URBAN 20 PRIORITIES.

Background Research & Good Practices







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A compilation of key facts and international initiatives on U20 priority areas











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CONTENTS.



Encouraging Environmentally Responsible Behaviours



Ensuring Water Security



Accelerating Climate Finance



Championing 'Local' Culture and Economy



Reinventing Frameworks for Urban Governance and Planning



Catalysing Digital Urban Futures

Bibliography

129

105

05

21

37

73

89





Encouraging Environmentally Responsible Behaviours



Abstract



Over the years a number of international treaties and protocols (COP, SDGs, etc.) have been signed, pledging global action for sustainable, equitable and resilient urban development. Achieving results on ground will require concerted action and behavioural change across the urban ecosystem i.e., in actions/policies of governments and in technological decisions made by industry. In fact, global sustainable development objectives can fully succeed only if they permeate the day-to-day lives of citizens and living sustainably is embedded into the ethos of urban living rather than handed down as a set of regulations. India's Lifestyle for Environment (LiFE) Mission is a global call for a mass movement to nudge action from individuals, community, institutions, governments and non-state actors to protect and conserve the environment. It covers circular economy, low carbon mobility, water conservation, green energy, urban farming and other critical aspects. Additionally, just transition has to be ensured as moving to low carbon buildings, technologies, transportation, energy and industrial production impacts traditional employment patterns. U20 deliberations can provide a framework for mobilising the urban stakeholder ecosystem to drive systemic change. This paper highlights the importance of ERB at city level localizing global agendas and recasting existing legal, policy, financial, and technological instruments to promote sustainability initiatives. It explores the various challenges that are critical to address in order to promote ERB at the local level, and presents opportunity areas and best practices in mobility, waste management, and education. In conclusion, the paper discusses the key drivers for action towards encouraging environmentally responsible behaviours by governments, industries and citizens while simultaneously contributing towards achieving the larger global agendas, such as the UN Sustainable Development Goals.

Introduction

The importance of environmental sustainability has emerged as a critical issue in recent years, given the consequences of climate change, which range from flooding and droughts to biodiversity loss, water stress and increased temperatures. However, environmental concerns have been present for long and can be traced back to the industrial revolution. The rapid industrialization and urbanization of the 18th, 19th and 20th centuries led to severe environmental degradation, including air and water pollution and deforestation. With climate change impacts becoming increasingly visible, the 21st century is seeing a major shift in focus towards saving the environment and a number of local, national, and global policies and pacts have been formulated to action this.

Encouraging environmentally responsible behaviour is regarded as a necessity to advance sustainable development. ERB is seen as a manifestation of individuals' environmental awareness, their inclination to act in a manner that supports the environment, and their perceived understanding of ecological issues (Cottrell and Graefe, 1997). Pro-environment behaviour can be enhanced through continuous knowledge sharing to raise awareness about myriad environmental issues and capacity building to provide tools to encourage change in behaviours that harm the environment. Peer to peer learning and information networks dedicated to sustainable practices can play a major role in taking ERB from an individual to collectives. This is important as ERB involves a collective effort from all sectors of society, and requires a comprehensive and integrated approach in order to effectively address environmental challenges and achieve sustainability.

For instance, governments promote ERB through a combination of policy development, incentives, investment, education, and enforcement. By taking a proactive approach to environmental protection, governments can help to ensure a sustainable future for both current and future generations. For organizations, ERB involves adopting sustainable business practices, reducing their carbon footprint, implementing environmentally responsible policies, and promoting environmental awareness among their employees, stakeholders and entire value chain. Individuals have the power to adopt ERB in their daily lives by promoting sustainable practices in their communities, such as reducing waste and energy consumption, practicing sustainable resource use, promoting environmentally conscious consumption patterns, and opting for environmentally friendly transportation options.

Information is the key to motivating individuals towards a behavioural shift. Knowledge, attitude, and enabling tools are the three pillars that support behavioural change, and context-specific variables shape an individual's specific actions. ERB is a key aspect of several international agreements and initiatives aimed at promoting sustainability and mitigating the impacts of climate change.

- Intergovernmental Panel The on Climate Change (IPCC) provides scientific evidence and recommendations to policy makers on the need for ERB and the role it plays in reducing greenhouse gas emissions and promoting sustainability. The IPCC's Fifth Assessment Report states that "individual and societal responses will be key to effective climate change mitigation and adaptation," and that "changes in behaviour and lifestyle are essential to reducing greenhouse gas emissions and limiting global warming." The report emphasizes the need for individual and collective action to reduce greenhouse gas emissions, such as reducing energy use, choosing more sustainable modes of transportation, and adopting sustainable agricultural and forestry practices. In addition, the IPCC recognizes that environmentally responsible behaviour can have co-benefits for health, economic development, and social equity.
- The New Urban Agenda by the United Nations, recognizes the important role of cities in promoting ERB and reducing their carbon footprint, and provides a framework for cities to implement sustainable urban policies.
- The SDGs, specifically SDG 11, "Sustainable Cities and Communities," addresses the need for cities to promote ERB and reduce their environmental impact by providing a framework to prioritize their efforts to promote sustainability.
- Many COP meetings have also deliberated on policies and initiatives aimed at promoting ERB.

2

Challenges Faced in Encouraging Environmentally Responsible Behaviours

Over half of the world's population lives in urban areas, and this number is projected to increase to 68 per cent by 2050, according to the United Nations (UN-Habitat, 2022). In G20 countries, transportation accounts for around 20 per cent of the total greenhouse gas (GHG) emissions. According to the World Bank (2022), cities are responsible for over 70 per cent of global carbon emissions, with transportation, buildings, and industry being the primary contributors. Urban activities, such as transportation and buildings, account for over 70 per cent of primary energy consumption globally (IEA, 2016). Around 88 per cent of the urban population worldwide is exposed to outdoor air pollution levels that exceed the World Health Organization guidelines. There are concerns related to the sectors of waste management and water too. By 2050, the waste generated globally will reach the mark of 3.4 billion tonnes. A number of developing countries are losing out on their natural water assets as untreated wastewater is being discharged into lakes, rivers and oceans.

Encouraging environmentally responsible behaviour at the local level is critical for achieving sustainable development. Despite various strides made by local governments, institutions, businesses and individuals in promoting ERB, numerous challenges still hinder progress in this regard. Thus, the identification and exploration of these challenges as well as opportunities will help in the development of effective strategies that promote ERB and create greener urban environments.

Legal, governance and regulatory challenges

Cities face several systemic and governance challenges in implementing ERB. One of the main challenges is limited financial resources or budgetary allocations to prioritize environmental initiatives and to fund programs and projects aimed at reducing environmental impact (Fenton et al., 2014; Dawkins et al., 2019; Mukim and Roberts, 2022).

Another challenge is the lack of effective coordination and collaboration among different levels of government, as well as between government and other stakeholders, such as businesses, communities, and environmental organizations. This leads both to duplication of efforts as well as scattered efforts with little impact.

Cities often encounter challenges in promoting sustainability initiatives due to the absence of clear policies and regulations that support such initiatives, leading to inefficiencies in their implementation (Dawkins et al., 2019). According to Dawkins et al. (2019), while a number of local governments have developed strategic plans for sustainable consumption, only a few regulatory instruments are available to them for the same. Even when regulations exist, their enforcement may be hindered by factors such as limited resources or lack of political will. Additionally, cities may be constrained in their legal authority to implement change, as some powers may be reserved for sub-national or national governments. Conflicting regulations and policies at the local, regional, and national levels, can also create confusion, complicating the prioritisation of environmental initiatives at the local level. At times, the lack of balance between the goals of economic growth and those of environmental sustainability can also lead to inaction.

Cities may also at times encounter opposition from businesses, particularly those in the fossil fuel industry, who may resist proposed changes. This resistance can manifest in various forms, such as legal challenges or political pressure, posing significant hurdles for cities to implement sustainability initiatives (Geels et al., 2017).

Technological Challenges

According to the World Cities Report by UN-Habitat (2022), the market for smart city systems and solutions is growing at a rate of 25 per cent annually, with an estimated value of around \$517 billion. Cities are adopting smart technology at a rapid pace, as evidenced by the high demand for Internet of Things (IoT) technology, which is projected to grow by 20 per cent annually in the coming years. However, cities face numerous technological challenges in implementing sustainability initiatives and environmentally responsible behaviours. One of the biggest challenges is integrating various new and existing technologies in a way that is both effective and efficient.

Additionally, cities, especially in developing nations, lack the advanced infrastructure and capacity to manage and monitor large amounts of data effectively, as well as to make use of the insights it provides (Dawkins et al., 2019; Franchina et al., 2021). Moreover, data on energy consumption, transportation patterns, or waste management practices can be challenging to collect and analyze, particularly in large and complex urban environments.

A crucial area for improvement is capacities to undertake informed assessment of any technology that a city wants to adopt from the perspective of environmental benefits versus financial savings. Cities have to be enabled to invest in low carbon technologies despite the higher costs associated with these. This is possible only through analysis of long-term ecological, social and economic gains from adoption of a particular technology.

Lack of Public Awareness and Collective Action

One major challenge faced in the implementation of ERB is a lack of public understanding and engagement, which can make it difficult to educate and motivate residents to adopt more environmentally responsible behaviours. Many citizens and decision-makers may not have a clear understanding of the benefits of sustainability, the impacts of human activities on the environment, or the most effective approaches for promoting sustainable practices (Brink and Wamsler, 2018; TERI and South Pole, 2021). This can make it difficult to build support for initiatives, secure funding, and implement effective policies and programs. Capacity building for environmental sustainability is also required for government institutions working on different sectors and projects within a city. For instance, a study undertaken in 15 Indian cities found that the majority of city governments use external support to understand the 'sustainability' of project. Thus, the required technical knowledge to finance and implement sustainable projects is never built in-house (TERI and South Pole, 2021).

Moreover, social norms, such as those related to consumerism and materialism, may encourage excessive resource consumption and social inequalities (UN-Habitat, 2022). These cultural and social norms can be deeply ingrained and difficult to change, making it challenging for cities to promote sustainable practices.

Reaching vulnerable or marginalized groups is a significant challenge for cities when raising awareness about environmentally responsible behaviour. These groups are often the most impacted by environmental degradation and climate change, but they also face numerous barriers that hinder their participation in and benefits from sustainability initiatives. Additionally, women are often at a disadvantage in terms of access to education, information, financial resources, and digital tools/platforms, limiting their participation in sustainability initiatives (UN-Habitat, 2021). As mobile phones, internet and digital platforms are modes and mechanisms through which ERB awareness campaigns or nudges may be done by government agencies, equitable access is therefore essential.

Encouraging environmentally responsible behaviour at the local level is critical for achieving sustainable development. Despite various strides made by local governments, institutions, businesses and individuals in promoting ERB, numerous challenges still hinder progress in this regard. Thus, the identification and exploration of these challenges as well as opportunities will help in the development of effective strategies that promote ERB and create greener urban environments.

Initiatives and Interventions to Encourage Environmentally Responsible Behaviours

1. E-mobility

In G20 countries, the transportation sector accounts for 20 percent of their total GHG emissions (Climate Transparency, 2022). In the U.S. alone, it accounts for 28 percent of its total GHG emissions (Graham, 2022). In India it is 10 percent (Paladugula et al., 2018), South Korea 12.6 percent (Kim, 2019), and Australia 18 percent (Climate Council, 2019) to mention a few. The transport sector globally has the highest reliance on fossil fuels, accounting for 37 percent of CO2 emissions in 2021 (IEA, 2022). Given this scenario, electric vehicles or non-motorized transport form an important mitigation strategy to limit global warming below 2 degrees Celsius in line with the targets of the Paris Agreement as the absence of a tailpipe means that there are no carbon dioxide emissions.

While the world has made significant strides towards electric mobility, as a technology, there is a wide socio-economic gap when it comes to adoption of EVs whether it is across class or regions (Bauer et al., 2021; Vandycke & Howells, 2023). A just transition to sustainable transport, means that no one is left behind in the shift towards cleaner options of transport. The mitigative impacts of e-mobility on effects of climate change or in reducing air pollution will be apparent only if it becomes the favoured choice of transport for everybody. In order to encourage this behavioural change, issues of access, viability and affordability of electric mobility will have to be tackled (Loorbach et.al. 2021).

1 (a): Electrification of Public Buses, Shenzhen, China

Buses form an important means of public transport in urban areas and are used more extensively by lower income groups. These are also, however, a significant source of urban pollution. A transition to electric buses thus presents an important alternative that can help save energy and a purposeful change as a matter of social justice can involve the electrification of routes serving poorer communities, while creating awareness about the potential public health benefits due to cleaner air.

In 2017, Shenzhen became the first city in the world to have a fully electrified bus fleet and now consumes 72.9 percent less energy than it did in 2016 along with reducing CO2 emissions by 1.353 million tons per year (IEA, 2021). The leaders of the city pushed for the complete electrification of the bus fleet consisting of 16,359 vehicles by 2017 and this was done without increasing the number of buses in the fleet or the customer fares (ibid.). Until 2021, the only other city to have achieved this was Guangzhou (ibid.).



Shenzhen Electric Buses Source: Yale Environment 360 'A Chinese Megacity Bus Fleet Goes Fully Electric'

1 (b): An affordable means of clean transport for last mile connectivity, Ahmedabad, India

While Ahmedabad city in the Indian state of Gujarat has invested a lot in public transport including a rapid bus service in 2009 and a new metro in 2015, there was lot of congestion due to first and last mile connection from bus stations being made by rickshaws. The Ahmedabad Municipal Corporation provided parking docks for the e-rickshaws in the city to reduce the problem of congestion and incentivised the adoption of e rickshaws through subsidies (IEA, 2021). At the end of 2020, it issued a tender to acquire 5,000 e-rickshaws for sale to e-rickshaw drivers (ibid.). With these e-rickshaws, the city has provided an affordable means of clean transport for last mile connectivity.

1 (c): Sustainable transportation, San Francisco

The City Government of San Francisco is currently in the process of updating the city's Climate Action Plan which is a road-map to meet its net zero ambition by 2050 alongside making progress on its socio-economic goals (IEA, 2021). The city acknowledges that climate change is a matter of equity wherein decarbonisation must be beneficial for the lower income communities (ibid.). "Transit-first" has been made key priority in order to nudge the 880,000 residents of the city towards green and shared mobility - making clean transport accessible to all sections of the population, in particular those from socio-economically backward communities (ibid.).



04. Pedestrian safety and accessibility projects help to promote walking, which improves public health, supports the local economy and is 100% GHG emission free. 05. Muni buses run on renewable fuels and plan to be 100% electric by 2035!

06. Muni moves more than 720,000 people every day in a safe, equitable and environmentally sustainable manner. 07. Bike projects result in an estimated 82,000 bike trips per day, reducing an estimated 385,400 tons of GHG emissions annually.

Implementation of the Climate Action Plan - transportation goal by the San Francisco Municipal Transportation Agency (SFMTA) Source : SFMTA 'Taking Climate Action to the Streets'

2. E-waste management

The variety and range of electronic items as well as the rapid speed at which the market offers ever new versions of every gadget, coupled with people's increasing ability to buy these products has led to a slew of electronic gadgets in every person's daily life. This is especially true for urban areas. However, as new gadgets replace old ones, there is a dearth of options to dispose electronic waste in an environmentally sensitive manner. While a few countries have put in place strict replacement and recycling laws, most countries still have to take that path.

At the individual level, practicing environmentally responsible behaviour by making an active choice to sell e-waste to formal collection points becomes important. At the government level, initiatives such as updating the infrastructure at already existing processing centers, segregating waste at source, setting up recycling centers in PPP model to ensure private sector plays a bigger role, and re-skilling workers through collaboration have proven to be useful in implementing ERB. Moreover, industries can invest in mature recycling technology, adopt Extended Producer Responsibility, and use Corporate Social Responsibility (CSR) funds to create skilled local workforce which aids in collection and segregation process.

2 (a): Divided Product Responsibility, Germany

A mechanism known as "divided product responsibility" was instituted in Germany for e-waste disposal in which the main obligations for electrical and electronic waste disposal fall to (a) public sector recycling companies; and (b) electrical and electronic device manufacturers. Public sector recycling companies are required to establish electrical and electronic waste recycling centres and to accept such waste at these centres free of charge. Manufacturers are responsible for properly disposing of the electrical and electronic waste that is brought to such facilities and bear the financial cost of product stewardship entailed by disposing of electrical and electronic devices that were placed on the market. Upon being returned, electrical and electronic waste is sorted into six different collection groups, so as to better meet the requirements of the various devices in terms of recycling and handling. Recycling procedures vary greatly from one type of product to another. Large devices and battery-operated devices are separated from small ones, refrigerators are processed separately because of the CFCs contained in them. Besides gas discharge lamps are collected separately owing to the mercury contained in them. The WEEE (Waste Electrical and Electronic Equipment) directive and Germany's Electrical Products Act (ElektroG) have also set specific recycling and recovery rates for various device classes. For example, the target recovery rates for non-reusable devices is 75-85 percent depending on device class, whereas the target recycling rates for such devices range is 55-80 percent. Germany has complied with all of these rates since 2007 (Umwelt Bundesamt, 2014).

2 (b): Basic Environment Law, Japan

Enacted a Basic Environment Law which bifurcates the task of e-waste management into treatment of waste and effective use of resources. The end users pay a recycling fee, the retailers ensure collection and the manufacturers ensure recycling. This results in a recycling rate of about 90 percent for ACs, LCD TVs, washing machines and dryers.



Disposal and treatment of home appliances in Japan Photo by Sung-Woo Chung in 2002.

2 (c): Extended Producer Responsibility system, South Korea

This is an example of a national legislation related to waste management being amended numerous times as it evolved with changing times and needs. In 1992, South Korea initiated the outsourcing of e-waste handling to skilled private recyclers. However, as the amount of e-waste rapidly increased, new programs were introduced which placed the responsibility of e-waste recycling on the manufacturers. This was followed by a volume-based user fee system, that gave local districts the authority to charge fees for e-waste collection. In 2003, the new Extended Producer Responsibility system proved to be more successful as it lowered the recycling costs for producers and consequently increased the amount of e-waste that was recycled. From 2008, the government expanded producer responsibilities in e-waste management and producers committed to minimizing waste generation during the production process. In 2014, South Korea once again redefined recycling criteria and broadened the responsibility of e-waste recycling from the manufacturers to a nationwide endeavor (Chung, 2008).

3. Urban forest cover and biodiversity reconstruction

Some of the major effects of climate change within a city include creation of urban heat islands, unfavorable micro-climate, reduced air and water quality, water stress, increased occurrence of extreme weather events such as urban floods/droughts etc. If we look at some of the prevalent and mainstream methods of climate risk mitigation, these include artificial cooling (AC), use of air purifiers, accessing healthcare services, reducing exposure etc. In such a scenario, some of the important considerations remain: whether some of the above-mentioned methods of risk mitigation are available to all equally? Are these accessible and affordable to all? Are these available to ones who bear the direct and often increased burden of climate change within a city?

The most universally accessible facility in cities for mitigation of climate impacts particularly heating and flooding is public open spaces, parks, and urban forests. These are essential to lower the urban heat island effect and cities across the world are making efforts to retain or enhance the percentage of land under green cover.

The corrective effect of such spaces (cooler surroundings, absorption of noise pollution, health benefits etc.) can be enjoyed by all. However, sometimes greens are inequitably distributed across the city and this must be rectified through the city plans. Through urban green spaces (UGS) and biodiversity reconstruction, climate risks may be mitigated and prioritized by administration and civil society alike.

These include spaces like public parks, urban forest covers, wetlands, community gardens, greenways, habitat corridors, street trees, roof gardens, etc. The positive effects of urban greening have proved beneficial in climate risk mitigation. It encourages individual, community and state actors to contribute to environmental protection and restoration.

3 (a): Ahilya vans, Indore, India

Indore has shown promising results in urban greening with projects such as 400 Ahilya vans (or forests) are being created within the city. These vans or forests are designed to include walking tracks and rainwater harvesting systems to recharge ground water. Provision to develop manure from dead leaves from the vans is also accommodated within the project.



