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Stakeholder Mapping for a Nature-Based Solutions Project: A Comprehensive Approach for Enhanced Participation and Co-Creation

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Abstract

In Nature-Based Solution (NBS) projects, stakeholder mapping is not merely a methodological step but a strategic process that enables meaningful engagement, co-creation, and the building of trust among diverse actors. This study describes the stakeholder mapping approach adopted in the NBSINFRA project, paying particular attention to methods designed to strengthen participation and co-creation. The process followed three inter-related steps: (1) stakeholder identification; (2) stakeholder analysis, filtering, and prioritization; and (3) stakeholder understanding. Drawing on a cross-methodological approach, including interviews, focus groups, direct observation, and on-site observations, the project engaged a wide spectrum of stakeholders, involving representatives of the local community. The findings point out that stakeholder mapping functioned as a catalyst for social engagement, co-design, informal collaborations, and the development of trustful and transparent relationships between team members and the community. The process made it possible to identify regional and national stakeholders, thereby opening avenues for international collaboration in later stages of the project. Finally, this study highlights persistent challenges that require attention, including information gaps, limited opportunities for participation due to time constraints, and the enduring prevalence of top-down decision-making.

Keywords: nature-based solutions; stakeholder mapping; social engagement; participation; co-creation; sustainability

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1. Introduction

This study focuses on describing the stakeholder mapping process carried out within the EU-funded project NBSINFRA [1] in the city of Aveiro, Portugal, whose aim is to contribute to reinforcing the relevance of NBSs for the future of urban planning, emphasizing the need to strengthen the engagement of people and communities from the design phase through to the monitoring of implemented NBSs. The study analyses the conditions, potentialities, and pitfalls of the stakeholder mapping process, while also considering its replicability and capacity to inform similar projects. The questions that structure the study are as follows:

- Q1: How was the stakeholder mapping process structured in the NBSINFRA project?

- Q2: What were the difficulties encountered during this process, and how did the project adapt?
- Q3: How did the NBSINFRA stakeholder mapping process enhance engagement, participation, inclusivity, and co-creation within an NBS project?
- Q4: How can NBSINFRA's stakeholder mapping be scaled to promote regional, national, and international cooperation?

The world faces a wide range of environmental, social, and economic challenges. These challenges can range from flooding, wildfires, coastal erosion, extreme weather events, biodiversity loss, social injustice, and air and water pollution to impacts on physical and mental health or the overall economy [2]. Thus, these challenges pose significant threats to human well-being and ecological balance [2]. In this context, Nature-Based Solutions (NBSs) emerge as sustainable and effective approaches to address these challenges [3,4]. They encompass strategies such as ecological restoration, green infrastructure, climate adaptation, and ecosystem-based disaster risk reduction [3]. Interventions such as green roofs, urban parks, retention basins, and wetland restoration can help to mitigate the urban heat island effect, reduce the risks of floods and droughts, prevent coastal erosion, and improve air and water quality. They can also provide green jobs and improve physical and mental health and quality of life [3–7].

Due to its varied intertwinements with many other domains of life, adopting an NBS approach involves a wide range of actors and expertise across multiple sectors and is deeply rooted in the idea that strategies for change must align with nature and society, demanding social engagement of every stakeholder that is more or less directly implicated in order to match innovation with sustainable development goals.

In this sense, an NBS project is expected to start with co-diagnosis and co-characterization stages that help to identify key challenges and opportunities, followed by co-design and co-creation stages where stakeholders participate in decision-making. The following stage consists of the implementation or co-implementation of the solution, after which the project moves into co-evaluation and co-monitoring, assessing its effectiveness. Finally, the process includes co-amplification or co-replication, where successful approaches are shared and adapted elsewhere, along with the dissemination of lessons learned (steps adapted from [8–11]). In fact, best practices, lessons learnt, and accumulated evidence consistently highlight that the effectiveness and sustainability of NBSs depend strongly on the active participation of all stakeholders [3,8].

Aligned with these ideas, authors state that in the implementation of an NBS, stakeholder mapping is pivotal in order to understand the context where the project is going to be enacted and to define the level of engagement of each stakeholder [8]. Stakeholder mapping consists of an operation that allows NBS implementers to know who, how, when, and why to involve certain stakeholders during different stages of the process [8]. Amongst other benefits, this process allows such implementers to become aware of the presence of vulnerable individuals or communities that may encompass communities, other than only the private and public sectors ("the usual suspects") [9] (p. 26) [8] (p. 13) [12]. Although participation is a core concept for understanding the relationship with engineering, the process of stakeholder mapping was more traditionally rooted in the fields of management [13]; however, it has been emerging constantly in the context of NBS projects, especially since social engagement and stakeholder participation are being recognized in the literature as key aspects affecting the success of NBSs [8]. Additionally, authors have argued that a greater understanding of stakeholder involvement has the capacity to improve communication between stakeholders and enable successful implementations, thereby achieving a greater impact for citizen science initiatives [14]. Therefore, building a long-lasting, trusting, and emphatic relationship with the stakeholders is one of the best practices pointed out in the

literature, which also emphasizes the need for co-creation [8,9,14–17]. Despite the fact that stakeholder mapping is increasingly being recognized as essential in NBS projects, some studies still adopt a top-down perspective, assigning disproportionate importance to the views of experts and policymakers while assigning less weight to the perspectives of local people and communities.

This study examines the stakeholder mapping process developed within the EU-funded NBSINFRA project, which tested Nature-Based Solutions (NBSs) for strengthening the resilience of critical infrastructures across five European cities (acting as city labs), while also comparing it with other projects that involved participatory methodologies. The analysis centers on the Aveiro City Lab, where NBSs were intended to be prototyped for a waterline infrastructure. In contrast to other City labs, the process in Aveiro was developed from scratch in the course of NBSINFRA by the Portuguese team. It offered a singular perspective on how social and political contexts, stakeholder profiles, and competing interests shaped the work up to the prototyping stage. The case is also presented because stakeholder mapping in NBSs remains scarcely explored in Portugal, where urban planning continues to struggle with participatory practices and citizen engagement.

In this paper, the main results of a narrative literature review involving several concepts related to participation and engagement are presented, as well as the several phases of that participative stance, involving general stakeholders and the community from the beginning. In this way, it is expected to be possible to understand the positionalities of each stakeholder and determine the respective level of engagement in the further phases of the project—from being informed, consulted, and involved to collaborating or empowering them to actively participate in determining a solution. To accomplish this task, this paper is divided into four main sections: in the Section 2, the methods used are described; in the Section 3, the processes of stakeholder mapping are detailed; the Section 4 focused on presenting the main outcomes and discussions outcomes of this experience, and, finally, we leave in the Section 5, the main conclusions.

