



IN-HABIT - INclusive Health And wellBeing In small and medium size ciTies

D1.4. - Monitoring and evaluation of VIS for IHW in Cordoba. Final report.





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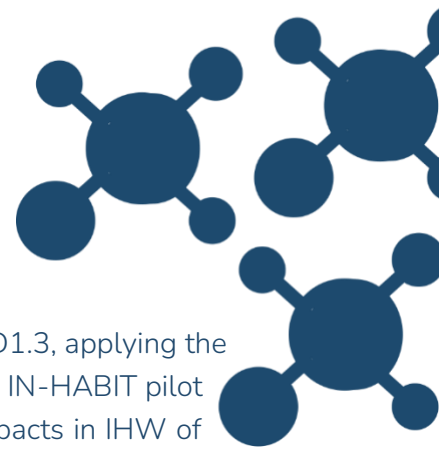
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ABBREVIATIONS

AI	Artificial Intelligence
AAI	Animal Assisted Intervention
AMD	Amendment
D	Deliverable
DEC	Dissemination and Exploitation Committee
DECO	Dissemination, Exploitation, Communication and Outreach
EAB	External Advisory Board
ERACIS	Andalusia Regional Strategy for Social Cohesion and Inclusion (Estrategia Regional Andaluza para la Cohesión e Inclusión Social)
ERDF	European Regional Development Fund
EU	European Union
EWB	Economic Wellbeing
GA	General Assembly
GDEI	Gender, Diversity, Equity and Inclusion
GDPR	General Data Protection Regulation
GL	Gendered Landscape
H&W	Health and Wellbeing
H2020	Horizon 2020
HL	Healthy Lifestyle
Hum-An	Human-Animal
IA	Innovation Action
IEC	International Electrotechnical Commission
IHW	Inclusive Health and Wellbeing
ITPath	Inclusive Transition Pathway
ITP	Inclusive Transformation Plan
KII	Key Impact Indicator
KLC	Key Local Communicator
KPI	Key Performance Indicator
LCA	Local Community Activator
LGBTQI+	Lesbian, Gay, Bisexual, Transgender, Queer, Intersex
MHWP	Mental Health and Wellbeing
NBS	Nature-Based Solution
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
OPI	International Project Office (Oficina de Proyectos Internacionales)
P	Partner
PC	Pilot City
PP	Project Partner
PPPP	Public-Private-People Partnership
PWB	Psychological Wellbeing
R&I	Research and Innovation
SC	Steering Committee
SMSC	Small and Medium-Size Cities
SWB	Social wellbeing
UAB	User Advisory Board
UNESCO	United Nation Educational, Scientific and Cultural Organization
VIS	Visionary and Integrated Solutions
WHO	World Health Organization
WP	Work Package





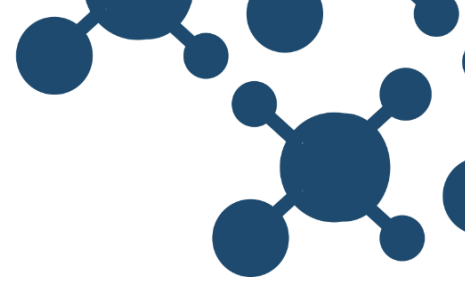
EXECUTIVE SUMMARY

This deliverable continues the monitoring and assessment work reported in D1.3, applying the same conceptual framework and analytical approach to the final phase of the IN-HABIT pilot in Córdoba. The aim has been to document the social and environmental impacts in IHW of the nature-based solutions (NBS) implemented in three contexts: the neighbourhood of Las Palmeras, the shelter for homeless people, and the patios of the historic Axerquía district.

In Las Palmeras, the project focused on the renovation of public spaces and the renaturalisation, with the planting of trees and shrubs, alongside social activities to involve residents in planning, planting, and maintenance. Surveys, interviews, and focus groups show that while environmental benefits are still developing due to the young age of the trees, residents already report improvements in well-being, social cohesion, and the image of the neighbourhood. The low incidence of vandalism towards the new plantings is linked to the active participation of residents in the process. At the shelter, interventions were smaller in scale but targeted daily living conditions. The creation of a vegetable garden, a therapeutic garden, the renovation of a nude patio and improvements such as outdoor lighting were accompanied by resident-led activities. Short-term monitoring recorded measurable improvements in emotional well-being, perceived health, and environmental perception. Even brief participation in structured gardening sessions had a positive impact, suggesting that NBS in this context can contribute to psychological relief and social inclusion when combined with other forms of support. In the Axerquía district, monitoring of 24 traditional patios confirmed their value as both cultural heritage and green infrastructure. Environmental measurements showed that patios with permeable soil, rooted vegetation, and water features provided better thermal comfort, particularly during summer nights. Social surveys indicated that these spaces are important for rest, social interaction, and cultural activities. As part of a wider network, patios contribute to cooling the city, maintaining biodiversity, and sustaining neighbourhood identity.

Across all three contexts, the results point to the importance of involving users in the design and maintenance of green spaces. Physical benefits such as shade, cooling, and improved air quality take time to develop, but social and emotional gains can appear earlier when people are actively engaged. This involvement strengthens the connection between residents and their environment, increasing the likelihood of long-term care and use of NBS. The findings also highlight the need for supportive policies and long-term investment to secure these benefits. Many barriers to improved well-being are linked to structural factors such as economic hardship, housing insecurity, and pressures from urban change. Integrating NBS into broader social, economic, and planning frameworks will be essential for sustaining their impact in the years ahead.





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1. IN-HABIT Conceptual and Analytical Framework

This deliverable builds on the results and lessons from the earlier phases of the project reported in the deliverable [*D1.3 Monitoring and evaluation VIS for IHW in Cordoba. Midterm report*](#), and looks at what happened between September 2024 and August 2025. To make sense of the new results, we start by going over the IN-HABIT framework we have been using to guide our work. We then summarise the key points from the earlier Córdoba work so that this document can be read on its own. These sections are the same as in the previous deliverable, but they are important for the reader to have the background of the impact and monitoring assessment.

The urban dimension of health has strongly emerged in research in recent years. The rise in urbanisation has brought about positive economic and social benefits. Still, it has also significantly impacted health and well-being, exacerbating segregation and disparities and raising awareness of the need to ensure inclusiveness in urban settings (Badland & Pearce, 2019).

With more than 80% of the European population expected to live in urban areas by 2030, health and well-being are increasing areas of attention in the urban political agendas. Furthermore, in Europe, the most significant proportion of the urban population (65%) lives in cities with fewer than 500,000 inhabitants (UN, 2014), prompting the need to pay attention to the context-specific and specific research and innovation needs of peripheral small and medium-sized cities (SMSCs).

IN-HABIT is giving answers to the challenges specified in [SC5-14-2019: Visionary and integrated solutions to improve well-being and health in cities](#): delivering visionary and integrated solutions at the intersection of social, cultural, digital and nature-based innovation to increase citizens' health and well-being in cities; demonstrating how the integration of these solutions into innovative land use management, urban design and planning could reduce health-related environmental burdens in socially deprived neighbourhoods, foster equitable access for all to public spaces, enhance their quality and use and promote sustainable urban mobility patterns; and testing new transition management approaches, governance models, legal frameworks and financing mechanisms to re-design public spaces and urban commons and assess their contribution to improving health and well-being. They should promote multistakeholder initiatives, citizens' engagement and co-creation and co-ownership of public spaces.

The project is developed in four European peripheral SMSCs - [Cordoba \(Spain\)](#), [Riga \(Latvia\)](#), [Lucca \(Italy\)](#) and [Nitra \(Slovakia\)](#) and is focused on the testing of visionary and integrated solutions (VIS) to foster Inclusive Health and Well-being (IHW) with a focus on gender, equity, diversity and inclusion (GDEI). Our conceptual approach combines the concepts of inclusivity, health, and well-being in urban areas and is based on the recognition that IHW is a collectively generated resource that surpasses the mere aggregation of individuals' personal well-being. IN-HABIT consider IHW as co-created common pool resources (CCPR), understood as resources that are owned, managed, and used by the community but have characteristics of both, a private good that is rival in consumption (community well-being depletes if citizens do not invest in it and are not concerned with the well-being of others) and a public good that is non-excludable (living in places of high well-being is beneficial to anyone who moves there). In this scenario, the most vulnerable and fragile groups have underserved needs.

Each of the 4 IN-HABIT pilot cities is different in size, demography, position in the settlement hierarchy of their respective countries and prevailing and emerging challenges in terms of health and well-being. Also, each pilot targets a different urban scale in the area of intervention and works with different vulnerable collectives (Figure 1):

- In **Cordoba**, the target area *Las Palmeras* is an entire deprived neighbourhood, affected by segregation, concentration of socio-economic-environmental problems and territorial stigma. Spatial isolation influences the reproduction of disadvantages and prevents social mobility.
- In **Riga**, conversely, the spatial extension is very contained, with the project entirely concentrated on the regeneration and management of a single building, although considering the district as the spatial dimension directly impacted by the building regeneration.
- In **Lucca**, the project works transversally in the city aiming at introducing the opportunity to promote non-human-animals for IHW for citizens. In this perspective the project works both structuring the idea and the evidence of A-NBS and to physically reorganise part of the existing urban space to create an infrastructural green urban system connecting the historical centre with peripheral areas.
- In **Nitra**, the spatial dimension is fundamental, with a focus on the development of an open and flexible green design principle for a peripheral area of the city and on its territorial integration within the urban system.

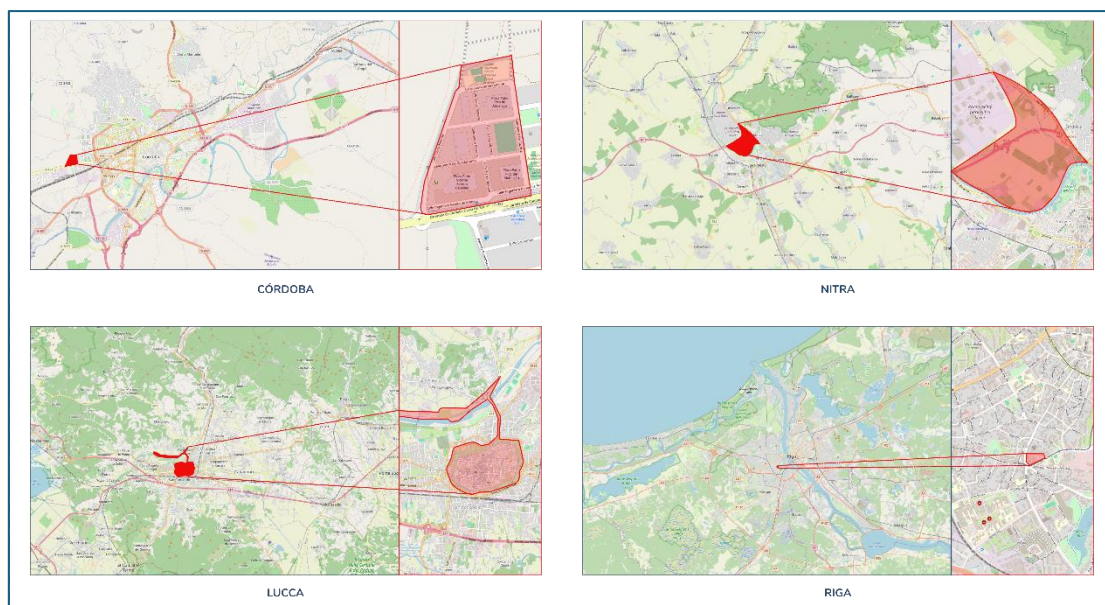


Figure 1: Urban scale of 4 IN-HABIT pilots.

IN-HABIT pilots are developed through the so-called **VIS for IHW**. **Visionary** because putting vulnerable collectives at the centre of the innovative solutions, we are mobilising existing undervalued resources, such as culture, food, human-animal bonds, environment and art, to boost IHW, overcoming the limited health and well-being provision for these collectives. **Integrated** because we combine ‘soft’ solutions based on social and cultural actions with ‘hard’ solutions based on NBS solutions,



infrastructures and digital tools. **Inclusive** because the project is developed with a gender, diversity, equity and inclusion approach. Soft and hard VIS are articulated around heritage and culture in Córdoba (as a nexus for inclusive societies), food in Riga (nurturing daily healthier lifestyles), animals in Lucca (human-animal bonds as new relational urban goods) and art and environment in Nitra (to connect places and people).

IN-HABIT is testing **innovative methods** of working with vulnerable collectives (elderly, excluded citizens, ethnic minorities, migrants, homeless, women, children and youngsters, LGTBQ+, people with mental disorders, refugees...) to make cities more liveable and inclusive and looking ahead to the threats they face, such as climate change, increasing disparities and exclusion, ageing and isolation, decreasing mental well-being or the increasing presence of animals in people's lives.

Our 4 cities are very different, and so are the VIS deployed and the collectives targeted, but in all of them, we work using the same conceptual framework for inclusive urban change and the same working methods. We never aimed at direct comparability but at complementarity, offering a broad catalogue of solutions, experimenting in different contexts and working with different collectives to deliver evidence of the results of our VIS and methods to other SMSCs in Europe and beyond.

Our **COMMON WORKING METHODS** are based on the following:

IN-HUBs: The IN-HUBs are inclusive innovation labs that mobilise human resources by activating people-public-private partnerships (PPPPs) and nurture VIS co-design, co-deploy, co-manage, and co-monitor processes (CO-CO-CO-CO). They are based on a science-society-policy interface where these different actors meet to do real practical work, share and transfer knowledge, deliver evidence, assess the impact, and craft the future legacy of the project. This collaborative approach enables civic, public, and private sector actors to work together, ensuring that everyone feels included and part of the solution. Together, we work to find the best solutions to improve IHW. IN-HABIT is not only building capacities in vulnerable collectives but also building communities and boosting the willingness to work together.

Different spatial scopes of the 4 pilot cities, as well as different target groups, also guided the engagement process. With the aim to **test innovative and inclusive governance models**, co-design methodologies and co-management schemes, the 4 IN-HUBs were launched. Building on the 4-P (Public-Private-People Partnership) as an emerging concept that broadens the scope of traditional public-private partnerships by including a wider range of actors, particularly NGOs, civil society, and informal groups, in planning and execution processes. This approach aims to address limitations of conventional public-private partnerships by incorporating the general public ('people') as active participants alongside public and private entities, fostering more inclusive and community-centred development initiatives (Maraña & Revert Roldán, 2020).

Vulnerable contexts and collectives as target groups and VIS based on addressing their perceived IHW needs. IN-HABIT has been based on multistakeholder engagement (listening to our target groups in our IN-HUBs), including **their views through our CO-CO-CO-CO method**, thinking differently and catalysing changes (small actions can make great differences), creating processes rather than actions (putting in place soft VIS before co-deploying hard VIS), listening and amplifying the voices of these collectives (making

Europe accessible to them for the first time thanks to the cross-case visits and the attention paid by a H2020 project to them). We aim to leverage the opportunities offered by the VIS to foster human-centred cities, where citizens become city-makers and shapers, taking an active role, but also the responsibility, in the co-creation of IN-HABIT public spaces and urban development.

The CO-CO-CO-CO working methods are inspired by the **Participatory Action Research (PAR)**. PAR is a qualitative methodology commonly used in community psychology that actively involves community members in the research process to effect social change (MacDonald, 2012; Miller, 2005). It is characterized by democratic, equitable, and liberating principles, distinguishing it from other qualitative approaches (MacDonald, 2012). In an iterative process, it links participation, social action, knowledge generation and organisational learning in various diverse stakeholder ecosystems (Greenwood et al., 1993). It's a particularly suitable concept when introducing marginalized populations as co-researchers, developing new roles and strategies of engagement (Frisby et al., 2005), and in recent years, the approach emerged as a flexible way to address the participation of vulnerable groups in identifying linkages between public space use and well-being in an urban setting (Corburn, 2005) and foster environmental learning and civic literacy (Ballard & Belsky, 2010).

Common Impact Assessment Framework, based on 5 dimensions of IHW: **subjective well-being, spatial and environmental well-being, social well-being, economic well-being and healthy lifestyles**. Different subdimensions have been identified for each dimension. The general framework has been adapted to the context and target groups of each city, and a battery of final indicators has been proposed (Mac Fadden et al., 2024) [for Cordoba's case study](#). Our innovative impact assessment framework goes beyond monetary and biophysical aspects to recognise the complex interrelationships among the economic, environmental, psychological, social and relational dimensions of IHW.

IN-HABIT has co-created an **Impact Assessment Framework** grounded in an interdisciplinary and multidimensional approach that integrates top-down and bottom-up approaches to measure Health and Well-being. We first did a comprehensive search for existing frameworks from reputable entities such as the World Health Organisation (WHO), the OECD and the European Commission. This allows us to work with well-accepted and common dimensions and subdimensions to assess IHW and several pertinent health and well-being indicators. Concurrently, we put in place a bottom-up approach involving interviews and questionnaires with various stakeholders in each city to adapt the indicators to the local context and their perceptions of health and well-being. This dual approach culminated in creating an inclusive health and well-being assessment framework specifically tailored to the needs of each pilot.

Central to the framework is the understanding that health and well-being are influenced by a combination of individual, social, and environmental determinants, a concept strongly supported by the World Health Organisation (WHO) and the Organisation for Economic Co-operation and Development (OECD). The WHO's **Social Determinants of Health (SDH)** framework emphasises that health outcomes are shaped by the conditions in which people are born, grow, work, live, and age, as well as by the broader systems and policies that influence these conditions (Marmot et al., 2012). The framework also aligns with Diderichsen's model of health inequality, which highlights how social

stratification leads to different health outcomes based on socioeconomic status (Diderichsen et al., 2012).

Our framework also incorporates the subjective experience of well-being, drawing on both hedonic and eudaimonic perspectives. Hedonic well-being is associated with constructs such as happiness, positive affect, and life satisfaction, while eudaimonic well-being focuses on positive psychological functioning and human development (Diener, 1984; Orden & Bradburn, 1969; Ryff, 1989; Waterman, 1993). Subjective well-being is thus a multifaceted construct that includes general psychological well-being, life satisfaction, and the absence of mental distress (Kessler et al., 2003; Topp et al., 2015). This approach is consistent with definitions from the Eurofound, which emphasise the individual’s assessment of their quality of life (Eurofound, 2015).

The following five dimensions form the cornerstone of the IN-HABIT assessment of IHW (Figure 2). The framework guides both PAR methodologies and the development of hard and soft VIS, ensuring that interventions are grounded in the lived experiences and needs of the community. By aligning assessment and intervention strategies with local conditions, the VIS can significantly enhance the effectiveness of health and well-being initiatives, ultimately leading to more resilient and thriving communities.

- **Subjective Well-being:** This dimension considers personal perceptions of psychological well-being, happiness and life satisfaction.
- **Spatial and Environmental Well-being:** This includes the quality of physical surroundings, green spaces, and environmental health.
- **Social Well-being:** This addresses social cohesion, community engagement, and social support networks.
- **Healthy Lifestyles:** This dimension focuses on behaviours such as physical activity, diet, and substance use.
- **Economic Well-being:** This encompasses income levels, employment status, and economic security.

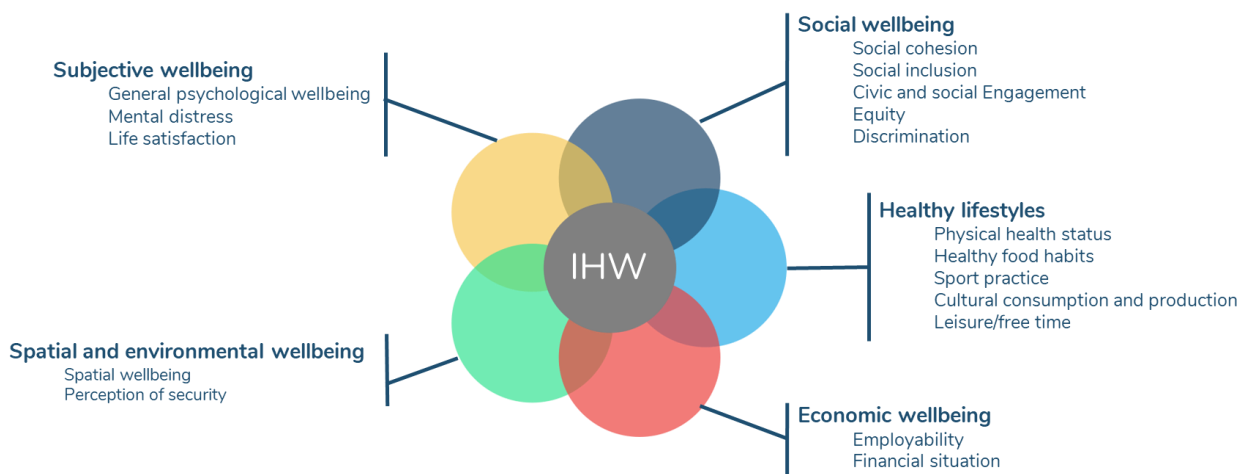


Figure 2: The IN-HABIT impact evaluation framework.

The significance of this methodology lies in the recognition of health and well-being as co-created common pool resources influenced by the collectively and the environment in which individuals reside, and not exclusively linked to the individuals. Consequently, the metrics for assessing health and well-being must be adaptable to the distinct characteristics of different urban settings. This hypothesis is particularly important when considering small and medium-sized cities, which often face unique challenges and circumstances that larger metropolitan frameworks may not properly address. The IN-HABIT framework has common indicators for the 4 cities, and some are more specific for each city's needs and context, supporting our CO-assessment.

GDEI as a cross-cutting perspective that emphasises the relationship between well-being and discrimination. Discrimination, often stemming from prejudiced attitudes, disempowers individuals, hinders their active participation, restricts skill development, and often obstructs access to essential opportunities such as work, health services, education, or housing.