Ahilya Van project : covered with invasive weedsAhilya Van project : Planted with native speciesSource: Search For Water blog on 'Ahilya Van: Creating green spaces in the clean city'



3 (b): Urban Forestry Project, Melbourne, Australia

Inner Melbourne has successfully implemented urban forestry projects, however, the outer suburbs of the city have largely been left neglected. The Urban Forest Visual Map project was initiated to help community members access details such as names of tree species, age, life expectancy of trees and to identify and report issues with them by means of email. Community members and city administration came together to identify local solutions based on area-specific needs. Value-based mapping. photo sorting and questionnaires were some of the innovative techniques used in the project.

3 (c): Niteroi, Rio De Janeiro, Brazil

Niterói Eco-Social, one of the three programs to restore natural forest cover in the suburbs, is designed to give opportunities to "out-of-school and out-of-job" youth from disadvantaged communities, which observe high crime rates. The program is designed by the city administration and supported by private and community organizations. The other two programs implemented in Boa Vista hills are Ecosystem Restoration and Forest compensation system. The Ecosystem Restoration program, funded by the Brazilian Development Bank aims at restoring habitats on offshore islands and fragile forest areas. Within the Forest Compensation System, legal provisions to replace cleared forest in development projects within the city are put in place.

3 (d): Biodiversity parks of Delhi, India

The six biodiversity parks of Delhi are a unique initiative by a team of landscape architects and engineers, from the planning agency and scientists and naturalists from the city university. In 2022, it was realised that tremendous amounts of local biodiversity had been lost in the city and the biodiversity reconstruction effort has been continuous since that time. Thousands of bird, animal and tree species have been restored in these parks that actually like green forests in the middle of the city. Delhi has brought more than 1500 acres of land under these biodiversity parks. Through this initiative, the city has got better quality and volume of greens and a number of water bodies have been revived. These parks also have visitors' zones that enable people (especially children) to connect with nature and learn about various species of flora and fauna.

Other initiatives

For sustainable behavioural change, policy level changes are critical to enable an overall shift. Financial gains, mandatory compliance, awareness campaigns and 'nudges' play an important role in this. However, for a transparent and effective behavioural change, policy instruments should be supported with public consensus and goodwill. An ambitious experiment (Guardian, 2011) by local governments in Coventry and Croydon (UK), was to categorize the local population into nature based value modes. Once this classification is available it is easier to design an influencer campaign based on the nature of the population. An effective message-media matrix can be constructed with the right combination



Yamuna Biodiversity park in Delhi Source: Delhi Development Authority

of triggers, interventions and incentives once the pulse of the population is understood. A demand based, people-centric behavioural nudge helps in keeping the citizens motivated and as stakeholders of the overall design (Costa et al, 2013).

India has demonstrated success in harnessing the power of collective action to solve complex problems. This is the guiding principle behind campaigns that engage well with the public. These include Swachh Sagar Surakshit Sagar campaign aimed to remove approximately 15,000 tonnes of waste from 75 beaches in 75 days. The Swachh Bharat Mission (SBM) is another ambitious movement that led to the construction and use of over 100 million toilets in rural India within a span of 7 years. Participation of multiple stakeholders and well-designed nudging techniques is extremely essential for the success of a behavioural change campaign.

Nations can reform education policies to drive systemic changes. Involvement of young citizenry to trigger responsible individual behaviour will create avenues to facilitate awareness, engagement and empowerment. During the G20 presidency led by Argentina (2018), the Education Working Group (EdWG) was established that focused on strengthening learning outcomes and equitable access through technological tools, digitalization, universal quality education, financing, partnerships for education and international cooperation. Education policies also have huge scope for instilling green skills amongst youth, and this orientation can transform into profitable social ventures. Similarly, ESG (Environmental, Social and Governance) is being recognised as a top tool for measuring non-financial performance indicators of a company, and hence employee engagement in social causes will trigger behavioural shifts.

Local governments play a crucial role in the context of ERB by creating policies, programs and partnerships that address environmental challenges at the community level. By leveraging their unique position, close connections and resources, local governments can drive change in ways that are impactful, inclusive, and effective.

India, the host country for G20 this year, has shown to the world the higher goals of Lifestyle for Environment (LiFE) Mission, which was launched in 2021. This is an innovative approach with a clear intention of 'leaving no one behind'. The 75 actions listed under LiFE are framed to motivate every individual to be a part of this mass movement to nudge action simultaneously from individuals, community, institutions, governments and non-state actors to protect and conserve the environment. Out of the 75 simple and sustainable solutions for tackling climate crisis, 19 have a direct Urban Local Body (ULB) connection. Solutions proposed for urban areas include those linked with energy, water saving, single use practices, sustainable food practices, waste reused, healthy lifestyles adopted, and e-Waste management.



Use public transport wherever possible



Install solar water or solar cooker heater on rooftops



Carry your own water bottle wherever possible



Use bicycles for local or short commute



Run outdoors instead of on a treadmill



Participate in and mobilize participation for clean-up drives in cities and water bodies



Prefer CNG/EV vehicle over petrol/diesel vehicles



Fix leaks in flushes, taps and waterpipes



Include millets in diets through Anganwadi, Mid-Day meals and the PD scheme



Create rainwater harvesting infrastructure in home/ schools/ offices



Invest in a water meter for your house to measure water consumption regularly



Practice segregation of dry and wet waste at homes



Do not discard waste in water bodies and in public spaces



Plant trees to reduce the impact of pollution

LiFE Actions that have direct ULB connection Source: City Climate Alliance, NIUA, 2022



Do not let pets defecate in the public places



Discard gadgets in the nearest e-recycling units



Start biodiversity conservation at the community level



Key Drivers for Action Towards Environmentally Responsible Behaviours

Encouraging environmentally responsible behaviours in urban contexts is essential for addressing the pressing environmental challenges facing cities today.

- For local governments, promoting ERB requires a comprehensive approach that incorporates legal, policy, financial, and technical measures at the local level. Legal interventions can involve the formulation and implementation of regulations. laws, and standards that mandate environmentally responsible practices. Policy interventions refer to the development and execution of programs, plans, and strategies aimed at advancing ERB. These can range from green building programs, sustainability action plans, and climate adaptation plans, to providing a framework and guidance to align actions and decisions with environmental objectives and priorities. Additionally, financial interventions such as incentives, subsidies, and other forms of support, can encourage and support the adoption of ERB. Technical interventions are also important for the development and deployment of innovative technologies and practices that promote and enable the adoption of ERB. Efforts by local governments must go beyond traditional hard infrastructure programs and consider the various spatial, social, and economic factors that result in exclusion and marginalization. To bring about this change, there must be a shift in mindset and an increase in knowledge and understanding of green practices, allowing individuals to make informed choices. By building public understanding and awareness of environmental issues through capacity building and training programs, cities can also work to mobilize collective action and build more sustainable and resilient communities.
- As major drivers of economic growth and development. businesses, too, have a responsibility to operate in a manner that minimizes their impact on the environment and promotes sustainability. One of the key ways that businesses can promote ERB and sustainability is by adopting sustainable business practices in their organization and their operations, such as reducing waste, conserving energy, and using renewable resources. Recognizing the significance of Environmental, Social and Governance (ESG) metrics as a means of evaluating a company's non-financial performance indicators, increased employee engagement in social causes is expected to drive shifts in behaviour. Businesses can use their CSR funds to create a skilled local workforce, invest in research and development of new sustainable technologies and innovations and engage with a larger audience on environmentally responsible behaviours.
- Citizens play a critical role in promoting and implementing ERB. As members of their communities, they have the power to make a positive impact on the environment by adopting environmentally friendly behaviours and supporting sustainability initiatives by the government. Pro-environment citizenry, where citizens are actively engaged in promoting and supporting environmental protection and sustainability, is essential in creating a more sustainable future by raising awareness about environmental issues, promoting environmentally friendly behaviours, and advocating for sustainability initiatives and policies. Citizens can adopt the circular economy model and support local sustainability initiatives such as recycling programs, renewable energy projects, and community gardens.. Additionally,

citizens can also participate in advocacy efforts to promote sustainability policies and initiatives, such as writing to their elected representatives, attending public meetings, and supporting organizations that advocate for sustainable policies.

Effective education is linked with behavioural change. It is conceivable that students who are educated to be active learners since their childhood can transform into an active citizenry that participates in activities towards achieving sustainable development. It can perhaps be accepted that lack of education and knowledge on issues catering to sustainable development will impact these processes negatively, thus becoming an obstacle in the path of behavioural shifts. SDG 4 (Quality Education) aims at achieving inclusive and quality education for all and reaffirms the belief that education is one of the most powerful and proven vehicles for sustainable development. SDG 4 has a list of targets to be achieved by 2030, out of which target 4.7 states: "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development." SDG 4.7 is a true reflection of behavioural shift that

can be influenced by quality education, leading to sustainability in thought and practice. To understand this better, we can examine SDG 7 i.e. 'Affordable and Clean Energy for all' which ensures universal access to affordable, reliable and modern energy services, higher levels of education on clean energy and its affordability can facilitate the usage of the same. Sensitization on issues through significant trainings and workshops, will conceivably lead to more responsible behaviour towards global issues.

Awareness and sensitization about different issues can positively influence the achievement of SDGs specifically SDG 12 i.e. responsible consumption and production. A possible reason behind the recorded progress in this particular goal in India could be the traditional concept of 'Circular Economy'. As a culture, India used to follow a practice where resources are used as long as possible, extracting maximum value followed by recovery and regeneration of products and materials at the end of each service life. This culture and practice has been embedded in Indian minds and behaviours since long and has positively impacted the process of achievement of SDG 12. From this example, it can perhaps be understood that awareness and knowledge on sustainable living practices can influence behaviour shifts in support of sustainable practices.



Upstream and downstream resource value chains influence sustainable consumption and lifestyles (Source: The Energy and Resources Institute (2022), Internationalizing Lifestyles for Environment: Messages for G20, SDG Charter, Act4Earth and World Sustainable Development Summit, New Delhi: The Energy and Resources Institute)

- In order to reach the top of the pyramid, ground level changes through "bottom-up" approaches are becoming critical. Strong interactions between civil society and public authorities are important. It is also important to recognise and incentivise positive behaviours. Role of positive messaging by media will be important to create narratives that highlight a cohesion of work being done at governance level, corporates, and general public.
- Urban Just Transitions-A just urban transition encompasses a collective understanding of justice to bring about equitable outcomes through representative and inclusive practices. This revolves around the principles of social justice, equity, participation, and inclusion. Mindset change, knowledge of green practices, ability to make informed choices through enabling conditions create opportunities for alternative thinking. Such transitions in urban space often focuses on technological innovations and economic shifts. However, the distribution of benefits of green urbanism across social groups and neighbourhoods remains deeply uneven as access to decision making on sustainability strategies and policy is restricted to the most influential and resourceful stakeholders
- Urban experiments targeting climate resilience, socially inclusive circular economy and energy strategies, nature-based solutions for climate adaptation and mitigation would not only make cities carbon neutral but also more livable, vibrant and fair. Multi stakeholder social dialogues, as highlighted by International Labour Organisation (ILO) which could be informal or institutionalized, can eventually help resolve socioeconomic issues, promote good governance, and build resilience. Further ILO's reports on social protection also provides a framework for factoring in equity, greater support, rights of labour, and enabling environment for vulnerable economies. In its entirety, it helps in inclusion and building resilience.
- Responsible Individual Behaviour to Facilitate Awareness, Engagement and Empowerment
 The world is moving from policy to action. While lifestyle shifts are at discretion of individual choice,

an enabling ecosystem in form of policy, economic and social instruments can nudge consumers towards environmentally conscious behaviour. The current decade of action to deliver alobal goals (2020-2030), has laid out three basic priority areas. These include Global action to secure greater leadership, more resources and smarter solutions for the Sustainable Development Goals; enabling Local action embedding the needed transitions in the policies, budgets, institutions and regulatory frameworks of governments, cities and local authorities; and finally People driven action including by youth, civil society, the media, the private sector, unions, academia and other stakeholders, to generate an unstoppable movement pushing for the required transformations. ERB is a requirement from all sections of society and is more inclined towards the downstream segment of resource value chains influencing the sustainable consumption and lifestyle patterns. As per AR6 WG-III report of the Intergovernmental Panel on Climate Change (2021), maximum emissions come from upstream segments such as industry and power generation. This dichotomy between upstream and downstream segments is being attempted to be addressed through the mission LiFE (Lifestyle for Environment).

Factors that influence individual choices are dynamic and are influenced by surrounding environment, work culture, urban amenities and marketing campaigns. Mainstream frameworks on sustainable consumption and production focus more on upstream and midstream components such as resource efficiency and circular economy. As per the COM-B model (Michie, van Stralen & West, 2011) of behaviour change, there are three pre-requisites to success of any introduced intervention- capability, opportunity, and motivation. For example, the LiFE mission in India further aspires to move society from knowledge to action. It supports achievement of specific goals, which are immediate, leading to positive gains, and a nudge to influence learning through measurable outputs rather than a glorification of theories are supportive to behaviour change (Gollwitzer, 1999).





Ensuring Water Security

Ensuring Water Security

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Abstract



Freshwater is a vital resource for human life, and its scarcity can limit the potential of development as well as result in severe health issues and social conflicts. Studies indicate that the proportion of global urban population facing water scarcity is likely to increase from 1/3 to 1/2 from 2016 to 2050. Rapid urbanisation and abuse of available water resources (overdrawing, pollution, encroachment) have increased the vulnerability of water ecosystems. Global warming is also rapidly reducing freshwater availability. Water management related challenges range from dwindling resources to water leakage and losses; from deteriorating water quality to aging infrastructure; from water pollution to flooding and storm water management. Water crises have been consistently ranked in the top five global risks since 2012. Water resource management is a top priority to ensure water security for future generations. There is an opportunity for the cities to learn from good practices adopted by cities that have successfully demonstrated management of their water resources.

This paper highlights many such exemplary cases which could help in ensuring water security and facilitating the achievement of interconnected goals of SDG 11, 14, &15. These include strategies for integrated urban water management, demand management interventions, improving efficiency of supply systems, using wastewater as resource, nature-based solutions for managing storm water, etc.

Cities and Water Security

More than half of the global population resides in urban areas, and it is expected that this proportion will increase to two-third of the world population by the middle of the century. Globally, rapid urbanisation has put significant pressure on the quantity and quality of available water resources affecting the water security of the cities. By 2030, half of the world's population is expected to live in water-stressed areas (UNEP, 2016). Additionally, climate change will exacerbate water security challenges; an average global temperature increase of 2 degree C is projected to expose an additional 410.7 million people living in urban areas to water scarcity from severe droughts (IPCC, 2022). This would have cross-cutting implications for food and energy security as well as the health and well-being of the people.

Concerns around access to clean water, water scarcity and associated risks have been a part of international developmental agendas since the middle of the twentieth century. The Conference on Human Settlements, 1976, highlighted that safe drinking water and sanitation are of utmost importance for the development of developing countries. The United Nations Water Conference held in Mar del Plata, Argentina, in 1977 recommended that "the decade of 1980-1990 should be designated as the international drinking water and sanitation decade". In continuation, many initiatives were taken and in 2015, UN member states adopted the 2030 agenda for Sustainable Development under which goal number 6 is dedicated to clean water and sanitation. This decade (2018-28) has been declared the UN Decade for Action on Water and Sanitation, reiterating the critical importance of water for sustainable development. A key outcome of the recently concluded UN 2023 Water Conference (first since the 1977 conference in Argentina), was a Water Action Agenda to accelerate implementation of the water-related goals of the SDGs.



Children access to safe water and sanitation Source: United Nations, 2017

State of Water Resources

Globally, the water demand from two key sectors domestic use and industries, is expected to increase by 50-80% over the next three decades due to factors such as population growth, urbanisation, and socioeconomic development (Chunyang, et al., 2021). Many cities are likely to face extreme scarcity where the water demand will exceed the availability of fresh water.

Water stress index' or 'Falkenmark indicator' is a commonly used measure of water scarcity, which measures the amount of renewable freshwater available for each person each year (White, 2012). If the amount of renewable water in a country is below 1,700 m³ per person per year, that country is said to be experiencing water stress; below 1000 m³ it is said to be experiencing water scarcity; and below 500 m³, absolute water scarcity. The figures below present a snapshot of the global annual baseline water stress¹, as well as the 'water stress score' of the G20 countries on a scale of 0 to 5.

The figure highlights that Saudi Arabia and India are in the 'Extremely-high' risk category, followed by Mexico, Turkey and Italy which are in the 'High' risk category. South Africa, Australia, South Korea, China, France, Germany and Indonesia fall in 'Medium' risk category while United States, Japan, United Kingdom, Argentina and Russia fall in 'Low-medium' risk category. Canada and Brazil fall in 'low' risk category. Countries having extremely high risk of water stress are using more than two-thirds of their available fresh water resources annually.



Global Annual Baseline Water Stress

Source: UNESCO; World Water Development Report (WWDR) 2020



Source: World Resources Institute's Aqueduct Water Risk Atlas

Key Facts and Figures

- There are more than 2 billion people who live in water-stressed countries, of which 733 million live in high and critically water-stressed countries (UN Water, 2021)
- 450 million children, reside in areas that have either high or extremely high water vulnerability (UNICEF, 2021. Water Security for All)
- About two-thirds of the world's population experiences severe water scarcity for at least one month of the year (UNICEF, Key Facts)
- 284 large cities worldwide could face water

scarcity by 2050 (He, C. et al., 2021)

- The number of city inhabitants lacking safely managed drinking water has nearly doubled since 2000 (UN Water 2021)
- Globally, around 55 million people are directly affected by drought annually
- Drought was one of the hazards that led to approximately 650,000 deaths, the largest human losses between 1970 and 2019
- By 2030, it is expected that as many as 700 million people are at-risk of being displaced due to drought

Challenges in the urban water sector

Dwindling Water Availability: Anthropogenic and natural factors have resulted in shrinking of water resource availability across the world. Major reasons include over-exploitation of groundwater resources, chronic mismanagement of water demand as well as continuous dry spells due to changing climatic patterns. Australia for example faced the well-known millennium drought (1997-2010) which affected most of southern Australia, including its largest cities like Melbourne, Sydney, and Canberra. In 2018, South Africa's Cape Town hit 'Day Zero' because of exceptional 3 years rainfall deficit and became the focus of looming water crisis discussions around the globe. Drought is one of the reasons that lead to water shortages in mega cities around the world.

Inequitable access: While drinking water coverage has improved across the world, there are still many people in urban and peri-urban areas across major cities that lack access to drinking water service. The figure below indicates that the global population having access to safely managed drinking water services increased from 70-74% from 2015 to 2020. However, there are considerable differences between and within the regions. As shown, Central and South Asia have 62% of the population with access to safely managed drinking water, while Europe and North America have 96% population in this category.

In the suburbs of Buenos Aires, around 3.7 million people still lack access to the water supply system. In the United States, around 1.1 million individuals lack piped water supply connection and of these around 73 per cent are in cities (e.g. Portland, Austin, Cleveland, and San Francisco) (Meehan, 2020). WRI analysis for 15 cities¹ in the global south indicates that piped water is the least expensive option for most households, but still, there are around 50 per cent of the households that lack access to piped water supply (Mitlin, 2019).

In-efficient & inadequate water supply systems:

Unaccounted for Water (UFW) and Non-Revenue Water (NRW) are the key detriments of efficient urban water supply and reflect the real and apparent water leakages/ losses in the system. Many water utilities across the globe still operate with high NRW and UFW. A study by the World Bank estimates that the global real water losses are about 32 billion m³/year, out of which 50 per cent losses are in developing countries (Kingdom, Soppe, & Sy, 2016). The average NRW in India is around 38 per cent, in Mexico, it is 51 per cent while a conservative average for developing countries as estimated by the World Bank is about 35 per cent (Nideshna, 2020). In Italy, of the total water extracted from sources, only around 52 per cent reaches end users because of high leakage and losses in the supply system. Ageing water infrastructure is one of the prime reasons for high water losses in cities. Water system of cities in the United States like Flint, Michigan, New Jersey and Newark are under tremendous pressure because of poor condition of distribution infrastructure. Dilapidated water supply network in the Russian Federation in general, is leading to water losses amounting to 25 per cent of the total volume of water intake. In Japan, water infrastructure was developed in 1960-70s and most of it has aged by now. The old infrastructure is causing over 20,000 cases of water leakages and supply interruptions annually, thus making the water supply system inefficient.