2. Materials and Methods

This section outlines the methodological framework adopted in this study. The description is supported by graphical representations and figures for enhanced clarity and comprehension.

2.1. NBSINFRA Project

In more detail, NBSINFRA ("Citynature-based Solutions Integration to Local Urban Infrastructure Protection for a Climate Resilient Society") is an EU-funded project [1]. It involves five city labs across Europe, with the aim of assessing how cities can handle different challenges and stay resilient by implementing Nature-Based Solutions. Each city lab aims to investigate how NBSs can protect local infrastructure, preserve biodiversity, and restore ecosystems in the face of climate change. The goal is to deliver tailored risk indicators for specific locations, contributing to city management risk plans and the NBS services provided by local emergency management structures, such as municipal civil protection units, local fire brigades, and other relevant entities, upon completion (City labs—NBSINFRA). The specific case of Aveiro City Lab involved creating an NBS along a waterline that is partially located in private lands. Within the scope of the project, it worked as an urban space where innovative Nature-Based Solutions for resilience could be tested, based on a participative and co-creative process involving stakeholders.

Ethical Requirements

All activities carried out within the scope of the NBSINFRA project were planned and received ethical approval under the framework of the project's approved funding and designated ethical reference (NBSINFRA Deliverable 1.1) [18]. Accordingly, all activities undertaken—such as interviews, observations, and the recording of photographs and videos, as well as focus groups—strictly complied with ethical procedures and data protection requirements. This included the use of informed consent forms signed by participants, whether they were institutional representatives or individuals, ensuring data confidentiality.

2.2. Methodology

The methodological approach for mapping stakeholders included three main steps—stakeholder identification; stakeholder analysis, filtering, and prioritization; and stakeholder understanding (adapted from [8,9,19])—developed over one year (2024). Each step involved different and complementary methods and data collection formats, as conveyed in Figure 1 below.

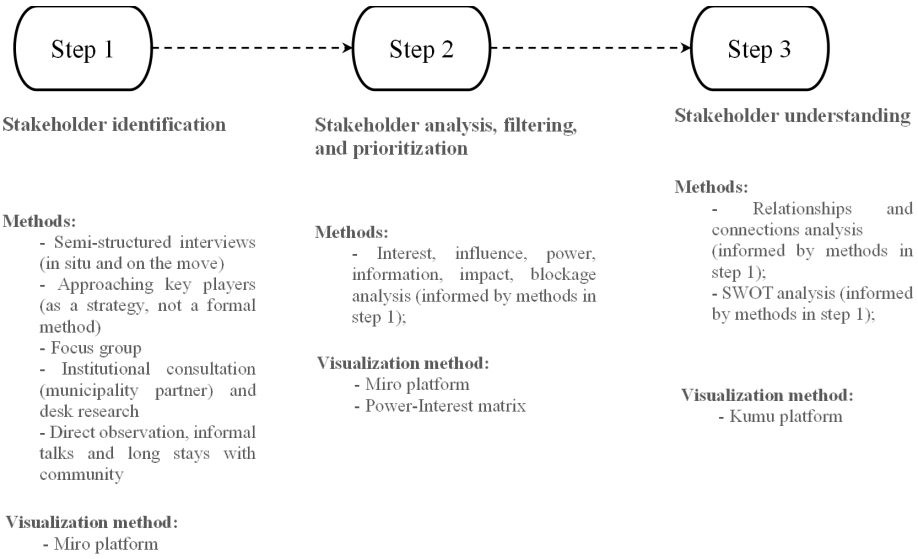

Figure 1. Stakeholder mapping process.

2.2.1. Stakeholder Identification

Stakeholders are defined as "any group or individual who can affect or is affected by the achievement of an organization's objectives" [12] (p. 46). In other words, they are anyone who has a stake in the project; thus, they may include private or public sectors, public authorities, associations, NGOs, community, academic institutions, and more socially and politically vulnerable groups, among others.

As can be observed in the figure above, the initial phase of the stakeholder mapping process was dedicated to the identification of all potentially relevant stakeholders. After several meetings with the municipality and political decision-makers for clarifying the aims of the project and its institutional scientific framework, team members engaged in multiple efforts to engage people in the project. With the help of experts from the team based in the municipality, the first step began by approaching key players, particularly project partners from the municipality and parish governmental representatives. These initial contacts were very important to enter the field, enabling the expansion of the stakeholder network through referrals and the subsequent identification of different individuals across various sectors. In a former phase, likely stakeholders were approached using publicly

available information obtained through direct searches on official websites and institutional directories. Others were approached using a snowball strategy. The first contact was established via email or telephone, and team members presented an introduction to the project and clarified the invitation to participate in future semi-structured interviews. At this stage, in-person interviews were conducted to foster deeper identification and involvement and to increase the involvement of people. The team also followed online modalities to respond to scheduling constraints and avoid barriers to participation from the side of some people. Most interviews were conducted in places selected by the stakeholders themselves, varying between their workplaces and local libraries, to their private residences. The interviews were semi-structured, allowing people to express their understanding of the subjects under analysis. The interview guide was structured according to the following main topics: local history description, collective memory of the place, identification with the place, perspectives for its development, and identification of additional stakeholders who might be relevant to the project. Complementary stakeholder identification methods included the analysis of documents provided by the municipality, as well as other public databases, and other information provided by associations and NGOs. These phases of interviews and informal interactions in the field were particularly relevant for access to information provided through direct contact with people such as landowners, and to resolve difficulties normally present in the access and use of personal contacts.

In some situations, focus groups were promoted—especially with organized collectives such as scouts and juvenile groups—to facilitate shared reflection, collaborative feedback, and the emergence of relational dynamics that enriched the overall understanding of stakeholder roles and interconnections. In addition, the fieldwork team engaged in immersive stays within the study area, allowing the team to participate in everyday life, establish interactions with residents, and observe community dynamics directly through informal conversations in moments such as having lunch or a coffee.

It is important to mention that most of the representatives of stakeholder groups were identified by people in the community. Individuals such as parish council presidents, scout leaders, and heads of local associations were initially approached due to their institutional or informal leadership roles. Other people joined these groups as they became interested and served also to mediate, disseminate the project, and bring more people into the project.

All relevant stakeholder information—such as profile (public sector, private sector, experts, public representatives, emergency services, associations, NGOs, landowners), sectoral area (specific field or domain within a broader system), designation (official title or label), location, name, competence (professional role, title, or qualifications), contact details, and geographical location—was collected and organized in line with ethical requirements (see Table 1).