The Gender, Diversity, Equity, and Inclusion (GDEI) perspective as another critical component of the framework is informed by theories such as the minority stress model, which describes how social stressors impact the mental health of marginalised groups, particularly the LGBT community (Meyer, 2003). The WHO also recognises that inequalities and discrimination significantly affect health and lifestyles, influencing individual well-being (Marmot et al., 2012). Research further supports that discrimination, whether structural or individual, has profound negative effects on both mental and physical health outcomes (Alvarez-Galvez & Salvador-Carulla, 2013).

Testing mindset and behavioural change approaches in the 4 cities to investigate the effects on mental health, well-being and healthier lifestyles of the VIS and the importance of adopting behavioural science to promote sustainable and inclusive mindset and behaviour changes in urban environments targeting vulnerable contexts and collectives. Prospective options are discussed to inform IHW policies.

To boost IHW in urban design and planning for small and medium-sized cities, a systemic urban planning framework is being developed based on the DOs and DON'Ts identified by the project. This framework will represent a unique reference for SMSCs.

Moreover, IN-HABIT is **fully aligned with the current EU policy priorities**: the EU Green Deal making Europe a **climate**-smart continent; the **One Health approach** and its links to human and nature health; the **Nature Based Solution approach** and the need for green-blue, but also animal spaces; the **Biodiversity-Climate nexus**; the restoration of urban ecosystems, aligned with the **Nature Restoration Law**, and last but not least, the **New European Bauhaus**. The project will deliver evidence to make these policies operational for the most vulnerable groups and places.

*In short, the IN-HABIT project addresses emerging, pressing and urgent problems: The need **for the inclusion of vulnerable and excluded collectives in the health and well-being agenda**, the specificities of SMSCs, the existence of unused or undervalued resources that can boost health and well-being at the city level and the impact of the integration of soft and hard solutions to boost social urban transformation and healthier cities.*

IN-HABIT Conceptual and Analytical framework

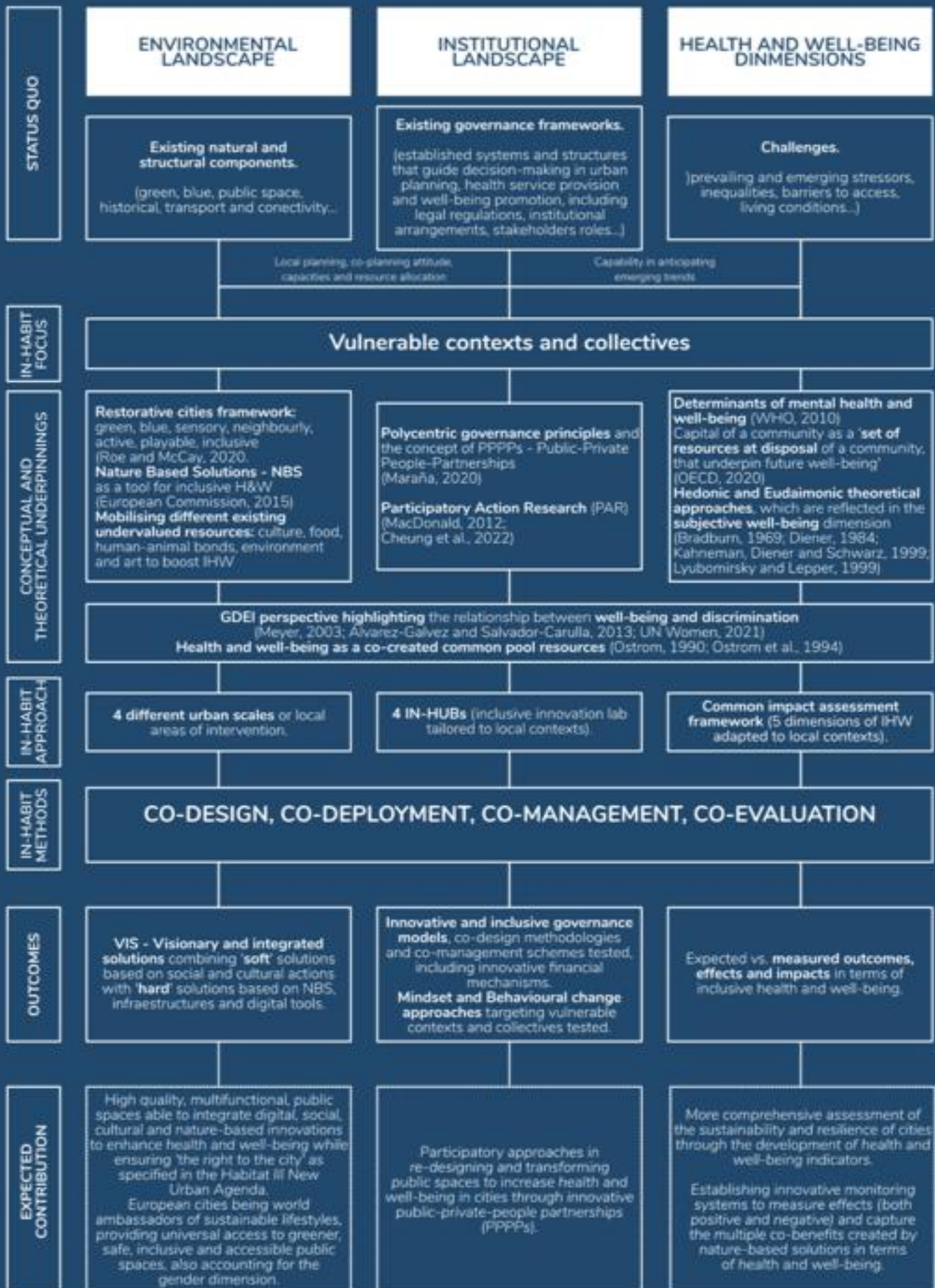


Figure 3: IN-HABIT Conceptual and Analytical framework.

The connection between mobilising undervalued resources to co-create visionary and integrated solutions for inclusive urban transformation and boosting the health and well-being of vulnerable collectives is grounded in the principles of **urban psychology** and the concept of **restorative cities**. In an urbanising society, building cities able to co-design, co-deploy and co-manage positive and liveable environments in the everyday life of the people really matters. The organisation of urban spaces has a clear impact on spatial and environmental well-being, subjective well-being, and social well-being, as well as in the organisation of everyday healthy lifestyles.

Among the specific challenges of a healthy city, **psychological well-being** is gaining increasing attention (Peen et al., 2010). Since the beginning of the last century, urban psychologists have focused scientific attention on the relationships between city living and the health and well-being of their citizens. City living offers access to shared resources and opportunities (Gifford & Sussman, 2012). While cities might be enjoyable, exciting, and potentially sustainable, they can also generate stress, health concerns, anxiety, insecurity and distrust, as well as frustration and isolation. Enhancing positive outcomes and reducing negative ones is essential in urban development. Studies have investigated diverse aspects like satisfaction with physical condition, social relations, political climate and convenience (Fried, 1984), as well as feelings of attachment to neighbourhoods, including place identity, dependence, and nature, friends and family bonding (Brown & Ryan, 2003; Raymond et al., 2010).

Following such a perspective, people are generally more satisfied when they feel at home in their living environment and have greater satisfaction when they have positive relationships with their neighbours (Gifford & Sussman, 2012). It is worth considering that in evolutionary contexts, stability and instability are always in a dynamic interplay. This can apply to urban infrastructures, social dynamics and geographical organisation (*i.e.*, different urban spaces within the same city can have diverse arrangements that may affect residents' satisfaction differently, depending on their specific evolutionary needs and community composition).

Subjectivity also plays a critical role (personal levels of anxiety, personal perspectives and attitudes to living in urban or rural settings). These subjective factors might influence and shape the behaviour and choices of specific groups of people (*i.e.*, the counter-urbanization movement of the 70's from urban to rural settings of groups of young people protesting the modernisation process and the individualisation of the way of living in the urban areas).

The extensive body of scientific literature produced by urban psychologists over the past century reflects this complexity (Takooshian, 2005). From Simmel (1950) exploration of 'The Metropolis and Mental Life' to Milgram's (1970) study 'The Experience of Living in Cities', and more recent reflections on restorative cities (Hartig, 2004; Kaplan & Kaplan, 1989; Ulrich, 1984; Weber & Trojan, 2018), there has been a continuous evolution in understanding urban living. The debate on restorative cities focuses on seven dimensions aiming to create an environment ready to better fit human needs at the city level (Roe & McCay, 2021):

- **Green:** the availability of green spaces and access to nature to reduce depression and stress, improve brain functions, and reduce anxiety, ADHD and dementia.
- **Blue:** about water availability, access, and cleanness that can reduce depression and stress.

- **Sensory:** regarding the level of noise, smell and pollution or, on the contrary, positive soundscapes, sonic refugees and visual complexity that might exert positive human outcomes.
- **Neighbourly:** the impact of city organisation and the presence of public spaces in the definition of social networks and social dialogue among ages, ethnicities, income, social classes and groups of individuals.
- **Active cities:** the possibility of having access to physical activities and different mobility ways – walking, running, biking, using transportation for diverse groups of people – women, elders, males, families, youngsters, children.
- **Playable:** regarding the availability of spaces where it is possible to play and to foster mental, social, cognitive, and emotional development.
- **Inclusive:** regarding spaces, activities, and services, able to reduce as much as possible diverse types of exclusion - linked to ages, ethnicities, genders, sexual orientation, physical and mental diversities and capabilities.

The seven dimensions of a restorative city should be read and adapted to each specific context, starting from the existing structural and social conditions and relating them to the existing evolutionary dynamics.

The seven dimensions match with the opportunity to co-design, co-deploy, co-manage and co-assess spaces, activities, services, and resources that enhance the 5 IN-HABIT dimensions and subdimensions of IHW:

- **Spatial and environmental well-being** (Sense of security, Satisfaction with urban green areas, Perception of noise and air pollution, Perception of the neighbourhood and sense of belonging)
- **Subjective well-being** (Mental distress, Psychological well-being, Life satisfaction)
- **Social well-being** (Social cohesion, Social inclusion and cohesion, Civic and social engagement, discrimination, and equity)
- **Healthy lifestyles** (Perceived physical health, Eating habits, Sports practice, Social and cultural habits, Human-animal interaction, Leisure and free time)
- **Economic well-being** (Employment, Job and skills satisfaction, Financial situation, Housing and living conditions).

Building on the existing literature, a specific conceptual and analytical framework can be organised to read the IN-HABIT approach (**Figure 3**). It looks at the analysis of state of the art in the 4 cities regarding the key health and well-being indicators of the common assessment framework, context-specific emerging trends and stressors at the starting point. The 7 regenerative dimensions are linked to specific intersections between “soft” and “hard” solutions combining social, cultural, NBS, technological and digital innovations co-created within the CO-CO-CO-CO methodology. The participatory approach takes the existing local institutional context into account, building on existing ones and creating new collaborative actions, boosting capacities, and empowering vulnerable groups.

2. Córdoba's pilot

The following sections outline the progress made by the IN-HABIT project over three years of work in the city of Córdoba, showcasing the impact of the activities carried out on our target groups. The document results from the collaborative efforts of partners in work package one (WP1): the **University of Córdoba (UCO)**, the **Las Palmeras Neighbourhood Association (AVUE)**, **Patios de las Axerquía (PAX)**, and the **Córdoba City Council (CORD)**.

In Córdoba, IN-HABIT uses culture and heritage as the foundation for the VIS implemented in the vulnerable neighbourhood of Las Palmeras, mainly emphasising the role of traditional patios as eco-social builders. Córdoba's patios have existed since Roman times and are part of the city's cultural and patrimonial value, as recognised by its **UNESCO World Heritage** designation. Patios are among the most representative elements of the city and could play a vital role in tackling global challenges such as climate change or pandemic situations. They serve not only as climate-adapted architectural spaces within homes but also as venues for social interaction and connection with nature across generations.

Patios can be considered social-ecological systems. As ecological systems, they are green areas within cities or neighbourhoods, especially in the historical centre where opportunities to develop green infrastructures are limited due to heritage protection plans. As green spaces, these patios provide many benefits similar to other green areas, including lowering temperatures, reducing noise, improving soil quality, and increasing urban biodiversity. As social systems, they have traditionally served as important spaces for socialisation. Typically, they were shared by several families as common areas for cooking, doing laundry, or interacting. Indeed, they can be seen as a precursor to current co-housing trends that aim to make cities more resilient to environmental and social isolation.

Most of Córdoba's traditional patios are located in Axerquía, the historical centre, which is also protected as UNESCO World Heritage, making it almost impossible to alter the built spaces. In this scenario, patios might be the sole green cells in these districts to reconnect with nature, fight climate change and increase thermal comfort. In *Las Palmeras*, there are public spaces known as 'patios', but they lack the green and socialising features that characterise Axerquía patios. IN-HABIT is implementing VIS in collaboration with the IN-HUB members to transform these spaces into greener and socialising areas that resemble the traditional patios at different scales and create links between the inhabitants of both neighbourhoods. The project investigates how various types of VIS linked to green spaces enhance inclusive health and well-being in vulnerable collectives.

The general objective of the Córdoba pilot (WP1) is to **enhance IHW** - particularly social and labour inclusion as well as healthy habits - **of marginalised people living in Las Palmeras neighbourhood** by creating happiness zero emission patios and an intangible corridor connecting *Las Palmeras* with Axerquia neighbourhood and transforming the district's central square into a green and creative area. We will deliver evidence on the role of patios in fostering health and well-being in marginalised neighbourhoods and in the historical centre. Our outcomes will contribute to the global debates on climate change adaptation and resilience of Mediterranean cities.

As secondary objectives, we established:

- **SO1:** To deliver knowledge and empirical evidence of the role of patios as cultural and heritage places, to increase IHW, and to link IHW with culture.

- **SO2:** To enhance cultural, labour, and healthy lifestyle opportunities for the citizens of *Las Palmeras* by connecting them with Axerquia and the city.
- **SO3:** To improve - both actual and perceived - safety, accessibility, and liveability by decreasing air temperature, noise, pollution, and environmental stress both in the patios and in the central square.
- **SO4:** To increase visitors' influx to *Las Palmeras* neighbourhood to visit and participate in different activities organised in the neighbourhood.
- **SO5:** To decrease the isolation of local inhabitants in *Las Palmeras*, considering their protected characteristics and improving inclusion and livelihood opportunities.

This document reports the progress in monitoring the VIS implemented during the final year of the project. To clarify the social monitoring activities, we first provide an overview of what has been monitored and the methods used. After this, we detail the VIS deployed in the past year, followed by three dedicated sections on *Las Palmeras*, the homeless shelter, and the Patios platform. In the first two sections, we describe methods, results, and discussion together, while in the case of the Patios, we report on the current status and preliminary findings. These key sections are complemented by a description of the dissemination strategy undertaken, and the document concludes with final remarks. This structure enables us to present both the ongoing work and the broader lessons from the Córdoba pilot in a coherent manner.

2.1. Córdoba case study

Las Palmeras has been excluded from Córdoba's growth and development plans for decades (net income per inhabitant: €6,013 and an unemployment rate exceeding 70%). The neighbourhood, located on Córdoba's outskirts, covers approximately 114,000 m² and houses 2,212 residents (Ayuntamiento de Córdoba, 2020). It is marked by segregation and disconnection; high reliance on social subsidies (such as low-rent social housing and social canteens); unstructured families and gender violence; lack of role models; and failure of educational systems. Robberies, drug trafficking, and raids are frequent issues.

Levels of health and well-being are **significantly below the city's standards**. Well-being is constrained by unemployment, poor quality social housing, lack of income to meet minimum welfare needs, scarcity of green spaces and public areas, and low educational standards. Being born in the neighbourhood is considered a stigma, causing many residents to conceal their origins or current residence and to leave the area once they are better off. The health profile is characterised by unhealthy diets and lifestyles. Common issues include obesity, unwanted pregnancies, and drug use from early ages. Additionally, problems linked to ethnicity and inclusion arise, as people from various ethnic backgrounds (including Roma) live here. Furthermore, residents have little to no access to culture and cultural activities.

Various strategies have been tested over decades, but they were short-term, top-down, and isolated initiatives that yielded very poor results and caused resident scepticism towards the potential for change and social transformation. The residents of *Las Palmeras* have a negative perception of the authorities and do not trust official aid projects, having been disappointed by past promises of projects.

Furthermore, the neighbourhood's residents do not feel part of the city, and residents from other districts hold very negative views of them, fearing visiting the area.

IN-HABIT hard VIS aimed to **renaturalise and renovate *Las Palmeras* patios, creating spaces for social life**. The neighbourhood is divided into five 'patios' connecting housing blocks and a main square. It is worth noting that the patios of *Las Palmeras* differ significantly from those in the rest of the city. In this neighbourhood, the 'patios' are concrete areas with one or two benches and only a few trees per patio. The central square is similar, featuring worn-out concrete benches and a few palm trees. IN-HABIT proposed using the patios and other green spaces as areas where people can connect with nature and with others for socialising and building community, while also incorporating the neighbourhood of *Las Palmeras* and its residents into the rest of the city.

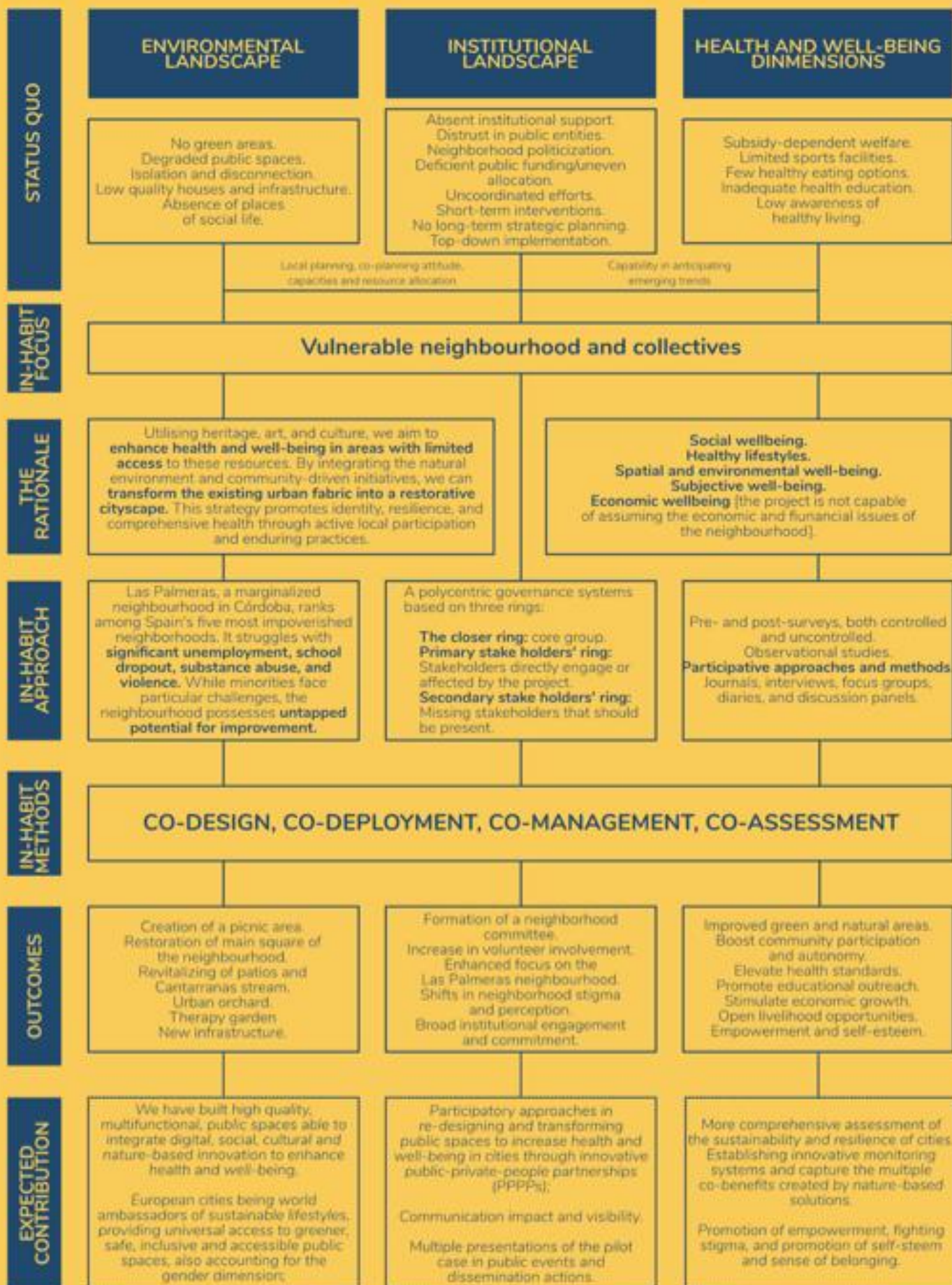
IN-HABIT's VIS ambition is to overcome the barriers described, but at the same time, this hostile environment complicates the implementation of social transformations that might require longer time frames to achieve sustainable changes. It is important to note that IN-HABIT was initiated in the neighbourhood during the pandemic, which further increased the vulnerability of the community. Livelihood opportunities, often based on the informal economy, decreased or disappeared, leading to more poverty and exclusion. The challenges faced by residents further weakened social bonds and trust among neighbours. Fear of others and mistrust grew, resulting in increased social isolation and individualism. In this context, the first two years of the project were very challenging, and most actions focused on the co-design and co-deployment of soft VIS, aiming to rebuild the social fabric and foster connections among neighbours.

Even if Córdoba's pilot focuses on the neighbourhood of *Las Palmeras*, other actions are being developed with different vulnerable groups. As the project follows the CO-CO-CO-CO methodology, regular work at the IN-HUB revealed additional needs and opportunities to improve access to health and well-being for other vulnerable groups in the city, such as the **homeless or people with Down syndrome**. Consequently, IN-HABIT Córdoba, committed to creating inclusive spaces to promote health and well-being, has launched new initiatives with these groups. Patios and gardens have also been constructed in a homeless shelter, which will be described in the following sections.