Water pollution & inadequate wastewater treatment: Many water bodies/ sources in cities across the world face the issue of deteriorating water quality and contamination or pollution caused by the inflow of untreated/ partially- treated waste/ sewage water, and/or agricultural runoff. Globally, about 359 billion m³ of wastewater is produced each year, and around 48 per cent of that water remains untreated (Jones 2021). According to UN WWDR 2017 (UNESCO, 2017), high income countries treat about 70 per cent of the waste water, whereas, upper middle income countries treat about 38 per cent of their wastewater. Lower middle income treat around 28 per cent and low income countries are able to treat only about 8 per cent of their wastewater. Wastewater collection and treatment remains a bigger challenge for informal settlements in cities.

Flooding and storm water management: An increase in the frequency and the intensity of flooding in cities has resulted from an intersection of climate change (increase in extreme rainfall, storm surges and sea level rise) with urban expansion and land use change settlements in flood pone areas as well as poor storm water and solid waste management, amongst other drivers. Urban flooding can cause significant damage



Improvements in access to safe water Source: UNESCO; World Water Development Report (WWDR) 2022 to houses, businesses, and critical infrastructure such as power plants, transportation networks, water treatment facilities, etc. In addition to property damage, flooding can also lead to the displacement of residents, the spread of waterborne diseases, and increased health risks for those who are vulnerable. Moreover, the cost of emergency response and recovery efforts can be significant and may place additional strain on already stretched government resources. In developing countries, residents is informal settlements are particularly at risk of flooding, where storm water infrastructure is limited and the drains that exist are often clogged with solid waste and silts, etc.

Every water-stressed city is affected by a different combination of factors, but the above mentioned issues and challenges are common across the globe and many cities are grappling with these challenges. To cope up with these challenges, cities are coming up with plans that are focusing on developing integrated urban water management strategies to ensure a secure, sustainable and resilient water future. Some of the action areas include ensuring climate resilient water management, efficient service delivery to ensure 100 per cent coverage in terms of safe drinking water and sanitation, conservation of water resources including reusing and recycling wastewater, etc.

A study by the World Bank (Rentschler, 2022) provides a global analysis of spatial urbanisation patterns and the evolution of flood exposure between 1985 and 2015.

- In 2015, 11 per cent of all settlement areas or 145,000 sq km - were located in zones with high or very high flood risk, which is roughly equivalent to the area of Bangladesh.
- Since 1985 the world's settlement extent has increased by 85 per cent - and settlements exposed to the highest flood hazard level have increased by 122 per cent.
- Globally, about 36,500 sq km of settlement areas have been built in the highest-risk zones since 1985.



2021 urban floods in Xinxiang in China's Henan province Source: AFP/Getty Images, 2022

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Strategies Adopted by Cities to Address Water Security

1. Adopting Integrated Urban Water Management (IUWM) Strategies through Regulatory Reforms

Many national, state and local governments are taking proactive measures through regulatory reforms that encourage efficient water use and help cities become water secure in the future.

State governments in Australia are attempting to drought proof their states by adopting strategies like grey water recycling, water efficient labelling on appliances, providing incentives to households conserving water, and putting in place water restrictions enforced through fines. Perth's long-term strategy for sourcing water and managing its use is called 'Fresh Water Thinking' (Core, 2020). The city has adopted multiple strategies which help in water conservation, developing alternate sources of water and recycling of storm water and wastewater. Perth's Water Corporation regularly engages with users to sensitize them about their current water usage and options to reduce their consumption. They also engage with plumbers and landscapers to encourage homeowners to adopt water efficient fixtures. Additionally, the government is operating two large scale desalination plants which cater to half of Perth's water supply (Core, 2020). Perth's first action plan was developed on the basis of ideas and actions suggested by over 200 stakeholders from diverse sectors including local Governments: communities: financial institutions. industries and various government departments/ utilities related to planning, heritage and water.

Cape Town in South Africa implemented a robust water demand management plan. With water-saving



Achievements of the Perth Water Action Plan Source: Government of Western Australia, 2022



Five Commitments as part of the Cape Town Water Strategy Source: Cape Town Water Strategy, 2019

efforts of citizens, achieved through significant water restrictions and increased water tariffs enforced by the municipality, the city's water demand reduced to 550 million liters per day (in 2018) from 900 million liters per day before the drought. Some of the key initiatives include proactive leak detection, pipe and meter replacement, comprehensive asset management, and smart pressure control. Residents are supported in installing rainwater tanks and sink boreholes, thereby reducing the amount of water purchased by such households from the city. The city government also ensures access to potable water through delivery by both centralized and decentralized infrastructure. In addition, the city has undertaken steps to integrate storm water treatment with the landscape.

The city of Los Angeles has initiated the 'One Water LA 2040' Plan which considers all of the city's water resources including wastewater and storm water as "One water". It also focuses on multi-departmental and multi-agency coordination to manage water in a more efficient, cost-effective and sustainable way. Two goals of the program are as presented below:

- Develop a vision and implementation strategy to sustainably and cost-effectively manage water, and
- Identify ways for city departments and regional agencies to integrate their water management strategies.

The main aim is to optimize and enhance the urban water cycle by undertaking strategies like increasing storm water capture, treatment and reuse, expanding recycled water for uses like irrigation, industrial use, groundwater recharge, etc.

2. Provision for Equitable and Safe Access to Water

In the Netherlands, public water supply is managed through 10 drinking water companies owned by the provincial governments. As per the Drinking Water Act, 2011, it is the responsibility of the drinking water company to "guarantee a durable and efficient public drinking water supply; ensure that future demand can be satisfied; carry out fault risk analysis; and provide for emergency drinking water when the delivery of drinking water is no longer possible or is unacceptable on public health grounds". To adhere to these responsibilities entrusted on them, every company must provide a connection under conditions that are reasonable, transparent and non-discriminatory to any person who requests access, apply appropriate tariffs that help to recover operational costs, and develop policies aimed at avoiding disconnection of small consumers. These steps help ensure that there is equitable access to safe water in the Netherlands. Moreover, the government undertakes performance assessment against service deliver and cost parameters, thereby ensuring that the companies enhance their performance and remain competitive.

The Government of Odisha, a state in India, launched "Drink from Tap Mission" with Puri city as the first city to implement 24 X 7 water supply for the entire city with a population of 0.25 million. This includes 32,300 house connections spread across 32 wards including 64 slum areas covering a population of 66,000 slum people. One of the key highlights of this mission was that the Government initiated the convergence of the mission with various ongoing development programs for the poor such as JAGA Mission which ensured greater reach. This mission has achieved 100% household connections



Public water supply in Netherlands Source: Author compilation

with 100% metering. The quality of water supplied is as per IS: 10500 and there is enhanced public confidence with significant reduction in the lag in complaint redressal. Overtime, this mission has reduced the NRW from 50 to 15 per cent.

Turkey is also making advancements in the water sector by adopting various strategies and has reached 97 per cent access rate in terms of piped water supply for the population living in urban areas. The main strategy adopted was institutional reforms, where the government of Turkey introduced a new service provision model in Istanbul's municipality. A dedicated Water and Sewage Administration called "ISKI" was established as a public utility owned by the municipality with an independent budget. Such ISKIs have been created across various metropolitan municipalities and they are responsible for the provision of water supply and sewerage services. The initiative has been successful in bringing down NRW from 54 to 35 per cent (World Bank, 2016).

3. Exploring Innovative Financing Mechanisms

Pune Municipal Corporation, India has raised INR 200 crore through municipal bonds to finance its 24X7 water supply project. Supported by subsidies and enabling frameworks provided by the Government of India, more utility boards such as Vadodara, Pimpri-Chinchwad, and Ghaziabad are adopting this approach.

Public-Private Partnership (PPP) is also a key institutional arrangement that can help in efficient management of water resources along with infusing required funds into the sector. The Umbulan Springs Drinking Water Supply in Indonesia is an example of a Build-Operate-Transfer (BOT) PPP model, with a concession period of 25 years. This water infrastructure development project comprises a transmission pipeline, construction of the production system, and offtake for five regencies and cities. The project caters to approximately 320,000 households and provides 4,000 L of drinking water. The partnership ensured gains for the government as well as the private partner. The support and guarantee through schemes such as Viability Gap Funding (VGF)¹ and Infrastructure Guarantee Funding (IGF)² led to an increase in confidence of private partners to invest in the Umbulan Springs Drinking Water Supply project.

PPP models with VGF have been adopted in several Indian cities as well. The Tirupur Water Supply & Sewerage Project (to draw and distribute raw water for industrial and domestic use) is based on Build-Own-Operate-Transfer (BOOT) mode. It is the first water and sanitation project in India on a PPP basis. Three private firms formed a consortium to take up the project for 30 years, after which it would be transferred to the state government. Similarly, JUSCO (Jamshedpur Utilities & Services Co.) entered a tripartite contract with the Mysore City Corporation (MCC) and the Karnataka Urban Water Supply and Drainage Board (KUWSDB) for distributing water to Mysore city from the Cauvery River. The Chennai Desalination Plant - Chennai Water Desal Ltd. was set up to implement a 100 MLD seawater plant on Design-Build-Own-Operate-Transfer (DBOOT) basis for 25 years.

In European countries, in order to give impetus to smart water management, alternative funding mechanisms such as 'Cohesion Funds' are provided. These funds co-finance capital-intensive investment opportunities in water infrastructure and help European Union (EU) member states comply with water legislation and focus on water efficiency.

4. Nature-based Solutions (NBS) for Increased Climate Resilience

Nature-based Solutions are natural and cost-effective solutions for providing various urban services like

wastewater and storm water management, addressing challenges such as pollution and improving the sustainability, resilience and liveability of cities.

The government of China launched the 'Sponge City Programme' in 2013 to effectively manage storm water drainage and address issues of urban flooding. Wuhan is leading the way with its exemplary "nature-based" approach for implementing green infrastructure such as rain gardens, absorptive roads, permeable pavements, rainwater reuse facilities, etc. The city's nature-based approach has cost around USD 600 million which is still low-cost compared to the alternative grey infrastructure-based approach (like upgrading the city's drainage system) and has improved the city's resilience to flooding.

Other examples of the use of NbS to achieve a number of interconnected water management outcomes are illustrated in the table below.

PROJECT	NATURE BASED SOLUTIONS	MAIN SERVICES
Water Park, Italy, 2013-2015	Constructed wetlands for water pollution control and hydraulic risk management	Water pollution control; Flood mitigation; Biodiversity increase; Aesthetic/Social benefits
HYDROUSA project on Greek Islands, 2018- present	Constructed wetlands in the food-water-energy nexus; Constructed wetlands for greywater treatment and reuse; Rainwater harvesting systems; Recreation of high-biodiversity and productive agroforestry site	Reuse of nutrient (N,P) rich treated wastewater; Reuse of treated grey water; Reuse of harvested rainwater; Linking reuse of water to agroforestry; Removal of emerging organic micropollutants from the water phase and plant uptake in edible plants
KURAS, Berlin, Germany, 2016 - present	Rainwater harvesting; Decreasing water consumption	Avoiding deposits in the sewer system; Reuse of harvested rainwater
G.I.A.R.E., Italy, 2011 - 2014	Compact storm drain prototype device for run - off rainwater treatment; Green roof systems for support in the management of urban drainage system; Urban drainage planning and design service to manage inflows and reduce pollution; Development of a technological platform. Decision - making support for sustainable management of water - energy cycle in urban drainage system	Removal of pollutants at storm drain inlet; Management and optimisation of water-energy performance; Hydraulic defence of urban area and control on discharge quality into water bodies
C2C-CC, Denmark, 2016 -present	Providing flood control; Running water treatment; Utilising sustainable heat energy	Water pollution control; Flood mitigation; Management and optimisation of water-energy performance

Table: Nature Based Solutions

Source: adopted from Oral, H.V. 2020

5. Protecting Water Ecosystems

In 1997, New York City passed its watershed regulations through the City Watershed Memorandum of Agreement (MoA) signed between the State of New York, watershed towns, villages and counties in the Catskill/ Delaware region and with environmental and agricultural organizations. The watershed meets 90 per cent of the city's water demand and the water quality received by the city was being affected due to chemical intensive farming being practised by upstream farmers within the watershed. Rather than invest in grey infrastructure to treat the pollution, the New York City administration decided to convince stakeholders to maintain the environmental quality of the watershed and enforce existing environmental regulations. The New York State Department of Agriculture initated a co-designing process with the farmers to adopt Whole Farm Planning' under which unique pollution control and forest management plans were developed for each participating farm, with technical support from experts (Farming Matters, 2018). All such pollution mitigation measures were financed by the New York City water authority; a strategy that helped reduce 75-80 per cent of farm pollution and led to restoration of the quality of city's drinking water in a cost effective manner. This program has facilitated many success stories across the globe from Xalapa, Mexico to Cebu, Philippines (Farming Matters, 2018).

The Government of India's flagship program 'Namami Gange' or 'National Mission for Clean Ganga (NMCG)' is an Integrated Conservation Mission with twin objectives of effective abatement of pollution, and conservation and rejuvenation of the river Ganga. Key pillars of this program include provision of sewage treatment infrastructure, industrial effluent monitoring, river front development, public awareness, etc. As cities in the basin have a central role to play in the rejuvenation and replenishment of the rivers, the mission also focuses on urban water management. Some of the key achievements of this ongoing program are:

- Enhancement of sewage treatment capacity- 73 sewage treatment projects have been completed in the states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Delhi, Himachal Pradesh, Haryana, & Rajasthan.
- Monitoring of industrial effluents Grossly Polluted Industries (GPIs) operating along the banks of the river are regulated and routinely inspected to comply with established environmental standards.

- Construction plus performance- A Hybrid Annuity Model has been adopted for projects to ensure that operators deliver high performance not only during construction but also during the operations of the project. 40 per cent of capital expenditure was given by the state and 60 per cent of capital expenditure to be raised by concessionaire will be returned over the next 15 years in the form of quarterly annual payments. This ensures quality of construction, processes and monitoring and management of the equipment.
- Water Sensitive Urban Design and Planning has been introduced and is being implemented through pilot projects.

In December 2022, the United Nations has recognized the initiatives of Namami Gange as one of the top ten World Restoration Flagship initiatives to revive the natural world.

6. Utilising Smart Technology for Urban Water Security

Seosan City in South Korea faced numerous water related challenges, particularly related to its challenging mountainous topography. Pipes in the region are more prone to leakages and at slopes water pressure in the pipes increases which often led to explosions. Around 40 per cent of water was lost, leading to significant financial losses to the local government. In addition, the city was facing issues of reduced precipitation leading to water scarcity. To solve this problem, the Seosan city government incorporated ICT tools into its existing water supply network in 2016 to: (i) minimize the loss of revenue incurred by water leakage and (ii) secure the city's finite water resources.

As part of a national initiative launched by the Ministry of Environment of South Korea, K-water undertook an optimization project and implemented the following measures:

 Smart metering system - Digital meters were installed to measure water flow multiple times a day and the collected data is transferred to a monitoring system operated by the city government. This has helped in providing near real-time data on water usage and allowed the city government to respond to water leakage detection and pipe repair more efficiently.

- Smaller District Metered Areas (SDMAs) using smart meters - Service area division into DMAs yields two benefits i.e. ensuring that water supply continues when damage occurs in other parts and improving the ability to identify leakage points in a smaller service area. Whenever there is a problem in a particular DMA, it is then divided into sub DMAs to solve the issue without disturbing other service areas.
- Water pressure optimization Based on the data received from SDMAs, Seosan city government used an automatic remote-control system to adjust water pressure in pipes accordingly.

Studies suggest that through this project, around 19,000 m³ of water could be saved annually for its eight year life span and the city government is expected to save up to USD 980,000 in water management for the same time period. (Smart Water Management: Seosan, Korea, 2020; Yi, 2018)

Many global cities are at risk of experiencing severe floods that can result in significant destruction. Early warning systems can play a significant role in planning for and mitigating the effects of such calamities. In the state of Assam in India, flooding is a perennial problem and realizing the need for an early warning system, Government of Assam implemented a pilot project to develop a flood warning system using geospatial technology. The Flood Early Warning System (FLEWS) system uses satellite and ground based hydro-meteorological analysis with the help of North Eastern Space Application Centre, Shillong. The system has an alert success score of 75 per cent and an average alert lead time of 12 to 36 hours.

7. Reuse of Treated Wastewater

Japan has been reusing its treated wastewater for past many decades to tide over the situations of water drought and other natural disasters (frequent earthquakes). Tokyo Metropolitan was the first in the country to reuse treated wastewater to replenish dry stream flow and aquatic ecosystems (Haruka and Hiroaki 2020). It was successfully replicated in many other parts of the country. The government of Japan established a law in 2014, "The Basic Act on the Water Cycle", and highlighted the importance of water reuse in water resource management. In 2015, the "Water Resources Policy" was also established to promote water reuse. Similarly, the UK is one of the leading examples of wastewater treatment and recycling. It strives to get maximum value and benefits from wastewater treatment, recycling and reuse, energy recovery and other products. South England, including London, is vulnerable to hydrological drought. As part of efforts to address this issue, it was proposed to replace the use of potable water for flushing with non-potable sources, considering that 23 per cent of the UK's domestic water is currently utilized for this purpose. As a part of Olympic Delivery Authority's (ODA's) Sustainable Water Strategy, UK's largest community wastewater recycling scheme was set up at the Old Ford water recycling plant. The benefits of this recycling project included (Rafin 2018):

- 41,000 m³ of water to irrigate the Parklands.
- 4,200 m³ were recycled at the Copper box, the 7,000 seats sport venue, representing 19 per cent of the site water consumption.
- The plant maintained a 40% water reduction in potable water use.

Key Drivers for Action

Focus on Regulatory reforms to promote water demand management (WDM) strategies: Regulatory reforms including provisions for decentralised treatment and reuse of wastewater, rationalised norms for per capita supply, on site management of storm water runoff, etc. will be critical in optimising the demand for fresh water. This can potentially change user behaviour, attitude and practices towards efficient water use and for reducing water consumption to achieve a set targeted level of consumption. This has to be supplemented through awareness campaigns for water conservation and promotion of water saving technologies that can have a significant impact on reduction of water consumption. Right Pricing of water also helps in efficient resource management.

Shift towards Green Infrastructure or Nature-based Solutions (NbS): NbS is a promising transition that is helping cities to enhance water security, reduce flood risks and improve resilience to potential impacts of climate change with many other co-benefits of saving money, better management of resources, etc. Interventions such as the use of multifunctional blue-green infrastructure cannot only help in better management of water resources but also ensure storm water management thereby reducing the risks associated with flooding.

Treat Wastewater as a Resource: Wastewater treatment and recycling/ reuse is emerging as a major alternative source for fresh water, with the potential for ensuring future water security and transitioning towards the circular economy. There is a need to transition from the conventional model of "obtain, treat, delivery, and dispose" to a circular economy model, focused on "reduce, reuse, and retention" which helps in reducing water use, preventing water pollution and enhancing water use efficiency. Wastewater treatment also offers significant co-benefits like providing biological nutrients for agriculture, energy recovery and reduction in carbon emission if based on circular economy principles.

Facilitate Innovative Financing: Blended finance structures that combine public and philanthropic capital with private investments using credit enhancement instruments could be explored for the water sector. Enabling policy frameworks for gap funding, credit enhancement, etc. can reduce the risks associated with the sector, increase investor confidence and thereby result in infusing required investments and private sector efficiencies in water sector service delivery.

Technological Advancement: Digitalization of urban water management systems enhances transparency and promotes innovation. It transforms passive water systems into active and adaptive units capable of responding to different contexts and situations. Investment into piloting and upscaling of innovative technologies in the water sector can help to solve many urban water problems e.g. advanced water leakages/ losses detection, real-time water flow and water quality monitoring, advanced wastewater treatment for fit-for-purpose recycle/ reuse & resources recovery. Adoption of digital technologies can also help in developing predictive early warning systems that can substantially reduce hazard risks.