Table 1. Stakeholder identification.

First Step: Stakeholder Identification							
Profile	Area	Designation	Local, regional, or national	Stakeholder name	Competence	Contact	Location
…	…	…	…	…	…	…	…

Source: NBSINFRA.

After analysis, the Miro® platform was used to present a visual stakeholder map, facilitating further decisions regarding the appropriate level of engagement for each stakeholder (the free version of the Miro® platform was used, accessed via first author personal email account. The stakeholder mapping was carried out on a blank whiteboard, using only digital sticky notes. No paid features or third-party templates were used). The table below outlines the process followed to structure this visualization.

2.2.2. Stakeholder Analysis, Filtering, and Prioritization

After concluding and validating the stakeholder identification phase, which involved several meetings in the municipality with decision-makers, attention shifted to a structured process of analyzing, filtering, and prioritizing the identified stakeholders. This step was essential for evaluating the strategic relevance of each stakeholder in relation to the project's goals.

The analysis was guided by a set of criteria (Table 2), including the following (criteria adapted from [18]):

- Decision-making power;
- Level of interest in the project;
- Potential contributions or blockages;
- Positive or negative impacts;
- Access to relevant information;
- Overall prioritization status (i.e., whether the stakeholder should be considered a key actor in engagement efforts).

Table 2. Stakeholder analysis, filtering, and prioritization.

Second Step: Analyze, Filter, and Prioritize							
Level of influence, power, impact, and information							Priority
Decision power	Influence	Interest	Contribution	Blockage	Positive impact	Negative impact	Information
...	...	...	...	...	...	...	...

Source: NBSINFRA.

These criteria were informed primarily through data collected in the semi-structured interviews and interpreted using a set of determinants such as the following (determinants adapted from [18]):

- Direct or indirect interest in the project;
- Possession of resources (e.g., technical, financial, or logistical);
- Level of formal authority or regulatory competence;
- Nature of existing partnerships or institutional affiliations;
- Degree of social influence and legitimacy within the community;
- Proximity or territorial connection to the study area;
- Legal rights or responsibilities;
- Social justice considerations (e.g., inclusion of marginalized and vulnerable groups);
- Type of information the stakeholder could provide (e.g., technical, contextual, historical, legal).

In addition to the information gathered through interviews, a documentary analysis was carried out. This included a review of the stakeholders' official websites, focusing primarily on organizational structure, core activities, and areas of competence. This methodological triangulation helped validate initial assumptions and identify potential information gaps—often due to missing data or limited access to publicly available information. The process also acknowledges uncertainties and limitations, particularly in cases where details about stakeholder roles or affiliations were not clearly accessible in the public domain.

Table 2 below illustrates how stakeholders were classified during this stage of the process, including the criteria used to analyze, filter, and prioritize stakeholders based on various dimensions such as decision-making power (their ability to influence key outcomes of the project), influence (the informal or formal capacity to shape opinions or decisions), interest (the level of concern or relevance the project holds for the stakeholder), contribution (their potential to provide resources, knowledge, or support), blocking capacity

(their ability to hinder or obstruct the project's implementation), positive impact (their potential to strengthen or advance the project's goals), negative impact (the risk they pose in undermining or damaging the project), and information availability (the extent to which reliable and sufficient data about the stakeholder is accessible). Each of these dimensions was informed by the criteria above.

2.2.3. Understanding Stakeholders

The stage of stakeholder understanding was informed by data provided by the initial interviews and interactions with the community, where knowledge about familiar ties, friendships, and neighborhood and professional dynamics was particularly important. These methods proved to be essential for gathering information that supported network and SWOT analysis. These initial maps were shown and debated with the municipality decision-makers, who also provided their opinion about each stakeholder's level of engagement.

The network analysis aimed to identify and categorize different types of links among stakeholders, allowing for an understanding of the network of influence and power among them, including within the community itself. Whenever possible, a preliminary SWOT analysis was also conducted for each stakeholder (see Table 3). The network analysis was visually mapped using the Kumu platform, where stakeholders were represented as nodes connected by lines indicating the nature of the respective relationships. Each connection was tagged according to a predefined typology of relationship types, allowing for visual and analytical clarity. This step provides a view of the stakeholder network and shows its relevance in refining engagement strategies because it highlights key actors, existing synergies, and potential gaps or power imbalances within the network. There were some limitations, as the collected information may not have been sufficient to characterize the network, especially regarding the implicit and hidden dynamics of the networks. While more explicit relationships (e.g., institutional ties, hierarchical links, service provision, or family/neighbor ties) were identified through interviews, it is possible that additional influence dynamics remained undetected. In any case, as is typical in these processes, the map will be kept open to alterations, as other information can be collected or can arise from the research.

Table 3. Stakeholder Understanding.

Third Step: Stakeholder Understanding						
Relationship analysis			SWOT analysis			
Relationship with the NBSINFRA team	Relationships with other stakeholders	Who identified the stakeholder	Strengths	Weaknesses	Opportunities	Threats

Source: NBSINFRA.

Table 3 (below) indicates the type of information collected in this phase.

3. Results

This section presents the results of the stakeholder mapping process, structured according to its various stages. For clarity and to ensure the protection of sensitive information such as personal names, company identities, and specific organizational affiliations, the data have been intentionally simplified and anonymized. Accordingly, the results are presented at the level of stakeholder profiles or sector categories, without disclosing the identities of individual stakeholders. A critical discussion and interpretation of these results be presented in the subsequent Section 4.

3.1. Stakeholder Identification Results

A total of 51 interviews were conducted across eight stakeholder sectors, following ethical principles and ensuring the representation of vulnerable populations. Figure 2 presents the distribution of interviews by stakeholder profile.

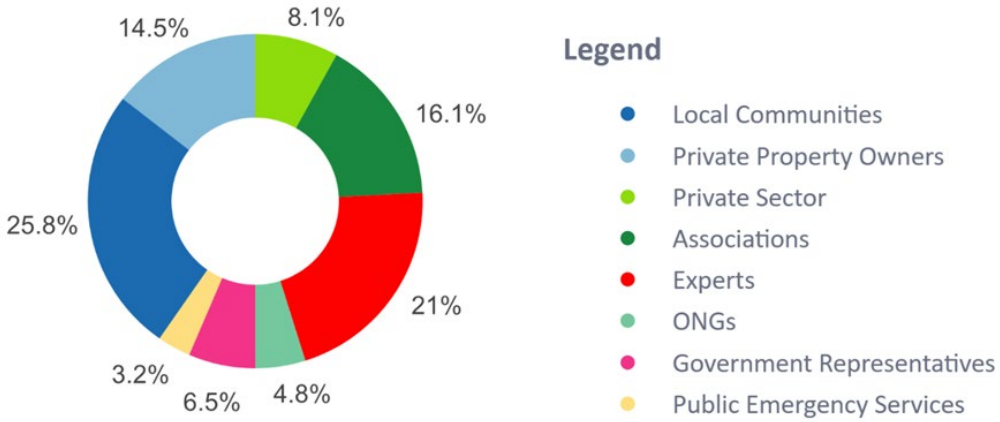

Figure 2. Distribution of stakeholder interviews conducted by sector/profile. Source: NBSINFRA.

