# PHUSICOS

## According to nature

Deliverable D3.5

**Lessons learned with the Living Labs Experience**

Work Package 3 – Service Innovation: Stakeholder Participation through Living Labs

Deliverable Work Package Leader:
TUM

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# Note about the contributors

| | |
|---|---|
| Lead partner responsible for the deliverable: | TUM |
| Deliverable prepared by: | Gerd Lupp, Josh Huang, Aude Zingraff-Hamed |
| Partner responsible for quality control: | NGI |
| Deliverable reviewed by: | Anders Solheim |
| Other contributors: | Idoia Arauzo, Eva-Maria Balaguer, Nicola Del Sepia, Trine Frisli Fjøsne, Sabine Kraushaar, Alberto Martinelli, Mari Olsen, Jan-Christoph Otto, Turid Wulff-Knutsen |

# Project information

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| Web-site: | www.phusicos.eu |
| Project coordinator: | Norwegian Geotechnical Institute, (NGI project no.: 20180404) |

# Project partners:

# Summary

This deliverable, D3.5 *Lessons learned with the Living Labs experience*, is linked to Task 3.4 and evaluates the first phase of stakeholder participation and the first Living Labs user experiences. The report is building upon previous reports elaborated by Work Package 3, namely on Deliverable D3.3 and D3.4.

The main goals of this deliverable report D3.5 are twofold. First, the deliverable describes the starting point of stakeholder engagement processes and especially their initial knowledge of NBSs, their expectations on NBSs, on PHUSICOS, on the Living Lab process and its goals. Second, it presents the first experiences made with stakeholder participation within the Living Labs, such as the assessment of user satisfaction with Living Lab experiences. The report is based on stakeholder interviews and a literature review with findings from other projects and theoretical reflections on stakeholders in participatory projects in the field of NBSs and neighbouring concepts. This deliverable follows the main guiding questions: What are the overall stakeholder perceptions of NBSs or neighbouring concepts? What are the overall main interests and concerns considering such solutions? What expectations do actors have regarding collaborative planning of NBSs? What are the first lessons learned that can be drawn from PHUSICOS experience?

Even in applying a broad scope in the literature search including neighbouring concepts to NBSs and disaster risk reduction, not much work on stakeholder perceptions on strategies to reduce risk with NBSs or similar concepts could be found. Interestingly, disaster risk reduction, similar concepts and stakeholder perspectives mainly relate to understanding their perception of natural hazards, risks, vulnerability and preparedness to react to an occurring disaster, e.g. evacuation rather than on solutions.

Despite the importance of NBSs on political and research agenda, in both the literature and the interviews, the concept and ideas are less familiar to stakeholders. NBSs are mainly encountered within river restoration measures. At the beginning of the project, expectations on the Innovation Action was conveyed to get new ideas on how to address natural hazards with new solutions. PHUSICOS is seen as a starting point to reduce risks and to find solutions that are attractive and interesting also from an economical point of view (e.g., a new business model for farmers and landowners). The rather strong interest in the economic aspect is quite different from findings in the literature. Most of the work published is on urban areas, and in these areas, multiple benefits are much more important for most stakeholders. With the pan-European perspective of the project including a retrospective learning case, upscaling and replication of good NBSs were perceived to be an attractive opportunity provided by the project.

At the beginning of the Living Lab process, NBSs were mainly seen as beneficial for nature and providing interesting opportunities for local businesses. Other topics of interest such as risk reduction, higher acceptance by the public or multiple benefits were less frequently mentioned. Main concerns in NBSs were seen in a lack of profitability or a lack of local value added by NBSs. Barriers to implement NBSs were seen in a multitude of issues such as the validation of the effectiveness of NBSs or applicability

at the case site and the time needed for NBSs to work (especially related to vegetation). Other barriers were related to human factors such as a lack of knowledge.

When asked for their expectations of Living Labs, most interviewees mentioned the aspects of engaging stakeholders and creating knowledge regarding NBSs. Most expressed interests related to economic aspects of NBSs, raising awareness and stakeholder engagement and want to see that NBSs are demonstrated to be effective for their region as the main outcome of the Living Lab process. Other expected goals to be achieved with Living Labs is to successfully disseminate NBSs, raise awareness and provide learning opportunities.

Already at this early stage, some lessons learned can be drawn: the importance of learning, hands-on opportunities for raising awareness on NBSs, trying to overcome or tackle lack of willingness at governance levels and converting diversity of opinions into strengths with Living Lab processes and their facilitation. However, it can be observed, that previous negative experiences are often repeated in new projects. It will be interesting to see in PHUSICOS, if hands-on learning experiences by using the opportunity to study retrospective cases such as the Isar can contribute to the speeding up of creation of common understandings, the building of trust and the reduction of scepticism, to the overcoming of obstacles quicker or to the using of innovative tools developed in PHUSICOS as an eye-openers for stakeholders in the Living Lab processes.

With many expectations expressed in the interviews at the beginning of the Living Lab processes and experiences collected from literature, stakeholders, and their perspectives, we will follow up on the satisfaction with the Living Lab processes and the evolution of stakeholder perceptions on NBSs. It will be interesting to see if learning and intensive in-depth collaboration processes are the key elements triggering action in real life, mainstreaming and NBSs being equally or more preferable over traditional grey solutions. Findings from this follow up will be part the next deliverable Report D3.7 on Lessons learned.

# Glossary

## KEY CONCEPTS, ABBREVIATIONS AND DEFINITIONS

**CO-DESIGN, CO-CREATION, CO-PRODUCTION:**

Co-design, co-creation or knowledge co-production can be defined as an innovation process that involves end-users as "actors" instead of solely "factors" in all phases of the design process, unlike traditional top-down linear design thinking where end-users may only be responsible for reviewing or giving feedback on the design process (Voorberg et al., 2014; Evans et al., 2017).

**CONCEPT CASE SITE (CC):**

Small-scale case study site which serves to test specific challenging aspects of NBS, and to study transferability of lessons learned. In PHUSICOS, the Kaunertal Valley of Austria and the Isar River watershed of Germany are designated as concept cases.

**DEMONSTRATOR CASE SITE (DS):**

Large-scale demonstrator case study site for the implementation of nature-based solutions (NBS). In PHUSICOS, these are situated in Gudbrandsdalen, Norway; the Pyrenees, France-Spain-Andorra; and the Serchio River Basin, Italy.

**EFFECTIVENESS:**

Extent to which a project attains, or is expected to attain, its objectives efficiently and in a sustainable way (Gujit and Woodhill, 2002).

**EFFICIENCY:**

Measure of how economically the inputs of a project intervention (funds, expertice, time, etc.) are converted into outputs (Gujit and Woodhill, 2002).

**EVALUATION:**

Systematic examination of a planned, ongoing or completed project, which aims to judge the overall value of a project intervention and provide lessons learned for corrective action, planning and decision-making. Commonly, an evaluation intends to determine the efficiency, effectiveness, impact, sustainability and relevance of the project intervention (Gujit and Woodhill, 2002; European Commission, 2004).

**IMPACT:**

Effect of a project intervention on its wider environment, and its contribution to the project's purpose or overall goal (Gujit and Woodhill, 2002; European Commission, 2004). Often, the impact is expressed by the changes the target groups of a project intervention perceive.

**INDICATOR:**

Quantitative or qualitative variable that provides a simple and reliable basis for assessing achievement, change or performance. Indicators can be formulated on various levels, such as output, outcome or impact level (Gujit and Woodhill, 2002; European Commission, 2004).

## KEY CONCEPTS, ABBREVIATIONS AND DEFINITIONS (continued)

**LIVING LAB (LL):**

A Living Lab is a physical area and interaction space, in which stakeholders form an innovation network including companies, public agencies, universities, users, and other stakeholders in the pursuit of collaboration for the creation, prototyping, validating and testing of new technologies, services, products, and systems in real-life contexts (based on Leminen, 2013).

**LIVING LAB FACILITATOR:**

A person who is in charge of facilitating and steering the local Living Lab process, which involves identifying, engaging, coordinating and monitoring stakeholders as well as pro-actively guiding the iterative knowledge exchange with a project's work packages and implementation of process outcomes (based on Van der Jagt et al., 2017).

**MONITORING / M&E:**

"The regular collection and analysis of information to assist timely decision-making, ensure accountability and provide the basis for evaluation and learning. M&E is the combination of monitoring and evaluation, which together provide the knowledge required for i) effective project management and ii) reporting responsibilities" (Gujit and Woodhill, 2002: A-7).

**NATURE-BASED SOLUTIONS (NBSs):**

"Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services " (European Commission, 2020).

**STAKEHOLDER:**

All persons, groups and organisations with an interest or "stake" in an issue, either because they will be affected or because they may have some influence on its outcome. This includes individual citizens, companies, economic and public interest groups, government bodies and experts. (Ridder et al., 2005: 2).

**STAKEHOLDER INVOLVEMENT / STAKEHOLDER PARTICIPATION:**

Process of involving those who are affected by and thus have an interest in a defined issue. This involvement of interest groups may refer to different contents, such as planning, decision-making or monitoring and evaluation of an issue (after Hauck et al., 2016 and FAO, 1995), and happen on different levels, ranging from information and consultation to active collaboration and transferring decision-making into the hands of the public (IAP2, 2018).

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# 1 Introduction

## 1.1 Lessons Learned from Living Labs in PHUSICOS – Positioning of the Report in Service Innovation

From an overall perspective, one of the barriers hampering the implementation of nature-based solutions (NBSs) at larger scales is a lack of inter-sectorial cooperation and in-depth stakeholder involvement from the beginning of the planning process. One example is stakeholder involvement in identifying the solution goals (Zingraff-Hamed et al., 2020a). While various governance models enable NBS implementation, partnerships and collaborative approaches are crucial factors for success when implementing solutions (e.g. Zingraff-Hamed et al., 2020b). The advantage of collaborative planning is well known but its use requires social competence to avoid congestion of the process. Therefore, identifying, understanding and addressing stakeholder values, interests, and knowledge are crucial steps for successful in-depth participatory processes (Burgers and Farida, 2017). NBSs often require integrated measures which implies collaboration and the willingness of stakeholders to act (Heitz et al., 2009). Especially for facilitators, understanding scepticism and motivation to take action is important to orchestrate collaborative planning processes (Lupp et al., 2016). According to Heitz et al. (2009), risk perception and striving to implement solutions are based on own experiences, beliefs, and psychological, social, economic, temporal or institutional factors. Venkataramanan et al. (2020) highlight the willingness to make changes depending on a variety of factors such as awareness of the problem, knowledge, attitudes, or intentions that lead to implementing or adopting solutions. Consequently, the stakeholder's willingness to take action is also related to their perception of hazards, risks, and exposure, their estimation of their own ability to contribute to a solution and the receiving benefits. For collaborative planning, facilitator knowledge about stakeholder perceptions will support the processes and elaboration of outcomes.

To ensure a successful implementation of NBSs in this context, in PHUSICOS, various stakeholders are actively involved throughout the project using Living Labs in order to incorporate their knowledge, preferences, views, values, scepticism and attitudes. The project aims to involve and motivate stakeholders to co-design, co-implement, and co-monitor NBSs. In PHUSICOS, Work Package 3 "service innovation" is dedicated to the collaborative planning process within Living Labs and related tasks with a number of products and activities providing a framework, tools for collaborative planning and monitoring and evaluation procedures.

This deliverable report D3.5 presents first insights on lessons learned from the Living Labs. This deliverable builds upon the previous reports elaborated by Work Package 3. The deliverable report is based on the theoretical foundation and framework, criteria and monitoring and evaluation processes to assess the performance of the Living Labs and of user satisfaction at the case sites. It builds on previous materials and follows up D3.3 and D3.4, Monitoring & Evaluation (M&E) scheme version 1 and 2:

- D3.1 *Guiding Framework for Tailored Living Lab Establishment at Demonstrator and Concept Case Study Sites* provides the theoretical background and project terminology for the Living Lab processes, as well as a practical guidance for the main steps to be taken to establish the Living Labs.
- D3.2 *Starter Toolbox for Stakeholder Knowledge Mapping to Co-Design Nature-Based Solutions at Case Study Sites* presents a comprehensive toolbox for fostering stakeholder involvement at the case study sites. It is a steppingstone from Living Lab preparation towards implementation by assembling a comprehensive Toolbox for fostering stakeholder involvement at the case study sites.
- D3.3 and D3.4, *Monitoring & Evaluation Scheme to Assess Stakeholder Participation and User Satisfaction with Living Lab Experience - Version 1 and 2* presents the theoretical framework of the Monitoring & Evaluation (M&E) scheme for Living Labs within PHUSICOS project. M&E serves various purposes and intends to accompany the achievement of goals and targets set for a project.

Following D3.3 and D3.4 (Fohlmeister et al.; 2019a, 2020), based on Eckart et al. (2018), Living Labs have different types of interconnected targets: practice-related targets, research targets and learning targets, namely fostering learning processes, knowledge generation, definition and co-design of research and practice-related targets, empowerment of innovators and fostering local innovation capacity.

Key elements of Living Labs within PHUSICOS are stakeholder involvement from the beginning, integration of identified stakeholders' priority demands, capacity building, innovation as well as learning, participants' power to influence, participants' impact on outcome, and resource accessibility and availability (Fohlmeister et al., 2018). To assess learning processes, evaluation criteria also need to relate to provision of learning opportunities, and raising the awareness of local stakeholders regarding natural hazards and the potential of NBSs.
Serving this purpose, the M&E scheme elaborated by Fohlmeister et al. (2019a, 2020) in Deliverable D3.4 and D3.4 aim at tracking these Living Lab goals outlined by Eckart et al. (2018).