2.2. Assessing the impact of Córdoba's VIS

Having established the dimensions of inclusive health and well-being as **Figure 2** the next step involved tailoring the framework to the specific conditions of a city like Córdoba. These dimensions form the cornerstone of the IN-HABIT project's approach to enhancing the IHW in the *Las Palmeras* neighbourhood. The framework guides both participatory action research (PAR) methodologies and the development of hard and soft VIS, ensuring that interventions are grounded in the lived experiences and needs of the community. By aligning assessment and intervention strategies with local conditions, such frameworks can significantly enhance the effectiveness of health and well-being initiatives, ultimately leading to more resilient and thriving communities (**Figure 4, next page**).

Figure 4: Adaptation of the IN-HABIT Conceptual and Analytical framework to Cordoba's case.



Córdoba is characterised by its medium size, extreme summer temperatures, and high levels of poverty and vulnerability in certain neighbourhoods and groups. These factors require a customised approach to assessing health and well-being. Our framework responds to the specific socio-economic and environmental conditions, helps identify and prioritise the most urgent issues for the local population, and supports the development of targeted interventions that are more likely to improve health outcomes. This section explains how IN-HABIT Córdoba conceptualises 'impact', clarifying how to assess the impact that the project's interventions have had on the health and well-being of those involved.

Initially, this process began with developing an impact concept supported by a thorough review of scientific literature covering public health, psychology, sociology, and urban planning. The approach combines multidisciplinary perspectives to ensure a comprehensive evaluation of the interventions. By synthesising insights from various fields, the project aims to adopt a strong definition of impact that reflects both quantitative results and qualitative experiences of community members. This method not only enables a more precise assessment of the direct effects of specific interventions but also helps to understand wider social changes brought about by the project.

2.3. Understanding 'impact' in Córdoba's pilot

The concept of '**impact**' in social or public health interventions refers to the significant and lasting changes resulting from specific initiatives (Burdge & Vanclay, 1996; Kidder & Chapel, 2018). Unlike immediate outcomes, which are short-term and direct effects of activities, impact reflects substantial, long-term alterations that influence individuals, communities, and broader societal structures (Kidder & Chapel, 2018). It (Weiss, 1998) clarified that while outputs are the immediate products of programme activities, impacts represent the ultimate changes within the community or target group, developing over time due to the intervention. Notably, the impact can be seen as a collection of multiple outcomes that build up over time (Al Sayah et al., 2021; Greco et al., 2019), especially when these incremental changes lead to meaningful improvements in community well-being or social frameworks (Greco et al., 2019).

Continuous monitoring is essential to effectively measure the impact of social and public health interventions (Islam, 2024). This process involves systematically collecting data to assess progress towards the desired long-term effects. (Patton, 2010) advocates for adopting developmental evaluation methods that are responsive to the complex dynamics present within community projects. This monitoring may include a variety of tools, such as longitudinal surveys (Piesse et al., 2009), interviews (DiCicco-Bloom & Crabtree, 2006), and observational studies (*Ibid*), which are critical in tracking changes and evaluating whether the intervention's objectives Barber et al., 2012; Palinkas et al., 2019; Pluye & Hong, 2014). Considering the characteristics of our target population in Córdoba, we have employed a combination of observational studies, interviews, personal diaries, focus groups, and before-and-after versus control surveys.

In the realm of community-based projects, social impact refers to how such initiatives strengthen the **social fabric** of a community and improve the communal sense of belonging and collective efficacy. For example, projects focused on renovating public spaces or providing community enrichment activities often lead to increased community spirit and social cohesion (Yan & Shahraki, 2023). The IN-HABIT project exemplifies this approach through initiatives aimed at social transformation in

vulnerable contexts based on urban renewal through community participation, such as reconstructing spaces and re-naturalising environments. These efforts not only improve physical spaces but also **foster a sense of pride and ownership** among residents, thereby encouraging greater community involvement and reducing antisocial behaviours (de Vries et al., 2013; Jennings & Bamkole, 2019).

The accumulation of small, positive changes through social interventions can gradually transform individual behaviours, community norms, and even systemic structures in meaningful ways (Davis et al., 2015; Hunter et al., 2017). Regular community workshops, for example, may initially seem to have minimal impact. However, over time, these workshops can significantly increase community knowledge, combat stigma, improve social cohesion, and empower residents, thereby contributing to community building, enhanced resilience, and a stronger collective identity. This view aligns with the theory of change underlying many social projects, where a sequence of small, strategically planned actions is expected to contribute to a broader goal (Connell & Kubisch, 1998; De Silva et al., 2014). This report provides the final set of observations and assessments of the change that IN-HABIT VISs have brought to the neighbourhood and to the shelter residents.

3. Final Visionary and Integrated Solutions (VIS) implemented

Deliverable *D1.3 Monitoring and evaluation VIS for IHW in Cordoba. Midterm report*, presented a summary of the VIS co-deployed up to August 2024. In this report, we present the final set of VIS implemented between 1 September 2024 and 31 August 2025. As in the previous deliverable, we first describe the soft VIS, which focused on working directly with people and promoting intangible changes, such as shifts in attitudes or mindsets. We then describe the hard VIS, which involved modifications to the physical environment.

During this final year of the project, weekly workshops continued alongside the Christmas party, cultural visits, and the 8th of May events. We do not describe them again because they can be consulted in D1.3. As mentioned, not all VIS were confined to the Las Palmeras neighbourhood. As the project developed, it became clear that other vulnerable groups were represented in the IN-HUB, and that collaborating with them was both possible and beneficial. One such group was the residents of the homeless shelter, whose initial VIS were documented in [Deliverable D.1.3](#), and whose impact is now evaluated here; another was people with Down syndrome. In this report, we introduce a pilot initiative that creates an immersive training experience designed to help individuals with Down syndrome develop skills for employment in events and conferences.

3.1. Soft VIS

Final Event in Las Palmeras

The final event in Las Palmeras lasted two days of sport, cultural, and gastronomic activities organised by AVUE and UCO within the neighbourhood. During these days, residents from across Córdoba were encouraged to participate. Both local residents and visitors from other parts of the city enjoyed football tournaments, exercise sessions based on flamenco dancing, children's games, and healthy food tastings. One of the football matches featured players with Down syndrome. However, the highlight was a **gastronomic experience** held in the neighbourhood's central square, prepared by Michelin-starred chef Kisko García, which opened to residents and visitors for a high-quality cultural and healthy food experience.

Much like the earlier *Perol Gourmet* (reported in D1.3), local women participated in healthy food workshops and contributed to the preparation and distribution of the meal designed by the chef specifically for this occasion. The menu focused on traditional, locally rooted healthy dishes and used zero-kilometre ingredients, that is, products from the local area. During this event, the IN-HABIT awards were also presented to collaborators whose contributions had made the project possible. A young artist composed a song for the event using the “neighbour’s clapping sound” and the well-rooted flamenco tradition as the base for the tune. Approximately 250 people participated in the dinner held in the main square. At the end of the evening, late at night, local residents participated in cleaning the square and preparing it for the following day's activities, demonstrating the social transformation in the care of public space prompted by the IN-HABIT CO-CO-CO-CO approach.



Figure 5 Poster of the final event inviting people to participate and visit the neighbourhood



Figure 6: Final event in Las Palmeras: group picture with chef Kisko Garcia (left), flamenco performance in the patio (centre) and the football team (adults and children) before the tournament (right).

Immersive experience for people with Down Syndrome

The immersive training experience (ITE) is a serious game created to help adults with Down syndrome learn to act as hosts and hostesses at conferences and events. It is a digital tool that simulates real-life situations, such as reception, catering, seating, and setup. It supports participants in learning routines, improving memory, and gaining confidence in performing these tasks. The ITE is the initial stage within a structured training cycle that combines gameplay, guided practice, and real-world application. This method enables participants to apply what they learn in the simulation to actual work settings, ultimately providing them with employment opportunities under standard labour conditions. It has been an innovative project developed jointly by researchers, a video game company, and the Córdoba Down Syndrome Association. We also received support from a conference company that hired participants for various events, proving its usefulness. The tool can also be adapted for use by individuals with other neurodivergent conditions.

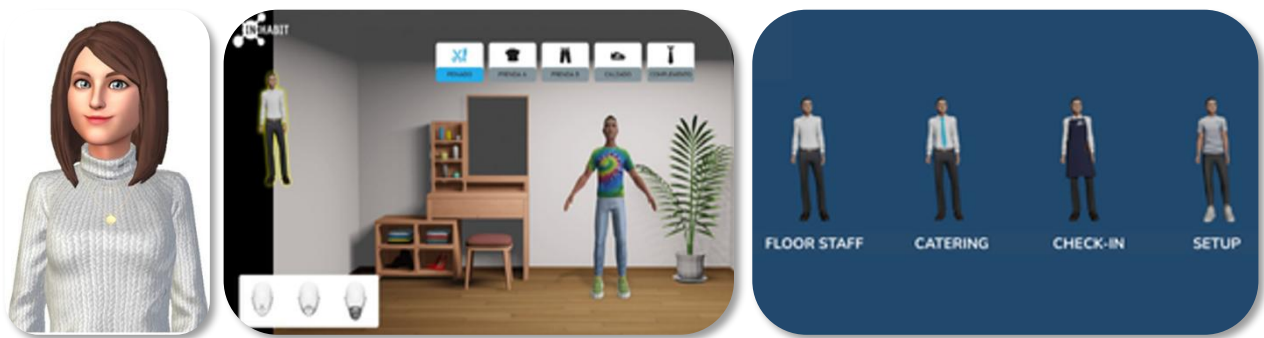


Figure 7 Maria José, the interactive character guiding users (left), and an exercise where participants choose the appropriate work uniform (centre and right)

The application was specifically designed to address the needs of individuals with Down syndrome. For instance, it was developed for tablets rather than computers or mobile phones, because fine motor skills can be challenging for some of these individuals, and tablets may offer a more accessible technological interface. At the end of the IN-HABIT project, the individuals with Down syndrome who participated in the training with the immersive experience were employed as staff members during the IN-HABIT project's final events.

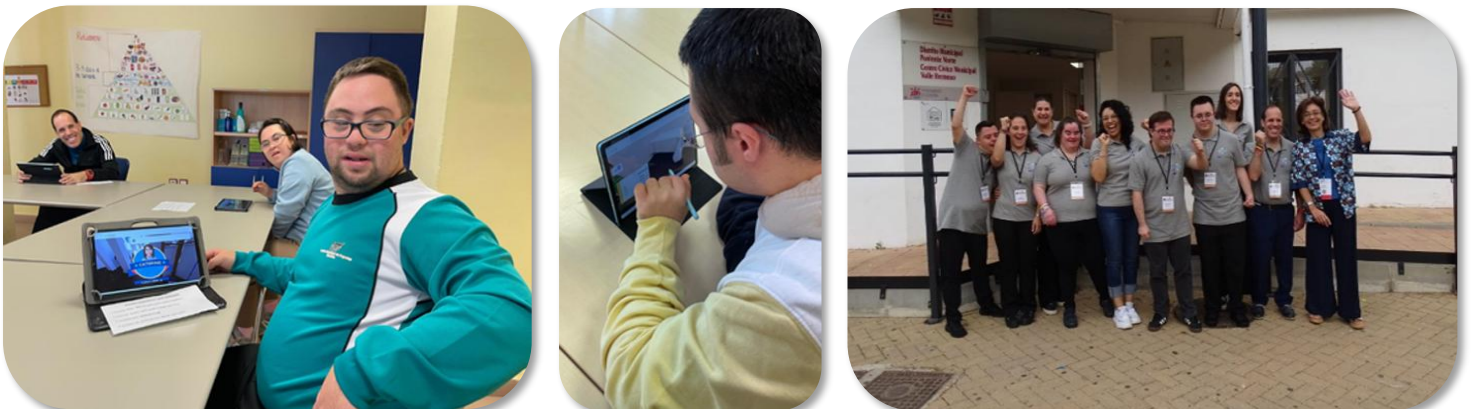


Figure 8: Participants using the app (left and centre). Participants who were hired to assist in the final event of IN-HABIT (right).

3.2. Hard VIS

Largest Mural in Córdoba

Following the replication actions included in the Grant Agreement, the University of Córdoba and the Pontificia Universidad Javeriana in Bogotá partnered to invite a local artist from Ciudad Bolívar (the sister neighbourhood of Las Palmeras in Bogotá) to paint a participatory mural. The artist, Wilson Niño Vargas, is part of a social Foundation that specialises in using art as a tool to support vulnerable groups. Wilson arrived in Córdoba at the beginning of May and, over the course of a month, worked on what is now the largest mural in the city, covering 400 m².

The mural was participatorily designed with local residents and features symbolic elements of the neighbourhood: the existing biodiversity (birds, frogs, plants), traditional costumes and jobs, and elements that reflect the roots of the district. The mural was officially inaugurated alongside the presentation of the aforementioned composed song, inspired by the neighbourhood and its residents.



Figure 7: From left to right, top to bottom: The building where the mural was created, pictured before the project. Top right and bottom left, the mural in progress. Bottom right, the completed mural.

Final green infrastructure and new lighting system in a shelter for homeless people

This greening intervention has refurbished neglected spaces, creating patios and gardens in a homeless shelter through the co-creation and shared management of initiatives by the so-called “Green Team”. A vegetable garden established in the previous period continued to be cultivated and harvested. The therapeutic garden, also initiated in the previous reporting period, has been completed, featuring a pond, bird cages, and insect hotels. Finally, the so-called “courtyard for the future” has been developed using plants that require minimal summer irrigation. A system of vertical gardens, inspired by Córdoba’s patios, has been designed, and sensors installed. The performance of various plants adapted to Mediterranean or desert climates is being tested to withstand Córdoba's extreme summer weather conditions. All spaces have been designated as socialising areas, including benches, tables, chairs) to enhance the health and wellbeing of residents.

All the work has been done with the volunteer work of the shelter residents. Only materials and specialised tasks have been subcontracted. Following the combination of soft and hard VIS promoted by IN-HABIT, homeless individuals were invited to participate in weekly sessions that included the development of social and team-building skills and physical work outdoors to build the mentioned spaces.

An innovative outdoor lighting system is being tested in these areas, designed to balance biodiversity conservation, energy efficiency, low maintenance, and user comfort. The system integrates solar and electric power with smart controls that automatically adjust brightness based on daylight, weather, and season. It can operate for up to three days without sunlight and switches seamlessly to the main grid when necessary, consuming 44% less electricity than standard lighting. This reduces costs and environmental impact while preventing glare and light pollution. Constructed with durable, standardised components that are easily replaced, the system is intended for long-term use with minimal maintenance. Beyond safety and accessibility, the warm lighting improves visibility of plants and architectural features, encouraging residents to enjoy the outdoor spaces after dark.



Figure 9 Lightning solutions implemented in the Caritas shelter (1)



Figure 10 Lightning solutions implemented in the Caritas shelter (2)

4. Assessment results

To make reading the document easier, this deliverable presents information in blocks rather than separating it into distinct sections for methods, results, and discussion. Each block relates to one of the main areas of work in the Córdoba pilot: Las Palmeras, the shelter for homeless people, and the Patios de la Axerquía. This format reflects the specific context and monitoring approach used in each location, enabling us to include the discussion of results immediately after the description and analysis. By keeping each block complete, we facilitate understanding of the activities, observations, and interpretations related to each intervention.

4.1. *Las Palmeras*

The monitoring and assessment methods applied in Las Palmeras followed the approach set out in [Deliverable D1.3](#). We kept the same conceptual structure, combining quantitative and qualitative tools to capture both measurable changes and lived experiences. This consistency allowed us to track changes from the baseline to the final survey in a coherent way. At the same time, some adjustments were made to incorporate lessons from earlier rounds and to reflect the characteristics of the later interventions.

The monitoring strategy in Las Palmeras was organised into three groups. The first group consisted of the twelve women in the core volunteer team, who had participated in the design and delivery of activities. The second group included other residents of Las Palmeras who had not been actively involved but might have benefited indirectly from physical changes or community events. The third group was made up of residents from neighbourhoods with similar socio-demographic profiles but without interventions, as well as a control group from other parts of Córdoba with very different socio-demographics. This approach enabled us to compare outcomes across different levels of exposure to the project and to identify which changes might be independent of the interventions.

Data collection tools included structured surveys, participatory observation, a focus group with the core group, individual interviews, and the systematic observation of space use. The final survey

combined elements from earlier questionnaires in a shorter format to improve response rates. It was administered to 100 residents of Las Palmeras, 100 residents from control neighbourhoods with similar characteristics, and 100 from other parts of Córdoba. Responses from the twelve core group members were recorded separately for targeted analysis. The survey measured socio-demographics, health and wellbeing indicators, lifestyle habits, quality of life, and specific questions on the value of green spaces and neighbourhood image. We used validated scales such as WHO-5 and K6, along with context-specific measures.

Results renaturalisation

One of the main outcomes in Las Palmeras was the re-naturalisation of the five patios, the central square and some streets in the neighbourhood (Fig. 9). This involved the planting of approximately 350 trees, along with over 800 shrubs and plants distributed along the pavements and within the neighbourhood patios, the main square, the community picnic area, and the riverside path. This re-naturalisation was carried out alongside the creation of the picnic area, which provided residents with a green, open-air space that had not existed before, the construction of a corridor parallel to the stream, which created another outdoor natural space, the refurbishment of the main square, and the development of socialising spaces in the patios using urban furniture.

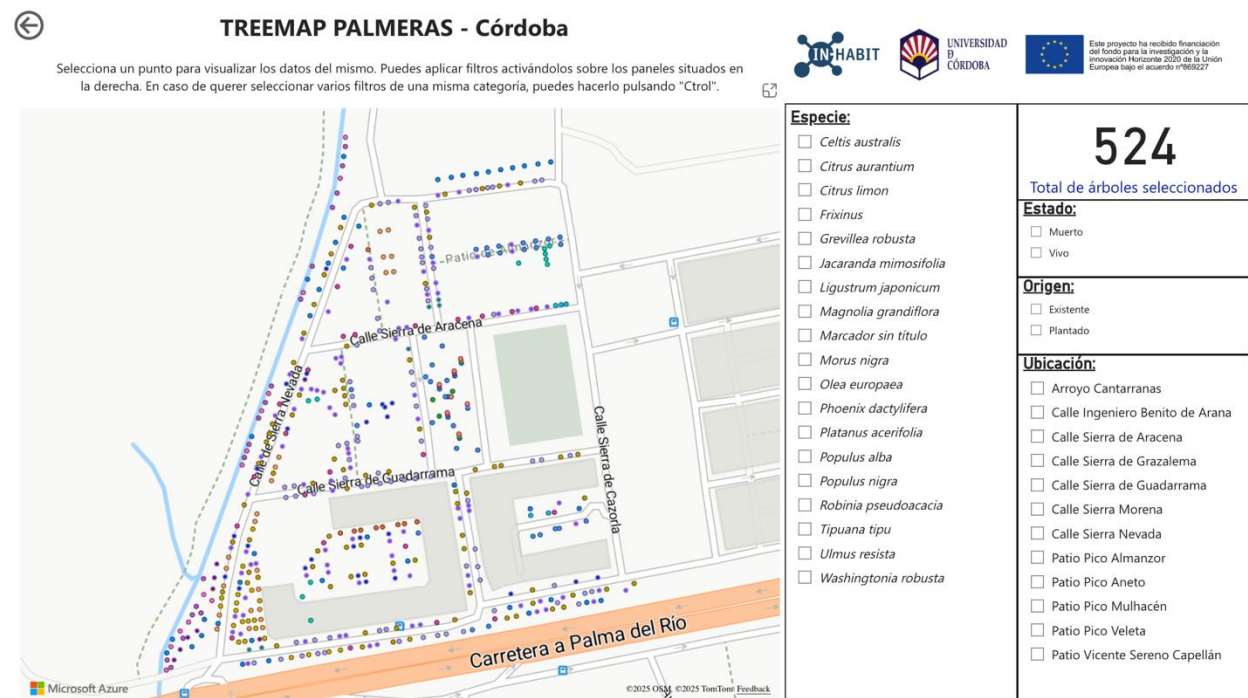


Figure 11 Map with all the trees planted by species (Link to the interactive map).

As shown in Table 1, overall tree survival rates are approximately 82 per cent, although these vary among species. IN-HABIT has monitored those better adapted to the local conditions and subsequently reported findings that could be very useful for future interventions in the area. These figures are similar to those reported in other re-naturalisation programmes, but for less dry and hotter climates. The survival rate in the City Hall interventions is rather lower (personnel communication of technical staff). It is also important to note that in 2025, Córdoba experienced one of the hottest June

months on record, and August saw a heatwave lasting over 15 consecutive days, during which temperatures exceeded 40 degrees Celsius and nights remained around 30 degrees.

Table 1: Complete list of trees planted by species. The table shows the number of trees that died, the number of trees that are still growing, and the percentage of survival (data from August 2025).

	Death/ or dying	Growing	Total	Percentage of survival
Frixinus	8	2	10	20%
Celtis Australis	11	33	44	75%
Citrus limon	3	10	13	77%
Citrus aurantium	2	18	20	90%
Tipuana tipu	4	86	90	95%
Jacaranda mimosifolia	3	103	106	97%
Grevillea robusta	7	19	26	73%
Populus nigra	6	8	14	57%
Populus alba	12	8	20	40%
Total	63	287	350	82%

The percentage achieved in Las Palmeras is particularly noteworthy because these trees were planted in a neighbourhood where vandalism is common, especially towards interventions led by external organisations. For example, as noted earlier, the first tree planted by IN-HABIT in the neighbourhood was destroyed within two weeks. Reducing vandalism to a minimal level, only two trees were vandalised, which was possible thanks to the CO-CO-CO-CO process with local residents and the use of citizen engagement initiatives. These included involving children in planting shrubs in the main square, providing training in gardening to increase their job opportunities and to maintain the trees and gardens, and inviting both children and other residents to decorate the tree stakes with creative paintings, fostering a sense of attachment to the specific tree they had decorated. Therefore, even if the percentage of tree survival is similar to that of other renaturalisation projects, in this case, it can be considered a greater achievement, as the trees and shrubs were planted under extreme environmental conditions of heat and in a social context where vandalism was a significant risk. The trees have not only been respected but also cared for.

