

Biophilic Urbanism

Summary report
TNO 2025 P11322



Biophilic Urbanism – summary report

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Author(s)	Menno Hinkema Carla Robb Eliane Overgaag-Schreuder Frank Krause Lisette Rueb
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Balanced Spatial Choices for a healthy and sustainable environment

This research project has been performed as part of the Balanced Spatial Choices programme. With the TNO programme Balanced Spatial Choices, TNO is investing in multiyear, transdisciplinary applied knowledge development aiming at integral balanced spatial choices for a healthy and sustainable living environment. The leading question for this programme is: how can we drive, support and substantiate integrated spatial decision making, by balancing social, environmental and economic needs?

Learn more about the program and insights so far at

www.TNO.nl/BalancedSpatialChoices



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Project objectives and approach



Problem statement

Biophilic design is gaining traction among urban planners, policy makers and developers. The use of natural elements in architecture and urban design is increasingly seen as a stratagem for urban environmental quality improvement. But the use of biophilic design currently seems primarily hype-driven and not based on considered use of available evidence. As a result, biophilic design is often viewed as a 'nice to have', rather than as a development priority warranting serious consideration with and against other development priorities. It is likely that creating access for stakeholders to the current state of knowledge will allow them to deploy biophilic concepts and strategies more effectively.

Overall purpose

The purpose of the project is to assess the current state of knowledge and explore how this can be best marshalled to support integration of biophilic design methods into informed spatial development. This includes an assessment of strengths and weaknesses of the methodology, as well as its complementarity and potential conflicts with other spatial development concerns and priorities. By doing this assessment, the objective is to ascertain biophilic design's potential relevance for TNO's research and innovation agenda on balanced, impact-oriented decision making in complex urban development issues, and to get an idea of the developmental steps needed. The end purpose of the project is to sketch out an innovation and valorisation path.



'Wonderwoods' biophilic design project in Utrecht NL (Image: Arcadis)



Overall approach

Biophilic design operates at various scales. An initial scoping exercise has identified a young, emerging discipline within biophilic design that goes beyond the building scale and specifically operates at the urban environment scale: this emerging discipline is called Biophilic Urbanism . Biophilic Urbanism has been selected as the main scope for the project's main research and scoping activities.

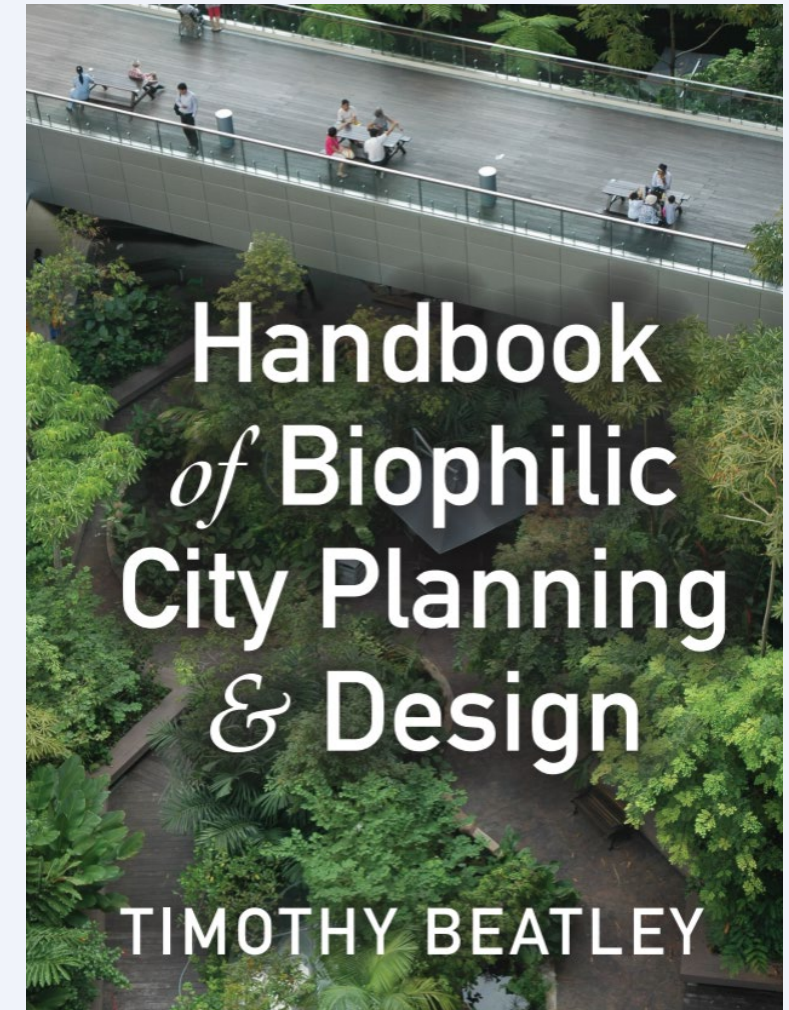
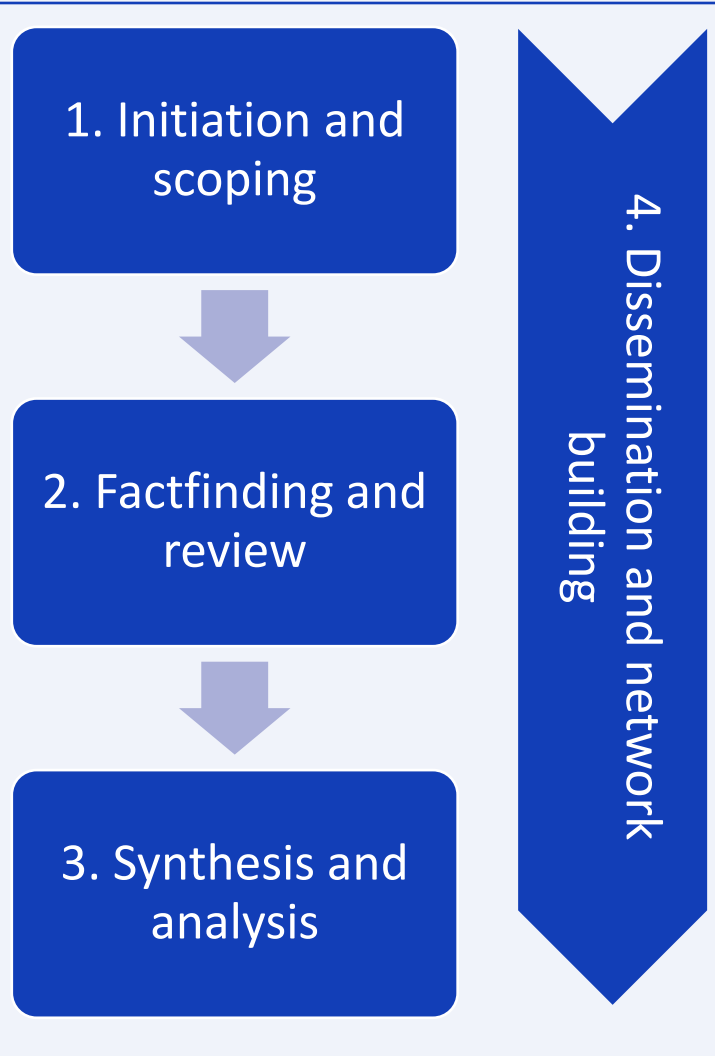
The overall approach of the project has been to examine Biophilic Urbanism's potential and relevance for policy and practice, including mapping out alternatives.

