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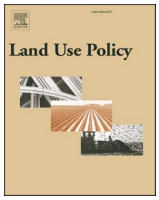

Context matters: Co-creating nature-based solutions in rural living labs

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ABSTRACT

The use of Nature-based Solutions (NBS), designed and implemented with participatory approaches, is rapidly increasing. Much use is being made of the Living Lab (LL) concept to co-create innovative NBS with stakeholders in a certain societal and environmental, real-life context. Most of the current research revolves around urban LLs, thus overlooking specificities of rural areas. Furthermore, the influence of the context itself on co-creation processes is insufficiently recognised, leaving challenges associated with co-creation such as stakeholder engagement unresolved. By exploring the co-creation processes in the LLs of the OPERANDUM project, this study identifies eighteen contextual factors shaping the co-creation processes of NBS within rural territories and provides associated recommendations. In addition, based on lessons learnt in the OPERANDUM project, we discuss the value of a relational place-based approach in LLs, suggesting that the co-creation process should be approached as a dynamic confluence of many interconnected contextual factors. We conclude that acknowledging the interconnections in co-creation in the real-life context of rural territories may increase the success and impact of the LL approach, and ultimately, the benefits of NBS.

1. Introduction

Nature-based solutions (NBS) represent a rapidly adopted new "green" concept that has been promoted by various national and international organizations (e.g. Hanson et al., 2020; IUCN, 2020). They are defined in multiple ways, but generally NBS are expected to solve societal challenges by using natural processes and materials with various benefits to society and the environment. Here we follow the definition of NBS by the European Commission as "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" (European Commission, 2015). NBS should take into account the surrounding social-ecological system and its functions, be environmentally sound, socially acceptable, and economically feasible to implement and manage (Nesshöver et al., 2017; Kumar et al., 2020).

To meet these requirements, participatory approaches, i.e. engagement of a variety of stakeholders such as private businesses, planning

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authorities, landscape planners, ecologists, citizens and citizen groups, and academics, are favored in the planning and implementation of NBS in order to generate environmental, social (Franzeskaki, 2019; Kumar et al., 2020; Puskás et al., 2021; Pilla et al., 2021), and economic benefits (Kooijman et al., 2021). Participatory approaches in general are promoted by EU and international guidelines (such as IUCN's Standards for NBS [2021]), policies and associated research and funding programs. They are also strongly supported by transdisciplinary sustainability-oriented environmental research (Lang et al., 2012). As a result, various "co-approaches" (see e.g. Hakkarainen et al., 2022), such as co-design, co-development and co-creation of NBS, with an emphasis on producing knowledge and solutions with relevant stakeholders are increasingly being applied in projects related to NBS (Santoro et al., 2019; Pagano et al., 2019; Faivre et al., 2017; Kumar et al., 2020; Nesshöver et al., 2017; Raymond et al., 2017). Potential benefits of this inclusive approach for NBS include securing cooperation of private landowners, long-term use, and greater potential for upscaling and repetition, among others (Anderson and Renaud, 2021a). Overall, co-creation is expected to lead to socially accepted place-based solutions that contribute to sustainability transition and transformation (Hakkarainen et al., 2022).

1.1. Real life context and co-creation as key characteristics of Living Labs

The Living Lab (LL) concept is used in participatory planning and design across various sectors in the fields of sustainability, environmental management, conservation, and more recently also NBS (Lupp et al., 2021). Living Labs were first introduced in the design of innovative information and communications technology (ICT) (European Network of Living Labs 2019; Zavratnik et al., 2019, Hossain et al., 2019). Currently, LL concept refers generally to experimental research approaches (Bergvall-Kareborn and Stahlbrost, 2009; Leminen, 2015; Hossain et al., 2019) under a broad umbrella of "real-world laboratories" (Schäpke et al., 2018). Despite the diversity in definitions and application contexts (Hossain et al., 2019), the common and interconnected principles of LL are *real-life contexts (or arena)* and *co-creation* (or *approach*) (Westerlund and Leminen, 2011; Schliwa, 2013, Coorevits and Jacobs, 2014). The real-life experimental context provides an asset for the co-creation process; i.e. collaboration with the stakeholders (users of the knowledge or solutions) to identify problems, design the project, explore the solution options, and deploy them (Hossain et al., 2019; Norström et al., 2020). The context is of critical importance not only for the innovation process, but also for a more structured scalability of the results by highlighting similarities in physical and socio-economic settings between different LLs.

Although there is agreement that a LL is embedded in a real-life context, the LL literature shows that there are diverse understandings of what real life context means and what kind of role it can play in the co-creation process (Hossain et al., 2019). From the current discussion we discern three approaches: First, a real-life context can refer to a physical context as such as a city, rural area, region or even a country (Leminen, 2015; Hossain et al., 2019) with certain, socio-economic, cultural, political characterisctics and governance structures. Here cities (Urban Living Labs, ULLs) are most often defined as a specific context or area (e.g.Voytenko et al., 2016; Franzeskaki, 2019). Secondly, real life context has been used to refer to different innovation activities, e.g. testing and validating ideas and prototypes; feed the innovation process with place-based knowledge and expertise to solve problems; find locally attuned solutions options (Leminen, 2015; Bergvall-Kåreborn et al., 2015) leading to collective learning (Knickel et al., 2019) and networking (Knickel et al., 2019; Leminen, 2015). Thirdly, some researchers have used the concepts of 'place' and 'space' to better understand the LLs as innovation environment (Bergvall-Kåreborn et al., 2015), participants relations and connections to their environment (Franzeskaki, 2019) or public stakeholders' acceptance of NBS in LLs (Anderson et al., 2021b).

As mentioned above, within a LL, the co-creation approach is often used to find solution options to a given problem in the LL. There are various ways to understand co-creation depending on the discipline or sector in which it is used. In transdisciplinary sustainability science literature, to which this research is associated, it is defined as an umbrella concept used to describe a process including co-design, co-development, co-production of knowledge, co-deployment and management of the solution, as well as associated social learning (Schmidt et al., 2020; Hakkarainen et al., 2022). A similar description is given in LL literature: to explore, co-create, implement, and evaluate solution options in an iterative process (Leminen, 2011). By bringing different types of stakeholders and knowledge together, co-creation aims not only to increase the legitimacy and quality of the sustainable solutions (in this case NBS), but also to enhance (social) learning, thereby enhancing and enabling a sustainability transition or transformation (West et al., 2020; Hakkarainen et al., 2022). It is therefore essentially about formation of new relationships between people, organisations, institutions, places and spaces, and different knowledges.

It is widely agreed in the relevant literature that a successful co-creation should be tailored to the context where it is applied and involve relevant stakeholders in the process to bring in diverse knowledges to increase the co-benefits, legitimacy and acceptance of the solutions, and enhance learning (Durham et al., 2014). Yet, many challenges have arised when co-creating NBS, and they have been identified and reported especially in the urban LLs (Kabisch et al., 2016; Puerari et al., 2018; Ferreira et al., 2020; Puskás et al., 2021; Ramírez-Agudelo et al., 2020). Often they are related to ownership of the problem (i.e. the public sector is expected to have responsibility), the demand for time and resources required for co-creation, a low number of participants (e.g. due to stakeholder fatigue), conflicts between opposing stakeholders, and unrealistically high expectations from participants resulting in disappointment rather than compromise. The few studies on co-creation of NBS in European LLs in rural, areas, show similar challenges and barriers as in urban areas (e.g. Solheim et al., 2021).