Results of the surveys and socio-demographics

The three surveys show differences in sample composition that need to be considered before interpreting changes over time. These differences are partly methodological, reflecting the evolving focus of the Córdoba pilot, and partly contextual, linked to levels of participation and accessibility in the different phases.

In the baseline survey, three groups were included: Las Palmeras residents (n = 230), a control group from similar socio-demographic areas (Margaritas, Moreras, Polígono Sur, Guadalquivir, n = 36), and a broader “Other neighbourhoods” category (n = 181). This design allowed both within-area and across-city comparisons.

The renaturalisation survey narrowed its focus to Las Palmeras (n = 103) and the comparable control neighbourhoods (n = 97). “Other neighbourhood” respondents were not included, because we were only looking for people from neighbourhoods with similar sociodemographics.

The final survey included people from “other neighbourhoods” so we can compare with baseline survey, hence a three-group design, with Las Palmeras (n = 81), the comparable control neighbourhoods (n = 106), and “Other neighbourhoods” (n = 103). It also added a distinct category for the Las Palmeras volunteer core (Palmeras core group, n = 12), enabling targeted analysis of participants most closely involved in the project.

Across all surveys, female respondents were the majority in most groups, although proportions varied. In the baseline, women accounted for 59–61% in Las Palmeras and “Other neighbourhoods”, and 53% in the comparable control group. This proportion increased notably in the renaturalisation survey, especially in Las Palmeras (74%) and the control group (66%). In the final survey, female representation dropped somewhat in Las Palmeras (49%) and the control (55–56%), but the Palmeras C. G. group was overwhelmingly female (92%). This shift in gender composition, especially in the final dataset’s core group, needs to be considered when interpreting results, as many social and health indicators are gender-sensitive.

Mean ages remained broadly similar in the baseline between Las Palmeras (39 years), “Other neighbourhoods” (40 years), and the control (40 years). In the renaturalisation survey, the control group’s average age increased (49 years) while Las Palmeras’ mean rose moderately to 42 years. The final survey showed a slightly younger Las Palmeras sample (37 years) compared with controls (46 years) and “Other neighbourhoods” (44 years). The Palmeras C. G. group was older on average (56 years), reflecting the demographic makeup of long-term, engaged community members. This difference in age profiles between groups and over time may influence reported wellbeing, health perceptions, and activity levels.

Educational differences between groups have been consistent and marked. Las Palmeras respondents, across all waves, have much lower proportions of higher education and higher proportions of primary or no formal education. In the baseline, only 0.9% reported a university degree and 30% had no education, compared with 30% and 0% respectively in “Other neighbourhoods”. The renaturalisation survey showed modest increases in higher education within Las Palmeras (1%) and persistent high rates of primary education (45%) and no education (17%).

By the final survey, the gap remained clear: Las Palmeras had 2.5% with a university degree, 46% with only primary education, and 15% with no education. In contrast, “Other neighbourhoods” had 58% with university degrees and no respondents with only primary education. The PalmerasVC group was split between low educational attainment (42% primary, 25% no education) and small representation in intermediate vocational training (25%) or university (8.3%). These persistent differences underline the structural inequalities that frame health and wellbeing outcomes.

Unemployment rates in Las Palmeras were consistently high, though there was variation between surveys. In the baseline, 61% of Las Palmeras respondents were unemployed, compared with 17% in “Other neighbourhoods” and 42% in the comparable control. In the renaturalisation survey, unemployment in Las Palmeras was 55%, still markedly higher than the control (31%). In the final survey, unemployment among Las Palmeras respondents was 49%, compared with 31% in the

control and 1.9% in “Other neighbourhoods”. The PalmerasVC group showed 42% unemployment, with small numbers in full-time (8.3%) or part-time (17%) work.

Employment-related differences are critical for interpreting wellbeing data, as unemployment is closely linked to lower self-reported health, reduced social participation, and increased stress, potentially moderating the observable impact of VIS interventions.

Results of the statistical analysis

To explore more carefully the possible impact of the VIS on the population, we organised the final statistical analysis in two main steps. The first step was a comparison between residents of Las Palmeras, residents of Moreras and Polígono del Guadalquivir, and residents of other neighbourhoods in Córdoba. In the second step, we divided the participants from Las Palmeras into two groups and removed the residents of other neighbourhoods of Córdoba from this comparison. We made this choice because, as the socio-demographic data show, residents from the rest of the city present very different determinants of health and well-being compared with those of Las Palmeras and other disadvantaged neighbourhoods. Another reason for carrying out this second step was that we believed the CO-CO-CO-CO process might influence health and well-being in ways that physical interventions alone might not, and therefore it was necessary to compare the core group with the rest of the neighbourhood.

Also, due to the two-step process, to the number of analyses that needed to be carried out between the surveys and samples were many, hence only the results that were significant in the preliminary tests, or that are important for analysing the dimensions of the framework used by IN-HABIT to assess the project’s impact, are reported here. Results that could be analysed earlier are presented in [Deliverable D.1.3.](#)

The first set of scales reported are those measuring perceived health and wellbeing, which have been evaluated throughout the project (WHO-5, K6, self-perceived health, and satisfaction with life). We then present variables analysing the impact of nature and green spaces in the neighbourhood. Finally, we examine the variables related to neighbourhood perception and sense of community.

As shown in the tables, residents from neighbourhoods with more favourable socio-demographic profiles score higher in all perceived health and wellbeing variables assessed here. Interestingly, Las Palmeras residents report slightly higher wellbeing in the WHO-5 survey, even compared to people from better-off neighbourhoods. However, this change amounts to only one point, which is not strong enough to be considered significant, especially given that similar improvements are seen in Margaritas, Moreras, and Polígono Guadalquivir, where no interventions were carried out. For the other three variables, we do not see changes between before and after in any of the three neighbourhood types. The core group of women residents, however, show a more substantial change in WHO-5 and K6 wellbeing variables, with a difference of about three points between before and after. This suggests an impact on their wellbeing linked to participation in the CO-CO-CO-CO process. For self-perceived health, the core group scored one point lower than the rest of the Las Palmeras population in the before survey, possibly due to the fact that all are women of a certain age. All these results are explored further in the modelling.

Table 2: Changes in health and well-being variables (before vs. after surveys)¹

Variable	Neighbourhood	Before	After
WHO-5	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	15.2	16.4
	<i>Other</i>	16.2	16.6
	<i>Palmeras</i>	16.2	17.8
	<i>Palmeras C.G.</i>		19.9
K6	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	10.3	10.8
	<i>Other</i>	6.97	7.04
	<i>Palmeras</i>	10.3	10.2
	<i>Palmeras C.G.</i>		7.83
Life's satisfaction	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	1.94	1.75
	<i>Other</i>	2.54	2.39
	<i>Palmeras</i>	2.12	1.99
	<i>Palmeras C.G.</i>		2.58
Self-perceived health	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	4.14	3.94
	<i>Other</i>	4.21	4.06
	<i>Palmeras</i>	4.17	4.05
	<i>Palmeras C.G.</i>		3.08

From the models evaluating relationships with green spaces and nature, we see that residents of the neighbourhood who are not part of the core group show improvements in scores across all measured variables or scales. In contrast, core group women show lower scores in some variables or only minor changes. However, in the two scales measuring green space, the core group of women show greater improvement than the others.

Table 3: Changes in natural and green space variables (before vs. after surveys)²

Variable	Neighbourhood	Before	After
NR6	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	3.13	2.83
	<i>Palmeras</i>	2.70	3.23
	<i>Palmeras C.G.</i>		3.54
Spend part of the day in nature	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	1.81	2.13
	<i>Palmeras</i>	2.02	3.06
	<i>Palmeras C.G.</i>		1.92
Be aware of nature around you during the day	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	2.90	2.77
	<i>Palmeras</i>	2.96	3.22
	<i>Palmeras C.G.</i>		2.83
Exercising in nature	<i>Margaritas Moreras/ Poligono Guadalquivir</i>	2.14	1.95
	<i>Palmeras</i>	1.53	2.83

¹ The neighbourhood "Palmera C.G." refers to the core group of women from Las Palmeras who worked with us throughout the project and were considered a distinct target group from the rest of the neighbours.

² The neighbourhood "Palmera C.G" refers to the core group of women from Las Palmeras that worked with us all the project and were considered a different target group than the rest of the neighbours in Las Palmeras.

Variable	Neighbourhood	Before	After
	Palmeras C.G.		1.67
Be aware of nature while exercising	Margaritas Moreras/ Poligono Guadalquivir	2.57	2.39
	Palmeras	2.07	3.31
	Palmeras C.G.		3.08
Green score	Margaritas Moreras/ Poligono Guadalquivir	3.53	3.49
	Palmeras	3.28	3.53
	Palmeras C.G.		4.68

Regarding variables on neighbourhood image and perception, both the general Las Palmeras population and the core group show some improvements in all variables, although these changes cannot necessarily be attributed to IN-HABIT interventions. The core group of women, however, show a marked improvement in all neighbourhood image perception variables except perceived safety in the neighbourhood.

Table 4: Variables related with social and communal aspects of the framework (before and after surveys). The neighbourhood “Palmera C.G” refers to the core group of women from Las Palmeras that worked with us all the project and were considered a different target group than the rest of the neighbours in Las Palmeras.

Variable	Neighbourhood	Before	After
Public activities in the neighbourhood	Margaritas Moreras/ Poligono Guadalquivir	1.89	2.75
	Other	2.02	2.31
	Palmeras	2.04	2.88
	Palmeras C.G.		3.17
Relationship with your neighbours	Margaritas Moreras/ Poligono Guadalquivir	3.58	3.13
	Other	4	3.54
	Palmeras	3.63	3.52
	Palmeras C.G.		4.08
Security green and public areas	Margaritas Moreras/ Poligono Guadalquivir	2.71	2.34
	Other	3.61	3.91
	Palmeras	2.01	2.42
	Palmeras C.G.		1.83
Community feeling	Margaritas Moreras/ Poligono Guadalquivir	3.17	3.47
	Other	3.44	3.60
	Palmeras	3.69	3.53
	Palmeras C.G.		4.25
Image of the neighbourhood	Margaritas Moreras/ Poligono Guadalquivir	1.89	1.72
	Other	2.57	2.68
	Palmeras	1.70	2.67
	Palmeras C.G.		4.33

Once the models were adjusted for the socio-demographic variables: gender, age, and employment, five variables remain significant: neighbourhood image”, “NR6”, “Spend time of day in natural environments”, “Exercising in green areas”, and “Being aware of nature while exercising in green areas”. The following figures show the changes in these variables among neighbours in Las Palmeras and the other neighbourhoods used as controls.

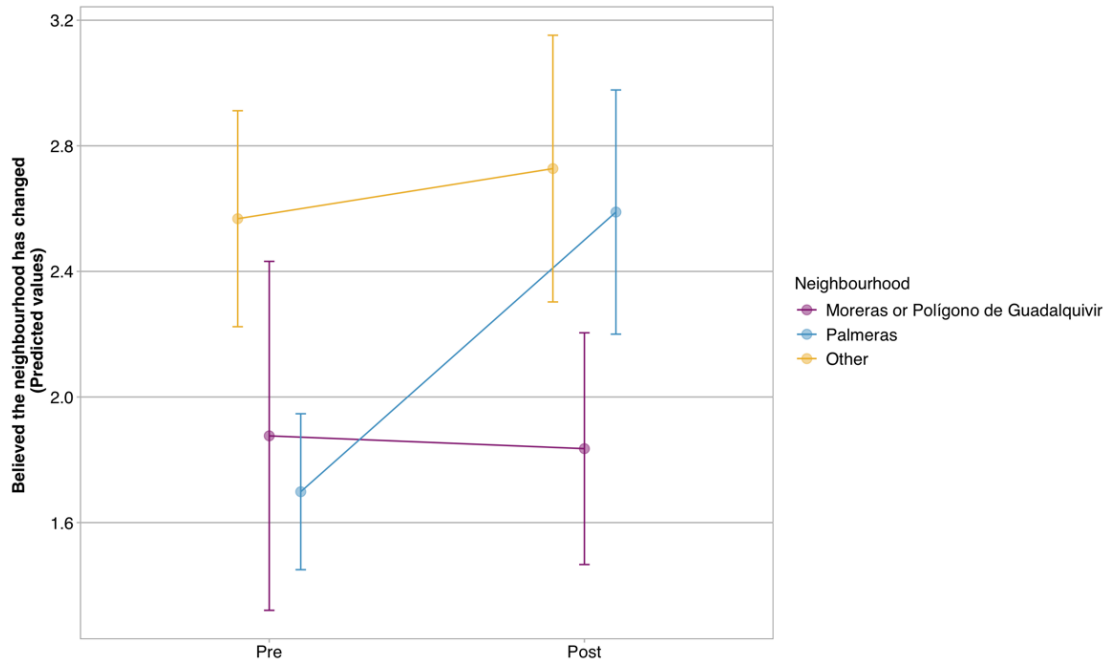


Figure 12 Results of models of the variable “NR6” corrected by socio-demographics, the model takes into account the interaction between neighbourhood and survey.

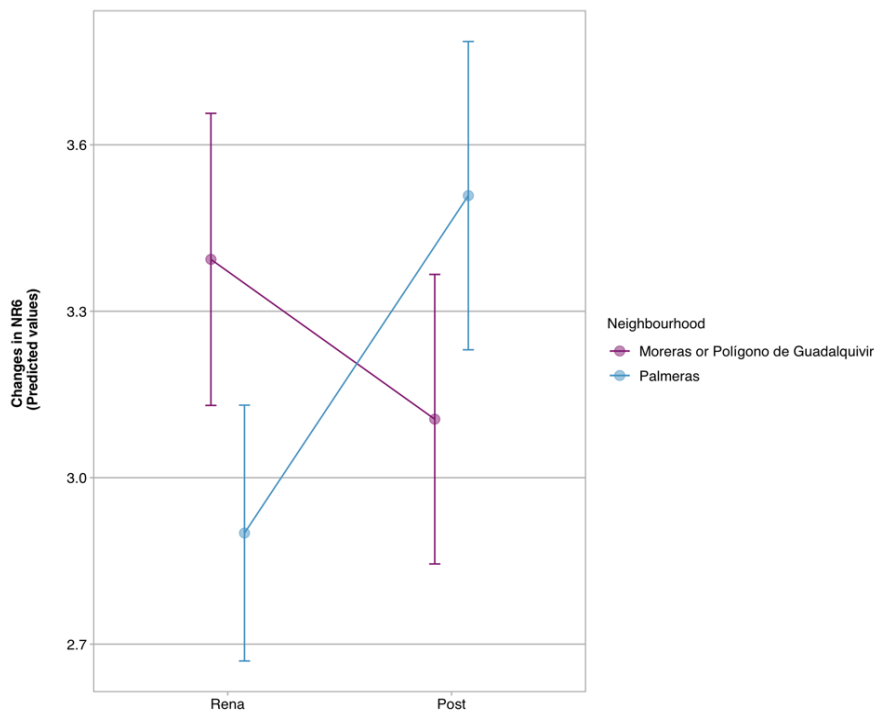


Figure 13 Results of models of the variable “Image of the neighbourhood” corrected by socio-demographics, the model takes into account the interaction between neighbourhood and survey.

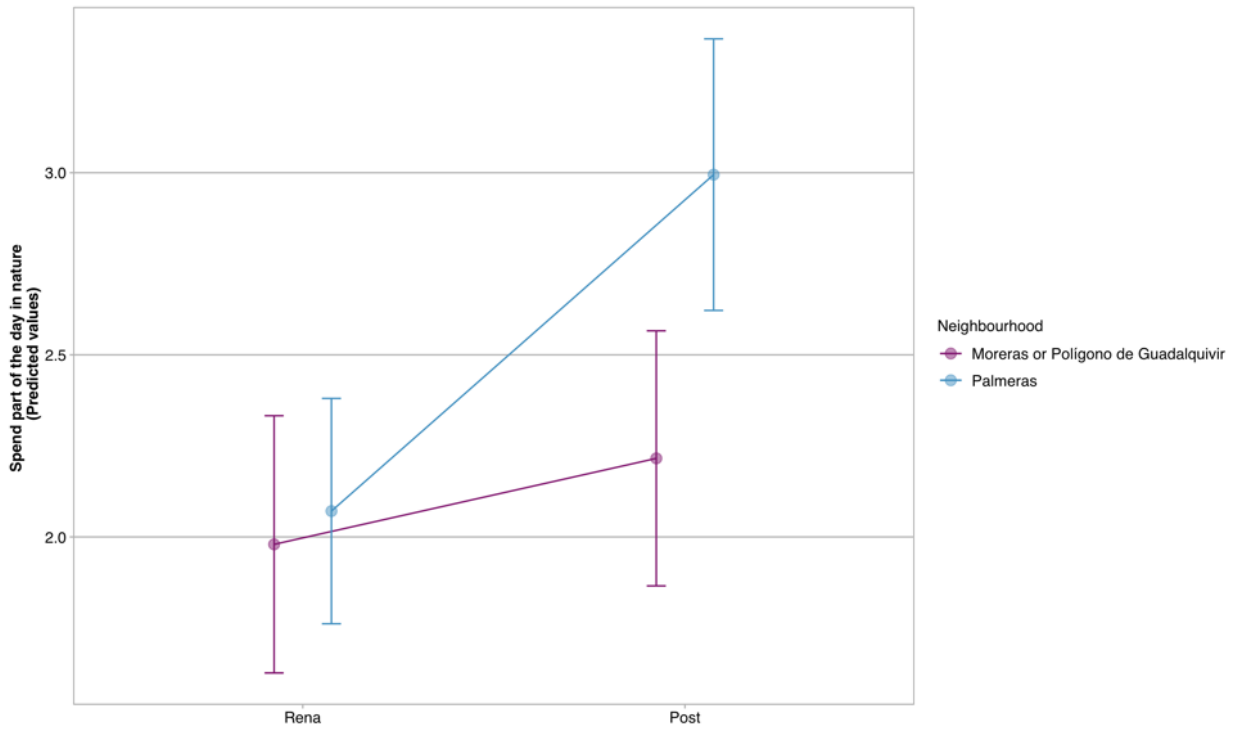
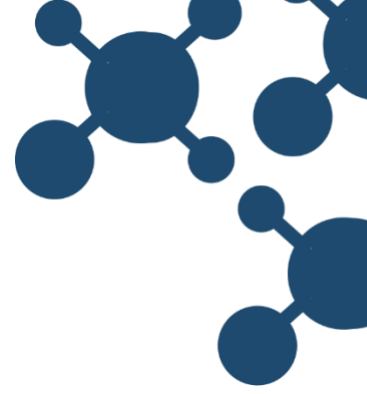


Figure 14 Results of models of the variable “spend part of day in nature” corrected by socio-demographics, the model takes into account the interaction between neighbourhood and survey.

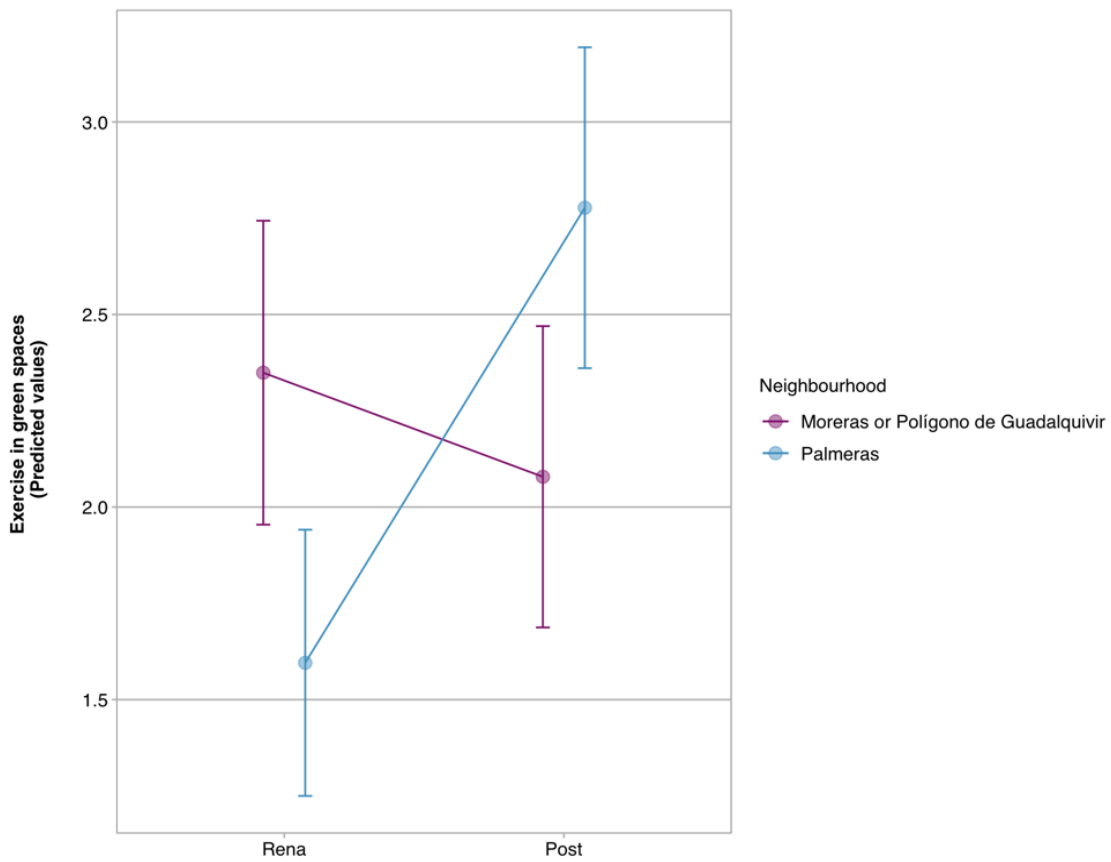


Figure 15: Results of models of the variable “Exercise in green areas” corrected by socio-demographics, the model takes into account the interaction between neighbourhood and survey.