The Living Labs at the case study sites in PHUSICOS go through different phases of stakeholder co-design stages and strategies with a variety of targets for practice, implementation, research and learning. The M&E scheme therefore intends to balance between individual needs, local contexts, and site demands on the one hand and cross-case comparison for ensuring a common ground for all case sites within PHUSICOS on a project level on the other hand.

Based on D3.3 and D3.4, a comprehensive pool of evaluation criteria reflecting stakeholder participation was collected. The first report on the lessons learned makes use of these criteria as a starting point (Table 1).

*Table 1: Criteria for monitoring and evaluation given in D3.3 and D3.4 (based on Fohlmeister et al. 2019a, 2020)*

| Objectives listed in PHUSICOS' Document of Action (DoA) | Proposed Indicators (D3.3 and D3.4) | Evaluation Criteria covered |
|---|---|---|
| Living Labs enhance **local innovation capacity** at case study sites | Degree of achievement of learning goals | Learning, innovation, capacity building |
| | Perception of innovation capacity enhancement by LL participants and other stakeholders | Learning, innovation, capacity building, empowerment of innovators |
| Living Labs **contribute to decision-making on NBSs** | Degree of uptake of LL inputs in relevant decisions on NBSs (selection; design; implementation; assessment) | Participants' power to influence, participants' impact on outcomes |
| | Perception of degree of uptake in relevant decisions by Living Lab participants | Participants' power to influence, participants' impact on outcomes |
| Living Labs enhance **NBS awareness & acceptance** and change **perception of health and safety** | Extent of NBSs awareness/acceptance/ health & safety perception change | Learning, capacity building, social capital, institutional capital |
| Living Labs have **functioning information exchange**, also with external stakeholders | Number of new stakeholder networks/relations | Social capital, institutional capital |
| | Perception of network quality | Social capital, institutional capital |
| Living Labs **co-design NBS** projects and other PHUSICOS products (WP2/4/5/6/7) | Degree of consideration of LL participant demands/inputs in research agendas of WPs and practice-related goals (e.g. NBSs) | Participants' power to influence, participants' impact on outcomes, integration of local and scientific knowledge |
| | Number and type of stakeholders involved in co-design per session | Representativeness, legitimacy, participants' power to influence |
| Living Labs **capture and leverage stakeholder knowledge** in an iterative manner according to identified priority demands | Perception of stakeholders of LL process as iterative knowledge exchange (incl. adequacy of participatory methods; accessibility of language; knowledge co-creation) | Integration of local and scientific knowledge, suitable methods, continuous and active involvement, provision of learning opportunities |
| | Ratio local/external experts per session | Integration of local and scientific knowledge, learning |
| Living Labs are **enabled to co-design** NBSs | Perception of stakeholders on quality of facilitation and accessibility of Living Lab process | Highly-skilled facilitation of process, transparency, resource accessibility and availability |
| Living Labs are **capable intermediaries between multiple actors** (public & private sector, enviro. & social NGOs, citizens) | Number and type of core stakeholders being actively and continuously engaged in Living Lab process | Representativeness, transparency, legitimacy, highly-skilled facilitation of process, suitable methods, continuous and active involvement |
| Living Labs are **established and work according to plan** | Frequency of Living Lab sessions | Continuous and active involvement |
| | Degree of conformity with work plan and PHUSICOS standard | Transparency, legitimacy, cost-benefit ratio, structured participatory process |

Performed regularly, monitoring and evaluation make use of impact indicators, supports progress reporting and serves as an instrument for both the overall project and the case study sites. It is intended to help keep the Living Lab processes on track and to gain valuable insights concerning the Living Labs` advancement to ultimately achieve the desired stakeholder support and ownership for the co-designed NBSs at the local level (Fohlmeister et al., 2019a, 2020). Based on PHUSICOS WP building blocks, monitoring

and evaluation follows three main strands (Figure 1). Strands relate to Living Lab strategies, performance and stakeholder knowledge.

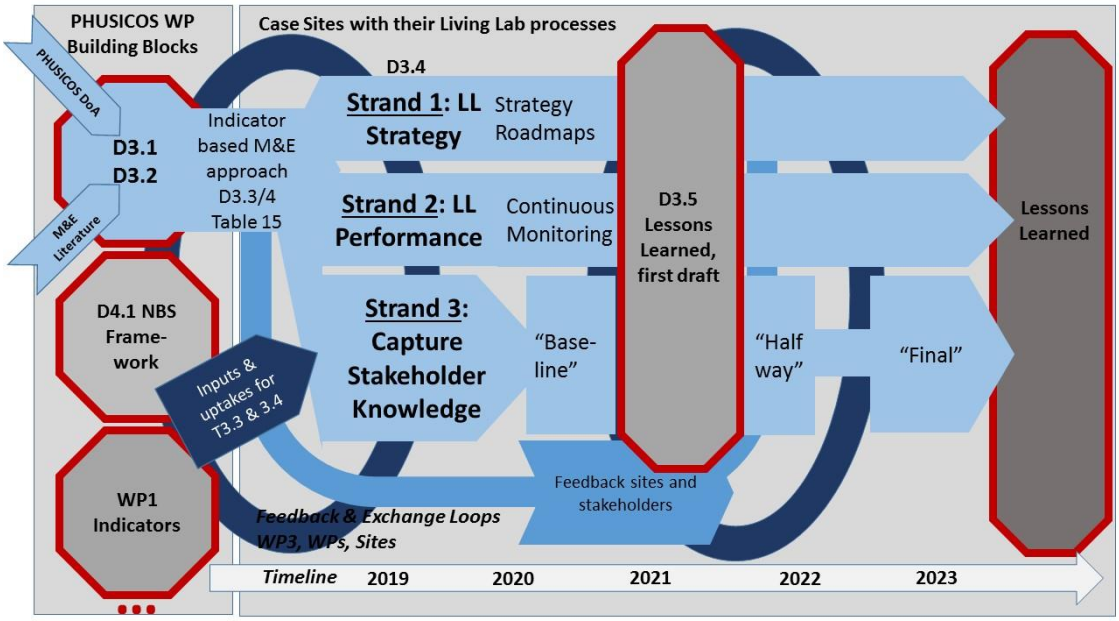


*Figure 1: Operationalization of the M&E scheme with different strands*

An important component of the M&E scheme is the Living Lab participants' awareness and acceptance of NBSs. This strand in M&E supports detection of changes concerning the NBS perception among the key stakeholders as well as more in-depth reflection of stakeholders. Repetition of the assessment around mid-term and at the end of the PHUSICOS project will help to describe the development of stakeholder knowledge, to develop the learning processes, to promote and to co-design solutions, and to increase acceptance of NBSs and stakeholder commitment (Fohlmeister et al., 2019a, 2020).

The goals of this deliverable report D3.5 are first to describe the starting point of stakeholder engagement process and especially their initial knowledge on NBSs, their expectations on NBSs, on PHUSICOS, on the Living Lab process and its goals. Second, experiences made so far with stakeholder participation and user satisfaction with Living Lab experiences are highlighted. This deliverable follows the main guiding questions:

- What are the overall stakeholder perceptions of NBSs or neighbouring concepts?
- What are the overall main interests and concerns considering such solutions which apply to PHUSICOS?
- What expectations do actors have regarding collaborative planning of NBSs?
- What are the initial lessons learned that can be drawn from PHUSICOS's experience?

This deliverable report presents initial results from the PHUSICOS's Living Labs and provides insights from the beginning of an intensive in-depth collaborative planning process using Living Lab approaches. They are flanked by a literature review with findings from other projects and theoretical reflections on stakeholder participation in the field of NBSs and neighbouring concepts. With these findings, initial lessons learned will be drawn

## 1.2 Target Groups of this Deliverable

Like previous reports of Work Package 3, this report is dedicated to support four groups:

- the facilitators of the PHUSICOS Living Labs who will steer and manage the stakeholder involvement processes at the demonstrator and concept case sites
- local scientific and end-user partners as well as other Living Lab participants of the case study sites
- PHUSICOS project partners
- a broader audience such as planning practitioners, politicians and scientists working on co-designing NBSs for climate change adaptation, land use planning, disaster risk management, and related fields. Finally, it is intended to serve as a source of inspiration for those wishing to employ Living Lab approaches to find innovative ways of developing and implementing solutions inspired by nature.

# 2 Methodology

In order to answer the main guiding questions, a methodological approach is based on different knowledge sources:
1) Theoretical knowledge collected by a literature review and 2) practical knowledge collected by a) interviews with key stakeholders and b) case site owners and facilitators.

## 2.1 Literature Review

A literature review was conducted using the Web of Science, Scopus and Google Scholar databases between February 10 and 23, 2021. It was considered important to use more than one database since search algorithms may vary across databases. First, searches were made from all three data bases with the search term combinations, NBS, nature-based solution, disaster-risk reduction, eco-disaster, risk reduction, eco-drr AND stakeholder awareness, stakeholder perception, stakeholder attitude.

We also used some terms on neighbouring concepts of NBSs to collect work on stakeholder perspectives from these fields that promote a similar intention: more natural or nature-inspired solutions, as well as sustainable drainage approaches for storm water management to reduce risks, exposure and vulnerability of natural hazards triggered by hydrometeorological events. With the growing popularity of more natural and nature-inspired solutions, the number of terms used to describe or conceptualize them has seen an explosive increase. Therefore, we realize our literature review cannot be exhaustive to include the abundance of all terms that currently exist.

A total number of 727 papers were identified. We utilized the PRISMA method (Moher et al., 2009) to identify the most relevant papers. First, we assessed the titles of these papers for relevance and categorized them based on relevance. Then, we assessed the abstracts of the papers with the most relevant titles to further determine which papers would be useful for our research. In this way, we identified 49 relevant publications. We then reviewed the content and extracted the relevant information to be incorporated into our research for a qualitative content analysis (Mayring, 2000).

## 2.2 In-depth Interviews with Key Stakeholders and Case Site Owners

### 2.2.1 Interview Design

To assess the stakeholder perspectives on NBSs, Living Labs, evolution of knowledge on NBSs and the in-depth participatory approach and to draw lessons learned, we opted for a qualitative approach (Atteslander, 2003). Semi-structured protocol interviews were developed for this purpose (Marshall and Rossman, 1998). The protocol interview was

designed in order to be used during face-to-face meetings as well as by telephone or during virtual one-to-one meetings. Considering the fatigue of digital tools experienced by facilitators and stakeholders during the COVID-19 pandemic, we used an interview form instead. The in-depth stakeholder interviews are based on template G of Deliverable Report D3.3 and D3.4 (Fohlmeister et al., 2019, Fohlmeister et al., 2020) and was further elaborated in an iterative way together with PHUISCOS partners and site owners. It intends to collect information on stakeholder knowledge based on the set of indicators from table 1 and picking up incoming products and reports from the other work packages that are important building blocks of the Living Lab processes (Fohlmeister et al. 2019a). The final set of questions were then elaborated, evolved and adapted together with facilitators, site owners and WP partners. The aim of this procedure was to tailor the resulting monitoring questions to the different case site needs while allowing cross case comparability and collecting in-depth information on stakeholder awareness. They picked up recent results and concepts available from PHUSICOS. For example, they link and reflect the ambits from D4.1 Comprehensive Framework for NBS Assessment (Autuori et al. 2019) and connected it with potential barriers and enablers of NBS implementation derived from D5.1, NBS in-depth case study analysis of the characteristics of successful governance models (Martin et al. 2019). Also, in the light of COVID-19 and associated restrictions, an in-depth qualitative approach was considered most useful as it best reflects that Living Lab processes almost came to a standstill in March 2020 and then gradually restarted in summer 2020 with major adaptations triggered by the COVID-19 situation. For instance, meetings could only take place in the form of individual exchanges or with only very few stakeholders present at one time. Digital formats were developed and used between March 2020 and April 2021 up to the preparation of this report. They will most likely be the most feasible formats and means of communication and exchange also in the coming months.

The interviews were designed to last around one hour maximum, and questions were communicated before the meeting to allow for preparation by the interviewees. The interview sheet that was used can be found in Appendix A.

### 2.2.2 Selection of the interviewees

A preliminary systematic mapping and selection of key stakeholders is recommended to target representative stakeholders, to save time and effort for the interviews and to collect information at certain points of time. Considering PHUSICOS's larger Living Lab groups as well as the specificity induced at the different sites and to allow cross-site comparisons and similar standards, this recruiting and selection processes for interview partners should be done following an appropriate method over all the different case sites.

For this purpose, first, a systematic stakeholder identification task was conducted following an approach developed by the PHUSICOS sister project RECONECT (Hüesker et al., 2019). Based on systematic stakeholder mapping described by Zingraff-Hamed et al. (2020c), potential stakeholders were listed based on available information from the different sites and on their documentation and available protocols from

stakeholders meetings within the PHUSICOS project. Lists and documentation sheets were given to the local facilitator teams who were asked to add more potentially relevant stakeholders, for example those not responding to invitations, unwilling to participate or relevant only for a single step or final stages (Lynam et al. 2007, Reed et al. 2009). Based on the concept of interest-influence matrices and three-dimensional power-influence-attitude grids (Murray-Webster and Simon, 2006), local facilitators were asked to evaluate the roles of stakeholders as well as their importance for different co-design, co-implementation and co-monitoring/evaluation stages, their relation and affectedness by natural hazards, and NBSs and decision processes on finding potential solutions to reduce hazards. Once the matrices were filled in, the WP3 partners contacted each facilitator for a short exchange about their stakeholder assessment and asked for further actors and groups that could be missing, not existing or considered not relevant at first glance for the case. This exchange is based on theoretical information presenting stakeholder constellations in comparable cases.

