



Nature for climate in cities

Where are nature-based
responses prioritised in
policy — and where are
they missing?

Nora Nisi and Nina Schoonman

Working Paper

September 2026

Climate change; Urban

Keywords:

Nature-based solutions, local solutions to nature and
climate crises, climate change adaptation, resilience,
informal settlements

About the authors

Nora Nisi is a researcher at IIED

Nina Schoonman is a researcher at IIED

Corresponding author: Nora Nisi, nora.nisi@iied.org

Acknowledgements

The authors would like to thank Anna Walnycki for her guidance and review of this paper. The authors are also grateful to David Ackers and Jodie Frosdick from the IIED Communications team for their editorial expertise, and Rosalind Cook for the design and layout.

Published by IIED, September 2026

Nisi, N and Schoonman, N (2026) Nature for climate in cities: where are nature-based responses prioritised in policy — and where are they missing? IIED, London.

iied.org/22758iied

ISBN: 978-1-83759-228-9

International Institute for Environment and Development
44 Southampton Buildings, London WC2A 1AP, UK
Tel: +44 (0)20 3463 7399
www.iied.org

 www.linkedin.com/company/iied

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Working with nature is increasingly championed as an effective ‘win–win’ climate response. However, it remains unclear how much this is reflected in policy and planning, and the extent to which urban areas — and particularly informal settlements — feature in these efforts. This paper examines how nature-based responses are reflected in policy frameworks in selected countries in the global South, and the extent to which they are specifically applied to urban and informal settlement contexts.

Contents

Abbreviations	4	5.3 NbS and informal settlements	31
Summary	5	6 Case studies of nature-based responses	34
1 Introduction	7	6.1 Harnessing nature in Bahia’s informal settlements	35
1.1 Why prevalence in policy matters	7	6.2 Water-sensitive upgrading in informal settlements in Indonesia and Fiji	36
1.2 Our analysis	9	6.3 Community-led nature-based solutions in Kibera, Nairobi	37
2 Nature-based solutions and cities	10	6.4 Grassroots greening transforms Nairobi’s informal settlements	38
2.1 Growing recognition of the role of NbS in a changing climate	10	7 Conclusions	40
2.2 Urban NbS	10	7.1 Moving from NbA to well-designed NbS	40
2.3 Momentum is building for working with nature in cities	11	7.2 Urban nature as essential rather than an ‘optional luxury’	41
2.4 Are NbS reaching informal settlements?	12	7.3 Co-producing urban futures with informal settlements	41
3 Why this research is important	14	7.4 Mainstreaming NbS into national and subnational policy agendas	41
3.1 Policy framing of NbS	14	8 Looking ahead: nature-based solutions as part of a multi-layered forward-looking urban resilience system	43
3.2 Our research approach	15	Appendices	45
3.3 Research questions	16	Appendix 1. Profile of selected countries	45
3.4 Methodology	16	Appendix 2. Baseline data for calculation of proportions	46
4 Findings	19	References	47
4.1 ‘Nature’ as a concept and NbR at the national level	19		
4.2 Urban contexts	21		
4.3 Informal settlements	24		
5 Analysis of findings	28		
5.1 NbR at the national level	28		
5.2 NbR in cities	30		

Abbreviations

CLiF-VI	Climate Finance Vulnerability Index
DRR	Disaster risk reduction
EbA	Ecosystem-based adaptation
INGO	International nongovernmental organisation
IUCN	International Union for the Conservation of Nature
KDI	Kounkuey Design Initiative
NAP	National Adaptation Plans
NbA	Nature-based actions
NbS	Nature-based solutions
NbR	Nature-based responses
NDC	Nationally Determined Contributions
ND-GAIN	Notre Dame Global Adaptation Initiative
NGO	Nongovernmental organisation
NRC	Nairobi River Commission
PSN	Public Spaces Network
RISE	Revitalising Informal Settlements and their Environments
UNFCCC	United Nations Framework Convention on Climate Change

Summary

Nature-based solutions (NbS) have been widely promoted by global North¹ governments, institutions and organisations as an affordable, adaptable and effective response to climate change – for both mitigation and adaptation. This is reflected in a widespread push to ‘work with nature’ in climate policy and planning. However, it remains unclear whether this global push has translated into policy uptake within countries. This includes the global South, which is already bearing the brunt of the worst effects of climate change, despite having contributed the least to global emissions.

This work initially focused on the incorporation and uptake of NbS. However, the mobilisation of nature to address various climate- and disaster risk-related challenges can appear in policy through a range of approaches and interventions, often accompanied by diverse terminology. This led to a broadening of the analysis to consider the wider category of ‘nature-based responses’ (NbR). This wider framing has made it possible to capture the diverse ways in which nature is mobilised to address climate- and risk-related challenges.

At the same time, this paper is motivated by a reflection that dominant narratives around working with nature often prioritise rural landscapes, despite the fact that cities and informal settlements are among the spaces most exposed to climate risks. We therefore take a nested approach, first assessing the prevalence of NbR across the full set of policy documents, before examining the extent to which they are specifically applied to urban areas and, finally, to informal settlements.

This paper therefore examines how various NbR are incorporated into climate change, disaster risk reduction and urban development policy frameworks across selected countries in the global South, and how they are distributed across spatial scales.

Key findings

NbR are widespread in policy, but mentions of NbS remain inconsistent. Across the 42 national and subnational policy documents reviewed, the mobilisation of nature to address climate- and risk-related challenges is widespread. **This is evidenced by the fact that 90% of the documents reviewed referenced some form of NbR.** These references are dominated by nature-based actions (NbA). Meanwhile, **only 29% of documents reviewed explicitly mention NbS.**

Urban climate risks are clearly recognised, yet nature remains insufficiently mobilised in city-level resilience planning. Cities are consistently framed as major climate risk hotspots (particularly for flooding and extreme heat), but NbR are less integrated in the city context, with **urban NbR appearing in just over half (57%) of the documents reviewed. NbA dominate urban NbR, while only 19% of documents explicitly mention NbS.** This represents a major missed opportunity to embed nature more systematically within urban resilience strategies.

¹ The term ‘global North’ is part of a ‘global North and global South’ taxonomy that is used to differentiate between countries based on relative economic prosperity and international power (Kenny, 2026). While the name implies a geographic location, it is primarily an economic and sociopolitical classification. This terminology is seen as an evolution of, and more nuanced alternative to, the three-world and the developing–developed country taxonomies (Kenny, 2026). Of course, while this is seen as an improvement on previous taxonomies, it still faces criticism and debate.

Informal settlements face the greatest climate risks but remain marginal in both recognition and nature-based policy responses. Although informal settlements are among the urban spaces most vulnerable to flooding, extreme heat, insecure infrastructure and environmental degradation, just over half of the reviewed policy documents mention them at all. Overall, **only 5% of policy documents explicitly reference NbR in informal settlements.** This demonstrates a profound gap in the spatial distribution of the mobilisation of nature to address climate- and risk-related challenges, where the urban populations most exposed to climate impacts are systematically overlooked in formal policy agendas.

Multistakeholder governance can play a key role in enabling NbS in informal settlements. Examples from Brazil, Fiji, Indonesia and Kenya show that meaningful NbS implementation is already occurring in informal settlements through grassroots action, nongovernmental organisation (NGO) and university partnerships, and broader multistakeholder governance. These initiatives demonstrate that NbS have the potential to address climate- and risk-related challenges in informal settlements while simultaneously supporting livelihoods, wellbeing and environmental restoration.

1

Introduction

Across the globe, climate change is already driving measurable and intensifying impacts. These contribute to more frequent and severe droughts and floods, and more extreme weather events such as tropical cyclones, flash floods and landslides, record-breaking heatwaves and storm surges. However, climate change is also a global social justice issue, whereby the burdens are not equitably distributed. Although the global South has contributed least to worldwide CO₂ emissions, it disproportionately bears the brunt of this global crisis.

The impacts of climate change *within* countries are also not equitably distributed, with disproportionate impacts being felt by society's poorest. This is most notable for the 1.1 billion people around the world living in informal settlements. These settlements are often located in hazard-prone areas, with poorly equipped infrastructure, lack of public services, and high population density (UN-Habitat, 2015). While key and emerging global climate risks are concentrated in urban areas in general (Revi et al., 2014), it is low-income and urban informal communities in the global South that are at the forefront of many climate impacts.

Nature, specifically NbS (see Box 1), has been enthusiastically promoted by global North-based governments, international organisations and environmental NGOs as an affordable, adaptable and effective response to climate change. NbS are presented as effective ways to mitigate emissions, support climate adaptation and address the parallel crisis of biodiversity loss, while also enhancing human wellbeing. This growing consensus has translated into a strong theoretical push to 'work with nature' in climate policy and planning. However, this is not always reflected in practice.

1.1 Why prevalence in policy matters

Momentum has been building around NbS for more than a decade, particularly since its formal adoption by the International Union for Conservation of Nature (IUCN) in 2009, the subsequent recognition of NbS as a major pillar in IUCN's 2013–2016 work programme, and its inclusion for the first time in a 'cover decision'² at the 27th United Nations Climate Change Conference (COP27) in Egypt in 2022. Given this, one might expect NbS to be increasingly systematically embedded within climate policies. Yet it remains unclear whether NbS are being meaningfully integrated into policy frameworks across the global South and, critically, whether these solutions are being considered for some of the most vulnerable areas: cities and informal residents. Cities in the global South, and informal residents in particular, sit at the intersection of climate risk, socioeconomic exclusion and environmental degradation, raising questions about who NbS are ultimately designed for and who benefits from their implementation.

Prevalence in policy matters because this determines which climate approaches are legitimised, funded, governed and scaled. Without the systematic integration of NbS into national and urban policy, regardless of their promotion by international actors or their uptake by communities, they will remain fragmented, project-based, and vulnerable to political and financial discontinuity. Much of the current enthusiasm around NbS may suggest that their mainstreaming into climate and urban policy is already underway. Policy analysis is therefore critical, as it reveals whether NbS are seen as core climate strategies or remain peripheral, symbolic or absent altogether.

² This is the politically negotiated text at the end of a UN Climate Change Conference, which outlines the key outcomes, high-level political commitments as well as next steps from the conference.

BOX 1. WHAT ARE NATURE-BASED SOLUTIONS?

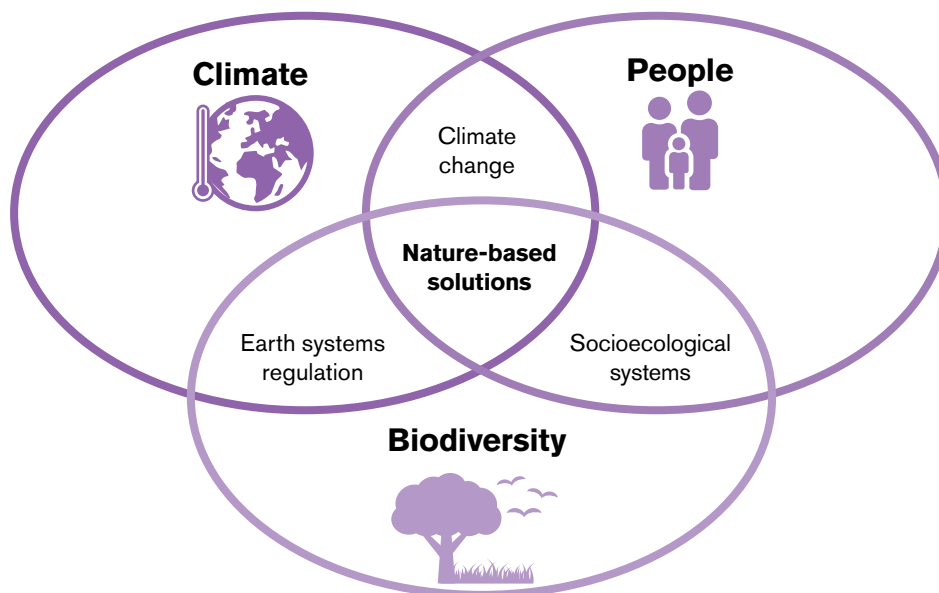
Nature-based Solutions (NbS) address societal challenges through actions to protect, sustainably manage, and restore natural and modified ecosystems, benefiting people and nature at the same time (IUCN, 2020). It can include working lands, aquatic systems and the creation of novel ecosystems (Seddon et al., 2021).

These societal challenges are wide-ranging and include: increasing exposure to floods, droughts, heatwaves and other weather- or climate-related hazards; declining water quality and scarcity; food insecurity linked to degraded soils and ecosystems; and the loss of biodiversity that underpins essential ecosystem services.

Although climate change is not explicitly named in the International Union for Conservation of Nature's definition of NbS, it is widely recognised as one of the principal societal challenges that NbS are intended to address. In practice, NbS contribute to both climate mitigation (for example, carbon storage in forests and wetlands) and climate adaptation (such as reducing flood risks or urban heat).

It is important to note that while climate adaptation is a key societal challenge that NbS seek to address NbS are generally understood to deliver benefits beyond the reduction of climate-related risks alone (see Figure 1). Alongside supporting adaptation outcomes (such as reduced landslide risk), they are typically expected to provide broader benefits for both people and biodiversity. These may include outcomes such as improved health and wellbeing, strengthened livelihoods, enhanced social resilience, increased biodiversity and enhanced ecosystem resilience.

Figure 1. What nature-based solutions seek to address



The term NbS is closely aligned with the concepts of ecosystem-based adaptation (EbA) and green infrastructure (Seddon et al., 2021). The concept of EbA for urban sustainability has been evolving for nearly 50 years (Fang et al., 2023). EbA is often considered a subset of NbS, focusing specifically on the use of biodiversity and ecosystem services to help people adapt to climate change (Brink et al., 2016), whereas NbS encompasses a broader range of societal challenges. Green infrastructure refers to the strategically planned interconnected network of natural and human-constructed spaces (including green spaces) that provide various social and ecological functions (Bartesaghi-Koc et al., 2015; Fang et al., 2023). For the purposes of this paper, both of these interrelated, and often overlapping, terms are considered alongside NbS as 'nature-based approaches' — although we recognise that NbS can often be more explicit in its integration of societal challenges, human wellbeing and biodiversity benefits (Mendonça et al., 2021) than approaches such as green infrastructure, which can emphasise a planning perspective (Fang et al., 2023).

It is also imperative to note that local societies have been working with nature to cope with challenges including natural disasters for millennia (Berkes et al., 2000 and Ruiz-Mallen et al., 2013 in Seddon et al., 2021). Therefore, while these practices have been given scientific terminology and particular standards, it does not denote the first time that communities began working with nature to deal with challenges they face.

1.2 Our analysis

Our initial objective was to assess whether NbS were being substantively embedded within key national and subnational climate policy frameworks across selected global South countries as mechanisms for both climate change mitigation and adaptation. We then aimed to assess the spatial distribution of NbS and understand if NbS are also being considered for urban areas and, crucially, for informal settlements.

However, in designing our research approach, we recognised that the policy landscape extends beyond the specific terminology of NbS. The concept of ‘working with nature’ to address climate-related societal challenges are often articulated through a range of approaches and interventions. We also recognised that disaster risk reduction (DRR) and urban development policies frequently address risks that are deeply interconnected with, and overlap with, climate change. As a result, our analysis broadened to examine how nature more generally is integrated into policy frameworks to address climate- and disaster-related risks in the global South.

More specifically, we sought to better understand how nature is mobilised through various ‘nature-based responses’ — an umbrella term that we use to encompass NbS alongside other established approaches that mobilise nature — to contribute to climate mitigation, climate adaptation, the reduction of climate risk and/or the reduction of weather-related risks associated with DRR (which are collectively treated in this paper as ‘climate- and risk-related challenges’). We then applied a nested approach, examining the prevalence of NbR across the documents overall, before assessing how frequently and in what ways they were specifically linked to urban contexts and informal settlements.

