Nature Based Solutions in Milan (Italy): Examples from CLEVER Cities project

Israa H. Mahmoud - *Laboratorio di Simulazione Urbana Fausto Curti, Department of Architecture and Urban Studies (DAStU), at Politecnico di Milano*
israa.mahmoud@polimi.it

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Keywords	co-creation, nature-based solutions, urban regeneration, socio-spatial inclusivity, urban planning
City Population	1.4 million
City Area	182 km^2
City GDP	265 billion USD
Climate Zone	Cfa (humid suptropical)
ARC3.3 Linkage	Nature-Based Solutions: Enhancing Capacity to Respond to Shocks and Stresses

Introduction. The city of Milan is building a comprehensive urban policy aimed at increasing social cohesion and inclusivity by implementing Nature-Based Solutions (NbS). Within the EU Horizon 2020 CLEVER Cities project (2018-2023), three “Urban Living Labs" (ULLs) have been designed in collaboration with citizens. Their purpose is to implement a co-creation pathway to take into consideration issues of social cohesion and inclusivity by implementing NbS in consideration with the contextual challenges of social inclusivity, health and well-being, and safety and security.

Brief History and Overview. The main project area of CLEVER Cities in the city of Milan is situated in its south transect. It has three Clever Action Labs (CALs), two of them being “spot” interventions (CAL 2 & CAL 3) and one (CAL 1) that covers a larger urban area (see Figure 1). The stakeholders in this collaborative process are a university partner (the Politecnico di Milano, hereafter POLIMI), a facilitating partner Eliante (ELI), the Municipality of Milan (CdM), Ambiente Italia Srl. (AMBIT), the Mobility and Environmental Agency of Milan (AMAT), Rete Ferroviaria Italiana (RFI), and Italferr (Società Gruppo FS Italiane). CdM, AMAT, AMBIT, ELI, and POLIMI are responsible for promoting urban greening measures such as NbS in terms of policy, planning, design, and implementation by using a co-creation process intertwined with citizens engagement.

Analysis, Evaluation, and Implementation. The project developed two main entities: Urban Innovation Partnership (UIP) and Clever Action Labs (CALs) (see Figure 2). These two entities represent key mechanisms to implement NbS in the urban fabric. Operating on different spatial scales, CALs operate as Urban Living Labs (ULLs) of co-created NbS. The co-creation pathway reflects the operational structure of NbS implementation and is established as a flexible framework encompassing six stages as follows: UIP establishment, co-creation planning, co-design, co-implementation, co-monitoring, and co-development.

In CLEVER Cities, a Co-Creation Guidance document has been developed (Morello et al., 2018). Its aim is to better understand and coordinate the co-creation processes that shape the implementation of NbS in socially inclusive urban regeneration. The pathway consists of 16 steps, not necessarily consecutive nor contemporaneous. The structure is intended to be flexibly applied in different urban contexts. The steps are provided with a variety of tools that help cities to establish a co-creation process taking in consideration the place-based context, the type of NbS interventions, and the governance model selected by the responsible authority.

Several toolkits for co-design, co-implementation, and co-maintenance of NbS are developed with cities to use as reference in their co-creation processes. The efficacy of the guidance is currently being monitored in the practice of nine CALs through corresponding deliverables as established by the Grant Agreement (Mahmoud and Morello, 2020; 2021). The co-creation pathway and guidance in CLEVER Cities are a form of 'open innovation’, in which ideas are shared and actively communicated to a wider public in order to promote originality and effective governance. Likewise, co-creation in practice is about motivating people, inspiring participation, sharing results, continuing development, and delivering results at different levels.

Implementing and Producing the Policy/Plan/Design/Institution. CLEVER Cities adopted a Public-Private-Partnership (PPP) model since the project's inception in June 2018. The established Urban Innovation Partnership is at the heart of the shared governance process among the diverse stakeholders. These stakeholders’ groups work to co-plan, co-design, and co-implement NbS for the city. For each ULL, different leading actors were identified in order to ignite the engagement with larger groups of stakeholders. Consequently, these lead actors report to the local project manager hired by the municipality. In other words, transversal coordination of co-creation in all aspects is followed (Mahmoud and Morello, 2021).