Based on the results of the stakeholder mapping, together with WP3 partners, the site owners and the facilitators of the three demonstrator sites, interview partners were selected in an iterative process to ensure that at least one representative from the relevant groups in the co-creation processes were selected following a selection process suggested by Hunziker (2000). This approach was used to choose very different views, perspectives and backgrounds to encompass a broad range of attitudes over all case sites. To cover the different perspectives, attitudes and opinions, interviewees were selected according to criteria connected to the principle of maximum contrasts based on the grounded theory (Strauss and Corbin, 1990). The aim of this strategy is to cover a wide range of perspectives within a rather small group of interviewees. Criteria can be differences in sociodemographic characteristics, such as professional background, but also obvious different opinions. However, not all of the initially identified persons could be interviewed. Some refused the request for an interview or were unavailable in the given timeframe. Also, some potential interview partners were difficult to reach during the COVID-19 pandemic, and approaches such as collecting interviews in suitable, good environments for building trust for exchange that are important for such qualitative interview approaches (Elwood and Marin, 2000), were difficult to realize. This might have led to a lack of participation as well.

Being largely a retrospective case with much expertise and experiences of stakeholders, the Isar concept case did not conduct baseline interviews. Interviews on lessons learned and experiences with NBSs and Living Labs were already conducted in the summer of 2018 for the elaboration of Deliverable D3.1 and in the spring of 2019 for Deliverable D5.1. The experiences gained during these interviews supported the design of the interview sheet in Appendix A.

With the different nature of the Kaunertal concept case and a different focus of the Living Lab activities, the questions were tailored for this case and conducted at a later stage. For this reason, the interview results for this case are not examined in this first assessment round.

A total of 13 persons participated in the interviews covering all stakeholder groups from different levels except two groups, media and international organizations (Table 2), which usually are observers rather than being intensively involved in the co-creation processes (Zingraff-Hamed et al. 2020c).

*Table 2: Interviewed stakeholders (anonymized).*

| Stakeholder | Stakeholder group (according to Hüesker et al., 2019; Zingraff-Hamed et al., 2020c) |
|---|---|
| Agriculture 1 (Business) | Commercial Sector |
| Agriculture 2 (Family-owned) | Commercial Sector |
| Research, Agronomist | Academia |
| Water Administration (Region) | Authorities |
| Water Administration (County) | Authorities |
| Authority (Region) | Authorities |
| Authority Infrastructure 1 (Province) | Authorities |
| Authority Infrastructure 2 (Province) | Authorities |
| Nature Manager Community | Political Representatives |
| Forest Administration | Political Representatives |
| Decision Maker County | Political Representatives |
| Decision Maker Community | Political Representatives |
| Representative of interest group for Nature and Outdoor Recreation | Civil Society |

### 2.2.3 Conducting the Protocol Interviews

Interviews were conducted by phone or video-calls. Notes were taken when interviewees rejected to be recorded. Recorded interviews were transcribed and translated to English for the assessment. The texts were then analysed, shortened and structured to highlight the key statements according to Mayring (2000). The Interview protocols are defined as sensitive, confidential documents and will not be made public. Therefore, they are not added as an Appendix to this deliverable.

### 2.2.4 Collecting Site Owner and Facilitator Perspectives with Interviews

The in-depth interviews to collect stakeholder perspectives were flanked with the perspectives, observations and experiences collected by the site owners and facilitators of the demonstrator cases. For this purpose, protocol interviews were developed following the set of questions for the stakeholders and addressing similar topics (Appendix B). Site owners were asked to fill in the questionnaires from their perspectives and to already draw their lessons learned at an early stage of the Living Lab processes. The protocols that we received were assessed in a similar way, following the steps for analyses, and shortening and structuring the key statements according to

Mayring (2000). The filled in documents are, similar to the ones from the stakeholder interviews, in that they are defined as sensitive, confidential documents and are not added as an Appendix to this deliverable.

# 3 Results of the Literature Review

## 3.1 Stakeholder Perception of NBS Implementation and Collaborative Planning in Literature

Despite the broad scope of the literature search that included neighbouring concepts and disaster risk reduction, not much work on stakeholder perceptions on strategies to reduce risk with NBSs or similar concepts could be found. Interestingly, disaster risk reduction and similar concepts and stakeholder perspectives mainly relate to describing their perception of natural hazards, risks, vulnerability and preparedness to react to an occurring disaster, e.g. evacuation. Related to disaster risk reduction, not much is mentioned about measures to reduce the risks. Buchecker et al. (2013) stated in their work that risk perception approaches in literature with a spotlight on disaster risk reduction have a strong theoretical nature and often focus on the perception of risks rather than on the perception of risk prevention measures. Han & Kulicke (2019) scanned 1834 NBS papers for stakeholder perspectives and perceptions of NBSs in literature but only found 15 papers addressing how people value and perceive the co-benefits of NBSs and related concepts. Ferreia et al. 2020 conducted a systematic literature review on NBSs with a focus on urban areas related to establishment of Green Infrastructure (GI) and sibling concepts and came up with 142 papers on stakeholder perspectives. Piacentini and Rossetto (2020) analysed stakeholders in water-related NBSs and GI which were almost all situated in urban and peri-urban areas in Mediterranean France and Italy. They only found little interest and response from rural areas on these concepts and not much awareness of water-related NBSs. In this section we will synthetize their results.

## 3.2 Theories of Stakeholder Perception of Natural Hazards and NBSs

According to Heitz et al. (2009) who examined mudflows, risk perception and implementing solutions are based on own experiences, beliefs and psychological, social, economic, temporal or institutional factors. A number of theoretical approaches exist to describe perception of risks, behaviours and actions. Pagliacci et al. (2020) outline the varieties of rationalist and constructivist approaches with the protection motivation theory and protective actions decision model being the most frequently applied in the field of disaster risk reduction and neighboring fields. These models are rooted in Planned Behaviour theories and consider subjective norms, attitudes, perceived

behavioural control and background factors that influence decisions that trigger action. The concept consists of three components: attitude, norms and motivation.

Mañez et al. (2016) describe a series of three steps leading to active risk management that can constitute co-designing NBSs:

- Risk - consisting of the combination of hazards, vulnerability and exposure on the one hand, and the mental construction regarding it as a possible dangerous event on the other hand
- Perception of risks - based on interpretations and possible responses and based on a variety of factors such as social, economic, political and cultural contexts as well as experiences and knowledge
- Management of risks

Mañez et al. (2016) extended a model of risk perception as a key stepping stone for taking actions based on cultural backgrounds, socio-political factors and cognitive affective factors that are influenced by individual and collective backgrounds (Figure 2).

However, according to Lindall and Perry (2012), one major implication of the literature cited in the previous section is that, despite extensive theorizing and data collection, it still is not entirely clear what motivates people to take protective action. Venkataramanan et al. (2020) highlight the willingness to make changes depending on a variety of factors such as awareness of the problem, knowledge, attitudes and intention that lead to implementing or adopting solutions. Knowledge in this context is frequently identified in theoretical reflections (e.g. Bustillos Ardayaa et al., 2017; Pagliacci et al., 2020) as a key factor as it can shape attitudes such as perceived benefits, perceived dangers, perceived susceptibility to a problem, and preferences for solutions.

Looking at these findings in the literature, it is important to understand worldviews, topics and aspects of NBSs of importance for stakeholders. This also underpins assessing stakeholder perspectives as suggested in the M&E schemes. This assessment is crucial for understanding stakeholders and is a vital cornerstone for continuous stakeholder engagement in collaborative planning processes such as Living Labs (Brugha and Varvasovszky, 2000, Lupp et al. 2021) as well as for understanding their motivation to take action.

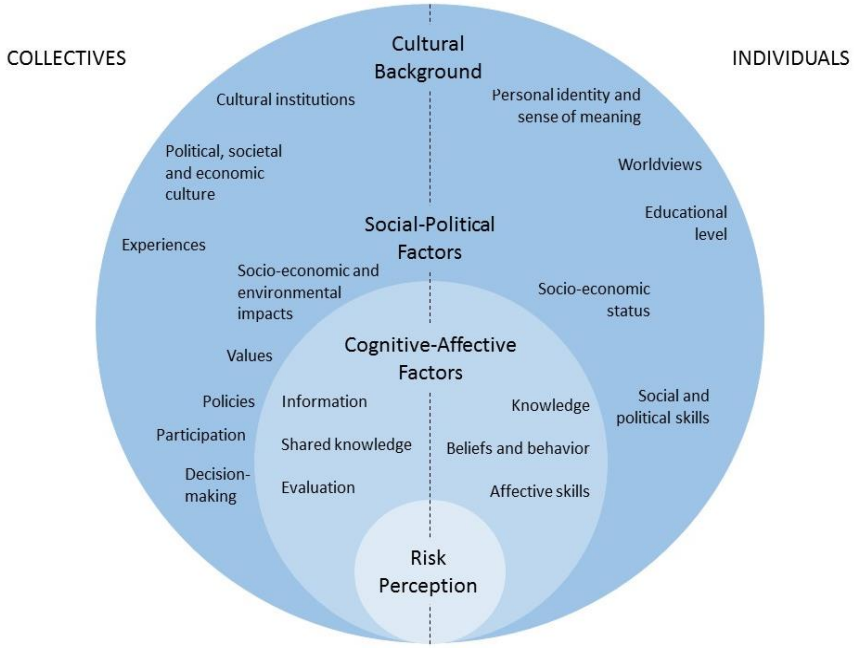


*Figure 2: Factors determining risk perception (Source: taken from Mañez et al., 2016, adapted from Renn and Rohrmann, 2000)*

## 3.3 Familiarity with NBS Concepts

Bark et al. (2021) described in their study from the UK on natural flood management (NFM) that two-thirds of the respondents considered themselves familiar with NFM, but only eight strongly considered themselves experts. Understanding and information were collected mainly by participation in one or more natural flood management projects. Heitz et al (2009) describe the farmer´s self-conception being "experts for soil", and information providers from the Farmers' Trade Union, technical papers and agricultural advisors. However, the examination of this case revealed that farmers often have a weak awareness of flood risks in the context of mudflows.

## 3.4 Perceived Positive Features of NBSs

Co-benefits and usability of NBSs are considered very important in urban areas in the literature. "Neat looking" solutions (Hoyle et al. 2017) can help to gain acceptance but might contradict the most desired co-benefits or the key purpose of NBSs which is to enhance biodiversity. Han and Kulicke's (2019) findings suggest that co-benefits are valued positively and important for many stakeholder groups. Thus, co-benefits are seen to have positive influence on people's perception of NBSs, although in some studies, aesthetical aspects were found to be perceived as of lower relevance compared to other co-benefits. It was assumed that people support or prefer NBSs if they also positively value wider social and natural co-benefits, such as aesthetical, recreational, economic,

and nature-related aspects. This result is confirmed by Pagano et al. (2019), particularly if people have direct access to NBSs in urban settings and can interact with them frequently. However, the studies assessed by Pagano et al. (2019) focused only on co-benefits related to recreational and aesthetical aspects. Other possible positive aspects such as health, wellbeing, cultural values, and economic development have not yet been considered.
For rural and mountain settings, a strong focus on addressing natural hazards and other features is important and decisive for successfully implementing NBSs. Bark et al. (2021) stated that for stakeholders in these settings, solutions should be cost-effective and needs to clarify issues such as tenure and coordination of maintenance of such solutions.

## 3.5 Concerns about NBSs

Han and Kulicke (2019) find that people often consider natural solutions as being less effective than traditional protection schemes. In the assessment of stakeholders by Bisonette et al. (2018), most of the interviewed persons stated that more information was needed on the biodiversity and ecological functionality of NBSs. Many participants in this study believed that an economic evaluation of ecosystem services is necessary to design effective planning interventions.
Several authors reporting on NBSs or neighbouring concepts in rural settings describe perceived negative economic aspects as important concerns or barriers to implement NBSs. Heitz et al (2009) also highlight economic issues as playing a role in measures that prevent mudflows. Portugal Del Pino et al. (2020) describes major concerns about NBSs with their high expected maintenance costs. Piacentini and Rossetto (2020) observed that stakeholders considered costs to be higher for NBSs compared to other solutions, but additional co-benefits might outweigh them. Pagano et al. (2019) state that the construction, maintenance costs and effort required are perceived to be the major limitations for disseminating and replicating more natural solutions. Bisonette et al. (2018) stated, that many participants believed that an economic evaluation of services such as recreation or aesthetics is necessary to design effective planning interventions. Santoro et al. (2019) highlight that stakeholders expressed their need to have a quantitative assessment of the effectiveness of the selected measures in reducing flood risk and expected impacts with specific reference to the costs and benefits of the chosen actions.
In their case of adapting to sea level rise in Scotland by Lieski et al. (2019), rural stakeholders claimed that decision-making should be based on economic rationality and locally derived evidence, and that poorly designed schemes might lead to increased maintenance costs. Willingness to manage flood risks with NBSs was accepted only if there would be evidence that considerable numbers of residents benefit from them with increased protection.
Pagano et al. (2019) refer to 10% of stakeholders explicitly preferring traditional grey solutions as they are well known and reliable. According to the authors, this stresses again the importance of demonstration pilots and capacity building.

## 3.6 Stakeholder Views on Involvement and Participatory Approaches Evolving Over Time

Only a few of the assessed papers followed up on stakeholder perception on participative processes and evolution of knowledge or changing attitudes in NBSs and neighbouring concepts. Wamsler et al. (2020) critically reflected on stakeholder involvement. In urban contexts, many stakeholders or involved citizens lack environmental awareness. As a consequence, individual personal interests are mixed in that are not related to NBSs or green infrastructure development. Furthermore, a lack of awareness even after severe events does not change the attitudes or willingness to act. Huq (2017) reports on a case from local communities. Despite several severe flooding in recent years, most actors believed that such events will not happen again in the near future, and therefore they are not open for natural flood management ideas. Also, priorities of farmers are not met, and they remain an isolated community of their own in collaborative efforts. Therefore, also from this perspective, stakeholder involvement and collaborative planning is challenging.