This analysis allows us to examine, within policy:

1. The many ways in which nature is mobilised — from more asset-based, single-risk reduction actions to more holistic approaches that explicitly consider co-benefits for people and biodiversity, as emphasised in NbS frameworks, and
2. How NbR are distributed across national urban and informal settlement contexts, providing insight into the extent to which nature is mobilised at different scales in and across different contexts.

To achieve this, we conducted a systematic review of 42 national and subnational policy documents across six geographically diverse countries (Bangladesh, Cambodia, Ecuador, Honduras, Kenya and Sierra Leone).

We then extended our analysis beyond formal policy commitments by issuing a call for case studies to examine what is actually occurring in informal settlements, irrespective of stated policy positions. This approach was guided by the understanding that the absence of explicit NbR commitments for informal settlements in national or subnational policy documents does not necessarily mean that green interventions are not being implemented in practice, whether driven by community-led action or by external actors such as large international NGOs (INGOs). An additional benefit of this case study approach is that it enabled us to identify the types of measures being implemented, the risks they seek to address and the challenges they might face, thereby generating practical insights and lessons.

The remainder of this paper is organised as follows. Section 2 reviews the growing role of nature-based solutions in addressing climate- and risk-related challenges in cities. Section 3 outlines the conceptual framework, research questions and methodology underpinning the analysis. Section 4 presents the findings from the policy review, which are explored further in Section 5 through a discussion of the findings. Section 6 presents case studies of NbR in informal settlements, before Sections 7 and 8 draw together the paper’s conclusions and reflect on future directions.

2

Nature-based solutions and cities

2.1 Growing recognition of the role of NbS in a changing climate

With the triple crisis of climate change, biodiversity loss and poverty, it is critical to address the interdependent challenges of mitigating and adapting to climate change, ensuring human wellbeing and protecting biodiversity (Seddon et al., 2021). Therefore, NbS has become an increasingly popular umbrella term over the last decade for a plethora of nature-centric approaches (Martin et al., 2025; Adams et al., 2023; Diep and McPhearson, 2025).

The climate risks faced by people, places, species and ecosystems from extreme weather or slow-onset climate change impacts can be assessed using three factors: the nature of the hazard (the physical event itself, including its strength and duration); exposure to the hazard (or the presence of people or assets in the hazard zone); and vulnerability to the hazard (or the degree to which those people or assets are likely to be harmed (UNISDR, 2015). Reflecting on this, NbS can reduce climate risk through several pathways. While NbS cannot change macro-level hazards (such as the occurrence of a cyclone), it can modify the hazard within the climate risk equation by reducing its intensity locally — for example, when mangroves reduce wave and storm surge energy, when restored wetlands absorb excess rainwater, or when urban green spaces reduce the urban heat island effect. Consequently, NbS can also reduce vulnerability by protecting people and assets from more intense impacts.

Importantly, nature is also critical for climate mitigation. The presence of healthy, intact and diverse natural ecosystems is now well recognised as one of the most effective solutions for carbon sequestration and above-and-below-ground carbon storage (Baker et al., 2023).

2.2 Urban NbS

Cities are centres of economic activity. They produce 80% of the world's gross domestic product (Seto et al., 2014) and are the site of most of the world's built assets and economic activity (Revi et al., 2014). They are also major greenhouse gas emitters — particularly through carbon-intensive transportation, buildings and industry. The concentration of people, power and resources makes cities key sites of innovation and transformative change (Delbridge et al., 2022). Together, the concentration of people, economic activities and assets in urban areas results in particularly high potential losses from climate impacts (Boyd et al., 2022). In fact, many of the key and emerging global climate risks are concentrated in urban areas (Revi et al., 2014). Urban climate change-related hazards include rising sea levels, storm surges, heat stress, extreme precipitation, inland and coastal flooding, landslides, water scarcity and air pollution (Revi et al., 2014). The trajectory of heat alone is alarming. From November 2022 to October 2023, global temperatures reached their highest levels ever recorded, with around 7.3 billion people experiencing extreme heat for at least ten days (UN-Habitat, 2024). At the time this paper is being written in 2026, Western Europe is experiencing its most severe and widespread heatwave since records began, including almost half of Europe's 850 largest cities enduring

their worst ever heat stress (Carrington, 2026). By 2040, half of all cities worldwide are projected to have average annual temperatures at least 0.5°C higher than in 2025, and roughly 400 of them are expected to warm by between 1°C and 1.5°C (UN-Habitat, 2024).

Overall, urban climate risks, vulnerabilities and impacts are increasing across cities of varying size, economic conditions and characteristics (Revi et al., 2014). Many conventional 'grey infrastructure' adaptation measures (such as seawalls, levees, and engineered flood defences) can be expensive, inflexible, monofunctional or even environmentally harmful. It is imperative to bridge the nature–city divide by treating urban nature not as an add-on, but as a core part of addressing climate- and risk-related challenges.

In cities, NbS can be integrated into the design of buildings and urban spaces or through the restoration of natural landscapes within, or close to, the city. It can include restoring urban rivers and wetlands, and expanding connected urban forests. Urban green spaces, such as city parks, street trees, retention ponds, urban forests, green roofs, green walls, community gardens, riparian buffers and rain gardens, can benefit the climate, people and nature alike. They can deliver a rich bundle of ecosystem services, helping filter air and water, reduce ambient temperatures through shading and evapotranspiration, and manage stormwater and runoff (Lopez, 2017). NbS are also seen as a cost-effective approach, with one estimate placing the typical costs for a nature-based intervention to be on average half the cost of conventional grey infrastructure of the same capacity (UN-Habitat, 2024). They can also create substantial health, wellbeing and social benefits for people.

From a health perspective, studies have documented associations between access to green space and reduced mortality, improved mental health (less stress, better mood), increased physical activity (walking, cycling, recreation) (Kondo et al., 2018; Ward Thompson and de Oliveira, 2016), lower risks of cardiovascular disease, obesity and diabetes (Ward Thompson and de Oliveira, 2016), and enhanced access to healthy foods (UN-Habitat, 2024). From a social perspective, NbS provide venues for community interaction, social cohesion, cultural identity and connection to nature — all of which are important for inclusive urban life (O'Brien et al., 2017).

The restoration of natural landscapes in or close to a city, as mentioned above, can also have many positive outcomes for biodiversity and ecosystems. Such initiatives are becoming more important than ever as biodiversity loss has escalated dramatically in rural and urban areas; globally, the share of green spaces in urban areas dropped from 19.5% in 1990 to 13.9% in 2020; and around 21% of the world's wetlands have disappeared since the 1700s, massively increasing the vulnerability of cities (UN-Habitat, 2024).

However, the effectiveness of NbS is inherently context-specific. A recent systematic literature review by Esraz-UI-Zannat et al. (2024) on urban flood mitigation through NbS found significant variation in outcomes across cities globally: green roofs were more effective in flood mitigation in Thailand than in Italy; rain gardens (a type of bioretention system) were comparatively less effective than green roofs for a two-year storm event in Bangkok, while a bioretention system in Viet Nam reduced urban stormwater inundation areas by 59% and flood risk by 29% within a watershed. These findings underscore that NbS are not universally transferable solutions, but interventions whose performance depends on ecological, climatic and spatial conditions.

The scale of NbS application is also important. In the same paper by Esraz-UI-Zannat et al. (2024), they indicate that in most cases, a combined set of NbS across the wider urban drainage areas contributes to reducing floods more effectively than a single NbS. This is also found in various other studies, such as Chen et al. (2021), which found that strategically combining and spatially distributing nature-based stormwater interventions across an entire urban catchment can significantly reduce runoff and flood peaks. This highlights that effective urban flood mitigation depends not only on the type of intervention but also on how interventions are coordinated across the broader catchment that feeds the city.

2.3 Momentum is building for working with nature in cities

With the push from donor agencies, INGOs and governments in the global North for the uptake of, and investment in, NbS (Gantner, 2025), a growing number of cities are exploring its use to meet their sustainability and resilience challenges (Cook et al., 2025). City networks and other transnational organisations have played a key role in advancing these approaches, offering guidance, showcasing effective practices and creating spaces for peer learning. Since its launch in 2021, for example, more than 40 cities have joined the C40 Urban Nature Accelerator. By signing on, cities commit to expanding urban nature by 2030 so that it covers 30–40% of their built-up area and/or ensuring that 70% of residents can reach a green or blue space within 15 minutes.

However, this growing momentum of NbS is accompanied by increasing concerns regarding distributional outcomes and the extent to which co-benefits are systematically realised in practice. Reductions in specific climate risks through NbS do not automatically translate into broader social or ecological outcomes such as enhanced resilience, unless these co-benefits are systematically embedded

within the process. Additionally, the wider distribution of outcomes depends on how interventions are governed and who they are designed to benefit. These issues can be even more pronounced in broader NbR, which may not explicitly adopt the co-benefit framing central to NbS approaches.

Urban green spaces are already unevenly distributed, with numerous studies showing that many cities continue to develop in ways that reinforce inequalities in access to green amenities (Chen et al., 2024). As one study states, “[I]n urbanised environments, limited ecological resources, the main resources in urban climate change adaptation, are not distributed fairly” (Parker et al., 2020). Without careful planning, the expansion of NbS in cities can reproduce or deepen these inequities, including through processes of green gentrification. Evidence shows that when NbS is introduced without sufficient attention to equity, justice and participation — such as the use of superficial public consultation over deeper participatory approaches (Goodwin et al., 2023) or when the needs of one community are prioritised over another (Esraz-UI-Zannat et al., 2024; Seddon et al., 2021) — outcomes can be maladaptive or ineffective. In some cases, it can catalyse displacement or raise living costs (UN-Habitat, 2024). Around the world, ‘green’ development agendas that do not take a justice or equity-centred approach have been linked to multiple forms of gentrification. Contemporary city design is increasingly aligned with a kind of ‘bourgeois environmentalism’³ by which areas such as informal settlements are framed as threats to ecologically valuable green spaces (UN-Habitat, 2024). NbS (and broader NbR) often sit uneasily within these dynamics. The removal of residents under these narratives has been described as “eco-cleansing” or “accumulation by green dispossession” (UN-Habitat, 2024).

2.4 Are NbS reaching informal settlements?

Informal settlements and unplanned urbanisation are the dominant forms of expansion in the global South. As of 2023, 1.1 billion people were living in informal settlements (UN Department of Economic and Social Affairs, no date), which are a global phenomenon. They exist in urban contexts across the world, in various forms and typologies, dimensions and locations, and are described in different ways (UN-Habitat, 2015) — including slums, squats and shantytowns. In some cases, the terms used are particular to a geography or language, such as favelas in Brazil, bastis in Bangladesh, townships in South Africa and bidonvilles in Francophone North Africa.

According to UN-Habitat (2015), informal settlements are residential areas where inhabitants have no

security of tenure with respect to the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing. The neighbourhoods usually lack, or are cut off from, basic services and city infrastructure. And the housing may not comply with current planning and building regulations, and is often situated in geographically and environmentally hazardous areas.

Climate hazards disproportionately affect poor and marginalised populations and those living in hazard-prone geographic areas. The residents of informal settlements are especially vulnerable to climate change impacts as they are often located in one or more dangerous or precarious sites. This includes sites that are: at a high risk of floods or landslides; in close proximity to unstable waste dumps, railway tracks or highways; in low-lying coastal areas at risk of sea-level rise and storm surges; or alongside rivers that frequently overflow (Satterthwaite et al., 2020). Informal settlements develop on dangerous sites because their inhabitants have a higher chance of avoiding eviction, given that such sites are unattractive to developers, and/or because they meet needs such as access to jobs and services (Satterthwaite et al., 2020). These locations put residents at higher risk. In addition, official hostility and social stigma towards informal settlements lead to the denial of basic services, absence of social welfare and exclusion from protective infrastructure (UN-Habitat, 2024).

BOX 2. SLUMS V INFORMAL SETTLEMENTS

Although informal settlements are often referred to as slums, it is important to note that informal settlements and slums are not necessarily the same thing. The terms ‘slum’, ‘shanty town’ and ‘slum dweller’ were used with widespread acceptance for much of the twentieth century. Today, however, slum is a term that is often politically and socially contested. Informal settlements are defined according to contraventions of specific laws, rules and regulations, whereas slums are usually defined based on measures of housing quality, overcrowding and the provision of urban services (Satterthwaite et al., 2020). This results in slums often being associated with visual aesthetics related to poverty and hygiene. Due to its pejorative nature, the term has been increasingly contested by community groups, social movements and critical scholars. While these words continue to be used by some researchers, practitioners, grassroots organisations and community groups without stigmatising intentions, a plethora of other terms are now used that reflect the geography, language and context at hand.

³ A term popularised by sociologists such as Amita Baviskar.

Given this, it is critical to recognise low-income and informal settlements in the global South as legitimate and urgent areas for climate adaptation. These equity concerns are particularly salient given that the population of those living in informal settlements is expected to triple by 2050 (UN-Habitat, 2025). As the Intergovernmental Panel on Climate Change (IPCC) has emphasised, the greatest gains in urban wellbeing can be achieved by prioritising investments that reduce climate risks for low-income and marginalised residents and by targeting informal settlements (Dodman et al., 2022). Yet despite the fact that many informal settlements are located along riverbanks, wetlands and coastal zones, are closely interconnected with natural systems (Adegun, 2017) and, in some cases, are dependent on nature for their basic needs (Nalumu and Perrotti, 2024), they are often excluded from formal urban planning and adaptation agendas.

However, it is unclear how NbS fit within different urban development contexts, particularly in the global South. These gaps are particularly concerning given the very real risk of maladaptation if solutions are replicated from cities in the global North. In the context of informal settlements, NbS should be considered carefully, because although they offer the potential for an integrated approach for addressing the complex interaction between environmental, social and economic issues that typically characterise informal settlements (Gantner, 2025), externally imposed interventions and inappropriate implementation can lead to inequality (Diep et al., 2022; Cousins, 2021; Kotsila et al., 2021). This could be through green gentrification, exclusionary zoning or displacement (Seddon et al., 2021; UN-Habitat, 2024). If we want to centre justice in research and practice on NbS (Tozer et al., 2020), we need to understand its limitations and trade-offs in the context of informal settlements, and ensure that NbS do indeed support (rather than undermine) equitable outcomes (Gantner, 2025; Tozer et al., 2020). With these factors in view, NbS and NbR remain vital tools for strengthening resilience in informal settlements.

3

Why this research is important

3.1 Policy framing of NbS

Policy documents such as National Adaptation Plans (NAPs), city-scale climate action plans and disaster management frameworks play a crucial role in the acceleration and implementation of climate action (Boasson et al., 2025), although their impact and actualisation are determined by various factors. Official policy documents and frameworks signal what is seen as credible, fundable and scalable by governments. This means examining both the inclusion and framing of a particular approach to addressing climate- and risk-related challenges across policy documents can reveal how these approaches are positioned within national and subnational priorities. In other words, policy inclusion provides a first indication of whether an approach is considered part of the response landscape, while framing offers insight into the narratives, actors and scales through which an approach is operationalised.

In line with this, assessing the integration of NbS within policy and planning instruments is key to understanding the extent of uptake, as policies and plans are responsible for guiding implementation in practice (Mendonça et al., 2021). Evidence from Europe and the UK indicates that insufficient policy development is one of the structural conditions blocking urban NbS in these contexts (Dorst et al., 2022).

