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Blue Cities, Green Laws: Legal Models for Urban Climate Resilience in the Global South

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ABSTRACT

Blue cities are cities that plan themselves around water rather than against it: rainwater is stored, recycled and reused, streets and parks are given permeable surfaces, wetlands and lakes are protected and restored, and coastal settlements are defended by mangrove belts and flood-resistant construction. Rivers, lakes, drainage, drinking water supply, sewage and storm water are treated as one interconnected system, and nature-based solutions such as rain gardens, bioswales and urban forests are preferred to concrete drains that push water downstream. The concept matters most in the Global South, where Jakarta is sinking through groundwater over-extraction, Mumbai floods every monsoon because of poor drainage and construction on wetlands, and Cape Town came close to running dry during its “Day Zero” crisis. This paper examines why blue cities and consistent green laws are needed, drawing on drought, excess rainfall and flooding, environmental degradation, climate-driven displacement and public health in India and elsewhere in the Global South, and considers how the blue-green infrastructure approach can be implemented, before analysing the experience of Rotterdam, Singapore and Cape Town. It argues that water should be treated as a resource to be planned with, not a threat to be engineered away.

Keywords: *Blue Cities, Green Laws, Urban Climate Resilience, Global South, India, Water Governance, Environmental Law, Climate Change, Sustainable Urban Planning, Blue-Green Infrastructure*

I. INTRODUCTION

What does the term blue city mean? A blue city is one that plans itself in a manner that helps to preserve one of the most basic and important resources on the planet, the water on which every living organism depends, and that ensures its own development does no harm to that water.¹ Water is a priority for humans, animals and countless other organisms, yet it also brings hazards such as floods, sewage overflow and tsunamis. Blue cities do not ignore these hazards, but they

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¹ Richard R. Brown, Nina Keath & Tony H.F. Wong, *Urban Water Management in Cities: Historical, Current and Future Regimes*, 59 WATER SCI. & TECH. 847 (2009), <https://doi.org/10.2166/wst.2009.029>.

respect water for its benefits and treat it as a resource to be worked with rather than a threat to be kept out, building a friendly environment around it. In a blue city, for example, rainwater is stored, recycled and used for urban needs rather than drained into sewers. Streets and parks have permeable surfaces so that rain can soak into the ground instead of causing flooding.² Wetlands and lakes within or near the city are protected and restored because they absorb excess water during floods. In coastal cities, blue city planning may include building flood-resistant homes on stilts, reinforcing sea walls and creating mangrove belts as natural barriers against storm surges.³

Another important aspect of blue cities is their approach to urban water management. They view rivers, lakes, drainage systems, drinking water supply, sewage and storm water as interconnected parts of one system. Instead of building concrete drains that push water away quickly and often cause downstream flooding, blue cities favour nature-based solutions such as rain gardens, bioswales and urban forests that naturally absorb and filter water. The concept is especially important for the Global South, where many cities face serious water-related challenges. Jakarta is sinking because of groundwater over-extraction,⁴ while Mumbai deals with recurring floods every monsoon because of poor drainage and construction on wetlands. Cape Town in South Africa nearly ran out of water during its “Day Zero” crisis, highlighting the need for urban areas to rethink water use. A blue city framework responds by making water conservation, recycling, flood protection and ecological restoration part of everyday urban governance. In essence, a blue city involves more than fighting floods or droughts. It aims to create a long-term, sustainable relationship between the city and its water resources, and it urges planners, engineers and lawmakers to design cities that can handle climate change and manage future water-related risks.

Climate change is one of the most urgent challenges cities face today, especially in the Global South. Cities are major contributors to climate change through high energy use, vehicle emissions and industrial activity, and they are also among the most vulnerable to its effects. Rising global temperatures, unpredictable rainfall, frequent floods, sea-level rise and extreme heat waves already affect millions of urban residents, and in cities with large populations, weak infrastructure and poor planning the risks are greater still. Coastal cities such as Mumbai,⁵

² UNESCO WORLD WATER ASSESSMENT PROGRAMME & UN-WATER, *The United Nations World Water Development Report 2018: Nature-Based Solutions for Water* (2018), <https://unesdoc.unesco.org/ark:/48223/pf0000261424>.

³ WORLD BANK, *Implementing Nature-Based Solutions in Cities: Sponge Cities Initiative* (2019).

⁴ Mayuri Mei Lin & Rafki Hidayat, *Jakarta, the Fastest-Sinking City in the World*, BBC NEWS (Aug. 13, 2018), <https://www.bbc.com/news/world-asia-44636934>.

⁵ *Explained: Why Mumbai Floods Every Monsoon*, INDIAN EXPRESS (2021).

Jakarta, Lagos and Manila deal with rising sea levels, stronger storms and coastal erosion. Jakarta is sinking so quickly, owing to climate impacts and groundwater use, that Indonesia has planned the relocation of its capital. Inland river cities face frequent floods during heavy rains, as Chennai did in 2015 and as Dhaka does, where poorly managed drainage and encroachment on wetlands worsen disasters. Semi-arid cities such as Cape Town and Chennai have also endured severe water shortages and droughts, showing that climate change creates problems of both excess and scarcity. Urban climate resilience focuses on how cities can prepare for these challenges rather than merely reacting to disasters. It involves creating policies, laws and infrastructure that anticipate floods, droughts and heat waves while minimising their impact. Examples include:

- Heat action plans: Ahmedabad was the first city in South Asia to adopt a heat action plan, which includes early warnings and cooling centres to protect people during heat waves.⁶
- Flood-resilient infrastructure: Singapore uses green-blue infrastructure such as parks, canals and reservoirs to manage storm water and enhance the city's liveability.⁷
- Coastal defences: Rotterdam in the Netherlands and Manila are testing sea walls, storm surge barriers and floating housing in order to coexist with water.⁸

For the Global South, urban climate resilience is essential. Many cities experience rapid and unplanned growth, resulting in overcrowded housing, construction in flood-prone areas and strained infrastructure. When climate disasters occur, it is typically the urban poor living in informal settlements who bear the brunt, because their homes are often situated in risky areas near rivers, coastlines or drainage channels.⁹ Climate resilience is therefore also a matter of social justice, protecting the most vulnerable populations from the effects of climate change. The legal dimension is crucial. Laws can compel cities to conduct climate risk assessments, incorporate climate resilience into urban planning and enforce building codes that strengthen infrastructure. International instruments such as the Paris Agreement and the Sustainable Development Goals also encourage countries to develop urban resilience strategies. The real

⁶ AHMEDABAD MUNICIPAL CORPORATION, INDIAN INSTITUTE OF PUBLIC HEALTH GANDHINAGAR & NATURAL RESOURCES DEFENSE COUNCIL, *Ahmedabad Heat Action Plan 2015: Guide to Extreme Heat Planning in Ahmedabad, India* (2015), https://iiphg.edu.in/images/pdfs/NRDC/HAP_2015.pdf.

⁷ PUB, SINGAPORE'S NATIONAL WATER AGENCY, *Our Water, Our Future* (rev. ed. 2018).

⁸ ROTTERDAM CLIMATE INITIATIVE, *Rotterdam Climate Proof: Adaptation Programme 2009* (2009), https://www.cakex.org/sites/default/files/documents/RCP_adaptatie_eng.pdf.

⁹ UN-HABITAT, *World Cities Report 2020: The Value of Sustainable Urbanization* (2020), <https://unhabitat.org/world-cities-report-2020-the-value-of-sustainable-urbanization>; Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104; G.A. Res. 70/1, *Transforming Our World: The 2030 Agenda for Sustainable Development* (Sept. 25, 2015).

challenge, however, is turning these commitments into local laws and enforcement measures that fundamentally change how cities develop and operate. Put simply, climate change forces a rethink of how cities are built and managed. Urban climate resilience goes beyond surviving the next flood or heat wave; it involves redesigning cities for a sustainable and climate-resilient future.

A. Aim of the research

The major aim of this research is to create awareness of why blue cities and green laws are needed in the current global and international scenario, to show why the need is greatest in the Global South, and to highlight the problems that arise from the improper planning of cities and from inefficient green laws. It seeks to emphasise the critical issues that are significantly affecting the present environmental situation, and in particular the problem of water scarcity. What is scarcity, and how has it manifested in India? Access to clean water has become challenging in India because so many water sources are contaminated. Many argue that India faces a severe shortage of water, especially where rainwater is not properly conserved. The reliance on grey infrastructure such as drainage systems adds to the problem, as major resources like ponds, lakes and the sea are being polluted, which in turn leads to scarcity.

B. Research methodology

This research adopts a qualitative, structured study to examine the implementation and usefulness of blue cities and efficient green laws for the Global South. It proceeds in stages, identifying the reasons for the concept, its modes of implementation and the places where it is actually followed. The research design is a structured one, intended to test the reliability of blue cities and green laws in contemporary society and to ask whether their implementation helps society to move beyond its present situation. Several countries are taken up for study in order to see whether they practise these approaches or are being affected by particular problems because of non-compliance.

II. IMPACT ON THE GLOBAL SOUTH

The prevailing approach to city planning is that cities are laid out to accommodate infrastructure for industries, technology plants, corporate offices and other facilities that contribute to the national economies of the Global South. Cities planned in this way, however, remain weak in the face of floods, droughts, cyclones and similar events. Researchers, scholars, professors and jurists argue that if cities were planned with proper vigilance and care towards water and the environment in general, it would be easier for them to tackle drought, floods and cyclones: a city that conserves its wetlands, lakes and groundwater can store water for the dry season. India

received 64.5 mm of rainfall between 1 and 18 June 2024, 20% less than the long period average of 80.6 mm.¹⁰ Yet during the most recent monsoons the country has also seen floods in cities and across states, causing traffic disruption, destruction of infrastructure, illness and death. In Punjab, 29 lives were lost between 1 August and 1 September 2025 in rain-related incidents, and more than three lakh acres of agricultural land were registered for crop-damage claims.¹¹ To cope with such floods, cities set up rescue and relief centres; in Ludhiana, for instance, rescue centres were established at Satsang Ghars on the Rahon (Ghonsgarh), Chandigarh and Tibba roads and at Kailash Nagar, as well as at schools and the grain market in Khassi Kalan, Bhukhri and Mattewara.¹² Ensuring people's safety in this manner is costly. It is in these scenarios that the conceptual strength of blue cities comes into play, since they are structured to safeguard people against any *vis major* or act of nature. It is therefore far more efficient for a city to develop in accordance with the environment and the resources that surround it than to make anything else its main focus.