Creating capacities in the ecosystem: Implementing sustainable water management practices will require individuals, households, commercial establishments, industries and institutions to make responsible transitions. This will require advocacy and awareness generation across users and suppliers, as well as capacity building of public officials so that they can make informed choices to ensure long-term water security.




Accelerating Climate Finance



Abstract



Cities are at the forefront of reducing greenhouse gas emissions and addressing climate change risks. Climate finance is thus critical to support large-scale investments required to adopt measures to significantly reduce emissions and mitigate adverse effects of climate change. While multi-national development banks have oriented their technical support and loan portfolios towards climate financing and global funding facilities such as GEF, GCF, and AF have been set up, the climate finance flows by 2017/18 reached only about USD 384 billion annually; far short of the needs. It is estimated that sustainable investment opportunities in six urban sectors (waste, water, renewable energy, electric vehicles, public transport, green buildings) in emerging markets alone amount to USD 2.5 trillion annually up to 2030. Cities lack the capacities for accessing such financing instruments and for these instruments to be impactful, the readiness of cities for attracting climate financing has to be accelerated. COP 27 has further endorsed the idea of cities being the change-makers in this area. Deliberations at U20 can come up with concrete strategies for mainstreaming climate financing, particularly for cities in the developing world.

Combating global warming and climate change requires individual and collaborative efforts at all levels. Thus, there is a need for adequate dedicated capital in the form of 'climate finance' to assist adaption and mitigation efforts. However, surprising as it may sound, there is no standard definition of climate finance. The subject of climate finance is complex due to conflicting perspectives regarding the funding types, delivery methods, and requisite amounts necessary for developing nations to address climate change and its effects, making it challenging to comprehend. This background research attempts to break down all the components that define "climate finance."

Introduction

Urbanisation is a complex phenomenon that involves the growth and development of cities and their surrounding areas. While it does have its challenges, it also has many positive aspects that make it essential for modern society. As cities grow, they often become centers of industry and commerce, which leads to increased productivity and economic growth. Cities also provide access to a wider range of services, such as healthcare, education, and transportation, thereby improving quality of life for its residents.

Urbanisation also has the potential to foster innovation and creativity. Cities are often hubs of cultural exchange and provide opportunities for collaboration and networking among people from diverse backgrounds. Additionally, the concentration of people in urban areas often results in the development of new ideas and technologies that benefit the society.

However, climate change is expected to have widespread consequences putting existing urban centers at risk. Hence, there is a need for cities to minimise impact of climate change by adopting modern climate change mitigation and adaptation strategies. The world faces a two-front battle to combat global warming and address the effects of climate change. Two key strategies for addressing the impacts of climate change are:

Climate Change Mitigation: Refers to decreasing or mitigating greenhouse gas emissions and boosting activities that remove these gases from the atmosphere (Intergovernmental Panel on Climate Change, IPCC), which in turn helps limit the extent of climate change. Climate mitigation projects can include renewable energy projects, energy efficiency measures, afforestation and reforestation, and others. Mitigation efforts aim to reduce the amount of carbon dioxide and other GHG emissions that are released into the atmosphere, to slow or prevent the long-term effects of climate change.

Climate Adaptation: Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices, and structures to moderate potential damages or benefit from climate change opportunities (United Nations Framework Convention on Climate Change, UNFCCC). It helps adapt to the impacts of climate change, such as sea-level rise, increased frequency and intensity of extreme weather events, and changing rainfall patterns. Adaptation projects include building sea walls, improving water management systems, and developing drought-resistant crops. These efforts aim to help societies and ecosystems cope with the inevitable impacts of climate change and reduce vulnerability to these impacts.

Both climate mitigation and adaptation are necessary to address the challenges of climate change. While mitigation efforts can help slow the rate of climate change, adaptation efforts are essential to cope with the impacts already occurring and build resilience for the future. A comprehensive approach that combines mitigation and adaptation is needed to address the challenges of climate change effectively.

Urgent Need to Accelerate Climate Finance in Urban Centers

Cities consume about 75 per cent of global primary energy and emit between 50 and 60 per cent of the world's total greenhouse gases (Climate Action, n.d.). Thus, to remain within a 1.5°C rise, average per capita emissions across cities must drop from 5 tonnes of carbon dioxide (tCO2e) per capita to ~ 2.9 tCO2e per capita by 2030 (C40, n.d.). For wealthier, high-emitting cities, an urgent and steep decline in emissions is the need of the hour. Further, urban residents and critical infrastructure will face more frequent flooding, drought, heat waves, extreme rain events, and other climate-related hazards. These are translated into sea-level rise affecting coastal cities, impacts on built infrastructures, health problems arising from higher average temperatures and extreme events, increase in energy demand and use, and adverse effects on water availability and resources. In addition, the expected growth in the global urban population will lead to significant increases in GHG emissions across multiple sectors and changes to the urban micro-climate due to the urban heat island effect.

Countries must agree on the additional investment required to undertake climate adaptation and mitigation measures to tackle climate impact, especially since some countries will require more support to fulfil their commitments to reach net zero. Undoubtedly, any strategy for achieving net zero will require huge investments. As per Climate Policy Initiative, the global climate annual finance requirement shall be at least \$4.3 Tn in annual finance flows by 2030 and \$6.2 Tn by 2050 to avoid the worst impacts of climate change. In contrast, only \$665 Bn were invested in the year 2020. (Climate Policy Initiative, 2022)

Investments in the power sector are required to enable a shift from fossil fuel-based electricity generation to renewables. Sectors using fossil fuel energy, such as transport, will have to shift to electricity, calling for new investments in the automotive industry. Industries in the "hard-to-abate" category, such as steel, fertilisers, and petroleum refining, which use fossil fuel for heating and as feedstock, will have to shift to alternatives such as green hydrogen. Buildings, both commercial and residential, will have to be made more energy efficient.

In addition to these investments linked with mitigation, countries will have to undertake investments for adaptation to manage the consequences of climate change that have already taken place and will continue for some time even if we succeed in limiting global warming to $\pm 1.5^{\circ}$ C by 2100.

Despite all these efforts, some areas will still need to use fossil fuels, leading to substantial emissions. These will have to be offset by expanded carbon sinks via afforestation and carbon capture utilization and storage.

TORONTO

Extreme winter conditions are leading to increase in demand on the energy sector resulting in brownouts and blackouts. Various health effects arise from periods of cold weather exposure, including frost-nip, frostbite and hypothermia.

FRANCE

Electricity generation in France plummeted, with low rivers reducing the ability to cool nuclear power towers.

SPAIN AND PORTUGAL

Extreme heat in Europe leading to wildfires in Spain and Portugal.

Drought in Spain dried up a reservoir, revealing the long-submerged "Spanish Stonehenge," an ancient circle of megalithic stones believed to date back to around 5000 B.C.

SOMALIA

Somalia is in the midst of the longest and most severe drought in its history, following five consecutive poor rainy seasons, which has devastated the country.

BUENOS AIRES

Heatwaves in Argentina in 2022 led to power grids failure in Buenos Aires.

CHENNAI

City of Chennai, on India's south-eastern coast, ran dry in the summer of 2019. On 19 June 2019, Chennai city officials declared that "Day Zero", or the day when almost no water is left, had been reached, as all the four main reservoirs supplying water to the city had run dry.

Climate impact on some cities across the world Source: Author Compilation JAKARTA

Indonesia will relocate its capital from Jakarta to Nusantara as rising sea levels will result in submergence of Jakarta by 2050.

Evolution of Climate Finance

The origin of climate finance is associated with the United Nations Framework Convention on Climate Change (UNFCCC), established in 1992 to address the challenges posed by climate change. The need for international financial assistance to developing countries was explicitly included in the UNFCCC in recognition of the fundamental asymmetry between advanced countries and developing countries in terms of their contribution to the problem of global warming and their capacity to manage it. Thus, Common But Differentiated Responsibilities (CBDR) were recognised by different member states where developed countries acknowledged their responsibility in the process of sustainable development given the pressures their societies place on the global environment, technologies and financial resources they command.

Global warming is caused by the increasing concentration of GHGs, mainly CO2, in the atmosphere. This increase is largely due to advanced countries using fossil fuels as their primary energy source as they industrialised. It was recognised that the developing countries were latecomers to industrialisation and had yet to contribute much to the accumulated concentration of GHGs. Their level of emissions per capita was also much lower, and the resources available to them for mitigation and adaptation were inadequate. Hence, climate financing was necessary for them to undertake adaptation and mitigation projects.

The concept of climate finance was further elaborated in the Kyoto Protocol, which was adopted in 1997 and came into force in 2005. The Kyoto Protocol introduced mechanism called the Clean Development n Mechanism (CDM), which allowed developed countries to invest in developing countries on emission reduction projects and receive credit for the resulting emissions reductions. The CDM was designed to provide a source of financing for climate projects in developing countries, while also promoting technology transfer and capacity building. However, the Kyoto Protocol had some shortcomings including lack of commitment from developing countries. This became a sticky point, particularly because China was growing exceptionally rapidly, and its emissions had increased considerably but being classified as a developing country in the UNFCCC framework, it was exempt from restrictions. (UNFCCC, n.d.)

In 2009, the Copenhagen Accord, which was a non-binding agreement that emerged from the UNFCCC Conference of Parties in Copenhagen, set a goal of mobilizing \$100 Bn per year in climate finance by 2020 to support developing countries in their efforts

to address climate change. This was later reaffirmed in the Paris Agreement, enforced in 2016. The Paris Agreement called for increased financial resources to support the implementation of climate actions, particularly in developing countries, and established a new goal of mobilizing \$100 Bn per year in climate finance by 2020 and beyond. (OECD, 2022)

There have been several initiatives and mechanisms established to mobilise climate finance. These include the Adaptation Fund, established in 2001 and the Green Climate Fund, established in 2010 to support climate projects in developing countries. There are a range of other sources of climate finance, including bilateral and multilateral aid, private sector investment, and carbon markets.

The Sustainable Development Goals (SDGs) emerged from the United Nations Conference on "Sustainable Development" in Rio de Janeiro (2012). Its objective was to develop comprehensive goals that meet the urgent environmental, political, and economic challenges of the developed and developing world. SDGs followed the MDGs (Millenium Development Goals) that had for the first time started a global effort in the year 2000 to tackle the indignity of poverty.

The SDGs are a bold commitment to tackle some of the most pressing challenges facing today's world. The goals are interconnected and every goal is impacted by the progress or lack of it in any other goal. For example, dealing with the threat of climate change impacts how we manage our fragile natural resources, achieving gender equality or better health helps eradicate poverty, and fostering peace and inclusive societies will reduce inequalities and help economies prosper.

At the Sustainable Development Summit (2015), United Nations announced the 2030 Agenda for Sustainable Development with an action agenda for the planet, people, and their prosperity. In this summit, 17 Sustainable Development Goals and 169 targets were announced to demonstrate the scale and ambition of this new universal agenda.

Given the importance of urban development to global development efforts, a standalone goal on cities and urban development has been included in the 2030 Agenda as SDG 11, i.e., "make cities and human settlements inclusive, safe, resilient and sustainable" There is also recognition of the ubiquitous nature of urban issues, which impact several other Sustainable Development Goals, including SDGs 1, 6, 7, 8, 9, 12, 15, and 17, among others.

In September 2019, to accelerate sustainable solutions

to achieve targets of the 2030 Agenda, the UN Secretary-General called on all sectors of society to mobilize for a Decade of Action on three levels:

- Global action to secure greater leadership, more resources, and smarter solutions for the SDGs.
- Local action embedding the needed transitions in the policies, budgets, institutions, and regulatory frameworks of governments, cities, and local

authorities.

 People action, including youth, civil society, the media, the private sector, unions, academia, and other stakeholders.

Climate Finance - Definition

In its broad interpretation, Climate Finance refers to local, national, or transnational financing–drawn from public, private, and alternative sources of financing–that



Source: Author Compilation

seeks to support mitigation and adaptation actions to address climate change impacts. Different institutions have defined Climate Finance uniquely. At present, some prominent institutions have defined Climate Finance in the following manner:

A standardised and universally acceptable definition of Climate Finance may enable more precise tracking of finance flows to different sectors, as well as help design effective policies, regulations, and institutional mechanisms directed towards increasing both public and private investments (Climate Policy Initiative. (2023, May 10)). It would also accelerate the development of financial products/services for investors and depositors, enabling financial intermediaries to assess their climate change risks and opportunities and improve reporting and disclosure practices. These benefits would assist the efforts to accelerate climate finance.

The Climate Change Finance Unit, Department of Economic Affairs, India, (2018) has recommended that the definition of climate finance should ideally include the following elements:

 Public grants, unrequited equity and grant-equivalent values of loans should count as climate flows. Loans have a role, only if measured in grant-equivalent terms.

- Transfers of finance ex-post that are formalised specifically as climate finance, and preferably earmarked as either mitigation or adaptation or cross-cutting, by both the recipient and the source countries count as climate flows.
- Value of climate finance flows must be counted as actual disbursements of such finance crossing borders in a particular year and not as multi-year promises or pledges.
- Next crucial element is how to treat private climate finance flows that are 'mobilised' or 'leveraged' in some form by the acts of public policies in source countries. 'Mobilised' or 'leveraged' finance would have a very precise meaning in terms of the public backing granted by the source countries to permit grant equivalency.
- Clear definition of 'new and additional' which must begin by defining the starting value or baseline value of climate finance flows. The term 'new and additional' was meant to mean that the climate finance flows would be 'new and additional' to other forms of assistance, and not just diverted from existing levels of assistance towards climate finance.

UNFCCC

Climate finance refers to local, national or transnational financing that seeks to support mitigation and adaptation actions that will address

climate change. Climate finance flows are typically directed to specific geographic areas or to specific sectors, including energy, agriculture, transport, and water. (Nations, n.d.)

German Federal Ministry for Economic Cooperation and Development (BMZ)

Climate finance refers to the provision of financial resources to developing countries to support the implementation of measures to mitigate and adapt to climate change. These measures can include the deployment of renewable energy technologies, the promotion of energy efficiency, and the development of climate-resilient infrastructure. (bmz, 2022)

Some definitions of Climate Finance Source: Author Compilation



Climate finance refers to local, national or transnational financing that seeks to support mitigation and adaptation actions that will

> address climate change. The World Bank's Climate Change Action Plan seeks to leverage \$200 Bn in climate-related investments over five years. (WorldBank I. F., 2019) n.d.)



Climate

Bonds

Climate Bonds Initiative

Climate finance refers to financing activities that support climate mitigation or adaptation objectives, such as renewable

energy, energy efficiency, sustainable land use, and climate-resilient infrastructure. Climate finance can be public or private, and can come from a variety of sources, including multilateral development banks, governments, private investors, and philanthropic organizations. (CBI, 2022)

Key Facts & Figures

A number of assessments of the quantity of finance needed to deliver on climate goals have been carried out - both at the global level and specifically for low-and middle-income countries. The estimates vary substantially across studies, reflecting differences in scope and methodologies.

There is a wide consensus that mitigating impacts of climate change and adapting to them require much more capital investment than is currently being provided. This section provides statistics about various elements of climate finance to understand the current situation.

Climate Finance Requirements

At the 15th Conference of Parties (COP15) of the UNFCCC in Copenhagen in 2009, developed countries committed to a collective goal of mobilising \$100 Bn per year by 2020 for climate action in developing countries, in the context of meaningful mitigation actions and transparency on implementation. The goal was formalised at COP16 in Cancun, and at COP21 in Paris, it was reiterated and extended to 2025. As of 2020, the total Climate Finance provided and mobilised by developed countries was only \$83.3 Bn. Between 2013-2020, public climate finance accounted for most of the total available annual Climate Finance, increasing from \$38 Bn in 2013 to \$68.3 Bn in the year 2020. Within that overall amount, multilateral flows grew by 138% over 2013-20, while bilateral flows grew by 40%. Mobilised private climate finance, for which comparable data is only available from 2016, increased by almost 30% over 2016-20, despite a drop between 2019 and 2020. The share of climate-related export credits in the total remains small. (OECD, 2022)

Climate Finance, overall, has seen a steady increase over the last decade leading to a total of \$665 Bn of fund flows in 2020, as per 'Landscape of Climate Finance 2021 Report' published by Climate Policy Initiative, an independent non-profit research group.

On an aggregate basis, a total of \$4.8 Tn has been provided by the public and private sectors during the period 2011-2020, with the private sector both public & private contributing almost equally.

As per Climate Policy Initiative, the annual global climate finance requirement shall be at least \$4.3 Tn in annual finance flows by 2030 and \$6.2 Tn by 2050 to avoid the worst impacts of climate change.



Climate finance mobilisation for developing countries by developed countries between 2013-2020 Source: (OECD, 2022)



Climate Finance mobilised by public and private sources between 2011-2020 (\$ Bn)



Source: (Climate Policy Initiative, 2022)



The fund requirement for Climate Finance is way more than the current supply. An additional \$3.6 Tn annually is required by 2030 to bridge the gap. (Climate Policy Initiative, 2022). The recent IPCC (2018b) study revealed that developing countries' Climate Finance requirements stood at \$600 Bn annually between 2020-50 in additional investments for the energy sector alone.

In India climate finance flows are falling far short of the country's current needs. In 2019/2020, tracked climate finance was ~\$44 Bn per annum, approximately a fourth of India's needs. (Climate Policy Initiative, 2022)

A report prepared by India's Department of Economic Affairs (DEA, 2020) focuses on the financial requirements for India to achieve its Nationally Determined Contributions (NDCs) under the Paris Agreement. The report sheds light on the scale of investment needed to achieve India's climate goals and the gap in financing has to be addressed to make this transition possible. Due to significant investment requirement in various sectors, including renewable energy, energy efficiency, and transportation, India's NDCs stands at \$7.2 Tn. (Goldar, 2022). This is almost thrice the preliminary estimate of \$2.5 Tn submitted to UNFCC in 2015 under the Paris Agreement. Also, India's current domestic resources and external funding from multilateral and bilateral sources are insufficient to meet the financial requirements of the NDCs. Therefore, the report emphasizes the importance of international support and cooperation, including increased financial flows from developed countries, access to technology and capacity building, and collaboration on carbon markets and carbon pricing mechanisms.

Country	Base year	Amount (\$ Bn)
South Africa	2015	697
India	2011	7,242
China	2016	8,420
Indonesia	Not specified	569
Brazil	2017	278-297
Mexico	2017	126
Turkey	Not specified	63-84

Summary of Financial Requirements for G20 Developing Countries up to 2030 with respect to their National Determined Contributions (NDCs)

Source: (Goldar, 2022)



Current global annual climate funding vis-a-vis incremental annual funding requirement by 2030 Source : (Climate Policy Initiative, 2022)

This report is significant because it highlights the urgency of addressing climate change and the need for international cooperation and support to enable developing countries like India to achieve their climate goals. It also underscores the importance of mobilizing domestic and global resources, leveraging market mechanisms, and promoting private sector participation in transitioning to a low-carbon economy.

Furthermore, the report's recommendations provide a roadmap for policymakers, investors, and other stakeholders to align their efforts towards achieving India's climate goals sustainably and cost-effectively. The report's emphasis on establishing a comprehensive monitoring and evaluation system highlights the importance of accountability and transparency in ensuring that climate finance is deployed effectively and efficiently.

Climate financing requirements will increase further, demanding more significant commitment from the international community. The recent IPCC (2018b) study revealed that developing countries' climate finance requirements stood at \$600 Bn annually between 2020-50 in additional investments for the energy sector alone.

Modes of financing

The most favoured mode of climate financing is still the conventional instrument of debt financing. Of the total climate finance flows in 2019-20, ~60%, or \$385 Bn was raised as debt. Further, most of this debt was formed by project-level market rate debt, with a meagre share of \$47 Bn, or 12%, being extended at low-cost project levels.



Global Climate Finance breakup by Instrument 2019-20 Source: (Goldar, 2022) Several multilateral climate funds have been developed to address this requirement with an amount of approximately \$43 Bn is being pledged by various funds till January 2023. Most of these funds are backed by prestigious organizations including multilateral development banks (MDBs) such as World Bank, Asian Development Bank, European Bank for Reconstruction and Development and Inter-American Development Bank.