This is significant as ‘path dependency’ — where decision makers prioritise solutions familiar to them (such as a bias for grey infrastructure) — is a major barrier to implementing NbS (Seddon et al., 2021). For example, Dorst et al. (2022) found that trust in

engineering practices underpins multiple barriers that work against urban NbS. Across the global South, a lack of policy and political will have been shown to act as barriers to the implementation of NbS. This lack of political will and a lack of financial incentives have led to insufficient public funds to finance NbS implementation at the city scale (Esraz-UI-Zannat et al., 2024). A review by Castaldo et al. (2025) found that barriers to the development and implementation of NbS in global South cities include challenges related to the low priority given to promoting/expanding green spaces in the city, especially when politicians may favour the economic interests of classic development projects. In terms of enablers, they found that the presence of a national-level policy framework can provide support for NbS planning and implementation at the local level (Castaldo et al., 2025). Meanwhile, a study from Latin America found that for NbS to be successfully implemented in cities, they must be embedded in both formal policies and adaptive governance systems that coordinate political priorities, institutional collaboration and practical decision making (Kuarek-Fontes et al., 2023). Finally, a study from the Mexican Caribbean found that the consideration and adoption of NbS for addressing coastal disaster risk is, in part, highly dependent on appropriate supportive policies (Moreno et al., 2022). Explicit policy inclusion can therefore act as a signal to decision makers that NbS are viable and legitimate interventions, with associated resourcing and implementation pathways. This signalling role may be particularly important in contexts where budgets are limited, and priorities must be justified within constrained national and municipal/city budgets.

3.2 Our research approach

Building on this understanding of policy as a critical signalling mechanism, existing studies have assessed the presence of NbS in Nationally Determined Contributions (NDCs) and point to limited and vaguely specified engagement. For example, a 2024 analysis by the United Nations Human Settlements Programme (UN-Habitat), UN Development Programme and the University of Southern Denmark found that only 53 (or 27%) of the 194 NDCs analysed included a 'strong urban context'⁴, and only 15 (or 7.7%) of 194 NDCs explicitly mentioned NbS or green and blue infrastructure in the urban context (Tollin et al., 2024). Similarly, Zhai et al. (2023), reviewing NDCs from 190 countries, concluded that NbS has not yet become a mainstream measure to combat climate change.

However, while NDCs are important indicators of national climate priorities, they represent only one part of a broader and more diverse policy landscape in which NbS may be embedded and therefore provide only a partial view of how nature is being mobilised in policy. In addition, focusing specifically on NbS as a search term or framing can further narrow this picture, as it may overlook a wide range of nature-based actions and approaches that are present in policy to address climate- and risk-related challenges, providing a deeper understanding of the ways in which countries and cities may be choosing to work with nature. This motivates the use of NbR as an analytical lens through which diverse forms of nature mobilisation in policy can be identified.

Accordingly, this research adopts a nested analytical approach to examine whether NbR are referenced in key national and subnational (city-level) policy documents, and how this framing is approached. We first ask whether NbR are recognised across all levels, then whether they are explicitly linked to urban contexts, and finally whether they are framed as solutions for those living in informal settlements. This tiered approach allows us to assess not only the presence of NbR in policy, but also the specificity and inclusivity of their framing, revealing how attention to cities and informal settlements may be progressively included, or omitted.

3.2.1 Conceptual frameworks

As already mentioned, there is an important distinction between the general acknowledgement of nature as a tool for addressing climate- and risk-related challenges and the more holistic concept of NbS (which represents a holistic approach that addresses a societal challenge, such as climate change, while simultaneously delivering co-benefits to people and biodiversity).

Given that NbS remains a relatively new and largely global North-driven concept, shaped by international organisations and networks, we anticipated that many countries might still be considering the use of nature to reduce risk, mitigate against climate change or adapt to climate change, but doing so by implementing singular nature-based actions or more systematic approaches such as green infrastructure. Furthermore, national and subnational policy development often lags behind international conceptual advances, meaning that many policies may predate the widespread adoption of the NbS framework. We therefore began to distinguish between three related but distinct categories representing different ways in which nature is mobilised to address climate- and risk-related challenges. This categorisation comprises an overarching category of nature-based responses and two nested subcategories of nature-based approaches and nature-based action. These are described in further detail below:

- **Nature-based actions:** functional or action-oriented interventions named as the action itself (such as tree planting, urban greening or wetland restoration), undertaken to manage specific climate- and risk-related challenges.
- **Nature-based approaches:** process-oriented approaches (including NbS, EbA and green infrastructure) that use planning and management to guide actions addressing climate- and risk-related challenges.
- **Nature-based responses:** a broader term encompassing all instances (actions and approaches) where nature is mobilised to address climate- and risk-related challenges, irrespective of the terminology used.

By prioritising the underlying intent to use nature as a solution, rather than adherence to specific terminology, our approach provides a more comprehensive understanding of how policymakers integrate nature into national and urban resilience strategies. It also enables a clearer assessment of the extent to which the NbS terminology itself has diffused and been adopted in policy discourse since its emergence.

Of course, while our analysis adopted a deliberately broad framing to capture the full spectrum of the use of nature, it is important to recognise that NbS remain a distinct concept. As mentioned previously, the value of NbS lies in its holistic, systems-oriented approach. Seddon et al's. (2021) work underscores that successful NbS are not simply actions that exploit nature as an asset, but must also be well-designed, biodiversity-supporting and people-centred (see Figure 1). This distinction is reflected in the IUCN Global Standard for Nature-based

⁴ Defined in Tollin et al. (2024) as: "NDCs that had one or more sections specifically dedicated to urban areas and/or NDCs in which urban areas are explicitly identified as priority sectors. Excludes NDCs that do not back up prioritization with a clear identification of specific urban challenges and/or responses."

Solutions, which emphasises that NbS are more than simply using nature to address societal challenges. Rather, they should be designed to deliver biodiversity gains, equitable governance and multiple co-benefits.

By keeping attention on the principles underpinning NbS, policymakers and practitioners can ensure that NbA move beyond functional outcomes to support transformative change. Of course, even when NbS is explicitly used as a term, this does not mean that its cross-cutting systems-oriented approach is inevitably considered. In fact, Zhai et al. (2023) in their analysis of NDCs found that only 18 countries have recognised the synergistic benefits of NbS in economic, social and environmental dimensions.

3.3 Research questions

Based on the broader framing of NbR outlined above, the analytical tiers were refined and our main research questions were as follows:

How, and to what extent, do policy instruments — such as national and subnational policy documents focusing on climate, disaster risk management and urban development — incorporate nature-based responses, and how are these spatially distributed within countries?

Tier 1 (broad focus): How frequently and in what ways are NbR to address climate- and risk-related challenges mentioned in key national or subnational policy documents across six global South countries?

Tier 2 (urban focus): If NbR are referenced in Tier 1, how frequently and in what ways are NbR specifically referenced in the context of cities?

Tier 3 (informal settlement focus): If NbR are referenced in Tier 1 and 2, how frequently and in what ways are NbR also referenced in the context of urban informal settlements?

3.4 Methodology

This research employed a qualitative content analysis approach, supported by quantitative keyword frequency analysis, to examine national and subnational (city-level) policy documents across six countries in the global South: Bangladesh, Cambodia, Ecuador, Honduras, Kenya and Sierra Leone. Documents were systematically reviewed using predefined analytical categories, and findings were recorded in a structured Excel spreadsheet to enable methodical analysis.

The documents reviewed included national climate change policies, national DRR and management strategies, national urban development plans and city-level climate action plans. While specific document

titles varied by country, the analysis focused on policy, strategy and planning documents within the following categories:

1. NDCs
2. NAPs
3. National disaster risk reduction/management documents
4. National climate change strategies or frameworks
5. National urban planning/urban development documents (or national development documents when communicated as the primary urban planning document)
6. City-level climate action plans

While city-level urban planning documents were originally within the scope of this analysis, their scarcity and uneven availability across countries meant they could not be systematically included.

3.4.1 Country selection

Six countries were selected to ensure broad geographic representation across the global South. The selection was guided by three main criteria: (i) climate risk (high or very high), (ii) size of the urban population (preferably large), and (iii) percentage of the urban population living in informal settlements (preferably high). Additional indicators such as annual urban population growth rate and ‘nature richness’ (a debated indicator) were considered but were not determinative.

The following data sources were used to identify and assess these indicators:

Climate risk:

- Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index: a data-driven measure ranking countries by climate vulnerability and readiness to adapt.⁵ Scores range from 0 to 100, with higher scores indicating greater resilience (that is, lower vulnerability and higher readiness). All selected countries were characterised by high vulnerability and low readiness, except Bangladesh, which was categorised as very high vulnerability and low readiness.
- Climate Finance Vulnerability Index (CliF-VI): a composite index measuring vulnerability to climate change in relation to the need for and access to climate finance.⁶ It combines indicators of exposure, sensitivity, adaptive capacity, and socioeconomic and financial vulnerability, identifying countries facing high climate risks yet limited financial support for adaptation.

⁵ See: <https://gain.nd.edu/our-work/country-index/>

⁶ See: <https://clifvi.org/>

Urban population, informal settlements and income level:

- World Bank: population living in slums (percentage of urban population)⁷
- World Bank: country classifications by income level (2024–2025)⁸
- World Bank: urban population (percentage of total population)⁹

Urban population growth and nature indicators:

- World Bank: urban population growth (annual percentage)¹⁰
- World Bank: forest area (percentage of land area)¹¹
- Fedele et al. (2021): human direct use of nature for basic needs across the tropics

We also wanted to ensure that the cities had the opportunity for NbS in their natural landscape. Towns and cities in arid and semi-arid regions face particular challenges because of the more extreme conditions and water shortages that make many NbS and ecosystem services impracticable (UN-Habitat, 2024).

Based on these criteria and indicators, six countries were selected: Bangladesh, Cambodia, Ecuador, Honduras, Kenya and Sierra Leone. Appendix 1 summarises the countries and their corresponding indicators.

3.4.2 Document identification and collection

Once the countries were selected, a broad search was conducted using Google and specific databases to identify relevant documents. For Ecuador and Honduras, searches were also conducted in Spanish. In addition to a Google search, the following platforms were used to locate documents:

1. National Urban Policy Database
2. Climate Policy Radar
3. C40 City Climate Action Plan Mapping, and
4. UNFCCC portals for NAP and NDC submissions.

In some cases, documents were identified as national urban or adaptation plans by national authorities even if their titles did not explicitly reflect this. These were nonetheless included in the analysis to ensure

comprehensive coverage of nationally designated policy frameworks.

In total, 42 documents were reviewed. The distribution of document types was uneven. For example, we reviewed ten city-level climate action plans, seven national DRR documents and six NDCs. This is because, in certain instances, multiple relevant policy documents were available for the same country. National urban planning and development documents were the least available, with some still under preparation. In our analysis, we calculate proportionality based on the number of documents. Annex 2 summarises the number of documents reviewed per country.

3.4.3 Document analysis

The tracker spreadsheet combined quantitative keyword searches (documenting how often a word appeared in the document) with qualitative narrative note (for example, a documentation of the quote in which it appeared for a reflection on framing) alongside it. Overall, 13 broader search themes were selected, within which 26 specific terms were selected for the keyword search analysis. These reflect themes relevant to the overarching research questions. As mentioned, keyword frequency was recorded, followed by a qualitative interpretation of context and relevance, including direct quotations. For multi-use terms such as ‘nature’, metaphorical or unrelated uses (for example, ‘the nature of this policy’) were excluded.

The key terms included:

1. Climate change¹²
2. Nature
3. Nature-based solutions/NbS
4. Ecosystem-based adaptation/EbA
5. Green infrastructure
6. Tree planting
7. Greening/Green wall/Green roof/Green corridor/Green space
8. Afforestation/Reforestation
9. Restoration
10. Forest/River/Wetland (for potential references to other measures such as rehabilitation)
11. Urban/City/Cities¹³

⁷ See: <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS>

⁸ See: <https://blogs.worldbank.org/en/opendata/world-bank-country-classifications-by-income-level-for-2024-2025>

⁹ See: <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>

¹⁰ See: <https://data.worldbank.org/indicator/SP.URB.GROW>

¹¹ See: <https://data.worldbank.org/indicator/AG.LND.FRST.ZS>

¹² This was not done for climate-focused documents as the focus on climate change is the entirety of the document.

¹³ This was not done for urban-focused documents as the focus on cities and the urban area is the entirety of the document.

12. Informal settlement(s) plus Slum/Shanty/Favelas/Basti/Squatter/Shack (common alternative terms for informal settlements or their residents).

13. Informal settlement(s): Urban poor

3.4.4 Call for informal settlement case studies

To identify examples of NbS implemented in informal settlements across cities in the global South, a public call for case studies was disseminated via IIED on LinkedIn. Those interested in submitting contributions were required to complete a structured questionnaire through a Google form. A total of 25 entries were received and case studies were screened based on three criteria:

1. They had to be of a nature-based response that sought to address climate- and risk-related challenges
2. They had to be located in an urban informal settlement, and
3. They had to be located in a city in the global South.

Of the 25 submissions, six case studies were successful in passing these criteria. Following further review, three closely related submissions were consolidated, resulting in four distinct case studies that are included in this paper.

3.4.5 Research limitations

As with any desk-based qualitative content analysis, this research has limitations that should be acknowledged:

- First, given that this review focuses on only six countries and 42 policy documents, the findings should not be interpreted as representative of the extent to which NbR or NbS are integrated into urban policy across the global South. Further, although we have sought to provide a comprehensive assessment of NbR/NbS inclusion across the selected documents, we acknowledge that relevant policy materials may have been overlooked, despite our systematic search strategy.

- Second, it was beyond the study's scope to assess whether any NbS or broader NbR referenced in the reviewed policy documents have in fact been implemented and, when implemented, whether they have been done so in an equitable manner or whether they effectively avoid maladaptation. While such considerations are central to evaluating the real-world outcomes of NbR, this research focused exclusively on the presence, framing and policy positioning of these concepts within national and subnational strategies.
- Third, not all mentions are equal. In some cases, we report the proportion of documents that reference NbR to provide a sense of coverage across the sample. However, the depth and quality of these references can vary. For instance, some documents make only brief or symbolic mentions of NbR (for example, a single reference to tree planting) while others provide more detailed coverage and reference multiple types of NbR.
- Finally, language and translation posed practical limitations. All documents from Kenya and Sierra Leone were available in English, and for Ecuador and Honduras searches were conducted in Spanish with the aid of automated translation tools to translate full policy documents often only found in Spanish. For Bangladesh, some government websites required navigation in Bangla, but the relevant documents were ultimately accessible in English. Cambodia, however, presented a more significant challenge, as most standard translation tools cannot accurately translate full documents in Khmer. While every effort was made to ensure accurate interpretation, we acknowledge that translation errors or loss of nuance may have occurred in all documents not originally published in English, which could have affected the comprehensiveness of our review.

4

Findings

This section presents the key findings on the prevalence of NbR across the policy documents overall, and their specific application to urban and informal settlement contexts. As outlined in Table 1, overall we found that 90% of the 42 policy documents reviewed mentioned some form of NbR, 57% mentioned some form of NbR in the urban context, and only 5% explicitly referred to NbR/NbS in relation to informal settlements.

For NbS specifically, we found that 29% of the 42 policy documents reviewed mention NbS specifically, 19% mentioned NbS in the urban context, and only 5% referenced NbR/NbS in informal settlements.

Table 1. Number of documents mentioning NbR

TYPE OF MENTION	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE
NbR in any context	38	90
NbR in the urban context	24	57
NbR in informal settlements	2	5

4.1 ‘Nature’ as a concept and NbR at the broad level

4.1.1 How is ‘nature’ framed across all policy documents?

Before examining the use of NbR, our analysis looked at how ‘nature’ as a concept is referenced more broadly. Unpacking the concept and use of the term nature is important for more precise and locally sensitive development of planning for NbS. This will enhance their effectiveness, inclusivity and attention to environmental justice, as the term can often be used abstractly

or through proxies such as ecosystem services or biodiversity (De Oliveira, 2025). We found that 16 of the 42 documents mention nature in some form. What follows is a brief overview of how these nature references are framed.

Nature at risk. Across the 42 policy documents reviewed, nature is often described as something under threat or degradation due to human activity, unsustainable resource use and urban expansion. Policies highlight the urgent need for protection, restoration and sustainable management, with nature (and ecosystems) presented as both a critical ecological asset and a provider of essential services, such as water regulation, carbon sequestration and flood control.

