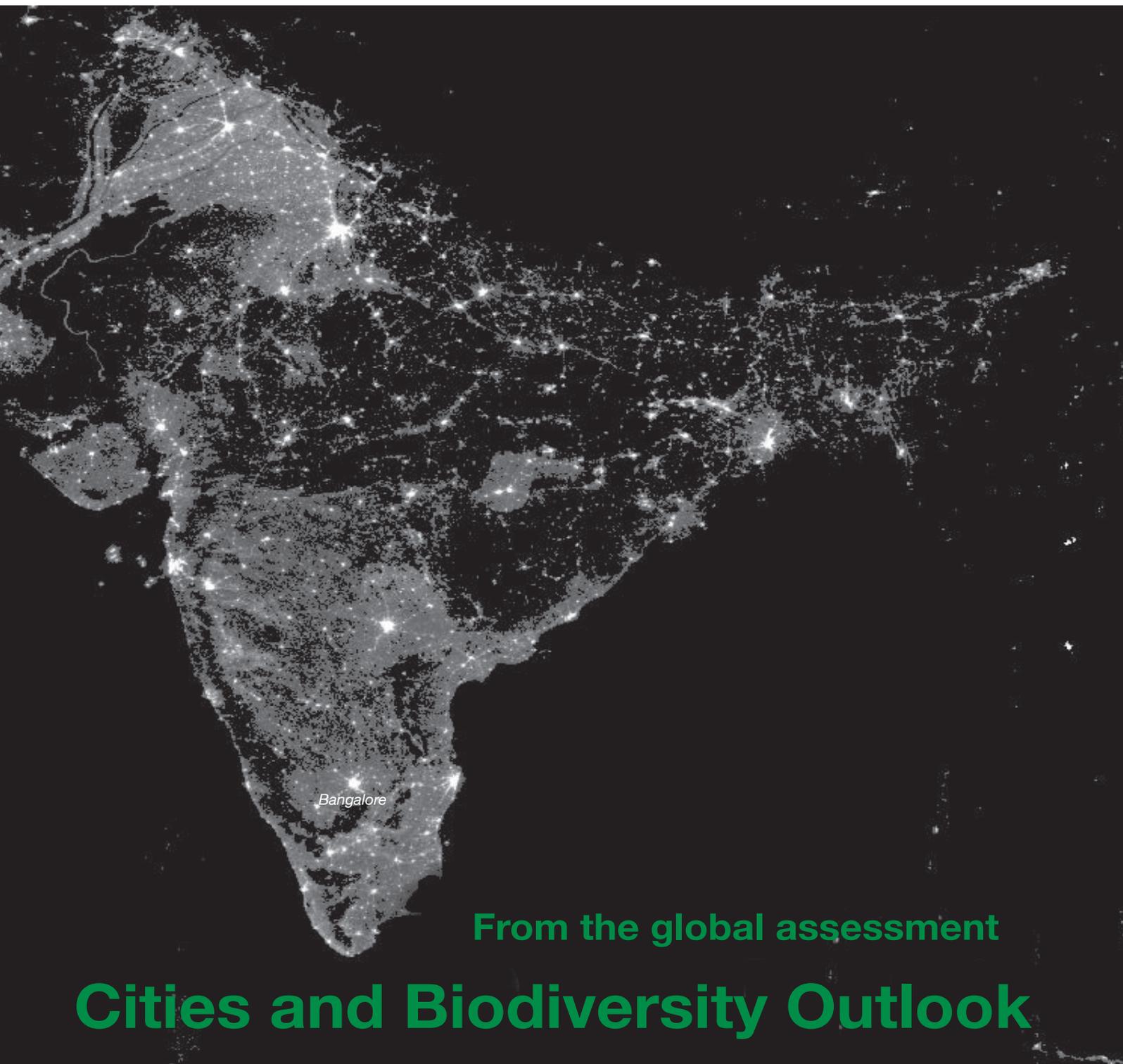


Urbanization, ecosystems and biodiversity: Assessments of India and Bangalore



From the global assessment

Cities and Biodiversity Outlook

Cities and Biodiversity Outlook

Assessments of India and Bangalore

This publication is an outcome and part of the global *Cities and Biodiversity Outlook* (CBO). The CBO project provides a global assessment in two publications, of the links between urbanization, biodiversity, and ecosystem services. The first part, *Action and Policy*, is released in Hyderabad at the Cities for Life Summit, parallel to the eleventh meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) in October 2012. Core chapters of the second part, the more detailed *Global Urbanization, Biodiversity, and Ecosystems - Challenges and Opportunities* will be available online at www.cbd.int/subnational/partners-and-initiatives/cbo, and will be published in its entirety in the spring of 2013.

This publication focuses exclusively on India's urbanization trends, and the links to and impacts on ecosystems and biodiversity. Bangalore is represented as a city-level case study. The ten key messages of *Action and Policy* are highlighted throughout the publication, with the text they are the most connected to. The texts build on the two case studies of India and Bangalore that will be parts of the forthcoming second part of the CBO - *Challenges and Opportunities*.

Drawing on contributions from more than 120 scientists and policy-makers from around the world, the CBO summarizes how urbanization affects biodiversity and ecosystem services, provides ten Key Messages for strengthening conservation and sustainable use of natural resources in an urban context, as well as showcases best practices and lessons learned.

Both CBO volumes - *Action and Policy*, and *Opportunities and Challenges*, are collaborative efforts of the CBD and the Stockholm Resilience Centre at Stockholm University, with significant input from ICLEI - Local Governments for Sustainability.

ICLEI South Asia in collaboration with ICLEI's Cities Biodiversity Center has developed a *Local Action for Biodiversity - India (LAB India)* programme, supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The programme has been developed based on a demand expressed by several Indian cities for support towards conservation and improved management of urban biodiversity.