Water scarcity is also one of the most pressing issues faced by countries of the Global South, including India and much of Africa, making it difficult for people to access good-quality water. Water, which is crucial for human life, is essential for hydration, sanitation and agriculture. Water scarcity has been a longstanding problem for the world, and it continues to be regarded as a challenge affecting billions of people every year. Rising demand, together with climate change and poor management, has turned water into a scarce resource, particularly in developing nations such as India. Scarcity arises when the supply of a resource is restricted relative to demand. Water shortage may arise from several factors, such as pollution, ineffective use and climate change, and many of these factors trace back to harmful human behaviour and to the way in which human beings continually undermine their own well-being while coexisting with nature.¹³

The whole point of using blue and green models is to be climate resilient and to rely less on grey structures such as pipelines and drains, using instead the natural resources known to us, such as ponds, lakes, rivers and other natural blue resources, to tackle climate change.

¹⁰ *June Rainfall 20% Below Average as Monsoon Stalls: IMD*, THE HINDU (June 23, 2024).

¹¹ *Heavy Rain Across India Leads to Flooding in Punjab, Delhi, Jammu & Kashmir, and Himachal Pradesh*, THE HINDU (Sept. 2, 2025).

¹² *Punjab Flood: Ludhiana Administration Sounds Alert After Embankment Faces Strong Flow of Water*, THE HINDU (Sept. 4, 2025), <https://www.thehindu.com/news/national/punjab/punjab-flood-ludhiana-administration-sounds-alert-after-embankment-faces-strong-flow-of-water/article70015193.ece>.

¹³ *World Water Day: Running Out of Water and Understanding the Scarcity's Aftermath*, THE HINDU (Mar. 22, 2025).

III. REASONS FOR THE NEED FOR BLUE CITIES AND EFFICIENT GREEN LAWS

A. Drought

Drought is a phenomenon that occurs when rainfall is deficient for an extended period, causing scarcity, crop failure and ecological stress. In recent years drought has been seen very frequently in the Global South. This is due to the failure of cities to conserve water resources, and also to the pollution of water on a large scale. GreenMatch's survey of global water access and quality notes that India, with 18% of the world's population, has access to only 4% of the planet's freshwater resources.¹⁴ India's water quality problem stems mainly from industrial sewage and pollution, the use of chemical pesticides and fertilisers in agriculture, improper waste disposal and inadequate water infrastructure, which lead to people falling sick from unsafe water, to organic and inorganic pollutants contaminating supplies, and to water scarcity at large, ending in drought. Industrial pollution arises from improperly treated industrial effluent, and pharmaceutical, medical and electronic waste pollute surface water. Agricultural pollution arises mainly from pesticides and fertilisers, in both surface water and groundwater. Sewage and domestic waste contribute vastly to river pollution in urban areas. Many rivers are used daily as dumping grounds for waste and for activities such as bathing people or cattle and washing clothes and utensils. Where such activity is not meant to take place it happens anyway, because the laws are inadequate and lightly enforced, whereas other countries focus on conserving their water resources and ensuring that no one misuses them. It is not only a matter of legal restriction; there is also a lack of the knowledge and information that would tell people where activities may be conducted and where waste may be disposed of. In Paraguay, drought significantly reduced soybean production in the 2021–22 season to 4.18 million tonnes, 56.6% less than the previous season, the worst harvest since 1985–86 and the lowest since 2008–09, when the cultivated area was 25% smaller.¹⁵ India's population is vast, and with a vast population comes a corresponding demand for water; for people to remain healthy, there must be safe water to drink. According to one industry estimate, water demand is shared by farmers (83%), industries (10%) and cities (7%), and governments have their hands full finding solutions.¹⁶ The steps taken by the government are not sufficient; there must be involvement from people as well. The

¹⁴ Inemesit Ukpanah, *Global Water Access and Quality*, GREENMATCH (Oct. 10, 2023, updated Jan. 8, 2025), <https://www.greenmatch.co.uk/blog/global-water-access-and-quality>.

¹⁵ Maria Victoria Andarcia, *Climate Disruptions Hit Argentina and Brazil, Two of the World's Breadbaskets*, GLOBAL AFFAIRS AND STRATEGIC STUDIES, UNIVERSITY OF NAVARRA (Feb. 14, 2024), <https://en.unav.edu/web/global-affairs/los-trastornos-climaticos-castigan-a-argentina-y-brasil-dos-de-los-mayores-graneros-del-mundo>.

¹⁶ *Why Clean and Safe Drinking Water Is Still a Struggle in Indian Cities*, DOULTON INDIA, <https://doulton.in/water-crises-in-india/india-needs-more-clean-and-safe-drinking-water/> (last visited Sept. 6, 2026).

government promised safe and clean drinking water to citizens by 2024 under the Jal Jeevan Mission, but it also spelt out the responsibility of citizens to conserve it: ensuring sewage treatment, using zero plastic and adopting water-saving initiatives are simple yet effective methods of reducing water pollution. People are not, however, taking the steps needed to fulfil that responsibility. This is largely because many people in rural areas lack awareness of the mission, even though the water they use is one of the key elements of their lives.

i. How drought affects cities

Drought affects farmers above all, because crop production depends on water; when water is scarce, crops do not receive the nourishment they need and production falls. Lower production means lower income, and where farmers carry debts the loss of income leaves them unable to repay, so that their land and houses, pledged as security, are taken to satisfy the loans. This is one of the common circumstances in which farmer suicides occur at scale.

Drought affects human life at large because it threatens water and food security, leading to malnutrition and to diseases such as diarrhoea, cholera and typhoid. Malnutrition rises with crop failure, which results in micronutrient deficiency; this happens principally because farmers cannot grow crops when rainfall is low. Malnutrition strikes children in particular, who should not be exposed to such illness at a young age. There is also a rise in respiratory and heart conditions caused by the dust storms and wildfires that occur in cities during drought. Many people migrate from drought-hit cities to others, causing the population of the affected city to fall.