Against this background, we find two main gaps in the research that should be addressed regarding co-creating NBS in LLs. First, although previous studies enrich the understanding of context in the LL, we argue that we need a better understanding of the opportunities and challenges the context may present for co-creation. Since LLs are embedded in the real-life context, this means that the co-creation is influenced by real-life contexts while at the same time shaping the context (see Fig. 1.). However, in academic literature the focus has been mostly on the latter; the influence of the co-creation process on the context including the actors involved and society more broadly (see e.g. Langley et al., 2018). Neglecting the influence of the context on co-creation may lead to standardized and "placeless" processes, and the underlying reasons for possible success factors as well as problems (e.g. stakeholder fatigue) in LL may remain poorly understood. We argue that embeddedness of the co-creation in the dynamic socio-ecological system context is of particular importance for LL focusing on NBS and other environmental innovations, where even natural processes may also have an agency.

Second, until now, most of the research on NBS with LL approach has been concerned with the urban context (Hanson et al., 2020; Bona et al., 2022) and some authors have even attempted to characterize "urban living labs" (ULLs) (McCrogy et al., 2020; Voytenko et al., 2016; Chronéer et al., 2019, Puerari et al., 2018). Only few studies concern LLs for NBS in rural territories (Solheim et al., 2021; Accastello et al., 2019), although some others LL have focused more generally on social, economic and cultural development of rural communities (Zavratnik et al., 2019; Knickel et al., 2019), or agri-food systems (McPhee et al., 2021). Although 'rural areas' remain conceptually, geographically and culturally diverse, they often share some common characteristics, for example, in lower population, demographical composition, land ownership, planning culture and governance, natural, cultural, and economic assets. Rural environments also enable large scale NBS. Therefore, it can be

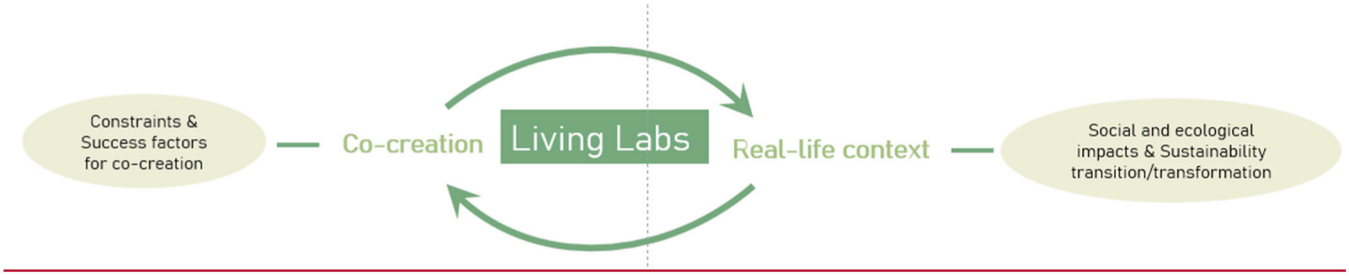

Fig. 1. Research setting: the relation between real-life context and co-creation.

expected that co-creating NBS in rural territories diverges from efforts in an urban context (Voytenko et al., 2016; Chronéer et al., 2019; Ferreira et al., 2020).

Against these two knowledge gaps, the first aim of this paper is to explore and identify contextual factors related to the rural territories that may influence the co-creation of NBS. To this end, we provide a list of key factors to consider, when co-creating the NBS in rural territories and provide recommendations in relation to these factors in terms of "best practices" based on experiences in the OPERANDUM project. The second aim is to further elaborate the role of the contextual factors in the co-creation to guide the initial design and implementation of co-creation process, in particular for NBS in rural areas. Thus, empirically, the results will create novel and relevant knowledge on co-creating NBS in rural territories with recommendations for similar projects, as well as potential differences to consider when compared against NBS in urban areas. Theoretically, the paper opens the discussion on applying a more relational place-based approach for LL to be further elaborated.

1.2. Characterizing the open air laboratories (OALs) of the OPERANDUM project

This research has been conducted in the OPERANDUM project (Open Air Laboratories for NBS to Manage Hydro-Meteorological Risks). The OPERANDUM project aims 1) to develop climate-proof NBS against hydrometeorological hazards through a co-creation process; 2) to monitor and evaluate the performance of the NBS in mitigating hydro-meteorological hazards; and 3) to create the applicable knowledge enabling their replication, upscaling and establishment as dominant solutions for the specific hazards involved (Kumar et al., 2020; Debele et al., 2019). This work was carried out in Open Air Laboratories (OALs) across six European countries (Table 1.). The OALs have followed a LL approach, but with a special focus on providing scientific evidence for the usability, replication and up-scaling of the NBS. By engaging multiple levels of stakeholders, the OALs aim to achieve broad acceptance, strengthen the local policy frameworks for NBS, and promote technology and innovation. The OALs are mostly located in rural territories and exposed heavily to one or more hydro-meteorological hazards exacerbated by climate change. Many of these areas are also facing several social and economic challenges, such as depopulation, youth brain drain, low diversification of job opportunities, or limited access to health, educational, and governmental services (Kumar et al., 2020).

The OALs are different in terms of size, hazards and risks as well as the planned NBS, social-economic system and composition of the type of the stakeholders (Table 1). Each OAL team has researchers with various expertise ranging from natural sciences, environmental modelling, and economics to social sciences and humanities and other stakeholders, who were carefully mapped and engaged at the beginning of the project. The OALs entered the OPERANDUM project with a different degree of maturity on several aspects: prior knowledge and know-how regarding the social-ecological systems and the stakeholders, experience of the hazards, and degree of previous NBS and co-creation carried out (D 1.3.). The OALs applied a shared co-creation process that was jointly developed within the OPERANDUM project ranging from stakeholder mapping, stakeholder engagement strategies to co-creation guidelines in order to support well-planned and conscious forms of working together with the stakeholders in a transdisciplinary research environment. The co-creation process of OAL Austria has been described in Fig. 2.

2. Material and methods

The study is based on three different datasets derived from 1) relevant deliverables from the OPERANDUM project (dataset 1), 2) focus group discussions among the OPERANDUM researchers in each OAL (dataset 2), and 3) two participatory workshops with OPERANDUM OAL researchers (dataset 3) (Fig. 3.). The first dataset was derived from the relevant deliverables from the OPERANDUM project (especially D1.2.; D1.3.; D2.1.; D2.2.; D3.1; D3.4; D4.1.; D6.2, see the full list of OPERANDUM Deliverables here: https://www.operandum-project.eu/deliverables/. These reports were analyzed qualitatively and commonalities and differences of the social-ecological context and their relevance in the co-creation of the OALs were identified using thematic analysis. Next, the experiences and lessons learnt from the co-creation process across the OALs were explored in focus groups in five rural OALs (OAL Austria, Greece, Italy, Finland, Scotland). German OAL provided their comments in the later phase of the process.

(N = 25) using the Transdisciplinary Wheel (TD wheel) (Carew and Wickson, 2010). The TD wheel is a framework to shape, support, and evaluate the different aspects of co-creation in transdisciplinary research, in particular those concerning the research context. It identifies broadly the important factors for evaluating transdisciplinary research that go beyond the stakeholders, such as issues related to the role of the research problem, research context and researchers. Carew and Wickson (2010) distinguish three different types of context: the problem context refers to the broad social or environmental setting of the research problem, the research context to the institutional aspects and support, and the researcher(s') context to the skills, experiences and intentions of the researcher/s engaged in the project (Carew and Wickson, 2010). The discussions were recorded and notes of the key findings relevant for this study were taken (dataset 2).