However, in the study of Buchecker et al (2013), the interviewees experienced the participatory process as an effective means of sustainable decision-making. At the end of the process, only one critical voice remained and doubted that the broad involvement of stakeholders would result in a feasible solution. Others, who had been sceptical in this respect at the outset, lost their doubts during the process.

# 4 Interview Results on Stakeholder Knowledge and Expectations towards the Living Labs

## 4.1 Stakeholders and the NBS concept

Around one third of the 13 interviewees discovered the NBS concept and related terminologies within the PHUSICOS activities, e.g. kick-off meetings at case study sites (Figure 3). The others came across it within river restoration measures, related to agricultural practices or forestry. One interviewee encountered the concept in an urban context.

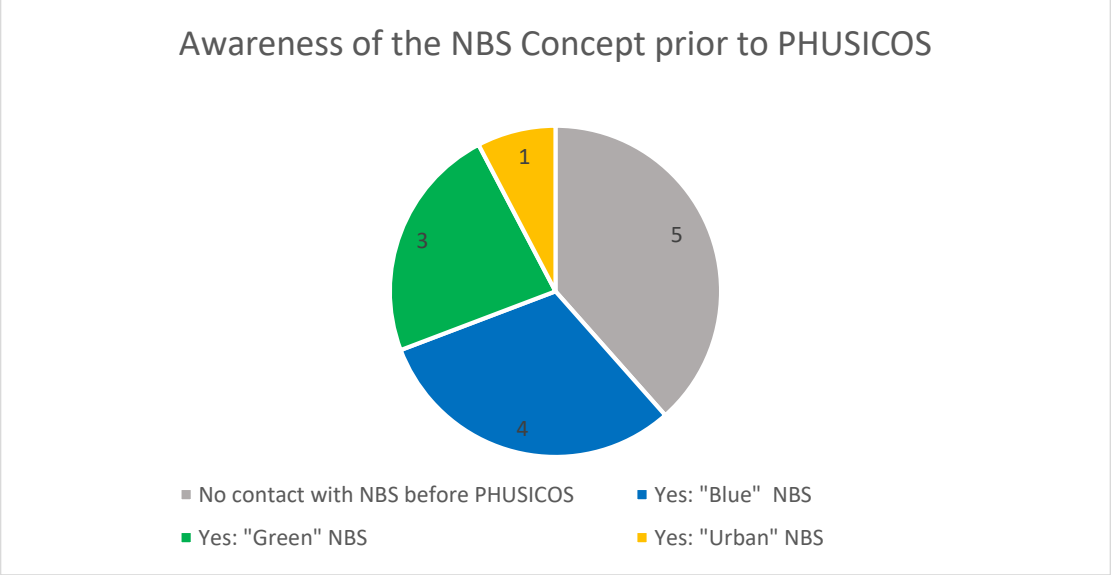


*Figure 3: Awareness of the NBS concept prior to the start PHUSICOS*

If stakeholders felt that they were familiar with the concept already before the start of PHUSICOS, frequently the interviewed stakeholders have gained their knowledge about the concept of NBSs through research activities or universities (Figure 4). For one interviewee who is a supporting partner institution for PHUISCOS, the proposal preparation phase was an important point to collect knowledge on NBSs.

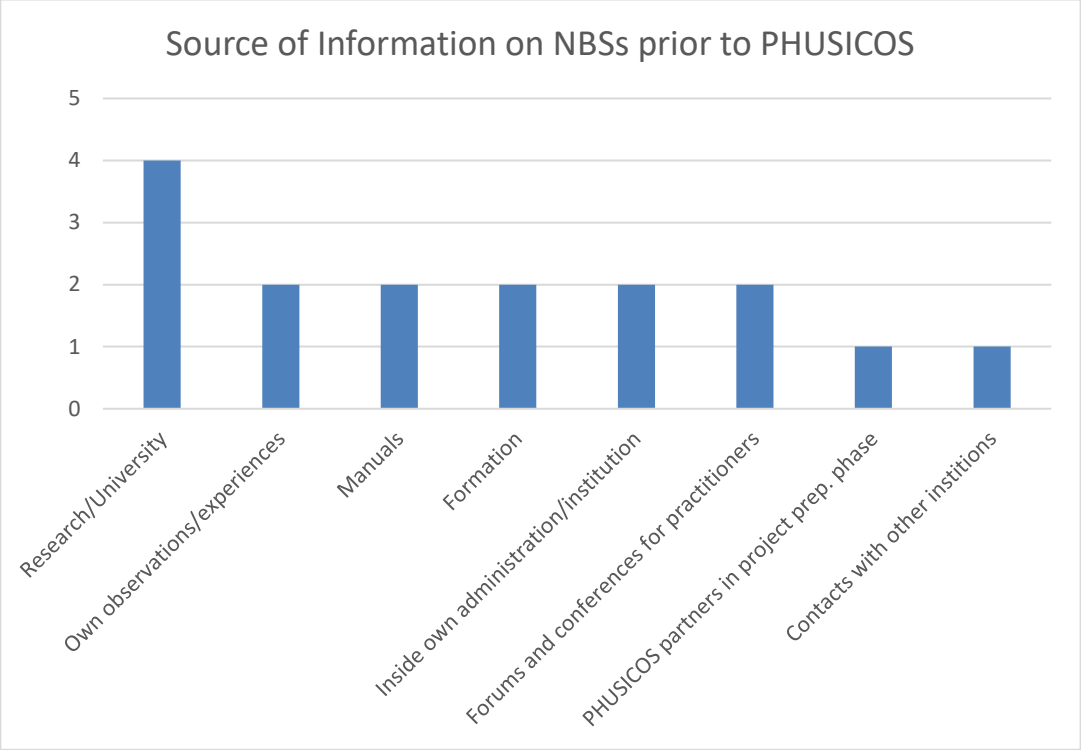


*Figure 4: Source of information on NBSs mentioned by PHUSICOS stakeholders prior to the project phase (multiple statements extracted from responses)*

Initially, stakeholders expected that PHUSICOS would provide more information on NBSs (Figure 5). Most stakeholders expect PHUSICOS to inspire them through the presentation of new solutions to address natural hazards or to reduce the risks in their case study site. An important aspect throughout all stakeholder groups was the desire to find solutions that are attractive and interesting from an economical point of view. For example, NBSs could provide new, interesting business models for land owners. With the pan-European perspective of the project including the Isar as a retrospective case, learning from this case, upscaling and adapting the solutions or strategies related to implementing good NBSs were perceived to be an attractive opportunity provided by the project.

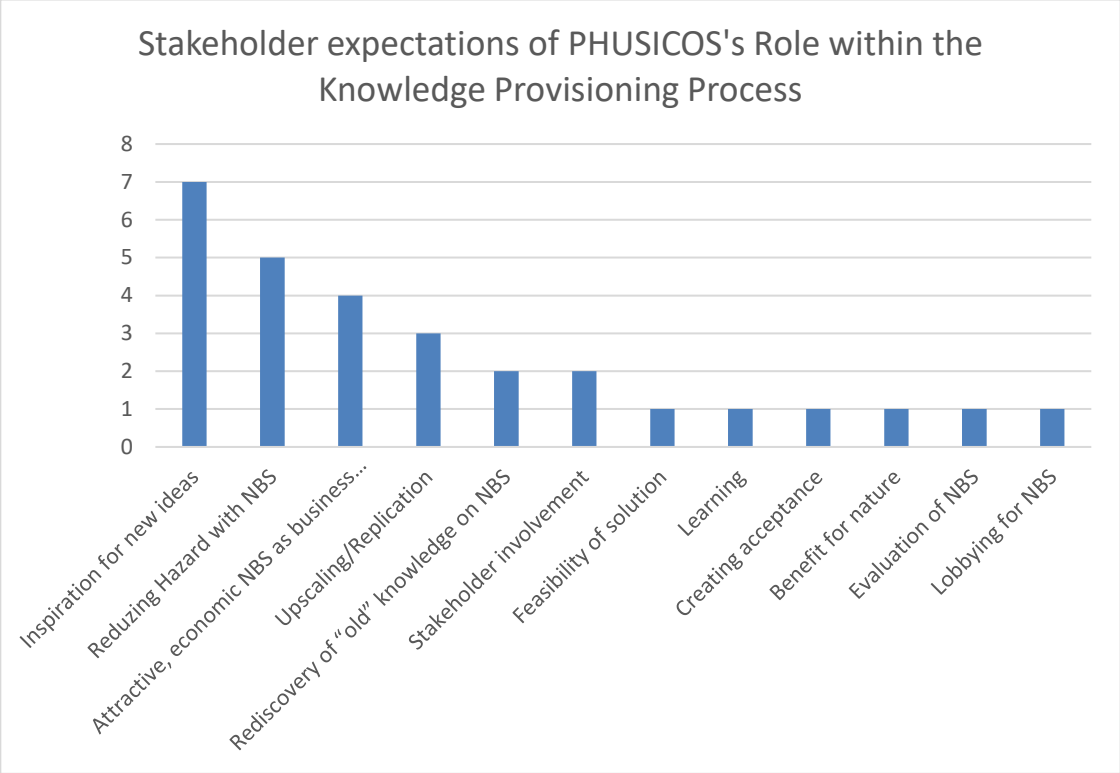


*Figure 5: Expectations of PHUSICOS's role within the knowledge provisioning process (multiple statements extracted from responses)*

**Role of PHUSICOS for Stakeholders – Site Owners´ and Facilitators´ Perspective**

Also, the site owners and facilitators have experienced very different starting points when it comes to knowledge of stakeholders in NBSs. With the first activities of the sites, some of the stakeholders have developed a more nature-based way of thinking, and they have included some of the things they have learned in their activities. PHUSICOS and Living Labs can address problems and concerns that many of the stakeholders and inhabitants have. From a site owner and facilitator perspective, to meet the expectations of PHUSICOS, the approach to meet the needs of stakeholders is fourfold with different emphasis at the different demonstrator cases:

1. Knowledge provision and dissemination: Provision of scientific and evidence-based data plays an important role for the site owners and facilitators. PHUSICOS is a tool to bring information and existing experiences to the sites and the different actors and showcasing good and concrete examples are important for the stakeholders. Also, it is seen as important to conduct site visits, because this contributes to a better understanding of the problems which needs to be addressed.
2. PHUSICOS can offer scientific evidence-based information and data and with the increase in publicity, implemented NBSs and their monitoring can showcase how they work.

3. Stakeholder involvement: Openness and expressing different opinions are seen as important and encourage stakeholders to learn a new way of thinking. Stakeholder involvement throughout the process of elaboration to implementation and the technical coverage of the solutions can show stakeholders how robust NBSs are and their ability to serve multiple interests. The co-created outputs as advocates and knowledge vectors for NBSs can support stakeholders working in other sites in the region.
4. Application and Demonstration of NBSs: PHUSICOS's role should be to showcase good NBS applications. PHUSICOS could provide "thought-through" measures that take several different interests into consideration, which ultimately can lead to a measure many can agree on. A full coverage of the solutions adopted can demonstrate robustness to stakeholders while serving multiple interests and provide synergies among many interests or needs. Finally, NBSs can encourage others to replicate good practices both in the demonstrator case area and also elsewhere.

## 4.2 Perception of NBSs

A second group of questions collects information about stakeholder perceptions of NBSs. This group asked about potential positive and negative aspects of NBSs as well as barriers for their implementation.
Results showed that at the beginning of the Living Lab process, NBSs were mainly perceived by the stakeholders as beneficial for nature and providing interesting opportunities for local businesses. Only to a lesser extent were other benefits mentioned at the very early stage of PHUSICOS, such as risk reduction, higher acceptance by the public or multiple benefits (Figure 6). One statement reflected on how solutions upstream might have consequences further down in the catchment area.

**Site Owners' and Facilitators' Perspective on Perceived Benefits**

At the beginning of the stakeholder processes, facilitators and site owners perceive that, awareness of risks from natural hazards rises and that NBSs can be a means to reduce threats. When actors start to assess NBSs, they can see the values and multiple benefits provided by NBSs, as well as the ones that are important for them. This attracts interest in such solutions. Nonetheless, fears or concerns were observed towards "new" solutions and concerns to the "unknown" in stakeholder perceptions are quite strong. One of the main advantages perceived by the stakeholders according to facilitators and site owners is their feasibility. NBSs are perceived as well integrated solutions within the rural environment that can be built and maintained by stakeholders as for example by farmers using their agricultural machinery and historical practices. Another main advantage of NBSs for stakeholders as estimated by the facilitators and site owners is their reversibility. Compared to grey solutions, NBSs can easily be removed or dismantled if they do not work as expected. Analysing the interviews and experiences from the sites showed some barriers for implementing NBSs. Facilitators and site owners underscore

that for a broader implementation of NBSs, it would require a detailed study of the problem. The challenge that was mentioned is the non-existence or lack of knowledge for the application of natural materials in the construction of protective infrastructures. This ultimately leads to the implementation of standardized and marketed "grey" solutions.

Main concerns that were formulated by the stakeholders themselves were the high expenses needed for NBS implementation, the costs of regular maintenance, or no local value-added. Furthermore, the lack of business models to support NBS implementation were mentioned. Another main concern was that NBSs are perceived as being potentially less reliable than grey solutions and therefore cause scepticism (Figure 7). In particular, NBSs are perceived as less reliable in mitigating extreme events. Beside the lack of evidence of effectiveness of NBSs or applicability at the case site, another concern is the time needed until NBSs reach their functionality. The concern is especially related to the time needed to achieve the necessary vegetation cover. Other concerns about NBSs were that they might not be sustainable if materials such as wood are imported from long distance or if excessive helicopter transport is needed for transporting material and workers to remote mountain areas. As a consequence, carbon footprints might be quite large for such solutions.