Two workshops were conducted to build the pathway to the implementation of NbS in each of the three ULLs (see Figure 3). Architects, experts on greening solutions, and citizens were involved in the co-creation process to implement green roofs and green walls in private buildings. Social experts and designers from the local municipality

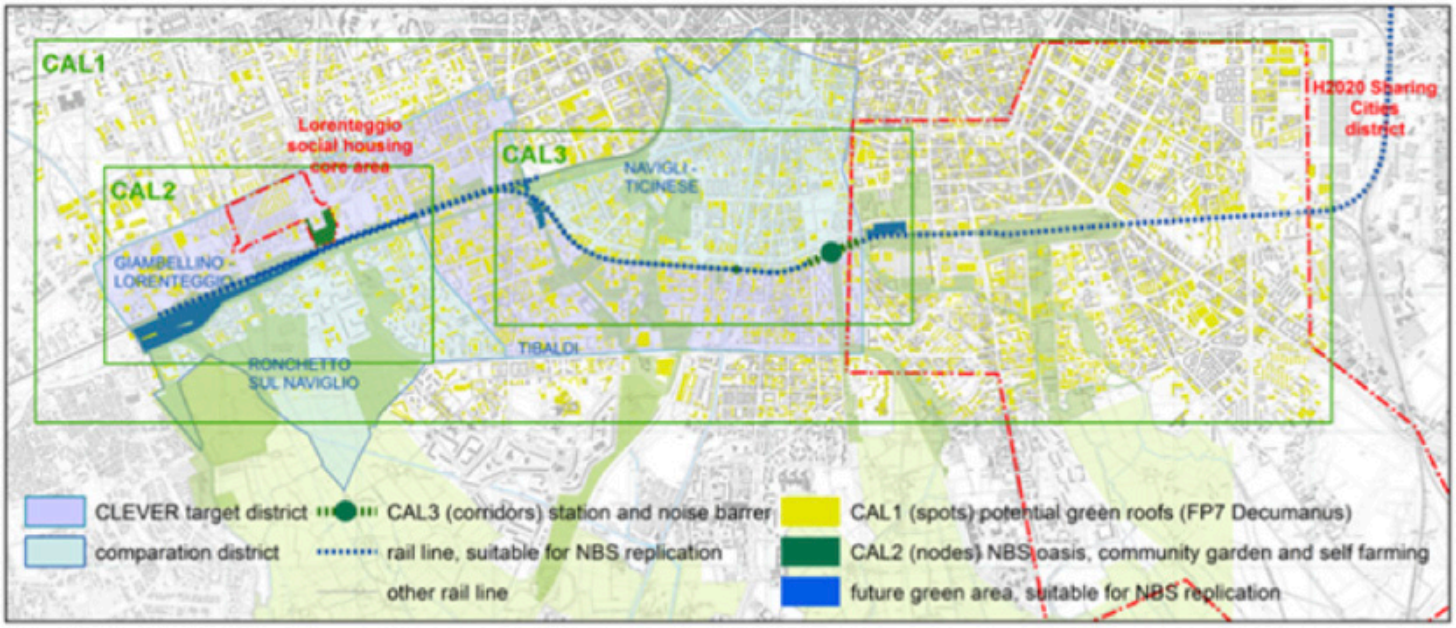

Figure 1. *Territorial operating area of the CALs of Milan, southern transect. Source: the CLEVER Milan team, GA – June 2018.*

of Milan, as well as citizens from the Giambellino 129 neighborhood, were also involved in co-designing a new community park. The main idea behind the workshops was to build on the narratives from the people that possessed contextual information about the ULLs in order to forecast the changes that they wanted from NbS solutions. Online participation was also granted for citizens during the co-design process in the ULLs of green roofs and green walls (CAL 1) as well as the Tibaldi station (CAL 3).

The Project, now in its final phase, is establishing a guideline that is of interest to new European projects and municipalities to uptake the implementation of NbS in policymaking, urban planning, co-design experimentation, and increasing institutional capacities in co-creation and public participation processes.