LAB India will support Indian cities in their efforts to (1) preserve, use and manage their biodiversity sustainably, and (2) to develop and implement local biodiversity strategies and action plans. In the process, the programme will be adapted to the Indian context while connecting Indian cities to a global network. This initiative will be launched at the Cities for Life Summit on 16th October 2012 in parallel to the CBD COP 11.

"Cities and Biodiversity Outlook (CBO) brings into sharp focus not only the extraordinary wealth of urban biodiversity but also its role in generating ecosystem services upon which large and small urban populations and communities rely for their food, water, and health. It makes a strong argument for greater attention to be paid by urban planners and managers to the natural or nature-based assets within their metropolitan boundaries as one way toward realizing a range of targets established both pre- and post-Rio+20."

Achim Steiner,
United Nations Under-Secretary General and
Executive Director,
United Nations Environment Programme
(Excerpt from the CBO Message)

"Cities and Biodiversity Outlook - Action and Policy stems from Decision X/22 requesting the Executive Secretary of the CBD to prepare an assessment of the links and opportunities between urbanization and biodiversity."

I hope you will read it, share it, and together with others, take action to save life on Earth."

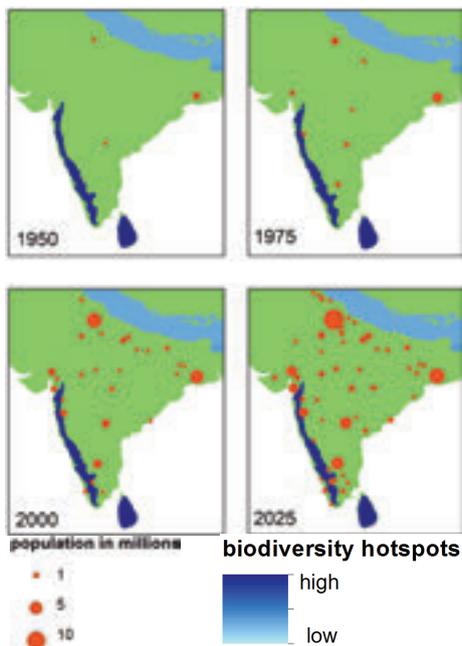
Bráulio Ferreira de Souza Dias
Assistant Secretary-General and
Executive Secretary,
Convention on Biological Diversity
(Excerpt from the CBO Preface)

India

Urbanization trends, challenges and opportunities

India is experiencing a massive trend towards urbanization. Currently, India's urban population is about 30 percent, accounting for about 11 percent of the world's urban population. Indian cities are expanding in number, density and size, and by 2031, 15 percent of the world's urban population is projected to come from India, with 600 million people living in Indian cities. India is expected to become 50 percent urban by about 2044.

In addition to an increase in people living in cities, urbanization also has major impacts on rural areas, reshaping lifestyles, livelihoods, and patterns of consumption and waste generation. Thus, the massive increases in urban population that are ongoing and anticipated across India are bound to have significant implications for the country's environment, ecology and sustainability. These implications must be taken into account for sustainable planning and development. This report provides an overview of the environmental and ecological implications of urbanization in India, also drawing on Bangalore as a city level case study.



Data sources: UN, Conservation International
Map maker: Femke Reitsma, University of Canterbury

India already contains three of the world's ten largest cities, Delhi, Mumbai and Kolkata, as well as three of the world's ten fastest growing cities, Ghaziabad, Surat and Faridabad. Urbanization in India is unevenly distributed, with about half the country's urban population living in smaller urban agglomerations where the populations are under 100,000.

Key Message 1. Urbanization is both a challenge and an opportunity to manage ecosystem services globally.

Most resources that people in cities use, for example food, water or energy, come from ecosystems somewhere else.

As cities grow in number, spatial extent and density, their environmental and ecological footprints increase. Urban expansion that takes place in forests, wetlands and agricultural systems leads to habitat clearing, degradation and fragmentation of the landscapes. Urban lifestyles, which tend to be consumptive, requiring great natural resources and generating increasing amounts of waste also lead to increased levels of air, water and soil pollution.

Due to the number of connections between cities and the hinterland, demands of urban areas for natural resources further lead to spillover effects, decreasing the supply of natural resources in far-off areas, and leading to pollution not just within but also outside cities. This is often exacerbated by the lack of appropriate policies for managing these effects, as well as poor regulation and enforcement.

However, urbanization in India also presents opportunities for the environment. For instance, at the national level following promotion of the transition from fuelwood to liquefied petroleum gas for household energy use in cooking, the urban fuelwood demand declined from 30% of households in 1993, to just 22% of households in 2005. This has reduced the pressure on forest habitats near urban areas.

Cities can also serve as nodes for ecosystem recovery. For instance, in Navi Mumbai, decreased pressure on mangrove forests has led to a remarkable recovery in the past two decades. In Bangalore, collaborations between municipal government and local communities have led to a growing movement towards the restoration of lakes; and in Surat, one of the world's fastest growing cities, a focus on integrated waste and sewage management has provided impressive results.

Cities in India have typically been smaller in area than cities in many other parts of the world such as the USA, Mexico and Brazil. Growth is often nucleated, with newly urbanized land usually seen in a tight band around the older parts of the city.

Reflecting the trend of rapid urbanization, cities in India can be categorized in terms of their size into megacities, incipient megacities and smaller cities. Rates of growth seem to be shaped by geographical and ecological location, as well as the existing size and density. However, cities' history, topography, planning and management also affect their development and sustainability. For instance, Pune and Bangalore continue to have significant green space in the city core areas despite rapid development and growth, due to the presence of institutions such as the military and public sector companies, which protect large green patches.

Compared to India in the past, when the country's population was mostly rural, the contemporary and future India is entering a new era, marked by the growing influence of urban areas, with large-scale, distal impacts on rural environments across the country. These changes will have a major influence on sustainability. They will impact land cover, natural habitats, biodiversity and ecosystem services that underpin human well-being.

Key Message 2. Rich biodiversity can exist in cities.