Based on the analysis of the first and second datasets, the preliminary factors that were considered to be critical for co-creation processes in the OALs were identified, and organized under four main contexts with associated factors in a table: 1) area/territory; 2) socio-economic aspects; 3) institutional and governance aspects; and 4) NBS. To create the third dataset, two semi-structured workshops (N = 7 +4) were organized with OAL leaders to discuss and elaborate the preliminary results from datasets 1 and 2 in relation to co-creation using partially prefilled tables as a basis for discussion, while also collecting new topics. The discussion revolved around the five dimensions and corresponding factors identified and the role of the LL context according to seven OAL leaders' specific experiences at their respective OALs. The contrast to urban LLs and NBS was also considered when possible. Based on the

Table 1
Characteristics of rural OPERANDUM OALs. We list only several key stakeholder characteristic to each site, besides local residents, land-owners,that are important stakeholders in all OALs. For a description of OALs with photos and more information on the stakeholders and co-creation process, see the OPERANDUM NBS GeoIKP page: https://geoikp.operandum-project.eu/oal/explorer.

OALS	Approximate OAL size (ha)	Hazards	Exposed elements and risks	Social-ecological context	NBS	Key stakeholder examples
ITALY (Bellocchio site)	150	Coastal erosion, storm surge, coastal flooding	Economic and livelihood impact on tourism, fisheries, agriculture and industry	Bellocchio Beach is a fully natural area within the Po Delta Biosphere Reserve, which is then surrounded by mostly artificial land. The greater area is a popular European touristic hub.	Artificially vegetated dune consolidated with natural engineering	The Management Board for Parks and Biodiversity - Delta Po Park, Authorities of the Emilia-Romagna Region (RER), Carabinieri for biodiversity - Punta Marina (Ravenna)
ITALY (Panaro site)	267,000	River flooding	Economic and livelihood impact on services and industry	The Panaro river is the final right-hand tributary of the Po River, with a basin of 2292 km2. The basin is the largest and most populated area of all OAL sites, with many industrial and agricultural activities, including livestock. The area has always been subject to flooding.	Herbaceous perennial deep-rooting plants as coverage of river embankments for preventing riverbank failures due to erosion	Inter-regional Agency of the Po River (AIPO), PratiArmati, Municipality of Bomporto
ITALY (Po di Goro site)	100,000	River flooding, drought, salt intrusion	Economic and livelihood impact on services, industry, agriculture, tourism; private property including residential and agricultural; infrastructure, and agricultural land	The Po di Goro river departs from the right bank for the Po River and flows into the Adriatic sea. The area is characterized by population growth, increased intensity of tourism and the agriculture sector. It is often affected by severe drought in the summer due to low rainfall and high temperature.	Plants along river embankment	RIS SAS Strategie per l'Ambiente (The Regional Agency of Land Security and Civil Protection Emilia-Romagna Region; ARSTePC), Carabinieri for Biodiversity – Punta Marina (Ravenna)
FINLAND (Lake Puruvesi catchment area)	101,601	Nutrient and sediment accumulation in the lake, eutrophication and algal blooms	Ecosystem degradation, reduced water quality, loss of tourism, fishing (also through changes in populations of fish species), aquatic recreation, aesthetics	Forests and semi-natural areas are the main land cover type. Surface water covers 54% and 44% of the land area. Forestry is most important form of land-use, followed by agriculture. High runoff peaks due to heavy rain or snowmelt impose suspended solid load, nutrient leaching and further eutrophication. Agriculture and forestry constitute around 10% of the livelihoods, while services (both public and private, incl. tourism) are most important livelihoods	1) continuous cover forestry 2) riparian buffer zones 3) constructed wetlands 4) sedimentation ponds 5) Peak flow runoff structures	Pro Puruvesi, Finnish Forest Centre, South Savonia-ELY centre, Forest owners' association, private forest owners
AUSTRIA (Watten Valley)	554	Landslide	Damage to managed forests and farmland, buildings, roads, power lines and water supply pipelines	Forests and semi-natural areas are the main land cover type. Most mountain farms are small and family owned. The main economic activities are agriculture and forestry, but residents have other external income-generating activities. Landslide velocity correlates with high groundwater levels.	1) Optimization of forest management 2) Nature-based sealing of streams and channels	Austrian Research Center for Forests (BFW), Austrian Service for Torrent and Avalanche Control (WLV), Municipality of Wattens
UNITED KINGDOM (Catterline)	30	Landslide and surface erosion	Potential future injury or death, damage to residential property and access roads, loss of recreation and aesthetics	Small village of ca 170 inhabitants located adjacent to Catterline Bay atop a series of slopes and cliffs rolling into the North Sea. The main land use is	Live pole drain (vegetated drainage system); live ground anchors, high density planting (planting for slope stabilization), live cribwall, live slope	Catterline Braes Action Group (CBAG), Naturalea, Aberdeenshire Council

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Table 1 (*continued*)

OALS	Approximate OAL size (ha)	Hazards	Exposed elements and risks	Social-ecological context	NBS	Key stakeholder examples
				agricultural land and pastures. Catterline residents are mainly employed by services and administration sectors outside of the community, but many are retired. Landslide events are triggered by heavy rainfall and surface water accumulation on the slopes and cliffs.	lattice, live palisade (vegetated retaining solutions), brush layer (fascine-based terraces)	
GERMANY (Biosphere Reserve 'Lower Saxony Elbe Valley')	56,741	Flood and drought	Economic and livelihood impact on agriculture and tourism, damage infrastructure	As part of the UNESCO Elbe River Landscape Biosphere Reserve, large areas of the OAL belong to the European protected area system NATURA 2000. Different protections zones types apply, whereby ca. 30% are settlements and their surroundings, agricultural and forestry usage areas. Grassland, arable land and woodland, fulfilling the requirements of landscape protection, covers 35%. The area under nature conservation protection covers a further 35%. The area was designated a "Model Region for Sustainable Development" by the state government to promote the economy and tourism.	Cooperative floodplain management	Biosphere Reserve Administration;, State Agency for Water Management, Coastal Protection and Nature Chamber of Agriculture Farmers Association;
GREECE (Spercheios River Basin)	210,695	Flood and drought	Potential future injury or death; damage to residential and agricultural property, access roads; loss of recreation, livelihood	Forests and semi-natural areas are the main land cover type. Agriculture is the most important means of living, followed by services and administration.	Natural water retention basins with dikes	Environmental Agency for Biodiversity & NATURA, ERGOSE, University of Athens

discussions, the dimensions and some of the factors were reorganized and a research context was added. OAL leaders were able to elaborate and comment on the final results. Overall, this process was designed to reflect co-production of knowledge on the role of context for co-creating NBS among the OPERANDUM researchers.

The results section reports on the place-based factors affecting the co-creation in the OALs along the aforementioned dimensions organised in three sections. This is not meant to be an exhaustive list, but more an overview of factors that in our experience play a role in the co-creation process of NBS specifically in the rural and natural territories across the OPERANDUM OALs. These factors are accompanied by recommendations (see the right column in the Tables 2, 3 and 4) that provide suggestions on how to use them to support the co-creation process and overcome their potential negative influence. In the descriptions we use the abbreviations of the OALs with the initials of the country (e.g., OAL-AT refers to OAL-Austria), and indicate with the numbers the factors concerned in the respective table (e.g. size of OAL, Table 2, item 1).

