

# Smart Urban Resilience: From Nature-Based Solutions (NBS) to Nature-Positive Cities and Landscapes

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## 1 ABSTRACT

In the current context of intensified climate change, global society is facing severe challenges. Among the various dynamics having a strong environmental and socio-economic impact on our lives, the increase in urbanisation demands particular regard. According to statistics published last year by the World Economic Forum, it is predicted that by 2050, nearly 70% of the world's population will live in cities (WEF, 2023), thus aggravating urbanisation's highly disruptive effects on the environment. Hence, creating smart and resilient cities emerges as an urgent and indispensable priority if both human and environmental well-being are to be safeguarded. Nature-based solutions play a crucial role in improving urban mobility, climate resilience and resource efficiency, provided they leverage cross-cutting cooperation and engage local communities. Consistent efforts towards nature-positive cities have been made by the international landscape consultancy LAND for over 30 years, in particular through actions aimed at depaving urban soils ("Let's Break it Up!") in Northern Italian metropolitan areas, through large scale territorial and sociocultural transformation in the wider Essen area in Germany, through the development and application of digital Natural Capital Accounting tools within the European project UrbAlytics and through innovative landscape planning in Saudi Arabia.

Keywords: landscape, nature, urban, city, resilience

## 2 NATURE-BASED SOLUTIONS AT THE TIME OF CLIMATE CRISIS

Nature-based solutions (NBS) are technical approaches capable of providing multiple benefits by supporting, restoring, and enhancing urban nature. The terms generally refer to "actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, providing human well-being and biodiversity benefits." (Cohen et al. 2016). From species diversity conservation to air quality improvement, or mental health enhancement, the effectiveness of nature-based solutions depends on the local context in which they are implemented: their design requires an approach based on knowledge of the landscape components of the involved area, considering environmental and climatic conditions as well as social and cultural factors. Furthermore, the European Commission defines nature-based solutions as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions" (EU, 2022). As such, NBS are an essential step towards Nature-Positive Cities (NPC), i.e. cities which developed an action plan according to the AR<sup>3</sup>T framework<sup>1</sup>, while committing to well-defined science-based targets (WEF, 2024). The NPC mission aims at building more resilient, prosperous, and equitable cities by 2030 through three core pillars: inspire nature-positive urban development by empowering urban leaders and enablers through new policy models, regulations and incentives; foster dynamic public-private collaboration; and drive a scalable impact by deploying nature-based solutions in pilot cities through the integration of nature in the built environment. Landscape projects thus play a central role in creating places that are resilient to climate

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<sup>1</sup> The AR<sup>3</sup>T framework sets goals as follows:

AVOID: Protect areas and land use; prevent water pollution, facilitate the transition to green energy sources;

REDUCE: mitigate city development impact, reduce water consumption and utilize renewable water, reduce waste and improve energy efficiency;

RESTORE&REGENERATE: rehabilitate land wetlands and shorelines, reverse desertification, ensure water quality standards, promote sustainable forestry and agricultural practices;

TRANSFORM: integrate nature into urban planning and policies ensure sustainable water management policies, adopt circular economy.

change, attractive, accessible, and safe, provided they directly involve public administrations, professionals, stakeholders and citizens.

## 2.1 Landscape projects to shape the city of the future

The international landscape consultancy LAND, founded in 1990, has committed to focus its research on NBS, offering solutions to make cities more liveable and resilient. Among them, the adoption of blue-green infrastructures has proved to be an effective strategy to address complex environmental challenges in urban contexts, systematically combining green areas and vegetation with water elements and drainage solutions (EC, 2013, 249). In this regard, depaving is a fundamental undertaking, intended as the targeted process of removing impermeable surfaces in urban areas to restore natural soil and enable the healthy growth of plants (EC, 2021). The de-impermeabilization of soil facilitates the return to its capacity to absorb and retain water, a crucial aspect, especially considering the increasing frequency of extreme weather events such as intense precipitation concentrated in short periods. Moreover, this innovative practice reduces the presence of surfaces that absorb and radiate heat. Allowing the introduction of vegetation, it makes open spaces more comfortable thermally, thanks to the shading and evapotranspiration properties of plants.