“Urban areas encroach on nature pockets, such as wildlife habitats, forests, and wetlands – land unprotected and poorly mapped biodiversity areas.” “Urban areas are substantial consumers of natural resources. Unsustainable utilization of these resources is fast leading to their degradation and depletion” Kenya National Urban Development Policy (2016)

“Climate-driven rural-urban migration drives deforestation for new settlements, putting biodiversity at risk and exacerbating climate risks” Freetown Climate Action Plan 2022–2030 (2023)

“Human encroachment into flood plains may increase the flood damage potential” Sierra Leone National Climate Change Action Plan (NCCAP) III 2023–2027 (2024)

Nature as a resource. Recognition of nature/natural resources/ecosystems supporting resilience and/or mitigation. This framing emphasises the role of nature in providing natural resources and critical services, protecting communities, and climate action.

“Enhancing nature in our urban environments and the natural ability of ecosystems to buffer climate change impacts” Freetown Climate Action Plan (2023)

“Restore mangroves and wetlands to reduce coastal erosion and provide protection against storm surges” Honduras NAP (2018)

“Robust ecosystem services/natural environmental ability to adapt to impacts (e.g. highly functioning dune or marsh system provides storm protection)”, “Promote reforestation and restoration to maintain the water cycle and control sedimentation in the watersheds that feed hydroelectric power stations” Climate Action Plan for Dhaka North City Corporation (2024)

“Improve and maintain Sierra Leone’s forests as a major carbon sink” Sierra Leone NDC3.0: 2025–2030 (2025)

4.1.2 Prevalence of NbR across all levels

It is important to note that, for this section, we did not distinguish between spatial contexts but rather assessed the mention and intended use of NbR in any context and across all documents (encompassing urban, rural and peri-urban areas, as well as various sites such as farmland, forests and so on).

As shown in Table 2, our findings indicate that nature is widely recognised and mobilised to address climate- and risk-related challenges.

Table 2. Number of documents mentioning NbR

TYPE OF MENTION	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE
Any NbR	38	90
NbS	12	29
EbA	14	33
Green infrastructure	14	33
NbA	37	88

In total, 38 of the 42 documents reviewed (90%) mention nature to address climate- and risk-related challenges. While some references are limited to brief or one-off mentions of NbA such as tree planting or reforestation, others describe substantial and comprehensive programmes. Even within countries, this distribution is different for different policy documents. For example, Kenya’s National Disaster Risk Management Strategy (2025) contained only one singular mention of “reforestation”, while their National Climate Change Action Plan (2023) includes four mentions of NbS, 49 mentions of tree planting, 14 mentions of reforestation, four mentions of greening mechanisms and 337 mentions of restoration.

We found that **only 12 of the 42 documents (29%) mention NbS specifically.** However, 8 of the 30 documents that do not mention NbS were found to mention EbA. Adjusting for climate change-related documentation only (a total of 29 documents), we found only a small increase, with 11 of the 29 climate-specific documents (or 38%) mentioning NbS.

Overall, we found that **NbA** were the most common reference — with 88% of all documents reviewed (37 out of 42) referencing specific actions such as tree planting, greening, reforestation or restoration — either in conjunction with broader approaches such as NbS, EbA and green infrastructure, or by themselves. When NbA were disaggregated by type (see Table 3), **restoration** was by far the most common cross-document NbR with a total of 30 out of 42 documents (or 71%). With 641 mentions across all documents, restoration is mentioned 4.3 times more frequently than greening measures, 14.9 times more than green infrastructure and 7.5 times more than NbS. When aggregated by country (see Table 4), the country with the highest number of restoration mentions is Kenya, with 363 mentions. While Kenya’s 363 mentions of the term restoration make up a large portion of the total 641 mentions, if Kenya is removed from the analysis of counts across countries, ‘restoration’ is still the most common response.

When we assessed what type of restoration was appearing, we found the following three were the most common types:

- **Ecosystem restoration:** broadly encompassing terrestrial, marine and freshwater systems (for example, degraded ecosystems, reef ecosystems, natural ecosystems)
- **Forest restoration:** including reforested, native, swamp and degraded forests
- **Water system restoration:** rivers, wetlands, canals, waterways, mangroves, coral reefs, and other aquatic or coastal systems.

Table 3. Mentions of different nature-based approach terminology

NATURE-BASED APPROACH	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE OF DOCUMENTS WITH MENTIONS	TOTAL NUMBER OF MENTIONS
NbS	12	29	86
Ecosystem-based solution	14	33	43
Green infrastructure	14	33	43
Tree planting	18	43	150
Reforestation/Afforestation	27	64	166
Greening, green space, green wall, green corridor	21	50	165
Restoration	30	71	641

Table 4. Mentions of NbR aggregated by country

NbR MENTIONS	BANGLADESH	CAMBODIA	ECUADOR	HONDURAS	KENYA	SIERRA LEONE
Number of NbS	19	26	11	3	7	20
Number of EbA	14	5	2	4	5	13
Number of green infrastructure	8	5	12	11	0	7
Number of tree planting	30	19	12	0	67	22
Number of reforestation/afforestation	66	18	20	12	25	25
Number of greening/green space/green wall/green corridor	40	40	22	20	31	12
Number of restoration	65	64	59	67	363	23

Restoration of mangroves and coastal ecosystems” Sierra Leone National Disaster Preparedness, Response, and Recovery Plan (2024)

“Recovery of affected ecosystems through reforestation with native species, soil recovery, habitat rehabilitation and control of invasive species” Quito Climate Action Plan (2020)

“Assisted natural regeneration will cover 450,000 ha, alongside restoration of 56,900 ha of flooded forests and 4,080 ha of mangroves” Cambodia NDC (2025)

The findings shown in Table 4 indicate that while NbS is the least mentioned NbR across policy documents, it is not the least referenced. EbA and green infrastructure have around half the number of references.

4.2 Urban contexts

4.2.1 How are cities and urban contexts represented across policy documents?

When reviewing all national documents that do not focus explicitly on the urban context (for example, city-level documents) we found that the urban context was mentioned across all documents (see Table 5).

The dominant framing of **urbanisation** emerging from the analysis across all documents is of urbanisation as a ‘challenge’. Urbanisation is overwhelmingly presented as a risk-driver and source of vulnerability. Rapid, unplanned and poorly managed urban growth is consistently linked to increased exposure to hazards (particularly floods, landslides and heat), increased pressure on infrastructure and a loss of green space. In some cases, urbanisation is associated with environmental degradation, loss of natural buffers (forests, wetlands) and reduced resilience. For example, the Nairobi City County Climate Action Plan (2020) states “continued growth and urbanisation are placing ever-increasing strain on the city,

Table 5. Mentions of the urban context in different document types

DOCUMENT TYPE	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE OF DOCUMENTS WITH MENTIONS	TOTAL NUMBER OF MENTIONS
NDCs	6	100	213
NAPs	5	100	490
National climate documents	8	100	213
National DRR documents	7	100	151
All document types	26		1,067

in terms of public services, food security, infrastructure and natural resources. This is leading to a decrease in green open spaces, and degradation in the quality of those spaces.” Similarly, Honduras’ NAP (2018) explicitly lists out factors contributing to the increase in vulnerability in its cities of which one is “unplanned and disorderly urban growth.”

4.2.2 Urban climate- and risk-related challenges

While urbanisation is highlighted as a factor that amplifies risk, cities and urban areas are primarily treated as inherently high-risk locations. A majority of the documents analysed (76%) identify specific climate-related risks in urban contexts. The hazards most frequently addressed across these documents are:

- Flooding and stormwater management, and
- Urban heat (including the heat island effect and cooling demands).

Flooding was the most frequently identified hazard, with two-thirds of documents (67%, or 28 out of 42 documents) highlighting this particular risk. Flooding in these documents is often cited as resulting from intense rainfall events, which overwhelms inadequate drainage systems and is exacerbated by the loss of natural infiltration capacity.

Following flooding, **urban heat** was the next most common concern, mentioned in 41% (or 17 out of 42) of documents, indicating a widespread recognition of the urban heat island phenomenon.

Lastly, 33% of documents (or 14 out of 42) cited **landslides**, while 24% (or 10 out of 42) mentioned either **drought or water scarcity**. Drought was primarily framed not as a direct hazard but as an indirect driver, notably by increasing rural–urban migration or threatening urban food security. Other, less frequently mentioned, location-specific risks included hurricanes (Honduras), cyclones (Bangladesh) and sea-level rise.

4.2.3 NbR in urban areas

Our analysis found that mentions of urban-specific NbR was significantly lower than mentions of NbR across all levels. **Only 24 of the 42 documents (57%) reference any type of NbR to address climate- and risk-related challenges in urban areas** (see Table 6). Meanwhile, only eight documents (19%) mentioned urban NbS specifically.

Table 6. Number of documents mentioning NbR in the urban context

TYPE OF MENTION	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE
Any NbR	24	57
NbS	8	19
EbA	3	7
Green infrastructure	12	29
NbA	23	55

NbA were the most frequently cited category of response in urban settings, appearing in 55% of the documents analysed. A full list of the various NbR mentioned (in no particular order) is as follows:

1. Urban greening and green space creation or expansion (parks, gardens, nearby national parks, corridors and green zones)
2. Green roofs
3. Green walls
4. Urban forests
5. Green corridors/blue–green corridors
6. Green buildings (sometimes including green roofs or energy-efficient features)
7. Sustainable urban drainage systems (SuDS)/ restoration of natural drainage channels (Khals)
8. Green infrastructure
9. Rainwater harvesting, retention ponds and bioswales

10. Urban agriculture (including rooftop gardens, vertical farming, community gardens)
11. River restoration, rehabilitation of streams, ravines, or hydrological systems
12. Protection or conservation of lakes, wetlands, rivers, aquifers and water catchment areas
13. Restoration of ecosystems (forests, wetlands, moorlands, mangroves, coastal vegetation)
14. Reforestation, afforestation or tree planting campaigns
15. Mangrove restoration and coastal vegetation restoration (including sand dune reconstruction)
16. Restoration of slopes and riparian vegetation
17. Ecological restoration for landslide prevention and soil management.

The term **green infrastructure** was used generically in most documents, only being explicitly defined in three. In those instances, it was used as an umbrella term encompassing parks, urban forests, green roofs and stormwater detention ponds.

The most common interventions mentioned were tree planting (including reforestation) and the creation of green spaces/urban greening (including the expansion or creation of parks, gardens and green urban landscapes). The documents primarily frame these interventions as key adaptation measures to address two dominant urban hazards: the reduction of urban heat, and the management of flooding and stormwater.

Table 7 lists different types of NbR with the issues or hazards that they aim to address.

Outside of NbR, documents also highlighted a range of other critical approaches to deal with the challenges and risks in urban settings. These primarily involved 'grey' or built-environment solutions, such as climate-smart urban planning, developing resilient housing and infrastructure, and upgrading drainage and water management systems (including wastewater treatment and stormwater drainage).

Within this context, strong emphasis was placed on the transportation, water, waste and energy sectors and making them more efficient, low-carbon and/or resilient. This makes sense as these sectors are both essential public services that are critical enablers of urban functioning in cities, as well as major sources of emissions and vulnerability to climate risks. When these systems are designed to be efficient and climate resilient, they can enhance urban productivity and improve quality of life (for example, enhanced access to safe, affordable and reliable public transport enhances the mobility of a city's residents). For many cities, fixing and addressing issues in these sectors lays the groundwork for resilience. This perspective is captured in Bangladesh's national urban policy, which states that the "[p]rovision of adequate infrastructure and services, such as water supply, sewerage and sanitation, drainage, electricity, energy, waste disposal, telecommunication in urban centres and their proper maintenance have major contributions in advancing the cause of sustainable and environmentally sound development."

Table 7. NbR and the urban hazards/issues they address

NbR	HAZARDS OR ISSUES ADDRESSED
Tree planting/reforestation	Urban heat, landslides, heavy rainfall impacts, carbon sequestration, air quality, erosion, loss of green cover
Green roofs/walls	Urban heat island effect, cooling demand, drought resilience (rainwater capture)
Green/blue corridors, green spaces, urban greening	Heat mitigation, stormwater drainage, flooding, biodiversity loss, quality of life, social inclusion
Wetland, lake and river restoration/protection	Flooding, stormwater drainage, ecosystem degradation, water pollution
Mangrove restoration/coastal vegetation	Coastal flooding, erosion, storm surge, blue carbon sequestration
Urban agriculture/community gardens	Food security, stormwater retention, local resilience, social cohesion
Green infrastructure (parks, drainage, bioswales, permeable surfaces)	Flooding, heat, poor water management, urban resilience
Restoration of slopes, ravines, moorlands	Landslides, erosion, droughts
Sustainable drainage systems (SuDS)/Khals restoration	Flooding, stormwater management
Blue-green infrastructure	Flood and heat risk reduction, multifunctional public space creation
Urban forest systems	Air quality, cooling, biodiversity, recreation
NbS frameworks, policies and guidelines	Climate resilience, integration of green infrastructure in planning, social co-benefits

4.3 Informal settlements

4.3.1 Are informal settlements or the urban poor explicitly mentioned? If so, how are they mentioned/categorised?

Although informal settlements exist in all six countries reviewed, our review found that only 52% of the documents (22 out of 42) referenced informal settlements or related terminology such as ‘slums’. In two of the 24 documents, only ‘slum’ was used. The term ‘urban poor’ appeared in 17 of the 42 documents (40%). Notably, in 5 of the 17 documents that referenced the ‘urban poor’, there was no mention of ‘informal settlements’ or ‘slums’. The highest frequency of these terms was observed in documents from Kenya and Bangladesh. Across document types, they appeared most often in NAPs and city-level climate strategies. Informal settlements were mentioned least in national climate documents. The analysis also identified several key themes in the way informal settlements and slums were described, which are detailed below.

4.3.2 How are informal settlements portrayed? Risk, vulnerability and problematisation

A dominant narrative across policy documents is the presentation of informal settlements as high risk/highly exposed areas. The risks predominantly mentioned in this context are those similar to the urban context, namely flooding, heat, landslides, water scarcity, heavy rains and erosion. Flooding is the most commonly identified risk. For example:

“Urbanization has not been met with sufficient resources to manage this fast growth and cities have lacked the financing to make the necessary investments to cope with the accelerated demand for infrastructure and services. This increases climate-risk vulnerability for an already vulnerable population, especially those in informal settlements or working in the informal sector.” Sierra Leone NAP (2021)

“Rapid urban expansion significantly increases the number of people at risk, as it encourages the creation of informal settlements in areas prone to threats.” Sustainable Ecuador 2036 Habitat Agenda (2020)

Another framing is informal settlements being places vulnerable to climate/natural hazards. The causes underpinning informal settlements’ vulnerability to climate/nature hazards vary across context. Many policies mention **location-based or physical-based vulnerability**, such as settlements being located on riverbanks, slopes, floodplains and reclaimed wetlands that are more exposed to hazards such as flooding or landslides. For example:

“Climate change increases risks for human health by impacting human settlements. Affected populations include the urban poor who tend to live along riverbanks; on hillsides and slopes prone to landslides; in unstable structures vulnerable to collapse in heavy rains, and along waterfronts in coastal areas. This is especially true in informal settlements and other low-income areas, where high population density and lack of infrastructure aggravates these problems.” Kenya National Climate Change Action Plan (2023)

Table 8. Documents mentioning informal settlements or other synonyms

DOCUMENT TYPE	NUMBER OF DOCUMENTS WITH MENTIONS	PERCENTAGE
NAPs	3	60
NDCs	3	50
National urban documents	2	67
National development documents	1	33
National climate documents	2	25
National DRR documents	3	43
City-level climate documents	8	80
All document types	22	52

"Informal settlements are located near slopes of rivers and small estuaries, and are made of unstable material, which may lead to damage and risk to life under heavy or prolonged rain."