3. Factors influencing the co-creation of NBS in rural and natural territory across OPERANDUM OALs

The size of the OAL (Table 2, item 1) varies from less than 30 ha (OAL-UK) to 267,000 ha for the OAL in Italy (OAL-IT/Panaro river). The size of the OAL appeared to play a significant role in the co-creation process, although in different ways. The smaller OALs, like OAL-AT, are also mostly geographically and socio-economically more homogenous than larger ones such as OALs Finland (OAL-FI), Germany (OAL-DE) and Greece (OAL-GR), requiring less time to map their characteristics, engage stakeholders, and manage the co-creation process. To overcome the disadvantages of managing a large OAL, we found more time was needed to get familiar with the area prior to or early on in the project, including any previous projects carried out and the stakeholders involved. The experience of OAL-DE has shown that a division of participatory groups with a focus on local solutions is useful in this regard. Additionally, the many modelling possibilities in larger OALs meant exploring all available data at different spatial scales and units was necessary.

The OALs also differ in terms of socio-economic factors such as *settlement patterns* (Table 2, item 2)*, demography and and population dynamics* (Table 1, item 3). The lower number of potential stakeholders and their dispersed location in some OALs meant that it was difficult to establish a committed group of stakeholders to collaborate within the co-creation process. For example, among the local landowners in Finland (OAL-FI), part-time residents or non-local forest owners are motivated to join the co-creation process, but are not consistently in contact and have different interests and perspectives due to their seasonality. In some OALs, communities are less defined due to the rurality and large land parcels of the residents (OAL-GR, OAL-FI). Most of the

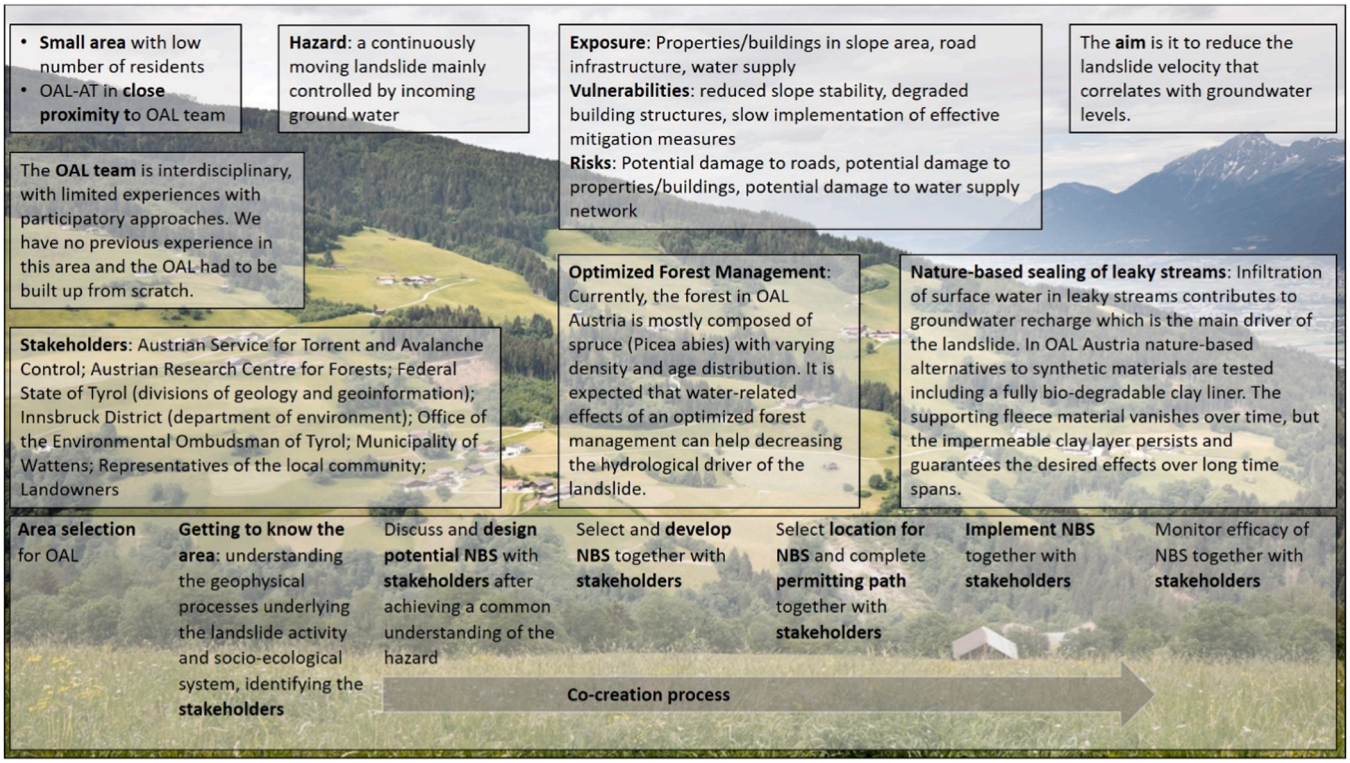

Fig. 2. Co-creation in OAL-Austria. The key elements of the co-creation process of the OAL-Austria. In the pre-project phase, an expert stakeholder suggested a location for the OAL to address a deep-seated landslide. Other relevant stakeholders were identified and engaged to create the OAL, and together with a research team a common understanding of the different drivers of the landslide and potential NBS to address the hazard was achieved. Besides the local experts who actively shaped the OAL, a representative of the residents was continuously informed about the latest developments. The selection of two NBS increased the number of stakeholders actively involved in the project, since new expertise and supplies were needed. The OAL team works more closely together with expert rather than public stakeholders due to the nature of the hazard. Optimized forest management (now in a modelling stage) is a long-term solution, and the nature-based sealing of leaky streams needs to be upscaled before any benefits may be observed in the larger OAL. Some residents have indicated that they prefer to have short-term results, either brought by traditional engineering solutions or hybrid solutions (these remain potential additional options) and to minimize the impacts of the landslide as soon as possible, but are nonetheless cooperative in the implementation of the nature-based sealing of leaky streams by providing machinery for the implementation of the NBS or providing access to their land for monitoring purposes. The co-creation process has not been a neat step-by-step process, but rather iterative and sometimes lengthy adaptations in the project plan have been necessary. The slow-moving landslide is an ever-present threat to the people living in the area that causes damage to homes, which has so far led to one house being declared uninhabitable, making OAL-Austria more than "a test case". (Photo: T. Zieher, 2018–05–29).

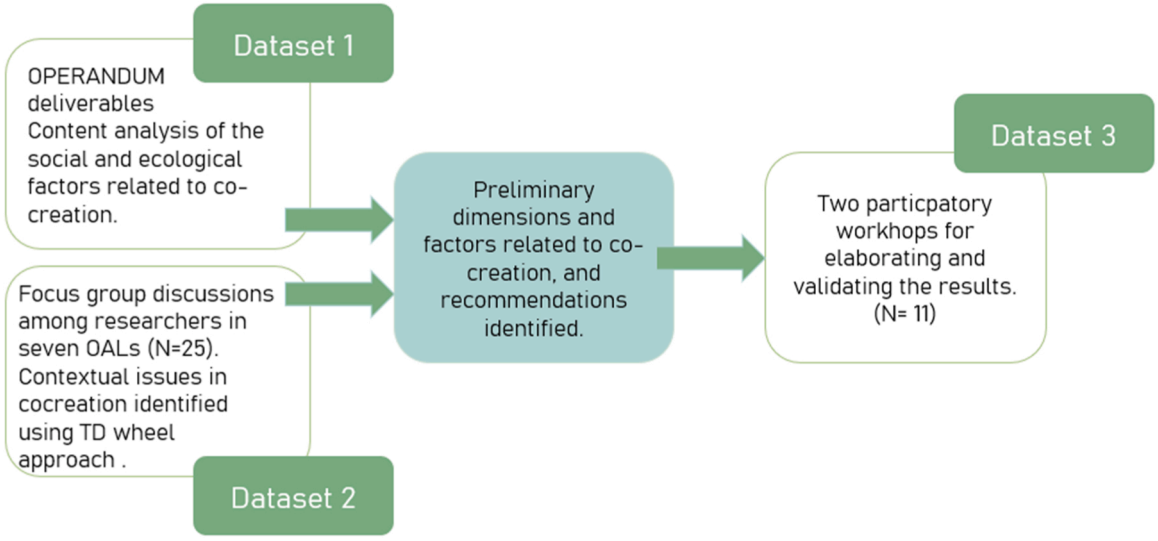

Fig. 3. Data sets and methodology.