Launching a key initiative under the targeted message "Let's Break It Up!" has effectively helped to reintegrate nature into the metropolitan areas of Milan, Turin, Vercelli and Essen by depaving streets, introducing permeable surfaces, and strategically planting trees to improve microclimates and overall urban liveability. The project gives rise to a new season of radical interventions in cities, where nature gains ample space to thrive and provide the environmental, social, and economic benefits needed to ensure more liveable cities for the new generations. Breaking the asphalt to let water flow openly again and allowing plants to take root in fertile and vital soil also aims to reconnect people with nature. As part of the Nature-Positive Cities initiative, the project further aims to support public and private sectors coalesce around common principles to recalibrate cities relationship with nature by promoting coordinated tangible actions and fostering a profound shift in urban development based on harmony between cities and environment.

## 3 FROM NATURE-POSITIVE CITIES TO NATURE-POSITIVE LANDSCAPES

For cities of the future to prosper and thrive, urban programmes should thus foster nature as a pillar of regeneration plans, considering the connections between urban fabric and the countryside, in a shift towards nature-positive landscape. The environmental crisis underway has led us to understand that the landscape in which we live is a complex and highly interconnected system. Landscape doesn't begin at the edge of cities, but in the city, in every home. It's a matter of being "in between" spaces and spatial dimensions (Kipar, 2023). Therefore, it is necessary to seek comprehensive and radical solutions to consider the interactions of natural systems that are completely interdependent with social systems. It is fundamental that cities undertake a comprehensive assessment of their local context, considering the specific environmental challenges, biodiversity hotspots, and community needs in the development of every plan and strategy. Recognizing the uniqueness of each city's ecological, social, and economic landscape is paramount in the development of a successful action plan, that should take into account the connections and interdependencies between city and country, city and landscape.

Urban nature, when strategically planned, can originate an osmotic system, which is permeable and implementable through multiple and collaborative processes with citizens, municipalities, and institutions. This approach to landscape design actively promotes the implementation of concrete, radical, and ecological behavioural processes through the construction and development of green spaces. Nevertheless, those processes are demanding urgent change, spanning from environmental to social and economic dimensions. Aiming to move from a vision of nature-positive cities (where the artificial and total built dimensions are the main focus) to a more radical one placing landscape and its positive impacts on the natural and human dimensions at the centre of the professional and scientific discussion, this new analysis and action frame is crucial for landscape designers and planners.

### 3.1 Approaching Nature-Positive Landscapes: the case study of Essen

With the Internationale Bauausstellung Emscher Park (IBA, 2000) in Essen, which lasted from 1989 to 1999, landscape architecture started playing an essential role in mediating between economic, social, and political interests in the Ruhr, summoning local communities. A deep structural change was initiated, transforming

one of the largest metropolitan areas in Europe into a greener, more liveable and increasingly nature-positive region. Spanning on an area 800 km<sup>2</sup> wide, involving 17 cities and 2.500.000 residents within 150 projects, the park worked as catalyst connecting fragmented landscape areas. The regeneration from grey to green infrastructures gave a new identity to the entire industrial region, creating a fluid landscape where settlement development was finally based on an ecological footprint, thanks to an unprecedented cell-like spatial structure. To recover and expand the natural capital of the Ruhr, the master plan “Freiraum schafft Stadtraum” (Open Space Creates Urban Space, 2005) created a network of green infrastructure between former industrial areas in the north of Essen and the city centre, amplifying the vision of previous master plans “Emscher Zukunft” and “Emscher Landschaftsparrk”. It followed a three-step collaborative and participative approach: opening new perspectives (Belichten) to define open areas, connecting these new areas with their surroundings through installations and events (Inszenieren), and eventually rooting the areas in the city through targeted projects (Projektieren). In addition, the master plan was integrated by the public-private project “Essen. Neue Wege zum Wasser” (2006), drawing inspiration from Milan’s Green Rays Model. To define the core areas of action towards a structural nature-positive revolution, thematic rays were identified along the existing waterways of the city. The roughly 230 hectares hosting the Kruppsche cast steel plant, which had been inaccessible to the public for over 200 years, were reunited with the city forming a unique green belt. By filling this urban void between the Altendorf district and the centre of Essen, Krupp Park opened in 2009 and combined the ecological needs of the area, such as drainage from the ThyssenKrupp Headquarters, with the features of a green public space dedicated to citizens’ well-being and relaxation. The project engaged schools, universities, associations and businesses to participate, while the overall green network positively affected mobility, local economy and quality of life. Moving 400,000 m<sup>3</sup> of land, the “Five Hills” park was shaped, embracing a 9,000 m<sup>2</sup> lake and a regional bike path, on the route of the disused “Rhine Railway.” Through this osmotic network of green and blue infrastructure, which helped to account for the natural capital of the region, Essen became “culture capital of Europe” in 2010 and “green capital of Europe” in 2017. Through the “green decade”, it has set its sights on the international Gartenbauausstellung IGA 2027 and beyond, with future goals already in place. These achievements have established Essen as an international role model, highlighting the city’s responsibility in promoting change.