The overall approach has been translated into a four-part workflow, illustrated on this page. Steps 1-3 have been organized sequentially.

Step 2 has been conducted through a scoping review of recent literature (mainly peer-reviewed) and through a series of semi-structured interviews with stakeholders in the Netherlands and abroad.

Dissemination and network building has taken place throughout the project.

At the basis of the analysis lies a set of five research questions. These are shown on the following page.



Foundational publication: Beatley (2016)



Research Questions

1. What is Biophilic Urbanism ?

How is Biophilic Urbanism (BU) defined in literature and practice? What are its key characteristics? What frameworks and methodologies have been developed?

2. Alternatives

What alternative frameworks can we identify and how do they compare with BU in terms of suitability? How does BU relate to these other frameworks?

3. Biophilic Urbanism impacts

To what extent and how does research in BU address current thinking and priorities in urban health, wellbeing and productivity? What are the main gaps and drawbacks?

4. Biophilic Urbanism in policy making

To what extent and how does research in BU address current thinking and priorities in public decision making and policy development for health-supportive (urban) environments? What are the main gaps and drawbacks?

5. Biophilic Urbanism in practice

What do we see going on in the field of Biophilic Design and urban planning/development in practice? Which networks and notable practices can we identify? Is BU an appropriate lens to make sense of what going on in these practical initiatives?

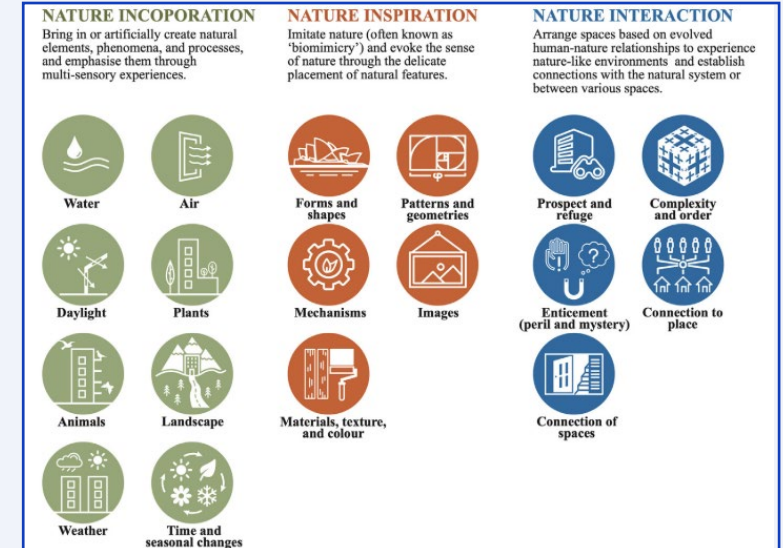
Findings literature review



Literature review

Approach

- A scoping review was conducted to identify recent academic studies into Biophilic Urbanism. The specific objective was to find recent review articles, to build up an overview of the current state of thinking and research in the field.
- The initial search was conducted through the Scopus database. After selection on the basis of abstracts, 26 articles were included for full-text analysis. Additional material was identified through Google Scholar and through snowballing from literature references in the 26 articles originally found.
- Several textbooks and handbooks were also analysed.
- The 26 articles and the additional material were analysed by members of the project team. The analysis was done using the five research questions formulated for the project.
- Full bibliographic references for the 26 articles and for some of the additional material have been included in an annex to this summary report. Numbers between brackets () on the following pages refer to items in this bibliography.
- An Excel file showing the full analysis conducted on the material is available on request.



Source: Zhong et al, 2021



1. Definitions of Biophilic Urbanism

Focusing on cities/urban areas, biophilic design has an emphasis on **human-nature interactions** to enhance the quality of urban life and well being. **Biophilic Urbanism** (BU) is an approach that **applies biophilic design principles** on a larger, urban scale. It bridges the gap between ecological cities, which prioritize green spaces, and resource-efficient cities, which focus on optimizing urban systems.

It aims to **enhance the relationship between humans and nature within cities**, focusing on improving urban liveability, sustainability, and resilience. It primarily focuses on connecting people with nature in urban environments (cities) so to improve their physical and mental well-being, while still benefitting environmental, social and economic sustainability. The idea is to be able to introduce natural elements at different scales to enhance human nature connection and improve urban resilience.

It aims to **integrate both ecological systems and human-centred design** to improve not only environmental sustainability but also public health, social cohesion, and economic outcomes. In addition to addressing environmental sustainability, BU also focuses on the quality of life for city inhabitants.

2. Relation to similar concepts

A number of concepts showing overlap with Biophilic Urbanism have been found in the literature.

Biophilic design seeks to balance modern architecture and urban living with elements of the natural world. Biophilic design can be seen as the ‘parent discipline’ from which Biophilic Urbanism grew.

Nature-based solutions (NBS) are ‘actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, simultaneously benefiting people and nature.’ (IUCN, 2020). Compared to Biophilic Urbanism, NBS are less focused on social implications and the effects of nature on well being.