Amount pledged by multilateral climate funds (\$Bn) till Jan' 2023

Source: (Climatefundsupdate, 2022)

Utilisation of Funds

As presented in a report published by OECD (2022), total climate finance provided and mobilised by developed countries for developing countries amounted to \$83.3 Bn in 2020. Of this total, \$48.6 Bn (58%) was for mitigation, \$28.6 Bn (34%) for adaptation, and \$6.0 Bn (7%) for cross-cutting activities. Between 2016 and 2020, adaptation finance grew the most in absolute and relative terms. In 2016, mitigation accounted for \$42.2 Bn (72%), adaptation for \$10.1 Bn (17%) and cross-cutting for \$6.2 Bn (11%).

Mitigation finance accounted for over two-thirds of total climate finance provided and mobilised within each

region over the period 2016-2020, except for Oceania. Still, between 2016 and 2020, the share of adaptation finance provided or mobilised in each region increased, most notably in Africa, where it jumped from 25% in 2016 to 45% in 2020 (i.e., a \$6.6 Bn increase). In all regions but Oceania, the share of cross-cutting finance remained small (less than 10%).

Developing countries vary widely in terms of levels and composition of national GHG emissions, and large emitters tend to attract larger shares of climate finance in support of mitigation activities:

- The 10 developing countries with the highest overall level of CO_2 emissions in 2016-2019, and which represented 68% of total developing country CO_2 emissions in 2016-2019, benefitted from 25% of total mitigation finance provided and mobilised over 2016-2020.
- Incontrast, the lowest 50 developing country emitters, representing 1% of total developing country CO₂ emissions, only benefitted from 3% of total mitigation finance provided and mobilised in 2016-2020.(OECD, 2022)

The mismatch between the channelling of funds toward mitigation and adaptation sectors has been a longstanding debate. Recent assessments of climate finance flows have shown that the adaptation sector is significantly dependent on public sector funds. As the benefits of adaptation are more local and involve a greater risk appetite, restricting the participation of private players in the sector. The lack of bankability of adaptation projects and limited internal capacity for private players to assess, identify, and develop an adaptation activities pipeline the "adaptation gap" further. (Goldar, 2022)



Climate theme split across developing country regions (2016-2020, %) Source: (OECD, 2022)

Key Aspects

Connecting cities with financing is an essential component of building urban resilience strategies and achieving mitigation targets. A city's ability to make climate-smart investments, particularly in emerging economies, often relies on the reallocation of existing budgets and the ability to raise revenue. However, the investment barriers faced by cities, such as creditworthiness, bankability, and the lack of a viable project pipeline, limit what they can do on their own and pose an obstacle to attracting private finance. Despite these fundamental issues that constrain investment in climate-smart urban infrastructure, cities can narrow this financing gap by taking advantage of a wide range of established mechanisms to access funding, and by deploying new and innovative models of finance and investment tailored to their specific context.

It appears that while there is liquidity in global financial markets, barriers impeding deployment in many emerging markets persist. Some of these barriers have been examined in this section.

1. More investments towards mitigation rather than adaptation

Broadly, adaptation can be defined as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities," (IPCC, 2001) and mitigation as "technological change and substitution that reduce resource inputs and emissions per unit of output." (UNFCCC, unfccc.int, n.d.)

It is challenging to provide a comprehensive explanation for the trends in the thematic split of climate finance is provided and mobilised by developed countries, due to the complexity of the international financial architecture, as well as the impact of large individual projects and adaptation and mitigation finance tracking methods. However, an analysis of the current trends provides us with the following observations:

The prospect of financial sustainability and returns, which is more easily attained in mitigation than in adaptation projects, provides an incentive for public and private stakeholders to invest.

Climate theme	Project description	Does the available revenue stream benefit the financer?
Mitigation	Design, construction and operation of a solar photovoltaic power plant and a transmission line.	Yes
	Construction of a metro line and purchase of a fleet of metro cars.	Yes
	Establishing an integrated regional solid waste management system consisting of collection, transfer, and treatment using advanced waste-to-energy (WTE) technology	Yes
Adaptation	Construction of cisterns for the collection, storage, and distribution of water.	Potentially
	Improving existing disaster risk reduction management plans at regional, national, and local levels.	No
	Contribute to improving the climate change resilience of small agricultural producers by channelling credit and basic technical assistance	Yes

Types of investments

Source: Author's compilation

Mitigation Activities	Adaptation Activities
Mitigation activities often consist of infrastructure projects in the fields of energy generation (e.g., construction of power plants) and transport (e.g., construction of metro lines, and railways), which often have an associated revenue stream and thus generate sufficient cash inflows to recover the initial investment and generate returns.	Adaptation finance can support large infrastructure projects (e.g., seawalls, raised roads and railways), many adaptation activities tend to focus on capacity-building or technical assistance that involves limited if any, financial returns.
The incentive for supporting "shovel-ready" projects (i.e., projects at advanced stages of development)	Less incentives for projects that relate more to planning, communication or engagement, which are often adaptation activities
Actions and targets needed to mitigate climate change are more easily identifiable (e.g., achieving net-zero emissions)	The availability of country-level impact assessments to form an agreed basis on which to design adaptation responses is limited.

Financial Sustainability prospects in Mitigation and Adaptation Activities

Source: Author's compilation

Finally, there may be a political incentive for policymakers and climate finance providers to prioritise the implementation of activities that can demonstrably contribute to the goals of the Paris Agreement. In this context, the impacts of mitigation projects can be more easily measured and guantified (e.g., in terms of emission reductions) and assessed against national quantitative targets of emissions reductions, e.g., those included in countries' NDCs. On the other hand, it is more difficult to define effective adaptation projects and activities and assess their contribution toward national adaptation goals. Larger shares of adaptation finance are key to support not only infrastructure projects that help them improve their resilience to climate-related hazards and risks but also capacity-building activities that can also strongly contribute to their socio-economic development in the longer term.

2. Lack of Municipal Funds in Cities

In most developing countries, municipal budgets are not adequate for one-time or initial capital-intensive investments. The rapid urbanisation and meagre endogenous financial resources stem the need for urban local bodies to raise finance through external sources, majorly through debt financing.

A city's, own source revenues are made up of taxes on property, goods, profession, trades, employment, vehicles, animals, entertainment etc.; octroi and grant-in-aid from the state government which is often not very significant.

While property tax is potentially a good source of local revenues but in cities from developing countries, property tax represents only3-4 per cent of local revenues, compared to between 40 and 50 per cent in cities in Australia, Canada, France, the UK, and the US. A survey conducted by 'New Climate Economy' of 100 cities worldwide found that 55 per cent of municipalities recognised lack of public funding as the biggest barrier to sustainable urban growth, while 50 per cent cited insufficient national support.

3. Low Creditworthiness of Cities

A city's creditworthiness is a vital component of its ability to finance low-carbon, climate-resilient projects, attract investment or issue bonds. Cities with a low level of creditworthiness will struggle to raise funds for new projects or to upgrade existing ones. An investment grade credit rating can help a city unlock access to a wide range of private investors (C40, www.c40.org, 2016).

Such assessments are conducted by independent credit rating agencies that study a range of aspects of a city's financial management as well as the wider socio-economic-political environment, and assign a score based on the results. The score, known as the credit rating, is used by investors to determine whether they are interested in providing finance to a city and at what level of interest rate: the higher the rating, the more finance will be available at a lower interest rate.

The World Bank estimates that currently less than 20% of the largest 500 cities in developing countries are deemed creditworthy nationally, with just 4% having access to international markets . The lack of a credit rating severely constrains these cities' ability to provide basic services, let alone invest in low-carbon, climate-resilient urban development. Estimates from the World Bank indicate that "every dollar invested in the creditworthiness of a developing country city is likely to mobilise more than \$100 in private sector financing for low-carbon and climate-resilient infrastructure"

In India, as part of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) scheme, 163 cities out of 468 cities, have received Investment Grade Rating (BBB- and above), among which, 36 cities had a rating of A- and above. Cities with poor credit ratings have been recommended to appoint a Transaction Advisor (TA) for credit enhancement planning. By assessing the poor ratings, TA can provide recommendations on the institutional framework, taxonomy, debt and other long term liabilities management, fiscal performance management etc. Based on the recommendations of TA, ULBs can initiate actions for improvement in the collection and coverage of property tax, other municipal fees and charges etc. After the incorporation of recommendations of the TA, cities can go for revision of credit rating.

Many ULBs are a long way from credit worthiness and need to go through the unnecessary steps of keeping their books in order before entering the world of borrowing and lending or accessing funds from private financial institutions.

Their cost of capital is also generally higher compared to advanced economies. Additionally, the cost of capital for developing countries is increasing due to climate vulnerability.

3 (a): Credit worthiness of Kampala, Uganda;

The city was able to double its debt capacity and improve its investment capacity by creating a Strategic Plan to restore good governance and service delivery, including improving the city's creditworthiness. In particular, the plan aimed to improve municipal revenues through better property record management, tackling inefficiencies in fee collections and billing processes, as well as stronger accounting and monitoring practices. As a result, in April 2015, KCCA was awarded an 'A' (Investment Grade) Rating by Global Credit Ratings, with an "A, Stable" outlook for 2016 (ratings on the national scale). (C40CCLA, 2016)

4. Lack of Taxonomy to Define Green/ Sustainable Investments

A green taxonomy is a framework for defining what can be called environmentally sustainable investments. In addition to tackling "greenwashing", such a taxonomy will help companies and investors make more informed green choices. Sustainability is a key feature of today's global corporate culture. But the term is often too broad for companies to process. Governments have trouble setting universal standards due to the absence of a clear taxonomy, while businesses struggle to measure progress against each other's records and, at times, their own. They are the go-to knowledge bank for investors who seek to ensure their money is causing positive change.

To enable investments on sustainable projects and activities, there is a need to define sustainable or green economic activities using a widely accepted green taxonomy. This helps companies become more climate-friendly, protect private investors from greenwashing, mitigate market fragmentation and shift investments where they are most needed.

Lawmakers and governments are the people who will weigh the pros and cons of every investment and decide what makes the list and what doesn't. Mostly, they do this by measuring the investment's promise of sustainability against the jurisdiction's green goals.

4 (a): Taxonomy in EU, China and Canada

The European Union's "Taxonomy for Sustainable Activities" was launched in July 2020. It's primarily aimed at supporting the bloc's ambitious target of being a "net-zero" economy by the year 2050.

China focuses its efforts on its Green Bond Endorsed Project Catalogues, issued yearly since the mid-2010s. These essentially list criteria for what projects can be attached to green bonds and have much the same result as the EU's green taxonomy.

Canada intends to publish its taxonomy in the coming years, although it is unlikely to have the "green" label as it is more tailored to Canada's resource-driven economy. (Byrne, 2023)

5. Low Institutional Capacities

The capacities of urban local bodies vary widely. Broadly, the factors causing low institutional capacities can be categorised as follows:

- Lack of personnel with appropriate skill sets: Professionalisation of urban management requires immediate attention. At present, most urban management is usually not identified as one of the regular streams of training in academic and professional institutions. The personnel engaged in the management of urban affairs and municipal services are usually not trained or aware of climate change impacts. The specific areas identified for attention are climate-resilient planning, socio-economic planning, environmental management, urban planning, citizen participation, public relations, urban reforms, municipal accounting and financial management, e-Governance, municipal service delivery including water supply, solid waste management, sewerage, and sanitation
- Inadequate skill sets of personnel already deployed: Training and capacity-building programmes show that many of the functionaries of the ULBs do not receive frequent training in their careers There is a scarcity of programmes for facilitating cross learning and exposure to best practices in innovative technologies etc. The problem is indeed acute in smaller ULBs for whom hardly any programmes exist as of now.
- Lack of appropriate training institutions
 The institutional arrangements usually comprise
 the government supported centers of capacity
 building and other administrative training
 institutes. Given the lack of overall capacity, the
 smaller ULBs are not able to even articulate their
 demand for training. In this regard, there is a need
 to institutionalize and set up centers of excellence
 that specialize in specific areas.

6. Lack of Climate Action Plans or Road-maps

For cities which do not have comprehensive climate roadmaps or action plans, it is highly difficult to identify appropriate climate projects and develop coherent climate finance plans accordingly. It is important to focus on long term strategic plans rather than annual budget cycles. A metric to define the prospective impact of expenditures can be developed to enhance the confidence of private investors.

The reasons for lack of roadmaps are mainly as follows:

- Awareness or understanding: ULBs may not fully understand the implications of climate change or the role they can play in mitigating its impact.
- Limited resources: ULBs may not have adequate financial, technical, or human resources to develop and implement climate action plans.
- Fragmented governance: In some cases, multiple agencies may be responsible for different aspects of climate change mitigation, making it difficult to coordinate and implement a comprehensive plan.
- Lack of data: ULBs may not have access to accurate and reliable data on climate change impacts and local emissions, making it difficult to develop evidence-based action plans.
- Lack of capacity: ULBs may not have the technical expertise or capacity to develop and implement climate action plans.
- Short-term thinking: ULBs may prioritize short-term goals and immediate needs over long-term climate action, especially if they are not fully aware of the potential impact of climate change.

6 (a): Climate Action Plan (CAP), Mumbai, India

Mumbai city, home to over 12 million people and thriving on a diverse economy, is increasingly at risk from the impacts of climate change including increasing temperatures, depleting natural green cover, extreme rainfall events resulting in severe flood conditions.

The Mumbai CAP followed the C40 climate action plan, a global framework aligned to the broader objectives of the Paris Agreement to have defined targets for emission reduction. The Mumbai CAP looked at six sectors: Sustainable waste management, Urban greening & biodiversity, Urban flooding & water resource management, Energy & buildings, Air quality and Sustainable mobility. It is closely aligned with the Development Plan for Greater Mumbai 2014-34 (DP 2034) and several sector-specific plans and policies to leverage the existing institutional capital.

The action plan presents information about the key stakeholders, outcome and output indicators, timeframes and revenue sources for each action. A climate budget is also being prepared which will help operationalize the plan, build on existing emission scenario analysis, targets, goals and actions, organize actions into prescriptive implementable tasks for relevant stakeholders, and help the city plan and secure financial resources. (C40Cities, 2022)

7. Need for Policies and Regulatory Reforms

Enabling policies for climate investments can accelerate finance flows into the city. While such reforms may be implemented at the state/ sub-national level, policies designed especially for cities are the need of the hour.

Climate solution projects also suffer from regulation uncertainty. Cost overruns, delays, and permit risks limit the supply of high-quality climate solution projects. Scarce public funding is directed at subsidizing the fossil fuel industry in many emerging economies.

In Africa, annual climate finance in 2019-20 stood at \$9.4 Bn, while government subsidies for fossil fuels was \$37 Bn. (Climate Policy Initiative, 2022).

7 (a): Athens Urban Resilience Strategy, Greece:

Athens's 2030 Resilience Strategy is supported via a Natural Capital Finance Facility, which includes €5 Mn in financing towards climate adaptation projects to revitalize an urban forest, stabilize water management, create green corridors and squares to lower temperatures, and improve air quality in the face of rising average temperatures. (Redefining the City: Athens Resilience Strategy for 2030)

7 (b): Financing of Municipalities through Private Sources – South Africa and India

In South Africa, the third tier of government has 278 municipalities, out of which eight are metropolitan, 44 are district municipalities and the rest are local municipalities. In the recent period, South Africa has been emphasising on municipal borrowings for financing local governments' capital and developmental expenditure.

Over the last two decades, South Africa has taken various legislative measures to harmonise municipal finances across all the municipalities. Active intervention from the national government through programmes like the Local Government Turnaround Strategy (2009) has improved municipal governance, accountability, service delivery and financial management system.

Municipal bonds issued by South African municipalities do not have provincial or national guarantees. Bondholders take their investment decisions based on the financial health of the issuing municipality. The timely availability of audited accounts and budgetary data of municipalities facilitate the assessment of risk, leading to higher investor confidence. So far, 97 municipalities are engaged in long term borrowings of an equivalent of US\$4.7 billion, out of which around a third has been financed through bond issuances, primarily issued to banks, insurance, and pension funds. Long-term municipalities accounting for 87 per cent of the total outstanding debt. These institutional investors generally hold the bonds till maturity, and the secondary trade is minuscule. South African legislation allows municipal borrowings to fund capital expenditure only.

In India, only a few prominent cities have used bonds as a source of finance. Indore, Lucknow and Ghaziabad raised INR 490 crore (approx \$60 m) via municipal bonds on a private placement basis using the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) bond platforms. Indore became the first municipal corporation to list on the NSE in 2018, while Ghaziabad became the first municipal corporation to issue green bonds in India in 2021. The coupon rates offered by the cities are generally higher than the government bonds of similar maturity, even though they are rated as adequately safe with low credit risk. (RBI, 2022)

8. Need for a national level organisation to promote collaborations

An organisation should be made to promote collaboration among different municipalities/cities. Due to a small ticket size or lack of creditworthiness will help with attracting initial investments, an individual municipality or ULB may be unable to tap large sources of funds like such as multi-lateral banks. But a group of such municipalities or ULBs can raise a single large funding which can further be disbursed for their small individual requirements. Such a national organisation is also important for:

- Developing uniform national policies for climate change
- Defining climate finance to facilitate better comparability
- Ensuring better data collection and uniform reporting of numbers
- Economies of scale for more favourable terms and better cost of funds
- Scaling up of climate finance opportunities for emerging markets and developing economies

9. Data: Critical for Climate Action

Data availability and analysis is essential for effective climate finance strategies. It provides critical information that enables stakeholders to comprehend the extent of the climate crisis, identify investment opportunities, track progress towards goals, and ensure accountability and transparency. Availability of good quality data is also extremely important to build the confidence and trust of investors.

As per SDG Report, 2022, published by United Nations, for 8 of the 17 SDGs, fewer than half of the 193 countries or areas have internationally comparable data from 2015 or later. While Goal 3 (health) and Goal 7 (energy) have the highest data availability (more than 80 per cent of countries have at least one data point since 2015), only around 20 percent of countries have data for Goal 13 (climate action). (UN, 2022). Some of the drawbacks of poor data collection are:

- Inaccurate or incomplete information: Poor data collection can result in inaccurate or incomplete information. This can lead to incorrect decisions and ineffective policies, which can have negative consequences.
- Inability to measure progress: Without accurate data, it is difficult to measure progress towards achieving goals and targets. This can make it challenging to track progress and adjust strategies accordingly.
- Inefficient resource allocation: Poor data collection an lead to inefficient resource allocation. Resources may be directed towards the wrong areas, resulting in wasted time, money, and effort.

- Lack of transparency: Poor data collection can also result in a lack of transparency. Stakeholders may not have access to accurate information, which can erode trust and confidence in institutions and organizations responsible for managing climate finance.
- Difficulty in reporting: Poor data collection can make it challenging to report progress accurately. This can lead to confusion and inconsistency in reporting, making it difficult to compare results across different regions and sectors.

9 (a): Climate SMART Cities Assessment Framework (CSCAF) and Climate Data Observatory (CDoT) under Smart Cities Mission ("SCM") in India

One initiative under SCM was 'Climate SMART Cities Assessment Framework' (CSCAF) was launched to incentivize a holistic, climate responsive development. A first-of-its-kind assessment framework for cities, aimed at creating a green mind-set in cities while they plan and undertake various developmental projects. Further, MoHUA has evolved the CSCAF 2.0 with revised indicators where cities are assessed on climate relevant parameters. It is now framed with 28 diverse indicators across five thematic areas such as Urban Planning, Energy and Green Buildings, Mobility and Air Quality, Water Management and Waste Management.

MoHUA has also developed a Climate Data Observatory (CDoT), a platform that serves as a repository for accurate and frequently updated city climate-specific spatial and non-spatial data that could be used as a decision support system. The observatory would allow decision-makers to visualize trends and analyse data to develop the most efficient strategies. (SCM, n.d.)



Sustainable Development Goals (SDG)

Percentage of countries with available internationally comparable data for each Sustainable Development Goal since 2015 (%)

Source: (UN, 2022)

10. Opportunities and Impact Areas

Climate finance flows in 2019 and 2020 were sector focused, as evidenced in greater flows to energy systems (52%) followed by Transport (26%). Remaining sectors like Building, Infrastructure, Water & Waste constitute the remaining 22% (Climate Policy Initiative, 2022).