#### 4 DIGITAL LANDSCAPE: TOOLS AND METHODS FOR MEASURING NATURE

Data modelling and reporting on the quantitative and qualitative values of nature in the city are essential steps for the design and supply of NBS in complex and heterogeneous environments; moreover, they are actions needed to turn cities and landscapes nature-positive.

The core mission of “Reconnecting people with nature” has found a promising application in the digital dimension through new forms of landscape perception, fruition and promotion: digital technology allows expanding, connecting and monitoring landscape, quantifying natural capital in terms of extension, state of health and benefits provided by ecosystems. The great potential of Digital Landscape (Balestrini, 2020) lies in re-establishing the human scale in our cities through an intelligent and interactive way following the needs of communities and the vocations of their territories, stimulating an act of conscious care of their natural and cultural capital. Natural Capital Accounting (UN, 2020) makes it possible to quantify every project’s performance based on environmental parameters related to greenery and water management, climate change mitigation and air quality provided by LIM® database<sup>2</sup>, with the objective of enhancing liveability conditions in cities.<sup>3</sup>

<sup>2</sup> LIM® (landscape information modelling) helps quantify landscape ecosystem services: it’s a data-based process that assesses positive environmental impacts produced by vegetation, providing specific predictions for all tree species (carbon sequestration, reduction of ozone concentration, oxygen production).

<sup>3</sup> “Natural capital is another term for the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.” The concept of natural capital extends beyond nature as a source of raw materials for production to include the role of the environment and ecosystems in supporting human well-being through the supply of such important goods and services as clean water, fertile soils and valuable genetic resources. Since the early 1970s, interest in the practical applications of a natural capital perspective has grown considerably within government, business, civil society and academic communities.” (UN, 2017).

#### 4.1 Fighting the urban heat island effect: the UrbAlytics project

In the era of climate emergency, landscape design must also be ethically justified. Integrating research units into private companies helps to inform concrete projects and planning with innovative and future-oriented technical solutions, as is the case with LAND's Research Lab®.<sup>4</sup> In compliance with UN Agenda SDGs and the New European Bauhaus principles (inclusivity, aesthetics, sustainability), the Research Lab® has developed a Sustainability Compass showing how given projects integrate these guidelines. This tool has found its best practice in the UrbAlytics project, an experimental sub-project of the H2020-funded project AI4Copernicus that combines artificial intelligence with Earth satellite observation producing information layers that can support city planners and decision-makers in the context of climate resilience and related challenges in urban areas. This research investigates, thanks to the joint expertise of the partners Latitudo 40 and LAND Research Lab®, the Urban Heat Island (UHI) effect evaluating its impacts on cities, assessing Ecosystem Services provided by Blue and Green Infrastructures and proposing a set of nature-based solutions (NBS) for climate adaptation and extreme heat mitigation. The methodology built up during the project proved to be fundamental in demonstrating how technology can be useful to measure impacts and benefits of nature in the city.

The preparatory research to identify new ways of mapping digital landscapes for nature-positive cities, i.e. research for the management and planning of green solutions according to new technologies also increases competitiveness in the international arena. A continuous development and implementation of the Research Lab® activities enable the enrichment of design challenges with new themes and lines of development, resulting in a demand for refined consultancy services with respect to European sustainability principles and protocols. The models and technological tools we develop reflect the mission to build knowledge based on nature-positive landscapes across the scales. Moreover, the research unit promotes and manages complex landscape transformation processes through solutions that respond to the most pressing challenges of our society. The commitment of the Research Lab® in the international sphere has made it possible to implement the spin-offs of consultancy services and research actions for applying to European Horizon calls with qualified international consortia.