Bangalore and Lucknow

In high growth cities like Bangalore, the city center maintains a fairly steady population because of a scarcity of land for further development. Instead, the city grows outwards, which leads to increased fragmentation at the periphery.

In the smaller Indian city of Lucknow, growth is largely in the city core through infilling, while little growth has taken place in the outskirts of the city. This makes the city compact and denser, and can lead to greater impacts on biodiversity located in the center of the city, as well as impacting species movements between the city center and surrounding areas.

The Atlas of Indian Urbanization

The aim of the project is to map land-cover and land-cover change for the top 400 Indian cities over the last two decades, in the Atlas of Indian Urbanization.

Thus far, the project has found that in the 100 cities that exhibit the fastest growth outside of the city core, the built-up area has increased by almost 2.5 times, often along major transportation networks. This translates to that in 100 cities alone, relatively low-density sprawl is taking up over 5000 sq.km more land now than twenty years ago.



Accelerated urban growth presents several difficult challenges for the natural environment. Increasing pollution of water and air degrade ecosystems. Continuous encroachment and transformation of ecosystems from woodlands, grass lands, coastal areas, wetlands and water bodies into urban concrete jungles further degrades them. Remaining green spaces in the cities have been transformed from their original state and species compositions to human-designed, landscaped and pesticide-intensive parks.

Further transformation of urban ecosystems is induced by their vulnerability to invasive species. The number and extent of exotic species invasions have increased. Although in some contexts exotic species can contribute to, and become integrated with urban habitats, they often pose new and significant challenges to ecosystem function and ecological integrity, such as the water hyacinth suffocating urban water bodies.

Cities can also become nodes for the spread of invasive exotic species into surrounding non-urban habitats. The biggest example of this is the exotic *Lantana camara*, which was introduced to India as an ornamental garden plant, but now chokes forest understories across the country.

Native bird species diversity has been shown to decline with an increase in exotic plant species in Delhi, and the same has been found in other cities in the world. This has disturbing implications for Bangalore, where 80% of the trees found in parks are exotic. Enhancing the amount of green areas in cities with native species, as has been done in Mumbai, holds the potential to offset some of this development.



Pigeons at a city square, Hyderabad. ©Harini Nagendra

Key Message 3. Biodiversity and ecosystem services are critical natural capital.

However, as both cities and the climate changes, some exotic species might have higher survival rates compared to native species and could provide support to other species, as well as services for humans. It is thus highly important to understand how exotic and native species impact both humans and the ecosystems in urban areas.

Climate change and Indian cities

As with other parts of the globe, Indian cities are beginning to witness and deal with the impacts of climate change. The high population density in many Indian cities and towns creates particular challenges. One main difficulty will be to manage scarcities and excesses of water in urban areas. Coastal cities such as Mumbai and Kolkata are poised to face some of the most severe impacts. In addition, inland and coastal cities located in areas next to rivers will have to deal with impacts of flooding, as is already being felt for example in Delhi, in areas around the Yamuna river.

Further, cities in semi-arid areas and drylands such as Bangalore are already dealing with problems of water scarcity due to unpredictable rainfall, compounded by the pressures of urbanization. These challenges will become intensified as climate change accelerates. For adaptation as well as mitigation, sustainability measures are being implemented in several cities, ranging from public transportation to solid waste management and rainwater harvesting. These measures need to be amplified and intensified.

Ecosystem restoration also requires to be made a major focus. Urban forests have a potential to reduce air pollution and decrease urban heat island effects, while urban wetlands and lakes can provide ecosystem services that can be influential in activities such as reducing flooding, increasing groundwater recharge, and stabilizing soil.

Further, the most vulnerable urban residents tend to be socio-economically deprived. They also tend to live in informal or traditional settlements, that are located in areas at greatest risk for flooding or landslides and at greatest risk of eviction during environmental crises.

Ensuring the most vulnerable residents continued access to well-functioning ecosystems that can provide the people with services such as food, fodder, water and timber, can be critical in ensuring greater food and water security for the most vulnerable in times of climate change.

Landscape transformation and ecosystem opportunities: the example of Mumbai

What is today the city of Mumbai started as a group of islands. However, as the city grew, urbanization claimed land which led to infilling of tidal flats and conversion of mangroves for urban development. As a consequence, large swathes of mangrove habitats have disappeared or been degraded in recent decades, which in turn has affected many other plant and animal species. This has also led to an increase in the city's vulnerability as mangroves can provide some natural protection against flooding during monsoons, as well as anticipated sea level rises due to global climate change.

However, the Mumbai example is remarkable in that the Navi Mumbai corridor along the eastern side of Thane creek has seen a recovery of some mangrove forests. This can be linked to a decrease in the dependence of surrounding villages on fuelwood, due to a shift to alternative sources such as compressed natural gas and electricity. Thus, changes in human resource use can have consequences for ecosystem degradation as well as for restoration.

Unfortunately, the natural recovery of the Navi Mumbai corridor's mangroves is not enough to offset the overall loss of Mumbai's mangroves. Increased urbanization also presents new threats: most imminently, the new proposed airport development in Mumbai presents a great risk, with the potential to destroy much of this newly re-created habitat.

Since the mid-1990s, Thane creek has also become an important wintering ground for a sizeable population (10,000 to 15,000) of Greater Flamingoes which started migrating to the area during winter. This is an unusual example of a native wildlife species choosing to occupy habitat right in the middle of a rapidly expanding megacity.



Lesser Flamingoes at Thane Creek, Mumbai. ©Ritesh Bagul

India

Governance structure, challenges and opportunities

The capacities of ecosystems within and around cities to provide services such as food, pollution control or ground water recharge, depend on the pressure that humans exert on the ecosystems. The pressure is shaped by population density, size, distribution and levels of consumption. Ecosystem integrity further depends on dynamics within the systems, for example changes in species and habitat composition and abundance over time. A better understanding and recognition of these dynamics can help improve management of urban ecosystems and mitigate the negative effects of urbanization.