Governance Structure. CLEVER Cities operates on four scales, in order from largest to smallest (see Table 1):

- Consortium scale – all stakeholders participate and share responsibilities in decision making.
- City scale (each city manages a local stakeholder team with a city project manager).
- The Urban Innovation Partnership (UIP) is a local alliance of stakeholders that implements the NbS.
- CLEVER Action Lab (the project specific ULL) for co-design workshops and co-implementation of NbS. Nine CALs exist in the CLEVER Cities project, three in each city.
- In Milan, the Lead of the consortium scale is the Directorate of Urban planning in the Municipality authority.

Leadership	Key Starting Approach	Core Typology Scheme	Polycentric Characteristic	Principal Pathway
Milan UIP (Lead: Directorate of urban planning, Municipality of Milan)	Municipality appointed stakeholders + manifestation of interest from local community and experts	Lead + enabler + appointed partnership + network, see figure 4	Yes, central partnership with three satellite networks.	Designing + strengthening intra-network connections.

Table 1. *Governance scales for the Milan case study in CLEVER Cities project.*

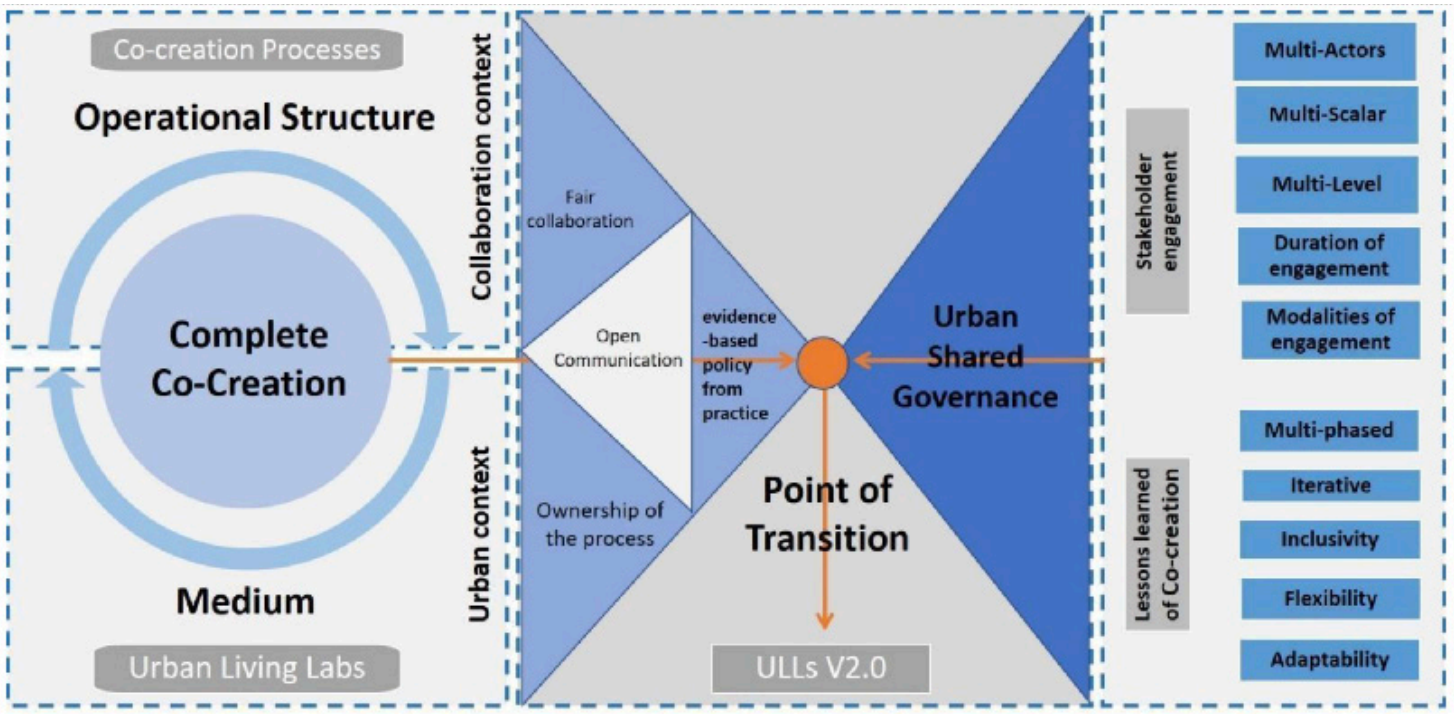

Figure 2. *Concept of the complete co-creation for NbS implementation that integrates the co-creation pathway (the operational structure) and the Urban Living Labs (the spatial medium) V2. (Source: Mahmoud et al., 2021b)*

