Demographic Benefits	Ageing Contrast	Population increasing (Natality + Immigration)	%	QT	+	S	
				Elderly rate decreasing	%	QT	+	S	
	Community Involvement & Governance	Participation and Design Capacity Building	Participatory Processes and Partnership	Citizen involved	nr.	QT	+	LL	
				Stakeholders involved	nr.	QT	+	LL	
				Public-private partnership activated	nr.	QT	+	S	
				Policies set up to promote NBSs	nr.	QT	+	S	
	Landscape and Heritage	Local Perception and Sense of Belonging	Identity	Traditional knowledge and uses reclamation	Yes/No	QL		LL	
				Traditional events organized in the new areas	nr.	QT	+	S	
				Social active associations	nr.	QT	+	S	
		Heritage	Heritage Accessibility	Natural and cultural sites, made available	nr. Site; ha	QT	+	GIS	
		Landscape Safeguard and Promotion	Landscape Perception	Viewshed	km²	QT	+	GIS	
				Scenic sites and Landmark created	nr.	QT	+	GIS	
				Scenic paths created	km	QT	+	GIS	
LOCAL ECONOMY	*Revitalization of Marginal Areas*	Promotion of Socio-Economical Development of Marginal Areas	New Jobs	Jobs created in the nature-based sector	nr.	QT	+	M/S	
				Jobs created in the nature-based solution construction and maintenance	nr.	QT	+	M/S	
		Promotion of Touristic Development of Marginal Areas	Tourism	New employment in the tourism sector	nr.	QT	+	S	
				New activities in the tourism sector	nr.	QT	+	S	
				Gross profit from nature-based tourism	€/area/year	QT	+	M/S	
				Touristic activeness enhancing	nr.visitor/year	QT	+	M/S	
	Local Economy Reinforcement including New Job Opportunities	Enhancement of Local Socio-Economic Activities	New Areas for Traditional Resources	New areas made available for traditional activities (agriculture, livestock, fishing,….)	km²	QT	+	GIS	
				Forest area planted	km²	QT	+	GIS	

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