

Nature and Culture-based Solutions for urban and territorial regeneration: governance models and tools

Giuseppe De Luca

Abstract: The paper advances an evolutionary reading of Nature-Based Solutions (NbS) towards Nature and Culture-based Solutions NCbS, conceived as bio-technological and cultural devices that trigger systemic processes of urban regeneration. The challenge, it argues, is not to reproduce nature but to govern hybrid systems in which humans are active and co-responsible components. This entails moving beyond the paradigm of ecological transition towards that of ecological conversion, grounded in reciprocity between society and the environment. NCbS requires collaborative, adaptive, and multi-level governance capable of integrating institutions, communities, and plural knowledge. The paper introduces the figure of the reflective ecotechnician, a professional who combines technical competence with ethical responsibility. NCbS thus emerge as ecological and cultural commons, instruments of territorial and ecological justice, and cornerstones of a transformative urbanism linking planning, care, and political imagination. Only through reflective and inclusive governance can planning transform transition into conversion, regenerating both the city and the very forms of human coexistence.

Keywords: Collaborative governance, Nature and Culture-based Solutions, Socio-ecological regeneration, Transformative urbanism, Ecological justice.

1. From Ecological Design to Systemic Governance

In recent years, NbS has emerged as one of the most promising strategies for addressing, in an integrated way, the environmental, social, and climatic challenges of contemporary cities.

The definitions provided by UNEA and the European Commission – describing NbS as *solutions inspired and supported by nature, cost-effective and capable of generating multiple benefits* – highlight their function as integrated actions aimed at protecting, conserving, and regenerating ecosystems. Yet, their true strength does not lie in the *naturalness* of their materials, but in their ability to generate ecological relationships among space, society, and technology. This reveals their transformative potential compared to merely engineering approaches: no longer punctual devices, but systemic and regenerative levers.

For this very reason, NbS face a structural paradox: while they have matured in technical and design terms, they often struggle to produce lasting effects where appropriate institutional conditions are lacking.

The challenge, therefore, is not to reproduce nature but to govern hybrid systems of which humans are active and co-responsible components. NbS thus become both ecological and social infrastructures – bio-technological and cultural devices that sustain territorial regeneration through adaptive and cooperative processes.

Their effectiveness depends, consequently, on governance and instruments capable of ensuring maintenance, cross-sectoral coordination, informed participation, and long-term co-production. No longer an *accessory green*, but structural infrastructures of urban transformation, endowed with their own spatial, functional, and symbolic logic.

Giuseppe De Luca, University of Florence, Italy, giuseppe.deluca@unifi.it, 0000-0001-7994-2217

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They do not operate in a vacuum: they require coordinated policies, coherent planning tools, stable financial models, and an administrative culture capable of mediating among disciplines, actors, and scales.

The shift from a *design* approach to one of *governance* implies recognising that ecological and social challenges cannot be solved through individual interventions but through institutional ecosystems that enable continuous processes of regeneration.

From this stems the dual proposal advanced in this text: both a conceptual and substantial evolution towards *Nature and Culture-based Solutions* (NCbS) and, at the same time, a move beyond the paradigm of *transition* to embrace that of *conversion*.

Including the cultural dimension does not mean adding a rhetorical embellishment, but rather acknowledging that nature – especially urban nature – also embodies intangible values, identities, practices, and narratives constructed over time and *naturally* embedded in the physical heritage.

Moving towards the paradigm of conversion, beyond transition, means essentially passing from a society centred on human dominance to one centred on a balanced relationship between humans and nature. This perspective has been particularly developed in theological contexts (Francesco 2015; Cassibba and Quadrelli 2021; Ormerod and Vanin 2016).

Here, however, it is interpreted in a secular sense (De Luca 2019), as an *act of humility and responsibility* (Latour 2017) and, above all, as an *active form of resistance to the collapse of modern civilisation* (Stengers 2015) – in the end, a conversion of thought and perception, and the construction of a new and desirable narrative of the world (Wieland et al. 2023), partly in the wake of a territorial principle (Magnaghi 2020), which calls for a co-evolutionary relationship between humans and nature.