Table 2
Factors related to social-ecological context (including ecological, institutional, socio-economic and governance attributes) found to influence co-creation of NBS in OPERANDUM OALs.

	Factor	OAL characteristics	Observations of co-creation experiences	Recommendations
1	OAL size	Size of OALs varies from less than 1 km2 to 2900 km2.	Larger OAL more difficult to set up and manage	Get to know the area and stakeholders beforehand, become familiar with previous research projects in the area. Utilise full potential of modelling the OAL. Divide into locally focused groups.
2	Settlement patterns	Usually low number of inhabitants and dispersed population	Low number of potential stakeholders and less defined communities, therefore difficult to reach	Use existing communication channels, go out to visit potential stakeholders
3	Demographics	Aging population	Physical capabilities and limited familiarity with participatory approaches may hinder participation	Find appropriate methods for inclusive engagement. Supporting meetings, fundraising, supporting communication, etc. are all important forms of engagement.
4	Natural and cultural values	High natural values (protected areas, biodiversity, etc.) and cultural values (landscape, livelihoods).	May increase NBS acceptance and willingness to participate in co-creation to protect values, but restrict planning and deployment of NBS.	Be familiar with areas with high natural and cultural values, their history and users; use them as an asset for planning the NBS; strengthen natural and cultural values through NBS. Be mindful of conflincting opinions.
5	Types of hazards, perceived risks, and impacts	Variation among: sudden vs. gradual; visible vs. invisible; various impacts; high vs. low perceived risk	May influence risk awareness, NBS acceptance, and willingness to engage in co-creation.	Conduct high resolution risk assessment, achieve good understanding of hazard/ risk/ impact chains in OAL, and ensure collaboration for development of NBS with all affected stakeholders
6	Land ownership	Both public and private land ownership in OALs	Land ownership is an important factor in co-creation (location and cost of NBS, potential changes in land value).	Identify the key land owners (public or private) at local level at an early stage of the project and co-create NBS in close collaboration
7	Public services and regional and national authorities	Presence, interest and accessibility of authorities responsible for decision-making.	In small communities the familiarity of the local authorities and simplicity of the governance structures may support the processes. Physical distance may decrease the involvement of regional/ national public authorities;	Keep the authorities involved throughout each step of co-design and co-development and clarify bureaucratic impediments. If difficult to make them visit the research area, use other means (videos) or visit them.
8	Participatory planning culture	Long tradition for a top-down approach; citizens are not always familiar with bottom-up practices.	Difficulties to amend or transform the existing planning cultures.	Be aware of different planning cultures and adapt the co-creation approach accordingly;create a common language.

OALs are experiencing the same demographic trends, in particular outmigration and aging. Elderly people can be active participants in co-creation and have valuable place-based knowledge. Age may, however, also constitute a practical challenge in co-creating NBS as we found some elderly people were less comfortable with participatory methods (OAL-FIN, OAL-GR). Age can also cause practical problems for participation in field trips or NBS deployment that require physical capabilities, as witnessed for landslide risk reduction on steep slopes in OAL-UK.

The OALs generally have high *natural and cultural value* and provide a range of *ecosystem services* (Table 2, item 4). This natural value is reflected, for example, in the number or size of protected areas (present in all OALs except OAL-AT) and the level of biodiversity. Cultural values relate to the landscapes, livelihoods, and (historic) use of natural resources, for example. In some cases, the high natural and cultural value restricted planning and deployment of NBS due to intervention restrictions (OAL-IT/Bellocchio site) and has made the permitting path more complex and time consuming, drawing out the co-creation process. At the same time, the high natural and cultural value are also an asset for the OALs and were used to align different stakeholder perspectives, fostering collaboration and increasing NBS acceptance, as in OAL-UK, OAL-DE and OAL-FI (Anderson et al., 2021b). For example, the high water quality of Lake Puruvesi in OAL-FI is a matter of local and even national pride, providing a common goal that aligns with the NBS objective and has helped to bring stakeholders together. Long-term residents and/or those with family history in the area occasionally underappriciated natural/environmental assets, likely because these assets were too self-evident for them (OAL-GR). On the other hand, equivalent regulations can lead to, e.g. flood protection being perceived as having priority over nature conservation, which makes it more challenging to accept NBS aimed at reducing risk (OAL-DE).

There are different *types of hazards* with *associated risks* and *potential impacts* (Table 2, item 5) within and among the OALs. Some key differences include: sudden vs. gradual onset (rapid landslides in OAL-UK vs. lake eutrophication in OAL-FI, drought in OAL-GR, and slow-moving landslides in OAL-AT), visible vs. less visible impacts (road blockages in OAL-GR and OAL-UK and damaged homes in OAL-AT vs. ecosystem degradation in OAL-FI and OAL-DE or erosion in OAL-IT/ Bellocchio site), and different degrees of severity for the local population, their well-being and livelihoods (for more details see Table 1. The possibility to observe the hazard and impacts had implications for the co-creation processes in the OALs. It was easier to engage stakeholders in the NBS co-creation process in relation to understood and perceived impacts, related to their rapidity of onset. Timing and frequency of the hazard can also be influential in this regard. The urgency of establishing

Table 3
Factors related to NBS found to influence co-creation in OPERANDUM OALs.

	Factor	OAL characteristics	Observations of co-creation experiences	Recommendations
9	Cost of NBS	Highly variable, impacting the feasibility of NBS implementation	The cost of NBS influences the stakeholder constellation. High costs may cause a shift towards other types of solutions or increase the need to attract funders/ investors.	Evidence of NBS effectiveness plus careful design and pricing of NBS is needed to secure funding.
10	Location and embeddedness of NBS	Location and embeddedness of the NBS (site) in its surrounding community varies among OALs	Limited visibility and/ or low accessibility of the NBS may cause lack of interest.	Organize field trips and find appropriate ways for communicating NBS co-benefits to stakeholders
11	Visual aspect of NBS	Integration of NBS in the surrounding environment	Whether the NBS stands out from the surrounding environment and/or provides distinct benefits compared to surrounding land may hinder or promote willingness to accept NBS. Added recreational or aesthetic value more difficult to achieve due to rural landscape characteristics.	Potential co-benefits should be clearly communicated and be based on stakeholder values and interests.
12	Experienced benefit of the NBS	The benefits from NBS could be mid- to long-term and be more or less noticeable to stakeholders. Benefits are not always equitable.	In case no benefits and losses are experienced, stakeholders can experience fatigue and loss of interest. Trade-offs can result in conflicts between stakeholders.	Use scenario and modelling tools to show the potential benefits and trade-offs of the NBS over time.

Table 4
Factors related to the research context found to influence co-creation of NBS in OPERANDUM OALs.