Social Inclusivity and Nature-based Solutions. A special study was conducted by the CLEVER Cities Milano research team with citizens engaged in the project about their perceptions and public acceptance of the NbS interventions in their neighborhoods (Mahmoud, et al., 2021a). Throughout one year from May 2020 until May 2021, social monitoring surveys have been conducted (mostly online due to the Covid-19 outbreak in Milan) with a sample of 338 citizens living around the same neighborhoods where the interventions are taking place. A notable outcome was the strong engagement of women and older age groups, who showed particular interest in co-designing and co-monitoring interventions at the local scale.

Throughout the project timeline the social inclusivity aspects were at the center of co-creation planning process and co-implementation of the NbS interventions. The main focus was on vulnerable populations, such as the elderly in particular areas of the project CALs (see results section and relative Figure 4). Since the start of the project, a group set of Key Performance Indicators (KPIs) were identified and divided into two main sets by category of measurement (environmental and social KPIs). Within the project's wider monitoring plans, the methodological framework presented here is only related to the social KPIs utilized and is based on the need to evaluate and monitor the advancements of social impacts related to NbS co-implementation in the city of Milan.

The Local Monitoring Team (LMT) started by identifying the main environmental and social aspects to be evaluated. Next, the team analyzed them with respect to the specific CALs in Milan and, finally, verified them in different team meetings starting from February 2019 onwards. In March 2019, three collaborative workshops were conducted, one per CAL. A Theory of Change (ToC) collaborative activity was carried out in order to forecast the possible expected outcomes in each CAL context. A first version of the Local Monitoring Plan (LMP) was developed afterwards in June 2019. The social monitoring methodology was developed collaboratively with all the interested stakeholder groups that were part of the Milan LMT.

The initial idea was to develop a mixed methodological framework using a variety of quantitative and qualitative measurement tools such as surveys, on site observations, interviews with stakeholders, focus groups, and online questionnaires. That scientific validation of the LMP and social monitoring methodological framework initially started in September 2019 during the Milan Green Week festival, where site visits were conducted at the three living labs (CALs), including a guided tour of Milan's existing green roofs and walls for CAL 1, a tour of Giambellino Park 129 for CAL 2, and the Tibaldi train station for CAL 3 (see Table 2).

Throughout the months from October 2019 until February 2020, a first tailored methodology was drafted and shared with CAL leaders to check on the scope and the set of indicators including the feasibility of measuring a pre-greening baseline built on place-based criterion. Later on, the arrival of the COVID-19 pandemic constrained the number of tools available to the team, leading to the choice of submitting online questionnaires starting from February and March 2020 when emergency levels of sickness hit Milan and blocked all activities in a hard lockdown.