Facilitators and site owners mentioned these concerns as important issues to be worked on and solved. It is expected that stakeholders would not carry out a NBS project themselves without any kind of European or national grant or support scheme, and conversely, projects are needed to stimulate action. Within PHUSICOS, NBSs s that are discovered and decided upon will benefit from EU funding for their implementation. However, the long-term maintenance of NBSs beyond the project lifetime remains a major concern. To address this, Living Lab activities will therefore strive to identify market mechanisms derived from the maintenance of NBSs that could compensate the maintenance costs.

The barriers identified by stakeholders were several human factors such as lack of knowledge of NBSs, lack of stakeholder acceptance or lack of collaboration (Figure 8). Facilitators and site owners see this factor as a main challenge and mention that the collaborative planning and the Living Lab process can help to overcome these barriers in PHUSICOS. For this, they also assume barriers for NBS implementation in the administrative procedures. There is some delay within the Living Lab process but this process then could also speed up the implementation of NBSs at the end. Finally, high costs were mentioned again. They were considered not only a concern for stakeholders but also a barrier for implementation. High costs were seen to be an overall barrier for reducing disaster risks in general, no matter if NBSs or "grey" solutions were considered, leaving these problems unresolved.

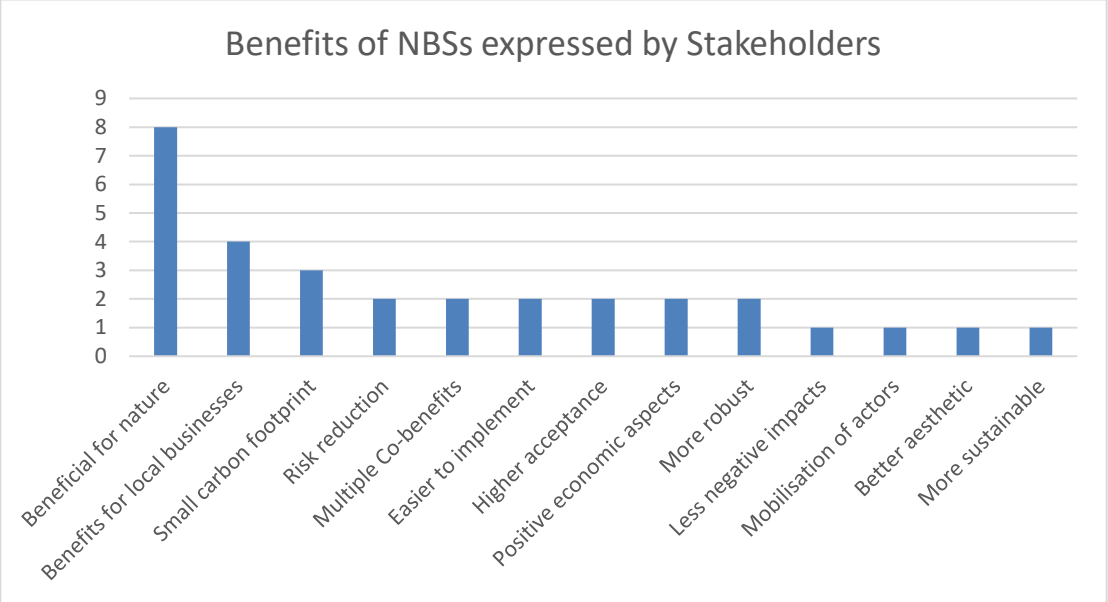


*Figure 6: Perceived benefits of NBSs from the stakeholder perspective (multiple answers)*


*Figure 7: Concerns expressed by interviewed stakeholders on NBSs (multiple answers)*

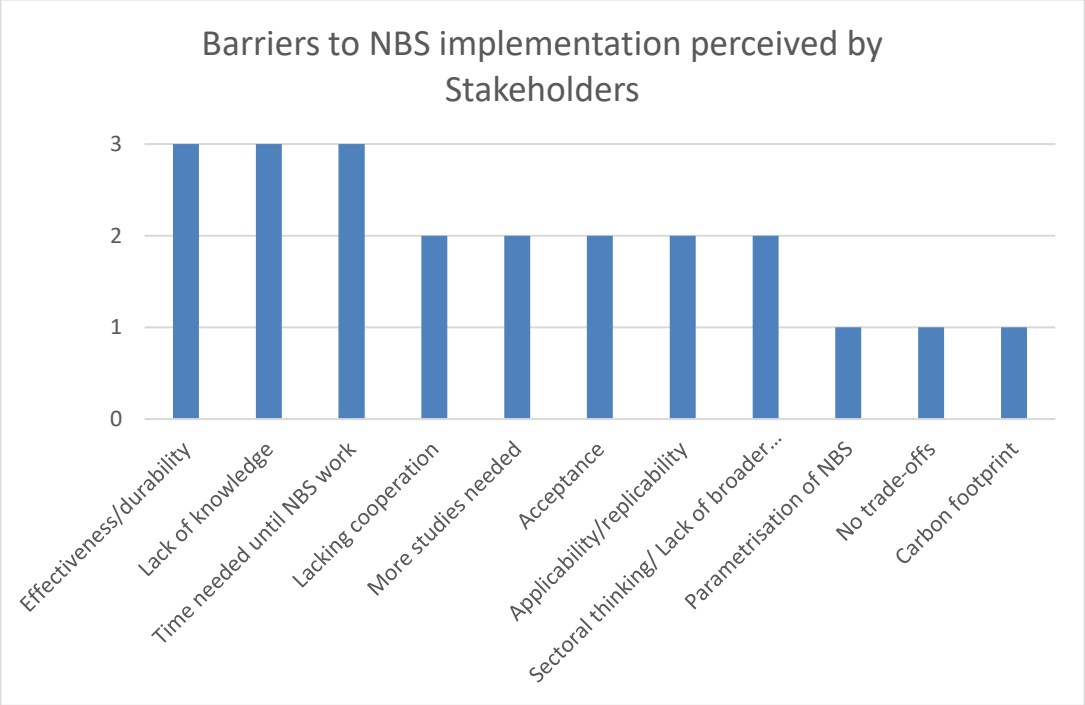


*Figure 8: Perceived barriers expressed by interviewed stakeholders (multiple answers)*

## 4.3 Living Labs Process: Expectations, Concerns, Barriers and Outcomes

Most interviewees expect that the Living Labs will lead to higher engagement in NBSs and that they provide opportunities to create knowledge about NBSs. Also, dissemination activities, raising awareness and networking were mentioned. For one interviewee, it was important that despite the co-design and collaborative approaches, final decisions on solutions should be made by experts (Figure 9).

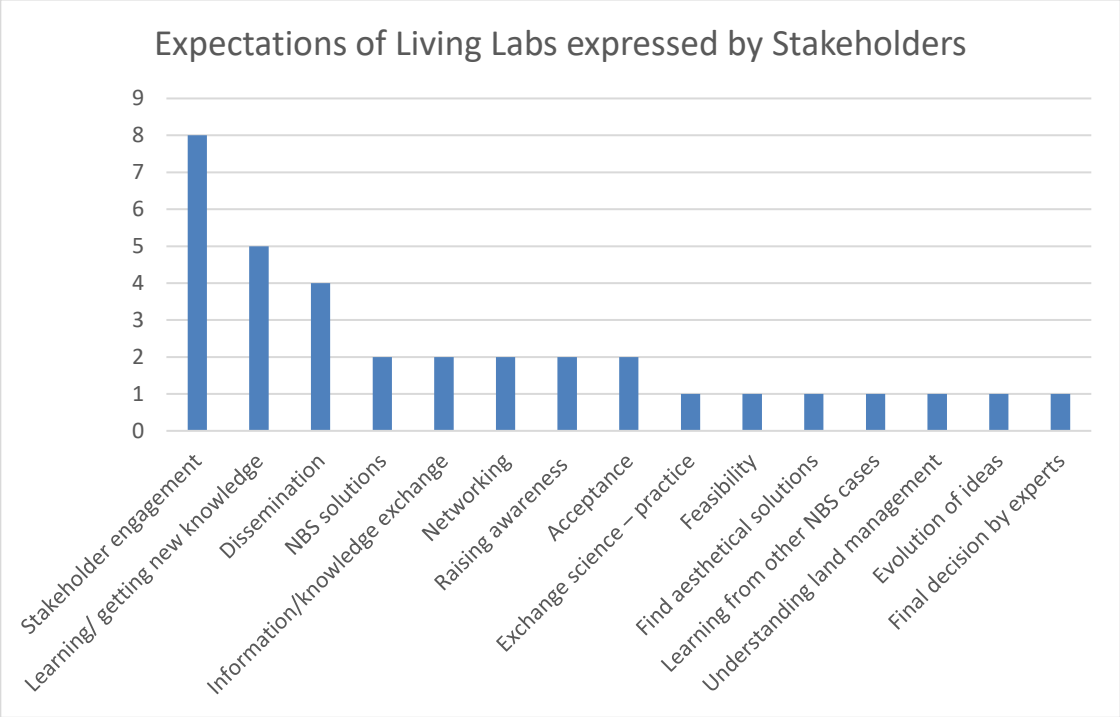


*Figure 9: Stakeholder expectations of Living Lab processes (multiple answers)*

Interviewed stakeholders expressed most frequently topics or interests that relate to economic aspects of NBSs as already stated earlier in the expectations of benefits of NBSs. For this reason, these topics should be an important aspect to be discussed or elaborated in the Living Lab processes (Figure 10). It also was considered important that the processes raise awareness, support stakeholder engagement and stimulate learning. With the perceived scepticism or personal concerns, seeing and demonstrating that NBSs can be a good and effective solution for their region is an important element of the Living Labs. Other subjects of interest that were mentioned were the dissemination of successful NBSs and the provision of learning opportunities on NBSs.

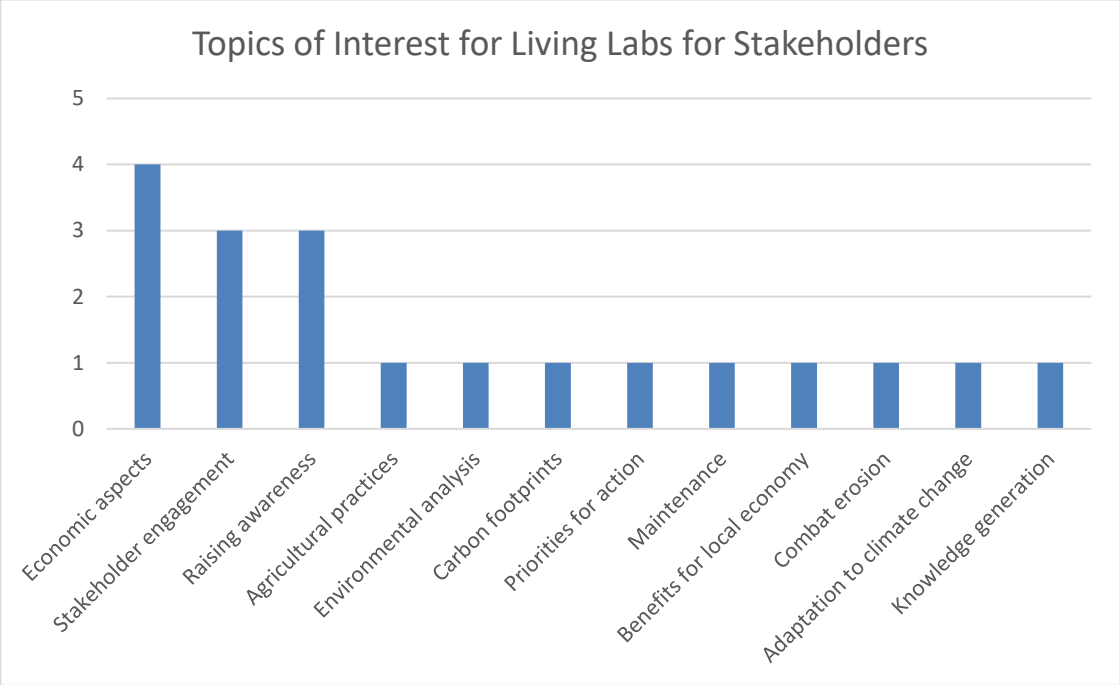


*Figure 10: Topics of interest of NBSs within a Living Labs context expressed by stakeholders (multiple answers)*

The stakeholders were then asked to reflect on the goals that the Living Lab processes should achieve (Figure 11). The interviewed stakeholders identified the demonstration or showcasing of the effectiveness of NBSs as a very important goal of the Living Lab. They also mentioned that evidence validating the cost-effectiveness or economic attractiveness of the solutions was important. Another important goal was to disseminate NBSs, raise awareness and acceptance, and stimulate learning processes, not only related to NBSs, but also to natural hazard risks in general. For the stakeholders that were interviewed, it was also important that the Living Labs during the lifetime of PHUSICOS should enable NBS implementation in their region. Other interesting goals that were mentioned was the co-design of NBSs, building of networks and cooperation.


*Figure 11: Goals to be achieved within the Living Labs according to stakeholders (multiple answers)*

### Site Owners' and Facilitators' Perspectives on Living Labs

According to the facilitators and site owners, one of the best outcomes of the PHUSICOS Living Labs would be that stakeholders would act as ambassadors of the NBSs for other sites under their responsibility in order to replicate and upscale these solutions. Another desire is that the Living Lab process would contribute to the learning and changing of attitudes towards NBSs and finding solutions most stakeholders could agree on. Another positive outcome would be the growth of the participatory culture during the planning process. In other words, successful collaboration and increased trust between the stakeholders will encourage collaborative planning beyond the lifetime of PHUSICOS.

Furthermore, Living Labs should enable networking and investigation of the upscaling potential of NBSs, economic opportunities that could arise from the implementation of the NBSs and additional funding to increase NBS implementation. Another goal for site owners and facilitators would be the knowledge transfer, benefit from local knowledge and collective learning. An important driver of knowledge exchange are site visits and dialogue about implemented NBSs.