A total of 115 stakeholders (entities and individuals) were identified across ten distinct sectors/profiles. Some individuals were also double stakeholders, representing more than one stakeholder category. As shown in Figure 2, not all stakeholders were interviewed or approached. In the figure, the mustard yellow-colored squares indicate that one or more individuals from the respective stakeholder group were interviewed, and the light-yellow color indicates that no individuals were interviewed in that stakeholder group. This was due to various factors, including time and resource constraints, lack of interest, declined invitations, or the inability to establish contact with certain stakeholders.

The profiles were characterized according to the following typology:

- Private sector;
- Public sector;
- Associations;
- Experts;
- Government representatives;
- ONGs;
- Religious institutions;
- Local communities;
- Private landowners;
- Public emergency services.

The Miro platform was used to visually present the results in a more user-friendly format. As previously noted, in order to safeguard sensitive information, stakeholder names have been omitted from the diagram shown in Figure 3.

3.2. Analysis, Filter and Prioritizing Stakeholders' Results

The interviews and additional methods informed the categorization presented in Table 2 (Section 2.2.2), enabling the team to identify which stakeholders were decision-makers or significant influencers, those with a high level of interest in the project, and those with the potential to block or negatively influence its progress (see Table 3, below).

The diagram of stakeholder identification allows for visualization of the diverse roles and contributions of each stakeholder—namely, as decision-makers, key influencers, stakeholders with high interest, information providers, and/or potential blockers—reflecting the outcomes of Step 2 (i.e., stakeholder analysis, filtering, and prioritization) (Figure 4).

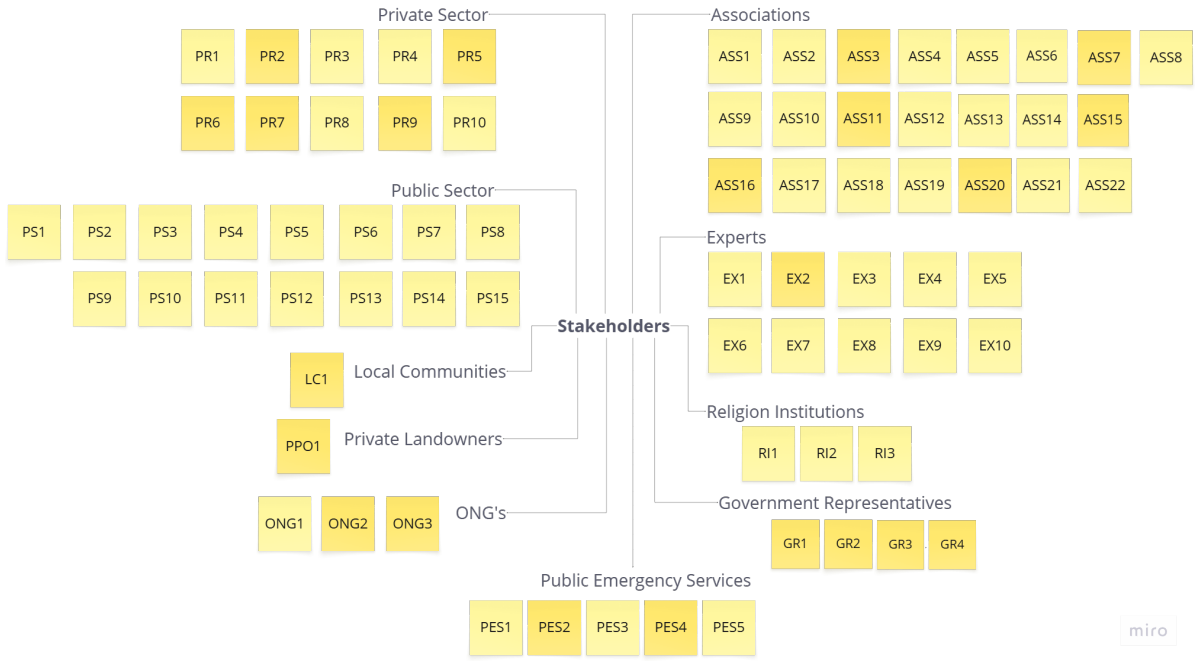

Figure 3. Visual representation of stakeholder identification (private sector, public sector, local communities, private landowners or ONGs), developed using Miro. Note: Dark yellow indicates that one or more people from the identified group were interviewed. Source: NBSINFRA.