The complete LMP for the pre-greening phase of each CAL,

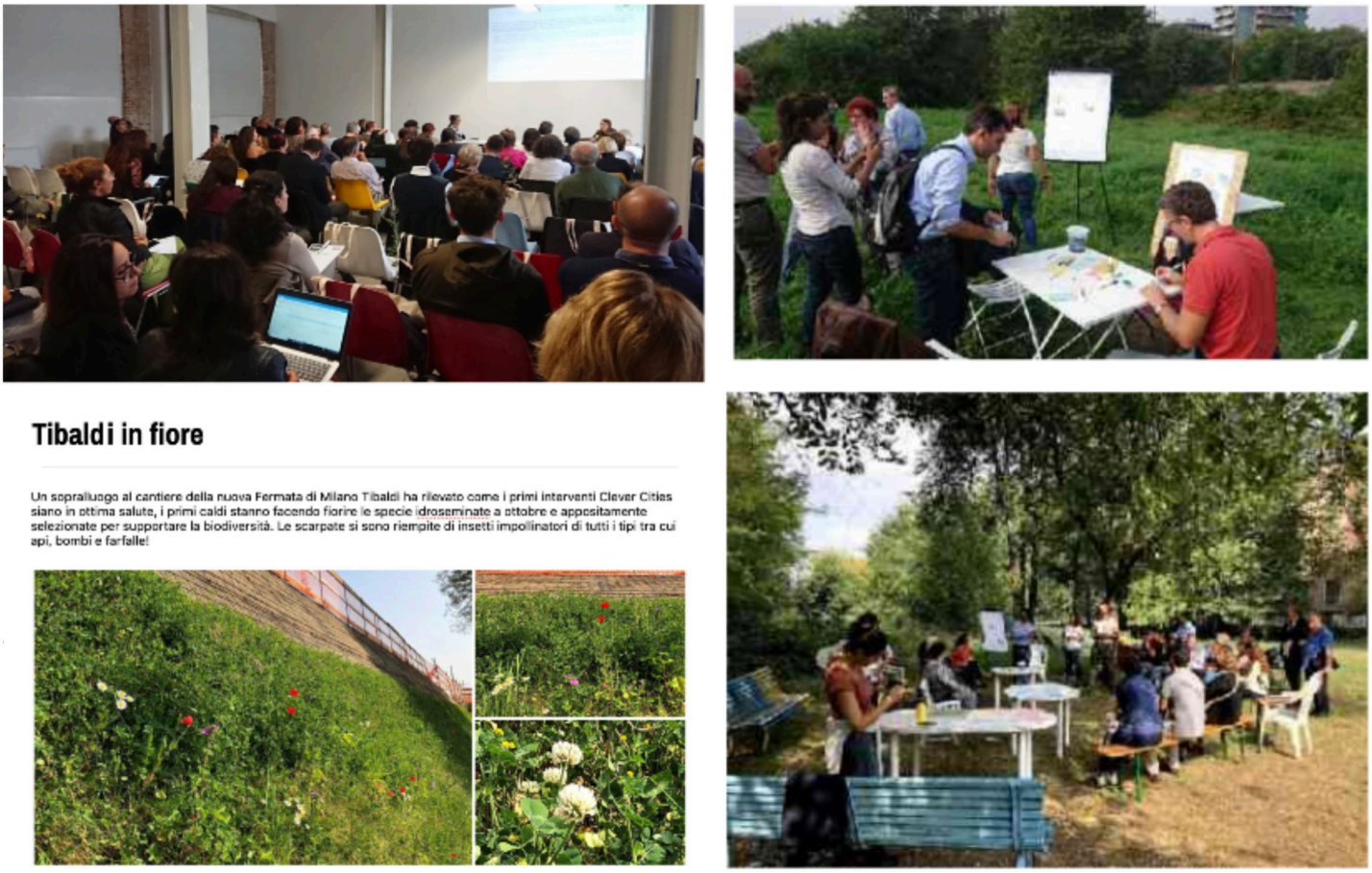

Figure 3. *Workshops, meetings and site construction images from CLEVER Action Labs of Milan.*
Source: Mahmoud and CLEVER Milan team, 2021.
See https://milanoclever.net/