To analyse the fund requirement for climate finance, it is very important to identify opportunities in cities as they represent a significant investment opportunity. The International Finance Corporation (IFC) estimates that urban sustainable investment opportunities in six sectors (waste, water, renewable energy, electric vehicles, public transport, green buildings) in emerging markets alone amount to \$29.4 Tn by 2030. (WorldBank I. F., 2019).

The lion's share of the opportunity is in green buildings (\$24.7 Tn), covering both new constructions and retrofits. Improvements in low carbon mobility solutions, driven by public transport infrastructure and the expected surge in electric vehicles, account for \$1 Tn and \$1.6 Tn respectively. The availability and management of water resources is a consistent primary concern for cities, presenting investment potential in cities by region and sector to 2030 a \$1 Tn opportunity in climate-smart water and wastewater management and infrastructure. The regional variations in the size of the investment opportunity by sector reflect both the range in the ambitions of targets set by cities and the differing costs for technologies and implementation. Cities have prioritized sectors for climate-smart investment depending on their size, population, and specific climate, development, and financial considerations (WorldBank I. F., 2019)

A. Waste

The waste management sector is in a unique position to move from being a comparatively minor source of global greenhouse gas (GHG) emissions to becoming a major



contributor to climate change mitigation. Preventing waste and expanding reuse, recycling, and composting programs – that is, aiming for zero waste – is one of the fastest, cheapest, and most effective strategies available for combating climate change (WorldBank I. F., 2019).

The preponderance of fund requirement by East Asia-Pacific among total fund required for addressing the waste management as a focus area for urban sustainability investment opportunity is a clear indicator of opportunities available. Out of total opportunities in waste, investment opportunities worth \$82 Bn are in East Asia-Pacific region, followed by Latin America & Caribbean region for \$37 Bn. (WorldBank I. F., 2019).

Cities can tackle waste emissions in a resource-effective way by adopting a "highest and best use" approach: first reducing waste upstream; then repurposing as much useful finished product as possible; then recycling, composting, and otherwise recovering materials for use; and finally, managing disposal to minimise emissions of any remaining organic matter.

10 (a): Waste Management in San Fernando, Philippines

The gigantic mountain of waste in northern Metro Manila, collapsed in 2001. Soon after, The Ecological Solid Waste Management Act was introduced, a law that seeks to manage Philippine's waste problem by reducing the amount of waste that needs to be disposed in landfills through recycling and composting programs. San Fernando, with 3,05,000 inhabitants, stands out as the city where the implementation of this law has been remarkably successful, achieving a 78% diversion rate for waste from landfill. It is one of the best examples in the field of waste management and it shows how it's possible to apply the principles of the Waste Hierarchy and Zero Waste in the Global South. (Viella, n.d.)





Sustainable investment opportunities in Waste sector by regions in the world

Source: (WorldBank I. F., 2019)

B. Renewable Energy

As per United Nations, energy is at the heart of the climate challenge - and key to the solution. Meeting international climate and development objectives will require a massive re-allocation of capital toward low-carbon technologies, including renewables, and the mobilisation of all available capital sources.

A significant portion of the greenhouse gases that envelop the Earth and retain the sun's warmth is produced by using fossil fuels to generate heat and electricity. Consequently, coal, oil, and gas, which are fossil fuels, are the primary cause of worldwide climate change, responsible for more than 75 percent of global greenhouse gas emissions and almost 90 percent of all carbon dioxide emissions.

Scientific efforts are aimed at preventing the most severe effects of climate change. To accomplish this goal, greenhouse gas emissions must be reduced by nearly 50 percent by 2030 and achieve net-zero by 2050. To accomplish this, we must move away from our dependence on fossil fuels and invest in clean, accessible, affordable, sustainable, and dependable alternative energy sources. Fossil fuels still account for more than 80 percent of global energy production, but cleaner sources of energy are gaining ground. About 29 percent of electricity currently comes from renewable sources. (Action U. N., n.d.)

Of the total investment opportunity worth \$842 Bn, more than 50% is available in East Asia Pacific and Latin America & Caribbean region (WorldBank I. F., 2019). The investment opportunities in renewable energy sector are directly proportionate to the urban population



Sustainable investment opportunities in Renewable energy sector by regions in the world

Source: (WorldBank I. F., 2019)

residing in these regions. Accelerating the transition to clean energy one of the most viable options for climate finance investments, given the following factors:

- Renewable energy sources are all around us: Renewable energy sources are available in all countries, and their potential is yet to be fully harnessed.
- Renewable energy is cheaper: Renewable energy is the cheapest power option in most parts of the world today.
- Renewable energy is healthier: Switching to clean sources of energy, such as wind and solar, thus helps address not only climate change but also air pollution and health.
- Renewable energy creates jobs: Every dollar of investment in renewables creates three times more jobs than in the fossil fuel industry.
- Renewable energy makes economic sense: The reduction of pollution and climate impacts alone could save the world up to \$4.2 Tn per year by 2030. (Action U. N., n.d.)

Cities play a vital role in the fight against climate change by establishing definite decarbonisation targets, combining the demand for renewable energy, encouraging energy efficiency, and transitioning more urban energy consumption to electricity, particularly in transportation and heating. By working together with utilities and regulators, and focusing on speeding up progress, cities have the potential to achieve a grid mix consisting of 50 to 70 percent renewables (specifically, solar and wind, balanced with other zero-emission power sources such as hydro) by 2030, depending on local resource characteristics, as well as the market and regulatory structure.

10 (b): Solar power plant in Samarkand, Uzbekistan

The EBRD co-financed one of the first private-sector renewable energy projects in Uzbekistan, to deliver a photovoltaic solar power plant near Samarkand. The initiative will help diversify Uzbekistan's energy mix, cut emissions and generate more electricity for thousands of inhabitants. The project is integral to Uzbekistan's EBRD-backed strategy to achieve the carbon neutrality of the power sector by 2050. (EBRD, Annual Review, 2021)

C. Transportation

To effectively address climate change with substantive greenhouse gas (GHG) emissions reductions by the transport sector will require fine-tuning transportation climate finance readiness to match growing demand.

Improvements in low carbon mobility solutions, driven by public transport infrastructure and the expected surge in electric vehicles, account for \$1 Tn and \$1.6 Tn respectively. With investment opportunities worth \$281 Bn in the middle east, more than a quarter of the total is required in Public Transportation. Opportunities in Electric Vehicles are worth \$569 Bn or 35% of the total in East Asia Pacific (WorldBank I. F., 2019). The difference is on account of existing situations in both parts of world. ULBs can focus on following broad changes required by transport sector:

- Avoid: Reduce the total volume of transportation activity required by physically locating urban citizens closer to their primary destinations. Optimal compact Transit-oriented development.
- Shift: Shift transportation activity from high-emitting modes (e.g., private vehicles) to modes that emit fewer GHGs per passenger-mile or ton-mile (e.g., active transport such as walking, cycling). Invest in public/mass transit systems Invest in active/non-motorized transportation.
- Improve: Increase the energy efficiency of each mode, or reduce the emissions associated with the use of each unit of energy for a transport mode.

10 (c): E-mobility in Beijing and Egypt

Beijing in China is attracting investment due to its use of smart technologies in transport. Mobike and Ofo are providing urban mobility solutions through dock less bike services, resulting in 50 Mn bike journeys a day and fewer cars on the road. In 2017, the city announced plans to replace its fleet of 70,000 fossil-fuel-powered taxis with electric cars, creating the space for further private investment. City policies are creating the space for companies to innovate and invest.

Egypt, is upgrading an existing rail line with the support of EBRD. Under the EBRD Green Cities programme, the Bank will extend a ≤ 250 Mn loan to co-finance the upgrade of the infrastructure and electrify an existing rail line, making it the first high-capacity metro line in Alexandria. (WorldBank I. F., 2019)

10 (d): Transport oriented development in Suzhou, Chengdu and Harbin in China

This was the first urban transport project in China that focused on public transport development and explicit travel demand management (TDM) interventions simultaneously, through large scale upstream technological assessment and institutional strengthening at both national and local levels, with downstream demonstrations. The objectives of the project were to help to establish a policy framework to alleviate traffic congestion and reduce greenhouse gas emissions in its large cities, primarily through public transport development and travel demand management.

A competitive selection process was launched to select the pilot cities based on the level of public transport development, economic and social development status, geographic location and commitment to success. Suzhou in Jiangsu Province, Chengdu in Sichuan Province, and Harbin in Heilongjiang Province were selected. With a population over \$10 Mn each that was still growing rapidly, the cites suffered from traffic congestion despite significant investment in urban public transport. The project promoted a comprehensive approach and complemented implementation of the public transport metropolises program by developing, piloting and demonstrating TDM strategies and measures, transit-oriented development (TOD), intelligent transport systems (ITS), and advanced public transport systems (APTS). The total project cost was \$121.74 Mn out of which Global Environment Facility (GEF) trust, backed by World Bank funded \$17.61 Mn. GEF grant of \$17.6 Mn resulted in reducing CO2 emissions by 56.6 Mn tons, based on conservative estimates. The GEF contribution per ton of CO2 is \$0.31. The unit cost of CO2 reduced against the total project cost (GEF and counterpart funds) of \$121.7 Mn is US \$2.2 per ton.



Private sector financing was mobilised in Chengdu by the government with a signed MOU for implementing transit-oriented development around Chengdu's urban rail system, which encouraged market participation and improved market readiness. In Harbin, a shared-mobility IT platform was developed under the government's mandate, which included, equity of the taxi and shared-mobility services. (Practice, 2019)

D. Water

The availability and management of water resources is a primary concern for cities to meet the needs of their communities and ensure that they continue to attract private investment from businesses that rely on the resource for their operations, reflecting the \$1 Tn opportunity in climate-smart water. The regional variations due to size of the investment opportunity by sector reflect both the range in the targets set by cities and the differing cost coefficients for technologies and implementation by region.

Maximum opportunities are available in the East Asia Pacific amounting to \$460 Bn out of total requirement of \$1 Tn. In order to attract finance, water projects should address both the aspects of climate mitigation and adaptation.

Regarding mitigation, the usual initiatives focus on decreasing greenhouse gas emissions from water and wastewater treatment facilities. These include efforts to decrease chemical use in water treatment, utilizing methane emissions from wastewater treatment to decrease energy consumption, replacing fossil fuels with renewable energy technologies for energy production, using by-products of wastewater treatment as fertilizers, and reusing industrial water to lessen withdrawals for agriculture.



Sustainable investment opportunities in Public Transportation by regions in the world Source: (WorldBank I. F., 2019)

10 (e): Wastewater management in Jordan

EBRD is improving water supply and modernising wastewater treatment facilities in Jordan with a sovereign loan of \in 30 Mn, co-financed by a \in 30 Mn grant from the EU. Under the EBRD's Municipal Resilience Refugee Response Framework, these funds will enable the Jordanian Ministry of Water and Irrigation to build a modern wastewater treatment plant. This plant will increase the network's capacity to serve households and will be able to reach up to 1 Mn people, including Syrian refugees living in Amman and Zarqa, who are not connected to the mains network. (EBRD, 2021)

10 (f): Egypt - Tackling water scarcity

The Kitchener Drain is one of the most severely polluted drains in Egypt causing significant environmental, economic and social harm. It extends 69 km and passes through the governorates of Kafr El Sheikh, Gharbeya and Dakahleya and discharges into the Mediterranean Sea.

EBRD provided sovereign loan of up to €69 Mn to the Government of Egypt against the total project cost of €96 Mn to finance the drain infrastructure rehabilitation component of the integrated depollution programme of the Kitchener Drain. The non-technical cooperation for the project will be co-financed by an investment grant of up to €9 Mn proposed to be financed by the Neighbourhood Investment Facility (NIF). The Project will improve the hydraulic performance and management of the drain, reduce energy consumption and further reduce the pollution in the Damietta Branch of the Nile River. Additionally, the introduction of a monitoring system will help control the level of pollutants in the water, demonstrating the development of new environmental technologies in Egypt.

The Project also promotes innovative technologies through the development of a pollutant monitoring system, which will enable the enforcement of existing environmental laws and help control the level of pollutants in the water.

This unique project will enhance the quality of water and wastewater services of the Kitchener drain and improved the health and environmental conditions for people living in 182 villages. (EBRD E. B., 2018)



Sustainable investment opportunities in Climate Smart Water by regions in the world Source: (WorldBank I. F., 2019)

E. Green Buildings

World Green Building Council (WGBC) explains green building as a comprehensive building model that minimizes the adverse impacts of residential and commercial buildings on the climate, environment, and its occupants while meeting net-zero emissions target, saves energy, and reduce overall project life-cycle costs significantly.

In developing countries and transition economies, rising populations and increased purchasing power are expected to drive considerable growth in construction and real estate. As building investments grow, energy consumption and CO2 emissions will also rise. These currently account for over a quarter of global CO2 emissions and more than a third of the world's energy consumption. With the global building area likely to double by 2050, energy consumption in buildings is expected to increase by 50 per cent.



Sustainable investment opportunities in Green Buildings by regions in the world Source: (WorldBank I. F., 2019)

In the construction industry, the stages of construction, operation, and demolition of buildings elicit a quantum of carbon emissions which makes the industry one of the biggest contributors to global warming and energy consumption. This phenomenon has led to an emerging and inclusive building model based on the philosophy of constructing buildings that produces a positive impact on the environment and climate. With the advent of new techniques and building technologies, green buildings can revolutionize the industry including existing buildings to the point of being an effective tool for reaching net zero emissions across the logistics and manufacturing chain. And that's not all. Green buildings can spur low-carbon economic growth, generating more than 9 Mn skilled jobs in both the renewables and construction sectors by 2030 (IFC, n.d.).

Green Buildings is one of the biggest investment opportunities of the next decade and the one currently receiving the least attention. There is a requirement of \$24.7 Tn across emerging market cities by 2030 for green buildings with \$16 Tn in East Asia Pacific. The growth of online shopping due to COVID-19, followed by a booming resumption of trade mean that green logistics buildings for e-commerce could be one of the most lucrative businesses post pandemic. Cities can adopt the following strategies:

New net zero buildings - Facilitate widespread design and construction of sustainable buildings by raising access to/use of financing to enable private investments through green mortgages, green bonds, large scale public private partnership framework programs or other structured financing options. **Energy efficiency renovations/ retrofitting** – Focus should be on heating and cooling energy efficiency solutions. Energy upgrades should be enabled in public and private buildings by introducing energy upgrade financing schemes, property assessed clean energy bonds (PACE) or on-bill repayments (OBR).

10 (g): Green Buildings in Romania and India

In Romania, IFC provided a green financing package of approximately €205 Mn for the project in April 2020, the financing is expected to save 12,083 tons of carbon dioxide every year.

In India, Rajkot, 22nd fastest growing city in the world, having population of 1.4 Mn, will require almost \$2 Bn of the investment in green buildings for achieving Rajkot's smart city and affordable housing targets. The city has made it mandatory for residential buildings larger than 150 square meters, hospitals, and other public buildings to install solar water heaters. (WorldBank I. F., 2019)

10 (h): Bulgaria Residential Energy Efficiency Credit Line

European Bank for Reconstruction and Development's (EBRD) Green Economy Transition (GET) approach was aimed to turn green building challenges into solid investment opportunities with clear economic, environmental and social benefits. The first residential Green Energy Finance Facility (GEFF) under GET approach was the Residential Energy Efficiency Credit Line (REECL) in Bulgaria.

REECL provides loans to Bulgarian banks to on-lend to individuals, homeowners' associations, utility companies and energy service companies for energy efficiency and renewable energy improvements in residential buildings. The credit line of over €100 Mn is the result of cooperation between the EBRD, the Bulgarian government and the Kozloduy International Decommissioning Support Fund.

Among the innovative features of REECL is implementation of the demand-side measures by service providers, such as construction and heating companies. Service providers can reach thousands of dwellings with a comprehensive refurbishment delivering higher efficiency and savings. Veolia Energy Bulgaria, a private heating company implemented a project in more than 500 apartment buildings in Varna, Bulgaria. New heating systems, hot and cold-water pipes, water circulation systems, individual water and heat consumption radio meters, and rooftop photovoltaic units have yielded significant benefits for both the residents and the environment. Construction companies implementing building upgrades to energy efficiency class B+ and higher under REECL are issued with energy performance certificates. This approach kick-starts the EPC culture in the country, leading the market towards low carbon buildings and preparing Bulgaria for nearly zero carbon buildings after 2020, as required by the EU. (EBRD, n.d.)

Launched in 2005, REECL has achieved significant outcomes in Bulgaria's carbon-intensive and fragmented residential sector, including annual cost savings of \in 19 Mn, energy savings of 240,132 MWh and reductions of 249,680 tonnes of CO2 equivalent.

11. Role of cities

Conveners and champions for systems thinking:

Cities are spaces where different jurisdictions and layers of government, sectors, and systems (energy, transport, wastewater, health, biodiversity etc, converge and interact to serve city dwellers and businesses. The intersection of these layers and systems presents a host of coordination challenges for managing urban growth and integrating climate-smart objectives for impact. In other words, an urban area is a "system of systems", and city governments can act as critical conveners and champions for systems-level thinking. City government leadership, if well-equipped in terms of capacity and aligned with other regional and national stakeholders, can be in a strong position to drive transformational change to achieve net zero carbon and resilient growth pathways.

City governments can impact climate outcomes by leveraging their roles both as providers of infrastructure and services (what cities pay for) and as stewards (what cities influence) with their capacity to plan, regulate, convene, and champion (Alliance, n.d.). How cities purchase goods and services, provide municipal services, raise financing, regulate private sector activities, and build coalitions of stakeholders that can influence their developmental trajectories significantly. In particular, the ability of city governments to convene stakeholders while aligning optimal urban planning practices, appropriate regulations, and targeted incentives can have systemic impact. These actions can help cities harness private sector and household investment in climate-action that may greatly exceed their current capacity to mobilise local public funds (Alliance, n.d.).

These roles fall along a continuum based on the level of city government agency (i.e., influence, decision making authority and control). The agency that city governments hold can range from 'high' (e.g., a decision to use solar panels for city government owned buildings) to 'low' (e.g., the city as an advocate or participant with national transportation authorities about regional transportation planning and public transit networks that is beyond its remit).Cities are critical 'space and place' to demonstrate systems-level thinking and transformative climate action, because they convene and concentrate multiple sectors, consumers, and actors. Subnational governments undertake multisectoral investments and therefore have potential to think about public functions in a more synergistic way in their territories.

City governments can encourage the directing of finance towards low-carbon and climate resilient investment in urban areas through five main roles: consumer, provider, fundraiser, regulator, and champion of systems thinking:

Consumer: Cities can act as powerful, demand-side influencers, demand aggregators and green bulk procurers. For example, a city government can choose to procure power for their municipal buildings from alternative renewable sources, rather than fossil fuel power sources.

Provider: To the extent that city services or infrastructure falls within their legal mandate and expenditure assignments, city governments may deliver goods and services to residents. Depending on their purview and financing sources, they can ensure that city investments and services are low-carbon and climate resilient.

Fundraiser: To finance their own investment and spending, city governments can raise revenues through the collection of own source revenue. In some cases, and under certain enabling conditions, cities can raise funds from debt through municipal bonds as well as from dedicated municipal trust funds and PPP. In such cases a city government can facilitate or establish green financing instruments that mobilize urban climate finance.

Regulator: City governments act as regulators of urban land use and commerce and are often empowered to regulate specific activities to reduce negative externalities. In addition, city governments can also offer incentives through local policies, regulations, standards, and subsidies to households and businesses to encourage climate-smart spending and investment.

11 (a): Taking Climate Adaptation to the grass roots level in South Africa

'Adaptation Fund' project being implemented under the auspices of the South African National Biodiversity Institute as the South African National Implementing Entity is a step to enable ULBs to tackle climate adaption challenges. A Small Grants Facility was established for enabling local level responses to climate change.