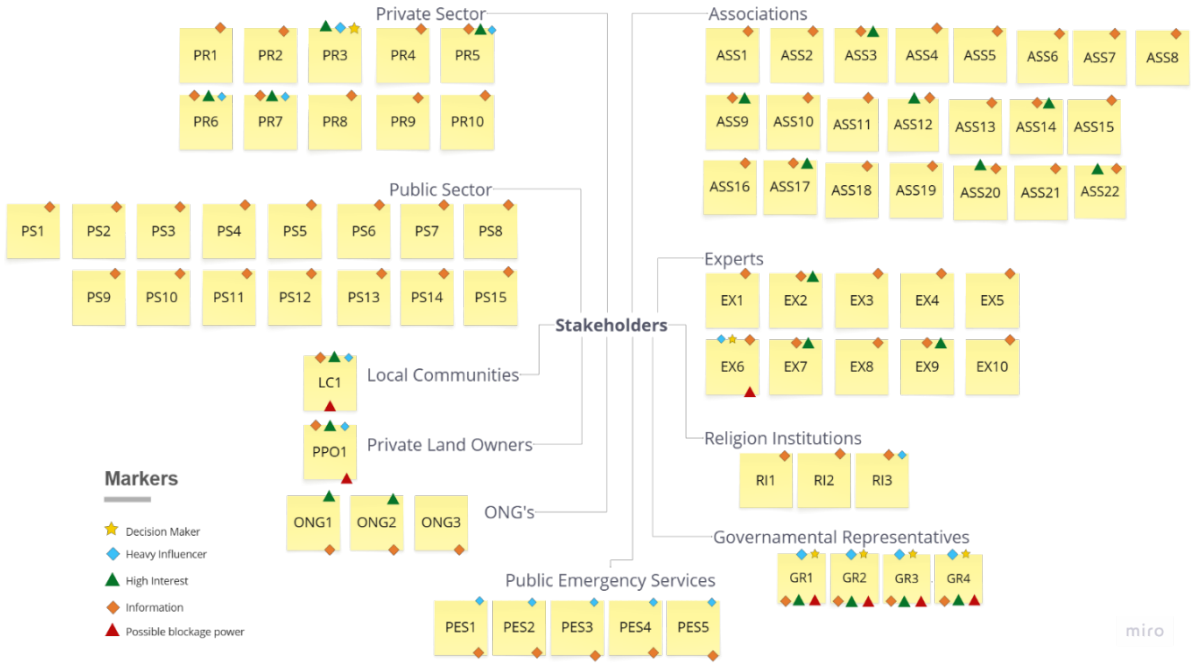

Figure 4. Visual representation of stakeholder analysis, filtering, and prioritization, developed using Miro. Source: NBSINFRA.

The NBSINFRA project recognized that each stakeholder could contribute valuable knowledge across a wide range of thematic areas, providing technical, historical, and contextual insights. Local communities and private landowners received particular attention, as they were categorized as informants, key influencers, and highly interested parties. However, some also emerged as potential blockers, expressing varying degrees of reluctance and criticism. From a methodological standpoint, certain stakeholders were identified as decision-makers due to their influential roles within their organizations or

because they belonged to institutions with regulatory authority and legal mandates that could directly impact the project.

3.3. Results of Understanding Stakeholders

The previous phases allowed for the gathering of vital information to gain a clearer notion of the relations between stakeholders, permitting a better qualitative understanding of how they compete or collaborate between themselves and with the team.

The identified relationship typologies included

- Work relationship;
- Hierarchical relationship;
- Regulatory oversight;
- Institutional support;
- Service provision;
- Community support;
- Governmental representation;
- Emergency response;
- Religious support;
- Membership relationship;
- Family relationship;
- Community support with high engagement

Another diagram (Figure 5, below) was made to present the main typologies of these relationships. Stakeholders are represented as nodes (with names removed to protect sensitive information), and relationships are shown with lines with arrows, indicating either directional or bidirectional connections. Most of the connecting lines have the same thickness, signifying equal relevance. However, some types of relationships are represented with thicker lines to highlight their greater significance, such as family and neighborhood relationships. These latter stakeholders were deeply embedded in the local community, including some landowners, which aligns with the nature of this city. It is noticeable that most people interviewed in the local community had a strong social and emotional attachment to the place and showed a high level of commitment to its protection, as the waterline is part of a wider green space with high potential for hosting activities that could benefit all.

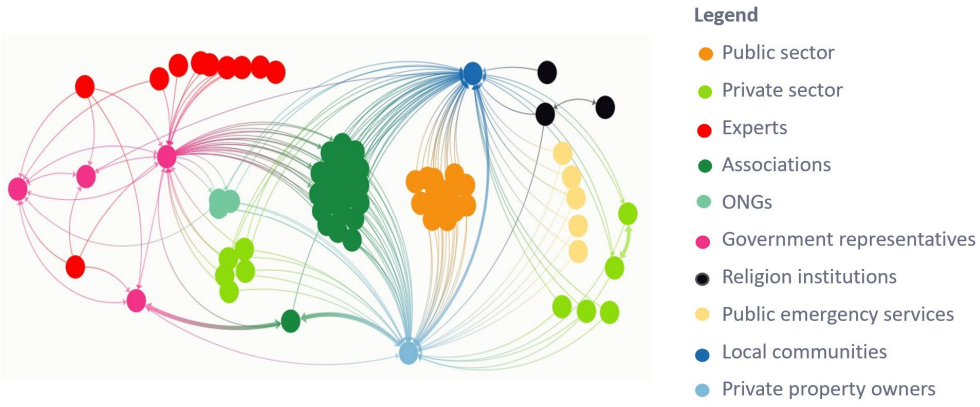

Figure 5. Visual representation of the understanding of stakeholders, developed using Kumu. Source: NBSINFRA.

3.4. Range of Engagement Levels of Stakeholders

At this stage, the stakeholder mapping process provided sufficient insight to determine the appropriate level of engagement for each stakeholder. These engagement levels follow a graduated scale: inform, consult, involve, collaborate, and empower, as demonstrated in Figure 6.

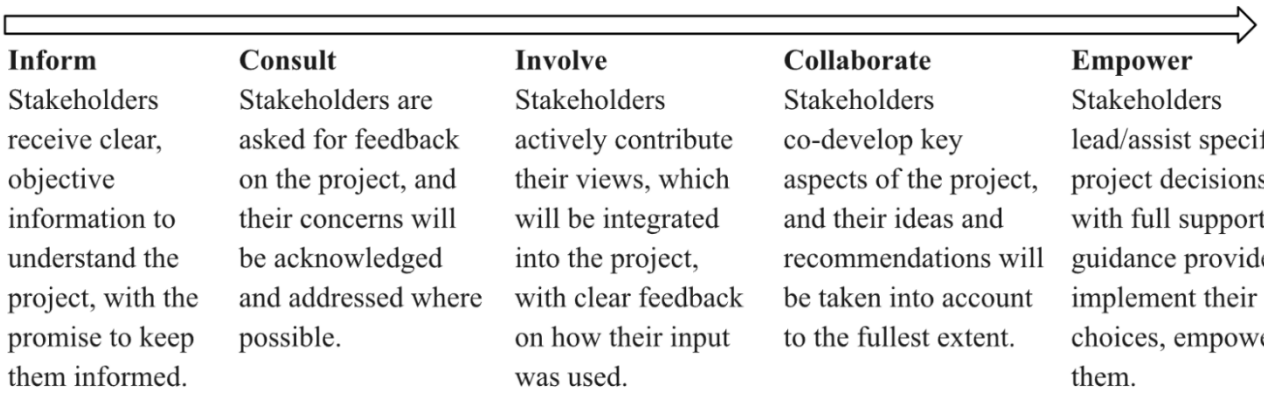

Figure 6. Range of levels of engagement (adapted from [8,20] (p. 25)).

As previously mentioned, and illustrated in Figure 7, the project placed strong emphasis on involving local communities and private landowners, recognizing them as pivotal. In addition, several other sectors (e.g., local associations, government representatives, and stakeholders from both the public and private sectors) were also included in the empowered layer, acknowledging their capacity to lead and influence the project's outcomes. While the project faced challenges in fostering strong community engagement, certain stakeholders—particularly those with limited interest—participated only at lower levels such as being informed or consulted. These included, for instance, entities with institutional responsibilities but little direct influence over the design and implementation of the NBS along the waterline.