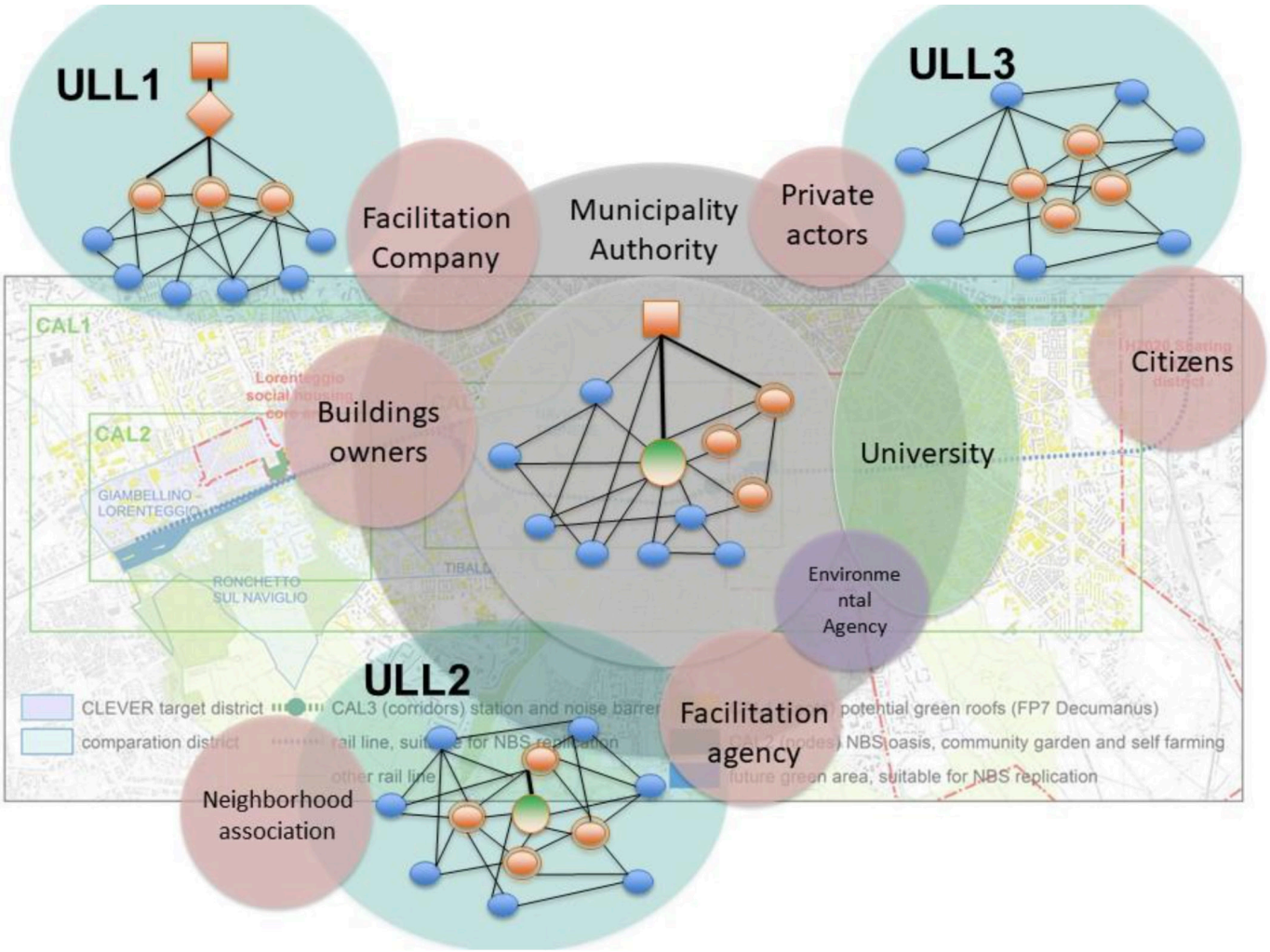

Figure 4. *Integrated collaborative governance models depicted in Milan. (Source: Mahmoud in Bradley, et al., 2022)*

	CAL 1	CAL 2	CAL 3
Brief Description	Green roofs and walls	A Community Public Park	An open-air waiting area
CLEVER identified Regeneration Challenge	Regeneration challenge 1: Human Health and well-being	Regeneration challenge 3: Social cohesion and environmental justice	Regeneration challenge 4: Citizen safety and security
Aims and expected outputs related to ToC	Better training of citizens in workshops New financial partnerships	Soil restoration Citizen Engagement in co-design activities	Changes to planning policies related to NbS
Expected Outcomes	• Higher availability of green roof spaces • Increased sense of belonging and social well-being • Increased quality of built environment	• Increased Biodiversity[1] • Increase of citizens' awareness through co-monitoring of nature-based solutions	• Reduction in crime • Reduction of acoustic noise from the station • Increased sense of belonging towards the neighborhood of interventions
Specific Micro Indicators	Increased connectedness to Nature and aesthetics	Increased social cohesion and support	Increased sense of safety and security
Expected Measured impact from social monitoring framework	Greener urban spaces generate increased well-being for residents and better environmental quality	A higher quality multifunctional green infrastructure with community involvement and social presidium	A new railway stop, bringing social and environmental benefits for the surrounding neighborhood and city

1 Biodiversity measurements in CAL 2 were originally planned to begin in summer 2021, using similar methods such as observations, community walks, and focus groups. However, these were to be complemented by a separate set of indicators under LMP, distinct from the social monitoring framework. The project was ultimately delayed until April 2023 due to unforeseen procedural and policy-related delays within the municipal authority.