Climate change projections indicated that both the Mopani District, in Limpopo in the northeast of South Africa, and the Namakwa District, in the Northern Cape in the northwest of South Africa, will be subject to increasing temperatures and changing rainfall patterns which are bound to negatively impact communities in both areas. This is a concern as water is already scarce in Namakwa and in parts of Mopani.

The project started in 2015 with a grant amount of \sim \$2.4 Mn and aimed to address this financial, capacity and adaptation need through three main components:

- Providing small grants to vulnerable communities that deliver tangible and sustainable benefits through a suite of interventions that are supported through at least 12 small grants to local level CBOs and NGOs in order of \$100,000 each.
- Supporting local institutions to identify, develop and implement small grant projects in the context of climate change adaptation at all stages of the project cycle.
- Compiling and sharing lessons learned to facilitate future scaling up and replication of small grant-financing approaches.

As per the Project Performance Report (2020), following results were measured:

- All 12 small grant projects are closed.
- The direct beneficiary targets for the number of vulnerable community members with reduced risk to extreme weather were significantly exceeded.
- Significant tangible climate adaptation assets were established, and the communities and local organisations received significantly more capacity building and support than planned. (AdaptationFund, 2019)

Climate Financing Options for Cities

This section talks about standard and innovative ways of climate financing being used by various cities/ULBs across the globe.

1. Standard Financing

Climate financing is a complex and evolving landscape with a range of financing mechanisms and instruments. Cities worldwide have urgent investment needs for climate mitigation, adaptation, and resilience. Globally, climate financing includes both public and private sources.

- Funding provided by governments and multilateral institutions such as the World Bank, International Monetary Fund (IMF), and the Green Climate Fund constitutes Public Finance. It can take the form of grants, concessional loans, and equity investments. Public sources provide the funds at a cheaper rate with favourable terms but are limited.
- Private Finance refers to funding provided by the private sector, including commercial banks, institutional investors, and private equity firms. Private finance can take the form of debt, equity, or guarantees. Private sources have much larger pool of funds but require attractive returns on their part.

1 (a): Agartala City Urban Development Project ("ACUDP") with support of Asian Development Bank (ADB) in India

The ACUDP is aligned with India's Smart City Mission. Agartala is the capital city of Tripura, the 2nd most populous state in the northeastern region of India with a population of 3.67 Mn. Tripura is an agrarian economy with more than 44% of its population depending on agriculture & allied activities while only about 26% of the land is cultivable. Thus, urbanisation of the state is crucial to better utilize its potential. Agartala's proximity to the Bangladesh-Bhutan-India-Nepal economic corridor has made it one of the fastest developing cities in India. The city seeks to establish itself as an economic-commercial hub for northeast India and a city of excellence by alleviating traffic congestion and preserving and promoting its natural and cultural assets. However, the city suffers from infrastructure limitations such as inadequate stormwater drainage, wastewater management, and road networks.

ACUDP aims to make urban areas more liveable, citizen-friendly, sustainable, and resilient. The project entails the implementation of a small grant finance mechanism to address this financial, capacity and adaptation need. It envisages an underground utility corridor, augmentation of the storm water network system, installation of smart energy meters and renewal of emblematic open spaces in the city to achieve the same. The project has a built-in component to increase the capacity of the Agartala Municipal Corporation, and other relevant agencies, on project management and operation and maintenance of urban infrastructure, own-source revenue generation, and climate- and disaster-resilient urban planning and gender-responsive budgeting.

The Tripura Government contributed -\$15 Mn towards the project cost and requested a regular loan of \$61 Mn from ADB ordinary capital resources to help finance the project. Climate adaptation financing of the project is \$8.25 Mn, out of which ADB will finance \$6.62 Mn including \$0.1 Mn. (ADB, 2021)

2. New Trends

Climate Finance is used to aid climate actions. Climate finance is extremely region specific i.e., a solution used to address the problem of water scarcity in one city may not be same in other cities. In addition, factors like NDCs declared by countries, COP Commitments, hard-to-abate emission problems, irregular cash flows from projects and long gestation periods are to be considered. Standard ways, due to their limitations, are not enough to cater to the need of climate finance for each city. Innovation in climate finance is required to address the urgent need for large-scale, sustained investment in low-carbon, climate-resilient infrastructure, and technologies. Innovative financial instruments can help address some of the barriers to investment in climate solutions such as better mobilization, access to more capital, better risk reward ratio. Apart from the ways of funding described above, the following steps can also help act as supporting measures to raising climate finance:

Carbon Markets

Carbon markets provide a financial incentive for reducing GHG emissions. Companies can purchase carbon credits from projects that reduce emissions, such as RE projects or reforestation projects. These credits can be used to meet emissions reduction targets or sold on the open market.

Climate Risk Insurance

Insurance companies are developing products to protect against climate-related risks such as extreme weather events and sea-level rise. These products can provide financial support for climate adaptation measures.

Viability Gap Funding (VGF)

VGF is a type of financial support provided by the government or other public institutions to bridge the gap between the financial viability of a project and the actual costs involved in implementing it. It can be effected through grants, concessional loans, or equity investments.

Financial Mechanism	Details	Implementation by cities/ULBs
Tranche financial instruments	Involves breaking a set of securities into segments by risk, time maturity, or other characteristics so that each tranche is designed to appeal to a different set of investors.	The Climate Investor One fund uses three tranches to allocate risk and make the fund more appealing to commercial investors.
Guarantees/ Insurance	Acts as an insurance policy in guaranteeing a bond or loan will be repaid if the borrower defaults.	The Climate Investor One fund, reduced the risk to the investor in its senior debt tranche by incorporating a guarantee, thereby increasing the field of potential investors, and increasing the potential for commercial investment.
Blended Equity Funds	Concessional equity is a common form of blended finance that can include first-loss equity and equity that bears risk at below-market financial returns.	In the Sub-national Climate Fund Initiative, which is structured as an equity fund, the public financial institution absorbs the brunt of potential losses, increasing the appeal of the investment to commercial investors.
Municipal Trusts	Third-party organizations can manage and invest funds for a set purpose, such as climate-resilient projects or investments.	The RAMCC trust, provides an example of this aggregation. With buy-in from multiple public trustors, trusts can both provide 'first loss' capital to attract commercial investors via blended finance.
Green Bonds	An asset-linked instrument that raises a set amount of money from investors that is earmarked for climate and environmental projects and can be used in both demand- and supply-side aggregation.	The Cape Town Green Bond case study shows that how by issuing a green bond, a city can raise funding via one instrument for multiple climate projects, some of which may be too small to raise funding individually.
Special purpose vehicles (SPVs)	A subsidiary created by a parent entity to isolate financial risk, as it operates under a separate legal status and its financial obligations are secure, regardless of the financial state of the parent entity.	The local municipal water utilities in Veneto, Italy, created an SPV in 2014. based on future revenues to raise secure and attract funds for climate projects.
Joint Procurement	Combining the purchasing power of two or more parties, under a single agreement on behalf of all involved parties.	This is a technique used by the RAMCC. Cities with similar equipment needs can join and pool purchasing power to ensure better products at a lower cost by buying in bulk.

Various Climate Financing Options Source: Author compilation Below are some instances where innovative ways have been used to provide climate finance.

2 (a): Climate Investor One

A blended finance facility was developed to finance wind, solar, and hydro projects in low and lower middle-income countries. The fund employs a mix of public and private-sector financing as well as commitments from DFIs and incorporating an export credit agency guarantee. Major contributors include the European Commission, the Green Climate Fund, USAID, the Nordic Development Fund and the Ministry of Foreign Affairs of the Netherlands. The overall fund consists of three stages:

A development fund, funded by donor contributions that finance up to 50% of development costs for projects by private sector developers, with the aim of improving a project's bankability from an early stage.

A construction fund, which provides up to 75% of investment costs on commercial terms. This fund has three different tranches to appeal to different risk and return positions, and the Senior Fixed Rate tranche incorporates a guarantee to reduce risk further.

A re-financing fund, which has right of first refusal on up to 50% of the long-term refinanced debt of products after they've proven commercial viability. This consists of investors seeking long-term, de-risked infrastructure debt to attract new investors to clean energy projects in developing countries.

Climate Investor One announced first close at \$412 Mn in June 2017. The initiative covers 18 countries in total across Africa, Latin America and Asia-Pacific. (Nicole Pinko, 2022)

2 (b): Sub-National Climate Finance Initiative

The Sub-National Climate Finance Initiative (SCF) was designed as a tranched finance fund to overcome project-level barriers to attract private investment in subnational climate adaptation and mitigation projects. The consortium has so far secured support from 42 emerging countries registered to the GCF. Using supply-side aggregation and structured as an equity fund, the initiative will use \$150 Mn in approved funding from the Green Climate Fund as a first-loss tranche to mobilize an estimated \$600 Mn in commercial investment from a consortium of private-sector partners, focusing on urban infrastructure projects. Aggregating concessional and commercial funding at this scale into a blended finance instrument will enable SCF to quickly evaluate and execute investment opportunities in individual small to midsize projects that contribute meaningfully to the UN Sustainable Development Goals, rather than needing to arrange separate financing for these projects on a case-by-case basis. In addition, the fund includes a \$28 Mn grant funded technical assistance facility managed by the International Union for Conservation of Nature (IUCN), through which the IUCN will provide technical assistance to identify suitable projects for investment. This technical assistance will enable more efficient aggregation and deployment of investor capital within the instrument's commercial fund structure. (Nicole Pinko, 2022)

2 (c): Cape Town Green Bond

In 2017, the City of Cape Town, South Africa issued a \$83 Mn green bond, marking two firsts: the issue was the first externally certified green bond to be listed on the Johannesburg Stock Exchange, and the first to be issued by a South African municipality. The use-of-proceeds bond carries a 10-year maturity, pays a coupon of 10.17%, and was certified by the Climate Bonds Initiative. Proceeds of the bond were used to refinance multiple municipal water projects within the city's capital program that were already under construction or in operation, including water capture, storage, and distribution infrastructure; flood defences; and alternative water treatment plants. By aggregating the multiple water projects into a single financial vehicle, the city was able to secure financing that may have been unavailable to smaller projects. The bond is a prime example of how both supply-side and demand-side aggregation can unlock more affordable long-term financing for creditworthy subnational borrowers. By refinancing several existing projects using one debt instrument, Cape Town was able to pool risk across multiple assets throughout the construction and operational phases via demand-side aggregation, while also accessing a broader market of investors by publicly issuing the bond on the Johannesburg Stock Exchange via supply-side aggregation. This built-in combination of risk mitigation, accessibility, and liquidity allowed the city government to issue the bond at a relatively low interest rate, and the issuance was four times oversubscribed, confirming the appetite of local and global investors to invest in green cities initiatives when they are properly developed and vetted (Nicole Pinko, 2022)

2 (d): Fannie Mae's Green MBS

Fannie Mae is a government-sponsored enterprise (GSE) of USA that purchases mortgage loans from smaller banks or credit unions and guarantees, or backs, these loans on the mortgage market for borrowers. Fannie Mae's Green MBS (mortgage-backed security) program is an eco-friendly lending platform designed to encourage investors to support the purchase of more environmentally friendly homes on the secondary market.

Introduced in 2020 to commemorate the 50th anniversary of Earth Day, Fannie Mae's Green MBS program - offered in the form of either a home purchase or mortgage refinance loan - helps provide innovative green financing options. Part of the organization's efforts to promote more environmental-, social-, and governance-focused solutions, it helps drive uptake in loans on properties that opt to incorporate greener technologies and upgrades as part of their construction. For example: Real estate that adopts ENERGY STAR standards (more energy-efficient residences), meets green building certifications, and is otherwise built or crafted with an eye toward eco-consciousness. (Nicole Pinko, 2022)

2 (e): Emerging Africa Infrastructure Fund

While it is a conventional infrastructure fund backed by the combined finance of major bilateral development banks, the Emerging Africa Infrastructure Fund nonetheless demonstrates the benefits of financial aggregation for cities climate finance, and specifically for urban critical infrastructure projects. The fund is a mix of government, development finance institutions (DFIs), and private investment. As of 2021, the fund had over \$1 Bn in capital in a mix of equity and debt finance. The fund invests in projects across Africa and the Middle East in eight crucial sectors: affordable housing, energy, telecom, water and waste, infrastructure components, gas transport and storage, transportation, agribusiness, and mining. This broad investment scope enables the fund to commit capital to a diverse array of projects, mitigating sectoral risks that would arise in a fund solely committed to one sector or project type. The fund's flexibility to invest in many types of projects also helps it prioritize projects in many areas of need, with the option to bundle these projects into a single financial vehicle to drive the construction of important urban infrastructure while offering its investors - a mix of public and private funders - exposure to a variety of industries and infrastructure types, including many assets serving the needs of large urban areas. (Nicole Pinko, 2022)

2 (f): Argentinian Network of Municipalities Facing Climate Change

Red Argentina de Municipios Frente al Cambio Climatico, or RAMCC, is a coalition of 250 Argentine municipalities that work under an executive secretariat to coordinate and promote strategic plans to address climate change. The RAMCC regularly facilitates both supply- and demand-side aggregation tools to secure financing and equipment for the municipalities under its purview. The RAMCC Trust, which pools funds from 21 local municipalities, aims to leverage city funds to attract additional financing from international public and philanthropic sources in order to execute joint climate projects or programs at a subnational level across member municipalities. Trust-funded projects are intended to promote economies of scale and networking to deliver the best opportunities and resources to the involved municipalities, and typically utilize both supplyand demand-size aggregation vehicles. While the 21 involved municipalities' annual contributions is a key source of funding for the trust, third party contributions assist in large-scale projects and equipment that benefit multiple cities and projects. (Nicole Pinko, 2022)

Key Drivers for Action

There is a need to identify prudent action areas taking into account financial markets, to increase and diversify climate finance. Two types of actions can be taken:



Short Term Action: Immediate actions can be taken to catalyse change towards a sustainable future

Long Term Action: Some crucial action areas need to be undertaken over a larger period

1. Streamlining climate finance for cities



Assessing Vulnerability

The first step is to conduct a comprehensive hazard vulnerability and risk assessment (HVRA) to understand the risks and vulnerabilities that the city faces due to climate change. Understanding the specific context of each city and planning accordingly will help pigeonhole climate mitigation efforts to do more with less. This can involve addressing a range of factors, such as rising sea levels, extreme weather events, water scarcity, and more. This assessment will provide a clear picture of the risks and help identify the most critical areas for action.

Assessing vulnerability of ULBs is important because:

- Planning: Assessing the vulnerability of ULBs can help in developing long-term planning strategies that consider the challenges and risks faced by these entities. This can help in building resilience and improving the overall functioning of ULBs.
- Disaster management: ULBs are the first responders and at the forefront of managing disasters such as floods, earthquakes, and epidemics. Assessing their vulnerability can help in identifying the areas that need urgent attention and investment.
- Resource allocation: Vulnerability assessment can help in identifying the gaps in resources and infrastructure that are required to strengthen ULBs.

Risk reduction: By identifying potential risks and challenges, the HVRA can help in developing strategies to mitigate or reduce the impact of such risks. This can help in ensuring the continuity of essential services during crises.



Building Institutional Capability

Capacity building is important for developing the knowledge and skills necessary to facilitate the flow of climate finance. This initiative should be spearheaded on a national level. Institutions should invest in training programs and technical assistance to build capacity in financial management, project development, and risk management. There is a need for a Vision and Framework at National, State and City level.

1 (a): Climate Investment Funds (CIF)

Established in 2008, the CIF is a funding mechanism created to support developing countries in their efforts to mitigate and adapt to climate change. The CIF has built institutional capacity for climate finance through its programs, including the Clean Technology Fund (CTF) and the Strategic Climate Fund. (CIF, n.d.)

1 (b): Training programs in Germany and Spain

Germany and Spain have established public sector training programs focused on transitioning workers away from legacy power sources like coal, towards new energy jobs. Additional private investment in smart-grid technologies can cut costs and facilitate decentralized energy systems and will also require another set of expertise for workers trained in digital technology. (Klein, 2021)



Streamlining support at multiple levels

Multilateral Development Banks have a global perspective with sustainable ideologies. They can thus continue to innovate funds and implement them through bespoke instruments.

National governments can help provide necessary funding and relay relevant guidance at the grassroot level.

ULBs must ensure accountability, transparency, and traceability throughout the implementation of climate adaption solutions and the results thereafter to help grow the confidence in financial investors and attract further investments.

Taxonomy- Enhancing accountability, transparency, and traceability

There is a need to be mindful while making investment decisions regarding climate finance. Investors must avoid being trapped by greenwashed opportunities which make fictious claims about the environmental benefits they bring to the table and the climate problems they propose to resolve. A clear green taxonomy for all market participants will not only help mitigate the peril of greenwashing, but also diminish ambiguity by providing well defined definitions for climate action related activities which can serve as a benchmark.

Some taxonomies used by different countries to identify sustainable/ green projects are given below.

Taxonomical framework

As part of the taxonomical structure, national governments can mandate environment and climate action related disclosures. Broad requirements can be framed at a global level and can be further detailed out by nations to address their specific requirements in form of frameworks. These disclosures or frameworks can be introduced as a voluntary measure initially which can later be mandated to ensure smooth transition.

The Next Generation EU Green Bond:

These are issued by the European Commission. It is based on the International Capital Market Association (ICMA) green bond principles. NGEU green bonds will finance and refinance eligible green expenditure which includes, green transition - R&D, green transition digital technologies, energy efficiency, clean energy, climate change adaptation, water supply & waste, clean transport & infrastructure. Besides this, nature protection, rehabilitation and biodiversity that are enabling activities indirectly leading to GHG reductions. This framework requires that issuers provide detailed information on the environmental impact of the projects financed by the bonds. This includes reporting on the estimated carbon emissions to be avoided or reduced by the project, as well as other environmental benefits such as improvements to water quality or biodiversity. The EU also requires that issuers provide ongoing updates on the environmental performance of the projects.