Mombasa City County Climate Action Plan (2023)

"Inhabitants of informal settlements on steep slopes or located in areas with a high historical incidence of flooding..." Quito Climate Action Plan (2020)

Others recognise socioeconomic or structural vulnerability linked to poverty, lack of tenure security, limited access to basic infrastructure and services, and social marginalisation. For example:

"Informal land tenure is one of the main problems in creating a quality habitat. In informal settlements, public services are of poor quality, making it difficult to guarantee the rights of their inhabitants." Sustainable Ecuador 2036 Habitat Agenda (2020)

"While the rich live in enclaves, the poor are balkanised in informal settlements." Kenya National Urban Development Policy (2016)

"The urban poor experience high unemployment and low incomes; inadequate housing and insecure land tenure; limited access to essential services such as water, sanitation, health and education." Kenya National Urban Development Policy (2016)

In many cases, urban growth is also seen as a driver of vulnerability, which includes rapid, unplanned urbanisation and rural–urban migration exacerbating the expansion of settlements in hazard-prone areas.

The narrative around informal settlements also mentions their problematisation. Informal settlements and slums are depicted as sources of urban problems (for example, poor waste management, invasion of public lands), framed as illegal and/or uncontrolled with little to no planning. Sometimes this reference is embedded in reflections on their vulnerability and high-risk status. For example:

"[In terms of social hazards and emerging issues] these include civil disorder/unrest, migration, corruption, poor urban planning, uncontrolled informal settlements, non-compliance with traffic rules, over-enrolment in schools, and non-compliance with building codes and standards." Kenya National Disaster Risk Management Strategy (2025)

"In most cities in the country, informal commercial activities have grown alongside informal settlements, generally located in high-risk areas, generating large amounts of solid waste in unsafe buildings, which lead to social insecurity, poor hygiene, difficulties in vehicle circulation, and failure to pay taxes to municipal governments." Honduras NAP (2018)

We also found that, in some cases, the narratives around vulnerability and problematisation may coexist uneasily, leading to a mixture of interventions ranging from settlement improvements to relocation. For example, Kenya's National Urban Development Policy (2016) recommends to "Initiate a programme of phased improvement and redevelopment of informal housing over the medium and long-term, including the provision of infrastructure and services and secure tenure" but also "Completely prohibit the formation of new informal housing settlements" and "relocate households occupying environmentally sensitive or hazard prone areas". Similarly, the Tegucigalpa City Climate Action Plan (2016) in Honduras mentions a "Plan for the eventual relocation of neighbourhoods located to the north and east of the city due to the severe risk of landslides," while acknowledging that "In some cases, it will be more appropriate to intervene in these neighbourhoods with neighbourhood improvement actions (see action C.3.1 -Consolidation of Comprehensive Neighbourhood Improvement Programmes), limiting action to locations with unmitigable risks."

4.3.3 Responses to risk in informal settlements

While we have noted that policy documents consistently frame informal settlements in the context of their climate and environmental risk exposure, our analysis of proposed solutions revealed a significant gap in NbR. This specific category of response was cited in only two of the 42 documents reviewed (or 5%) (see Table 9).

This does not mean, however, that no solutions were proposed. Responses linked to dealing specifically with environmental and climate risk in informal settlements included:

- Data collection/risk assessments or mapping
- Early warning systems and increased preparedness
- Relocation/resettlement. Mostly because of the location of slums or informal settlements in risk-prone or at-risk areas like floodplains
- Settlement improvements, directly linked to making settlements more climate resilient

Table 9. NbR mentions in documents mentioning informal settlements

DOCUMENT TYPE	NUMBER OF DOCUMENTS THAT MENTION ANY NBR IN INFORMAL SETTLEMENTS	PERCENTAGE
NAPs	0	0
NDCs	0	0
National urban documents	0	0
National development documents	0	0
National climate documents	0	0
National DRR documents	0	0
City-level climate documents	2	20
All document types	2	5

Other responses proposed that are not related to environmental or climate risk, but more to other issues that informal settlements face are:

- Improvements to infrastructure (for example, roads and sewage systems) or housing (housing resilience, cooling)
- Increasing the availability of affordable housing
- Controlling, regulating or preventing the spread of informal settlements by imposing penalties, changing land use planning laws or other restriction programmes
- Improving tenure/formalising land holding
- Water, sanitation and hygiene programmes, and
- Social protection programmes.

This means that responses can be put into three distinct reoccurring categories:

1. State-led control approaches

This category encompasses policies aimed at managing informal settlements through direct, top-down government intervention. These responses include the prohibition of new settlements, formalisation of existing ones and, in high-risk scenarios, planned relocation. It also includes the provision of affordable housing. This framing is evident in policy goals such as to “Phase out informal housing by the year 2030”, “Completely prohibit the formation of new informal housing settlements” and “enforce development regulations in hazard-prone areas and relocate households occupying environmentally sensitive or hazard prone areas” (Kenya National Urban Development Policy, 2016). Similarly, Ecuador’s 2036 Habitat Agenda aims for “Reversing informal settlement processes and preventing irregular occupation”. When settlements are in hazardous areas, this approach often translates into managed resettlement, such as “Relocation in areas of active landslides and precarious housing” (Tegucigalpa City Climate Action Plan, 2016).

2. In-situ upgrading and enhanced resilience

This category shifts the focus from removal of informal settlements to improving existing settlements. This approach includes general calls to “Enhance informal settlements improvement schemes” (Mombasa City County Climate Action Plan, 2023) as well as strategies that directly link upgrading to climate resilience. These interventions can be physical, such as “Increase the application of cool and reflective roofs in informal settlements” (Freetown Heat Action Plan, 2025), or social and financial. For example, the Cambodia NDC (2025) proposes “climate-sensitive housing assistance for poor and vulnerable populations... in informal settlements prone to climate hazards.” Ecuador’s NAP (2023) likewise aims to “develop and implement programmes to improve living conditions... to strengthen their adaptive capacity.”

Some policies provide a more nuanced framework for this approach. The Bangladesh National Urban Sector Policy (2025), for example, states that “slums are an integral part of urban areas” and advocates for “slum upgrading/improvement”. However, it crucially distinguishes between “tenable” and “untenable” slums, defining the latter as settlements where habitation “entails undue risk to the safety or health, or life of the residents” or is “contrary to ‘public interest’”. This distinction often provides the rationale for deciding between in-situ upgrading and the control-based approaches mentioned previously.

3. Risk assessment and monitoring

This third category of responses focuses on risk assessment and monitoring. These non-physical interventions are foundational to understanding and communicating climate threats, rather than physically altering settlements. They prominently include data collection, risk mapping and the establishment of warning systems.

Some policies call for direct risk analysis, such as Ecuador’s NAP (2023), which plans to “Develop an assessment of climate risks in existing informal settlements in the event of extreme weather events”.

Others, like the Nairobi City County Climate Action Plan (2020), link data collection directly to participatory planning, committing to the “Development of Flood Management Plans & Guidelines with city residents (especially those in informal settlements...)” by “increasing continuous data collection and flood-hazard mapping”. Beyond assessment, this category also includes proactive communication tools, such as Freetown’s Heat Action Plan (2025), which proposes a “Comprehensive Heat-Health Early Warning System (HHEWS) incl. IS [Informal Settlements].”

5

Analysis of findings

5.1 NbR across all levels

Overall, the evidence suggests that NbS is not yet a commonly used term in policy documents. However, the broader category of NbR is widespread, meaning that the absence of the NbS label does not imply that nature is not widely viewed as a means to address climate- and risk-related challenges.

Our findings suggest that policy frequently mobilises nature to address climate- and risk-related challenges. However, this broad prevalence does not translate consistently into explicit application to urban contexts: while 90% of documents referenced some form of NbR, only 57% linked NbR specifically to urban areas. Our findings further suggest that this seems to be done more through NbA designed to address specific risks (such as restoring riverbanks to reduce flood risks or reforesting slopes to reduce landslides) rather than through the explicit use of the term NbS.

We also found varying degrees to which NbRs reflected the systematic inclusion of co-benefits for biodiversity and people. Although some initiatives may generate these outcomes incidentally (for example, urban green spaces created to reduce the impacts of the urban heat island effect may also improve urban residents' wellbeing and increase biodiversity), this does not mean that they are systematically designed or implemented with these wider NbS principles in mind. Rather, the evidence suggests uneven and context-dependent incorporation of co-benefit considerations across countries, sectors and policy domains. This is in line with Zhai et al.'s (2023) analysis of 190 NDCs, which found that only 18 countries (about 9.5% of NDCs) had recognised the synergistic benefits of NbS in economic, social and environmental dimensions.

In our review, co-benefits were mentioned in a number of ways — for example benefits to either biodiversity or people were mentioned, but not together. Examples of the various ways that NbR are written to benefit either

one component (reduce risk or climate mitigation) or consider additional benefits — either singular (people but not biodiversity) or multiple — can be found in Box 3.

Importantly, 12 of the 37 documents that explicitly mention NbA also make reference to NbS. This could imply that these NbA are being designed with the broader co-benefit principles of NbS in mind but that they simply appear in separate areas of the policy document. At the same time, the frequent use of NbA without explicit reference to NbS does not necessarily indicate a rejection of co-benefit approaches. Rather, it may reflect differences in institutional language, sectoral framing or the relatively recent emergence of NbS as a policy term compared to more established practices. It is also possible that broader considerations of co-benefits are more present in implementation processes than in policy documentation.

Deeper analysis of these dynamics is beyond the scope of this research, which prioritised the systematic identification of NbR, and their distribution across policy documents and spatial scales, rather than a detailed discourse analysis within each category. As a result, while the study captures the frequency and contextual use of these framings, it does not examine in depth how co-benefits, equity considerations or socioecological outcomes are constructed differently across NbR (for example, between NbS and NbA), or how these framings interact with policy type, sectoral focus, a country's political economy or broader regulatory environments. It also does not systematically assess how NbA-only documents may implicitly reflect NbS principles. This limits the ability to compare in detail how co-benefits and distributional outcomes are articulated across framings. Future research could build on this dataset to investigate how differently equity, co-benefits and socioecological objectives are defined, prioritised and operationalised across urban policy contexts. Another area of future research could be an investigation into the types of measures that are prioritised in policy to address climate- and risk-related challenges.

BOX 3. HOW BENEFITS AND CO-BENEFITS ARE DESCRIBED

“...the restoration of land in flood plains by planting trees, which helps to reduce impacts of floods, improve water quality, and lead to co-benefits such as restoring biodiversity and sequestering greenhouse gases” — Sierra Leone National Disaster Preparedness and Response Plan (2024)

“...restoring natural barriers such as mangroves and dunes to protect against coastal hazards” — Sierra Leone National Disaster Preparedness and Response Plan (2024)

“Mitigation – GHG [greenhouse gas] emission reductions of 37.3 MtCO₂eq by 2027, against a BAU [business as usual] (based on FRL3 analysis) of 52.3 MtCO₂eq, through forest restoration, afforestation and reforestation” — Kenya National Climate Change Action Plan (2023)

“...planting trees in urban centres to moderate temperatures and ensure fresh air for healthy living” — Kenya National Climate Change Response Strategy (2010)

“Promote the protection, good management and restoration of ecosystems as a fundamental axis for the adaptation of urban and rural communities, as well as the achievement of environmental and socio-economic co-benefits” — Honduras NAP (2018)

“To address urban heat, a green space development toolkit will be introduced by 2028, with pilot projects in two cities” — Cambodia NDC (2025)

“Practices like tree planting help buffer climate impacts (e.g., heat, flooding)” — Cambodia NDC (2025)

“The importance of thick belts of mangroves in reducing the destructive capacity of storm surges, was demonstrated during Cyclone Sidr. An expansion of the ‘green belts’ would afford extra protection and increase livelihoods opportunities for the poor” — Bangladesh Climate Change Strategy and Action Plan (2009)

5.1.1 The risks of not considering biodiversity in NbR

The degree to which interventions deliver co-benefits for biodiversity and human wellbeing hinges on how intentionally and systematically they are planned, implemented and monitored. Without such intentionality, the use of nature risks being reduced to a narrow technical fix with possible negative consequences, even for nature itself.

For example, 64% of the documents we reviewed mentioned reforestation or afforestation initiatives. Interventions such as reforestation, without consideration for biodiversity benefits and broader ecological processes, may not result in a healthy forest and may even defer to single-species interventions that sequester carbon, therefore contributing to climate mitigation, but fail to support broader ecosystem functions. A lack of consideration for biodiversity can also impact the long-term resilience of interventions. Ecosystems that are rich in genetic and species diversity tend to be more resilient to climate shocks and better able to recover from extreme events.

Of the documents we reviewed, 43% mentioned tree planting. Large-scale national tree planting campaigns have become a popular ‘solution’ in tackling climate change, from major government programmes to local grassroots campaigns. The idea is simple and appealing, but the outcomes depend heavily on how projects are designed and implemented (Moosa,

2024). Tree planting itself is an umbrella term that can range from approaches — such as urban greening, agroforestry, ecological restoration and reforestation of previously forested land — to more expansive and interventionist strategies that begin to resemble afforestation, where forests are established on land not historically forested. While many tree-planting interventions can be ecologically grounded, in all cases, tree planting requires careful attention to ecological suitability (for example, hydrology). This is particularly important in afforestation contexts, where trees are introduced to landscapes that did not historically support forest cover, making them more ecologically uncertain. Therefore, when done without attention to biodiversity, ecosystem health or local context, tree planting may provide limited benefits, such as mitigating heat or landslides, but fall short of supporting broader ecological functions (Moosa, 2024). In the worst cases, poorly planned projects can fail because they introduce the wrong trees (for example, non-native species) in the wrong place (Saad, 2024), create monocultures, or increase vulnerability to fire, leading to unintended environmental and social impacts (Moosa, 2024; Heal, 2023). Large-scale initiatives like the Bonn Challenge, which aims to restore 350 million hectares of degraded land by 2030, have inspired regional efforts such as Africa’s AFR100 and India’s national tree-planting drives, highlighting both the potential and the challenges of scaling tree-based interventions responsibly (Moosa, 2024). This can explain the high level of mentions of tree planting and reforestation in the documents analysed. In Kenya, for example, ‘tree planting’ was mentioned

67 times across policy documents. This prevalence likely relates to ongoing national tree-planting objectives such as the 15 Billion Tree Growing Programme linked to the government's ambitious goal of 30% tree cover by 2050. A concern over the over-emphasis of tree-planting was noted by Seddon et al. (2021), highlighting the above-mentioned issues but also the neglect of a wide range of NbS as funds are channelled towards this universally appealing intervention.

5.2 NbR in cities

Our analysis highlights that urbanisation is consistently recognised across policy documents as a major driver of environmental degradation and increased climate risk. Rapid urban growth is linked to the degradation of nature, which in turn exacerbates flooding, landslides, coastal hazards and urban heat. In this sense, degraded nature is commonly framed as a risk multiplier within urban contexts.

However, while many documents acknowledge the negative relationship between urban development and ecological decline, nature is not often treated as an active mechanism for addressing climate- and risk-related challenges. The analysis indicates that NbR remain only partially integrated into urban policy and planning frameworks (covering 57% of documents). With urban NbS only mentioned in 19% of documents, their presence is even more limited than the already modest integration of NbR.

Although nature is increasingly acknowledged within urban resilience discourse, its translation into city-level strategies appears uneven and limited in scope. This resonates with our review as well as the review by Zhai et al. (2023), which found that across 190 NDCs, NbS has not yet become a central measure for addressing climate change in cities, with most emphasis placed on forest and agricultural ecosystems. Taken together, these findings suggest that the embedding of urban NbS (or any NbR) into policy to address climate- and risk-related challenges in urban contexts remains incomplete.

Importantly, 57% of papers *did* include urban NbR, and this figure should not be interpreted as indicating an absence of progress. Cambodia and Ecuador provide some positive examples of nature's integration in urban policy. In Cambodia's National Cooling Action Plan, nature is explicitly linked to urban cooling and climate resilience. It states that "the provision of parks and urban forests, lakes, streams and canals is essential to maintain the coolness of cities with hot climates and to reduce the urban-heat island effect." The plan further aims to "reduce cooling demand... through better urban planning and building design, and the use of nature-based solutions such as green public spaces and green roofs and walls," directly embedding NbS into cooling and energy strategies. In Quito's Climate Action Plan (2020), a sub-action to eco-efficient

neighbourhoods and parks is: "Nature-based solutions for climate change adaptation in the San Enrique de Velasco neighbourhood. It includes the proposed NbS plan (urban trees, stream management and resilient public spaces) for this neighbourhood and surrounding neighbourhoods, which in turn includes proposals for long-term interventions for urban regeneration, taking into account the potential risks of climate change".