Table 2. *Table of Contents for CALs interventions in Milan related to the social monitoring framework. (Source: Mahmoud et al., 2021c)*

including the social KPIs, was then co-designed and approved by all the involved partners based on their specific interests.

Results. The results from the questionnaires give indications of the different social impacts of NbS interventions in urban environments and the correlation to human relationships with nature. These impacts are linked to the main co-benefits associated to improve general health and well-being, social interactions and cohesion, as well as an increase of the use of space, place satisfaction, the connectedness to nature, and safety perception.

The following graphical representation of the wind-rose (see Figure 5) aims to give evidence from the previous analysis on the most relevant categories of interest, hence correlating between social impacts from NbS and outcomes from the methodological analysis of the data from the questionnaires.

The legend indicates if the resulting percentage is representing results from all the three CALs or just one or two of them. For each sub-indicator, data was averaged and elaborated according to a new percentage scale (green < 60%, yellow >60% and <70%, Orange >70% and <80%, Red >80%) to visually showcase on the most important macro categories and micro indicators by consequences.

In relation to human health and well-being, it emphasizes the strong importance of green infrastructure as a priority, medium positive impact from green areas on aesthetics, air quality, and general well-being in residents' opinions. The model also reflects on the relationship between residents and their permanence stability with the building and/or neighborhood where the CLEVER Cities interventions are taking place.

Reflecting on social cohesion and environmental justice, the model specifically investigates the clear high value of measuring aspects related to proximity to parks and green spaces, maintenance, and cleaning of the areas with perception on general satisfaction and place ownership of one's building or neighborhood of residence. Commonly, the survey results guide a high social interaction in terms of happiness and significant trust and support among neighbors. Increased sense of belonging also results in an important aspect to focus on throughout the interventions in the CALs context.