	Factor	OAL characteristics	Observations of co-creation experiences	Recommendations
13	Multi-and interdisciplinary collaboration	In all OALs there was collaboration across a variety of disciplines	Mutual understanding and trust among researchers from different disciplines have a positive influence on collaboration with the stakeholders.	Invest time for multi-and interdisciplinary collaboration in the beginning of the project.
14	Experience in participatory research with different roles of the researchers.	Only a few researchers had previous experience in participatory research methods	Facilitating or knowledge brokering was not always considered a comfortable role to undertake	Common guidelines and procedures for conducting participatory research is important; External facilitators may be useful.
15	Proximity of OAL team to OAL	OAL usually not located near the research teams	Researcher as "visitor": low frequency of visits, fully focused on co-creation, longer time needed to build trust. Researcher as "insider": familiarity with local context, easier to gain trust, loss of objectivity.	Have a researcher familiar with the OAL area, interact with stakeholders in face-to-face meetings, but also through other channels, identify a project champion(s) among stakeholders, identify past positive/negative experiences with stakeholders and research institutions
16	Researchers' familiarity with and (personal) relationship to the place	Varied relations: from previous research collaboration to personal relation to no relation	May affect the motivation/ role or agency in the project	Positionality and reflexivity; be aware of the position of researchers and others in relation to the place
17	Institutional support for participatory research by the involved research institutions	Institutional support was available for all OALs	Institutional support gives legitimacy to the work	Institutional support (also financial) is a condition for a participatory research.
18	Unexpected changes in the research environment	Natural hazards, exceptional weather conditions during the project COVID-19, political changes/ debate	Changes in the co-creation plans, may affect the motivation or ability of stakeholders to participate in the process	Be ready to adjust the processes in case of unexpected changes. Discuss the issues within teams and with the stakeholders. Take into account the current institutional and political changes around the topic.

a functioning NBS for flood protection in the OAL-DE has substantially decreased since the last flood event in 2013. Looking at historical hazard events in the OALs and discussing the spatial and temporal characteristics of risk raised awareness, for example in the context of focus groups in OAL-UK.

Land ownership (Table 2, item 6) is a key factor in the co-creation of the NBS. For the implementation of NBS on private land (OAL-FIN, OAL-GR, OAL-AT, OAL-DE) landowners' permission was needed. Further, residents may perceive nature conservation requirements as an economic disadvantage, and thus meet the NBS with resistance (OAL-DE, OAL-GR). This meant convincing landowners of NBS benefits or

searching for an alternative location for the NBS. When NBS was planned on public land (OAL-IT/Panaro and Bellocchio sites), raising awareness about the collective (co-)benefits of NBS and ensuring NBS acceptance among public authorities was essential. In OAL-DE, contractual nature conservation has been used as a decisive financial and administrative tool on state territory. OAL-UK was planned and implemented in a 'contested space', where the ownership of the land was unclear due to historic reasons and the unsuitability for development on the steep landslide-prone slope. This actually made planning easier, since the land had little to no value and only local public authorities needed to first be consulted.

The presence, accessibility, and engagement of *public authorities* (Table 2, item 7) can be pivotal. They are important stakeholders in co-designing NBS and should be involved throughout, for example, to issue any necessary permits (OAL-IT/Bellocchio and Po di Goro sites), specify regulations for the design and construction of the NBS (OAL-GR, OAL-DE), and in some cases provide financing for its implementation and monitoring (OAL-GR). In the case of OAL-DE, the NBS is a project initiated by the biosphere reserve administration making the public sector a strong actor in the OAL to end the long-standing conflicts between the stakeholders. In OAL-GR there are relatively small communities in which the local population know the local authorities well, which facilitated contact and initiation of regulatory procedures. Furthermore, in a small community the boundaries between the administrative sectors can be easier to cross and therefore the collaboration between stakeholders are less complicated. Additionally, authorities located farther away were sometimes less knowledgeable about the natural hazard and its impacts, slowing the authorization and acceptance-building process (OAL Italy/Bellocchio and Po di Goro sites, OAL-UK).

There are differences in the level of public involvement in the practice of *participatory planning* (Table 2, item 8) within and between the countries and regions. OAL-GR showed ineffective results of flood risk reduction efforts in the past undermined the trust of local stakeholders and authorities and had to be regained. In OAL-DE, the biosphere reserve administration has implemented the participatory approach to end long-standing conflicts and resentment towards flood protection and nature conservation. Because of its relative isolation and distance from local authorities, a strong sense of community and responsibility for personal protection in OAL-UK provided a good platform for participatory planning and co-creation. In OAL-FI, participatory planning is a common practice in the land-use context. Yet, planning in the forestry sector, required for the NBS, is normally made at the level of private land owner. Designing and managing effective NBS for forestry at the watershed level required collaboration across properties and the development of a new participatory planning culture.

Among factors directly related to the NBS is the funding *as financial cost* (Table 3, item 9), which varied considerably and influenced the type of stakeholders needed for a successful co-creation process. OPERANDUM -project did not provide direct funding for NBS deployment. Some of the OALs were co-supported by other public project funding (OAL-DE, OAL-FI). More expensive NBS needed the financial backing from public authorities or other funders (OAL IT/Panaro site). To secure funding, evidence of NBS effectiveness plus careful design and pricing was necessary. For instance, in OAL-AT there are plans to possibly scale up the NBS in the case of satisfactory results to secure further funding, among others. Furthermore, the *location and embeddedness of NBS* (Table 3, item 10) in their surroundings affected public acceptance. For example, in OAL-FI, the many of NBS are distant and not visible in the everyday environment of local residents, making wider interest more challenging. In OAL-UK, local residents preferred and were more supportive of measures near their own property, since this meant greater protection from landslides.

The *visual aspect of the NBS* (Table 3, item 11*)* also plays a role. Although the OPERANDUM OALs vary in landscape type, many are characterized by large areas of green or open spaces. Therefore, the NBS do not necessarily add natural area for aesthetics and wildlife habitat or recreation opportunities that may be valued in more urban or degraded areas. This may lead to lack of incentive for participation in the co-creation process, particularly for stakeholders who are not directly at risk from the hazards. This was countered by organizing frequent field visits. Here, the expected or *experienced impact of the NBS* (Table 3, item 12) becomes important. In OAL-FI and OAL-UK, a long planning and implementation phase, along with delayed effective mitigation of the hazard and co-benefits led to a potential loss of interest in participating in the co-creation process and beyond. Using scenario, modelling and monitoring tools that became available during the project to show the changes in the environment and potential impact of the NBS to stakeholders was often considered useful to overcome this obstacle.

OAL *research teams* (Table 4, item 13) were highly multidisciplinary with competences from different fields of research including for example climate modelling and meteorology, physics, engineering (agriculture, forestry), hydrology, ecology, geology, planning, architecture, economics, geography, social sciences, media providing a basis for an interdisciplinary collaboration and participatory research. Previous collaboration with other disciplines was considered as a benefit (OAL-IT, OAL-FI). which was important for communication with stakeholders in a clear and consistent manner (OAL-DE). Only few researchers, technical experts or citizens had *previous experience in participatory research* (Table 4, item 14) with systematic stakeholder engagement (D 1.3., 2020). Co-production of knowledge with the stakeholders was also new for some researchers, who were used to linear knowledge transfer rather than dialogue and co-production for joint problem solving (OAL-FI). There were different views within the OAL teams about the relevance of the non-academic stakeholders' participation in the process, especially within OALs where hazards and associated NBS were perceived as highly technical, e.g., demanding an extensive engineering perspective (OAL-GR).