Overall, documents that explicitly reference NbS tended to be more likely to articulate co-benefits in a multidimensional way, linking human wellbeing (for example, resilience, health and livelihoods) with ecological outcomes (for example, biodiversity and ecosystem restoration).

Of course, the question still remains: within the 57% of documents that reference NbR, for whom are NbR actually intended?

5.2.1 Equity considerations in urban areas

Equity considerations are central in urban NbR, as the benefits and burdens of these interventions are not automatically distributed evenly across urban populations. An NbR may successfully reduce flooding, heat exposure or erosion for one group, yet still produce adverse social outcomes if these benefits are achieved through the displacement of other communities, the loss of access to land or resources, or the marginalisation of local livelihoods. For instance, measures that reduce flooding in densely populated upstream areas may inadvertently intensify exposure downstream (Lee and Huang, 2018 cited in Esraz-UI-Zannat et al., 2024). In another example, a shelterbelt project in China intended to shield urban residents from dust storms, but it constrained irrigation water availability for downstream Uighur communities (Seddon et al., 2021). In this sense, effectiveness cannot be defined solely by aggregate risk reduction, but must also account for how benefits and harms are distributed across different groups. This issue raises a critical question around the distributional justice of all forms of NbR.

As noted earlier, cities are spaces of high inequality, and common NbR such as urban greening do not automatically translate into equitable access to green spaces, as access often aligns closely with income and socioracial divides. In fact, studies in several global North and global South countries show systemic inequities in the distribution of urban green spaces — including parks, tree canopy and other vegetated spaces — across socioeconomic and racial/ethnic lines (Rigolon et al., 2024). Major South African cities illustrate this clearly, where urban green infrastructure remains unevenly distributed across income and racial geographies, with affluence strongly predicting access to green space (Venter et al., 2020). This urban

inequality can be tied to broader concepts such as 'residential segregation' (Smith, 2015).

This inequality is particularly relevant given the frequent mentions of 'green spaces' as urban NbS in the policy documents we reviewed, raising questions about how the benefits of urban greening are likely to be distributed in practice. This is in line with findings that systemic inequities in the distribution of green spaces in cities exist because underserved groups, such as the urban poor and people of colour, are generally not represented in decision-making processes about the location and qualities of new green spaces (Rigolon et al., 2024). For example, Quito's Climate Action Plan (2020) states that they will prioritise an urban green network which will be a "system of green connectors, through the urban fabric, [that] will generate a spatial link between natural conservation areas (forests, shrubs and moors) and natural urban green spaces [...], recreational spaces [...], road infrastructure [...], [and] buildings (green roofs and urban gardens), with the aim of increasing the percentage of urban green space and revitalising the city's neighbourhoods". However, which neighbourhoods will be prioritised, and which segments of the city may be excluded, has not been clarified.

In a paper by Goodwin et al. (2023), the authors mapped and analysed NbS approaches specifically for climate change adaptation across 216 urban interventions and 130 cities worldwide. They speak of NbS as attempting to address the interconnected climate–biodiversity–society nexus. Their results suggested that current urban NbS practices are limited in how they may comprehensively address climate–biodiversity–society challenges, as most of the NbS tended to be 'reformist' rather than transformative (that is, looking to address the problem structurally or systemically). They argue that this was often due to limited engagement with meaningful social participation beyond superficial consultation, piecemeal approaches to enhancing urban biodiversity, and weak integration with broader urban planning systems and governance structures. These findings resonate strongly with the concerns around distributional justice discussed above. While many urban NbS seek to reduce climate risks, they do not necessarily challenge the underlying social and spatial inequalities that shape vulnerability and access to environmental benefits. In other words, NbS may successfully deliver environmental improvements while leaving existing patterns of exclusion intact. Goodwin et al. therefore argue that more transformative approaches require greater attention to social recognition, participation and the equitable distribution of benefits, all of which are central to achieving more just and sustainable urban futures. Importantly, the authors also found that interventions in the Americas, particularly in Latin America and the Caribbean, accounted for a disproportionate share of transformative examples of NbS.

5.3 NbR and informal settlements

The analysis underscores how dominant narratives around informal settlements can shape the types of interventions that are imagined as appropriate or legitimate. Where risk is framed primarily as a function of hazardous location, the policy logic tends to favour relocation or resettlement to less exposed areas. By contrast, if there is recognition that risk is shaped by factors such as poor housing, infrastructure and services, then there is a rationale for improvement in these areas. This reframing legitimises upgrading, improved service provision and safer construction. It is also the most likely to legitimise in-situ nature responses such as enhanced drainage, heat mitigation or slope stabilisation. Similarly, social vulnerability narratives can enable more supportive measures, including social protection, cash-for-work schemes and participatory upgrading processes that strengthen agency and collective capacity. Thus, the way informal settlements are problematised is not merely discursive; it can shape the range of responses considered legitimate and influence prospects for more just and durable forms of urban resilience.

5.3.1 How vulnerable groups are addressed

Given that gender and inclusion are cross-cutting priorities for many countries, the review also examined whether, and in what ways, other climate- and disaster-vulnerable groups are addressed in these policy documents. These groups included women, children and youth, people with disabilities, the elderly, and lesbian, gay, bisexual, transgender, queer, intersex and more (LGBTQI+) people. With the exception of LGBTQI+ people, these groups appear consistently across the documents, are mentioned hundreds of times in some documents, and are frequently linked to specific programmes, actions or targets. They are predominantly framed through a social vulnerability lens, in which vulnerability arises from inequality, exclusion and deficits in rights, with recognition of intersectional dynamics. In these contexts, rights-based and inclusion-oriented language is more explicitly mobilised, including references to empowerment, participation in decision making, and mainstreaming through gender equality and social inclusion (GESI) frameworks. These portrayals are often paired with narratives of agency: for example, women as "frontline agents of adaptation," youth as "leaders in innovation" and people with disabilities as "key participants in inclusive disaster risk management."

In contrast, references to informal settlements typically present them as descriptive categories of exposure or vulnerability, framed primarily through environmental and governance challenges (for example, being 'unregulated') with little reference to the residents of these settlements.

Their vulnerability is often depicted primarily as spatial and physical, and notions of agency are extremely limited and inconsistently articulated, despite notable exceptions. When residents are explicitly mentioned, they tend more often to be described as ‘at risk’, positioning them as vulnerable objects of intervention to be corrected or managed and the informal settlements in which they live as problems to solve. Women, children, people with disabilities and other socially vulnerable groups are also residents of informal settlements. However, the analysis suggests that policy documents tend to frame vulnerability differently depending on the category invoked.

This can be linked to broader issues with informality as urban dwellers and their self-constructed settlements are often subject to official hostility and social stigma (Agyabeng et al., 2021). Informal settlements fall outside formal laws and regulations on land ownerships, land use and buildings, and this illegality makes government agencies unable or unwilling to work with them (Satterthwaite et al., 2020). These patterns of policy framing may also help explain some of the barriers identified in the NbS literature. For example, Castaldo et al. (2025) note that informal and self-constructed housing is frequently presented as a challenge for the implementation of NbS at city, building and household scale in cities across the global South. Such characterisations highlight the view of informality as an obstacle to intervention rather than recognising residents as active participants in adaptation processes.

It is important to clarify that this distinction in policy framing between residents of informal settlements and other vulnerable groups, even when including narratives of agency, does not equate to a resolution of underlying inequalities or the adoption of intersectional justice. This observation should not obscure the reality that substantial progress is still required to address the systemic vulnerabilities and significant gaps in inclusion affecting all these populations. As UN-Habitat’s 2024 World Cities Report made clear:

“The climate crisis is already interacting with existing patterns of inequality and exclusion, meaning the most marginalized populations—including women, children, migrants, people with disabilities, ethnic minorities and Indigenous Peoples—are disproportionately affected. Currently, urban climate interventions are failing to adequately recognize the specific challenges these groups face. Consequently, millions of urban residents (especially those living in informal settlements) are being excluded from adaptation plans and even negatively impacted by climate interventions that overlook their needs.”

(UN-Habitat, 2024, p.xvii).

The situation is particularly dire for people living with disabilities, who are often invisible in climate change policies and programmes. As a result, they are up to four times more likely to die in the event of a climate-related disaster compared to other groups (UN-Habitat, 2024). This understanding that social, economic, historical and political processes interact with intersectional dimensions of identity, such as gender, age, sexual orientation, physical ability, ethnicity, language and religion, means that even within a broadly vulnerable group, such as residents of informal settlements, individuals may face added risks based on factors like gender, ethnicity or physical ability.

This framing of informal settlements in the policy documents we reviewed (as well as broader, well-documented framing outside of this research) means that urban NbR can have disproportionately negative impacts on these residents, even as they aim to improve environmental outcomes for the wider city. In India, for example, informal settlements have been cleared to make way for interventions such as mangrove restoration and urban green space conservation (Doshi, 2018). Similarly, in Nairobi, in response to rivers facing severe pollution and biodiversity loss due to unregulated development, the Nairobi River Commission (NRC) was established to restore Nairobi’s rivers and promote sustainable urban development. Informal settlements along the riverbanks face heightened risks of flooding and contamination, as evidenced during the heavy rains in early 2024, which led to widespread destruction and loss of life. While the NRC has been working to develop a master plan for river regeneration and coordinating various actors, recent government-mandated demolitions in riparian zones have displaced thousands, complicating the regeneration process (KDI, no date).

This tension is dramatically evidenced in Dhaka, Bangladesh where urban greening is entangled with processes of exclusion and redevelopment, as shown by a study undertaken by Sultana et al. (2020). The study examines how the aspirations of policymakers to action urban greening has manifested in relation to the lived reality of Dhaka’s citizens, particularly those in Korail, the largest informal settlement in Dhaka. As part of broader urban development plans aligned with the government’s greening policymaking, Korail’s centrally located land has been earmarked for redevelopment, including the proposed Mohakhali Information and Communications Technology (ICT) Village. The aim is to foster economic growth and introduce planned areas for urban greening. This planned urban greening, however, requires the relocation of Korail’s residents to peripheral areas, exposing them to risks of livelihood disruption and spatial marginalisation (Sultana et al., 2020). Sultana et al. (2020) also highlight that urban greening already exists within Korail through grassroots practices, despite limited policy recognition or support. Informal settlements have the fewest formal green spaces in Dhaka, and those that

do exist remain vulnerable due to insecure tenure, lack of planning inclusion and redevelopment pressures. Urban greening policies such as this one tend to reflect middle-class priorities, often framed in terms of beautification (Sultana et al., 2020). Resettlement in this case is presented by authorities as offering a win-win situation — improved amenities and services to residents of informal settlements in municipally planned fringe sites, and a 'slum-free' urban core to wealthier residents (Sultana et al., 2020). These dynamics illustrate how urban greening, rather than being universally beneficial, can reproduce existing power relations and exclusions.

Such examples illustrate the difficulty of equitably distributing the benefits and burdens of NbS, underscoring the importance of governance frameworks that explicitly prioritise resilience and justice (Driessen

et al., 2018 cited in Esraz-UI-Zannat et al., 2024). A review by Castaldo et al. (2025) on the practical viability of urban NbS in the global South found that justice and public participation emerged as cross-cutting issues — specifically finding that vulnerable groups such as the urban poor were disproportionately affected by issues related to environmental justice, unequal access to green space and greater exposure to environmental risks.

As outlined in Table 1, of the 42 documents we reviewed, we found two that reference NbR in informal settlements. Both documents were from Sierra Leone. One of these is Freetown's community tree initiative, The #FreetownTheTreetown initiative that forms part of the Transform Freetown agenda and the Freetown Climate Action Plan (2023). Details of this initiative are highlighted in Box 4.

BOX 4. FREETOWN'S COMMUNITY TREE INITIATIVE TARGETS INFORMAL SETTLEMENTS

The Freetown Climate Action Plan for 2022–2030 positions nature as central to its adaptation strategy. Vision 3 of the plan is about “developing climate-resilient communities in Freetown by enhancing nature in our urban environments and the natural ability of ecosystems to buffer climate change impacts.” This is implemented through a dedicated Urban Nature-based Solutions Programme focused on EbA.

The programme's flagship initiative is #FreetownTheTreetown, a community-driven tree-planting and reforestation effort. It aims to plant one million trees specifically to reduce landslides, erosion, flooding, heat stress and deforestation. #FreetownTheTreetown uses a community growing model, where reforestation is co-designed and co-managed by the community and the city government. Freetown residents are involved in decision making on where trees are planted and receive payments to plant, grow and digitally track trees on a mobile TreeTracker app. Trees are planted to restore urban land in and around Freetown, including planting on roadsides, schools and in residential areas. The plan is to: reduce heat stress and improve air quality; plant in water catchment areas and Freetown's greenbelt to improve water security; plant in the upper water catchment and on high slopes around Freetown to reduce the risk of flash flooding and landslides; and plant in mangroves for reforestation to reduce coastal erosion and flooding.

The digital system creates a unique geotagged record for each tree planted. Growers revisit each tree periodically to water and maintain it, and to verify and document its survival, receiving micro-payments via mobile money every two months over the first three to five years of the tree's life (when trees need most maintenance). The growers' financial compensation is tied to continued tracking. The seedlings are procured from local nurseries to maximise the benefits to the local economy. This model has enabled 80% of the total resources leveraged for the project to be injected into local communities.

The initiative also plans to introduce NbS through the restoration of watersheds, mangrove areas, wetlands, urban forests and natural areas with steep slopes.

The plan explicitly recognises that informal settlements are disproportionately vulnerable to climate impacts, including heat, flooding and disease, due to unsafe locations and inadequate housing materials. The #FreetownTheTreetown initiative aims to improve the equitable distribution of trees and green space by ensuring that 35% of areas targeted for new trees or vegetation are in informal settlements with low coverage, including them as priority sites for intervention.

In addition to the above, strategies for green corridors are also planned for 'vulnerable communities', directly linking NbS to heat mitigation and wellbeing. However, while the document consistently and explicitly identifies informal settlements as a key 'vulnerable group', it is unclear whether the strategy will include informal settlements explicitly.

While the #FreetownTheTreetown initiative and the wider NbS/EbA framework are city-wide programmes, they explicitly integrate informal settlements as key target areas for the distribution of trees and green spaces. This inclusion signifies a clear policy intention to direct nature-based interventions to these vulnerable locations, even if it does not constitute a comprehensive solution for all climate risks they face.

6

Case studies of nature-based responses

Despite the social, physical and legal issues that they face, residents of informal settlements are agents of change, uniquely positioned to lead effective community-driven initiatives to tackle the various challenges they face.

Whether governments permit, support, restrict or prohibit people from doing their own housing or neighbourhood construction or renovation work, people make choices and take actions in order to address their own needs even when it challenges centralised authority (Holston, 2008 cited in Carrasco and Dangol, 2020). Of course, governance provides an important contextual framing, particularly in environments where it is weak or contested (Birkmann et al., 2022). In these cases, it can mean that adaptation options stem largely from the local level (Birkmann et al., 2022). Studies have shown how disadvantaged urban communities self-organise to demand public services and use collective action to pursue their own development (Rigon, 2014). These grassroots practices respond to the urge to survive and withstand disruptive challenges such as hazard exposure (Carrasco and Dangol, 2020), ultimately keeping residents and their communities safe when facing government neglect (Sudhakar, 2024).