Green Infrastructure usually incorporates strategically planned out natural or semi-natural areas that manage water, prevent floods, increase urban biodiversity in addition to incorporating green roofs among other environments like permeable pavements and wadis.

Relative to these related concepts, Biophilic Urbanism can be understood as a holistic approach that integrates ecological benefits of NBS and the health, societal, and economic improvements derived from enhancing the human-nature connection (Lefosse et al, 2023)



“...the beneficial experience of interacting with nature - in all its forms - through senses and emotions, whose positive effects are mutually increasing in the built environment when designed according to Biophilic Design and Biophilic Urbanism” [Lefosse, D et al, 2023].



3. Biophilic urbanism impacts

There is considerable quantitative research on the effects of applying Biophilic Design principles on a *building level* on health and wellbeing parameters. Zhong et al. (2021) and Lefosse et al (2023) provide detailed overviews based on extensive reviews of available literature and offer robust interpretative frameworks. A scoping review done by TNO offers a brief synthesis of available evidence at building level (2024, in Dutch).

Exploration of the impact of biophilic design methods on larger scales, the scale domain of Biophilic Urbanism, is a much younger research discipline. Not surprisingly, the evidence base at this scale is, as yet, less developed and Biophilic Urbanism less well known.

Still, a recent systematic literature review indicates the effects that have been found on economic, social, physical, environmental and psychological dimensions (Lefosse, D et al., 2023).

The study clearly shows the benefits of BU for humans and urban liveability and offers a framework showing the relations between the benefits and interventions on different urban scales (on buildings, in neighbourhoods and in city/bioregions).

What are the main gaps and drawbacks?

Critical gaps in the research field:

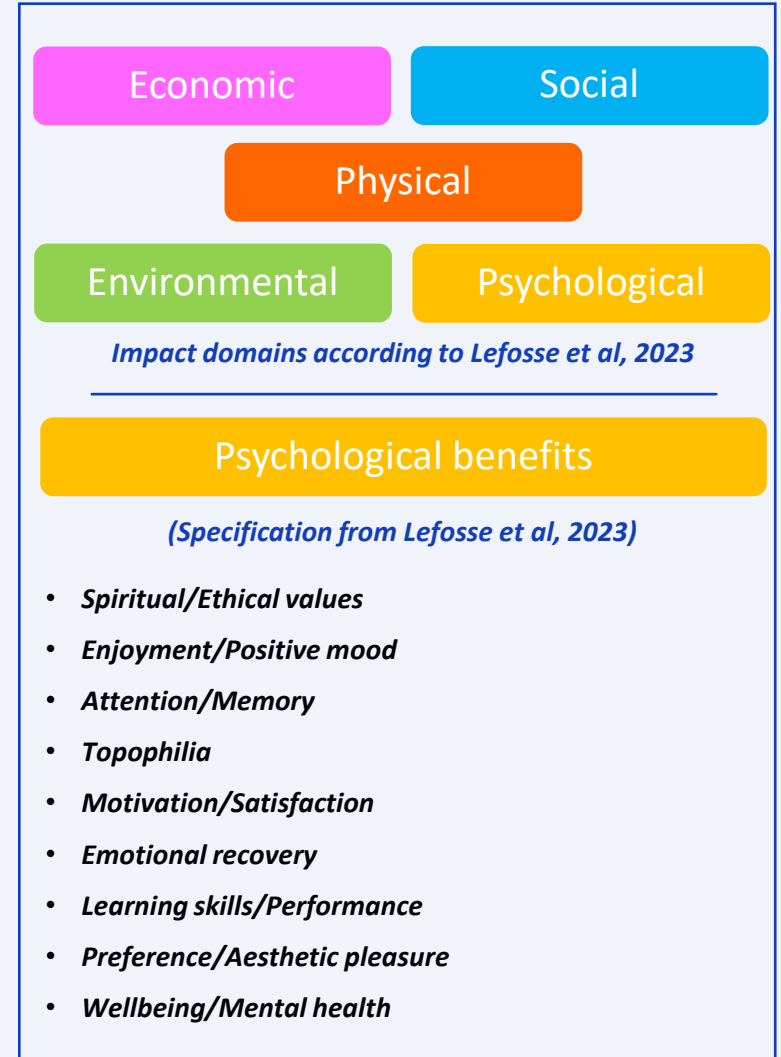
- **Scientific objectivity and validity** (limited evidence –base, no standardisation, quantifying Biophilia is difficult, but crucial for making informed decisions, lack of evidence of large-scale applications)
- **Measurability** (measuring health effects in macrosystems is a challenge. A major challenge is the requirement for longer-term assessment)
- **Upscaling process** (less evidence at scales beyond the building and problems with translating and generalizing effects across settings)

The reviews consulted point out the need to adopt a three-metric approach (quality, quantity and application) and a multidimensional perspective, in order to address these knowledge gaps.

Priorities for further research:

Among many issues highlighted as warranting further research work, the articles consulted point out four particular areas where further research would be societally relevant:

- BU and large-scale applications
- Assessment methods
- Biophilic strategies for climate resilience
- Digital and multisensorial experiences





4. Biophilic Urbanism in policy making

In general, the literature consulted supports BU's potential to assist designers, planners, and city makers in addressing the growing sense of urgency they experience to achieve ever higher environmental and social quality. Articles specifically point out the value of BU's holistic, integrative approach as well as its emphasis on the interaction of humans. However, the lack of evidence supporting the benefits or impacts of BU has limited its integration into urban policies at the global scale.