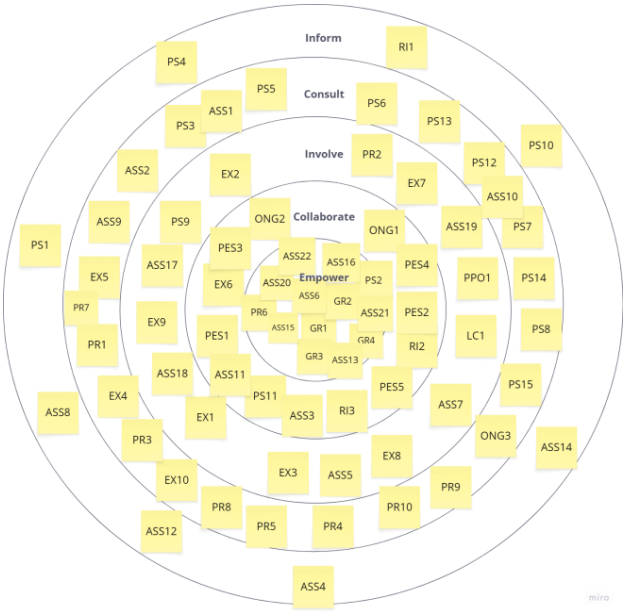

Figure 7. Stakeholders' range of engagement visual representation developed using Miro. Source: NBSINFRA.

The map below shows the distribution of the stakeholders according to the level of involvement in the project as decided: empower, collaborate, involve, consult, and inform.

The results of the mapping were presented to and discussed with the municipality, specifically with city council representatives holding formal competence in the area. A dedicated meeting was organized to examine whether any stakeholders had been overlooked and to assess possible revisions to the initial map. Following the identification stage, the proposed levels of engagement assigned to each stakeholder were also debated with these

decision-makers, who contributed additional insights for validating the map. It was only necessary to revise the engagement level in two cases; in all other cases, decision-makers and technical staff agreed with the proposed classifications. This was, however, a demanding meeting that required considerable empathy and negotiation skills from the research team. Even in the context of broad agreement, it was essential to carefully explain the methodological process, justify its rigor, and ensure collective understanding. At the same time, sensitive information, particularly comments made by stakeholders regarding the municipality, had to be handled with discretion and kept strictly confidential.

4. Discussion

The discussion presents the contributions of the study, aligning with a synthesis of the main methodological and theoretical achievements obtained through the work developed, guided by the following questions presented in the Introduction:

- Q1: How was the stakeholder mapping process structured in the NBSINFRA project?
- Q2: What were the difficulties encountered during this process, and how did the project deal with them?
- Q3: How did the NBSINFRA stakeholder mapping process enhance engagement, participation, inclusivity, and co-creation within an NBS project?
- Q4: How can NBSINFRA's stakeholder mapping be scaled to promote regional, national, and international cooperation?

Below, these questions are addressed through the provision of specific details to facilitate the reader's comprehension.

4.1. NBSINFRA Approach (Q1)

Regarding Question 1, the stakeholder mapping process in the NBSINFRA project was structured around three key phases (Figure 1), grounded in the existing literature, lessons learned, and recognized best practices. This initial phase placed strong emphasis on engaging the local community as early as possible and employing a diverse set of methods to foster interest and ensure transparency. As emphasized throughout the paper, NBSINFRA adopted a qualitative approach, relying primarily on documental analysis and participative observation, making use of semi-structured interviews to gather stakeholder perspectives around the memory, attachment, and visions for the future of the place where the waterline is located [21]. The adoption of a qualitative stance required substantial time and resources, as the team members had to relocate to the field site, conduct ethnographic observations, and establish relationships with the community. This approach provided meaningful contexts for interaction and exchange, fostering opportunities to build trust between the researchers and stakeholders. It proved particularly valuable for understanding both the aspirations and the concerns of private landowners regarding NBS interventions along the waterline. While they sought to protect the site and prevent erosion or degradation, they also feared losing full access to their land or facing disruptions from outsiders if the area were opened for leisure or sports activities. These concerns demanded careful attention from the research team, who had to navigate them without making promises or commitments to any particular group of stakeholders. Therefore, it was observed that despite the interest and the advantages provided by the qualitative approach with regard to the proximity it created with the community, team members also needed to avoid dependencies potentialized by that proximity.

4.2. Difficulties Encountered: Persistence of Top-Down Governance Cultures (Q2)

Efforts to integrate community engagement and co-creation into the implementation and design of NBSs have increased substantially in recent years. However, various policy

gaps and structural shortcomings continue to limit the depth, inclusivity, and legitimacy of these participatory practices. There are a great deal of studies showing that citizen participation is vital in successful governance and sustainable development [22–27]. It seems that co-creation and social engagement have assumed a prominent role and are considered as a requirement in the eyes of politicians and experts; especially in the context of public projects [28]. Many current policy environments continue to reflect top-down governance paradigms, where decision-making authority remains centralized and citizen input is largely symbolic. Although terms such as co-creation and engagement are increasingly present in policy discourse, the implementation of bottom-up mechanisms remains weak. Policies often stop short of operationalizing participatory principles into planning cycles, monitoring procedures, or feedback loops. As a result, co-creation is often reduced to consultation phases with limited impact on agenda-setting or resource allocation [23,29–38]. As some authors have highlighted, one of the main problems with innovation is the absence of communities and civil society in assessments, strategic planning, and local development planning [39]. Even if they are invited to provide their opinion, they are not involved in the design and are not considered in the decision-making process. To fight against this "feedback-only" model, which marginalizes the community's role in shaping the policy agenda, more inclusive approaches are emerging that assume that stakeholders are knowledgeable co-producers, which assures legitimacy in the whole process.

Similarly to other projects where urban planners or people with responsibility are not aware of the different individuals and their stakes in the project [26,37,39], NBSINFRA also observed that there were tensions and disagreements between landowners and municipality members, where local communities demonstrated distrust due to past experiences. The process in Aveiro went beyond a consultation exercise (see Figure 7). The stakeholders were engaged in multiple activities designed to build trust and capacity. For example, through initiatives such as the summer school, participants were empowered with knowledge onNature-Based Solutions, urban governance, and collaborative planning. Informal collaborations also emerged, strengthening relationships and fostering shared ownership of the process. The stakeholders are expected to remain central in the forthcoming co-creation workshops. However, it is important to stress that NBSINFRA does not aim to directly implement the proposed solution. Thus, although stakeholder mapping proved to be a valuable methodology—generating networks of trust, co-designed ideas, and a sense of ownership—the actual implementation ultimately depends on decision-making at the local political level. This raises pitfalls for the interaction between experts and policymakers and poses sensitive challenges for the research team. Despite avoiding promises or commitments, it was undeniable that certain expectations were created, and any adaptation of the solution will inevitably reflect the relationships built with the community, particularly with private landowners.