Recent trends show that India has faced severe drought, particularly in its agricultural regions.¹⁷ In mid-2025 nearly 19% of India's land area was experiencing some degree of drought, including extreme conditions in places.¹⁸ The World Bank notes that India's drought-prone area has increased by 57% since 1997.¹⁹ August 2023 was the driest August on record since 1901, raising concern for the summer crop.²⁰ Within India, Maharashtra is known for severe droughts,

¹⁷ *Biggest Drought in India: Know Major Droughts of 1876–78, Drought Affected Areas in India & Their Impact*, TESTBOOK (2025), <https://testbook.com/geography/biggest-drought-in-india>.

¹⁸ Shagun, *Around 19% of India Under Drought, Drought-Like Conditions Despite Above-Normal Rainfall in Early Monsoon: DEWS Data*, DOWN TO EARTH (Aug. 7, 2025), <https://www.downtoearth.org.in/agriculture/around-19-of-india-under-drought-drought-like-conditions-despite-above-normal-rainfall-in-early-monsoon-dews-data>.

¹⁹ WORLD BANK, *India: Managing the Complex Problem of Floods and Droughts* (Aug. 17, 2023), <https://www.worldbank.org/en/news/feature/2023/08/17/india-managing-the-complex-problem-of-floods-and-droughts>.

²⁰ *After Driest August Since 1901, India Could Receive Average Rains in September: IMD Official*, BUSINESS TODAY (Aug. 31, 2023), <https://www.businesstoday.in/latest/economy/story/after-driest-august-since-1901-india-could-receive-average-rains-in-september-imd-official-396440-2023-08-31>.

including major events in 2016 and 2024 caused by erratic rainfall and poor water management.²¹ Drought also affects the Horn of Africa, where Somalia and Kenya face the threat of famine, and in 2021 and 2022 Brazil and its neighbours in the La Plata basin suffered severe agricultural losses in the worst drought in a century,²² which also strained Brazil's hydroelectric generation. Many countries in the Middle East, such as Syria and Iraq, face critical water shortages, and many people have moved to other cities because of prolonged drought. To reduce drought, the Indian government has introduced policies and legal reforms that focus on conserving water, using water resources efficiently and building agricultural resilience. The key government initiatives are the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) for improved irrigation, MGNREGA for water conservation and employment, and the Pradhan Mantri Fasal Bima Yojana (PMFBY) for crop insurance, while the main community initiatives are the revival of traditional water harvesting and water-efficient practices.²³ In Southeast Asia, Cambodia's National Action Plan on Drought Management and Adaptation 2025–2030 provides for early warning systems, climate-resilient infrastructure and efficient water-use technology.²⁴ In conclusion, drought is one of the major problems of the Global South: it leaves cities short of water, causes food scarcity and illness, reduces farmers' crops and income, and drives migration from one city to another. Drought is thus one of the major consequences of cities failing to plan themselves with regard and respect for water resources and the environment.

B. Excess rainfall and floods

Floods occur when rainfall exceeds the normal level in cities that lack an adequate drainage system. The amount of rain outstrips what the ground can absorb, so the water quickly becomes runoff, flowing over the land surface rather than soaking into it. Besides rainfall, floods can be caused by rapid snowmelt, by storm surges in coastal regions or by the failure of dams. There are two broad types of flood. Flash floods, the more dangerous, occur within minutes of heavy rainfall and sweep through urban areas. Long-term floods are extended events in which the water level rises gradually, as during prolonged heavy rain. Floods ruin not only a person's dwelling but also infrastructure, buildings and other structures in a city. They also endanger life:

²¹ *Maharashtra Reels Under Severe Drought, Reservoir Levels See Drastic Dip*, THE NEW INDIAN EXPRESS (May 24, 2024).

²² Andarcia, *supra* note 15; see also *Brazil on Drought Alert as Country Faces Worst Dry Spell in 91 Years*, REUTERS (May 29, 2021), <https://newsinfo.inquirer.net/1438488/brazil-on-drought-alert-as-country-faces-worst-dry-spell-in-91-years>.

²³ Nirmalya Bandyopadhyay, C. Bhuiyan & A.K. Saha, *Drought Mitigation: Critical Analysis and Proposal for a New Drought Policy with Special Reference to Gujarat (India)*, 5 PROGRESS IN DISASTER SCI. 100049 (2020), <https://doi.org/10.1016/j.pdisas.2019.100049>.

²⁴ *Flowing Toward Resilience: Cambodia Sets Course with Water and Drought Action Plans*, GLOBAL WATER PARTNERSHIP (June 30, 2025), <https://gwpo-gwp.org/en/GWP-South-East-Asia/WE-ACT/Events/2025/flowing-toward-resilience-cambodia-sets-course-with-water-and-drought-action-plans/>.