From the site owner's and facilitator's perspective, it was difficult for local collectives to be involved in a Living Lab process because the NBS concept was not understood very well at the beginning. For others, they have never participated in such collaborative approaches and believed that they would not be able to contribute in a Living Lab. The main topics of interest that could motivate stakeholders to engage in Living Lab processes are the possibilities of reducing vulnerability to natural hazards at a local level,

the possibilities of generating income and employment in the area of the intervention and the use of local materials.

Based on experiences with the first meetings with stakeholders and based on some Living Lab activities knowledge, awareness of the role and meaning of NBSs is growing. With the "hands-on" cases, stakeholders began to perceive NBSs as an opportunity for widespread environmental improvement and not as a rival to economic aspects. The PHUSICOS project with its opportunities is therefore seen as a turning point for stakeholder awareness on NBSs. Local stakeholders and in particular "on-the-ground stakeholders" [*practitioners such as farmers – Authors note*] understood that NBSs can be an opportunity for long-term growth and environmental sustainability.

Site owners and facilitators name a variety of issues with the perceived benefits of Living Labs that make such processes difficult. Starting from evaluating all the input and ideas during and after the process, conflicting interests can be difficult to solve and might delay the process. Creating a common understanding about the fact that not everyone will have their needs met is seen as a challenge as well. Two major concerns about Living Lab processes from site owners and facilitators perspective have been formulated. One concern is the need of permanent stimuli to generate interest among the participants so that participants follow the process closely and participate in all the sessions. Another concern is that Living Lab results require governance and policy changes that are beyond the competence of the Living Lab members.

Facilitators and site owners identified a number of barriers within the Living Labs. One of these barriers is the necessity to handle the timing for the co-design and the implementation of the proposed NBS measure in the frame of the PHUSICOS project lifetime. In addition, another barrier is the launching of a public tender for the implementation of a NBS that includes enough description of the service and at the same time flexibility to integrate suggestions from the stakeholders. It might also be a challenge to discuss with all stakeholders about some very technical issues, such as monitoring after the implementation. In general, it is very important that the technical teams and risk modelling and calculation teams go beyond just sharing information and present information that is understandable to different stakeholders and adapted to the different target audiences within the Living Lab integration process. Furthermore, the participants in the Living Labs should realize that their contributions have had a real impact on the final solution. Finally, facilitators and site owners underscored that further barriers can arise if the participatory process is not well conceived and inserted within the planning and implementation of the project, especially because it could prolong the time and not coincide with the deadlines of the project and related funding.

# 5 Initial Lessons Learned

## 5.1 Importance of the Learning Processes

A concern for hazards (Ding et al., 2019), or a certain perception of negative impacts of hazards on the civil society (Böhm and Pfister, 2000) are widely cited as potential drivers of personal or community based actions. Despite several attempts to explain stakeholder perception, awareness and support for actions with models, researchers cannot not fully explain stakeholder action or inaction (Lindall and Perry, 2012). Even with a high level of awareness of NBSs in the cases described in the literature, the motivation to take action is often low. "Grey" solutions are preferred, or appraisal of risks does not necessarily result in protective action and may even cause dissonant attitudes. Motivation is a decisive element but is a very complex system with a multitude of theories (de Brabander and Martens, 2014). The main elements of importance are "perceived competence", "effects of own action" and "expected benefits" (Lupp et al., 2016). Key factors for motivation in the field of NBSs (Maidl et al. 2020) seem to be the sense of responsibility to implement a shared solution among different stakeholders, the collective engagement in risk mitigation, and the importance of dialogue.

Comparing the findings from the literature with the interviews from PHUSICOS (Table 3), we can underline a lack of knowledge of ecosystem-based, near-natural or nature-based solutions. This especially highlights the importance of education. This could take place in an indirect way, such as visiting implementation sites and discussing implemented projects or in a direct way such as providing documentations, brochures, and newsletters on the topic. In many cases described in the literature, the effectiveness of NBSs are perceived very critically and much scepticism exists towards such solutions. PHUSICOS stakeholders that were interviewed provided a much more positive perspective. Nonetheless, they considered more learning and demonstration of the durability and effectiveness of NBSs in particular to be useful. Knowledge institutions such as academia are another key group that can be involved in the learning process. Knowledge institutions are one of the necessary core groups of the Living Labs according to theories presented in Deliverable D3.1 (Fohlmeister et al., 2018). They are able to provide a basic understanding of NBSs and are widely accepted by most of the other stakeholders as a neutral actor. Stakeholder mapping also showed that within PHUSICOS and RECONECT, academia is the major component of both stakeholder groups, "the wise and active stakeholders" and "the observers" (Zingraff-Hamed et al., 2020c). Both groups are mainly in the least affected by the hazard and/or the least affecting the NBS implementation category so they are often not part of the collaborative planning. Our results show that they can play a very important role. Therefore, core features of successful projects on NBSs from both stakeholder perspectives in PHUSICOS and the literature provide a proof of concept with learning from a "hands-on" demonstration case or other cases. In addition to demonstrating durability, literature with a focus on urban areas emphasize the importance of co-benefits for society. The highlighted importance of economic aspects of NBSs in our interviews with both stakeholders, site owners and facilitators can also be found some of the literature where NBSs are implemented in more rural settings, as well as in some described managerial

perspectives from urban areas. However, only a few studies on the monetary value of NBSs in comparison with grey solutions exist, especially because the monetary value of the social co-benefits is difficult to assess (Perosa et al., 2021). Future efforts therefore should strive to demonstrate for stakeholders that cost-benefit analysis for NBS could be very promising from an economical perspective compared to grey solutions. The most important and a main motivation for rural mountain actors to participate in collaborative NBS planning processes are not only the benefits for nature, but especially the economic opportunities.

*Table 3: Comparison of findings in the literature and from interviews with stakeholders and site owners/facilitators*

| Description | Findings from the literature review | PHUSICOS site owner observations | PHUSICOS stakeholders' answers |
|---|---|---|---|
| Stakeholder familiarity with NBS and related concepts | Lack of knowledge, but land users and farmers consider themselves the experts (e.g.Heitz et al., 2009). Most of the literature underlines the importance of NBS projects for learning and raising awareness/knowledge (e.g. Bustillos Ardayaa et al., 2017; Pagliacci et al., 2020) | Some familiarity at the beginning of PHUSICOS, importance of knowledge provision and learning, topics related to benefits are gaining interest and are attractive for stakeholders | About one third have not encountered the concept of NBSs before the start of PHUSICOS, "entry-point" knowledge often provided from universities and related contacts |
| NBS benefits perceived by stake-holders | Mainly urban NBSs in the literature, mainly co-benefits for society are valued (Han and Kulicke, 2019), managerial views relate to easier maintenance (Bark et al., 2021) | Desired outcome is a broader view on the multiple benefits achieved. Key elements to be achieved are well integrated solutions that are built and managed. Their economic attractiveness will be a key factor for stakeholder motivation for implementing NBSs | Interviewees mainly refer to benefits for nature and express potential economic opportunities |
| Concerns of stake-holders on NBSs | Less effective especially in severe events (Pagano et al. 2019), high maintenance costs (Portugal Del Pino et al., 2020), little acceptance for solutions that are not aesthetically pleasing (Hoyle et al. ,2017) | Stakeholders need stimuli in the form of projects as a starting point for collaborating, long-term commitment and collaboration for maintenance of NBSs beyond project life time | Evidence of durability or functionality is largely missing, effectiveness is lower, maintenance is more costly, fear of invasive species |
| Perceived barriers to NBSs by stake-holders | Often, a lack of knowledge and awareness of evolution and importance of participation (e.g. Venkataramanan et al., 2020; Buchecker et al., 2013) | Lack of knowledge on NBSs, lack of stakeholder acceptance or lack of collaboration and long term commitment could be addressed by the development of viable business models | Lack of knowledge, PHUSICOS project approach could help to overcome or address this issue |
| Collabo-rative processes | Mixed experiences, critical reflections (e.g. Wamsler et al., 2020) as well as positive reports (Buchecker et al., 2013) | Improving understanding of natural hazards and NBSs at the local level. Topics related to economic aspects are important to awaken interest, raise awareness for multiple benefits, and promote critical reflections on timing and time needed for such processes | Expectations relate to raising awareness, learning, experiencing hands-on cases, collecting experiences, demonstrating effectiveness and viability, and new attractive business models |

## 5.2 "Hands-on" Cases for Learning and Raising Awareness of NBSs

With more learning opportunities in NBSs, knowledge and awareness of the role and meaning of NBSs is rising among stakeholders. Group work, skilled and neutral facilitation with follow-up on stakeholders are seen as an important aspect that provides these opportunities. Considering the role of academia in collaborative planning processes (Zingraff-Hamed et al., 2020c; Lupp et al., 2021), knowledge institutions can be one of the key contributors to Living Labs with knowledge generation, providing learning opportunities with elements related to the validation of the NBS concept. Often, the role of knowledge institutions can be important, and even decisive for transferring existing knowledge. Academia can provide information or generate results for the proof of concept. In particular, knowledge institutions such as universities are considered to be trustworthy.

Site or field visits were seen as the best experiences for stakeholders to learn about other NBSs. With these "hands-on" cases, stakeholders began to perceive NBSs as an opportunity for widespread environmental improvement and not as a rival to the economic aspects. Stakeholders and in particular the farmers for example perceived the buffer strips or cover-crops as a limitation to their economic potential initially. Now, because of the PHUSICOS project and Living Labs, a real-life NBS example can demonstrate that combining environmental sustainability and agricultural activities is possible and an interesting opportunity. Cleary describing the monitoring results of such NBSs supported and strengthened the results that were obtained.

## 5.3 Facing the Lack of Willingness at Governance Levels

A variety of challenges at several points of co-designing and collaborative planning of NBSs arise when looking at the initial experiences gained from coordinating the PHUSICOS sites at the beginning (Solheim et al., 2021). A number of barriers that were encountered are a result of external factors arising from governance obstacles. Overall legal frameworks or regulations such as tendering processes, specific legal framework regarding water bodies, policies and financial mechanisms in agriculture negatively affect the implementation of NBSs. Regarding stakeholder perceptions and engagement, the main barriers were:

- a lack of sense of a urgency among policy makers even after natural disasters
- a lack of political willingness for action and long-term commitment in finding a solution
- a lack of public awareness and support
- missing knowledge about hazard and exposure
- risk aversion and resistance to change
- a lack of skilled knowledge brokers and training programs on natural hazards and NBSs addressing different stakeholder groups and their level knowledge

Cancellation of intended measures from a very early stage of PHUSICS demonstrated that more time is needed to build trust and develop a close cooperation that includes the local and regional administrations as well as other relevant stakeholders such as farmers or landowners. This includes finding common ground, starting with a common understanding and defining the problem with natural hazards.

Looking at some of the results from governance analyses using retrospective cases such as the Isar (Martin et al., 2019, Zingraff-Hamed et al., 2019, Martin et al., 2021), it can be shown that despite the importance of NBSs and being at the top of political agendas, supportive governance at various levels from the European to local levels are lacking. There is a need for adaptation or change. Nonetheless, some of the barriers can be addressed on the local level, such as innovative stakeholder participatory processes and involvement supporting the formation of advocacy for NBSs. Other ways to address these barriers might be related to local policy approaches of providing funding to support implementation or follow-up activities. Municipalities, citizens and NGOs, are important actors that can drive NBS implementation in urban as well as in rural areas. Local authorities have a crucial role in integrating NBSs into location-based planning strategies. Despite a lack of clear guidance or supporting instruments from the state and regional level, committed politicians at the municipal level can drive such planning outcomes to the implementation phase (Edelenbos 2005, Wamsler 2015, Zingraff-Hamed et al., 2020b).

## 5.4 Converting Diversity of Opinions into Strengths – Facilitating Living Labs

In order to solve complex problems and to find innovative designs, partnerships and collaborative approaches have proven to be successful in implementing NBSs (Ershad Sarabi et al., 2019; Frantzeskaki et al., 2019; Zingraff-Hamed et al., 2020b). Formalized procedures for collaboration and participation can support the elaboration and implementation of such solutions (National Research Council, 2008), such as applying the Living Lab concept in PHUSICOS. With no general recipe for setting up and operating Living Labs no matter if it is seen as a methodology, system concept, or an environment, the key elements are openness, knowledge development, learning processes for all participants, and meeting on equal ground, including the parties that initiate the process. A key element of Living Labs is to place the affected parties in the centre of the processes and to find good collectively elaborated solutions.

A key challenge observed in both the literature, the Isar case and the initial interview results are the diversity of interests based on differing NBS knowledge, and also the lack of awareness of natural hazards and resulting risks in general. Based on Living Lab theory, the derived recommendations for their setup for PHUSICOS in D3.1 (Fohlmeister et al., 2018), and the experiences gained by learning from the in-depth collaborative processes at the Isar concept case (Lupp et al., 2021), skilled neutral facilitation can be a key element for success. Nonetheless, these negotiation processes

require time, resources and funding. Such is the case in hiring a neutral facilitator to moderate and to guide the processes of finding common ground. While these learning processes are explicitly addressed in PHUISCOS with a dedicated work package, some challenges remain, such as finding the time needed for building trust and common ground. Along with the challenge of impressing the stakeholders of the urgency to address natural hazards, there is a need to motivate them to continue with the processes beyond the project lifetime. Issues to be worked out are the maintenance of the chosen NBSs and the mechanisms that would make NBSs an attractive sustainable business model. Experiences showed that involving as many stakeholders as possible at a very early stage is a factor of success for collaborative planning. Furthermore, even if it is difficult to find common ground at the beginning, involving stakeholders with different backgrounds and expertise is useful for creating solutions in the long run.