Equity and access to green areas, clean air and water, as well as other ecosystem services, also presents an increasing challenge in urban areas. Thus, for instance, less than 50% of the population in South Asian cities has access to piped water. In many Indian cities, such as Bangalore, there are substantial inequities in access to green spaces and ecosystem services,. Slums have significantly fewer trees and plants compared to wealthier residential neighborhoods. Many traditional common property areas used for activities such as grazing and fishing are converted to other uses.

Cross-sectoral governance, the example of Pune Tree Watch, Surat Tree Watch and Bangalore's Hasiru Usiru

Many Indian cities have developed strong civic programs to monitor and protect urban biodiversity. Pune Tree Watch, active since 2005, is a forum to unite people who are concerned about the city's dwindling tree cover. They provide information and generate awareness about the ecological benefits of the urban ecosystems.

Surat Tree Watch, initiated in 2009, derives its inspiration from the success of the Pune Tree Watch program. It has been successful in saving several hundreds of trees, including some 500 year old heritage trees in the city, from felling.

In Bangalore, the civic action group Hasiru Usiru (loosely translated as "Greenery is life" has been very active since 2005. They are instrumental in bringing attention to issues of lake encroachment, tree felling and the insufficiencies of public transport in the city.

All three groups have worked with a wide variety of cross-sectoral groups, including the government, judiciary, press, local communities, educational institutions, and other NGOs.



Beach visitors and local market stalls along one of Goa's many beaches. ©Harini Nagendra

India's coastlines

A major element of India's projected urbanization will take place along the coastlines through the growth of existing coastal cities as well as proposed and ongoing development of major new ports. This threatens important coastal regions, both through direct destruction of sensitive habitats such as mangroves and sea turtle nesting beaches, and indirectly through increased demand for fish, turtle eggs and other seafood. Construction of buildings close to the shoreline, along with mangrove destruction, also leave cities more vulnerable to flooding and other damage from natural disasters due to cyclones and tsunamis, as well as projected sea level rise from global climate change.

Maintaining the integrity of Indian coastlines is crucial. The recent tsunami that hit India's east coast clearly demonstrated the importance of maintaining natural mangrove vegetation as a buffer against the sea's surge, with development too close to the water's edge being most severely damaged. Future development along the coastline must incorporate strategies to maintain and restore natural vegetation as a buffer along the water's edge.

Sacred and cultural traditions of conservation in India

India has had a long and rich tradition of conservation associated with sacred religious and cultural beliefs. Sacred groves are conserved in many peri-urban areas and smaller towns, while it is quite common to find massive, centuries-old sacred trees being protected in densely congested urban neighborhoods across India.

These trees are very important in urban contexts, acting as keystone species and providing important biodiversity support for urban wildlife. Sacred ecosystems are associated with a variety of religious traditions. Apart from trees, other habitats and species such as bat roosts, bonnet macaques, Hanuman langurs and fish are protected in certain areas.

In addition to complete protection, there are cultural taboos associated with hunting and harvesting of certain plants and animals during particular seasons of the year, like fruiting or breeding seasons, which contribute to traditions of restrained resource utilization.

Cultural influence shaping urban ecosystems

History and cultural preferences for specific types of landscaping and biodiversity play a major role in shaping Indian urban ecosystems. In the capital city of Delhi, the trees in the old city where the British influenced landscaping, differ clearly in tree distribution and species from the trees in the new gated communities in the periphery of Delhi, such as Gurgaon.

Similarly, in Bangalore, there are differences between parks belonging to different time periods; older parks are more wooded, while newer landscaped gardens tend to be dominated by neatly trimmed shrubbery, which may appeal more to the wealthier of the city's residents.

People also feed urban wildlife during certain times of the day, or specific seasons. Water, wetlands and lake ecosystems also occupy a prominent position in many Indian cultural traditions, with traditional restrictions on the conservation and management of fresh water resources, maintained through worship of local lake deities.

Although disrupted by urbanization, many of these practices continue to survive in Indian urban areas. Such traditions shape and sustain biodiversity in diverse socio-religious settings, and can be very influential in providing a unique, India-specific path for sustainability in an urban future.



Slums and biodiversity in Bangalore



Trees provide crucial ecosystem services, such as shadow for slum inhabitants. ©Divya Gopal

Key Message 9. Cities offer unique opportunities for learning and education about a resilient and sustainable future.

In cities like Bangalore, with dense populations living in close proximity in concrete jungles, the role of green spaces becomes extremely important. Today one-third of the world's population lives in slums. The knowledge and experiences amongst slum areas' inhabitants on supporting, using and maintaining biodiversity in cities can be highly valuable for planning and management that supports social and ecological well-being.

A study from 2011 found that while trees and plants in wealthier residential areas in Bangalore are of aesthetic and cultural value that can be seen as a part of people's lifestyles, greenery in slums support people's livelihoods. At the same time, tree density in the slums was alarmingly low at 11 trees per hectare, whereas wealthier (and legal) residential neighborhoods had more than double that density, at 28 trees per hectare.

The extremely difficult conditions under which the majority of the slum residents managed their daily activities meant most of their days were spent outside, in common areas on the streets in front of the people's homes. Trees provided shade that is of increasing importance as the number of people increase and as summers are increasingly hot.

Trees in the slum were hubs of activities. People spent time in the shadow talking, gossiping, cooking, washing and playing. The canopies of trees acted as large umbrellas and sustained many professions: flower selling, broom making, incense sticks making, and the running of a mechanic shop, tea stalls and telephone booths.

Some slums did not have trees but they all had potted plants, mostly of species that had direct value for humans. Due to space constraints, most plants were in pots rather than growing directly from the ground. 'Pots' included for example cemented structures, plastic bags, discarded paint containers, earthen water pots and plastic buckets. The study thus showed that the people directly contributed to supporting the ecosystems and maintaining biodiversity, as well as how slums can be great hubs for innovations.