Evidence from across the global South suggests that low-income and informal urban communities already engage with nature in adaptive and resourceful ways. For example, Kibii et al. (2025) found that NbS are already implemented in informal urban settlements in Nairobi and Buenos Aires to provide multiple benefits to residents. Similarly, a systematic review of projects in Southeast Asian and Pacific countries found at least 37 projects using NbS in informal settlements, including green open spaces, community gardens, waterfront revegetation and constructed wetlands

(Wolff et al., 2023). The same study also found that NbS projects were motivated by at least one of four reasons: climate resilience and adaptation; sanitation and waste management; income and food security; and compensation and culture. At least 17 out of the 37 identified projects claimed to address one or more concerns related to storms, floods and extreme temperatures. Examples from this review showed that NbS in informal settlements can be highly site-specific and deeply connected with the needs of residents. Boxes 5 and 6 indicate examples where informal settlements have used nature to deal with societal challenges related to food security, while also interconnecting outcomes for environmental restoration, livelihood generation and community resilience building.

It is important to explore how NbR can manifest itself in informal settlements. This is either through projects that are externally initiated or funded, or bottom-up grassroots community-only initiatives. The inclusion of both types of NbR are in line with Wolff et al.'s (2023) assessment where they noted that the literature showed that most projects implementing NbS in informal settlements are developed either by communities in response to local needs or by international organisations as part of infrastructure development efforts — NbS can therefore often be framed as either grassroots initiatives spearheaded by local communities or as technical systems implemented within “upgrading programmes delivered by multilateral banks, researchers or international organisations.” Furthermore, Castaldo et al. (2025) point out that the involvement of nongovernmental actors such as research entities and transnational organisations is of great significance in promoting the uptake of NbS in global South cities.

BOX 6. DANDARA PEOPLE'S AGROECOLOGICAL GARDEN, RECIFE, BRAZIL

Located in the Peixinhos neighbourhood of metropolitan Recife, the Dandara People's Agroecological Garden is a grassroots urban agriculture project led primarily by Black women. Established four years ago with support from the Sabiá Agroecological Development Centre, the initiative promotes agroecological food production, food sovereignty, women's empowerment, and community self-care in an underserved urban area.

The garden provides nutritious food while contributing to climate adaptation through the creation of green, permeable space within a densely built informal settlement. Community-led activities in this space also include rainwater harvesting through a cistern and composting systems for organic waste management. Beyond food production, the project supports literacy and cultural revival through partnerships with the Nascedouro Multicultural Library, a space for women of the community to support each other, and an area of the settlements that is cooler in the hottest months. Situated on the site of a former slaughterhouse and phosphorite factory, the garden demonstrates how neglected urban land can be transformed into productive green infrastructure that strengthens environmental resilience, social inclusion, and community wellbeing.

BOX 5. NEW GREENLAND URBAN FARM, QUEZON CITY, PHILIPPINES

Established in 2021 during the COVID-19 pandemic, the New Greenland Urban Farm is a community-led urban agriculture initiative in Barangay Bagong Silangan, Quezon City. Building on existing small-scale farming and vegetable vending activities, the project began with 60 farmers and has expanded to around 100 cooperative members, including women, men and youth. Guided by the principle '*Tanim, Pitas, Kita*' ('Plant, Harvest, Earn'), the initiative strengthens food security, livelihoods, and community health within an informal settlement context.

Supported through partnerships with local and national government agencies, the cooperative demonstrates how NbS can address food insecurity and climate risks in flood-prone urban areas. Members cultivate climate-resilient crops, maintain community savings groups, and organise preparedness measures such as evacuation planning during the rainy season. The project highlights the role of urban farming and cooperative organisation in building resilience and generating income for low-income communities facing insecure land tenure and environmental vulnerability.

It is important to note that interventions by INGOs, universities and multilateral agencies tend to be documented — resulting in online available publications as either grey literature (for example, project reports) or peer-reviewed literature (for example, journal articles). In comparison, community-initiated projects tend to be sparingly documented and information may be found on unconventional channels, such as the Instagram or Facebook pages run by the grassroots organisation leading the project. Lastly, household-level initiatives may not be documented at all.

Below is a selection of case studies that resulted from our call for case studies.

6.1 Harnessing nature in Bahia's informal settlements

In Salvador, Brazil, informal settlements are facing overlapping environmental, social and health challenges. The settlements have high population densities and their communities are among the city's poorest, regularly

exposed to flooding and landslides alongside structural issues such as inadequate sewage systems and irregular waste collection.

Residents also have to cope daily with severe heat, water scarcity, food insecurity and rising rates of mosquito-borne diseases. In response, the Institute of Collective Health at the Federal University of Bahia as well as the Gonçalo Moniz Institute at the Fiocruz/Bahia initiated community-based participatory research, which supported local communities to develop NbA tailored to their needs and context. The project worked through partnerships with community-based organisations, women's groups and youth groups.

Interventions focused on using nature to improve living conditions and reduce risks — including tree planting and beekeeping to improve biodiversity and protect ecosystems, rooftop gardens to address food insecurity, the recovery of natural springs and streams to reduce water scarcity, and sustainable construction practices to improve thermal comfort.

To maintain strong community engagement, they prioritised locally identified needs by forming local groups and creating outreach activities. Offering training courses (for example, language and computer skills) and hosting health fairs increased participation.

6.1.1 Outcomes

The initiative has led to some positive outcomes. Socially, it has contributed to increased social cohesion, greater awareness of environmental health issues, and the development of skills and some income-generating opportunities. While climate-related impacts are still emerging, early observations include lower temperatures in shaded areas and a reduction in breeding sites for disease reservoirs and vectors. The process has also fostered renewed awareness of ancestral knowledge related to the potential of NbS to address environmental and climate challenges.

6.1.2 Challenges

The initiative encountered several challenges and constraints. Despite lack of finance and technical capacity, the initiative developed a strategy in collaboration with the government, university and local NGOs. For example, the university technical teams organised practical workshops for residents on NbS. However, consistent engagement from government actors was a challenge.

The initiative adopted a demand-driven approach that prioritised locally identified needs. This involved forming local community groups and launching outreach activities tailored to community needs. However, in some instances, not all community concerns could be fully addressed, which influenced participation and engagement. Certain NbS were not pursued due to the need to align with local cultural values, ancestral customs and community preferences, while others, such as green roofs and biofilters, faced feasibility challenges related to maintenance demands and associated costs. Additionally, security concerns in the area posed some serious threats and hindered project development.

6.1.3 Recognition

Although the initiative received on the ground support, it has not yet been formally recognised or embedded within policy frameworks. However, it offers an example of how NbS are being explored in informal settlements through participatory, community-led processes despite challenging conditions.

Submitted by: Hernan Darío Argibay

Email: mvhernanargibay@gmail.com

Affiliation: Institute of Collective Health — Federal University of Bahia

6.2 Water-sensitive upgrading in informal settlements in Indonesia and Fiji

The RISE (Revitalising Informal Settlements and their Environments) programme works in 24 informal settlements in Suva, the capital of Fiji, and Makassar, the capital of South Sulawesi province in Indonesia. Together, these settlements are home to approximately 1,700 households and around 9,000 adults and children. Long-standing degradation, poor infrastructure and limited services, combined with increasing climate risks and the location of settlements in low-lying flood prone coastal zones, have resulted in chronic exposure to frequent flooding, faecally contaminated environments and unreliable water access. Persistent flooding not only increases residents' exposure to polluted waters, but also restricts access within settlements and limits residents' ability to reach work, school and essential services. Heat stress is an additional threat, exacerbated by low-quality housing, limited vegetation and airflow, lack of cooling options, water insecurity, and exclusion from services.

The RISE programme takes a water-sensitive approach to informal settlement upgrading, combining technical, environmental and social strategies within a sociotechnical delivery model. Participatory co-design is central to this process, placing communities at the heart of decision making. Through facilitated workshops, residents identify urgent climate-related risks, map areas of exposure and help assess feasible adaptation options based on lived experience. In partnership with the RISE team, communities then co-design and implement context-specific solutions that address immediate environmental threats, strengthen longer-term climate resilience, and foster local ownership of the interventions.

NbS are key to the approach. Technical interventions include constructed wetlands alongside drainage systems, rainwater harvesting tanks, internet-connected pressure sewer units, and flood-mitigation features such as elevated pathways. Complementary upgrades are also included, and each upgrade is co-designed through participatory processes to ensure alignment with local needs and priorities, including the needs of women, children, older adults and people with disabilities. Stewardship of the infrastructure is shared between communities, local governments and the RISE programme, encompassing system monitoring, maintenance and collaborative governance.

The wetlands naturally treat wastewater, rainwater harvesting reduces pressure on scarce freshwater supplies, and smart pressure sewers complement low-energy ecological drainage processes.

RISE (with primary funding from the Wellcome Trust) is led by Monash University in collaboration with a consortium of partners, including the City of Makassar, Hasanuddin University, the Government of Fiji and Fiji National University. The programme brings together local authorities, utility service agencies, academia, private contractors and communities. Community participation is coordinated through Community Engagement Committees, each with a nominated leader from the 24 settlements, creating a platform for cross-sectoral collaboration grounded in local leadership.

6.2.1 Challenges

Implementation has involved navigating complex technical, social, financial, and regulatory challenges. A key issue has been establishing funding and financing pathways capable of supporting not only initial construction, but also the participation, operations and maintenance needed for long-term performance. Delivery has also required working in challenging biophysical contexts, alongside constraints such as limited land availability, the international procurement of specialist equipment and extended approval processes for unconventional wastewater systems. Informal land tenure has required continual negotiation over infrastructure placement, while fragmented bureaucratic responsibilities have demanded sustained coordination across multiple agencies. Ensuring long-term success also depends on strong community stewardship, supported by intensive engagement, behaviour-change processes and transparent governance arrangements.

6.2.2 Outcomes

Early feedback from residents suggests high levels of satisfaction with the infrastructure, with access pathways, rainwater tanks, improved drainage and new or repaired toilets being most beneficial. Residents have also reported improved safety and both cost and time savings. A randomised controlled trial continues to rigorously assess impacts on environmental quality, community health and child microbial exposure, with full results expected in 2027.

6.2.3 Recognition

The programme has also been recognised in policy. In Fiji, the RISE approach has led to the establishment of an Inter-Agency Taskforce on Informal Settlements, endorsed in Parliament, with a dedicated working group focused on scaling up RISE. The model has been incorporated into the Fiji Water Sector Strategy 2050 as a recommended approach for addressing water and sanitation challenges in informal settlements. In Indonesia, capacity built through RISE has contributed to national initiatives, including the design

and training of staff for the country's new capital city, demonstrating the programme's broader influence beyond the pilot settlements.

Submitted by: Trish Nichols

Email: rise.communications@monash.edu

Affiliation: Monash University

6.3 Community-led nature-based solutions in Kibera, Nairobi

Kibera, Nairobi's largest informal settlement, stretches along the Ngong River and is home to around 200,000 to 300,000 residents living in dense villages. Access to basic services is limited, tenure is insecure and everyday life is shaped by exposure to environmental and climate risks.

Residents face frequent heavy rains, flash flooding, heat stress and stagnant surface water. Narrow footpaths, poor drainage, riparian encroachment and the dense settlement pattern mean that during the rains, paths turn into fast-flowing channels with mobility severely disrupted. In hotter months, the absence of tree cover and green space intensifies heat stress. These conditions undermine health, livelihoods and quality of life. In response, the community decided to act through NbS.

Working in partnership with the Kounkuey Design Initiative (KDI), an international community development and design non-profit, Kibera residents redesigned flood-prone and heat-exposed sites into functional green-blue public spaces that slow stormwater, stabilise riverbanks, cool the microclimate and maintain safe circulation. The initiative developed vegetated swales and shallow bioswales to slow and infiltrate stormwater, and pocket wetlands to hold and filter runoff, as well as widened riparian buffers along the river to stabilise banks and reduce flooding. Footpaths were upgraded with permeable surfaces, while low earthen bunds guide water away from homes and kiosks. Trees and indigenous groundcover were introduced to provide shade and reduce radiant heat, improving comfort during hot periods. Riverbanks were replanted and transformed into accessible green public spaces.

Resident committees — largely made up of youth and women's groups — guided site design, organised clean-ups, managed daily operations, handled maintenance, and oversaw usage rules and small revenues. The long-standing partnership with KDI provided technical expertise, design support and organisational continuity. Collaboration with Nairobi City County also played a key role.

6.3.1 Challenges

There were some challenges. Upstream solid waste frequently overwhelmed swales and wetlands, requiring constant clean-ups and coordination beyond the immediate sites. Riparian encroachment and insecure land tenure created ongoing risks of eviction or clearance, particularly after major floods when blanket city directives were issued along riverbanks. Dry-season plant stress required reliance on indigenous species, frequent watering and expanded caretaker rotations. Sustaining even modest operational budgets depended on careful management of kiosk rents, water and laundry fees, and volunteer labour. These pressures demanded continuous adaptation, negotiation and collective effort.

6.3.2 Outcomes

Nature was used to reduce everyday risk and improve living conditions. The vegetated swales, bunds and pocket wetlands slowed and absorbed stormwater before it reached homes and footpaths, making floodwaters shallower and allowing areas to drain more quickly after heavy rain. Restored riparian buffers reduced flooding along the river, improved the environment and reduced stagnant water. Meanwhile, permeable surfaces made paths passable during downpours. Tree cover and ground vegetation created cooler microclimates, easing heat stress for residents. Previously unsafe or derelict areas became visible, well-used spaces that supported mobility, safety and livelihoods, even during challenging weather. Economically, the sites support small livelihoods and save residents time and money, while modest revenues help sustain maintenance. The locally governed model has strengthened community ownership and improved daily resilience for those most affected.

6.3.3 Recognition

The Nairobi City County Climate Change Act of 2024 and the County Climate Action Plan recognised NbS as legitimate climate actions, creating an enabling policy environment for green–blue projects in informal settlements. The Kibera experience has helped shape how the city approaches NbS in informal settlements, demonstrating that community-governed interventions can function as effective climate infrastructure.

Submitted by: John Omwamba

Email: john.omwamba@un.org

Affiliation: UN-HABITAT

6.4 Grassroots greening transforms Nairobi's informal settlements

Communities across Nairobi's informal settlements are tackling climate risks through a mosaic of locally led actions shaped by their everyday realities. From addressing food insecurity in Mukuru, to flooding and degraded public space along the Nairobi River, to large-scale tree planting in Mathare, residents use nature to decrease risk and improve their wellbeing in the three distinct grassroots initiatives highlighted in the following sections.

6.4.1 Mukuru

In Mukuru, one of Nairobi's largest and most densely populated informal settlements, climate risk is felt most acutely through food insecurity. With rural and peri-urban food systems increasingly disrupted by floods and droughts, and urban reliance on external sources for food, households face rising food prices and unreliable supplies. In response, the Viwandani Comprehensive Community Organization (VICCO), a Nairobi-based non-profit focused on food and nutrition, with support from the Africa Population and Health Research Centre as well as Slum Dwellers International, is promoting urban farming as a form of climate resilience. Working with youth, women's groups and schools, they have transformed small, underused spaces into productive gardens using recycled materials and organic waste. The project is reducing dependence on distant rural producers while building environmental awareness among children. The food grown in schools is consumed by the children attending. These green pockets do more than produce food: they recycle waste into compost, make use of plastic water bottle waste to irrigate the demonstration farms, reduce emissions from food transport and help residents see nature as something that can be integrated into urban resilience strategies. Of course, issues with land space and land tenure present ongoing challenges throughout the project.

Submitted by: Dedan Njeru

Email: shakur@viwandani.org

Affiliation: Viwandani Community CBO

6.4.2 The Public Space Network

Urban riverine communities in Kenya are on the frontlines of climate change. Over the past decade, they have been disproportionately affected by extreme heat and increasingly frequent and intense flooding. Another community-based initiative is responding to this through the Public Space Network (PSN), a community-based organisation that works with communities in Nairobi's informal settlements to turn neglected public spaces into cleaner, greener, safer, and more inclusive urban spaces.