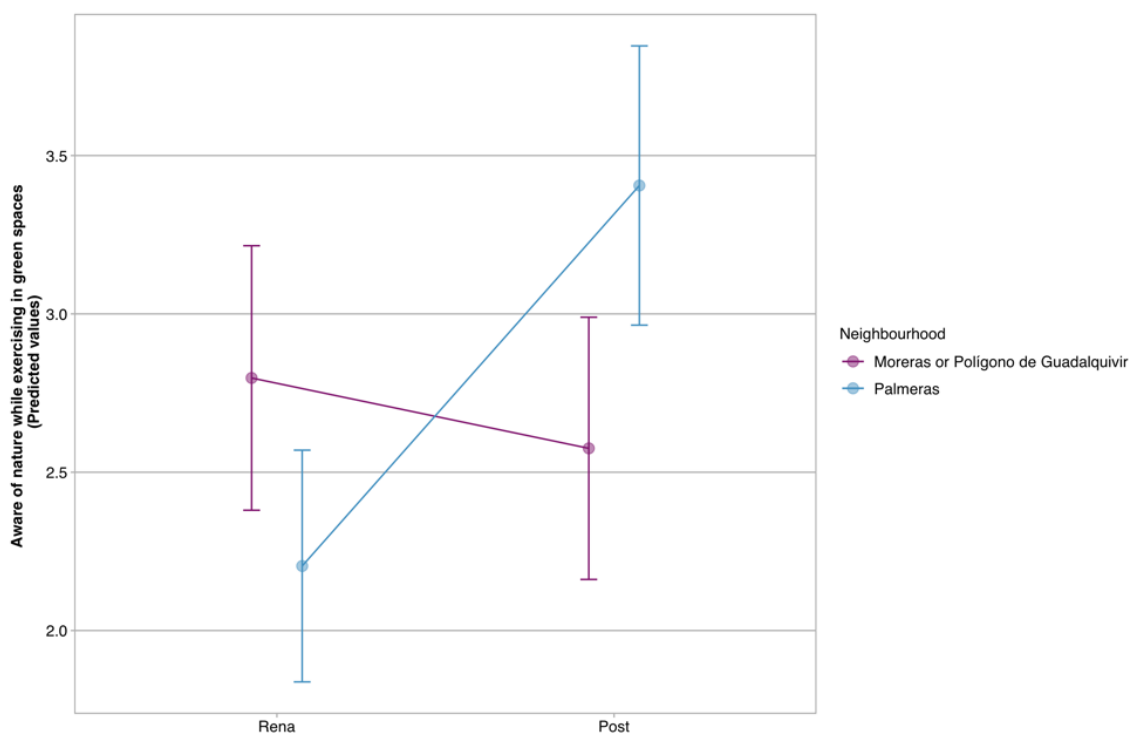


Figure 16: Results of models of the variable “Aware of nature while exercising in green areas” corrected by socio-demographics, the model takes into account the interaction between neighbourhood and survey.

Following the models comparing the populations of the different neighbourhoods, we then focused specifically on the residents in the core group. Given the small sample size (only twelve participants, all of whom were women), we conducted separate analyses using bootstrap techniques. Only the variables that were found to be significant are reported here. The variables showing the greatest changes were mainly related to wellbeing, perceptions of the neighbourhood, and two variables linked to green areas. These findings are consistent with the outcomes observed in the preliminary analysis when the entire samples were compared. Furthermore, some of the impacts identified in the statistical analysis are corroborated by the responses given by core group members during the focus group.

Table 5: Outcomes of the 2000 bootstrap simulation, with the model estimate and the 95% CI intercept. Variables: Who-5, K6, Perception of changes in public activities in the neighbourhood, neighbourhood image, NR6, green score.

	Estimate	95% CI Low	95% CI High
WHO-5			
<i>Intercept</i>	18.0	16.2	19.8
<i>Post survey</i>	4.48	2.00	6.87
<i>Age</i>	-0.0459	-0.0914	-0.00124
K6			
<i>Intercept</i>	10.1	8.12	12.1
<i>Post survey</i>	-2.50	-6.39	2.03
<i>Age</i>	0.00363	-0.0430	0.0514
Public activities in the neighbourhood			
<i>Intercept</i>	2.33	1.96	2.70
<i>Post survey</i>	1.25	0.339	2.17
<i>Age</i>	-0.00739	-0.0158	0.00100

	Estimate	95% CI Low	95% CI High
Neighbourhood's image			
<i>Intercept</i>	2.75	2.23	3.29
<i>Post survey</i>	3.09	2.31	3.75
<i>Age</i>	0.0269	-0.0387	-0.0157
NR6			
<i>Intercept</i>	14.1	10.9	17.3
<i>Post survey</i>	4.39	-0.556	8.89
<i>Age</i>	0.0488	-0.0211	0.122
Green Score			
<i>Intercept</i>	3.01	2.44	3.53
<i>Post survey</i>	1.32	0.833	1.73
<i>Age</i>	0.00622	-0.00513	0.0176

Results of the focus group

The core group of residents expressed a shared perception that the neighbourhood had experienced a series of positive transformations, particularly in relation to the condition and use of public spaces. They noted visible improvements in areas such as the central plaza, newly planted trees, and the new path parallel to a stream, which they felt had made the neighbourhood more pleasant, accessible, and conducive to well-being.

The group also reported a strengthening of community ties. In their view, participation in the project had encouraged greater involvement among residents in neighbourhood activities and decision-making processes. They observed that individuals who had previously remained disconnected or disengaged were now contributing actively to shared initiatives, often expressing a sense of collective responsibility.

Regarding the use of public spaces, the residents acknowledged a shift in local attitudes. They referred to initial concerns about potential vandalism, particularly in newly developed areas such as the picnic area (merendero) and the renovated square. However, over time, they noted a growing respect for these shared environments, which they attributed to the direct involvement of residents in the co-design and co-deployment of interventions. According to the group, seeing neighbours actively shaping their surroundings contributed to a broader sense of mutual trust and accountability.

Although physical changes in the neighbourhood were viewed positively, the core group placed greater emphasis on the social and emotional impacts of the process. They considered the collaborative experience, overcoming difficulties, engaging in dialogue, and working towards shared goals, as more valuable than the physical outcomes themselves. For many, the project had offered a rare opportunity to experience effective collaboration and to witness tangible results emerging from community effort.

In discussing personal impacts, several group members described an increased sense of connection to their environment, greater self-confidence, and pride in contributing to local improvements. They felt that participation in the project had given them a clearer role within the neighbourhood and strengthened their sense of belonging.

in more detail in the focus group carried out with them. In that discussion, the women explained that they had created new friendships, met new people, and formed a close group of friends. They also said they felt proud of the work they had done, and that they felt the reforms in the neighbourhood belonged to them. This was a sense of pride from being part of the change, not simply passive actors. These women were not only interacting with the environment, but they were also taking ownership and transforming it, generating processes of co-creation of public and natural spaces. They were part of the decision-making and felt that they had been listened to. This interpretation reflects evidence from urban regeneration studies that active involvement in local decision-making might enhance perceived control and collective efficacy (Campbell & Cornish, 2012; Caperon et al., 2022).

These feelings of social cohesion, social interaction, ownership, and pride appear to come together to create a synergy that might improve mental health and perceived wellbeing, strengthening both the subjective wellbeing and social wellbeing dimensions. The feeling of pride seems most visible in the variable “change in the image of the neighbourhood”. This variable shows the largest impact, both among the women and other inhabitants of the neighbourhood. It is possible that in the case of women, the effect is stronger than for men, because having been part of the process may increase their sense of pride and ownership, making them more likely to like and view the changes positively. Similarly, they are the ones who report the greatest impact on the perception of changes in public activities in their neighbourhood. This is possibly because the core group of women were central actors in all the activities, so for them the change is greater and more noticeable than for others. This interpretation aligns with previous studies suggesting that women often experience stronger emotional and social benefits from community engagement and urban greening projects, particularly in contexts of disadvantage (Cattell et al., 2008; Jennings & Johnson Gaither, 2015).

We also observe that women seem to feel more closeness to the green spaces they created, as reflected in the NR6 variable and the green score. However, they show little or no change in the indices for sport in nature, spending more time in natural spaces, or other aspects of spatial and environmental wellbeing and healthy lifestyles. This might indicate a difference between the priorities of women and other members of the neighbourhood. For them, the most important aspect seems to be the transformation of the neighbourhood and being active participants. They tend to be more critical in character and focus on improving the neighbourhood not for their own benefit but for others. This is evident in the focus group, where they explained that the re-naturalisation changes are so that their grandchildren can enjoy a better neighbourhood, and they were very aware that they would not directly receive the benefits from the trees, as these still need to grow. This difference in use and perception of green spaces suggests that their priorities may be more about collective change rather than personal leisure habits. It echoes findings from community stewardship literature, where emotional attachment to place can arise from co-creation, even without increased nature usage (Ihle et al., 2024).

Even so, they are not people who demonstrate lifestyle habits closely connected to nature, such as walking in it, spending time in the places they have created, or observing nature closely. However, among the variables indicating attachment to natural elements, they show the greatest change. This is likely due to their direct engagement in the process, which may have fostered a bond with the trees planted and the spaces they developed. They also participated in workshops and courses that possibly provided them with new ideas about the importance of the green areas they themselves created. This interpretation reflects findings from research on environmental stewardship that direct involvement in

creating and maintaining green spaces may increase attachment and sense of responsibility (Raymond et al., 2017).

In the healthy lifestyles and economic wellbeing dimensions, the core group of women appears unchanged. These variables were not heavily addressed in group activities, even though the women participated in the pilot entrepreneurship project. None of the business initiatives have been successful, likely because entrepreneurship requires substantial financial resources that these women do not have. Additionally, other socio-demographic factors, such as age (almost all the women are older), employment status, health, and monthly income, seem to impact these two dimensions more significantly than others (Karki et al., 2021). These factors are beyond the scope of the project and continue to be very unfavourable for residents in this neighbourhood. This underlines the importance of official institutions supporting such initiatives. For instance, government support for entrepreneurship projects might have increased their chances of success. This is consistent with broader evidence that structural inequalities, rather than community engagement alone, largely determine outcomes in domains such as economic wellbeing and lifestyle health (Marmot, 2002; Pickett & Wilkinson, 2015).

Interestingly, residents of the neighbourhood who were not part of the group also show impacts in areas we had not expected to observe, all related to Spatial and Environmental Wellbeing and Healthy Lifestyles. These results are both unexpected and encouraging because they suggest that the project might have had a broader impact on the neighbourhood, even on those who did not participate. The results also indicate that there may have been a measurable change in the physical characteristics of the neighbourhood. Surveyed residents of Las Palmeras reported a shift in their perception of the neighbourhood's image, increased time spent in green and natural spaces, more engagement in sports within these areas, and an enhanced awareness of the surrounding nature whilst exercising. Evidence from urban green space research indicates that improvements to the built and natural environment may encourage greater physical activity and awareness of surroundings, even among residents not directly involved in planning (Hartig et al., 2014; Maas et al., 2008).

This, combined with the lack of vandalism in the green spaces, suggests that residents perceive the neighbourhood as now offering them physical benefits that they can enjoy and should take care of. Increasing green areas where they can be active or do sport will possibly bring benefits for their health and wellbeing, as sport and contact with nature are often linked (Twohig-Bennett & Jones, 2018). However, none of these factors appear directly linked to social cohesion and wellbeing, as observed with the women in the neighbourhood. This might be because, as the women told us, most of the changes are due to the process rather than the immediate results. Strictly speaking, the benefits from re-naturalisation are unlikely to be realised for several years, until the trees mature and may help mitigate effects like the urban heat island. Research on urban greening confirms that ecological benefits such as cooling and carbon storage usually accrue only once vegetation reaches maturity (Gill et al., 2007). Meanwhile, its impact may not be as strong as participating in the change process, as the women's accounts and the results suggest. However, the fact that people are already taking ownership of the new image of their neighbourhood, are not vandalising it, and are also appreciating and using it for sports and leisure activities indicates that even though the trees are not yet mature, the provision of new, well-conditioned public spaces might already be sufficient for residents to use and enjoy. These early behavioural changes are in line with wider findings that improvements to

neighbourhood environments can alter perceptions and practices before ecological benefits fully develop (Jennings & Bamkole, 2019; Kuo, 2015).

4.2. Shelter for homeless people

At the homeless shelter, the methodology followed the same four-phase structure used in Las Palmeras: co-design, co-deployment, co-management, and co-assessment, alongside the integration of soft and hard VIS. This greening intervention revitalised neglected spaces within the shelter through the efforts of the so-called “Green Team (GT)” composed of residents. Homeless individuals were invited to take part in weekly sessions that focus on developing social and team-building skills and outdoor physical labour to create the following spaces: a vegetable garden; a therapeutic garden featuring a pond, bird cages, and insect hotels; and the development of the “patio for the future” using plants that demand minimal summer irrigation. Weekly sessions were led by psychologists and botanical researchers to address emotional dynamics, alongside practical horticulture sessions, field visits, and skills training.

Monitoring in this context focused on short-term changes in mood, perceived health, and environmental perceptions, using adapted versions of the WHO-5, K6, and self-rated health scales. Participants completed pre- and post-session questionnaires, with different instruments rotated across sessions to minimise repetition. A control group of non-participating residents provided a comparative reference. A perception scale based on restorative environment theory was developed to explore which garden elements were most valued. Semi-structured interviews with a purposive sample explored emotional change, motivation, social connection, and the meaning of participation, offering qualitative depth to the quantitative findings.



Figure 18 Logo co-designed for the green team

A total of 156 individuals in the "Green Team" responded to the WHO-5 Well-Being Index, while 45 responses were collected from participants in the comparison group. For the K6 Psychological Distress Scale, 101 responses were obtained from the GT and 48 from the comparison group.

157 individuals completed the Self-Rated Health (SRH) scale in the first group and 51 in the comparison group. In addition, 103 participants from the GT completed the environmental perception questionnaire developed using Ulrich’s restorative environment framework. This instrument was applied exclusively within the GT.

Table 5 presents the sociodemographic characteristics of the sample. The profile broadly reflected the known demographic distribution of individuals experiencing homelessness in Córdoba. Approximately 76 per cent of participants identified as male and 24 per cent as female, which corresponds with recent municipal records indicating a distribution of 78 per cent male and 22 per cent female. The median age in the sample was 50 years (interquartile range: 41 to 60), closely aligning with the local average of 54 years (interquartile range: 45 to 65) reported by municipal sources (Co-Habitat, 2024). The most frequently cited reasons for homelessness were economic hardship and irregular immigration status, which are also among the main drivers reported in the city’s wider homeless population.

Table 6: Table of socio-demographics of participants for each scale and separated by Non-Green Team or Green Team.

	WHO-5		SRH		K6		Ulrich based scale	
	Non-G T	Green T.	Non-G T	Green T.	Non-G T	Green T.	Non-G T	Green T.
Age								
	50 (15%) ¹	49 (12%)	50 (15%)	49 (12%)	50 (15%)	50 (12%)	48 (14%)	51 (11%)
Gender								
Female	7 (22%)	41 (33%)	6 (19%)	44 (35%)	5 (19%)	23 (31%)	15 (45%)	23 (32%)
Male	25 (78%)	83 (67%)	26 (81%)	81 (65%)	21 (81%)	52 (69%)	18 (55%)	48 (68%)
Reason for homelessness								
Addictions	3 (9.4%)	27 (22%)	3 (9.4%)	26 (21%)	4 (15%)	15 (20%)	0 (15%)	15 (21%)
Lack of resources	17 (53%)	21 (17%)	17 (53%)	22 (18%)	12 (46%)	9 (12%)	12 (36%)	9 (13%)
Out of prison	2 (6.2%)	13 (10%)	2 (6.2%)	12 (9.6%)	2 (7.7%)	9 (12%)	6 (18%)	8 (11%)
Mental health	6 (19%)	36 (29%)	6 (19%)	37 (30%)	5 (19%)	22 (29%)	15 (45%)	21 (30%)
Illegal immigrant	4 (12%)	27 (22%)	4 (12%)	28 (22%)	3 (12%)	20 (27%)	0 (0%)	18 (25%)

Mean (SD); n (%)

Self-Perceived Physical Health

Prior to the gardening sessions, 32 per cent of participants in the GT rated their health as “poor”, 31.2 per cent as “regular”, 16.8 per cent as “good”, 12.8 per cent as “very good”, and 7.2 per cent as “excellent”. In the comparison group, the initial distribution was similar, with 34.3 per cent reporting “poor”, 37.5 per cent “regular”, 9.3 per cent “good”, 15.6 per cent “very good”, and 3.1 per cent “excellent”.

Following participation in non-gardening structured activities, the comparison group presented a shift towards lower perceived health. After the session, 43.8 per cent of this group rated their health as “poor”, 25 per cent as “regular”, 18.7 per cent as “good”, 9.3 per cent as “very good”, and 3.1 per cent as “excellent”. The most marked change occurred in the “regular” and “very good” categories, which decreased, while the proportions reporting “poor” or “good” increased. This variation reached statistical significance ($\chi^2 = 13.4$, $df = 4$, $p = 0.009$).

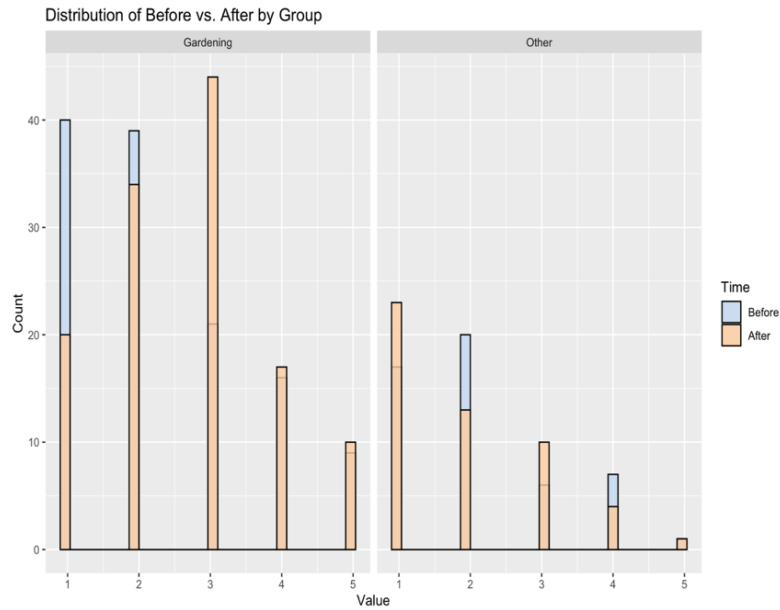


Figure 19: Distribution of self-reported physical health data. A scale from 1 to 5, where 1 indicates poor physical health and 5 indicates excellent physical health.

In contrast, responses from the GT Group after the activity indicated a positive shift. Reported health status improved to 16 per cent “poor”, 27.2 per cent “regular”, 35.2 per cent “good”, 13.6 per cent “very good”, and 8 per cent “excellent”. Here, the improvement was most evident among those who had initially placed themselves in the “poor” or “good” categories. The overall difference between pre- and post-session responses was statistically significant ($\chi^2 = 15.2$, $df = 4$, $p = 0.004$). However, due to the categorical format of the health scale, it was not possible to trace individual transitions between categories.

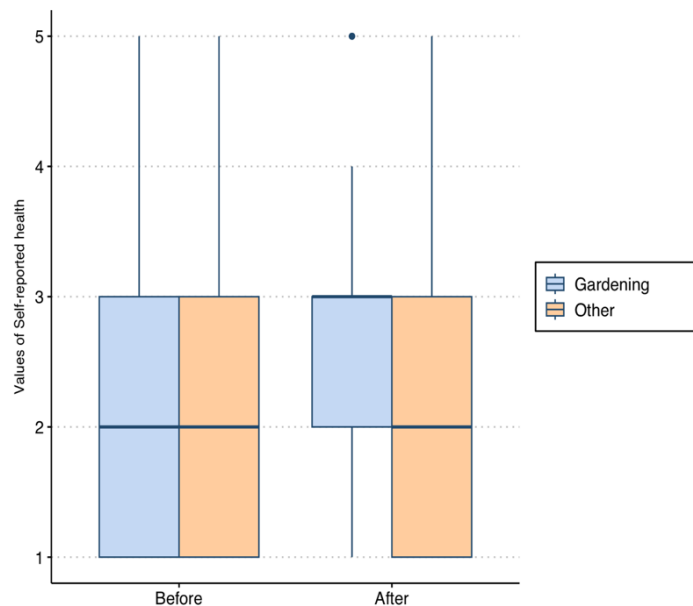
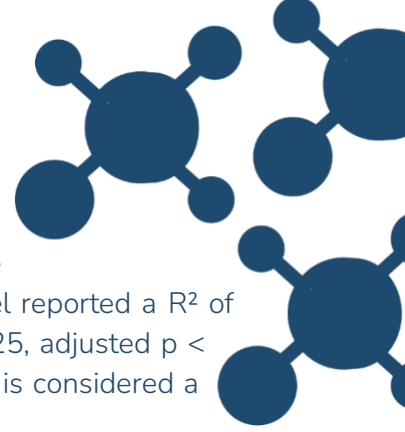


Figure 20: Boxplot of SRH scores pre- and post-session for each group: Green Team (structured gardening activity) and non-Green Team (informal shelter activities). Boxplots show median, interquartile range, and outliers.