Ecosystems in the slums were found to provide other crucial services to the areas' inhabitants. Plants could for example add variety and nutrition to the people's diets, as well as provide herbal medicines. As they were important for cultural and religious expressions, ceremonies and beliefs, trees and plants also had cultural and psychological significance.

Governance of urban biodiversity and ecosystems is exercised by the decisions and actions of multiple actors, including formal and informal institutions and individuals. Governance of ecosystems in India is characterised and shaped by a complex network of actors interfacing on multiple levels. Key actors to be mentioned are the judiciary, elected officials, city municipalities, corporate and public sector agencies, Non-Governmental Organizations (NGOs), local community groups, research institutions and activist groups.

Elected officials, judiciary, city municipalities and planners can devise and seek to implement laws and regulations, but they are not necessarily always followed. Community groups, corporate and public sector agencies, as well as NGOs constitute important actors, for example for knowledge and information sharing. Also important are informal, loose coalitions of different social, economic and interest groups that are often influential in negotiating local-scale agreements about resource use. These coalitions also provide an important link with official institutions.

In the Indian context, local municipalities can unfortunately often face knowledge constraints that limit their capacity to plan for sustainable development. Resource and manpower limitations can restrict their ability to effectively implement regulations that limit the over-use and exploitation of urban ecosystems, as well as resource and manpower limitations that can affect their ability to effectively implement regulations.

Key Message 7. Ecosystem services must be integrated in urban policy and planning.

Thus, the integration of information, perspectives and on-the-ground action provided by researchers, NGOs and community groups can be essential for environmental protection and restoration in the Indian urban context.

NGOs, informal and formal local community groups, and Residential Welfare Associations are widespread and influential in most Indian cities. These informal and formal institutions play an important role in making diverse perspectives and requirements of different local social and economic groups, such as urban poor or migrants, in Indian cities heard by decision-makers. They can also increase knowledge dissemination within their own groups and implement sustainability initiatives at a micro-scale that can become very valuable when accumulated at a city scale. Examples include wildscaping of local gardens in Pune, solid waste management in Chennai, and lake restoration and governance in Bangalore.

People protesting around a polluted lake in Bangalore. ©Harini Nagendra



India's governance structure at a glance

The judiciary

One example of the role of interventions by the judiciary in protecting the urban environment in India is provided by the case of actions aimed at air pollution control in Delhi. In the 1990s, the Indian capital city of Delhi witnessed a rapid and alarming increase in air pollution levels, being ranked the fourth most polluted city in the world. Interventions by the Supreme Court of India ruled *“all buses and public transport in Delhi to run on CNG (Compressed Natural Gas), to improve the air quality (...) which is becoming a health hazard besides being an environmental enemy.”* Despite a substantial delay, the implementation of this ruling was eventually forced through sustained follow-up by the judiciary, and pressure from civil society groups. Delhi has since implemented a number of new policies designed to reduce air pollution. These initially led to an impressive drop in air pollution but recent years have seen a rise due to large increases in the number of private vehicles on the roads. This is a challenge faced by most Indian cities, which lack sufficient and reliable public transport.

City municipalities

The city of Surat, Gujarat state, Western India, is the fourth fastest growing city in the world, having recorded massive rates of over 80% increase in population for the past three decades. Despite being one of the most densely populated Indian cities, Surat has transformed itself over the past couple of decades into one of the cleanest cities in India, with an excellent public bus service, well planned water distribution and well functioning waste management and treatment plants. A key factor was the implementation of a well designed municipal management, brought about by streamlining of functional, administrative, financial and technological bodies within the municipality, in collaboration with NGOs, local community groups and the public. Surat thus provides an example showing that local municipalities have great capacities to face the challenges of rapid urbanization. However, it is critical that municipalities work pro-actively to avoid problems rather than tackling them after appearance. It is also important to actively involve representation from a variety of social and economic groups, providing ecosystem and environmental protection and restoration, while also paying attention to issues of equity, social justice and human wellbeing.

Media and the civil society

Traditional channels such as newspapers and television bring mainstream news from across the globe. Newer online social media networks and tools whose availability is expanding, have the potential to allow people from broader segments of society to directly participate in information dissemination. A rapid exchange of information has been facilitated for example by the explosive growth in mobile telephone usage across the country, which allows simple text-messaging (SMS), as well as an increasing use of online networks like Twitter and Facebook. Civil society groups increasingly use blogs and other social media channels to share information, grow their networks and rally support for campaigns by targeting people from levels of society most likely to influence decision makers, for example within the government. These tools also allow individuals, organizations and interest groups to monitor activities of, and environmental compliance by, vested interests.



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Bangalore

Urbanization trends, challenges and opportunities

An incipient megapolis, Bangalore's economy has been undergoing transformations driven by information and communication technology (ICT) and other types of economic growth, leading to accelerated environmental and ecological degradation in recent years. Bangalore provides a characteristic example of global and Indian urbanization trends, and their impacts on urban nature.

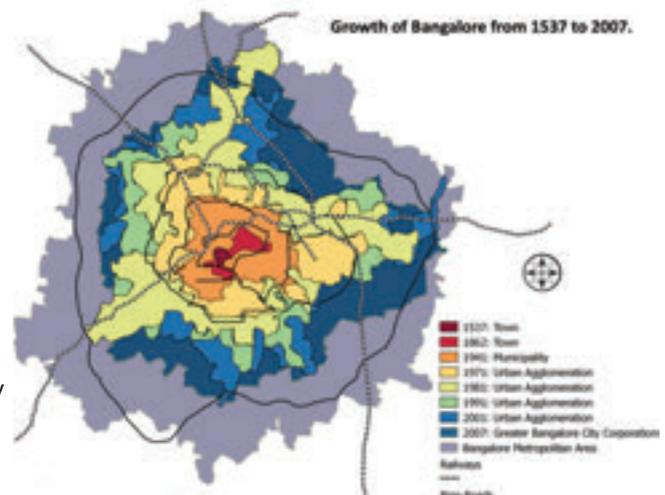
In high growth Indian cities like Bangalore, most land in the city centre is already utilized or owned by various agents, with limited availability for further expansion. Thus, instead of densification in the centre, Bangalore has expanded at the periphery, leading to a spread-out and fragmented city periphery. A significant proportion of green space has been preserved in the city core, however largely in areas owned by the military, government, public sector, corporate sector, and educational and religious institutions.