In contemporary debates on the relationship between society and environment, the terms *ecological transition* and *ecological conversion* are sometimes used as synonyms belonging to the same logical-argumentative continuum. In reality, they express two distinct – epistemological, cultural, and operational – visions of the change required to shape a different future.

At the epistemological level, transition relies on quantitative and functional knowledge, whereas conversion invokes relational and reflexive knowledge. The former mobilises engineers, economists, and planners; the latter engages educators, theologians, philosophers, but also citizens and local communities. They are two complementary ways of responding to the ecological crisis: transition acts *upon* systems, conversion acts *within* systems and subjects.

At the cultural level, the difference is even more evident. Transition retains a modernist and technocratic framework: change is managed, measured, and optimised. Conversion, by contrast, recentres the principles of care, sobriety, and fraternity with other species, proposing a reconsecration of the world as our common home. It is a bottom-up, generative change that treats the ecological question not merely as a technical problem, but as a crisis of meaning.

From this standpoint, NCbS – within the paradigm of conversion – can assume the role of common goods, generating belonging, care, and ecological justice, thus strengthening social cohesion, attachment to place, and community spirit.

While, at the technical and operational level, transition translates into plans and strategies (decarbonisation, circular economy, green infrastructures, energy transition), conversion, on the contrary, is expressed through everyday practices, educational and communal pathways, and new ways of inhabiting and designing. In planning terms, this means shifting from a planning that *manages* sustainability to one that *builds* reciprocity between society and environment, between the built and the living.

For this shift to occur, however, a new form of governance is required – one able to guide and orient urban and territorial transformation.

2. Governance as an Enabler: Models, Actors, and Transformative Capacity

The forms of governance applicable to NbS are manifold, yet they converge on one central idea: no single actor can face the complexity of urban transitions alone. What is needed are collaborative, adaptive, and multi-level models capable of facilitating dialogue among institutions, citizens, businesses, and the research world.

Their transformative capacity depends on government devices that coordinate policies, mobilise heterogeneous actors, stabilise shared visions, and guarantee continuity over time.

Rather than *governing NbS*, it is necessary to rethink urban governance starting from NCbS.

Let us see how.

2.1. Collaborative Governance: From NbS to NCbS

Collaborative governance is founded on co-production among public, private, and civic actors, and on the construction of common goods. It is particularly effective at the neighbourhood or district scale, where the direct involvement of communities fosters belonging, stewardship, and shared maintenance.

However, it is not without challenges: it requires trust, management of power asymmetries, adequate timeframes, and above all institutionalisation – mandates, resources, rules, and accountability – to prevent it from remaining episodic.

The extension towards NCbS strengthens this framework, as they connect nature with social practices, heritage, and symbols, generating *eco-cultural commons*. In this sense, models inspired by plant biology – distributed networks, adaptability, mutualism – help to imagine cities as resilient organisms, with horizontal and cooperative governance.

Typical tools include: participatory (and digital) mapping that merges ecological and cultural data; co-design laboratories; integrated management plans for open spaces; and policies protecting urban cultural landscapes.

This reading, in dialogue with biomimetic metaphors – the city as a cooperative and adaptive organism – shifts the focus from the technical solution to the relational system that keeps it alive, incorporating the issue of proximity to individual and collective services into co-design as a key driver of this approach.

2.2. Adaptive Governance

NCbS are living elements: they require monitoring, feedback, and continuous learning. Adaptive governance institutionalises iterative cycles – experimentation in living labs, participatory evaluations, updates of plans and standards – and values the management of uncertainty.

However, this demands robust inter-institutional capacities, shared metric bases (microclimate, energy, ecosystem services), and an administrative culture that treats error as an opportunity for learning.

2.3. Hybrid and Multi-Level Governance

In practice, hybrid and multi-level arrangements prevail, combining collaboration and adaptability within broader institutional systems.