A Generalised Linear Model (GLM), in which the outcome variable was the change in health rating (post minus pre), indicated a significant group effect. The model reported a R^2 of 0.18, with a beta coefficient of -0.50 (SE = 0.12, 95 per cent CI = -0.73 to -0.25, adjusted $p < 0.001$). The estimated effect size, calculated using Cohen's d , was 0.83, which is considered a large effect in this context.

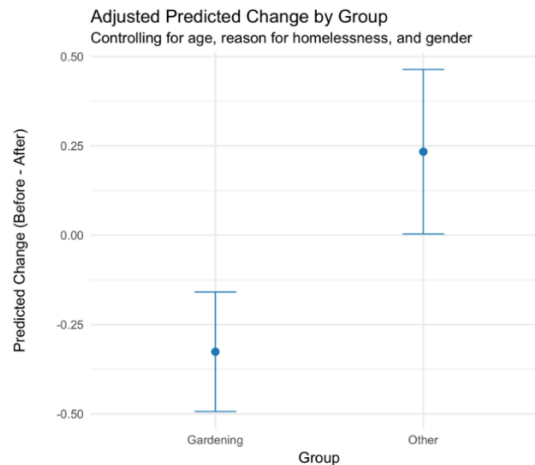


Figure 21: Predicted change in self-perceived physical health (Before – After) for Green Team and Non-Green Team. Zero indicates no change; negative values reflect improvement after the activity.

Self-Perceived Well-Being (WHO-5 Scale)

Within the comparison group, the mean score on the WHO-5 Well-Being Index prior to participating in activities was 11.3 (SD = 3.3). Following the activity, this decreased slightly to 10.7 (SD = 2.8). A paired t-test did not indicate a statistically significant difference between the two time points ($t = 2.1$, $df = 31$, $p = 0.07$).

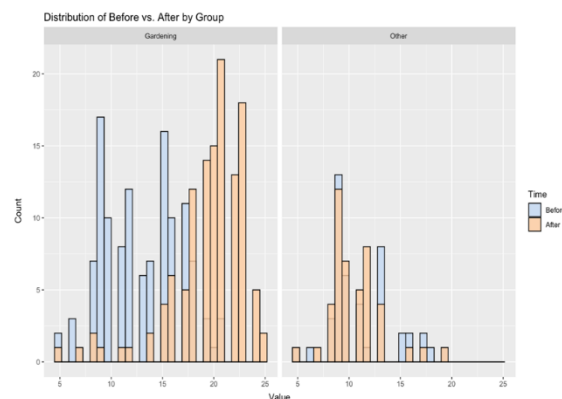
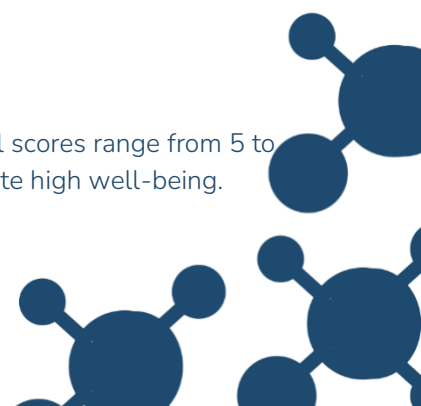
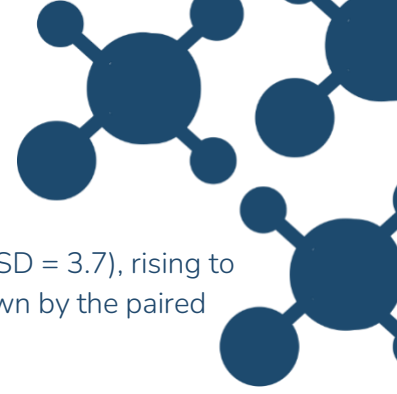


Figure 22: Distribution of self-reported well-being data using the WHO-5 Likert scale³.

³ Values are obtained by summing responses to five items, each rated from 1 to 5. Total scores range from 5 to 25. Scores closer to 5 indicate low levels of well-being, while scores closer to 25 indicate high well-being.





For participants in the GT, the mean WHO-5 score before the session was 13.0 (SD = 3.7), rising to 19.5 (SD = 3.6) after taking part. This increase was statistically significant, as shown by the paired t-test ($t = 26$, $df = 123$, $p < 0.01$).

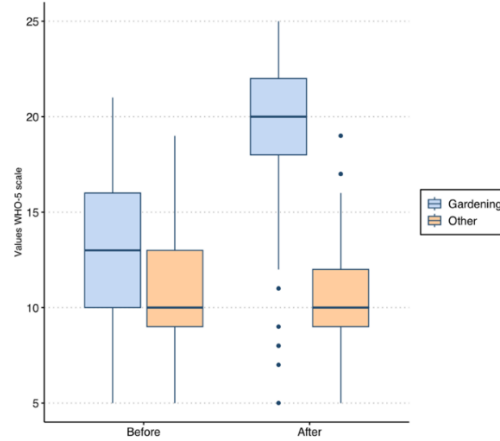


Figure 23 Boxplot showing WHO-5 pre- and post-session scores for each group. ⁴

A Generalised Linear Model (GLM) was used to account for possible demographic influences, with change in well-being score (post minus pre) as the outcome variable. The model identified a significant effect associated with participation in the gardening activity. The R^2 was 0.16, with a beta coefficient of -7.1 (SE = 0.52, 95 per cent CI = -8.1 to -6.1, adjusted $p < 0.001$). The effect size, based on Cohen's d , was calculated at 1.1. While this suggests a substantial change, it is important to consider that the effect size may have been influenced by the sample size and the short time interval between measurements.

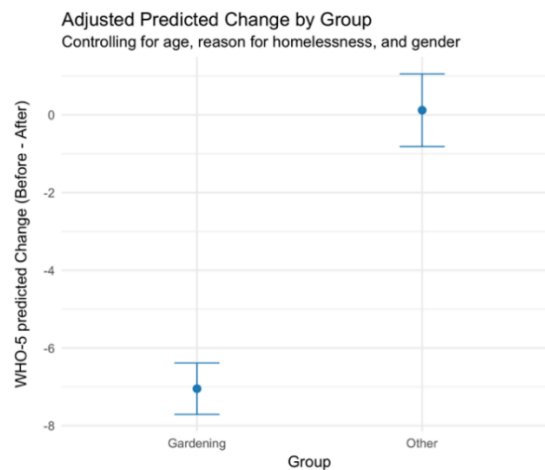


Figure 24: WHO-5 predicted change (Before – After) for Green Team and Non-Green Team. A value of zero indicates no change; negative values indicate improved self-perceived wellbeing following the activity.

⁴ For the Green Team, values represent scores before and after participating in a structured gardening activity. For the non-Green Team, values reflect scores before and after any informal



Self-Perceived Mental Health (K6 Scale)

Results from the K6 Psychological Distress Scale indicated a notable reduction in reported distress among participants in the GT. The mean score declined from 12.4 (SD = 3.6) before the session to 3.4 (SD = 2.4) after participation. This difference was statistically significant ($t = 32$, $df = 74$, $p < 0.01$).

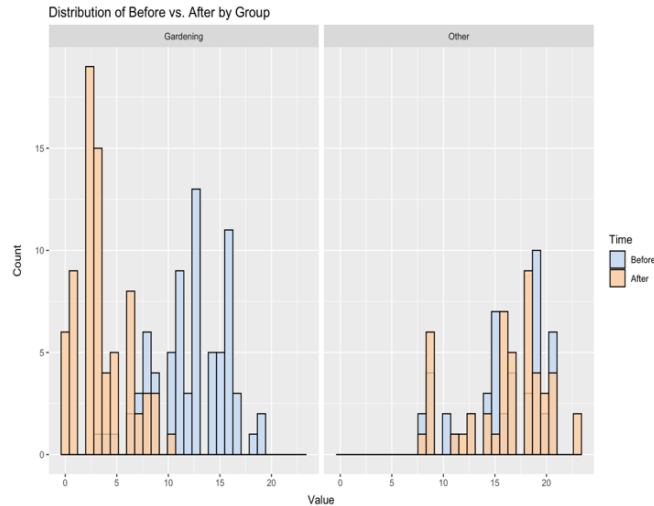


Figure 25: Distribution of self-reported mental distress data using the K6 Likert scale. Values are obtained by summing responses to six items, each rated from 0 to 4. Total scores range from 0 to 24. Scores above 13 indicate a higher likelihood of experiencing a mental health issue such as depression or anxiety.

By comparison, the Non-GT showed no significant variation in scores. Their mean score was 15.6 (SD = 4.2) before the session and 15.9 (SD = 4.1) afterwards. The paired t-test did not identify a statistically significant change ($t = 1.3$, $df = 25$, $p = 0.2$).

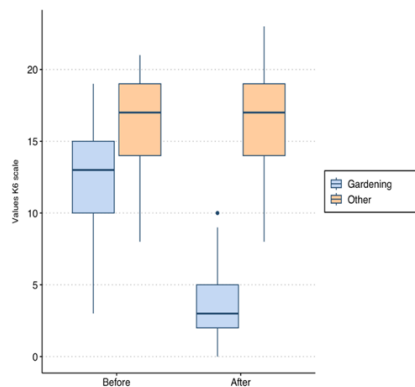


Figure 26: Boxplot showing K6 pre- and post-session scores for each group.⁵

⁵ For the Green Team, values represent scores before and after participating in a structured gardening activity. For the non-Green Team, values reflect scores before and after any informal, non-structured activity within the shelter. The boxplots display median, interquartile range, and outliers.

The Generalised Linear Model (GLM), adjusted for relevant covariates, confirmed a significant difference in psychological distress outcomes between the two groups. The model produced a R^2 of 0.27, with a beta coefficient of 8.9 (SE = 0.47, 95 per cent CI = 8.0 to 9.8, adjusted $p < 0.001$). The effect size, calculated using Cohen’s d , was 1.3. While this suggests a substantial group difference, the magnitude of the effect should be interpreted with caution, given that sample size and the short interval between measurements may have influenced the estimate.

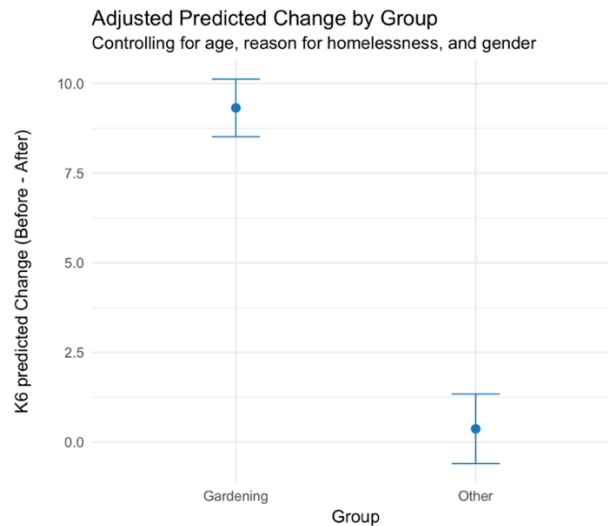


Figure 27: K6 predicted change (Before – After) for Green Team and Non-Green Team. A value of zero indicates no change; positive values indicate improved self-perceived metal distress following the activity.

Perceived Impact on Mood and Biodiversity Appreciation (Ulrich-based Scale)

Responses to the environmental perception questionnaire, developed using Ulrich’s framework, indicated overall agreement with positive statements about the garden space. Most participants selected responses ranging from 3 to 5 on the five-point Likert scale, suggesting generally favourable perceptions.

Among the items, the presence of a water feature was rated most positively. Many participants also associated the gardening activity with reduced stress, greater physical comfort, and perceived support for physical recovery. A smaller number mentioned a greater ability to manage intrusive thoughts, although this was not a shared experience across all participants.

Elements related to biodiversity, such as the presence of birds or animals, received lower ratings, which may suggest that these aspects were not prioritised by this group. While other studies have identified perceived biodiversity as a factor contributing to well-being, the lower importance attributed to it here may reflect the specific needs and preferences of the population involved. The patterns observed in the questionnaire responses were broadly consistent with themes that emerged during the qualitative interviews.

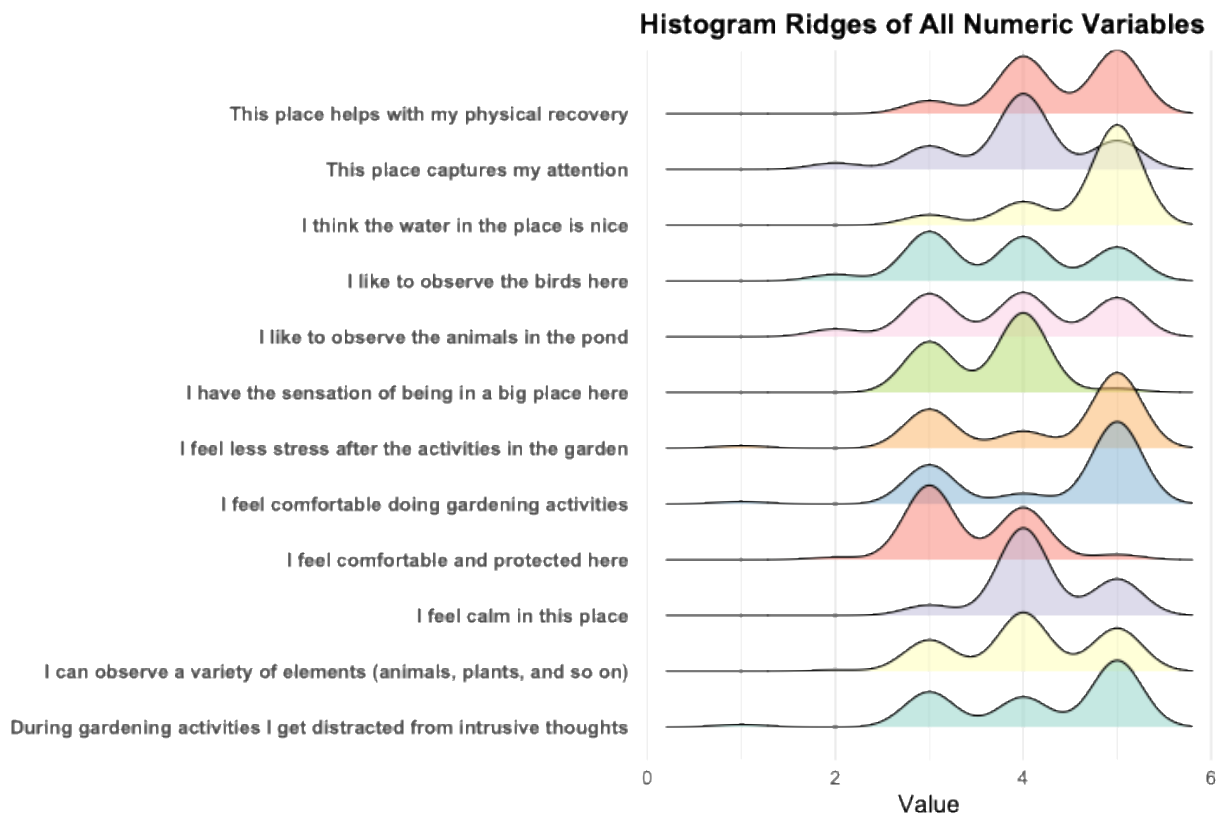


Figure 28: Density plots of every item measure on the Ulrich-based scale. Each item was measured in a Likert scale of 1 to 5. All distributions were left-skew but some had on average higher median values, while others were not considered as important, like “I like to observe the birds here” or “I feel comfortable and protected here”.

In-depth interviews

As part of the qualitative evaluation of the gardening initiative, in-depth interviews were conducted with members of the GT. The sample included individuals from diverse and often vulnerable backgrounds, such as immigrants, people experiencing homelessness, individuals with histories of addiction or alcoholism, and those living with mental health challenges. Both men and women took part in the interviews. The aim was to explore their experiences of participation and to understand how the project may have shaped their perceptions of self, community, and the environment. Taken together, the interviews provide insight into the ways in which involvement in the gardening project may have contributed to emotional wellbeing, a growing sense of agency, and enhanced social connection. The combination of structured psychological and emotional activity, contact with nature, and shared responsibility appeared to offer an enabling context for personal reflection, social recovery, and the formulation of future goals. The interviews were divided into five main blocks.

- **Block 1: Autonomy and Sense of Responsibility**

Participants described a gradual shift in their ability to act independently. At the outset, most preferred clear instructions and found comfort in structured tasks. However, over time, several participants began to report growing confidence in their own judgment and abilities. Although many still depended on guidance from facilitators or peers, the opportunity to engage in a tangible, collaborative activity appeared to build a sense of personal responsibility.

Statements such as, “I want to be a gardener. I have always liked it, and now I feel more motivated to pursue this” (Participant from Morocco), and “I feel like I could take on the world, as long as the world gives me the chance here in Europe” (Participant from Pakistan), suggest that some individuals experienced an increase in motivation and self-efficacy, especially those with prior interest in nature-based work. The process helped participants connect their efforts to future aspirations, even if full autonomy had not yet been achieved.

- **Block 2: Emotional and Mental Benefits of Contact with Nature**

Participants consistently described the garden environment as calming and restorative. The time spent outdoors was associated with temporary relief from emotional distress, worries, and anxiety. Working with plants allowed them to focus on the present moment and experience a sense of tranquillity, which was particularly valued by individuals living with stress-related or psychological challenges.

As one participant shared, “Working in the garden helps me forget everything else and focus on the present moment” (Participant from Spain). Another added, “I feel more relaxed and peaceful after spending time in nature” (Participant from Morocco). These reflections indicate that natural settings provided an accessible form of psychological relief, supporting wellbeing even in contexts of high vulnerability.

- **Block 3: Perceptions of Physical Transformation and its Connection to Wellbeing**

Participants responded positively to the transformation of the shared outdoor spaces. Many commented on the change from what had been a neglected area to one they now found pleasant, clean, and useful. For several individuals, these changes not only improved the physical surroundings but also led to greater feelings of connection, pride, and emotional stability.

One interviewee noted, “The space looks much better now, and it makes us feel more connected to the project” (Participant from Morocco). Another reflected, “Working together here in the garden has brought us closer. It makes me feel part of something” (Participant from Cameroon). These comments suggest that the improved environment symbolised a broader process of renewal, in which both the space and the individuals themselves experienced positive change.

- **Block 4: Group Dynamics and Social Relationships**

A strong sense of group cohesion emerged as a recurrent theme. Participants described how the gardening activity contributed to a shared experience that encouraged interaction, mutual respect, and emotional support. For many, the group aspect of the project was just as meaningful as the gardening itself.

“Working in the garden brings us closer. It makes me feel like I belong” (Participant from Cameroon), and “It’s good for the house, and for me. I feel like I am doing something important, and my work is valued” (Participant from Spain) illustrate how the collective dimension of the intervention created opportunities for inclusion. Participants, particularly those with histories of social isolation, found the structure and companionship of the group valuable.

- **Block 5: Motivation and Future Aspirations**

The project appeared to have an encouraging effect on participants’ outlooks and future goals. Many described a clearer sense of direction, including ambitions related to employment, personal growth,

or community contribution. Some connected the structure and support of the project to increased motivation and the development of concrete goals.

One individual shared, “I feel like I am ready to take on new challenges. Working in the garden has shown me that I am capable of more than I thought” (Participant from Spain). Others expressed the intention to continue in similar initiatives or find work related to gardening. These reflections suggest that for some participants, the intervention became a foundation for longer-term personal development.



Figure 29: World cloud of the most mentioned and important words from the interviews. They reflect the impact of the process of working with nature and finding sense of achievement during the process.

Discussion

The results indicate that even brief exposure to structured gardening sessions led to measurable improvements in emotional wellbeing, perceived physical health, and psychological distress. These findings are consistent with earlier research on the benefits of nature-based interventions in marginalised populations (Malberg-Dyg et al., 2020; Tracey et al., 2023). Although the study did not assess long-term outcomes, the immediate improvements observed after the sessions suggest that even short-term, low-intensity nature-based activities may provide meaningful support to people living in situations of chronic instability.

The improvement in self-rated physical health aligns with previous studies on community gardening, which report that physical activity, engagement with food growing, and involvement in environmental tasks can improve body awareness and subjective health (Cruz-Piedrahita et al., 2020; Genter et al., 2015). While this study did not measure physical activity or diet directly, participants often linked gardening with a greater sense of vitality and purpose.

Mental wellbeing also improved notably. The increase in WHO-5 scores after the gardening sessions matches results from therapeutic horticulture studies, which report reductions in depressive symptoms and greater emotional resilience (Wood et al., 2025). These results are also supported by research with homeless populations, particularly women in shelter-based gardening programmes, who have reported reduced anxiety and greater calm (Grabbe et al., 2013). The significant reduction in K6 psychological distress scores reinforces the value of low-threshold, socially supported, nature-based activities for highly vulnerable populations (Kim et al., 2020; Tracey et al., 2023).

Environmental perception emerged as an important part of the experience. The adapted Ulrich-based scale showed strong preferences for certain features, particularly the presence of water, feelings of comfort, and a sense of calm. These responses support key ideas from Attention Restoration Theory (Kaplan & Kaplan, 1989) and the biophilia hypothesis (Ulrich, 1984), which propose that contact with certain natural elements restores attention and reduces stress. Interestingly, biodiversity-related aspects, such as the presence of birds or insects, were rated as less important. This differs from studies that link biodiversity to better psychological outcomes (Naeem et al., 2016; Schebella et al., 2019). One possible explanation is that people experiencing homelessness may place higher value on environmental features that offer safety, predictability, and emotional comfort, rather than ecological richness. Limited exposure to biodiverse environments or low environmental knowledge might also shape how these features are understood or valued.