apart from the loss of shelter, prolonged flooding breeds mosquitoes that spread malaria and dengue, and floodwater that has mixed with sewage and waste carries cholera and other water-borne disease. Excessive rainfall also causes problems for farmers, since it leads to waterlogging, nutrient loss and crop disease that can destroy an entire crop, and it damages farm equipment such as tractors and prevents farmers from reaching their fields. Because rural areas have less medical infrastructure, farmers may also be unable to obtain adequate medical care. People living in cities prone to excess rainfall face the risk of drowning, particularly those who cannot swim. During floods, hospitals may be affected so that flood victims go untreated, and schools, colleges and universities usually close, forcing students to study online or take unscheduled holidays. The Southeast Asia Flash Flood Guidance System (SeAFFGS), launched in 2022, helps in tackling and responding to flash floods and provides alerts when they occur in countries such as Cambodia, Laos and Thailand.²⁵ Chennai suffered devastating floods in 2015 and again in 2023, aggravated by the loss of the city's lakes and wetlands.²⁶ In 2025 floods in Punjab breached embankments, triggered alerts in Ludhiana and cost lives, and nearly 5,00,000 trees were uprooted; the Prime Minister visited Gurdaspur on 9 September 2025 to meet the affected families.²⁷ Floods in Nigeria in 2022 displaced more than two million people, and Jakarta is literally sinking under the combined effect of rainfall and sea-level rise, causing great hardship to its residents. The significant Indian legislative responses built around floods are the Disaster Management Act, 2005, which provides a framework for disaster response and preparedness;²⁸ the National Water Mission, a more recent initiative that promotes integrated water resource management and contributes to conservation, efficient use and flood preparedness; and the National Disaster Management Plan, released in 2016 under the Act, which sets out strategies for responding to floods with an emphasis on risk reduction and preparation. In the Middle East, the Middle East Anticipatory Climate Action Model has been implemented to predict floods in countries such as Iraq, Syria and Yemen and to issue warnings, so that governments are alert to any flash flood.²⁹ In conclusion, one of the major risks of flooding arises when a city does not plan itself in accordance with, and with respect for, its water resources and environment.

²⁵ WORLD METEOROLOGICAL ORGANIZATION, *Southeast Asia Flash Flood Guidance System Launched* (Aug. 10, 2022), <https://wmo.int/media/news/southeast-asia-flash-flood-guidance-system-launched>.

²⁶ Anuradha, *Urban Wetlands and Floods*, SANDRP (Apr. 5, 2016), <https://sandrp.in/2016/04/05/urban-wetlands-and-floods/>.

²⁷ Akshat Trivedi, *PM Modi to Visit Flood-Hit Punjab's Gurdaspur on September 9 to Meet Families*, INDIA TODAY (Sept. 7, 2025).

²⁸ The Disaster Management Act, No. 53 of 2005, INDIA CODE (2005).

²⁹ Ellen Reid, *Middle East Anticipatory Climate Action Model: Conceptual Overview*, MERCY CORPS (Nov. 12, 2024), <https://www.mercycorps.org/research-resources/anticipatory-climate-action-model-overview>.

C. Protection of the environment

The need for environmental protection has grown as urbanisation and industrialisation have placed immense pressure on natural ecosystems, leading to the degradation of rivers, deforestation and the mass pollution of water bodies, wetlands and green spaces. Traditional city planning often neglects ecological balance, resulting in loss of biodiversity, increased pollution and, not least, the deterioration of natural water bodies. The problem with the planning of cities is that they focus on grey infrastructure: dams, levees, floodwalls, pipelines, drainage systems, reservoirs, roads and bridges, designed to manage water flow, prevent flooding and supply water. If cities were instead planned around their water bodies and environment, they would be better able to withstand climate change; blue cities use wetlands, rivers, ponds and rainwater to tackle it. Blue cities plan themselves in accordance with water bodies and are therefore more cost-effective, since grey infrastructure is very expensive to build and maintain, and they become more resilient as they expand. Green infrastructure may fail under extreme events, for example when overwhelmed by floods, and its one basic aim is to tackle climate change; green cities, however, also help to ensure air and water quality, provide recreation and support biodiversity. It is therefore better to build and plan cities around water bodies and the environment than around grey infrastructure. Blue cities protect the environment because they preserve both the environment and the water bodies, which is crucial, whereas grey-infrastructure cities have no particular plan to preserve either: their aim is to industrialise and urbanise, and to build infrastructure to cope with climate change afterwards. Blue cities ensure that the ecosystem is preserved and biodiversity saved; rivers, lakes and the sea are protected, whereas in grey-infrastructure cities they are not, and failure to protect rivers, seas, lakes, ponds and other water bodies means that marine life is ignored as a whole. Grey-infrastructure cities that prioritise industrialisation and urbanisation do not keep the environment as a priority, because building industries and other economically productive infrastructure is their first goal.

This careless attitude highlights the need for environmental protection, for which cities must plan in order to protect the environment as a whole. Blue cities protect the environment by working with nature instead of against it: the integration of rivers, wetlands and green belts into urban design ensures that water cycles are not disrupted and the environment is preserved. Grey-infrastructure cities, by contrast, rely heavily on concrete and steel to control water through dams, drains, channels, floodwalls and pipes, which offer only short-term rather than permanent relief. Blue cities have features such as rain gardens, replenished aquifers and open waterways, which allow rainfall to seep into the ground and help to reduce pollution; these systems also help to reduce heat in the urban environment. Grey-infrastructure cities have been seen to face

more problems than relief, for example the destruction of habitats, increased erosion, untreated waste and no groundwater recharge.

In recent years Singapore has been known as one of the best examples of a blue city in practice, with clean waters. Its Active, Beautiful, Clean Waters (ABC Waters) Programme, launched in 2006, has helped to achieve water quality, flood mitigation, groundwater recharge and urban cooling. Singapore is thus a major example showing that blue cities preserve the environment to a far greater extent than a grey-infrastructure city.