Vertically (municipality–metropolitan city–region–state–EU) and horizontally (across sectors and actors), the governance of NCbS requires coordination mechanisms that overcome compartmentalisation.

These can take the form of sustainability-oriented public–private partnerships, inter-municipal consortia, transformation agencies, multi-stakeholder platforms, or intermediate institutions capable of translating territorial complexity into coordinated action.

Experiences beyond the European context further illustrate the diversity of governance arrangements supporting nature-based urban transformations. In Latin America, community-based territorial governance inspired by the Buen Vivir paradigm has connected ecological restoration with social participation and cultural values (Escobar 2020; Gudynas 2011). In Asia, large-scale programmes such as China’s Sponge City initiative demonstrate how adaptive governance can institutionalise nature-based infrastructures through coordinated planning and monitoring (Li et al. 2017). In African cities such as Durban, ecosystem-based adaptation strategies have combined biodiversity protection, climate resilience and community stewardship within municipal governance frameworks (Roberts et al. 2012). These experiences suggest that NBS governance can emerge through different institutional trajectories—community-driven, state-led or hybrid—while converging around collaborative and adaptive approaches.

3. Key Actors and Transformative Capacity

Success depends on the interaction among multiple actors: local administrations, called upon to integrate ecological, design, and relational competences; communities and citizens, as co-producers of value and stewards of shared spaces; the third sector, as a catalyst for social innovation; universities and research centres, for their knowledge bases, archives, and technical as well as theoretical expertise; and the private sector, through green finance, social responsibility, and measurable impacts.

What matters is not only *who participates*, but *how* they interact: shared visions, co-ordination tools (intersectoral roundtables, river contracts, integrated plans, participatory budgets), clear responsibilities, and stable resources turn isolated interventions into collective infrastructures.

Thinking in terms of NCbS means referring to everything that roots and sustains a solution over time: the ensemble of practices, local knowledge, care forms, and behavioural models that make both the built and surrounding environment part of a shared ecosystem.

NCbS may therefore represent the convergence of three inseparable planes:

- a) the **ecological-technical**, concerning environmental performance and ecosystem services;
- b) the **social**, based on participation, co-design, and community responsibility;
- c) and finally the **cultural**, understood as the recognition of symbolic and immaterial values, identities, and relationships that motivate care for places, restoring meaning to the local proximity between homes and services as a fundamental component of living.

At this point a key question arises: which professional figure can assist this conversion? Which *institutional design* can translate ecological strategies into normative, fiscal, and managerial instruments within urban and territorial policies?

Such a figure could be termed a “Reflective ecotechnician”, following Schön (1983) and his notion of professional reflexivity; or a “Sensitive ecotechnician”, drawing on Escobar (2017) and Davoudi (2015) – someone who, combining the ability to measure with the ability to listen, can operate across environmental humanities, landscape governance, eco-urban design, and public participation.

In both cases, this is a form of territorial curator: a professional who combines technical expertise with ethical responsibility, connecting nature, society, and meaning.

The key ethical principles within an *ecotechnical* perspective include:

- *Social responsibility*: the duty to consider the needs and interests of all members of society, particularly marginalised and vulnerable populations, and to promote social justice and equity in policy planning decisions.
- *Environmental sustainability*: the effort to minimise the negative environmental impacts of development and to promote sustainable practices in land use, transport, and resource management.
- *Transparency and accountability*: operating transparently and involving the public in planning processes to ensure that decisions are made openly, fairly, and responsibly.
- *Integrity and professionalism*: maintaining high ethical standards in professional conduct, including honesty, fairness, and impartiality, and avoiding conflicts of interest or even their appearance.
- *Long-term vision*: considering the long-term consequences of decisions and aiming to create resilient, adaptable communities capable of thriving amid future challenges such as climate change and demographic shifts.
- *Cultural sensitivity*: respecting and incorporating diverse cultural perspectives and heritage in the planning process, recognising the importance of identity and cultural heritage in community formation.
- *Legal compliance*: adhering to laws, regulations, and professional codes of conduct that govern institutional activities, ensuring that actions are both legitimate and ethical.