PSN's Cool Waters Project was developed to strengthen youth-led climate adaptation through the Climate Adaptation Academy, which provides technical and governance skills for local action. Technical support for PSN initiatives has been provided by numerous external actors — including Ramboll Water and the Kounkuey Design Initiative. Specifically, the Cool Waters Project empowers youth groups along Nairobi's rivers to map local climate vulnerabilities, design adaptation strategies and implement practical solutions (with a particular focus on heat and flooding risks) by providing technical skills, funding and advocacy tools. For example, they have built semi-permeable drainage systems in the informal settlements allowing water to pass through while filtering out solid waste, directing runoff into ponds where it is naturally treated. Community-led activities in Nairobi's Dandora informal settlements have included reforestation, semi-permeable paving, rain gardens and rainwater harvesting systems, all intended to cool the microclimate and manage stormwater runoff.

One of the community-based organisations PSN supports is Komb Green Solutions, a grassroots environmental regeneration initiative working in some of Nairobi's most vulnerable communities, particularly the informal settlement of Korogocho. Alongside its work on family planning awareness and sexual and reproductive health, Komb Green Solutions undertakes a wide range of nature-based and community-led interventions. Their nature-based initiatives include planting bamboo and fruit trees along the banks of the river, restoring riparian vegetation, establishing water filtration ponds and community rain gardens, and planting urban vegetable gardens. The group has also created a project that aims to transform a polluted dumpsite into a model community eco-park titled the "People's Park". This park was motivated by the need to create a safe, inclusive public space that would improve water quality, enhance biodiversity, act as a water sink to help reduce flood impacts in surrounding communities, reduce heat stress, tackle food shortages, and increase community pride and wellbeing.

Submitted by: Edwin Muigai

Email: climate@publicspacenet.org

Affiliation: Public Spaces Network

6.4.3 Mathare

Further upstream, in Mathare, climate action has taken the form of tree planting along the river corridor, led by the Mathare Green Movement under the umbrella of the Mathare Social Justice Centre. The Mathare Green Movement mobilises and supports the people of Mathare to plant and care for trees, clean the environment and rejuvenate depleted urban landscapes. Their work is volunteer-driven through community groups, friends and concerned environmental agencies. Since 2017, the Mathare Green Movement has been planting trees across sites such as schools, riverbanks, playgrounds, open spaces and hospitals in order to improve air quality, prevent soil erosion, provide cooling and reduce stress, among other things. They are guided by their mission "to make Mathare Green" and the belief that "green spaces are safe spaces". Every Saturday morning, they host a two-hour tree planting session open to community members. Some trees are planted in memory of people killed by law enforcement, turning the landscape itself into a site of remembrance. The intention of the tree planting is to stabilise riverbanks, absorb floodwaters, reduce heat and discourage dumping.

Submitted by: Giulia Sagarriga Visconti, Annu Kumpulainen, Michael Mawuena Bacciah, Joan Watetu Gachoki, and Calvin Opoku

Emails: giulia.sagarriga.v@gmail.com, annu.odessa@gmail.com, michaelmawuenam@gmail.com, watetujei@gmail.com, opoku.calvin@gmail.com

Affiliation: Aalto University

7

Conclusions

7.1 Moving from NbA to well-designed NbS

Our analysis indicates that policy documents more frequently reference NbA, often in isolation but sometimes alongside NbS, EbA or green infrastructure, rather than consistently articulating integrated or explicitly holistic approaches. NbA, while able to reduce acute risk, are not inherently ecologically sound, socially just or spatially equitable. Without careful attention to design and governance, such practices can become maladaptive, reinforce existing inequalities, or render positive consequences for one community at the expense of another. The same, however, can be said of NbS. Explicit use of the term NbS does not guarantee adherence to its underlying principles or a commitment to equitable and spatially-just outcomes.

Thus, while we call for NbS to be prioritised over NbA as the primary means of mobilising nature to address climate- and risk-related challenges at both national and urban scales, we emphasise that such NbS must be carefully designed and assessed against their ability to deliver multiple, interlinked and equitable outcomes, including benefits for biodiversity and human wellbeing, alongside contributions to societal challenges such as climate change mitigation and adaptation. These dimensions are best understood as mutually reinforcing rather than sequential or selectively prioritised. As Rigolon et al. (2024) have noted for ‘green space policy’, NbS must go beyond formal inclusion to actively address disparities in access, quality, safety and long-term maintenance, particularly for historically underserved communities.

Meaningful community participation must be integrated into this process. The consultation and active engagement of relevant communities are critical to ensuring the long-term sustainability and legitimacy of any chosen measure, while helping ensure more equitable outcomes. Meaningful public participation in the planning

of NbS fosters further benefits such as the integration of knowledge acquired by local stakeholders, and promoting stewardship and a sense of ownership, which in turn can lead to more effective upkeep and reduce barriers to implementation (Castaldo et al., 2025).

Finally, the term ‘nature-based solutions’ should not be diluted through its indiscriminate application to any action involving the use of nature. Not all nature-related interventions qualify as NbS. It is important, as we have attempted in this paper, to distinguish between responses that use nature to mitigate risk, but do not consider the implications (or systematically design for the positive outcomes of) biodiversity and/or broader wellbeing. Terminological precision is important because it shapes policy direction, funding allocation and accountability. Referring to any NbR as an NbS risks weakening the transformative intent embedded within the concept and undermining its credibility in policy and practice.

While this paper argues for the greater mainstreaming of NbS, not every urban intervention that works with nature will necessarily meet this standard. In dense urban environments, some measures may be designed primarily to reduce heat, manage stormwater or improve human wellbeing, while delivering more limited biodiversity benefits. Although such interventions may not fully align with established conceptions of NbS, this should not diminish their value. They can still make important contributions to urban climate resilience and quality of life and therefore remain important components of broader NbR, provided they are well designed, inclusive, equitable and seek to maximise benefits for nature wherever possible.

7.2 Urban nature as essential rather than an ‘optional luxury’

There is an urgent need for broader recognition of the role that nature can and must play in urban (and peri-urban) areas to address climate- and risk-related challenges. While early applications and much of the empirical evidence base for NbS have been rooted in rural and landscape-scale ecosystems, there is now growing recognition of their essential role in urban areas — especially as the world is rapidly urbanising. Failing to integrate nature into cities represents a significant missed opportunity to enhance climate resilience, improve liveability, and strengthen the relationship between urban systems and the ecosystems that sustain them (particularly those in the peri-urban environment). This relationship is increasingly important because healthy ecosystems help regulate climate and reduce climate risks, while climate change simultaneously undermines the ecosystems upon which urban resilience depends. As climate impacts intensify, this relationship is becoming increasingly critical, and well-designed NbS can help address the complex and cross-cutting issues that cities experience globally (Kauark-Fontes et al., 2023). As illustrated in the examples discussed in Chapter 6, NbS can enhance the resilience, health, wellbeing and food security of residents. As argued by Montgomery (2013), urban NbS should be regarded not as an ‘optional luxury’, but as essential.

7.3 Co-producing urban futures with informal settlements

Informal settlements represent sites of acute and intersecting climate risks that exacerbate existing infrastructural and basic service deficits. Formal planning and policy processes often fail to recognise and work with urban informality. Informal and low-income communities are not peripheral to resilient urban futures; they are central to them. These areas should be recognised as legitimate and strategic sites for NbS implementation. Realising the potential of NbS in informal settlements requires action from governments, urban planners, donors and other urban stakeholders. There are **four key priorities** to enable this approach and overcome structural barriers evidenced in both our research and case studies:

1. The reframing of informality as a social and institutional condition rather than merely a spatial one that presents challenges as well as opportunities to do things differently.
2. Institutional support and policy recognition of existing green interventions within informal settlements.

3. Developing policies that provide stability and protect residents’ rights, as insecure land tenure further constrains long-term investment in NbS.
4. Resourcing residents with funding and technical support to implement NbS (and expand and strengthen existing efforts) drawing on the knowledge, preferences and lived experiences of residents in the process. Given the technical complexity and maintenance/operation costs of some NbS initiatives, this funding and technical support should be both long-term and adaptive.

Additionally, informal settlements present a particular need for justice-centred NbS. Recognising that the benefits and burdens of NbS are not distributed evenly, authors such as Dushkova et al. (2026) have developed comprehensive frameworks and guidelines to support researchers, policymakers and practitioners in designing and implementing NbS that prioritise inclusivity, equity, justice and community empowerment. Their work emphasises several core principles, including leaving no one behind, ensuring the equitable distribution of benefits and the reduction of burdens across communities, and fostering meaningful community empowerment through inclusive and multilevel governance processes. These kinds of justice-centred approaches are critical both in how residents of informal settlements are considered in broader urban NbS planning and design (for example, avoiding their relocation to make room for central city green spaces), and in how they guide the design and implementation of interventions within the settlements themselves. ‘Green gentrification’ is a real and ongoing risk, capable of deepening inequality when NbS are implemented without explicit safeguards for vulnerable populations, including the urban poor and residents of informal settlements. Even where the ‘people’ dimension of NbS is acknowledged, it remains essential to ask: which people benefit and at whose expense? Without careful attention to equity, NbS can drive displacement, increase living costs, and reinforce existing social and spatial inequalities. Therefore, justice-centred frameworks must underpin NbS planning both within informal settlements and across wider urban areas to ensure resilience-building efforts protect, rather than marginalise, those at risk.

7.4 Mainstreaming NbS into national and subnational policy agendas

Policy documents play a decisive role in shaping priorities, directing funding and generating political will. Although NbS appears to be gaining momentum (particularly within global North discourse and multilateral climate and biodiversity processes), this review indicates that NbS may not yet be systematically

embedded in climate and DRR policy frameworks across the global South. Without deliberate efforts to mainstream NbS into national and subnational policy agendas, institutional mandates and budgetary commitments, their transformative potential in rapidly urbanising and high-risk contexts will remain constrained. This may mean that the successful examples of NbS being adopted by INGOs or communities stay at the piloting stage, are not scaled, or even fail because of a lack of funding or support.

8

Looking ahead: nature-based solutions as part of a multi-layered forward-looking urban resilience system

While this paper has spoken to the multiple benefits of NbS, it must not be misconstrued as an all-encompassing panacea. Given the complexity of the risk landscape that communities face, NbS should be considered as part of a broader, integrated approach to resilience applicable to the full urban landscape, including informal settlements, rather than as an isolated response to individual risks.

As was noted previously, the scale of NbS application can determine its success. In many cases, a combined set of NbS across the urban landscape contributes to reducing risk (for example, flooding risk) more effectively than single NbS interventions. In addition, climate risks are cumulative, compounding, and often interact with non-climatic stressors such as pollution or earthquakes, as well as with underlying socioeconomic factors. As a result, poorer communities (sometimes with little to no savings) are frequently exposed to multiple hazards that occur simultaneously or in quick succession, reducing their capacity to recover and prepare for future shocks. Therefore, while NbS offer significant potential to enhance resilience, they are not a standalone remedy. Effective urban resilience requires layered and integrated strategies. As suggested by Nisi (2022), the

strategic ‘layering’ of responses — combining multiple NbS initiatives alongside complementary measures such as early warning systems, disaster-risk management strategies, social protection, and hard infrastructure such as drainage systems and climate-resilient infrastructure — is essential to address the complexity of the climate and non-climate risk landscape and to address climate-related loss and damage. In the case of informal settlements: our review revealed various ways in which the risks faced by informal settlements were aimed to be addressed through in-situ upgrading. Well-designed and participatory NbS should be integrated within these upgrading efforts.

NbS should also be forward looking. In their analysis of urban NbS in cities across the globe, Goodwin et al. (2023) found that many interventions inadequately consider the climate vulnerability of the ecosystems and species upon which NbS depend. They note that failure to account for the future resilience of these ecological systems may ultimately undermine the long-term capacity of NbS to deliver both biodiversity and social co-benefits, thereby constraining their transformative potential (Goodwin et al., 2023). In line with this, the selection, design and implementation of NbS should

integrate future climate-risk scenarios by engaging with climate models and their projections to better understand future climate hazard projections and their pathways. For example, wetlands can reach a saturation point for absorbing and storing excess water under intensifying or prolonged rainfall, which may reduce their effectiveness in mitigating flood risks under future climate conditions. By embedding NbS within adaptive, forward-looking planning, cities can ensure these measures remain effective as climate risks intensify rather than becoming overwhelmed over time.

Finally, robust research, mapping and data collection are fundamental to ensuring the appropriate NbS are selected and to enable their implementation across multiple scales, including informal settlements. Such evidence is critical for understanding the contextual conditions and enabling environment necessary for successful NbS, as well as identifying the location of vulnerable populations and the risks that they face. A strong empirical evidence base not only supports informed planning but also facilitates buy-in from decision makers, practitioners and local communities.

Ultimately, NbS are most effective and transformative when they are equitable, participatory, context-specific, and integrated with broader social, institutional and infrastructural strategies that together strengthen communities' capacity to anticipate, absorb, adapt to and recover from interconnected shocks.

Appendices

Appendix 1. Profile of selected countries

COUNTRY	CLIMATE RISK PROFILE	PERCENTAGE OF URBAN POPULATION LIVING IN INFORMAL SETTLEMENTS	INCOME GROUP	ESTIMATED PERCENTAGE OF POPULATION LIVING IN URBAN AREAS	URBAN POPULATION GROWTH (% ANNUAL)
Bangladesh	ND-GAIN: Score: 32.9 Country rank: 178/187 CliF-VI: Country rank: 136/188	52	Lower middle income	41	3.1
Cambodia	ND-GAIN: Score 43.4 Country rank 161/187 CliF-VI: Country rank: 125/188	42	Lower middle income	26	3
Ecuador	ND-GAIN: Score: 48.3 Country rank: 125/187 CliF-VI: Country rank: 138/188	58	Upper middle income	65	1.2
Honduras	ND-GAIN: Score: 37.9 Country rank: 152/187 CliF-VI: Country rank: 154/188	32	Lower middle income	61	2.7
Kenya	ND-GAIN: Score 38: Country rank: 150/187 CliF-VI: Country rank: 167/188	40	Lower middle income	30	3.7
Sierra Leone	ND-GAIN: Score: 33.8 Country rank: 175/187 CliF-VI: Country rank: 177/188	49	Low income	45	3.2

Appendix 2. Baseline data for calculation of proportions

DOCUMENT TYPE ANALYSED	TOTAL	BANGLADESH	CAMBODIA	ECUADOR	HONDURAS	KENYA	SIERRA LEONE
Number of NAPs	5	1	0	1	1	1	1
Number of NDCs	6	1	1	1	1	1	1
Number of national urban documents	3	1	0	0	1	1	0
Number of national climate documents	8	1	3	0	1	2	1
Number of national development documents	3	0	1	2	0	0	0
Number of national DRR documents	7	1	1	1	2	1	1
Number of city-level climate documents	10	2	1	2	1	2	2
Total number of documents	42	7	7	7	7	8	6

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Working with nature is increasingly championed as an effective ‘win-win’ climate response. However, it remains unclear how much this is reflected in policy and planning, and the extent to which urban areas — and particularly informal settlements — feature in these efforts. This paper examines how nature-based responses are reflected in policy frameworks in selected countries in the global South, and the extent to which they are specifically applied to urban and informal settlement contexts.

IIED is an international policy and research organisation working with partners globally to build a fairer, more sustainable world. Together, we challenge the destructive economic models, unjust power dynamics, entrenched mindsets and protectionist laws that perpetuate poverty, suppress rights and hinder progress towards a thriving world. We explore solutions to complex economic, social and environmental crises, using research, action and influencing to tackle the root causes of climate change, nature loss and inequality.



International Institute for Environment and Development
44 Southampton Buildings, London WC2A 1AP, UK
Tel: +44 (0)20 3463 7399
www.iied.org

IIED appreciates the contributions of Irish Aid, the Danish Ministry of Foreign Affairs and Quadrature Climate Foundation in supporting our research and publications. Any views expressed do not necessarily reflect the views of these donors.



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