Proximity to the OAL research teams (15) appeared also as an issue. OAL-GR, OAL-FI, and OAL-IT (all three sites) are located hundreds of kilometres away from the research institutes where the researchers were based. The OAL researchers who were farther away from their OAL had a lower frequency of visits and a need for a longer time to build trust among the range of stakeholders (OAL-FI, OAL-UK). In contrast, researchers who are in close proximity to the OAL often had a more established network in the area and therefore could identify relevant stakeholders more easily (OAL-AT). Distance could be overcome through frequent visits and using other means of communication, such as online meetings and emails (OAL-GR; OAL-FI). The researchers' relation to the OAL and broader place was influential and developed during the project. *Familiarity with the social-ecological system* (16) through the projects previously conducted in the area lessened the time needed for the 'get to know each other' phase and building trust. (OAL-GR; OAL-UK). All the OALs found that the *participatory, solution oriented research* was *supported by their institutions (17)*. Yet, in some cases it was felt that this did not always materialized financially (OAL-UK).

LL and co-creation processes are relatively long lasting, increasing the likelihood of *unexpected changes and events (18)* in the research environment for which the project cannot fully prepare. New knowledge and experiences become available shaping the perceptions of the participants: for example in OAL-FI the NBS of continuous cover forest management has only recently become a highly debated topic both in science and among the public. Weather conditions have varied and extreme events have affected stakeholder perceptions, increasing risk awareness and possibly also motivation to participate like in OAL-UK. Declaring a house in OAL-AT uninhabitable made the negative impacts of the slow-moving landslide very concrete to the stakeholders. In the case of OAL-IT/Bellocchio site, planning for NBS deployment was forced to drastically alter and a new location for deployment found due to a major storm surge event. COVID-19 has also had a huge impact on the co-creation activities. Many planned meetings, workshops and field trips were cancelled. Eventually, these were replaced with virtual

meetings, which have changed, the extent the composition of participants towards more expert-oriented participants.

4. Discussion

4.1. Lessons learnt from OPERANDUM about the role of context in Living Labs

Co-creating NBS in rural territories involves context-related opportunities and challenges that had not yet been thoroughly and coherently addressed in the current literature (Albert et al. 2021; Cohen-Shacham et al. 2016). Based on the experiences and lessons learnt in the OPERANDUM project, we describe the main context dimensions (Fig. 4). These follow the dimensions that were presented in the Chapter 3, but the socio-ecological dimension was deconstructed into three contexts: physical-ecological context; social andcultural context and institutional context. NBS context is placed in the middle as all the other contexts are somehow in relation to that in the case of co-creation. Research context, in turn is placed at the outer circle as it has an influence on how the other contexts are perceived and dealt with in the co-creation.

The *ecological and physical context* including the size, type of ecosystem, and natural and cultural landscape of the LL defines certain general conditions for participation. The size of the LL and access to the OAL also has implications for collecting and managing knowledge. Furthermore, the type and potential impacts of the natural hazards as well as the documented natural and cultural value of the area (e.g. nature conservation areas) determine the accessibility and perception of these factors by stakeholders. We have also observed that extreme weather conditions and hazards may affect the stakeholders awareness, as well as interest in the co-creation.

The socio-economic and cultural context of co-creation has been highlighted in academic literature, including various issues mainly related to the dynamics among participants (or stakeholders) (e.g. Geaves and Penning-Rowsell, 2015; Otto et al., 2018). Co-creation calls for acknowledging social and cultural diversity among the stakeholders, and requires equal recognition and participation (OPERANDUM D8.1.). This principle results in socially and culturally heterogenous group of participants. LL participants have different physical, social and cultural relations to place and nature (Buijs, 2009; Roca and Villares, 2012), for example due to distance from the hazard impacted area (Schaich, 2009; Abbas et al., 2016), which require additional attention for co-creation. Furthermore, in rural territories different interests may exist between landowners who depend on natural resources and seasonal as well as permanent residents. This conflict of interest adds an additional layer of complexity to the social dynamics of co-creation (Esteves and Thomas, 2014; Rambonilaza et al., 2016).

We have also highlighted the role of the *institutional context,* particularly the public sector for planning and obtaining permission, who, together with the researchers, often must lead NBS projects (Ramírez-Agudelo et al., 2020). Local authorities are generally easier to reach and engage with than national and regional authorities due to distance, interests, and personal relations to the place. Proximity is essential for trust-building (Gössling 2004), which, in turn, is also a crucial aspect in co-creation. Our results show differences between countries and

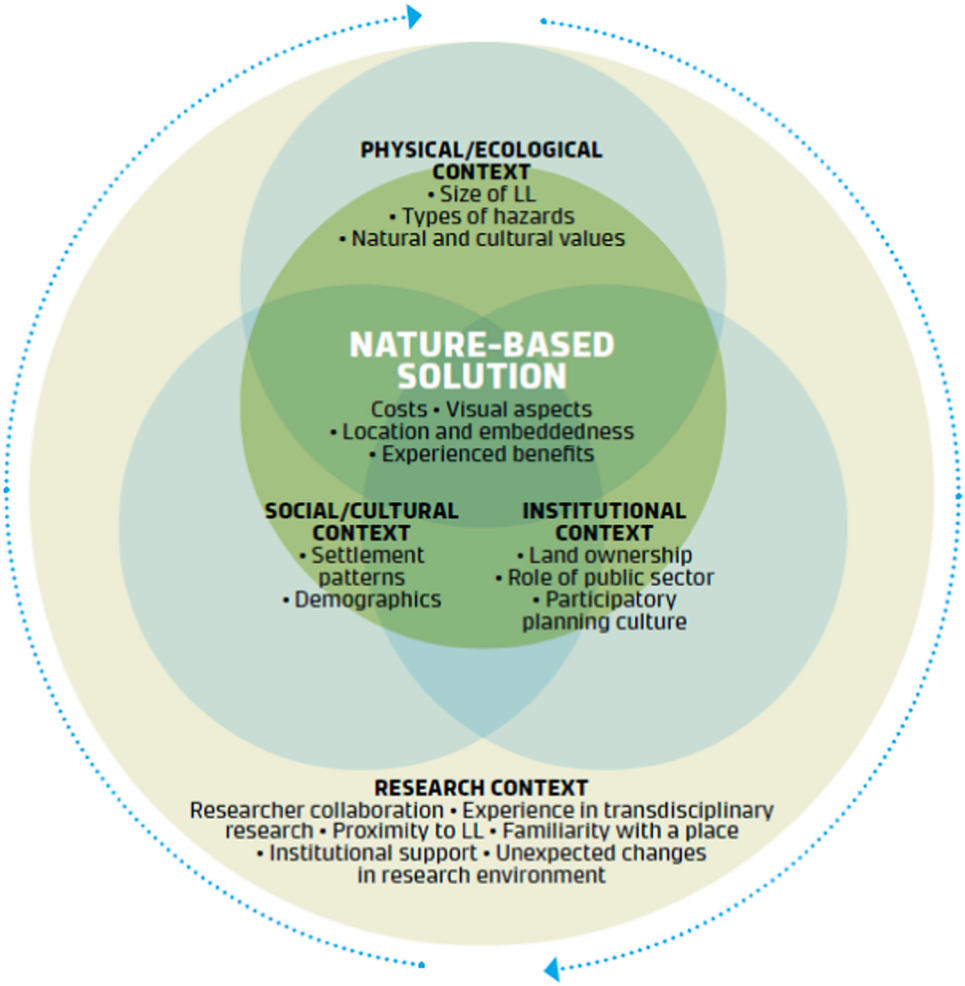

Fig. 4. Various interconnected contexts and factors affecting co-creation of NBS. The arrows illustrate the dynamic character of the contexts and the factors.

locations in this respect, confirming the influence of the spatial and that of the historical development of the institutions, awareness, previous experience and trust in public authorities and local socio-economic dynamics (Nadin and Stead 2012).