4.3. Participation and Inclusion (Q2)

Participation and inclusion are essential to address growing urban inequalities [30]. A critical issue identified is the conflation of "participation" with "inclusion" in public engagement. While many policies mandate public participation, they often fail to institutionalize inclusive practices that secure and sustain long-term engagement and capacity-building among stakeholders. Distinguishing between participation and inclusion is crucial to understanding the implications of different practices of social engagement. Authors have stated that participation focuses on public input on the content of any programs and policies, while inclusion means the continuous creation of community involvement in co-producing processes, policies, and programs for defining and addressing public issues [30]. Inclusion and participation are two different dimensions of social engagement;

therefore, organizing public management to incorporate both enhances the quality of the decisions agreed upon and the society's long-term capacities to engage [31]. The existing policies are limited in terms of structured tools or guidelines for identifying and providing opportunity to diverse and marginalized stakeholders.

As stated before, engagement often remains surface-level, involving only vocal or readily accessible groups, fails to foster the whole community, and neglects low-income groups, ethnic and religious minorities, and immigrants [32,33], thus complicating the work of scientists at this level. In NBSINFRA, the process of mapping stakeholders demonstrated the difficulties in balancing inclusion and participation, as people frequently did not recognize their importance in the process.

Access to the field also presented challenges, since establishing contact with certain groups—particularly private landowners—proved difficult due to privacy protections and restricted access to personal information. Extended stays within the community, combined with the support of local mediators, were essential in overcoming these barriers and building trust. Aware of the potential biases associated with snowball sampling, particularly the risk of reaching only the most vocal or socially connected individuals, we sought to mitigate these limitations by combining formal networks (e.g., local authorities, associations) with informal ones (e.g., community referrals). In addition, the team's prolonged presence in the field enabled the identification of less visible or initially hesitant stakeholders such as private landowners, thereby expanding the range of voices represented. Nonetheless, we acknowledge that achieving full representation remains a continuous challenge, and team members need to make a constant effort to analyze the interest in continuing to update information and to concern themselves with the inclusion of other voices, as participation and inclusion are essential to address growing urban inequalities [30].

4.4. Temporal Inequality (Q2)

While the use of semi-structured interviews proved to be a rich and insightful methodological choice—enabling the development of relationships with community members—it also presented certain limitations, as noted in the literature [22]. One major challenge was the difficulty in allocating sufficient time and resources to interview all potential stakeholders, particularly as the number of identified individuals expanded significantly through snowballing and iterative identification processes.

Therefore, an important constraint faced by the team was the limited availability of participants, who often lacked time or flexibility to attend assemblies, focus groups, or interviews. Therefore, one often-overlooked limitation for inclusive stakeholder engagement is the temporal inequality between participatory activities and the daily routines of targeted community members. While co-creation frameworks emphasize inclusivity, they frequently fail to account for the time constraints imposed by participants' occupational roles, particularly in working-class or informally employed groups [34]. For instance, factory workers typically operate within rigid, shift-based schedules, making participation in mid-day interviews or workshops virtually impossible. In contrast, individuals who are not employed during rigid working hours can have more temporal flexibility, thus becoming over-represented in consultation processes. Participatory processes are often constrained by project timelines, institutional work hours, or bureaucratic issues which do not align with the daily lives of diverse stakeholders. Standardized and conventional engagement formats—such as community meetings during working hours—fail to accommodate the time constraints of diverse stakeholders such as shift workers or caregivers. This leads to under-representation and a lack of participation.

Authors [34] have described how adopting a temporal approach to participation contributes to current efforts in recent participatory design (PD) aimed at cultivating more

complex conceptualizations of participation [35]. NBSINFRA attempted to address this challenge by creating flexible and inclusive opportunities for engagement, by proposing interview slots outside of traditional working hours (including interviews at late-night hours), choosing accessible venues, and tailoring methods to participants' preferences; for example, using maps or conducting walking interviews through the case study area. To address this, participants were allowed to choose both the time and venue for meetings, helping to minimize scheduling-related barriers. For example, some late-evening sessions with landowners and local associations were held at a local association, which allowed for greater participation from working-class stakeholders who would otherwise have been unable to attend during regular hours.

4.5. The Impact of Stakeholder Mapping on Participation and Co-Creation (Q3)

The most immediate and evident impact of stakeholder mapping on participation and co-creation lies in the inclusive methodological approach adopted by the project and its capacity to strengthen the networks between different actors and institutions, raising awareness of the waterline and providing means to increase knowledge about the vulnerabilities of the city to extreme events. By emphasizing broad and participatory stakeholder identification, NBSINFRA ensured that a diverse range of stakeholders, across multiple sectors and including vulnerable or traditionally under-represented communities, were mapped and considered (while acknowledging the aforementioned limitations). This approach represents a step further when compared with quantitative and top-down methodologies that often focus solely on the so-called "usual suspects," thereby excluding critical perspectives and reducing the potential for meaningful engagement [8,9].

The stakeholder mapping process significantly enhanced the project's social engagement activities and continues to contribute to ongoing participation and co-creation efforts. For example, informal partnerships emerged in which stakeholders offered venues and resources for project activities (such as venues for a summer school, assemblies, and co-creation sessions) at no cost. This not only reduced logistical barriers such as venue rental costs, but also facilitated a deeper integration of the project within the local context.

Furthermore, the relationships established through the mapping process served to create informal "community mediators"—individuals or groups who acted as bridges between the project team and the broader community. These mediators often proved more effective in disseminating information and mobilizing participation than traditional communication tools such as flyers or emails.

While the formal co-creation phase of the project—consisting of structured workshops—is still forthcoming, several co-design and co-creation activities have already taken place. These were made possible due to the relationships nurtured with local stakeholders, including community members, associations, and government representatives. Their ongoing involvement has not only supported the logistical implementation of activities but also provided valuable input, both analog and digital, that is helping to shape the project's direction.

4.6. Relevance of Stakeholder Mapping in Regional, National, and International Cooperation (Q4)

A crucial part of NBS projects is the amplification, replication, or scaling-up of the NBS and, as authors have mentioned, the scaling of NBSs is part of a broader strategy at the regional, national, and international level [40].