Qualitative interviews gave more detail and depth to the quantitative findings. Participants described gardening as a source of emotional stability, social connection, and personal motivation. For people facing addiction or mental health problems, the structured nature of the programme and its group-based format were particularly important. These observations fit with research on social capital and recovery, which emphasises the importance of trust, shared goals, and a sense of belonging in improving wellbeing (Veen et al., 2016). The presence of trained facilitators and the opportunity to make decisions that contribute to a shared space also appeared to increase self-confidence and accountability, particularly for those with previous experiences of social exclusion.

Differences were also noted depending on cultural background and personal histories. Migrant participants often spoke about future goals and showed high motivation to engage in productive activities. In contrast, people recovering from addiction highlighted the need for supervision and expressed concern about keeping routines without external support. These differences can be linked to their backgrounds, in some cases connected to rural or agricultural life. This highlights the need for flexible programme models that can adapt to different levels of independence and emotional readiness.

Overall, these results indicate that nature-based, participatory activities in a safe and supportive setting can have a positive impact on three of the five IN-HABIT framework dimensions. The immediate improvements in wellbeing, environmental perception, and social connectedness suggest that even short-term interventions may provide psychological relief, help social inclusion, and strengthen emotional resilience among highly marginalised groups. Although the benefits recorded here are short-term, the findings support the idea that integrating restorative green spaces into social care settings may bring long-term advantages for people experiencing homelessness, especially when combined with other forms of social and economic support.

4.3. Patios of Axerquía

One of the main proposals of IN-HABIT Córdoba was the use of patios as a social nature-based solution. In the city of Córdoba, summer temperatures often exceed forty degrees, and with the current climate crisis this problem is likely to worsen. Among the urban solutions that scientists propose to mitigate the challenges of high temperatures are the creation of green areas and the increase in the presence of trees in cities. However, in the historic centre of Córdoba such projects cannot be carried out on a large scale, since the area is part of the UNESCO World Heritage and cannot be altered. This

recognition, while very important and a central element of Córdoba's identity, does not allow interventions on façades or streets in the centre that could affect heritage values.

For this reason, it is necessary to think of solutions that can integrate nature and green spaces into the city without altering its façades. The solution proposed by the IN-HABIT project came from the city's own cultural identity. The patios of Córdoba are famous worldwide and widely recognised, representing both an architectural and social expression present in various cultures, including Mediterranean ones, and which are still preserved in Córdoba. Patios are open-air spaces within houses, containing abundant vegetation and sometimes water. As private green spaces, they do not provide the same social benefits as public areas, yet they appear as the most suitable natural solutions for the city. They continue to deliver important ecosystem services, such as soil permeability (Fig. 26).

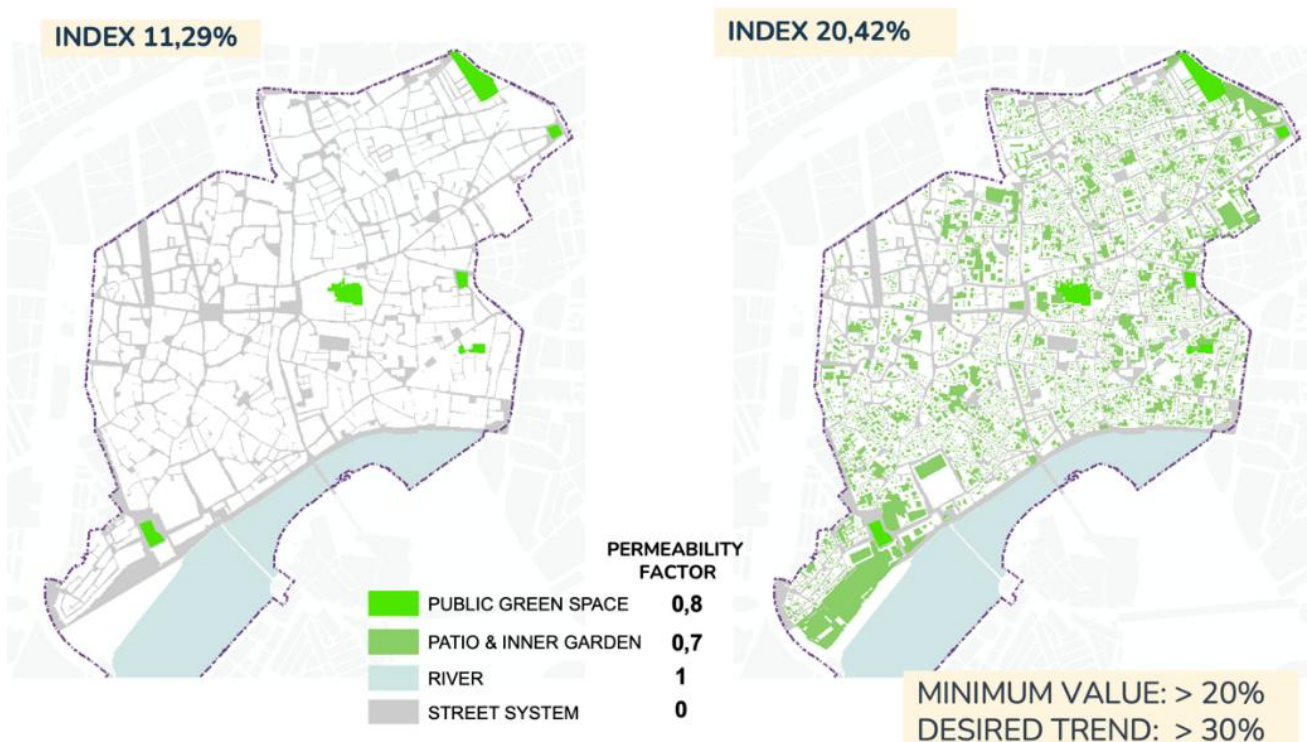


Figure 30: Soil Biotic Index within the Historic Center. ⁶

With this premise, IN-HABIT proposed using the patios of the Axerquía as a case study to monitor environmental variables through an interactive platform that would allow researchers to evaluate patios, even in real time. For this purpose, in collaboration with the University of Córdoba partner “Patios de la Axerquía (PAX)”, 24 courtyard houses were studied and grouped into six categories according to two main variables: soil permeability (high, medium, or low) and type of vegetation

⁶ On the left 11.29% considering only the permeable gardens and squares in public spaces. On the right 20.42% considering 70% of the soil in private patios and gardens as permeable.

(potted or rooted in the ground). At least two patios were selected from each category for comparison (Fig. 30).

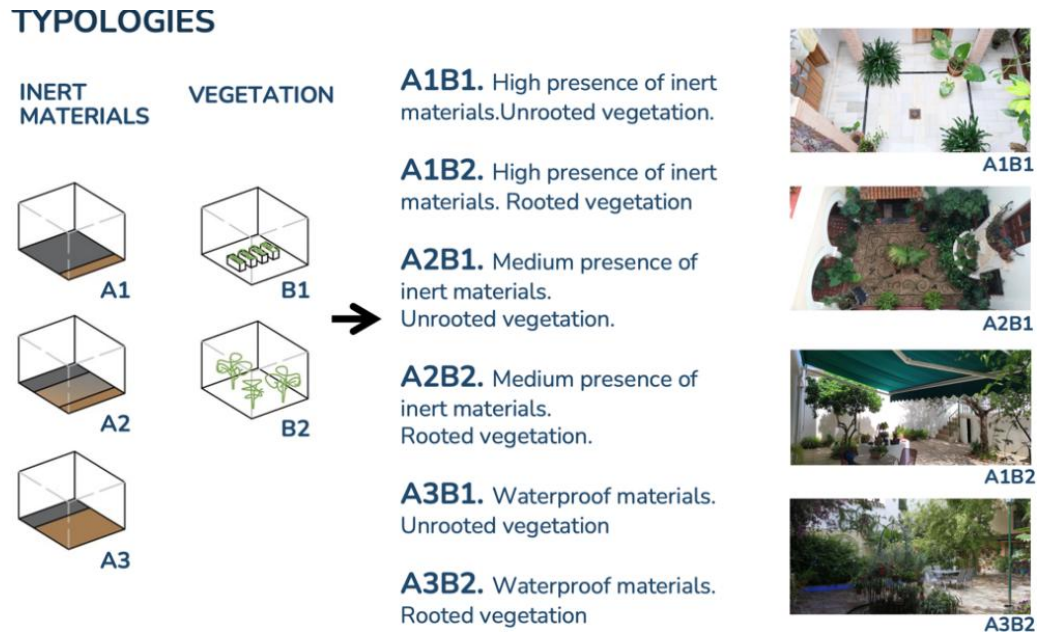


Figure 31: Examples of house typologies.

With this premise, IN-HABIT proposed using the patios of the Axerquía as a case study to monitor environmental variables through an interactive platform that would allow researchers to evaluate patios, even in real time. For this purpose, in collaboration with the University of Córdoba partner “Patios de la Axerquía (PAX)”, 24 courtyard houses were studied and grouped into six categories according to two main variables: soil permeability (high, medium, or low) and type of vegetation (potted or rooted in the ground). At least two patios were selected from each category for comparison.

According to the grant agreement, the platform was expected to be installed during the first year and to collect data during the following years for evaluation. However, due to reasons beyond the control of the project’s researchers, the platform could only be fully installed in the final year of the project, and the sensors did not have enough time to collect the data required for the proposed analyses. For this reason, only preliminary analyses are presented here, these outcomes have been published in detail elsewhere (Delgado-Serrano et al., 2025).

Quantitative Analysis of Patio Temperatures

To examine patios as ecological systems, the research team selected four patios with different characteristics of size, geometry, soil type, and vegetation cover. Sensors were installed at two heights in each patio (400 cm and 150 cm) and recorded temperature data, from sensors in the upper part of the patio and the lower part of the patio between July 2023 and August 2024.

Patio 1: very small (6 m²), paved with impermeable asphalt, little or no vegetation.

Patio 2: very large (142 m²), L-shaped, permeable soil, abundant vegetation.

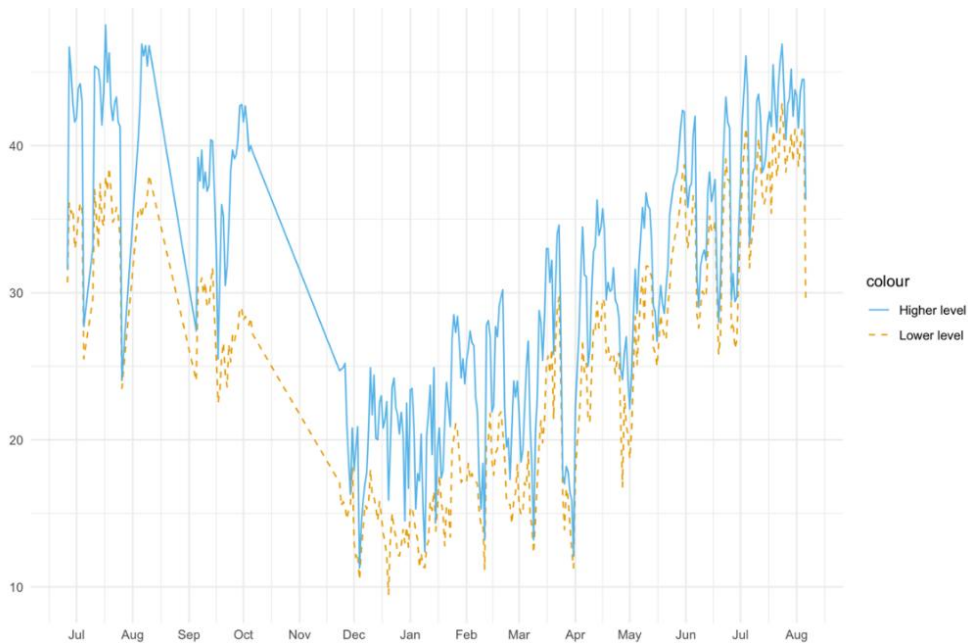
Patio 3: medium (30 m²), square, permeable soil, moderate vegetation.

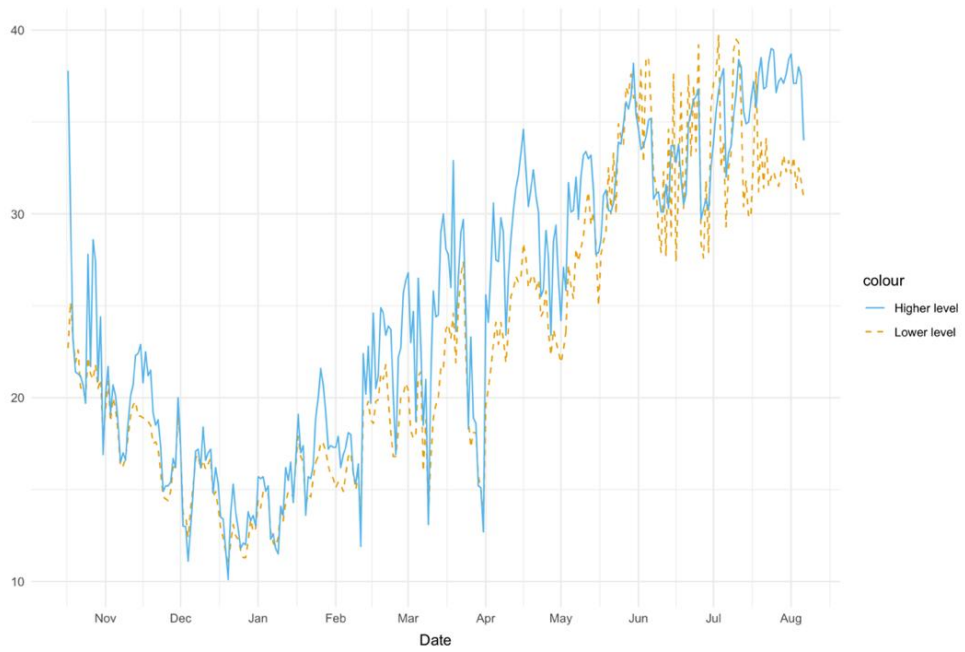
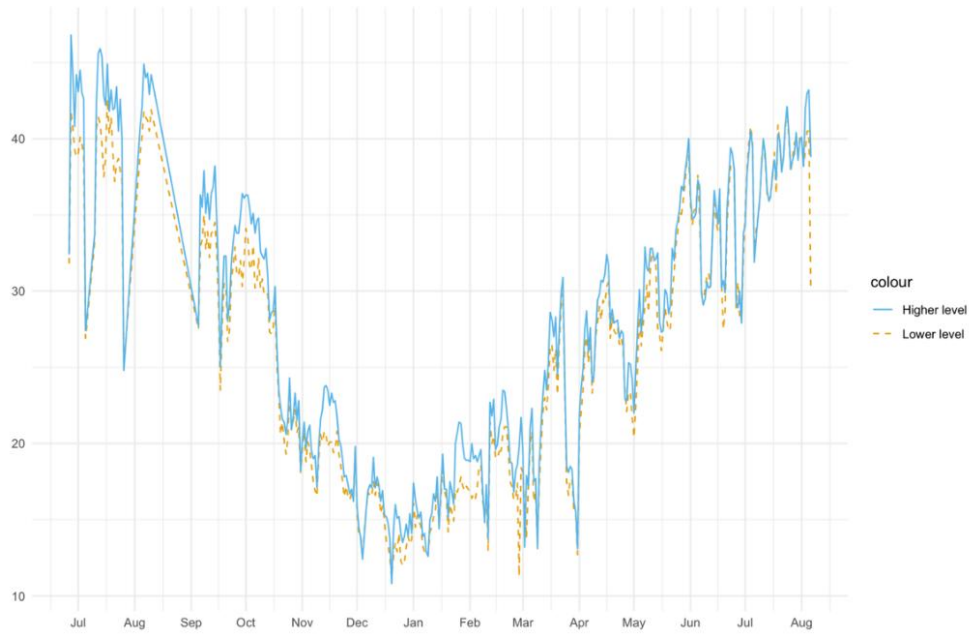
Patio 4: medium (77 m²), square, permeable soil, moderate vegetation.

The results show patterns. In Patio 1, the absence of vegetation and impermeable ground produced high contrasts between the upper and lower sensors, with differences up to 9°C. The lower level remained dark and cool, but also colder in winter due to the lack of thermal stability.

In Patio 2, differences between sensors were smaller (1–4°C), thanks to the large space, permeable soil, and extensive vegetation. This patio showed more stable temperatures throughout the year.

Patios 3 and 4 also showed modest differences (0–2°C), though larger during the summer months, when vegetation and permeable surfaces helped moderate heat at ground level. In these patios, vegetation not only reduced summer temperatures but also prevented sharp drops during winter.





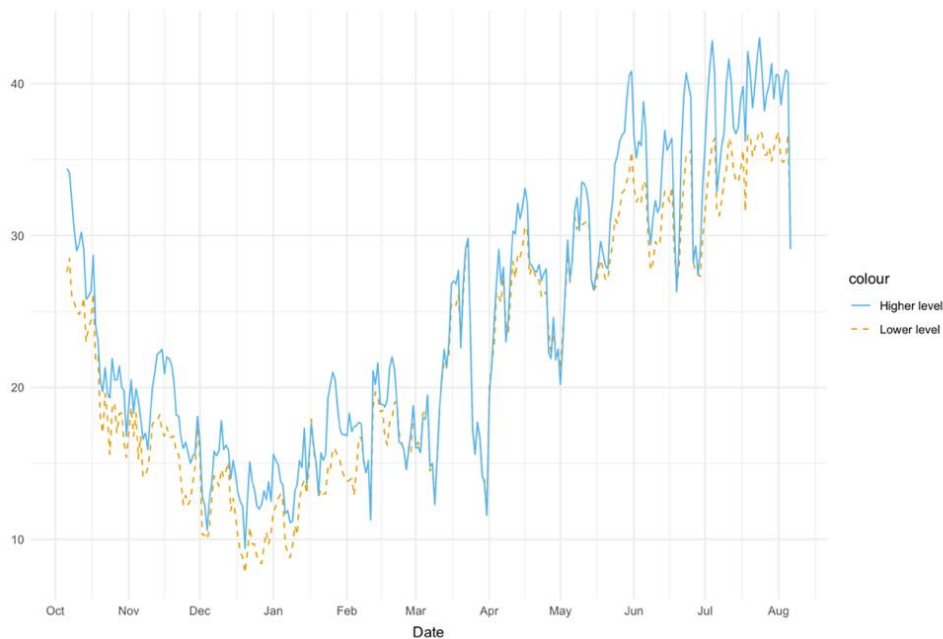


Figure 32: Seasonal variation of temperatures in Celsius degrees in four patios in Córdoba, Spain⁷.

Overall, the analysis confirmed that vegetation, soil permeability, and architectural proportion influence the thermal performance of patios. Green patios stabilise temperatures and reduce heat stress, while paved, vegetation-poor patios intensify extremes.

Qualitative Analysis of Social Perceptions

Nine interviews explored how people in Córdoba understand green spaces and patios. Three interviewees were experts (an architect, a botanist, and a long-time patio owner in the historic centre), three were residents from the city centre, and three came from a vulnerable neighbourhood with limited greenery, where “patios” are often just large concrete areas.

When asked about green spaces, participants generally described parks or gardens, associating them with plants, flowers, and cooler air. They emphasised recreation, socialisation, and contact with nature, while also highlighting scarcity of green spaces in the city.

When asked about patios, experts defined them as open courtyards inside buildings, often decorated with plants and porous surfaces. They underlined patios’ historical role as places for socialisation and their cooling function through vegetation and evapotranspiration.

Residents from the historic centre emphasised patios as spaces for family and social gatherings, valuing their aesthetic beauty but without focusing much on the cooling effect. Residents from the

⁷ The blue line represents the temperature of the top sensor, and the dotted orange line represents the temperature of the bottom sensor. The temperature sensor in the first patio had malfunctioned between October and December; those differences were not considered

vulnerable neighbourhood described patios simply as open areas between buildings, often without greenery, and complained about the lack of vegetation. For them, patios were useful social spaces, particularly after sunset when heat in their flats was unbearable and frequent power cuts limited the use of air conditioning.

These findings indicate a social divide. While centre residents associate patios with cultural heritage and aesthetic pleasure, residents in disadvantaged areas see patios more as basic communal spaces where vegetation is missing but strongly desired. Both groups, however, valued patios as places for gathering and interaction.

Ecological and Cultural Role of Patios

The preliminary results suggest that patios may play both ecological and cultural roles in Córdoba, in line with existing literature on their function as passive cooling systems. Early data indicate that evapotranspiration from plants might reduce surrounding temperatures by as much as 10°C, and estimates suggest that a single well-irrigated tree in Córdoba can generate a cooling effect comparable to eight domestic air conditioners. Additional elements such as permeable pavements, water features, and balanced design ratios appear to strengthen this effect, whereas poor design or the absence of vegetation limit the cooling capacity of patios.

The architectural configuration also seems to matter. Enclosed walls appear to help retain cool air, while appropriate height-to-width ratios support optimal shading. Air circulation, both vertical and horizontal, appears to enhance evapotranspiration, although at very high temperatures this effect may be reduced or even reversed.

From a socio-cultural perspective, the preliminary findings indicate that patios continue to represent symbols of community and identity. Historically, they were spaces for collective tasks such as cooking or washing at shared wells, and today they maintain their social relevance through practices like the Patio Festival, which brings residents and visitors together and reinforces a sense of belonging. However, these meanings are not uniform across the city. For wealthier residents, patios are often associated with heritage and aesthetic value, while in more disadvantaged neighbourhoods patios are more functional but lack adequate design or vegetation. In these areas, patios are often used as “heat escape” spaces during summer evenings, providing relief from indoor discomfort even though they do not offer the same cooling or visual benefits as greener patios.

Discussion

The preliminary evidence suggests that patios might act as nature-based solutions that bring together environmental, social, and cultural benefits. Patios featuring vegetation and permeable soil seem to help lower temperatures and stabilise microclimates. Their potential as passive cooling systems offers an affordable solution that can contribute to the rising issue of high temperatures in the city. Moreover, patios are already embedded in Córdoba’s cultural fabric, possibly making them easier to incorporate, than other large or complicated solutions. Additionally, they appear to deliver ecosystem services, such as biodiversity presence or improved air quality, which could enhance urban resilience.