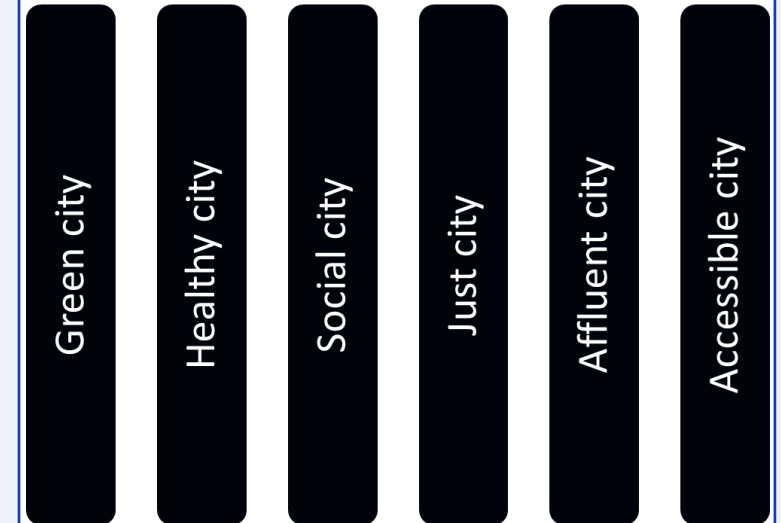
Source (10) identifies four interrelated factors enabling application of BU:

- Political leadership
- Strong community support
- Government incentives and financial support
- Research & development

What are the main gaps and drawbacks?

- **Institutional and governmental barriers:** challenge to integrate BU planning policies and achieve multiple environmental objectives; and concurrently overcome institutional and governmental barriers and siloed focus of related disciplines (e.g. landscaping, green infrastructure, stormwater management (14))
- **Equitable distribution:** addressing social inequalities by ensuring green spaces are equitably distributed to prevent gentrification and displacement (15)
- **Badly planned strategies:** Careful planning is required to introduce natural elements in a proper environmental and social context. Badly planned or thought-out interventions can have adverse effects. (15) references increased carbon levels through soil respiration and decomposition, damage to infrastructure or failure to survive under urban conditions as possible adverse effects of unsuitable interventions.

Siloed policy objectives





5. Biophilic Urbanism in practice

Many theoretical tools, frameworks and methodologies exist in the field of BU and related concepts (e.g. Beatley, 2011; Simona Totaforti, 2020; Maibritt 2019; Tarek and Ouf 2021; Lee & Kim 2021; Xing, 2024). There are, as yet, few examples in the literature of these frameworks being applied in practice. A notable exception is the Biophilic Cities Network (see below).

The common objective of the tools, frameworks and methodologies found is to support extending biophilic principles from buildings to city scales, improving overall liveability and addressing environmental challenges.

Biophilic Cities Network

One of the main applications of Biophilic Urbanism in practice is the [Biophilic Cities Network](#). Established by Beatley, this network aims to include biophilia in urban policies and practices and currently consist of over 32 cities connected cities across North American, Europe and Asia.

Examples of application in Practice:

- **Singapore:** applied BU strategies, including parks, green roofs, and street trees, enhancing environmental quality and urban resilience. Programs like the Sky-Rise Greenery Initiatives and the BCA Greenmark scheme support these efforts.
- **New York:** High Line
- **Fukuoka:** Canal City Hakata.
- **Rome:** ReLAB studies for urban reEvolution launched in 2018.
- **London & Paris:** Urban gardens/agriculture on rooftops.
- **Birmingham:** Green living spaces (Helene 2016).
- **Hamburg:** Bio-reactive facades in the BIQ house.
- **Malmo:** Example of biophilic street designs.
- **Freiburg:** Specific example of Bachle
- **Portland, Chicago, Toronto, Berlin** applied various biophilic elements (preferably successful) (3,4,6,7,10)

Biophilic City Dimensions & indicators (Beatley 2011, examples)

Conditions and Infra

- ≥ 1 park by 100m per capita
- 20% Forest canopy cover
- $\geq 1/2500$ community garden

Activities

- 1-5% pop in nature restoration & volunteer efforts
- $\geq 40\%$ residents active in gardening

Attitudes & knowledge

- $\geq 1/3$ pop express care and concern for nature
- $\geq 1/3$ pop aware of common native species of flora and fauna
- $\geq 5\%$ city budget devoted to biophilic programs

Institutions & governance

- ≥ 1 Biophilic institutions and cultural/training services
- ≥ 5 /city biophilic pilot projects and actions

Findings interviews



Interviews

- **9 Interviews across private sector, academia and public sector.**
- **6 from the Netherlands, 1 from Germany and 2 from the United States**

Variety of professions including:

- Landscape Architect
- Urban Designer, architect and Professor
- Urban Designer, turned researcher (PhD on Green Health)
- Professor at Department of Urban & Environmental Planning and Founder of the Biophilic Cities Network
- Urban Planning and Development Expert, architect and academic
- Strategic City Planning Programme lead of regional co operation
- Health policy advisor and Planner (healthy, active and sustainable cities)
- Strategic Programme Lead Sustainable Cities
- Senior Policy Advisor Urbanisation at Ministry



1. Definitions of Biophilic Urbanism

Across the 10 interviews that were conducted it became evident that the term Biophilic Urbanism is generally unfamiliar to interviewees from Europe.

Biophilic Urbanism is more of an item in North America and (to some degree) Asia, primarily in research and research-based practice in small-scale networks. Through the interview conducted with Timothy Beatley, the founder of the Biophilic Cities Network, the following definition has been formulated: *Biophilic Urbanism seeks to create urban environments that foster meaningful human-nature connections, enhancing both ecological and resource efficiency while improving the overall quality of life in cities.*

In general, Biophilic Urbanism primarily focuses on access to nature and the human-nature interaction. What makes Biophilic Urbanism unique/different from the other concepts is that it is not only interested in the human benefit but also the benefit for nature itself. The **Biophilic Cities Network (BCN)**: established in 2007, includes over 32 cities globally, promoting biophilic initiatives not by insisting on using specific frameworks but by guiding progress. From the BCN, there is a belief that cities or urban areas have an **ethical obligation** to protect and restore nature, therefore recognizing its intrinsic value.

2. Relation to similar concepts

Nature Based Solutions was adopted by the UN and has therefore become a more well-known term across Europe.

Nature-based solutions and green infrastructure are well known terms across the European landscape. While all these concepts have slightly different desired outcomes, they are similar in the fact that they all intend to increase greenery in urban environments while also aiming to create healthier living environments or support ecosystems.

Most of the interviewees noted that a holistic approach is important when it comes to 'green' and health. While the terminology and concepts differ across countries and professions the main idea is still strong across all concepts: **nature is good for health outcomes**. In urban areas, health outcomes should be integrated with other urban systems.