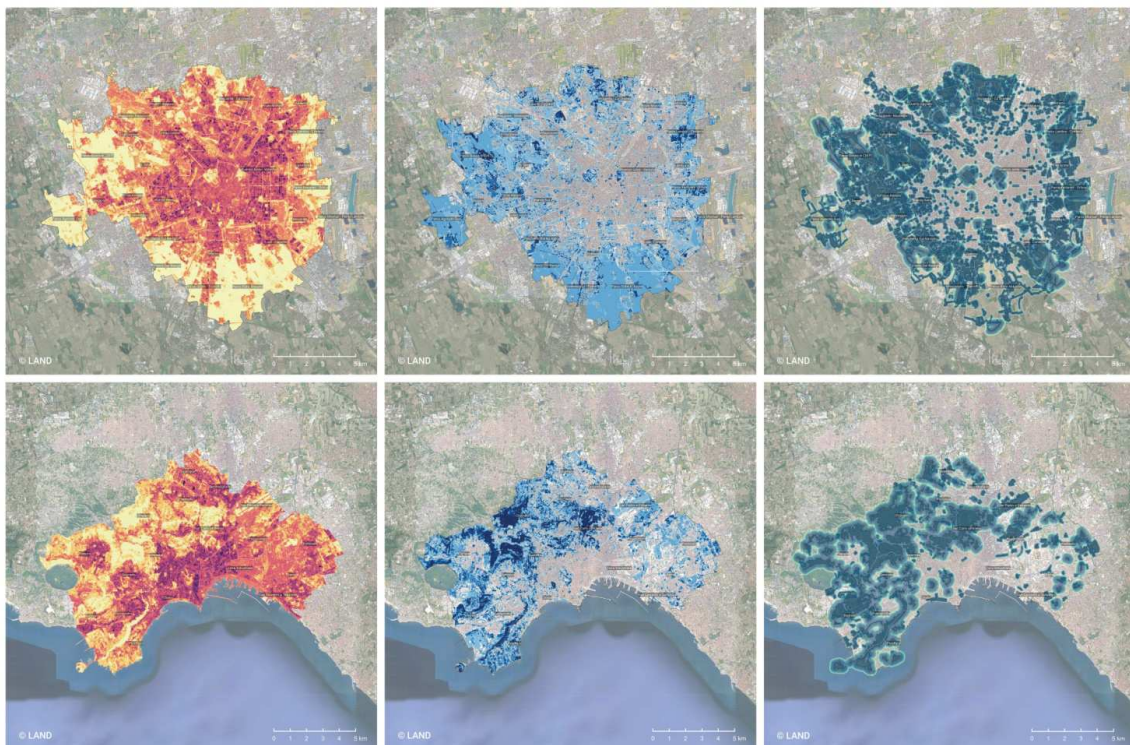


Fig. 1: Heatwave Potential Risk (HPR) Index, Microclimatic Performance Index (MPI) of urban vegetation and Park Cool Islands (PCI) Assessment in Milan and Naples, Italy. Data produced by LAND and Latitudo40 in the UrbAlytics project, 4th Open Call of AI4Copernicus (Horizon 2020). Sentinel 2 database, UHI risk analysis considering Land Surface Temperature data during summer months from 2018 to 2022.

<sup>4</sup> LAND Research Lab® is committed to foster research by delving into five fields of landscape applications: streetscape, water-sensitive design, urban forestation, slow mobility, digital landscape and public space.

## 5 A STRONGER COMMITMENT FOR PUBLIC WELL-BEING

An increasing “call for Nature” is spreading across the continent: according to the latest statistics of the European Commission survey (EU, 2023), climate change remains among the top three concerns of Europeans and an overwhelming majority support action across the Union to tackle the climate crisis and make Europe the first climate-neutral continent. Unprecedented intervention could also improve public health, as furtherly underscored by the European Biodiversity Strategy for 2030 (EU, 2020) aiming at the recovery of species for the benefit of people, climate and the whole planet. The essence of human well-being is thus intricately tied to the natural world and serves as the cornerstone for every economic endeavour. Collaborative and coordinated efforts are essential to address the dynamic relationship between the environment and climate. With respect to natural ecosystems, our shared responsibility involves stabilizing the climate, safeguarding freshwater reservoirs, rejuvenating landscapes, ensuring the vitality of oceans, and conserving biodiversity. It is imperative to undertake these endeavours within scientifically established boundaries and with a commitment to social equity, in the hope that this radical shift of paradigm can radiate to other continents.