But why preserve the environment at all? The answer is simple: the environment is preserved to secure the future of the coming generation, its livelihood and its betterment. This is not a choice but a necessity for human survival and sustainable development. The environment provides the clean air, water and food that living beings need to survive; it is the foundation of life, and it should not be degraded by urbanisation and industrialisation to the point where it becomes unusable, driving health emergencies and climate instability. Building climate resilience into blue cities helps to preserve wetlands, which absorb excess rainwater and mitigate floods, and this not only secures human survival but also helps to regulate rainfall, prevent soil erosion and supply fresh water to living organisms. Destruction of these natural resources results in floods and droughts. Grey-infrastructure cities also play a part in the depletion of the ozone layer, since urban models that prioritise rapid urbanisation and industrialisation drive the demand for cooling and for the refrigerant gases that come with it. The ozone layer shields life on Earth from ultraviolet radiation; without it, humans would be prone to skin cancer, premature skin ageing and cataracts.

Grey infrastructure, characterised by heavy fossil fuel use and concrete construction, is known for urban heating, and the resulting demand for artificial cooling contributes in turn to the depletion of the ozone layer, a risk not only to humans but to every other living creature, since a depleted ozone layer would make large parts of the Earth's surface uninhabitable. Blue cities differ in that they involve nature-based urban design that respects the existing environment and water resources, which facilitates:

- Urban cooling: wetlands and trees keep cities from overheating and reduce reliance on air conditioners, which are used widely where there are no trees or water bodies. Older air conditioners used chlorofluorocarbons (CFCs) as refrigerants, which have been phased out under the Montreal Protocol because of the immense depletion of the ozone layer they caused.³⁰

³⁰ *Ozone Layer on Road to Recovery Despite Volcano Eruption, UN Weather Body Says*, REUTERS (Sept. 17, 2024).

- Improved air quality: Delhi has recently been badly affected by smog and ground-level ozone.³¹ In the summer of 2025 ozone exceeded the national safety standard in Delhi on nearly every one of the 92 days from March to May, and in the wider National Capital Region on 83 of those days, with the widest geographical spread in five years. This shows how air quality suffers in cities that neglect the blue city model or lack effective green laws. Blue cities ensure that there are enough trees in the planning of the city, which improves air quality because trees absorb pollutant gases such as nitrogen oxides, sulphur dioxide, carbon monoxide and ozone through their leaves. By lowering these pollutants they reduce the risk of smog and poor air quality. These scenarios show how ozone and other hazards affect living beings and how grey-infrastructure cities cause or contribute to them. The step which humanity has taken is the Montreal Protocol,³² under which, on current trends, the ozone layer is expected to return to its 1980 levels by around 2040 over most of the world, by 2045 over the Arctic and by 2066 over the Antarctic.

D. Human displacement and migration due to climate

As discussed above, significant changes in climate and an increase in risks such as floods and droughts have led to an increase in the number of people migrating to cities, which is a bad sign for the cities they leave, since it underlines that those cities were incapable of mitigating risk and ensuring climate resilience. In 2022, weather-related hazards such as floods and drought caused nearly 32 million internal displacements, most of them in Africa and Asia.³³ Grey-infrastructure cities, built on concrete and with extensive use of fossil fuels, aggravate such weather-related problems, which are among the key reasons people migrate from one city to another. Blue cities offer solutions such as mangroves and floodplains that build climate resilience, keeping the city safe and free of threat, so that people stay rather than migrate. Mumbai has recently become known as one of the cities practising “blue-green infrastructure” to manage the monsoon and prevent mass evacuation.³⁴ Jakarta’s coastal flooding has forced

³¹ *Ground-Level Ozone at Five-Year High; South, Northwest Delhi Worst Hit*, TIMES OF INDIA (June 2025) (reporting CENTRE FOR SCIENCE AND ENVIRONMENT, *Delhi-NCR Ozone Levels Higher and More Widespread This Summer: CSE* (June 17, 2025), <https://www.cseindia.org/delhi-ncr-ozone-levels-higher-and-more-widespread-this-summer-cse-12748>).

³² *Ozone Layer on Road to Recovery*, *supra* note 30.

³³ UNHCR, *Climate Change and Displacement: The Myths and the Facts* (Nov. 15, 2023) (citing INTERNAL DISPLACEMENT MONITORING CENTRE data), <https://www.unhcr.org/news/stories/climate-change-and-displacement-myths-and-facts>; *Climate Migrations: Displaced by Climate Change, a Growing Reality*, IBERDROLA (2023) (citing INTERNAL DISPLACEMENT MONITORING CENTRE data), <https://www.iberdrola.com/sustainability/climate-migrations>.

³⁴ WRI INDIA, *Blue-Green Framework Workshop, Mumbai* (Conference Proceedings, May 7, 2025) (documenting the October 2024 workshop), <https://wri-india.org/research/blue-green-framework-workshop-mumbai>; Smita Rawoot, James L. Wescoat Jr., Karen Noiva & Alex Marks, *Mumbai Case Study: Enhancing Blue-Green*

many to evacuate, which could have been prevented more easily by mangroves,³⁵ since they absorb floodwater more quickly than grey infrastructure such as drains or sewage pipes can. This shows how green laws and blue cities strengthen people's ability to reside in a city with proper safety and health, unaffected by floods or drought, because these cities ensure that they are climate resilient. A blue city not only retains its population but also represents its country as one that can withstand the impacts of climate.