3. Biophilic urbanism impacts

Nature in urban environments is generally known to impact social cohesion and mental health. There is an implicit health effect when reducing eco-risks or improving quality of living (ecosystem services). There is also some research around the benefits of experiencing green (being in nature) versus just seeing green.

Internationally, there are 'measures' in place to monitor health progress:

- [The Ross Center](#) – has a set of indicators to monitor health in urban settings.
- The Biophilic Cities Network (BCN) notes governance, exchanges and activities to support the measuring across cities.
- Additionally, Amsterdam has the [Monitor Groen 2022 | Website Onderzoek en Statistiek](#).

In some municipalities in the Netherlands there has been a shift towards 'functional green' - "*from decorative to functional green*" (Wageningen slogan). This also supports the shift towards green for health purposes, biodiversity as well as ecological benefits.

In the Netherlands, Municipalities are coming up with ways to measure the impact of green on health (Amsterdam, Rotterdam, Arnhem), but there is no standard way of doing this.

Main Gaps and Drawbacks

There is a growing shift from valuing green spaces for their presence alone to focusing on their actual impact—prioritizing quality over quantity. However, assessing this impact, particularly on health, remains challenging due to the long-term nature of such benefits.

Demonstrating the economic value of health improvements is also difficult. As a result, financially quantifiable options, like parking lots, are often favoured over parks. The question remains: how can we effectively monetise green spaces?

Although the belief persists that any green is better than none, the design and connectivity of green spaces significantly influence their effectiveness. Yet, there is still no clear correlation between specific types of green spaces (e.g., networks vs. pocket parks) and their impact on wellbeing.

The trend is moving toward interconnected green systems, which are believed to enhance social cohesion and indirectly support mental health.



In the Netherlands there is a primary focus on creating healthy living environments, not necessarily focusing on urban greening. This incorporates questions such as:

- "How do we get more nature into urban spaces for human health benefits?"
- How do we get nature into cities to provide ecosystem services in order to reduce heat stress and improve water management?
- How do we change the urban environment to support with human behaviour change and healthier people? "



4. Biophilic urbanism in policy making

Climate change and health seem to be at the forefront of policy making in both Europe and abroad. There has been a specific movement in urban planning towards integrating health aspects and green is associated with improved mental health (through concepts such as active mobility (cycling, walking) and mental wellbeing).

It is difficult to objectively prove health effects from 'greening'. When evaluating health effects, the focus is primarily on (self-reported) wellbeing.

Various health initiatives and frameworks exist in the Netherlands such as:

- **Ministry of Health, welfare and sport** focuses on a bottom-up initiative for people to live healthier: [Alles is gezondheid / All about health](#) - [Landelijk netwerk preventie en gezondheid](#) - Alles is gezondheid
- Amsterdam is one of the few municipalities that includes health in their approach to green design
- <https://gezond010.nl/> (Gemeente Rotterdam)
- Institute for Positive Health: [beter in het groen web](#),
- [Home | One Health](#), Monitor Groen

Main gaps and drawbacks

Through a number of the interviews with Dutch organisations, it became clear that it would be good to have a set of green and health guidelines that are applied in all new developments. This would support with connecting health aspects to urban planning processes from the start of new developments. There is also a strong need for social impact analysis and the long term benefits of design decisions in relation to green.

Considering health outcomes in urban planning projects could have major benefits in general. This should become a starting point for all urban planners.

There are a number of 'green design' handbooks such as [Handreiking Groen in en om de Stad](#). However, the feedback from interviewees is that in practical use these can encourage an indiscriminate 'green for green's sake' approach. In order to be effective, nature-based interventions need to be both targeted and appropriate. This may entail making sure that a species of plant or animal introduced fits a specific environment, and more generally that biophilic interventions fit both environmental conditions and social and cultural implementation context.





5. Biophilic Urbanism in practice

The disconnect between academia and practice is still relevant: it is not always easy to substantiate or justify all choices in practice and social desirability sometimes outweighs scientific evidence.

When trying to achieve wellbeing through design, we should aim to design environments that lead to the desired behaviour that we are aiming for, which should ideally be linked to health outcomes.

It emerges from the interviews that – in Europe at least – Biophilic Urbanism is not something that is explicitly applied in practice. However, European interviewees have tended to assess Biophilic Urbanism as a relevant and potentially value-adding lens through which to look at health-oriented nature-based interventions in urban planning and design.

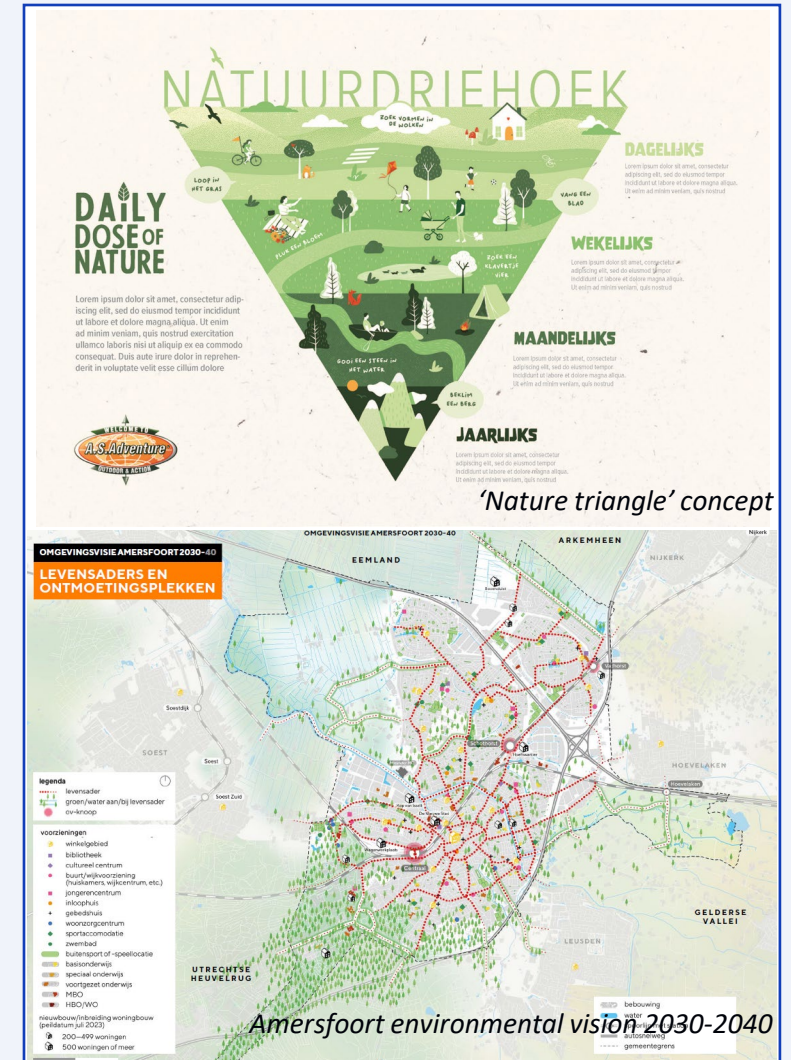
Interviewees from (local) government and project design agree that the biggest obstacles in practice are encountered in the transition from vision development and goal-setting to actual implementation of interventions. It is in this phase that actionable knowledge and decision support expertise could add most value.