4. Tools for Integrating NCbS into Policy-Making

Making NCbS effective, from an *ecotechnical* perspective, means working across strategies, rules, finance, and collaboration.

The goal is twofold: to make them structural within the language and fabric of plans, and to provide flexible, enabling tools for complex and evolving projects.

4.1. Integrated Planning and Systemic Vision

Traditional planning, often sectoral and rigid, struggles to capture the dynamic nature of NCbS.

The most advanced experiences adopt integrated frameworks: green and blue infrastructure strategies, climate adaptation plans, ecological networks, and multiple corridors in which NbS guide transition and connect cohesion with regeneration.

In Italy, the newest general plans are beginning formally to recognise the role of NbS within the plan's structure, but they still occupy a secondary position compared to land-use regulation.

4.2. Normative and Regulatory Instruments

To give NCbS binding strength, it is necessary to:

- introduce minimum standards (permeability, ecological surfaces, green endowments);
- provide obligations or incentives for green roofs and façades, SUDS, and tree-lined corridors;
- activate ecological equalisation and compensation mechanisms to engage private operators.

Building and urban green regulations can reward ecosystemic performance and environmental quality; international *green codes* demonstrate how to integrate such requirements into urban standards.

The key lies in linking rules to measurable indicators and ex-ante/ex-post evaluations.

4.3. Financial and Fiscal Instruments

Fragmented funding remains a recurrent obstacle.

A diversified *policy-mix* is needed – including green bonds, European and national funds, public–private partnerships oriented towards measurable impacts, fiscal incentives, and *Payments for Ecosystem Services* (PES).

Integration with circular economy principles – local supply chains, reuse, reduction of operational expenditures along the life cycle – reinforces the economic sustainability and managerial durability of NCbS.

4.4. Participatory and Collaborative Instruments

The collaborative dimension is a key enabler: partnership agreements, participatory budgeting, community monitoring protocols, citizen science, *ecological citizenship agreements* and *revitalisation of local services*.

These are not mere accessories but structural components of design, especially in fragile contexts.

Their institutionalisation prevents engagement from remaining episodic and ensures continuity of care.

5. Recurrent Challenges

NCbS are not an automatic remedy. Certain challenges recur frequently and demand governance antidotes:

- *Greenwashing and technocratic simplification*: the risk lies in using *green* as a narrative ornament or reducing complexity to standardised metrics, neglecting local contexts and cultures. The antidote is a set of measurable objectives linked to explicit social and cultural values, with transparent monitoring.
- *Institutional fragility*: weak or fragmented institutions, political discontinuities, and normative instability undermine coherence and longevity. Intermediate institutions, multi-year mandates, and multi-level coordination mechanisms are required.
- *Environmental injustices and green gentrification*: without redistributive design, NbS may increase rents and displace vulnerable populations. Key questions are: who decides, who benefits, and how is access ensured? Answers lie in territorial equity criteria, the *just green enough* principle, and structural participation practices.
- *Maintenance, management, monitoring*: the weak point is often not implementation but what comes after. NbS demands differentiated care, adaptation, and long-term evaluation. Ecosystem performance contracts, dedicated funds, and structured feedback systems are necessary.
- *Local vs systemic scale*: NCbS work when they are place-based, but to exert real impact they require metropolitan coordination and networked action. The tension can be resolved through multi-scalar architectures connecting micro-participatory interventions with urban ecological infrastructures.

6. Towards a Transformative Urbanism

The transformative potential of NCbS lies not only in their technical or environmental dimensions, but in their capacity to regenerate relationships among nature, society, and institutions.

They invite a different understanding of urbanism: no longer a prescriptive discipline, but a transformative, reflexive, and relational practice.

Transformative urbanism arises when planning becomes a space of collective learning and co-production among actors – where scientific knowledge intertwines with situated knowledges and the cultural fabric of places.

In this perspective, transformative urbanism represents the operational translation of the paradigm of *ecological conversion*: a passage from a system that *designs* sustainability to one that *builds* reciprocity between human and non-human environments.