### 5.1 Improving the citizens’ quality of life in Saudi Arabia

In 2016, the Kingdom of Saudi Arabia entered a new historical phase launching Saudi Vision 2030 (Saudi Arabia, 2023), a strategic program aimed at improving government efficiency, stimulating growth and investment opportunities, and most importantly, enhancing visitors and residents’ wellbeing. The mission of creating an ambitious Nation entails the opportunity of enabling social responsibility thanks to a specific Quality of Life program, bound to promote happiness and fulfilment for all Saudi citizens. The Royal Commission for Riyadh City launched the Green Riyadh Program (Riyadh, 2023) to further fuel these objectives through, above others, the development of city parks. The program aims to strategically increase the quality and quantity of all vegetation in both urban and suburban setting and develop a strategically planned interconnected network of natural and semi-natural areas with other environmental features, designed to deliver a wide range of ecosystem services. To achieve the above, the Strategy targets to increase vegetation coverage in Riyadh from the current 1.5% to 9.1% in 2030. Green Riyadh initiatives span over 541 km<sup>2</sup> of Green Space and along a Green Belt of 1.100 km<sup>2</sup>.

Complying with the Saudi Vision 2030 is Al Urubah Park – a 75-ha park where a piece of nature is secluded by a 3 km long building – the first City Park within the Green Riyadh Program. The park brings organic and fluid elements to the city. It nurtures a dialogue with the wadis and the surrounding areas: the west side of Al-Urubah is characterized by a natural system consisting of Wadi Hanifa, Wadi Al-Laysan and sand dunes, edging the city by a winding strip of farms, parks and green plot. Within the Nature-positive landscape perspective, the project got integrated into the existing context by reproducing a “piece of nature” inside the urban fabric: the interpretation of the territorial elements converged at the site through the planting of over 10.000 trees, the use of existing soil for inner paths and the utilization of Riyadh stone and granite transformed in contemporary urban furniture. Shadow represents the connecting feature for all public spaces to ensure a liveable outdoor space for all Riyadh citizens. The park also serves as retention pond in case of extreme rainy events, pursuing the Green Riyadh Program goal to safeguard the Kingdom’s environment and promote the optimal use of water resources by reducing consumption and utilizing treated and renewable water. Moreover, the innovative Digital Landscape monitors the park’s environmental data, provides cultural in-depth tools with specific points of interest, and intends to become the digital control core for all the parks yet to be developed within the initiative. Working on connectivity, regeneration and connection of green spaces as a benchmark for future projects, the park embodies the Saudi Vision’s focus on the Kingdom community by enhancing the participation and experience of “a vibrant society...with fulfilling lives”.

## 6 CONCLUSION

Nature-based solutions have emerged as essential for infusing a green essence into global cities and mitigating climate change. This holds especially if we recognise that nature is already in the city, rather than considering it as an abstract dimension in antithesis with the urban realm. In accordance with this recognition, natural capital is in fact the result of what has been understood as the natural and geographical vocation of cities.

In this respect, the integration of Natural Capital Accounting can enable the quantification and replication of sustainability in landscape projects on a broader scale.

To acknowledge nature as an asset, incorporating natural capital management into urban planning should be prioritized. This contributes to create Nature-positive cities which balance urban development with environmental conservation, promoting the well-being of both residents and the planet. Only by disseminating Nature-positive cities around the world will we be able to see the concrete benefits of an improved enabling environment. Among these benefits, we count enhanced processes and transparency in city governances, improved climate risk management frameworks to reduce accidents and unexpected events, increased investment from MDBs and ESG-aligned investors, an enhanced spirit of innovation, the replication of governance and communication mechanisms across society and the cultivation of talent and culture. Such innovative solutions offer a holistic approach to urban planning that addresses multiple challenges while fostering more and more sustainable, resilient, and liveable environments: nature-positive landscapes. Thus, to enable the green transition to Nature-positive cities we need to start from designing the big picture of change. How? Starting from landscape, with three basic guidelines for leading design practices: making landscape visible, making it measurable with day-by-day monitoring actions and making it inclusive with people-oriented spaces and practices.

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