Promising practices

During our research we came across a number of interesting projects and city-level developments. Though not always called Biophilic Urbanism explicitly, they evince many of its characteristics and approaches. These include conception of the urban environment as a complex system, emphasis on urban connections and encounters, emphasis on regular and varied exposure to nature.



Abufeira, Portugal



'Nature triangle' concept



Main Challenges

Scientific substantiation and evidence-base

In general, interviews show that there is a need for better scientific substantiation and a broad evidence-base for health benefits of the incorporation of natural elements in urban planning and development. The potential for wider deployment of Biophilic Urbanism hinges on it being a suitable framework for collection, interpretation and integration of evidence.

Comparability of economic and health benefits

Economic drivers for urban development are currently much easier to quantify and monetize than health benefits. There is an extensive evidence-base and long-term tradition to use these drivers as KPIs in e.g. (S)ROI, SCBA et cetera. No such tradition has as yet been established for health benefits and the evidence-base is both smaller and more complex.

Since urban and spatial planning decisions tend to (want to) make use of quantitative KPIs, economic considerations tend to trump health aspects. This holds true even where – on a vision and policy level – health aspects are recognized as (very) important. A major challenge lies in developing evaluation frameworks and methodologies that allow better and more equitable comparison of economic and health benefits.

Specific Challenges

- Development of monitoring frameworks for assessing the impact of greening efforts.
- Finding a balance between standardisation and norm-setting versus context-sensitive guidance.
- Avoiding zealotry: keep an open mind on the relative value of greening versus other strategies: sometimes green is not the optimal solution.
- Be aware of potential adverse effect of nature in urban development. E.g. hay fever and other allergies; green spaces perceived as socially unsafe. Development of mitigation strategies for adverse effects.
- Economic benefits often outweigh health benefits in decision making.
- How to establish an 'economic valuation' of health interventions to support demonstrability of benefits.

Opportunities

- Guidelines and Frameworks can be useful to structure designs more intentionally, which can contribute to ensuring consistent integration of nature and health outcomes.
- There is an opportunity for urban planners to consider health outcomes from the start of a project, to ensure real health benefits for cities.
- There is a strong need for clearer implementation strategies, funding mechanisms and stronger health-focused urban greening initiatives. This need is recognised by stakeholders in policy and practice. It can be expected that advances will resonate with these stakeholder groups.
- Collaboration across domains and sustainable groups of individuals that fight for nature & health is beneficial to success. Frameworks and methods that support such collaboration and sustained effort can help generate impact

Dissemination and networking



General

Networking activities have taken place throughout the project.

Internally, alignment has been sought and synergies and communalities in approach explored with the Nature-Based Solutions project.

Externally, the interviews conducted have been used to establish contacts. Online meetings have been had with researchers in the Netherlands (Delft University, Leiden University) and beyond (US), as well as with architects and designers and with policy and planning professionals in three Dutch municipalities and at the Dutch ministry of Housing (VRO). All interviewees have expressed an open attitude to collaboration and knowledge sharing and would be willing to engage in further discussion and exploration.

Over the course of the project an especially relevant network of Biophilic Cities has been identified and contacted. A presentation on Biophilic Urbanism and Nature-based solutions has been held at the Blue Zone festival in Amersfoort (NL, May 15).



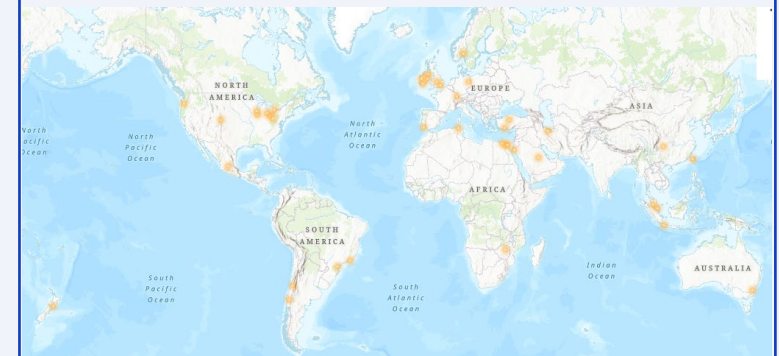
Biophilic Cities partners with a network of cities, scholars, and advocates from across the globe... Biophilic Cities facilitates a global network of partner cities working collectively to pursue the vision of a natureful city within their unique and diverse environments and cultures. Network partners are working in concert to conserve and celebrate nature in all its forms and the many important ways in which cities and their inhabitants benefit from the biodiversity and wild urban spaces present in cities. Biophilic Cities acknowledges the importance of daily contact with nature as an element of a meaningful urban life, as well as the ethical responsibility that cities have to conserve global nature as shared habitat for non-human life and people.