Successful collaborative planning models taken from literature and examples from the Isar concept case (Lupp et al., 2021) underline the importance of skilled, neutral facilitation. It helps to consider all voices including silent or quiet voices. For collaborative planning, despite the openness of Living Labs, it was helpful to define clear goals, identify barriers and bring in possible examples as a starting point for the discussion.

## 5.5 Repeating Negative Experiences: An Avoidable Pitfall?

Even with benevolent and interested stakeholders willing to implement NBSs, the collaborative planning process can be slow. With the lack of knowledge or awareness, the creation of a more common understanding for the problem of natural hazards, the building of trust, and the overcoming of scepticism take time. Developing overall knowledge on NBSs with its mechanisms, abilities, proof of concept and providing needed learning opportunities are time consuming and demand significant resources. Creating the needed environment of trust and understanding, developing knowledge with co-designing, and implementing a solution to serve as a local hands-on case within the lifetime of a project such as PHUSICOS is one of the dilemmas.
Looking back at the Isar concept case described in depth in D3.1 (Fohlmeister et al., 2018) and D5.1 (Martin et al., 2019) we can identify that the Isar river restoration faced the same difficulties. Key findings from the Isar (Zingraff-Hamed et al., 2019; Martin et al., 2021) were that NBSs conflicted with the long history of implementing grey infrastructure. Therefore, much time and effort was needed for addressing and overcoming doubts existing in all the actor groups. Technical challenges had to be worked on, as not much experience with NBSs existed, and many prototypes had to be tested to ensure efficiency. Furthermore, restricted space and budget were strong limiting factors. Moreover, conflicts of interest had to be resolved. Even between NGOs for nature conservation, interests varied greatly. Finally, a long period of time was needed to build up the necessary trust between the stakeholders to enable effective collaborative planning (Zingraff-Hamed et al., 2019). Because of the intensive collaborative and in-depth participatory approaches within the context of a Living Lab approach (Lupp et al., 2021), the Isar Allianz leaders were able to effectively facilitate

the associations who committed to work on a common vision. The result of this was the reduction of the historical conflicts. The NGOs and especially the Isar Allianz played a special role in the overall process to bring forward the Isar River restoration. The openness of the involved public authorities to share power and take into consideration citizens voices on many occasions was a factor of success. This largely contributed to the success of the Isar Plan despite it taking much time and resources.

Since the Living Lab processes in PHUSICOS just started, it will be interesting to see and follow-up on learning and "hands-on" approaches that use the opportunity to study retrospective cases such as the Isar case. In particular, it will be interesting to see if past experiences can speed up the development of common understandings, the building of trust and the overcoming of obstacles. It will be also interesting to see if tools from the D3.2 toolbox (Fohlemeister et al., 2020b) such as participatory scenario planning (Syrbe et al., 2013) and the innovative tools that are currently being developed for PHUSICOS by WP6 such as digital VR tools or serious games can serve as eye-openers for stakeholders in the Living Lab processes.

## 5.6 Challenges with COVID-19 and Living Labs

The site owners and facilitators experienced several challenges related to the COVID-19 pandemic and related restrictions. The work with "hands-on" cases and field trips almost came to a standstill. Instead, alternative digital solutions have been sought. But despite the opportunities for digital meetings, face-to-face work is considered more effective and essential for building trust and, above all, more inclusive for participants that have trouble with digital tools. However, online formats might be easy to access for those familiar with tools such as Microsoft Teams or Zoom, and they allow for a greater overall presence at events. But this virtual format hinders the more personal exchanges and the development of trust associated with face-to-face participation. A decrease in participants was observed at sites carrying out such online meetings. This was assumed to be related to the pandemic. Despite available digital formats and tools, shifting to the digital space suffers from a "digital divide" (Ramsetty and Adams, 2020). Some stakeholders are unable to use such online tools or have little to no experience with digital means of communication. Thus, several actors have a hard time to become engaged. Case study sites experienced difficulties to reach out for certain stakeholders and groups with digital formats. This inequity is linked to age, education, income levels, available digital equipment, internet access, experience with online work and living in rural areas (Ramsetty and Adams, 2020). For this reason, digital meeting formats were considered to be a barrier for some of the stakeholders and not inclusive. Also, site visits and "hands-on" case studies were considered irreplaceable by digital formats. The same was observed for in-person meetings that build trust among the different stakeholders which does not have the same effects with online formats.

# 6 Outlook

This deliverable D3.5 provides an initial insight to the Living Labs at the PHUSICOS case study sites. It is based on literature, initial outcomes of the collaborative processes and initial impressions from the in-depth qualitative stakeholder interviews. It forms a baseline for further elaborations and analyses. With the many expectations expressed by the interviewed stakeholders in PHUSICOS at the beginning of the Living Lab processes, it will be interesting to follow up on the Living Labs and stakeholder perspectives and the development of their skills, knowledge, experience and satisfaction. In the coming years, the stakeholders will be interviewed again to assess their perspectives on NBSs, the learning processes, their expectations towards NBSs, the collaborative planning and the co-design with the Living Lab processes. In this way, more lessons from the collaborative work will be drawn. A follow-up version of this report, Deliverable D3.7 on Lessons Learned (Version 2) will capture, evaluate and update the initial findings presented in this deliverable.

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# 8 References

Atteslander, P. (2003): Methoden der empirischen Sozialforschung. De Gruyter, Berlin, New York, 411 p.

Autuori, S., Caroppi, G., De Paola, F., Giugni, M., Pugliese, F., Stanganelli, M., Urciuoli, G. (2019): Comprehensive Framework for NBS Assessment - Work Package 4 – Technical Innovation to Design a Comprehensive Framework, 58 p., https://phusicos.eu/wp-content/uploads/2019/05/D4.1_Task4.1_UNINA_14052019_Final_withAppendicies.pdf, accessed 6 April 2020.

Bark, R.H., Martin-Ortega, J., Waylen, K.A. (2021): Stakeholders' views on natural flood management: Implications for the nature-based solutions paradigm shift? Environmental Science and Policy 115, 91–98.

Bissonnette, J.F., Dupras, J., Messier, C., Lechowicz, M., Dagenais, D., Paquette, A.; Jaeger, J.A.G., Gonzalez, A. (2018): Moving forward in implementing green infrastructures: Stakeholder perceptions of opportunities and obstacles in a major North American metropolitan area. Cities 81, 61–70.

Böhm, G., Pfister, H.R. (2000): Action tendencies and characteristics of environmental risks. In Acta Psychologica 104 (3), 317–337.

Brugha, R., Varvasovszky, Z. (2000): Stakeholder analysis: A review. Health policy and Planning 15 (3), 239-246.

Buchecker, M., Salvini, G., Di Baldassarre, G., Semenzin, E., Maidl, E., Marcomini, A. (2013): The role of risk perception in making flood risk management more effective. Natural Hazards and Earth System Sciences, 13, 3013–3030.

Burgers, P., Farida, A. (2017): Community Management for Agro-Reforestation Under a Voluntary Carbon Market Scheme in West Sumatra. In Co-Investment in Ecosystem Services: Global Lessons from Payment and Incentive Schemes; Namirembe, S., Leimona, B., van Noordwijk, M., Minang, P. (Eds.); World Agroforestry Centre: Nairobi, Kenya, 2017.

Bustillos Ardaya A., Evers M., Ribbe L. (2017): Participatory approaches for disaster risk governance? Exploring participatory mechanisms and mapping to close the communication gap between population living in flood risk areas and authorities in Nova Friburgo Municipality, RJ, Brazil. International Journal of Disaster Risk Reduction 25, 227–237.

De Brabander, C.J., Martens, R.L. (2014): Towards a unified theory of task-specific motivation. Educational Research Review 11, 27-44.

Ding, L., Ren, X., Gu, R., Che, Y. (2019): Implementation of the "sponge city development plan in China: An evaluation of public willingness to pay for the life-cycle maintenance of its facilities. Cities 93, 13–30

Eckart, J., Ley, A., Häußler, E., Erl, T. (2018): Leitfragen für die Gestaltung von Partizipationsprozessen in Reallaboren, in: Defila, R., Di Giulio, A. (Eds.), Transdisziplinär und transformativ forschen. Eine Methodensammlung. Springer VS, Wiesbaden, Germany.

Edelenbos, J. (2005): Institutional Implications of Interactive Governance:
Insights from Dutch Practice. Governance 18, 111–134.

Elwood, S.A., Martin, D.G. (2000): "Placing" Interviews: Location and Scales of Power in Qualitative Research, The Professional Geographer 52(4).

Ershad Sarabi, S., Han, Q., Romme, A.G.L., de Vries, B.,Wendling, L. (2019): Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review. Resources 8, 121.

European Commission (2004): Project Cycle Management Guidelines, Brussels, 149 pp. https://ec.europa.eu/europeaid/sites/devco/files/methodology-aid-delivery-methods-project-cycle-management-200403_en_2.pdf, accessed 10 January 2019.

European Commission (2015): Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities: Final report of the Horizon 2020 expert group on 'Nature-based solutions and re-naturing cities'. Publications Office of the European Union, Brussels, 71 p.

European Commission (2020): Nature-Based Solutions – State of the Art in EU-funded Projects. European Commission; Brussels, Belgium, 308 p.

Evans, P., Schuurman, D., Ståhlbröst, A., Vervoort, K. (2017): Living Lab Methodology - Handbook (K. Malmberg & I. Vaittinen Eds.) Manchester, UK: U4IoT Consortium,76 p.

Fohlmeister, S., Zingraff-Hamed, A., Lupp, G., Pauleit, S. (2018): Guiding Framework for Tailored Living Lab Establishment at Concept and Demonstrator Case Study Sites: Work Package 3 – Service Innovation: Stakeholder Participation through Living Labs. Technical University Munich, 68 pp. https://phusicos.eu/wp-content/uploads/2018/10/D3_1_GF_Final_Version_complete_201807312-Disclaimers.pdf, accessed 7 December 2018.

Fohlmeister, S., Tiebel, M., Augenstein, I. (2019a): Monitoring & Evaluation Scheme to Assess Stakeholder Participation and User Satisfaction with Living Lab Experience – Version 1. Work Package 3 – Service Innovation: Stakeholder Participation through Living Labs. Technical University Munich, 83 p.

Fohlmeister, S., Augenstein, I., Jones, C., Ramirez, D., Lupp, G. (2019b): Starter Toolbox for Stakeholder Knowledge Mapping to Co-Design Nature-Based Solutions at Case Study Sites Work Package 3 – Service Innovation: Stakeholder Participation through Living Labs. Technical University Munich, 156 p.

Fohlmeister, S., Tiebel, M., Augenstein, I. (2020): Monitoring & Evaluation Scheme to Assess Stakeholder Participation and User Satisfaction with Living Lab Experience – Version 2. Work Package 3 – Service Innovation: Stakeholder Participation through Living Labs. Technical University Munich, 89 p.

Frantzeskaki, N., McPhearson, T., Collier, M.J., Kendal, D., Bulkeley, H., Dumitru, A., Walsh, C., Noble, K., van Wyk, E., Ordóñez, C.; et al. (2019): Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making. BioScience 269, 455–466.

Guijt, I., Woodhill, J., (2002): Managing for Impact in Rural Development: A Guide for Project M&E, Rome, 239 p.

Han, S.; Kuhlicke, C. (2019): Reducing Hydro-Meteorological Risk by Nature-Based Solutions: What Do We Know about People's Perceptions? Water 11, 2599;

Heitz C., Spaeter S., Auzet A.-V., Glatron S. (2009): Local stakeholders' perception of muddy flood risk and implications for management approaches: A case study in Alsace (France). Land Use Policy 26, 443–451.

Hoyle, H., Jorgensen, A., Warren, P., Dunnett, N., Evans, K. (2017): "Not in their front yard" The opportunities and challenges of introducing perennial urban meadows: A local authority stakeholder perspective. Urban Forestry & Urban Greening 25, 139–149.

Hüesker, F., Begg, C., Kuhlicke, C., Barquet, K., Segnetsam, L (2019). Preparing Co-Creation: Stakeholder Analysis; RECONECT: Brusel, Belgium, Volume D2.1, 152 p.

Hunziker, M. (2000): Einstellung der Bevölkerung zu Möglichen Landschaftsentwicklungen in den Alpen, Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf.

Huq, N. (2017): Stakeholder's Perceptions to Natural Flood Management (NFM): a Descriptive Assessment of Cumbria County in England. Agricultural Research & Technology 4 (4).

IAP2 (2018): IAP2 Spectrum of Public Participation, 1 p. https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf, accessed 2 April 2019.

Leminen, S. (2013): Coordination and Participation in Living Lab Networks. Technology Innovation Management Review 3(11), 5–14.

Lindell, M.K., Perry, R.W. (2012): The Protective Action Decision Model: Theoretical Modifications and Additional Evidence Risk Analysis 32 (4).

Lindell, M.K., Perry, R.W. (2012): The Protective Action Decision Model: Theoretical Modifications and Additional Evidence Risk Analysis 32 (4) https://doi:10.1111/j.1539-6924.2011.01647.x

Liski A.H., Ambros P., Metzger M.J., Nicholas K.A., Wilson, A.M.W., Krause T. (2019): Governance and stakeholder perspectives of managed re-alignment: adapting to sea level rise in the Inner Forth estuary, Scotland. Regional Environmental Change 19, 2231–2243.

Lupp, G., Heuchele, L., Renner, C., Konold, W., Siegrist, D. (2016): Biodiversity, Climate Change and Outdoor Recreation: Stakeholder Perception, Motivation and Spatial Scenarios for Adaptive Management in Protected Areas. International Journal of Climate Change Strategies and Management 8 (3), 356-374.

Lupp, G., Zingraff-Hamed, A., Huang, J.J., Oen, A., Pauleit, S. (2021): Living Labs—A Concept for Co-Designing Nature-Based Solutions. Sustainability, 13, 188.