E. Ensuring safety and health for the people of these cities

The consequences of climate change, floods and drought, expose people to injury and illness while they protect themselves. Beyond climate events, deterioration in air quality, water quality and other environmental resources may cause people to fall sick or, in the worst case, be injured. Delhi, a city that does not practise the blue city model, has recently faced smog so severe that schools were shut and people had to wear masks outdoors to avoid its effects. Prolonged breathing of such air causes respiratory conditions such as asthma and lung infections, and other problems that may affect human beings in the long term.³⁶ South Sudan has seen a significant rise in displacement caused by floods, with limited access to infrastructure and healthcare and an increase in malnutrition, psychological trauma and extreme insecurity.³⁷ Similarly, the Philippines has seen rising migration driven by sea-level rise, powerful typhoons and economic disruption.³⁸ In conclusion, blue cities help to safeguard not only human health but also that of many other living organisms, ensure social security and reduce the rate of migration.

IV. WHY THE IMPLEMENTATION OF BLUE CITIES IS NECESSARY AND HOW TO IMPLEMENT IT

With the increase in industrialisation and urbanisation, the world's tendency to misuse the valuable resources that the environment provides, such as water, air and sunlight, has increased, and the Earth now faces resource shortages and calamities such as drought, floods, depletion of

Environmental and Social Performance in High Density Urban Environments (Massachusetts Institute of Technology, Ramboll Foundation, July 13, 2015), https://globalgbc.org/wp-content/uploads/2022/08/0864_BGI_Final-Report_MIT_Mumbai_20160403.pdf.

³⁵ *Investing in Mangroves for Coastal Resilience in North Jakarta*, EARTH SECURITY (Sept. 1, 2024), <https://www.earthsecurity.org/news/case-study-investing-in-mangroves-for-coastal-resilience-in-north-jakarta>.

³⁶ Rebecca Slutsky, *Delhi's Air Pollution and Its Effects on Children's Health*, YALE GLOBAL HEALTH REV. (May 14, 2017), <https://yaleglobalhealthreview.com/2017/05/14/delhis-air-pollution-and-its-effects-on-childrens-health/>; see also S. Gopikrishna Warriar, *The Disease Burden of Delhi's Smog Is Among the Highest in the World*, MONGABAY INDIA (Jan. 8, 2018), <https://india.mongabay.com/2018/01/the-disease-burden-of-delhis-smog-is-among-the-highest-in-the-world/>.

³⁷ Florence Miettaux, *As Flooding Becomes a Yearly Disaster in South Sudan, Thousands Survive on the Edge of a Canal*, AP NEWS (Dec. 22, 2024).

³⁸ Charlie Campbell & Chad de Guzman, *Fishing Communities in the Philippines Are Fighting for Their Future as Waters Rise*, TIME (June 5, 2025), <https://time.com/7289533/philippines-fishing-communities-rising-water/>.

the ozone layer and poor air and water quality that worsen human health. All of this makes clear that the need to preserve such resources and to use them with strict vigilance is real and necessary. Blue cities help to resolve these matters by planning cities in a way that tackles such situations and preserves the resources of the environment.

A. How to implement blue cities and efficient green laws in the Global South

Blue cities and efficient green laws can readily be adopted by cities that currently rely on grey infrastructure through a “blue-green infrastructure” (BGI) approach, which integrates water and vegetation into urban planning and ensures interconnected green and blue spaces in the form of networks. BGI helps in the following ways:³⁹

- **Water management:** BGI introduces features such as green roofs, rain gardens and permeable pavements, which capture rain and storm water, reduce the pollution emitted directly by industry and improve water quality. This step is useful because many countries face both droughts and excess rainfall; it equips cities to respond to such calamities and offers prevention rather than cure.
- **Improving air and water quality:** air and water quality improve automatically as pollution falls; since BGI reduces pollution, it ensures good air and water quality.
- **Safeguarding habitat:** by reducing ozone depletion, BGI helps humans to go on living on the Earth’s surface, and animals in aquatic regions or forests do not have to migrate, because BGI safeguards green corridors, parks and other environmental areas such as aquatic regions.

Beyond these benefits, BGI is cost-effective and protects the environment for the long term. Although it is adequate in itself, there are many complementary strategies, one of which is the improvement of environmental legislation. The current laws in the Global South are largely ineffective and have not kept pace with the dynamic needs of a changing society; even after stricter regulation, many citizens do not comply, and the result is widespread pollution. This helps to identify the legal challenges facing green laws today: the lack of stringent penalties, which undermines compliance with the regulations laid down by governing bodies; the failure of the law to adapt to developing technology; and, not least, the number of people using environmental resources in the wrong way, so that those resources are misused or become scarce.

³⁹ *Urban Green and Blue Infrastructure*, EUROPEAN ENVIRONMENT AGENCY, CLIMATE-ADAPT (Apr. 15, 2021), <https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/green-spaces-and-corridors-in-urban-areas>.