(Source: <https://www.biophiliccities.org/our-vision>)

Biophilic Cities Network



Partner Cities



Case studies

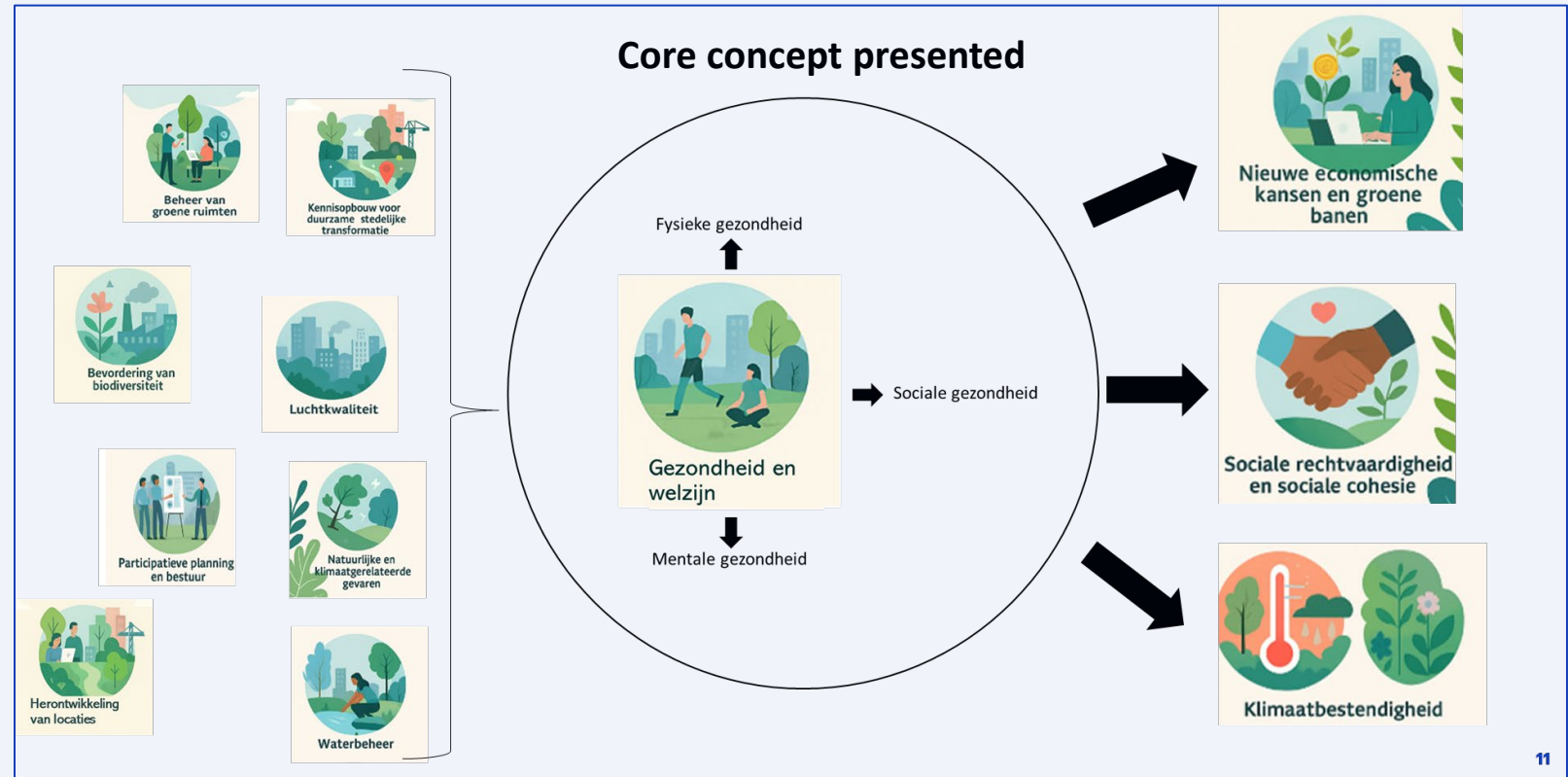


Blue Zone Festival

At the invitation of the municipality of Amersfoort, TNO held a presentation at the Blue Zone Festival, which took place in Amersfoort on the 15th of May 2025.

The Blue Zone Festival is an annual event which brings together researchers, innovators, health and care professionals, architects and urban planners as well as local and regional government representatives around the general theme of designing and shaping our everyday living environments to support long life in a state of positive health.

The presentation by TNO was a joint initiative of the Biophilic Urbanism and Nature-based solutions projects. It highlighted key findings from the projects, delved into the potential of application of these methods and engaged participants in discussion of key dilemmas encountered in moving from policy to practical implementation.



Key dilemmas discussed in session

1. Nature for citizens or citizens for nature?
2. Science leads practice or practice leads science?
3. Governance: top-down or bottom-up?
4. Management of urban transformation: dedicated team or transversal integration?

Synthesis and Analysis



What is Biophilic Urbanism?

- Biophilic Urbanism is best understood as a sub-discipline of Biophilic Design. Biophilic Design is the systematic integration of nature and natural elements in design of indoor and outdoor built environments, with the aim of promoting health and wellbeing through restoration of meaningful connections to nature for individuals and communities. Within this field, Biophilic Urbanism specifically focuses on scale-levels that are in scope for spatial and urban planning.
- Biophilic Urbanism shares a number of characteristics with its 'parent discipline':
 - A holistic approach, encompassing multiple impact domains and focusing on understanding integrated effects of biophilic interventions.
 - A multi-sensory, multi-domain understanding of 'nature'. Biophilic Urbanism encompasses more than just 'Green' and 'Landscaping'. It also targets water- and air-based interventions, the introduction and protection of 'animals' and exposure to natural patterns of weather, daylight and seasonal variations.
 - Primacy focus on the interactions between humans and natural elements in evaluating effects and effectiveness of interventions.

Alternatives

- Biophilic Urbanism is one of a number of concepts that address nature and urban development.
- Prominent among these are:
 - Nature-based solutions
 - Green Infrastructure
 - Nature-inclusive building
- Of these, Nature-based solutions and Green Infrastructure are most directly relevant at the scale-level of urban planning and development. Both are reasonably current in policy-making, with nature-based solutions being adopted by the United Nations.
- Compared to Biophilic Urbanism, these alternative frameworks lack Biophilic Urbanism's integrative, holistic approach, and/or they focus less explicitly on the interactions between humans and natural elements in their assessment frameworks.
- It seems counterproductive to consider these other concepts as 'one-for-one' alternatives to Biophilic Urbanism. Rather, the concepts should be seen as complementary and provide potential for exploration of synergies. Given its more holistic approach, Biophilic Urbanism might be used as an overarching framework to combine and interpret findings from other concepts.