Stakeholder mapping plays a crucial role in regional, national, and international cooperation, as it identifies stakeholders capable of creating dialog with different countries, capable of sharing information and findings, and creating or being involved in the creation of national and international regulation [40]. Q4 aimed to explore how stakeholder mapping

contributes to regional, national, and international cooperation. In the NBSINFRA project, this was particularly supported by the role of the UNESCO partner in charge of the creation of a framework for cooperation between global and EU policymakers, national and regional stakeholders, and populations by emphasizing structured forms of information exchange for mutual learning and enhancement of stakeholder capacities. For this reason, stakeholder mapping was crucial to inform this partner and to create room for the possibility of amplification and replication by identifying and analyzing the regional and national stakeholders of the Aveiro City Lab.

4.7. Impact of Stakeholder Mapping Process for Conceiving of NBSs in the Context of Urban Planning, Resilience Strategies, and Natural Disasters

The stakeholder mapping process significantly contributed to this NBS project. As mentioned above, NBS projects are multi-step and multidisciplinary by nature, involving many organizational factors that affect their overall effectiveness [8,9]. NBSINFRA is a complex project receiving attention from different stakeholders, with centrality given to decision-making at the local level. At this stage, it can be said that this stakeholder mapping approach positively impacted many organizational processes related to urban planning in the city, particularly those addressing the local level. First, it helped us to understand the context of a specific area and provided important historical and sociological data during the co-diagnosis and co-characterization phases involving stakeholders early on. It also enhanced general participation and inclusion of more vulnerable populations, including elderly people, women, and migrants, leading to a more inclusive design of the solution for the waterline through stakeholder engagement in the co-design phase.

Moreover, many stakeholders will continue to be involved throughout the co-creation phase, either through formal collaboration with technical experts or by participating in local co-creation workshops. During the implementation stage, stakeholder mapping can also help to operationalize the NBS project by identifying actors such as local businesses (e.g., for the supply of materials or services) and community members, who may be directly engaged in constructing the NBS infrastructures (e.g., community gardens), following technical guidelines.

In addition, stakeholder mapping was an important means for identifying local associations and organizations capable of assuming responsibility for possible future maintenance of the NBS or contributing to its monitoring and evaluation. During the replication or scaling-up phases, this mapping approach also facilitated the identification of regional and national stakeholders who may support dissemination and institutional adoption.

4.8. Comparison with European and International Experiences

In recent years, several European projects have addressed stakeholder engagement in the context of NBS implementation with varying degrees of depth and scope. Some projects have applied co-creation processes both in cities (CLEVER Cities UNaLab, Urban GreenUP, and GrowGreen [41–43]), as well as in critical public and private infrastructure (PRECINCT [44]). These projects promoted cooperation between various stakeholders [44], creating reference groups (FORESEE [45]), improving risk communication and decision-making processes (RESOLUTE [46]), through workshops (RESILENS [47]) and engagement platforms, which led to the development of guidelines for future cases of participatory governance. Although these approaches are very important, these projects showed a predominance of expert-led implementation, with stakeholders playing a reactive role, validating tools and strategies rather than actively shaping them throughout the process.

Experience from Europe has provided very important and complementary insights. In Latin America—specifically in countries such as Argentina, Paraguay, and Bolivia—the

project "Living and Producing in the Chaco Forest" [48] has been created, which aims to improve the socio-ecological resilience of local populations by strengthening forest management mechanisms in productive environments. To this end, they seek to increase the knowledge, capacities, and skills of local actors in the management of multiple-use forests and integrated systems. In Peru, the MERESE (Mechanisms of Remuneration for Ecosystem Services) program [49] has been created, which focuses on promoting financial compensation for the provision of ecosystem services. Thus, economic resources are channeled into investment in conservation, recovery, and the sustainable use of ecosystem service sources through the creation of voluntary agreements between contributors (companies seeking to reduce their environmental impact through compensation mechanisms) and recipients (exclusively families that perform ecosystem services). In Sub-Saharan Africa, NAbSA, a Global Affairs Canada initiative [50], supports projects to develop a gender-responsive framework for Nature-Based Solutions with biodiversity benefits. On the other hand, the ASSAR project [51] combines interdisciplinary scientific areas and thematics, capacity building, and stakeholder engagement to improve understanding of the barriers and enablers to effective climate adaptation approaches.

It is clear that European projects and initiatives benefit from more structured governance frameworks, while countries outside of Europe often rely on bottom-up practices and different and innovative financial or funding mechanisms. NBSINFRA contributes to bridging these different approaches by combining formal stakeholder mapping with the application of qualitative methodologies that reinforce the broad participation of different groups, build trust, and account for temporal inequalities. This demonstrates its potential for application and replication in all global contexts.

5. Conclusions

The stakeholder mapping process in the NBSINFRA project proved to be a fundamental tool to facilitate inclusive and significant social engagement, gather information about the history and social dynamics of the place, and build relationships and mutual trust, especially among the local community where the waterline is situated. The methodological path of stakeholder identification, stakeholder analysis, and filtering and prioritizing stakeholders' understanding, through methods such as approaching key players, interviews, focus groups, and direct observation, in addition to the use of visualization tools such as Miro and Kumu, allowed us to effectively identify stakeholders and acquire a better understanding of the context and dynamics of the case study.

Despite the limitations and challenges found during the mapping process, such as providing institutional and political support for developing a participative approach, accessing certain groups, temporal inequalities, existing information gaps, and bias with the interview—and, at times, logistics and meteorological conditions—the project managed to involve a diverse range of stakeholders who were very important in order to gather complete information on the memories of the locals, aspirations for the waterline surroundings, and ideas for a socially accepted NBS.

Overall, stakeholder mapping proved to be crucial not only in the local arena, creating more space for participation and strengthening co-creation, but also showed great potential for the creation of national and international cooperation in later stages, such as scaling-up, amplification, and replication. While this contribution is particularly relevant in the field of urban studies and planning, it also extends to ecological restoration and infrastructure resilience in the face of human and natural hazards, including climate change, demonstrating that meaningful change in these areas requires deep social involvement and empowerment. Finally, it was possible to highlight both methodological challenges and adaptive strategies in stakeholder mapping, thereby offering insights for other projects fac-

ing similar complexities. In particular, the presented findings call for continued efforts from project teams to enhance inclusivity and strengthen participatory processes in NBS projects, enriching reflexivity about the need to improve participation and citizen engagement in decision-making processes that affect their lives at the local level.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated and analyzed during this study are not publicly available at this time due to confidentiality agreements with participants. However, aggregated and anonymized data will be made available in a forthcoming handbook publication related to this research. Requests for data access can be directed to the corresponding author.

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