With a population rapidly approaching 9 million inhabitants, Bangalore is India's 5th largest city. Economic growth pushed by a booming IT-industry has improved people's median income and living standard; however, the economic growth has had major impacts on biodiversity and ecosystems. Encroachment on the city's water bodies, severe water and air pollution, felling of thousands of trees and development of green spaces into built-up land are some examples.

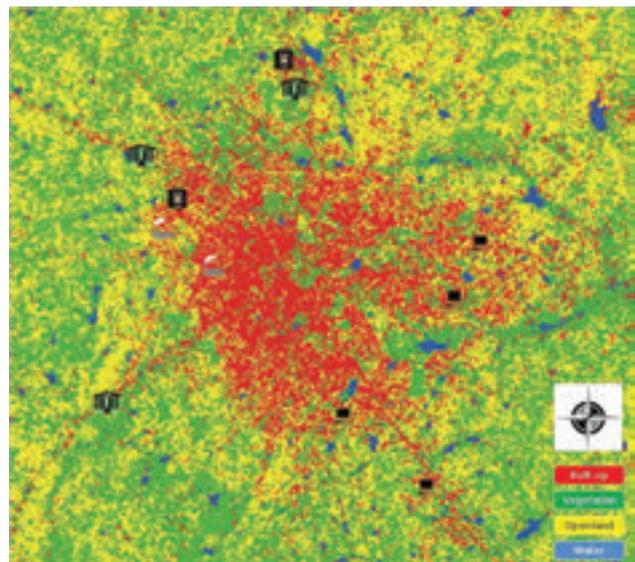
Bangalore, including its green spaces and lakes, is governed by a multiplicity of institutions with overlapping and often uncoordinated jurisdictional responsibilities. However, there is little formal recognition of the existing and potential role of the civic society, which plays a central role in the management of the green areas. The civic society is involved indirectly in the management by monitoring encroachment and engaging with city municipalities and political entities for restoration. They are directly involved through varied interventions as initiators of public interest litigations, as garden owners, or as park visitors.

In the coming decades, it is expected that rising temperatures due to climate change and scarcity of clean water will pose significant challenges for the city. The loss of lakes, wetlands and urban green-spaces will most likely exacerbate the challenges. The poorest people will be hardest hit by the changes.

Key Message 4. Maintaining functioning urban ecosystems can significantly enhance human health and well-being.



Bangalore 1537 - 2007.
From Shashidar, Paper 2 of 2001. Census of India



BangaloreSim model output for 2006.

From the “Garden City” to the “Silicon Valley of India”

There are many beliefs about the origin of the name *Bengaluru* (as Bangalore is known locally). Several of these have ecological significance. For instance, one belief states that Bangalore got its name from the local Kannada language term for a deciduous tree, *benga*, and the word for town, *ooru*. Another story considers “Bengaluru to be a condensed version of *benda kaalina ooruu*, the city of boiled beans”, following a story about a king who founded the city. He once dined on a meal of boiled beans, served by an old woman in a forest where Bangalore is now located.

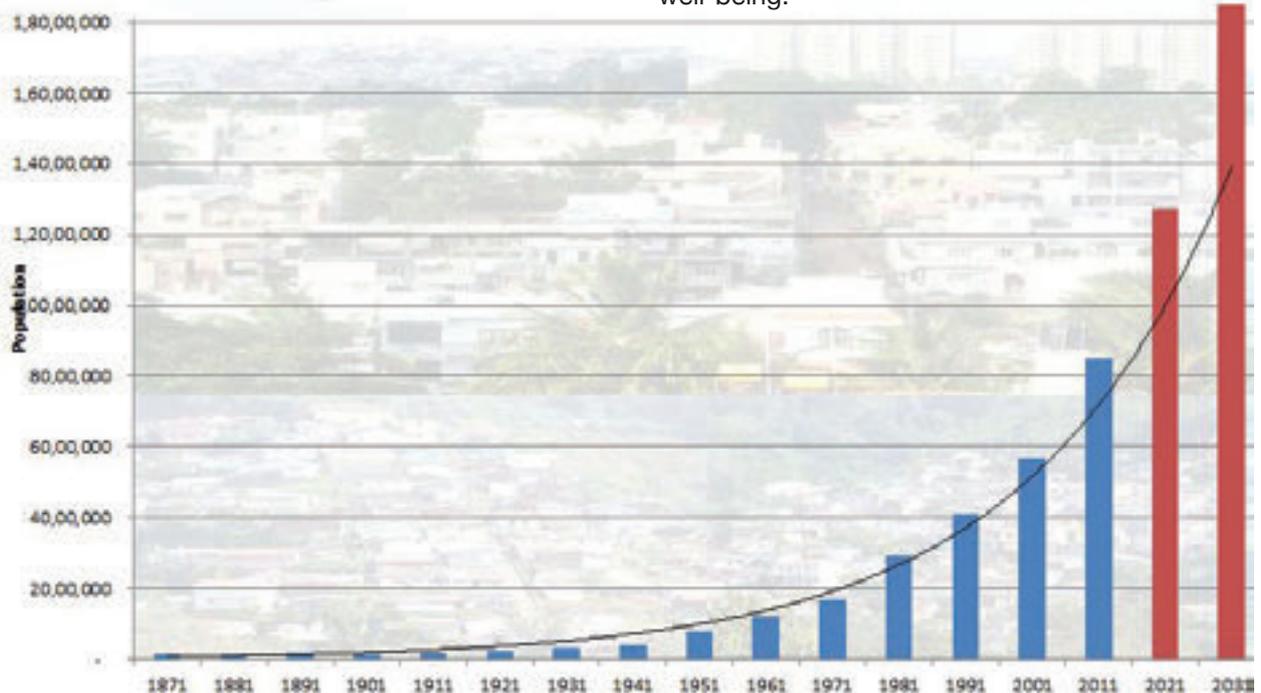
Indeed, the city considered the “Garden City of India” has a long ecological history, with tree-lined avenues, parks and a multitude of waterbodies considered an integral part of the cultural landscape throughout most of the previous century. The broader region within which Bangalore is embedded is built around a well developed system of man-made lakes, created across a topographic gradient, with some lakes being managed as far back as the 4th century A.D. Throughout the centuries, the city’s inhabitants developed a sophisticated system of collective management of these lakes, with water used for household needs, irrigation and for cattle. The lakes also provided important sources for ground water recharge.