It is a way of planning that embraces complexity as a generative condition, values difference and uncertainty, and recognises the plurality of knowledge and agencies inhabiting territories.

Within this framework, NCbS become *living infrastructures of conversion*, connecting care, ecological justice, and political imagination.

Such urbanism does not merely *mitigate* environmental impacts, but promotes systemic transformations – of the urban metabolism, of administrative culture, and of collective imaginaries.

Its strength lies in activating adaptive and collaborative processes that connect design, governance, and participation, reconfiguring the city as an ecosystem of relationships rather than a functional machine.

In this sense, *designing with nature* also means *designing with society* – with its conflicts, vulnerabilities, and aspirations.

A transformative urbanism is therefore:

- *Ecological*, as it regards the city as part of a living continuum and recognises biophysical limits as project resources;
- *Cultural*, as it values material and immaterial heritage, practices of care, and local identities as structural components of regeneration;
- *Collaborative*, as it grounds its effectiveness in the interaction between institutions, communities, and plural knowledges;
- *Ethical and reflexive*, as it connects technical responsibility and social sensitivity, translating design action into public responsibility.

From this viewpoint, NCbS become keystones of a new urban metabolism, mediating between physical and social infrastructures, between natural and relational capital.

Through them, urbanism regains its original political dimension: not only regulating land use but orienting the transformation of ways of living and coexisting.

NCbS thus appear as *ecological commons* and *devices of citizenship*, tools for redistributing access, opportunity, and well-being, and for promoting ecological justice as territorial justice.

Transformative urbanism cannot be measured solely by spatial outcomes, but by its ability to foster collective learning and mutual responsibility.

It is an urbanism that unites technical competence and cultural sensitivity – in line with the figure of the *reflective ecotechnician* described earlier: a professional able to listen to the territory, translate complexity, and build alliances among nature, technology, and community.

In this sense, planning becomes again a public and dialogical art, capable of generating meaning, trust, and shared care.

Only such an urbanism can transform NCbS from environmental experiments into enabling urban policies – capable of reorienting territorial transformation according to principles of conversion, justice, and ecological responsibility.

7. NCbS as frontiers of contemporary territorial governance

Today, NCbS represent one of the most advanced frontiers of contemporary territorial governance, as they enable the integration of biodiversity, resilience, the definition of proximity service areas, and collective well-being into a single systemic vision.

They transcend the logic of technical solutions to become *cultural infrastructures of ecological conversion* – instruments through which the city rethinks its relationship with nature and with itself.

However, their effectiveness depends not only on design quality but on the ability to embed them within institutional, social, and cognitive ecosystems that can sustain them over time.

NCbS fully express their transformative potential – or rather, their *transformative regeneration* (Fainstein 2010) – only when they become integral to urban and territorial policies, when they generate collective learning processes, and when governance itself evolves into a cooperative platform capable of integrating competences, cultures, and scales.

In this sense, planning is no longer an act of control but a process of *ecological negotiation* among knowledges and forms of life, among communities and institutions. The resulting city is plural – it regenerates through networks of care and social alliances, where innovation is not only technological, but also cultural and relational, in accordance with the fundamental principles of harmonic innovation (Cicione, 2023). NCbS are thus not merely environmental devices, but *political devices of conversion*: they build trust, activate shared responsibility, and nurture belonging.

For this to occur, a qualitative leap in governance is needed – from technical coordination to *reflective governance*, capable of measuring but also of listening, of evaluating but also of accompanying, of treating uncertainty as an opportunity for learning.

NCbS thus become the keystones of a new public ethics, grounded in reciprocity, care, and ecological justice. Only in this way can ecological transition become ecological conversion, and planning once again a project of civilisation.

Integrated within a transformative urbanism, NCbS remind us that urban regeneration concerns not only physical spaces but also the forms of thought, dwelling, and coexistence.

It is within this renewed alliance between nature and culture, between technique and sensitivity, that the future of the planning discipline resides: no longer regulating growth, but guiding transformation – with humility, responsibility, and imagination.

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