Patios also appear to play an important social role, acting as spaces for interaction, cohesion, and pride. Their semi-public and semi-private nature provides accessible areas for groups who may not feel equally safe in larger public parks. This is especially relevant for women, children, and older adults, who often require spaces near their homes where they can meet, rest, and spend time together. In Córdoba, this role is reinforced by the cultural importance of patios, highlighted each year through the Patio Festival, which continues to foster a sense of ownership and identity among residents.

At the same time, the initial findings suggest that access to green, well-designed patios is uneven. In the historic centre and wealthier areas, patios often have rich vegetation and are carefully maintained, while in vulnerable neighbourhoods, patios are mostly concrete spaces without greenery. These areas are still used for gatherings, especially during summer evenings, but they lack the cooling and aesthetic benefits of greener patios. Expanding the model of vegetated patios into such neighbourhoods could improve equity by providing residents with access to green, cooler, and more welcoming spaces.

Finally, while a single patio only affects its immediate surroundings, the potential increases when patios are connected. Networks of patios in dense neighbourhoods might function as green corridors, producing cooling effects at a larger scale and creating a continuous fabric of social and ecological benefits. This preliminary evidence suggests that patios could not only mitigate urban heat but also contribute to social cohesion across different areas of the city, indicating their possible role as both local solutions and elements of broader urban strategies.

Although the project will formally conclude in August 2025, UCO researchers will continue pursuing these investigations. The ecological and social importance of patios, together with their potential for replication, makes this line of research highly relevant for the city. Additionally, the availability of longer time series from all monitored patios will enable the team to draw more robust and reliable conclusions.

5. Dissemination strategy

We continued the media monitoring that began at the start of the project. From October 2020 to July 2025, we tracked coverage of Las Palmeras in local and regional outlets. We coded all articles as positive or negative to give an external view of possible changes in the neighbourhood's image. At the same time, we put a lot of time and energy into widely disseminating and communicating the project and its outcomes. Building on the coverage we had in earlier years, we expanded our outreach. We organised a breakfast meeting with policy makers, offered several [interviews](#) to explain the project, being cover page in the leading city newspapers (i.e.,), appeared on [television](#) and radio programmes, and produced the documentary [Palmeras en Positivo](#) (see description below). The aim of this film was to give people across Córdoba and Spain a different and more positive view of the neighbourhood. We also used these activities to open conversations about replication. We presented the work in Las Palmeras to people from other sectors and contexts. We demonstrated how approaches based on community involvement and nature-based solutions can be adapted for other neighbourhoods or cities with similar social and environmental challenges.

5.1. Breakfast with Policy Makers

As part of the IN-HABIT project, each city has organised a meeting with policymakers to discuss results and methods. Lucca was the first to hold its event. In the case of Córdoba, the main objective was to test the interest and replicability of the methodology used to transform vulnerable urban realities. A recording of the presentation (in Spanish) can be accessed [here](#). The panel of speakers comprised the senator responsible for the Spanish Urban Agenda, the Andalusian General Director for Vulnerable Neighbourhoods, a representative of an NGO working with homeless individuals, and the Project Coordinator. The speakers were invited to share their views on the IN-HABIT methods and results. Over 30 other representatives from local authorities (especially from the cities interested in replicating IN-HABIT), public administrations, NGOs, associations, social workers and others attended the meeting and participated in the discussions. The hostesses of the event were people with Down syndrome trained by the project, as described above. Following the breakfast meeting, the guests visited the urban garden and therapeutic green space at the shelter for homeless individuals mentioned in the previous session to observe first-hand the regenerated spaces and the green therapies for the residents of the shelter.



Figure 33: From top left: attendees (stakeholders from public and private entities); top right: guest speakers with the IN-HABIT project director; bottom: group photo with invited guests and speakers.

5.2. Documentary “Palmeras en Positivo”

One of the main objectives of the IN-HABIT project in the city of Córdoba has been to fight stigma by changing the negative perception of the Las Palmeras neighbourhood within the city, without denying its complex and problematic situation. To address this, IN-HABIT has implemented various communication strategies, focusing on the publication of positive news, personal stories of the residents, and encouraging people from other neighbourhoods to visit Las Palmeras.

After a soap TV programme that portrayed a very negative and inaccurate image of the neighbourhood, the IN-HABIT strategy culminated in the shooting of a documentary produced by the project journalist, with the support of the local community activator. The documentary aims to challenge the stigma and negative reputation often associated with it. It presents the views of many residents, highlighting that not everything is negative and that many positive things and reliable people exist there.

The documentary, titled “Palmeras en Positivo” (A Positive View of Las Palmeras), premiered at the “Filmoteca de Andalucía” and featured a panel discussion with professional journalists, expert researchers on communication and vulnerability from the Complutense University of Madrid and the University of Huelva, and practitioners from other vulnerable neighbourhoods. Over 70 people from across Córdoba attended the screening, which is notable, especially considering we were in the midst of a heatwave with temperatures exceeding 40°C at 19:00.

Among those present was the Deputy President of the Córdoba Press Association, and we advanced the possibility of drawing an agreement to promote ethical journalism and equip these neighbourhoods with tools to share and communicate their stories. The documentary was uploaded to the IN-HABIT YouTube channel, where it is openly accessible and, in a couple of months, has reached almost 600 views. It is also set to be used in social work classes at the Complutense University as an example of tools and strategies that can help shift public perception and promote a more balanced and respectful understanding of marginalised urban areas.



Figure 34 Palmeras en Positivo - Poster



Figure 35 Palmeras en Positivo: colloquium with invited experts before the streaming of the documentary

5.3. Results of news monitoring

Upon completion of the media monitoring, several key observations emerge. As illustrated in **Figure 36**, a noticeable shift in the ratio of positive to negative news coverage begins in 2023, following three years of project implementation and coinciding with the delivery of the first urban interventions (VIS) in the neighbourhood. This trend has remained relatively stable until the end of the project.

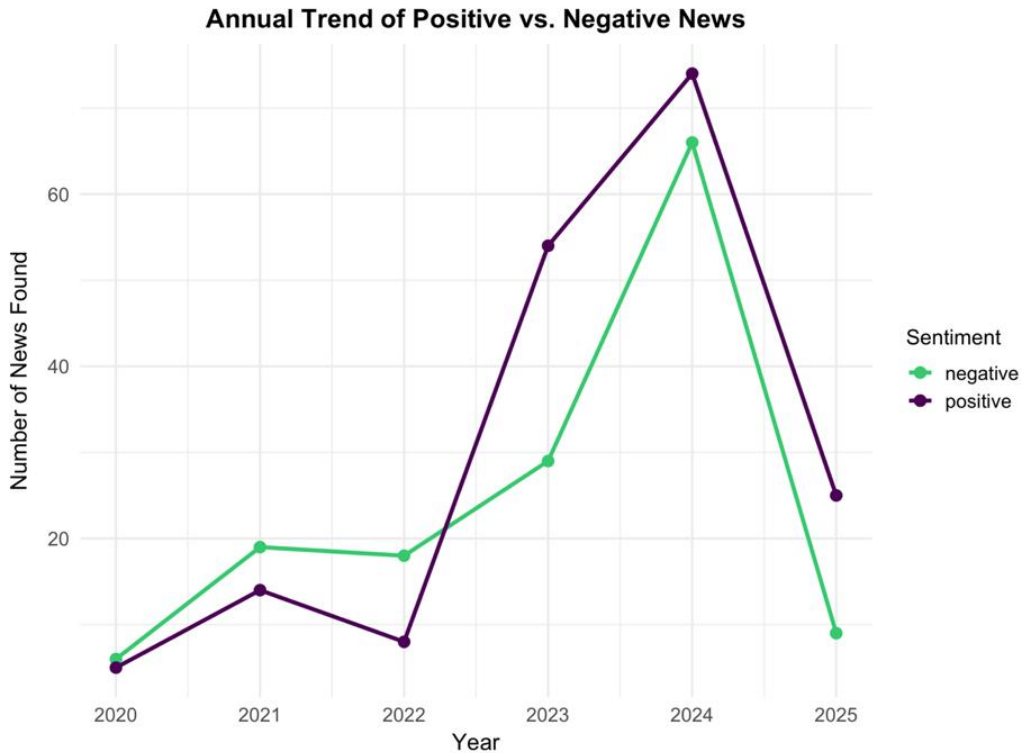


Figure 36: News trend over the years of the project (From Oct. 2020 to July 2025)

It is important to note, however, that negative news has not disappeared. Rather, it has been outweighed by the growing number of positive articles. This reflects both the complex reality of the neighbourhood and the scope of the project itself. While many physical aspects of the area have improved and the lives of several residents have been positively affected, the neighbourhood continues to face serious challenges. These include persistent economic hardship, incidents of violence, illegal activities and policy raids, limited state support, and high unemployment rates. Such conditions continue to influence both the area and its residents, as highlighted by members of the core group during interviews.

These issues lie beyond the reach of this project and are acknowledged here to underline the limits of localised action. The findings suggest that a well-resourced social project, supported by committed local actors, can generate meaningful benefits. However, broader structural change depends on sustained public investment and the provision of essential services by the state. Despite these limitations, the visible improvements in the neighbourhood and their dissemination through media have supported the replication of the project model elsewhere, including its adaptation in Puente Genil at the request of the local council, and exploratory exchanges in Medellín, Colombia.

6. Final remarks

From the start, we have approached nature as an active part of the urban fabric, not just an aesthetic addition. In Las Palmeras, planting trees and shrubs was only part of the story. The real change began when neighbours became involved in planning, planting, and caring for these spaces. Even though the trees are still young and far from reaching their full ecological potential, residents might be already gaining from the presence of more green space. They walk past areas that were once gray and now have colour and shade. Children recognise the plants they helped put in the ground. Possibly, this connection to place is already a form of benefit, one that can help strengthen community ties and encourage care for public space. In the future, as the trees mature, they will provide more shade, help reduce the heat island effect, and improve air quality, adding environmental benefits to the social and emotional gains that are already visible.

The shelter for homeless people offered a different kind of challenge. Here, the interventions were smaller in scale and more directly linked to daily life. The vegetable garden, therapeutic garden, and even improvements like the new lighting system were designed to create an environment where residents could feel safe, valued, and part of a shared space. The results show that even short-term activities in contact with nature can have a positive effect on emotional well-being, perceived health, and the way people see their surroundings. For residents facing instability, these changes matter because they help rebuild a sense of control and belonging. While the gardens themselves may not solve deeper social and economic issues, they can be an important part of a supportive environment that helps people engage with other forms of assistance and recovery.

In the Axerquía district, the focus was on the patios, a centuries-old architectural and social feature of Córdoba. These spaces are not public in the same way as a park, but they are vital to the health of the city. They offer shade, reduce temperatures, support biodiversity, and act as places of social interaction. The preliminary monitoring work has shown how their design, permeable soil, rooted vegetation, water features, have the potential to create a cooler and more comfortable microclimate, even during the hottest months. Residents adapt their habits to make the most of these spaces, using them not only for practical purposes but also for social gatherings, relaxation, and cultural activities. The patios work as “green cells” within the dense urban fabric, and when seen together, they form a network that helps the city cope with climate challenges. Protecting and improving these spaces is not just about preserving heritage, it is about maintaining an essential part of the city’s environmental and social infrastructure.

Looking across these three cases, a few themes stand out. First, we believed that nature-based solutions might be more effective when they are connected to people’s daily lives. A tree can cool the street, but it has greater value when someone feels it belongs to them because they planted it or look after it. A courtyard can lower temperatures, but it also matters that neighbours see it as a shared space worth caring for. In this sense, the social process is as important as the physical outcome. In Las Palmeras, the low levels of vandalism against the new plantings are not just a coincidence, they are the result of involving residents from the start. In the shelter, the gardens are used and appreciated because residents had a hand in shaping them. In the patios, the benefits for well-being are tied to the traditions of care and seasonal adaptation that have been passed down for generations. Second, the benefits of NBS often grow over time, but early involvement helps secure those future gains. In Las Palmeras, the trees will take years to reach their full size, but the community connection formed now

will help increase their survival rates and reach maturity. In the patios, the environmental role they play is the result of decades of maintenance and adaptation. In the shelter, the assessed impact of gardening on well-being is immediate, but it also lays the groundwork for longer-term habits of engagement with the natural environment. This is why it is important to think about NBS not as one-off interventions but as ongoing processes that combine ecological growth with social participation. Third, the scale of intervention can vary greatly, but the principles remain the same. Whether it is a single courtyard, a neighbourhood square, or a small plot at a shelter, the combination of green space, user involvement, and attention to local conditions can generate benefits. The patios demonstrate the importance of fine-grained, small-scale green spaces in dense urban areas. Las Palmeras shows that even in neighbourhoods with limited resources, adding and caring for greenery can start to shift perceptions and habits. The shelter case shows that NBS can work in highly constrained environments where space is limited and residents may be dealing with acute challenges.

Finally, these cases highlight the need for supportive policy and long-term investment. Many of the barriers to improving well-being through NBS are not environmental but structural. In Las Palmeras, economic hardship limits some residents' ability to engage in activities linked to healthy lifestyles, even if green space is available. In the shelter, housing insecurity and the need for broader social services mean that gardens are just one piece of the puzzle. In the patios, pressures from tourism and urban change threaten the conditions that make them work as green infrastructure. For NBS to deliver lasting benefits, they need to be part of a wider framework that addresses these social and economic factors.

Looking ahead, the lessons from this project suggest that cities should think about green infrastructure not only at the level of large parks or tree-lined avenues but also through the network of smaller, distributed green spaces that people encounter every day. These might include neighbourhood gardens, shared courtyards, green roofs, or even small planters along streets. When connected, they can form an ecological and social network that makes the city more liveable, resilient, and inclusive. In Córdoba, the combination of Las Palmeras, the shelter, and the patios shows three ways this can work in practice. In Las Palmeras, the aim was to change the image of the neighbourhood, improve environmental conditions, and build community pride. In the shelter, the focus was on immediate well-being and creating spaces of calm and connection. In the patios, the goal was to understand and preserve a historic system that already delivers environmental and social benefits. Each case is different, but all three point to the same conclusion: nature in the city matters, and people's involvement in shaping and caring for it matters just as much. The benefits of these interventions will continue to unfold. The trees in Las Palmeras will grow, casting more shade and cooling the air. The gardens in the shelter may inspire new projects or become models for other facilities. The patios will go on adapting to climate pressures, supported by the knowledge and care of their residents. If there is one message to carry forward, it is that the full value of NBS lies in their ability to connect environmental improvement with human engagement, creating spaces that people feel are theirs and that they want to protect. This is the foundation for sustainable change in any city.

7. References

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8. Appendix

8.1. Methodology of Las Palmeras assessment

To evaluate the potential impacts of the project in the Las Palmeras neighbourhood, we revised the initial methodological proposal entirely. We realised that the original approach would not enable us to measure the types of impacts that could occur, since the project lacked the capacity to influence all the social dimensions covered by the first baseline survey. However, because that survey had already been conducted, we decided to retain it as a “before” reference tool for comparison, as it was the only available instrument.

The first adjustment involved the number of questions. The original survey was too lengthy and included information not relevant to the Córdoba context. The second issue identified was that comparing Las Palmeras with other neighbourhoods in Córdoba was inappropriate because most of these neighbourhoods did not share the same socio-demographic profile. Consequently, they had very different factors affecting health and wellbeing. This was clear in the baseline socio-demographic data, which showed that Las Palmeras consistently scored lower than residents of other neighbourhoods. Another problem was that the initial survey covered many neighbourhoods but lacked stratified sampling, resulting in very small sample sizes for each area, ranging from $n = 3$ to $n = 15$ per neighbourhood. As a result, meaningful comparisons by neighbourhood or income could not be made. The first methodological change, therefore, was to select one or two Córdoba neighbourhoods with profiles similar to Las Palmeras to act as suitable controls. Luckily, we identified Moreras/Margaritas and Polígono de Guadalquivir/Polígono Sur. These areas are also among the poorest in Europe, share cultural and demographic characteristics with Las Palmeras, and many families have relatives living in both.

We also observed that the baseline instrument lacked sufficient variables to measure green spaces and their interaction. The first step was to count how many respondents from Moreras/Margaritas and Polígono de Guadalquivir/Polígono Sur participated in the baseline survey. A total of 35 respondents were included, which was a small number but still adequate for basic statistical analysis. To improve this and incorporate variables related to green spaces, we conducted a second 'before' survey prior to the re-naturalisation and main VIS interventions. This survey collected socio-demographic data and included several questions on green spaces and neighbourhood perception. To ensure a representative sample, we targeted $n = 100$ in Las Palmeras and $n = 100$ in the socio-demographically similar neighbourhoods.

For the final survey, we needed an instrument similar to the baseline to enable comparisons, but it also had to include variables from the re-naturalisation survey. It was crucial that the “after” survey allowed our partners at UNITO to make impact comparisons across all cities, while also permitting us to follow our adjusted methodology. Therefore, we developed a shorter survey compared to the first one, incorporating additional variables from the re-naturalisation survey. We then collected responses from $n = 100$ people in Las Palmeras, $n = 100$ in socio-demographically similar neighbourhoods, and $n = 100$ in other parts of Córdoba. Among the 100 people in Las Palmeras, we included three questions on behaviours following the re-naturalisation. For the women who had worked with us on the project, we administered the survey during one of the workshops, recording their data with an

additional marker indicating their participation in the core group, all while respecting data protection and anonymity rules. This was important because we believed that the CO-CO-CO-CO methodology might generate wellbeing and health benefits through participation itself, beyond the physical results. We anticipated that the women who had actively worked with us would demonstrate greater impact than the rest of the population.

Based on this, we designed a three-tier approach. The women of Las Palmeras who collaborated with us formed the target group, as they had been active participants in the project. The other residents of Las Palmeras served as “control 1”, meaning they might benefit from the physical changes but without additional process-related effects, as they were passive actors. Lastly, residents of the socio-demographically similar neighbourhoods were “control 2”, the group in which we did not expect to observe changes. To maintain consistency with the original design, we also included respondents from other neighbourhoods in Córdoba in the dataset and presented them in the results, but only as a reference. The direct comparisons in this deliverable were between Las Palmeras and the socio-demographically similar neighbourhoods, both in the “before” and “after” surveys. For variables related to re-naturalisation, we had no data from other Córdoba neighbourhoods, so these were not included, even as a reference.

All analyses followed the same procedure. We conducted exploratory tests and correlation analyses for all variables. Only those showing significance were taken forward for more advanced analyses, such as GLM. Before running GLMs, we tested correlations among the socio-demographic variables to prevent inflated covariance, then selected the best model using ML and AIC criteria. Once we had the models with socio-demographic controls, we calculated R^2 , 95% CI, β , and p-values with correction for multiple testing.

To compare changes within the group of women, we used specific methods because this group included only 12 participants, all female, which meant a very small sample size. To address this, we extracted data for all women from all survey rounds and compared changes solely within women. The models were adjusted for age, the most relevant socio-demographic factor for such a small group. We then applied a Bootstrap with 10,000 replications and analysed the 95% confidence intervals, as this is regarded as the best technique for small samples. To see if the statistical findings matched lived experiences, we conducted two focus groups, one of which was reported in Deliverable 1.3 and the other in this report. We observed a strong link between the data and the women’s accounts. We recognise that the analysis has many limitations, especially because it was restricted by the design of the initial baseline survey. For this reason, the final discussion of impact is not framed as certainty or definitive evidence of change, but instead presented in a more cautious and moderate manner.

8.2. Methodology of shelter for homeless people assessment

The evaluation of the homeless shelter was also revised. At the start of the project, the plan was to assess the participants of the Green Team and then repeat the assessment after one year to observe long-term changes in health and wellbeing linked to their involvement in the team. However, this design had a clear limitation, as it is not possible to measure a highly mobile population longitudinally,

especially over a year. The residents of the shelter change constantly, meaning that the participants assessed at baseline would not be the same individuals available at follow-up. This issue became clear after the first year when the results showed no meaningful findings. Since it was already evident that the lack of results was not due to the work of the Green Team, which was benefiting the shelter, but due to the chosen methodology, a new design was developed to suit the specific characteristics of this population.

Three validated and straightforward indicators of health and wellbeing were chosen: WHO-5, K6, and Self-Rated Health (SRH). Additionally, a perception scale was developed to identify which features of the green spaces under development were deemed most important by the participants. This scale was adapted from existing validated green space instruments but modified to suit the setting and the population in question.

The experimental design involved randomly selecting one of the four instruments for each session and administering it to participants in the Green Team on the day of the activity, first before the activity and again afterwards. The only exception was the perception scale of green spaces, which was only applied after the activity, as it was not intended to measure change but to identify which elements of the green spaces participants valued most. The aim was to keep the questionnaires brief, since participants often found it hard to concentrate for long periods, which could increase the risk of inaccurate responses. The pre- and post-structure allowed us to measure the immediate impact of the activity on participants' health and wellbeing, while also addressing the constant turnover of residents in the shelter. Each time an activity was conducted, one of the scales was chosen at random, gradually increasing the total number of participants assessed across all instruments. Lastly, the short questionnaire also collected three socio-demographic variables: age, gender, and the main reason for being in the shelter. To enable comparison, the same questionnaire was also administered to other residents who were not participating in the activity.

Once the data had been collected, the analyses were conducted in the same way as those for Las Palmeras. Exploratory analyses and correlation tests were performed first. For each variable, models were run to assess health and wellbeing outcomes according to whether or not the participant had taken part in the Green Team, while adjusting for the three socio-demographic variables. For all models, R^2 , corrected p-values for multiple testing, and 95% confidence intervals were calculated. As in the case of Las Palmeras, we recognise that this evaluation has important methodological limitations. For this reason, the discussion of results has been cautious, taking into account both the characteristics of the population and the limitations of the evaluation design.