B. Basic features required for blue cities and efficient green laws in the Global South

The first requirement is to assess the city properly. Assessment provides valuable insight into the city as a whole and helps to identify the primary areas of need, such as flood hotspots, damaged or polluted rivers and vulnerable communities.⁴⁰ Policy also needs to become more favourable to, and stricter about, preserving nature, for example by requiring proper spatial plans, mandating that industrial waste be disposed of in the right places and preventing water from being polluted. Investment from the municipal corporation helps to budget for green projects. Many private companies practise corporate social responsibility, returning to society what they take from it in resources and thereby mitigating the risk of their neglect of the environment, and many NGOs help to fund green projects, as do instruments such as green bonds,⁴¹ diaspora funds and the Cape Town water fund, which channel money through trusts and private-sector contributions. The most important element of all is the participation of society at large. Many countries in the Global South have populations that do not abide by laws and regulations, even by initiatives that benefit their own environment, and as a result the laws have become ineffective and lost their integrity. This too is largely a matter of awareness. People pollute water by using it to wash themselves or their cattle or to dispose of waste, and waste is dumped not only in aquatic areas but in other natural places as well, causing many problems. When people are made aware of how their attitude towards the environment affects not only the environment but also themselves and other organisms, many change. A recent example is the YouTuber MrBeast, one of the most-subscribed creators on the platform, who set a challenge to plant 20 million trees by the start of 2020, with one tree planted for every dollar donated; the campaign succeeded tremendously, with more than 24 million trees funded. This shows how celebrities and other influential people can lead the public to care for the environment.

V. CASE ANALYSIS

A. Rotterdam, Netherlands: Room for the River and water squares

In Rotterdam, instead of combating water, urban spaces have been restructured to hold and store excess rainwater.⁴² This shows that precautionary measures are more effective than fighting

⁴⁰ *Capibaribe Park, Environmental Recovery of the Ecological Corridor That Leads to Urban Redevelopment, Recife, Pernambuco (PE)*, BUILDING HEALTH (Dialogues with Brazil, Berlin, Aug. 28–Sept. 1, 2023), https://www.buildinghealth.eu/capibaribe-park-environmental-recovery-of-the-ecological-corridor-that-leads-to-urban-redevelopment-recife-pernambuco-pe_-1/.

⁴¹ *India's Municipal Green Bonds Market Could Mobilise up to USD 2.5 Billion with the Right Reforms: CEEW Green Finance Centre*, COUNCIL ON ENERGY, ENVIRONMENT AND WATER (Mar. 27, 2025), <https://www.ceew.in/press-releases/indian-municipal-green-bonds-market-could-mobilise-to-usd-2.5-billion-and-boost-climate-resilient-urban-growth>.

⁴² RIJKSWATERSTAAT, MINISTRY OF INFRASTRUCTURE AND WATER MANAGEMENT, *Room for the River*, <https://www.rijkswaterstaat.nl/en/projects/iconic-structures/room-for-the-river> (last visited Sept. 6, 2026).

water after no precautions have been taken, and it ensures the efficient use of water in the city, preventing drought. The Dutch national Room for the River programme managed the excess flow of the rivers so that it did not lead to floods, relocating dikes and giving the rivers room to spread, so that water does not overflow into the city and force people to migrate.

B. Singapore: Active, Beautiful, Clean Waters Programme

Singapore's ABC Waters Programme uses green-blue infrastructure to store and clean rainwater for reuse.⁴³ Why is this helpful? Excess rainwater is not a problem if it is stored properly and cleaned efficiently, so that it can be reused for future purposes, including agriculture and the daily activities of people. Bishan-Ang Mo Kio Park⁴⁴ was one of the measures adopted by Singapore, transforming a concrete canal into a naturalised river with floodplains that absorb excess rainwater, and measures such as bio-retention swales help residential areas to filter storm and rainwater naturally.

C. Cape Town, South Africa: "Day Zero" and the Water Strategy

Cape Town's Water Strategy was a direct response to the drought that culminated in the 2018 "Day Zero" crisis; the city adopted more efficient public parks and green infrastructure so that rainwater is actively captured, and projects such as aquifer recharge show how such measures can generate legislation and rules against such threats.⁴⁵ This shows how efficient laws and infrastructure of the blue city kind help cities greatly. These case studies illustrate how green laws and blue city planning enable cities to combat climate change and to turn such threats into an opportunity to grow.

VI. CONCLUSION

In conclusion, this research identifies water not as a threat but as a resource which, if used with proper diligence and care, helps to reduce a range of problems. Blue cities and green laws are complementary: together they show how cities can be protected without repercussions. Blue cities build a city with proper blue infrastructure, while green laws shape the legislation and regulatory frameworks that ensure no place is left facing such difficulties. Nature has provided the wonders of natural resources, but humanity is using the maximum of those resources to build grey infrastructure, which is not always required. It is certainly needed in order to develop

⁴³ PUB, SINGAPORE'S NATIONAL WATER AGENCY, *About ABC Waters*, <https://www.pub.gov.sg/Public/Places-of-Interest/Our-Reservoirs-and-Waterways/ABC-Waters/About> (last visited Sept. 6, 2026).

⁴⁴ PUB, SINGAPORE'S NATIONAL WATER AGENCY, *Kallang River (Bishan-Ang Mo Kio Park)*, <https://www.pub.gov.sg/Public/Places-of-Interest/Our-Reservoirs-and-Waterways/Bishan-Ang-Mo-Kio-Park> (last visited Sept. 6, 2026).

⁴⁵ CITY OF CAPE TOWN, *Cape Town Water Strategy: Our Shared Water Future* (2020), <https://www.capetown.gov.za/general/cape-town-water-strategy> (last visited Sept. 6, 2026).

an economy, but when it comes to threats such as floods and excess rainfall, it must be remembered that river beds and green corridors are available to protect living organisms from those threats. Even if the economy grows on the back of grey infrastructure, such threats and their repercussions must be considered, because they could cause significant damage to cities and infrastructure, leading to many problems and ultimately threatening life and disrupting the habitat of living organisms. In a world of rising technology, it is very important for humanity to preserve nature and to take care of it with proper diligence.