The co-creation work revolves around the *NBS* and societal issue it aims to address is the ultimate aim and the practical outcome of the process. Overall, issues around the NBS context are related to aspects that determine public acceptance, such as the visual impact of the NBS and the technical feasibility, funding and other resources for its deployment being accessible within a reasonable timeframe (Ramírez-Agudelo et al., 2020). The risk perceptions of stakeholders, both regarding the natural hazards and risks associated with the measures themselves (e.g. lack of effectiveness), can increase the willingness to join the co-creation process or potentially lead to preferences for other types of solutions perceived as quicker and more efficient (Anderson et al., 2021b).

In our case *research* is a context that is framing the other contexts in the project (Fig. 1). Our findings emphasize that researchers should be considered endogenous actors in relation to the OAL site, since their past experiences and perceptions influence their research and how co-creation evolves in the project. Good multi- and interdisciplinary collaboration is also fundamental in the NBS design and implementation, since participants come from different disciplinary backgrounds (Tzoulas et al., 2021), influencing also how the other contexts are perceived. Researchers tend to have a leading role together with public sector representatives in a co-creation process (Ramírez-Agudelo et al., 2020), although the multiple roles in beyond "observer" is also significant (Wittmayer and Schäpke, 2014).further increasing the importance of factors that can affect these roles. Besides the internal collaboration within a LL team, these factors include the spatial relations and place that frame the practical work, including the physical and cultural accessibility and researchers' familiarity and own relation to place. Reflexivityis becoming a key phrase in transdisciplinary research (Schmidt et al., 2020), and our findings support this perspective, along with the consideration of temporal aspects (e.g. pre-project collaboration, dynamics during the project lifetime).

We also realised that the aforementioned contexts are inherently connected. For example, the factors related to the physical context (like size of the OAL, or physical characteristics of the site) may be linked with the settlement aspects (social context) or land ownership (institutional context). Factors related to NBS context, like location is linked to physical/environmental, social and institutional aspects of the co-creation. Researchers are obviously part of the institutional context, which may define their resources and capacities for co-creation, and to different extend, also part social context (local resident), suggesting different roles and positions in the co-creation.

4.2. Key differences between LLs in rural and natural territories and urban LLs

As indicated earlier, most of the reported NBS research using an LL approach has taken place in urban contexts. "Rural" and "urban" are general concepts and as we have seen, the rural OALs of OPERANDUM diverge in respect to their ecological, environmental, social, cultural, institutional and ecological characteristics. Although we can identify some similarities with the co-creation in urban context, our insights gained from the project so far suggest the following differences in co-creating NBS in rural and natural versus urban areas:

- Visibility of the hazard and its social-economic impacts: Urban areas with greater economic asset and population density means the visibility of the hazard and its social and economic impacts may be higher than in rural areas. This may attract more attention from the public, public authorities, and the private sector and increase their motivation to act and participate in the design and implementation of NBS.
- Space for NBS: In urban areas, and especially in inner-city areas, both private and public land is a scarce and expensive commodity (Sarabi et al., 2019), which means that there is usually less land available for NBS implementation and limited freedom to negotiate its location.
- Physical proximity/accessibility of different types of stakeholders: The collaboration between (research, businesses, public sector (so called triple helix) is often weaker in rural and natural areas than in urban areas. This highlights the need to more intensively engage the wider community in rural and natural areas and build a quadruple helix, i.e. research, businesses, the public sector and citizens as communities to foster innovation and regional development (Kolehmainen et al., 2015, Nordberg et al., 2020).
- Institutional arrangements: the degree of institutional overlap due to the city and possibly neighborhood level tend to be more complex in urban areas, i.e. with many experts from different departments involved in developing and deploying NBS, which can make procedures more challenging. If this leads to institutional fragmentation (sectoral silos) in larger urban areas, it can act as a barrier to NBS development (Sarabi et al., 2019; Dhakal et al., 2016). The institutional arrangements are often more straightforward in rural areas, with fewer people and departments/sections involved.
- Access to co-creation: More people share the same spa-ces in urban areas due to higher population density. This makes it easier to organize highly attended face-to-face co-creation meetings and therefore achieve a sense of ownership of the NBS. This issue may rapidly change due to the increasing familiarity of stakeholders with knowledge sharing technologies (Sarabi et al., 2019; Gulsrud et al., 2018), and intensified adoption of virtual meeting culture due to restrictions brought about by the COVID-19 pandemic. Ideally, this will lead to more democratic participation regardless of the size or other characteristics of the place.
- Added value and co-benefits: Due to the lower availability of green spaces in cities compared to rural, NBS that include increased green space as a co-benefit with its associated recreational, aesthetical and health benefits (Franzeskaki, 2019) may be more highly valued (and therefore a stronger motivator) for NBS acceptance in urban areas than in rural and natural areas.

5. Conclusions and future research

Living Labs can produce knowledge in the context of application and have been considered valuable platforms for territorial development and environmental innovations. Yet, there has been less research on LLs in rural territories using co-creation approaches when planning environmentally sustainable risk reduction infrastructure. Furthermore, the different aspects of the real-life context are not consistently or adequately considered when designing and implementing LLs. This paper has explored these topic using experiences gathered through the OPERANDUM project, leading to lessons learnt and recommendations. We argue that the rural context matters for co-creation, and overall more attention is needed for factors related to social-ecological systems, institutional environment, the characteristics of the NBS being developed, as well as role of research and researchers, when planning and implementing co-creation. The general list of potential factors we provided should be considered on a case-by-case basis and linked to identifying specific factors that can affect the co-creation process and its outcomes. Especially we suggest systematically considering differences between rural and urban LLs, given the divergence we have identified regarding the design and implementation of NBS. Obviously, forthcoming studies should validate and develop these factors and recommendations further.

Furthermore, our results showed the interconnectedness of different contexts calling for a more relational approach to the co-creation process. Various natural and social systems are interconnected in such a way that they produce their own pattern of behaviour over time. Therefore relationality is a key in understanding complex systems as a

set of things (Walsh et al., 2021). The relational emphasis in sustainability science (West et al., 2020) and ecosystem service research (Chan et al., 2016) calls for more research on the preferences, principles, and virtues associated with relationships. These can be both interpersonal or include non-human elements (animals, plants and ecosystems), that have not been sufficiently acknowledged in NBS design and implementation (Maller, 2021). The key message of these discussions also for co-creating NBS is that we should move from a technical, instrumental and process-oriented understanding of problems and their solutions towards more place-centered approaches that enable greater exploration of relations and co-evolution of different aspects (Herrmann-Pillath et al., 2022).

By adopting a relational lens to co-creation to complement a place-based approach, a stronger acknowledgement of relations would be advantageous for several reasons. First, considering the different contexts and the relations between them would help to design and iterate the co-creation process more sensitive to the context increasing the long term impact. Secondly, the relational lens may help to deal with various dynamics related to these relationships during the project lifetime and be responsive to them. Thirdly, NBS are expected to contribute to overall transformation for sustainability in the long term. A relational approach that considers the values, knowledge systems and practices of all the participants (including the researchers) is a key issue also in this respect (Palomo et al., 2021). Therefore, we suggest that LLs take an relational and interactional view of context from the beginning, and encourage place-based co-creation, where the different contextual factors are seen as interrelated and dynamic.

Declaration of Competing Interest

none.

Data Availability

Data will be made available on request.

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