Key Message 5. Urban ecosystem services and biodiversity can help contribute to climate change mitigation and adaptation.

Bangalore’s urbanization rate is remarkable and a key factor to why historically important water bodies are now being encroached on and polluted, why the trees that have strong roots in the culture are being felled in thousands, and why open green areas such as parks are being converted into commercial, industrial and residential settlements. The scale of impact of urbanization on the city’s ecosystems and biodiversity has exploded in recent decades, as the illustration below depicts.

As high land prices and scarcity of land in the city centre has created a building boom in the city periphery, the loss in vegetation and fragmentation is relatively higher there than in the city core.

Changes in ecosystems, land use and governance has led to deterioration of biodiversity and soil quality, aggravation of urban heat island effects, increased air, land and water pollution, flooding, water scarcity and disease epidemics, with consequent impacts on human health and well-being.



Bangalore’s projected population growth per decade 1871 - 2031. Starting at 5000 people in 1871, the population is expected to increase to 19 million in 2031.

Bangalore

Urbanization trends, challenges and opportunities

The urban greens

Bangalore contains a diversity of green spaces such as parks, gardens, wooded streets, wetlands and patches of remnant forests. Vegetation in the city core typically has a greater biodiversity, including a larger proportion of exotic species compared to rural and forested areas. However, most of the urban ecosystems have been modified according to human preference and land use.

In older wooded streets and parks it is common to find large-canopied, slow growing long-lived tree species. Provision of shade, support of biodiversity, and reduction of particles in the air are just a few examples of the services that these trees impart to humans and the city. Planting nowadays, however, typically focuses on ornamental species and small, short-lived tree species with small canopies that are easier to maintain but with less capacity to provide services to the city and to the ecosystems.

Despite the extensive clearing and fragmentation of vegetation in many parts of Bangalore, the city core still supports substantial vegetation. The city hosts large botanical gardens, a number of educational institutions surrounded by green spaces and trees, a number of historic cemeteries with high tree density, and sacred sites dispersed across the city that carry at least one or a few but often also a small grove of trees.

The neighborhood parks that have come up in the core of Bangalore are important as recreational spaces for the local people and can support migratory birds and local biodiversity.

However, a major problem is the ongoing fragmentation of green spaces that forces migratory birds and other species to move between small, scattered habitats of various quality, making their survival challenging. Where greening in the city does take place, it is often short-term planting of water hungry, fast-growing exotic timber species such as *Acacia* and *Eucalyptus*.

Biodiversity facts

A faunal checklist compiled in 1999 found 40 species of mammals, over 340 species of birds, 38 species of reptiles, 16 species of fish and 160 species of butterflies within a 40 km radius from the Bangalore city centre.

Pockets of native vegetation cover persisting in academic institution campuses and botanical gardens contribute significantly to the high biodiversity. Findings of rare species have been reported at the campuses of Bangalore University, the Indian Institute of Science and University of Agricultural Science, as well as in the two botanical gardens. Not only have rare species been reported, but new species have been discovered, including a new ant species and several diatom species in lakes.

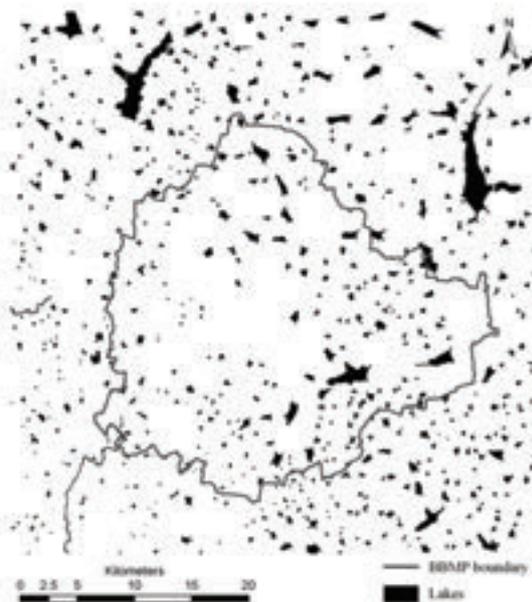


The urban blues

The transformation of Bangalore has also affected the city's water bodies. Once home to thousands of reservoirs, constituting the backbone of people's lives, a much smaller number make it to the maps today. Around 200 lakes remain in what is today greater Bangalore and a larger number remains in the periphery of the city. Many are degrading in quality, despite expensive government restoration projects.

There are several reasons behind the ongoing decline in numbers and quality of water bodies: they have been encroached upon to enable city growth, many dry out because the traditional drainage network has been largely destroyed, and pollution degrades the quality of the water that remains.

In contrast, a number of restoration projects that have been conducted in collaboration between the government and local communities have locally stopped or even reversed lake degradation. Some lakes have seen a significant recovery, with an increase in ground water tables and native biodiversity. These collaborations can also work to include social groups that otherwise may be excluded from official management of the lakes.