Lynam, T., De Jong, W., Sheil, D., Kusumanto, T., Evans, K. (2007): A review of tools for incorporating community knowledge, preferences, and values into decision making in natural resources management. Ecology and Society 12 (1), 5.

Maidl, E., Bresch, D.N., Buchecker, M. (2019): Culture matters: factors influencing natural hazard risk preparedness - a survey of Swiss households, Nat. Hazards Earth Syst. Sci. Discuss.

Marshall, C., Rossman, G. B. (1998): Designing Qualitative Research. Thousand Oaks, CA: Sage. 321 p.

Mañez, M., Carmona, M., Haro, D., Hanger, S. (2016): Risk perception. In: Novel Multi-Sector Partnerships in Disaster Risk Management. Results of the ENHANCE Project; Aerts, J., Mysiak, J., Eds.; Commissioned EU FP7 Project ENHANCE: Brussels, Belgium, 51–67.

Martin, J.; Bayer, J., Liu, W.; Scobolig, A. (2019): NBS in-depth case study analysis of the characteristics of successful governance models - Work Package 5 – Governance Innovation. https://phusicos.eu/wp-content/uploads/2019/12/D5_1_NBS-in-depth-case-study-analysis_Final-2.pdf, accessed 6 April 2020.

Martin, J.G.C., Scolobig, A., Linnerooth-Bayer, J., Liu, W., Balsiger, J. (2021): Catalyzing Innovation: Governance Enablers of Nature-Based Solutions. Sustainability. 13(4), 1971. https://doi.org/10.3390/su13041971

Mayring, P. (2000): Qualitative Inhaltsanalyze – Grundlagen und Techniken, 7. Auflage. Beltz Deutscher Studien Verlag, Weinheim, Basel, 135 p.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. (2009): Reprint – Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. Physical Therapy 89(9), 873–880.

Murray-Webster, R., Simon, P. (2006): Making Sense of Stakeholder Mapping. PM World Today Tips and Techniques. Published in PM World Today - November 2006 (Vol. VIII, Issue 11) "Connecting the World of Project Management".

National Research Council (2008): Public Participation in Environmental Assessment and Decision Making: Panel on Public Participation in Environmental Assessment and Decision Making; Dietz, T., Stern, P.C., Eds.; National Academies Press: Washington, DC, USA, 322p.

Pagano, A., Pluchinotta, I., Pengal, P., Cokan, B., Giordano, R. (2019): Engaging stakeholders in the assessment of NBS effectiveness in flood risk reduction: A participatory System Dynamics Model for benefits and co-benefits evaluation. Science of the Total Environment 690, 543–555; https://doi.org/10.1016/j.scitotenv.2019.07.059

Pagliacci, F., Defrancesco, E., Bettella, F., D'Agostino, V. (2020): Mitigation of Urban Pluvial Flooding: What Drives Residents' Willingness to Implement Green or Grey Stormwater Infrastructures on Their Property? Water 12, 3069.

Perosa, F., Fanger, S., Zingraff-Hamed, A., Disse, M. (2021): A meta-analysis of the value of ecosystem services of floodplains for the Danube River Basin, Science of The Total Environment 777, 146062 https://doi.org/10.1016/j.scitotenv.2021.146062.

Piacentini, S.M., Rossetto, R. (2020): Attitude and Actual Behaviour towards Water-Related Green Infrastructures and Sustainable Drainage Systems in Four North-Western Mediterranean Regions of Italy and France. Water 12, 1474; https//doi.org/10.3390/w12051474

Portugal Del Pino, D., Borelli, S., Pauleit, S. (2020): Nature-Based Solutions in Latin American Cities. In: Brears R.C. (eds) The Palgrave Handbook of Climate Resilient Societies. Palgrave Macmillan, Cham. Online first, https://doi.org/10.1007/978-3-030-32811-5_120-1

Ramsetty, A., Adams, C. (2020): Impact of the digital divide in the age of COVID-19. Journal of the American Medical Informatics Association 27(7), 1147–1148; https://doi.org/10.1093/jamia/ocaa078

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L. C. (2009): Who's in and why? A typology of stakeholder analysis methods for natural resource management. Journal of environmental management 90(5), 1933–1949.

Ridder, D., Mostert, E.,Wolters, H.A. (2005): Learning together to manage together. Improving participation in water management. Harmonizing Cooperation in Planning (HarmoniCop) comp., ed. and designed by the HarmonyCop Team; core ed. team: D. Ridder, E. Mostert, H.A. Wolters. University of Osnabrück, Osnabrück, 99 p.

Santoro, S., Pluchinotta, I., Pagano, A., Pengal, P., Cokan, B., Giordano, R. (2019): Assessing stakeholders' risk perception to promote Nature Based Solutions as flood protection strategies: The case of the Glinščica river (Slovenia). Science of The Total Environment 655, 188–20.

Strauss, A., Corbin, J. (1990): Basics of Qualitative Research, Grounded Theory Procedures and Techniques, Sage, New Bury Park, CA, London, New Delhi.

Solheim, A., Capobianco, V., Oen, A., Kalsnes, B., Wullf-Knutsen, T., Olsen, M, Del Seppia, N., Arauzo, I., Garcia Balaguer, E., Strout, J. M. (2021): "Implementing Nature-Based Solutions in Rural Landscapes: Barriers Experienced in the PHUSICOS Project" Sustainability 13(3): 1461.

Van der Jagt, A., Anton, B., Reil, A., DeBellis, Y., Fischer, L., Kowarik, I., Cvejić, R., and Mårsén, A. (2017): Cities and Researchers learning together: What does it take? Evaluating the process of iterative knowledge exchange and outcomes generated in each of the Urban Learning Labs and Learning Alliances. GREEN SURGE Deliverable 8.7. Brussels, Belgium, 63 p.

Venkataramanan, V., Lopez, D., McCuskey, D.J., Kiefus, D., McDonald, R.I., Miller, W.M., Packman, A.I., Young, S.L. (2020): Knowledge, attitudes, intentions, and behavior related to green infrastructure for flood management: A systematic literature review, Science of The Total Environment 720, 137606.

Voorberg, W.H., Bekkers, V.J.J.M.; L.G. Tummers, (2014): A Systematic Review of Co-Creation and Co-Production: Embarking on the social innovation journey, Public Management Review.

Wamsler, C. (2015): Mainstreaming ecosystem-based adaptation: Transformation toward sustainability in urban governance and planning. Ecology and Society 20 (2).

Wamsler, C, Alkan-Olsson, J, Björn, H, Falck, H, Hanson, H, Oskarsson, T, Simonsson, E, Zelmerlow, F (2020): Beyond participation: when citizen engagement leads to undesirable outcomes for nature-based solutions and climate change adaptation. Climatic Change 158, 235–254.

Zingraff-Hamed, A., Martin, J., Lupp, G., Linnerooth-Bayer, J., Pauleit, S. (2019). Designing a Resilient Waterscape Using a Living Lab and Catalyzing Polycentric Governance. Landscape Architecture Frontiers 7(3), 12-31.

Zingraff-Hamed, A., Hüesker, F., Lupp, G., Begg, C, Huang, J, Oen, A., Vojinovic, Z., Kuhlicke, C., Pauleit, S., (2020): "Stakeholder Mapping to Co-Create Nature-Based Solutions: Who Is on Board?" Sustainability 12(20): 8625.

Zingraff-Hamed A., Schröter B., Schaub S., Lepenies R., Stein U., Hüesker F., Linton J., Meyer C., Nicolas C., Schleyer C., Schmeier S., Schröder N., Watson N., Pusch M. (2020a): Bottlenecks for the implementation of the European Union Water Framework Directive principles and instruments – governance, planning processes and institutional obstacles, Water alternatives 13(3); 458-483.

Zingraff-Hamed A., Hüesker F., Albert C., Brillinger M., Huang J., Lupp G., Scheuer S., Schlätel M., Schröter B. (2020b): Governance Models for Nature-based Solutions: cases from Germany, Ambio.

Zingraff-Hamed A., Hüesker F., Lupp G., Begg C., Huang J., Oen, A., Vojinovic Z., Kuhlicke C., Pauleit S. (2020) Stakeholder Mapping to Co-Create Nature-Based Solutions: Who Is on Board? Sustainability 12, 8625.


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# Appendix A

Questionnaire for in-depth Stakeholder interviews

### List for Questions for the WP3 Baseline Assessment

# Protocol interviews with selected stakeholders

**Q.0 Introductory questions:**

Q 0.1 Please briefly introduce yourself, your background and your function in the organization

## Q.1 Meeting the Concept of Nature Based Solutions:

**Q.1.1a How have you been involved in measures or solutions to reduce hydro-meteorological risks?**

**Q1.1b How would you describe these solutions? Were they traditional grey engineering solutions or were ecosystem Based solutions/green engineering/Nature Based Solutions among them?**

**Q1.1c Have you heard about Nature Based Solutions?**

**Q.1.2 Which sources of inspiration or information do you use to inform, design or decide about the design and implementation of measures to reduce hydrometeorological risks?**

Please reflect on potential inspirations from science and education or professional training, media (other than related to professional training or education) and role of your professional contacts but also your private surrounding

**Q.1.3 PHUSICOS is a European funded research and innovation project focusing on Nature Based Solutions to reduce hydro-meteorological risks. What has been the role of PHUSICOS in getting inspirations so far and how could PHUSICOS contribute to provide inspiration for you for the design and implementation of alternative solutions to reduce hydrometeorological risks?**

## Q.2 Benefits of, concerns/preoccupations about and barriers for implementing Nature Based solutions

### Q.2.1 What do you think are the main benefits of implementing alternatives to grey solutions?

### Q.2.2 What would be your concerns about implementing alternatives to grey solutions?

### Q2.3 What might be the main barriers to implementing alternatives to grey solutions?

Please reflect on technical aspects, human and societal aspects or governance aspects (regulative framework and administrative settings) that might lead to opt for a traditional grey solution or not taking action at all.

## Q.3 Living Labs

In PHUSICOS, an important activity is the active involvement of participants and Stakeholders beyond a “business as usual” approach. This activity is referred to as Living Labs.

**Q3.1 How can the PHUSICOS Living Labs generate new knowledge and truly develop, co-design and implement together with different stakeholders new forms of non-grey solutions to address hydrometeorological risks?**

**Q3.1a What might be benefits of such an approach?**

**Q3.1b What might be concerns of such an approach?**

**Q3.1c What might be barriers for such approaches?**

Do these barriers exist in general or are they only related to new forms of non-traditional solutions?

**Q3.2 What contents or topics would you, from your perspective, like to discuss and elaborate in the Living Labs?**

**Q3.3 What would you like to see as outcomes of the PHUSICOS Living Labs?**

**Q.3.4 Is there anything else you would like to share with us or is there something important for you that we have not asked about?**

**Q.3.5 Would you be willing to participate again in an interview to reflect again on these points and share your views on the experiences made with PHUSICOS?**

Thank you very much for taking your time! They provide very valuable and very relevant inputs to stimulate and improve Living Lab processes.

# Appendix B

Questionnaire for Site Owners and Facilitators

First Round at the Beginning of the Living Lab Processes

List for Questions for the WP3 Baseline Assessment

# Question for Site Owners and Facilitators

**Please fill the questionnaire in considering your perception namely your point of view.**

**Case Study Site:**

## Q.1 Perceived learning about Nature Based Solutions:

**Q.1.1 What is your experience so far with stakeholders and their knowledge on Nature-Based solutions? What was the starting point when stakeholders met with PHUSICOS? Depending on your state of Living Labs – where does knowledge increase and what were the most interesting step stakeholders took since the very beginning?**

**Q.1.2 How do you try to address and provide opportunities for stakeholders to learn about Nature-Based solutions? Which points or aspects of NBS and/or Living Lab processes are most interesting for stakeholders (Please also consider your "small" exchange formats that are "below the radar" that cannot be captured with the questionnaires provided by the Monitoring and Evaluation scheme)**

**Q.1.3 From your point of view, how have/can PHUSICOS support stakeholders, their interests and learning process about NBSs (both concept so as measures)?**

## Q.2 Benefits of, concerns/preoccupations about and barriers for implementing Nature Based solutions

**Q.2.1 In your opinion, which are the main benefits of NBS for the stakeholders?**

**Q.2.2 Which concerns about implementing alternative solutions to grey solutions do you observed? Do you think that this concern(s) can be easily addressed within the Living Labs?**

**Q.2.3 Which barriers in the planning/implementation/monitoring process have been identified by the stakeholder as barriers? Did these barriers congestioned or delay the process? Could they be solved or adressed in the Living Lab processes?**

## Q.3 Living Labs

**Q.3.1a What are your impressions about the benefits of Living Labs so far?**

**Q.3.1b Which concerns do you have about the Living Lab approach?**

**Q.3.1c Which might be the barriers for working with Living Lab approaches to co-design/implement/monitor NBS?**

Do these barrier are related to the Living Lab process, to the solution targeted or related to other reasons?

**Q.3.1d Which meeting formats have been implemented before the COVID-19 pandemic and which ones were the most fruitful ones? (Site visits, small group meeting, large group meeting, face-to-face meeting, phone call, phone conference, informal meetings?**

**Q.3.1e Which meeting formats do you try to implement during COVID-19 pandemic? Which were a success and which not? Why?**

**Q.3.1f Do you have recommendations on how to document Living Lab activities (even small meetings, 1:1 exchanges, and site visits) so they could serve for the M&E reporting tasks?**

**Q.3.2 What would you like to see as outcomes of the PHUSICOS Living Labs from a Facilitator Perspective?**

**Q.3.3 What would be your lessons learned so far on Living Labs so far? Any recommendations already for Living Labs?**

**Q.3.4 Is there anything else you would like to share with us or is there something important for you that we have not asked about?**

Thank you very much for taking your time!