Impacts

- Various impact frameworks for Biophilic Urbanism are in use.
- Some of these have been specifically developed for Biophilic Urbanism. E.g. Beatley, 2011 and Beatley, 2016
- Others include Biophilic Urbanism as one (or more) scale-level(s) in frameworks for Biophilic Design. Best framework in Lefosse et al, 2023. Zhong et al, 2021 gives the best conceptual presentation of the Biophilic Design methodology and philosophy.
- Frameworks developed by Beatley et al are explicitly used in practice networks and research. Lefosse et al and Zhong represent recent, high-quality syntheses of academic work and could potentially be deployed as frameworks in future research and innovation activities.
- All frameworks cover a wide range of supposed benefits, including economic, social, environmental and (mental) health impacts, but with little quantification at urban scale levels.
- Availability of actionable evidence is highlighted as the main bottleneck, in both literature and interviews. This is partly due to the fact that:
 - Biophilic Urbanism is still a young research discipline; and
 - More fundamentally, collecting and interpreting evidence for Biophilic Urbanism is complex, so traditional research methods fall short.
 - There is a need for new models for evidence collection and assessment.



Policy making

- Biophilic Urbanism has some (but limited) traction in policy making in North America and – to some degree – Asia.
- In Europe, Biophilic Urbanism is not a framework that is used in policy making or even known to most policy makers. Other frameworks and approaches dominate. These include: European Union Plans for Green and Health Nature Restoration Law; the Nature-Based Solutions (NBS) Assessment Framework; and the City Biodiversity Index.
- There is a growing sense of urgency among policy makers about the need to improve the urban living environment through the introduction of nature. Policy-makers also seem increasingly aware that natural interventions need to be targeted and context-specific in order to be effective.
- Specific problems highlighted in literature and interviews include
 - The siloed nature of policy-making structures
 - The general reliance in policy-making on quantifiably KPIs. This in turns means that policy priorities are skewed towards issues that CAN be quantified / monetized.

Practice

- In the Netherlands, Biophilic Urbanism is not used explicitly as a framework for nature-based spatial planning.
- When confronted with an outline of Biophilic Urbanism, stakeholders working practically in urban development do tend to see the potential of its holistic, integrative approach.
- Internationally, the Biophilic Cities network represents a flourishing practice and research community.
- Both the literature search and interviews have yielded several case studies, good practices and innovative practices. A systematic comparative analysis using a consistent interpretative framework could yield valuable insights for scalability and replicability of good practices.
- This would feed into an explicitly expressed need by stakeholders for more substantive guidance and guidelines.
- The key bottleneck in application of Biophilic Urbanism, emerging both from literature and interviews, is making the transition from policy to practical implementation. It is here that development of actionable knowledge to support better monitoring and steering on integrated health and societal benefits could generate substantial social return on investment.



Biophilic Urbanism – Strong points and limitations

Strong points of Biophilic Urbanism emerging from the analysis are its holistic perspective, its multidomain definition of 'nature', encompassing both green and blue natural features, fauna as well as flora, and multisensory perception. Equally valuable is Biophilic Urbanism's emphasis on the interaction of individuals and communities with nature.

At the same time, it has become apparent that Biophilic Urbanism is currently not well-known outside a comparatively small circle of researchers and practitioners. Biophilic Urbanism as a discipline is young, with a correspondingly limited evidence-base, but the analysis has also shown up more fundamental difficulties in evidence collection and interpretation. Traditional scientific methods seem ill-suited to understanding the systemic effects of urban design interventions.

Development potential

There is limited utility in introducing Biophilic Urbanism as a competing or additional tool alongside other approaches, concepts and methods that are already used at urban scales, such as Nature-based solutions, Urban Greening, Green Corridors, Nature-inclusive design, Rewilding and so on.

Rather, there is potential in developing Biophilic Urbanism as an underlying analytical framework that can help (primarily) municipalities to better understand and more effectively deploy nature-based urban design interventions towards health-supporting impacts. Biophilic Urbanism's integrative, multi-domain approach is well-suited to this, and its use can help municipalities map nature-based interventions onto existing and emerging indicator frameworks for healthy urban environments.

Benefits of an integrative analytical framework

In developing Biophilic Urbanism in this direction, it is crucial to focus on areas and project development stages where the challenges municipalities encounter are at their most acute, and where Biophilic Urbanism's integrative approach could yield greatest benefits. From the info gathered during our project, this means focusing on the transition point where vision and policy need to be translated into actual project definition and implementation.

It is at this point that financial constraints start to bite, siloed ways of working hinder collaboration, stakeholder interests and planning priorities need to be juggled, and it becomes ever more difficult to keep track of original planning objectives and impact expectations. Developing an integrative analytical framework can help municipalities:

- Develop better, easier to track key performance indicators.
- Set up goal hierarchies, weigh priorities and expected impacts against each other.
- Provide monitoring and guidance information throughout project development and implementation.
- Identify and help manage conflicts of interest.
- Offer guidance for marshalling and channeling citizen engagement.

Practice-based innovation

Municipalities' needs are practical. Traditional research approaches are not fit for purpose to predict and evaluate nature-based system interventions. For both reasons, in developing Biophilic Urbanism in the direction indicated, practice must lead the way and science should follow.

Together with the stakeholders that we encountered and talked to over the course of our exploration, we want to explore the perspective of setting up one or more collaborative, practice-based research trajectories. These must be organized around real, current urban development policy and implementation programmes. Through working jointly with stakeholders from government, research, industry and civil society, we hope to be able to make rapid progress towards developing a sturdy, actionable Biophilic Urbanism analytical framework.



An open invitation

In the follow-up to our exploratory research project, we will be reaching out to municipalities, researchers and designers, to explore interest and potential involvement in setting up these practice-based innovation projects. But we are also extending an open invitation to others interested in working on this subject to get in touch!

Contact info

Lisette Rueb

+31 6 27 38 99 13

lisette.rueb@tno.nl

Menno Hinkema

+31 6 11 70 04 45

menno.hinkema@tno.nl

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