Bangalore's waterbodies. Note the absence of them in the city's core area.

Key Message 6. Increasing the biodiversity of urban food systems can enhance food and nutrition security.



Fishermen at Kaikondarahalli lake, Bangalore. ©Vanila Balaji

Bangalore

Governance structure, challenges and opportunities

A multitude of laws and institutions regulate the city's natural resources and ecosystems; so many that the structure is rather confusing, with gaps between the responsibilities of the governing bodies (see the theme box below).

The BBMP (see theme box below) has three departments - Urban Forestry and Environmental Management, Lakes, and Horticulture, aimed at conserving and maintaining urban forests, lakes and parks in Bangalore. In addition, in some parts of the city, the BDA is in charge of urban forests, tree parks, lakes and environmental protection.

The environment agenda is prioritized by the Karnataka State Pollution Control Board (KSPCB) and the Lake Development Authority (LDA). KSPCB is responsible for enforcing various acts and rules concerning the environment. In Bangalore, it monitors air pollution, water pollution, solid waste disposal and noise pollution. KSPCB is also responsible for conducting public hearings for any major projects that can have impact on the environment. However, Because the jurisdiction of KSPCB extends throughout the state, its focus and attention is divided between environmental issues within the state and the city of Bangalore. This can lead to a lack of sufficient human and financial resources in proportion to the local issues and needs.

LDA was set up by the Government of Karnataka in 2002 as a non-profit organization working solely for the regeneration and conservation of lakes in and around Bangalore city. LDA initially developed five lakes in Bangalore and later extended its jurisdiction to all major water bodies in Bangalore.

Local individuals, non-governmental organizations and civic activist groups such as the Environment Support Group have been successful in receiving support from the Karnataka High Court

Key Message 8. Successful management of biodiversity and ecosystem services must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement.

in a number of cases relating to conservation and protection of lakes.

The presence and involvement of the civil society, represented by non-governmental organizations (NGOs) and community based organizations (CBOs) is a second crucial factor. The organizations often hold great knowledge of local conditions and can work in two ways: (1) they can inform decision-making so that decisions respond to local conditions and needs, and (2) they can also link back to local people and enhance the implementation of regulations, by for example spreading information and encouraging action.

Bangalore's water supply system

It is easy to understand the governance challenges in Bangalore by taking a glance at the multitude of institutions responsible for Bangalore's water supply system: the Bruhath Bangalore Mahanagara Palike (BBMP), Bangalore Development Authority (BDA), Bangalore Water Supply and Sewerage Board (BWS&SB), Lake Development Authority (LDA), Karnataka State Pollution Control Board (KSPCB), Department of Major and Minor Irrigation, Fisheries Department, Karnataka State Council for Science and Technology (KSCST), Agenda for Bangalore Infrastructure Development (ABIDe), Ministry of Environment and Forests, Government of India (MoEF), and Department of Science and Technology (DST), Government of India.

Large numbers turn up for an organized protest against tree felling in Bangalore. ©Harini Nagendra



Conclusions and the way forward

India's massive increase in urban population, from 377 million people in 2010 to 600 million in 2031, is bound to create massive challenges for the environment, ecosystems and human well-being in India. These challenges need to be addressed upfront. City planning, infrastructural development and the consumption patterns of urban inhabitants will impact ecosystems within cities as well as far beyond the city areas, with implications for the quality of life for people across the country.

Cities can and do harbor great biodiversity, in many cases managed and maintained by citizens of different levels of society, including underprivileged groups. This illustrates a great potential and opportunity within cities. Many Indian cultural traditions are associated with nature and its protection, which has added to the resilience of urban green (and blue) spaces in spite of rapid urbanization during the last decade.

Informed decision-making will be of increasing importance as India's cities are expected to face a changing climate with major effects on the ecosystems that support human well-being and people's everyday environments. Furthermore, Ecosystem management has great potential to improve the capacity of cities to mitigate and adapt to climate change.

Key Message 10. Cities have a large potential to generate innovations and governance tools and therefore can -and must- take the lead in sustainable development.

Sustainable planning and implementation builds on inclusion of people and groups from all levels and backgrounds. A network of official governance institutions, civil society groups and individuals can contribute to informed decision-making and effective implementation. There need, however, to be clear and distinct but overlapping responsibility areas of the official governance institutions, with social and ecological well-being as the main focus.

This publication highlights the diversity of environmental actors including government, NGOs, civil society, media and corporate groups that influence urban conservation in India. It demonstrates that people from all levels of society, from wealthy neighborhoods to slums, show engagement, concern and come together to manage urban nature sustainably. Initiatives to reduce urban ecological footprints, improve solid waste management, rainwater harvesting and lake restorations, need to be supported and scaled up to national level.

Below: Pockets of green space in a densely congested city area in Hyderabad. ©Harini Nagendra



Ten Key Messages

From *Cities and Biodiversity Outlook - Action and Policy*

1. Urbanization is both a challenge and an opportunity to manage ecosystem services globally.
2. Rich biodiversity can exist in cities.
3. Biodiversity and ecosystem services are critical natural capital.
4. Maintaining functioning urban ecosystems can significantly enhance human health and well-being.
5. Urban ecosystem services and biodiversity can help contribute to climate change mitigation and adaptation.
6. Increasing the biodiversity of urban food systems can enhance food and nutrition security.
7. Ecosystem services must be integrated in urban policy and planning.
8. Successful management of biodiversity and ecosystem services must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement.
9. Cities offer unique opportunities for learning and education about a resilient and sustainable future.
10. Cities have a large potential to generate innovations and governance tools and therefore can -and must- take the lead in sustainable development.

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CHALLENGES & OPPORTUNITIES

INDIA'S URBAN POPULATION EXPECTED TO NEARLY DOUBLE BY 2031