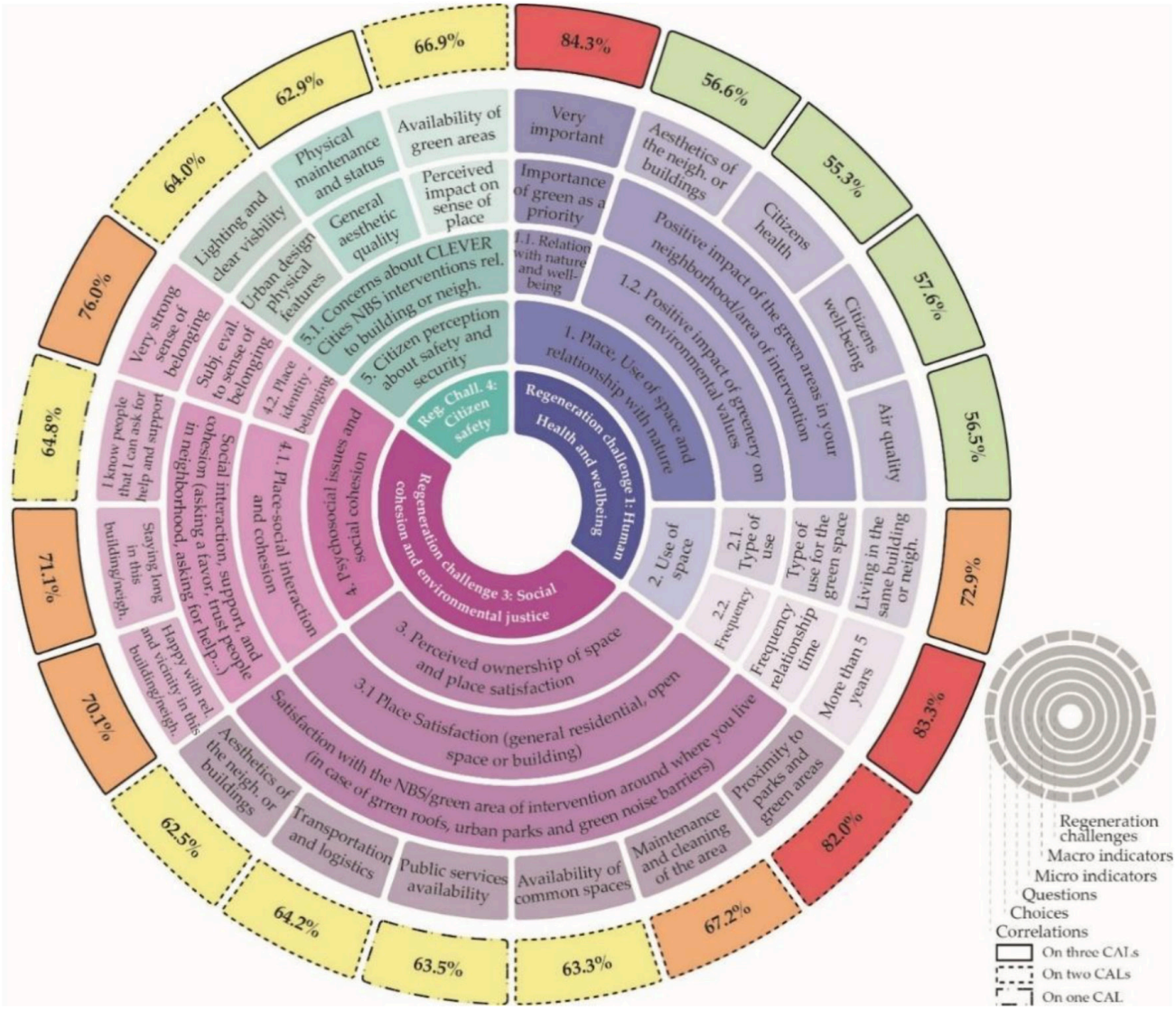

Figure 5. *Social Monitoring pre-greening wind rose model from the Milan CLEVER Action Labs (CALs).*
(Source: Mahmoud et al., 2021a)

Reflecting then on the regeneration challenge 4 on safety and security, citizens' perceptions reveal high interest on maintenance, aesthetics, and presence of other people in the green areas towards lowering their concerns on the areas of interventions related to safety and security. However, reflection on safety outcomes was not prioritized equally across all three CALs and was, on average, overlooked in two of them.

The most striking result of this study is the widespread priority given by participants to proximity to green and natural elements within their urban environment, especially related to CLEVER interventions. This is irrespective of whether the interventions are carried out in buildings, train stations, or in urban public spaces. This result contrasts with the trend observed in cities in recent decades of soil sealing and land consumption in our environments, eliminating green or blue elements, both in public spaces (elimination of trees, gardens, fountains, etc.) and in our residential buildings, where flowerpots and small vegetations in balconies have been noticeably disappearing.

What the public seems to be calling for is a return to greening and blueing our spaces of coexistence with nature. During the COVID-19 pandemic and, especially, during the period of confinement, the windows and balconies of our residential buildings have recovered their function as public spaces for enjoyment and social interaction.

Future Implementation and Concluding Thoughts. The CLEVER Cities project has a wider consortium operating in two frontrunner cities other than Milan, which are London and Hamburg; as well as six fellow cities around the world, Malmo, Madrid, Larissa, Belgrade, Sfantu Gheorghe, and Quito. These fellow cities are implementing the co-creation pathways for planning and upscaling nature-based solutions, considering the previous experiences from frontrunner cities and their local context for public participation.

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Additional Data

- **Population Density:** 7,551 people/km^2
- **Per Capita Gross National Income (GNI):** 61,620 USD (High Income) [2024]
- **Gini Coefficient:** 34.3 [2023]
- **Human Development Index (HDI):** 0.915 (Very High) [2024]
- **Type of Climate Intervention:** Hybrid **(**Adaptation and Mitigation)