Framework for Sovereign Green Bonds (Government of India):

The framework is designed to comply with four components and key recommendations of the International Capital Market Association (ICMA) Green Bond Principles (2021). A 'green project' classification is based on the following principles:

- Encourages energy efficiency in resource utilization
- Reduces carbon emissions and greenhouse gases
- Promotes climate resilience and/or adaptation
- Values and improves natural ecosystems and biodiversity especially in accordance with SDG principles

Eligible Category of Projects and the SDGs impacted are Renewable Energy, Energy Efficiency, Clean Transportation. Climate Chanae Adaptation. Sustainable Water and Waste Management, Pollution prevention and control, Green Building, Sustainable Management of Living Natural Resources and Land Use and Terrestrial and Aquatic Biodiversity Conservation Government of India commits to providing investors with transparent reporting on the allocation of proceeds of Sovereign Green Bonds as well as on the environmental impact of projects funded by the proceeds. The annual allocation report is expected to consist of the following:

- Information about issuance
- List of allocated proceeds to eligible projects and type of expenditure (tax, subsidies etc.)
- Alignment of the eligible procedures with stated objectives
- Description of projects financed and their status of implementation,
- Total quantum of proceeds generated, allocated and remaining unallocated (if any)
- Assumptions made, if any

Expected impact of the projects in quantitative indicators (to the extent possible) indicating reduction in carbon intensity, other environmental benefits and, where possible, social co-benefits. (DEA, 2022)Certain other existing taxonomies for green bonds and climate bonds across nations have been detailed below:

S. No.	Name of Organization	Details
1	European Commission- EU	The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities.
		The EU taxonomy aims at defining which economic activities can be considered as sustainable as per European legislation. The definition of sustainability includes social elements on top of environmental objectives. The six environmental objectives identified for the taxonomy are:
		1. Climate change mitigation
		2. Climate change adaptation
		3. Sustainable use and protection of water and marine resources
		4. Transition to a circular economy
		5. Pollution prevention and control
		6. Protection and restoration of biodiversity and ecosystems.
		For an economic activity to be considered taxonomy-compliant, it must: contribute substantially to one or more of the environmental objectives. Do no significant harm to any other environmental objective and comply with minimum social safeguards (OECD Guidelines, UN Guiding Principles, International labour organisation's declaration on Fundamental Rights and Principles at Work). (European Commission, 2020).
2	The Green Bond Endorsed Project	The 2019 Industry Catalogue identifies a concise list of industries considered green in China. It lists the categories in a three-level structure where:
	Catalogue (2021) and Green Industry Guidance Catalogue (2019), China	 Level 1 includes six broad categories: energy conservation and environmental protection sectors, clean manufacturing sectors, clean energy sectors, ecological environment sectors, green upgrade of infrastructures, and green services.
		Level 2 covers 30 categories.
		Level 3 lists 211 categories
		The 2021 Project Catalogue stipulates an exhaustive list of eligible projects for green bonds in China, envisioning green bonds' support in improving the environment, addressing climate change, saving and efficiently utilizing resources, etc. The 2021 Project Catalogue also does not compare the level of "greenness" of different projects. All projects included are considered green, if they meet the conditions set out in their respective descriptive explanation in the catalogue. (Bank of China, 2021)
3	Climate Change and Principle-based Taxonomy, 2019, Malaysia	Malaysia's taxonomy is principally designed for financial institutions to classify the assets in their lending and investment portfolios, measure climate-related risks and exposure, and report to BNM, for internal risk management and supervisory purposes. The taxonomy does not provide an exhaustive list of green activities or projects but provides a framework for financial institutions to classify their assets into categories
	related to climate transition. The level of climate-friendliness ranges from category C1 ("climate supporting") to C2 and C3 ("transitioning") to C4 and C5 ("watchlist"). While the framework does not provide quantitative thresholds like the EU Taxonomy or qualitative descriptions like China's catalogue, it provides additional lists of examples of economic activities that are generally regarded as contributing to CCM and CCA. (CentralBankofMalaysia, 2021)	

Climate Taxonomy of different Countries

Source: Author compilation

Countries/ Framework	Description
United States' Climate Bonds Initiative and the International Capital Market Association (ICMA)	These standards outline the types of projects that are eligible for financing, but issuers have more flexibility in terms of reporting requirements and disclosure.
China's green bond framework	More prescriptive than other frameworks, with detailed guidelines on the types of projects that are eligible for financing. For example, the framework includes specific requirements for renewable energy projects and energy efficiency projects. Issuers must also disclose information on the environmental impact of the projects and provide ongoing updates on their performance.
Japan's green bond framework	Includes requirements for both the use of proceeds and reporting on environmental impact. Issuers must provide ongoing updates on the environmental performance of the projects and are required to obtain third-party verification of their environmental reporting.

Climate Bonds of different Countries

Source: Author compilation



Ensuring Transparency & accelerating change through technology

Technology can be harnessed to accelerate climate finance. It can help drive efficiency by nurturing transparency and increasing access to financial transactions and data. Availability of adequate, functional data will also aid analytical endeavours in this direction leading to deliberate innovation.

Real time monitoring of data is one of the best ways for climate adaption for cities. Timely response to climate linked disasters can help avoid loss of life. Data availability would reduce perceived uncertainty thereby also attracting investors.

Artificial intelligence can help all parties prevent climate risks and discover opportunities. Big data analytics can be utilised to derive insights from these identified risks and opportunities apart from adding accountability to the process by tracking performance.

Other novel technologies such as blockchain can also be utilised to build a transparent framework through a decentralized ledger for recording and verifying transactions.

2. City readiness

City infrastructure is particularly susceptible to extreme weather events such as heat waves, flooding, storms etc. Thus, making cities ready to tackle climate change is a crucial step. Furthermore, readiness of cities towards climate adaption would make them a more viable funding option. Cities can aim for the following to ensure appropriate readiness:



A city level Climate Action Plan with a clear roadmap broken into individual milestones, will not only aid the planning process but also induce confidence in investors.

Developing partnerships with the private sector can help cities leverage their technical expertise and innovation. Municipalities can engage with private players having expertise to execute climate action projects. Such support from private sector can also help in credit enhancement for the project and thereby making it easier to get the required funding. Some ways in which private financing for climate action can be increased:

- Carbon pricing: Mechanisms such as carbon taxes or cap-and-trade systems, can incentivise private sector investment in low-carbon technologies and practices. This can also help to reduce emissions by making it more expensive to continue emitting greenhouse gases.
- Green bonds: Green bonds are a type of fixed-income security that is specifically designed to finance climate and environmental projects. These bonds are issued by governments, companies, and other organizations, and have grown rapidly in recent years, reaching a record \$269.5 Bn in issuance in 2020. (CBI C. B., 2021)

- Climate-focused venture capital: Venture capital firms that focus on investing in climate solutions have emerged as an important source of private financing for climate action. These firms invest in start-ups and early-stage companies that are developing innovative solutions to climate challenges, such as renewable energy technologies or carbon capture and storage.
- Public-private partnerships: Private institutions should position themselves to work more proactively with city governments and providers of risk coverage to identify workable solutions from an early stage. Public-private partnerships, can leverage private sector resources and expertise to support climate action and explore a range of financing mechanisms, including grants, concessional loans, and equity investments.



Behavioural change is essential to tackling climate change. The choices we make in our day to day lives as individuals, communities and societies impact the environment and can either contribute to or minimise climate change impacts.

Educating and spreading awareness about climate actions is extremely important to build a climate conscious society. ULBs can conduct events and roadshows to spread awareness of their projects being undertaken.

Measures should be taken to foster sustainable business practices. Businesses can adopt sustainable practices across their value chain, such as reducing energy consumption, reducing waste, and investing in renewable energy.

Consumers can choose to support companies that prioritize sustainability and climate action, and boycott those that do not. This can encourage companies to adopt more environmentally friendly practices and reduce their carbon footprint.

Cities can make people more aware by providing necessary data to make an informed decision.

A climate responsible population can also participate more directly in climate financing arena by contributing to crowdfunding of climate conscious projects.

2 (a): Athens Urban Resilience Strategy, Greece

The City of Athens, with around 700,000 residents and part of a 3.75 Mn people metropolis, was for several years facing a serious socio-economic crisis. Boosting the city's resilience meant creating new as well as revitalizing existing open and green public spaces. This is vital for a densely built and populated city, threatened by both intense heat (climate change) and earthquakes. The city has made significant efforts to expand welfare services and provide citizens with critical relief - food, shelter, childcare, and healthcare services - but this has strained city resources. Over 30% of buildings in the city were constructed before the first building code for earthquake protection.

In 2018, the European Investment Bank signed a €55 Mn loan to support Athens's 2030 Resilience Strategy via a Natural Capital Finance Facility. The Facility's focus is broader than climate change but includes elements that focus on climate change adaptation. These include €5 Mn from the Facility towards climate adaptation projects to revitalise an urban forest, stabilize water management, create green corridors and squares to lower temperatures, and improve air quality.

In response, the city undertook a large urban regeneration plan, which will provide long-term risk management for climate shocks. The goal was to turn challenges into resources (vacant buildings, newly arrived refugee and migrant populations, energy and waste). Funds required for implementing this strategy included private donors, municipal funds, PPP models, green funds, private donors, structural funds, European Funding and Bloomberg Philanthropies. (Redefining the City: Athens Resilience Strategy for 2030)

3. Climate finance facilitation



National Climate Organisation

While there has been discussion around climate financing at a global level, it is imperative that countries work towards climate financing on a national level. There is a need for the creation of a National Climate Organisation (NCO) that can serve as a policy lighthouse to guide actions at the grassroot level. The primary responsibility of the NCO will be to design climate impact policy, enable climate finance at the grassroot level and monitor progress at city level.
NCO can also be supported through national climate funds and national development banks which can extend necessary funding support. These funds can be pioneered for specifically identified actions and dedicated focus areas

A Centre of excellence for Public and Private partnership can also be developed which can complement the NCO in its efforts to promote collaboration. Further, tying up with educational and vocational institutions can aid in promoting NCO's objectives.

Funding requirement of various municipalities/ULBs can be aggregated to reach out to a larger pool of funds such as MDBs, World Bank etc. A nodal agency like NCO can help to negotiate better terms as compared to the terms without such agency.

A knowledge database can help municipalities benefit from experiences of other municipalities within the same country and across globe.



Standardisation of processes

Creation of standard mechanisms for project inception, appraisal, implementation and real time monitoring through modern technological solutions. This will help the implementing agencies steer away from cost overruns while producing more stable cash flows conducive to acquisition of requisite funding. Evolving rating systems for cities based on their level of urbanisation, climate adaptation, policy support and financial reporting and management can act as a metric to benchmark progress for all stakeholders including financiers.

Taking corrective actions towards barriers to climate financing i.e., simplifying the regulatory frameworks, aiding projects achieve secure and predictable revenue streams is also necessary.





Championing 'Local' Culture and Economy

Championing 'Local' Clulture and Economy

74

Abstract



In an ever-globalising world, strengthening local identities, practices and economies can provide substantial benefits for long term economic resilience (particularly in times of global downturns and pandemic events). Thinking locally also helps leverage traditional place-specific knowledge about sustainable building design, resource conservation practices, approaches to disaster management and other challenges. The push for local will have to be made on several fronts such as reinforcing the 'sense of place', local economic development, boosting cultural and creative economies, protection of historic city fabrics and socio-economic networks, etc. In fact, locally developed frugal innovations can potentially provide cost-efficient solutions to many urban needs. Governments, industry and non-profit sectors have to create conducive policy environment for encouraging local practices and managing cultural assets. India's Prime Minister made the clarion call to be 'Vocal for Local'. U20 can recommend a robust framework for re-positioning the 'local' within urban development.

This background research examines the efforts of cities from the G20 countries to understand the different aspects involved in successfully facilitating the growth and sustenance of cultural and creative economies, protecting tangible and intangible heritage, and encouraging overall local economic development.

Re-Infusing the 'Local' Within Urban Development

Globally there is an increasing trend to include attributes such as cultural vitality, urban experience, local talent and human capital, innovation and sustainability in determining the liveability and attractiveness of cities. These attributes are considered critical not only from the point of view of attracting new talent and investments but also from a resilience perspective. Unique local identities, heritage, and culture can significantly impact urban settings, economic stability, socio-cultural values of the community, and help to foster a sense of pride and belongingness amongst residents.

Local cultural and creative economies therefore play a seminal role, both in preserving local built environment, cultural heritage and architecture, and boosting economic growth by generating new jobs, innovative products, services and urban experiences. Importantly, the creative economy is also contributing to Sustainable Development Goals (SDGs) in multiple ways, especially to Goals 1 (no poverty), 5 (gender equality), 8 (decent work and economic growth), 9 (industry, innovation, and infrastructure), 10 (reduced inequalities), 11 (sustainable cities), 12 (sustainable consumption and production patterns), 16 (peaceful and inclusive societies) and 17 (means of implementation and global partnerships) (United Nations, 2022).

Creative and cultural economies thus refer to industries involved with the creation, production, distribution, and exhibition of creative and cultural goods and services such as the arts, crafts, music, film, television, publishing, digital media, fashion, and design. Such economies are also closely linked with the "knowledge economy," a key driver of investments in human capital. The rise of digital technologies has led to new opportunities for creators and cultural entrepreneurs to reach global audiences and this has further intensified the vitality and reach of such economies.

Frugal innovation, stemming from local resourcefulness and creativity in the face of limited resources and unique 'place-specific' challenges, is another important aspect to consider when thinking about local identity. Recognising and facilitating such frugal innovation can lead to development of unique and contextual solutions to urban issues, creation of new businesses and also contribute to strengthening of local communities since it often involves community actors as innovators. Combining frugal innovation principles with creativity and cultural elements can provide unique and culturally rich experiences. For example, a low-cost music studio or a platform that uses local resources and incorporates local cultural elements, and creates a unique and affordable solution that serves practical and cultural needs.

The contribution of cultural and creative industries to the world economy is substantial. The cultural sector accounts for 3.1 percent of the global gross domestic product (GDP). The United Nations Conference on Trade and Development (UNCTAD, 2022) estimates that in 2020, creative goods and services represented 3 and 21 percent of total merchandise and services exports, respectively. In addition, cultural and creative industries provide 6.2 percent of all employment, generating nearly 50 million jobs worldwide, and employ more young people (15-29 years) than other sectors.

Key Facts and Figures

- 3.1% of global Gross Domestic Product (GDP)
- 3% of total global merchandise

- 21% of total global services exports
- 6.2% of all global employment
- 50 million jobs worldwide

Despite the role played by culture and creativity in sustainable development, (through adaptive re-use of heritage buildings, better use of local resources thereby reducing carbon footprint, fostering of public spaces, integration of people with greens, etc.), the sector remains largely under invested. At the international level, the proportion of official development aid allocated to culture and recreation accounts for only 0.23%. Moreover, the contributions to the International Fund for Cultural Diversity have decreased in recent years. Furthermore, the transformative power of culture and creativity to raise awareness, accelerate and localise climate action and shift towards more sustainable models is not well-recognised. Acknowledging the key role such economies play in improving urban resilience, can open up substantial avenues for funding and knowledge support to such economies. It must also be recognised that a substantial proportion of the creative sector operates informally and through organic and vulnerable networks. This leads to a lack of reliable data, making it difficult to estimate the economic contribution and employment potential of the sector and hindering the design of appropriate policy frameworks for supporting such economies.

UNESCO has recommended the following key enablers for fostering cultural and creative industries and mainstreaming them into the city economy: i) Quality urban infrastructure and good quality of life, ii) Skills, talent, and a capacity to innovate, iii) Social networks that can act as creative catalysers coupled with technical and financial support, iv) Regulatory support such as protection of intellectual property rights, v) Diverse cultural resources and cultural infrastructure, and vi) Digital infrastructure and connectivity to expand reach beyond the local geographical sphere of influence.

Various international conventions have foregrounded the importance of this aspect and instituted global frameworks for working with cultural economies and heritage. During the Convention Concerning the Protection of the World Cultural and Natural Heritage held in 1972, the Member States of UNESCO approved the World Heritage Convention to secure the correct identification, protection, conservation, and presentation and transmission of the world's heritage to future generations. The Convention called for forming a "World Heritage Committee" and a "World Heritage Fund", which have been in operation and supported initiatives in a number of cities. The 2005 UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions was a milestone in international cultural policy, recognizing the need to maintain, adopt and implement policies to protect and promote the diversity of cultural expression, both nationally and internationally. The Convention supported governments and civil society in finding policy solutions for emerging challenges,

GOVERNANCE FOR CULTURE	FLOWS AND MOBILITY	SUSTAINABLE DEVELOPMENT	HUMAN RIGHTS
Policies measures for informed, transparent and participatory systems of governance for culture.	A balanced flow of cultural goods and services, ensuring global mobility of artists and cultural professionals.	Sustainable development policies and assistance integrate culture as a strategic dimension.	Human rights legislation to promote artistic freedom and artists' social and economic rights.

The UNESCO 2005 Convention Framework

Source: The 2005 Convention on the Protection and Promotion of the Diversity of Cultural Expressions

recommended a governance structure for culture and set out a monitoring framework for various overarching goals (along with expected results, monitoring areas, core indicators and means of verification). UNESCO has also outlined the Historic Urban Landscape (UNESCO, 2011), which talks about the policy, governance, and management issues of historic cities/quarters that affect a wide range of stakeholders in the development process.

The integration of culture in the 2030 Agenda for Sustainable Development adopted in 2015 as well as the New Urban Agenda (UN Habitat) are landmark events. UNESCO has developed the Culture 2030 Indicators "whose purpose is to measure and monitor the progress of culture's enabling contribution to the national and local implementation of the Goals and Targets of the 2030 Agenda for Sustainable Development"(UNESCO). The European Union has collaborated with UNESCO to support the roll-out of the Culture 2030 Indicators in six countries and set up an Expert Facility on the Governance of Culture. The Facility's pool of international experts provides on-demand technical assistance (policy advice, skills training and knowledge sharing) to create sustainable regulatory environments for the cultural and creative industries in 12 developing countries and foster South-South cooperation. The past few decades have also seen an increased interest in the culture and

creativity sector from multilateral organisations. This is encouraging, even though at present they provide only half of the funding in developing countries invested by the private sector (UNESCO, 2022).

Building upon the platform created by such global frameworks, a concerted effort will be required to protect cultural assets and economies and promote local identities in all relevant spheres such as renewal of traditional settlements/ historic inner-city areas, adaptive reuse of the built heritage assets and promoting tourism as well as local economic development. It will also be critical to ensure that the approach towards fostering creative industries is place-specific and inclusive and respects the rights and needs of all community members, including marginalized groups. Numerous efforts have been made globally to create enabling frameworks for supporting cultural and creative economies, and preserving tangible and intangible local heritage. This paper documents typological case studies where state/city level strategies have been adopted in this regard.

Case Studies of Initiatives

1 (a): London, UK - A Global Centre for Creative and Cultural Industries

London has established itself as a major global centre for the creative and cultural industries, which significantly contribute to the city's economy. Following are some key highlights:

- £ 10 million is generated every hour by the creative industries.
- One of every six jobs in London are in the creative economy.
- £ 52 billion contributed by culture and creativity to London's economy annually (Greater London Authority, 2023).

The productivity of the creative industries in London (estimated at £ 71,100 on a GVA per workforce job basis) was 25 per cent higher than the average across all sectors of the London economy (estimated at £ 56,700 in 2012). London's creative industries are also more productive than the average for creative industries across the UK. Organisations operating in the creative economy are important employers in London. In 2014, there were 795,800 jobs in the creative economy in London, equivalent to 16.3 per cent of total jobs in the capital (compared to 7.4 per cent of the total number of jobs in the Rest of the UK) (GLA Economics, 2015).

To strengthen its cultural identity, maintain a competitive edge for investments and retain its advantage as the leader in promoting creative and cultural industries, several initiatives have been taken by the national government, the Mayor of the city and civil society. Investment in creating venues like libraries, theatres, and art centres alongside structures such as skateparks, enabling people to experience and participate in cultural activities, is the central strategy to complement a thriving creative economy (Mayor of London; London Assembly, 2023). Such investments have direct advantages to the city-wide economy and have a cascading impact on the creative industries supply chain in generating financial gains and employment (Greater London Authority, 2019).

The Mayor of London launched the first ever Creative Enterprise Zones (CEZs) as part of an initiative to support artists and creative businesses while developing skills and jobs for Londoners. Nine such CEZs are planned across the city.

- Croydon (Croydon Creatives): Strives to develop itself as a 'music city' and encourage young people into creative careers. Features include cultural internships at London Living Wage with national and leading arts organisations, subsidised workspaces for artists, creative career roadshows in local secondary schools, etc.
- Haringey (Made by Tottenham): South Tottenham Employment Area celebrates and builds on the borough's rich manufacturing and maker heritage by supporting fashion, furniture and small scale manufacturing industries. Other features include conversion of council-owned assets into native workspaces and a Warehouse Living Policy that encourages establishment of artistic communities.
- Hounslow (Great West Creatives): Builds on the area's reputation as a leader in TV and film production. The focus is on strengthening networks, engaging multi-national media companies, work closely with local creative and digital companies to boost opportunities. Other features include use of council assets to unlock new affordable work, production and studio spaces.
- Lambeth: Located in Brixton, this CEZ is supporting the development of the area as creative tech and digital hub by facilitating affordable creative production spaces, building a world-class business support system and improving availability of jobs for local creative talent.
- Lewisham (SHAPES): Focus is on retaining graduate talent educated in the Burrough's renowned institutions to grow its creative economy and increase affordable creative space. Local high streets are being converted into cultural hubs through use of identified council assets.
- Hammersmith & Fulham: Working towards establishing a brand-new 'Made in Hammersmith and Fulham' hub by providing support, skills and training of local makers and creative entrepreneurs.
- Ealing: Focus is on increasing creative employment opportunities through a targeted skilling programme and facilitation of small grants to develop community spaces through murals and

public art installations.

- Blackhorse Lane (Waltham Forest): Aim is to offer a first-class creative curriculum for nurturing creative talent and becoming London's leading provider of skills. Features include creation of a 15-minute neighbourhood and cultural destination at Blackhorse Lane, and improved connectivity between education providers and the local business community.
- Tower Hamlets and Hackney (Hackney Wick and Fish Island): Protect one of the world's most recognisable artistic hubs by providing training and business support for local people, facilitating internships, apprenticeships and freelance creative work.

Collectively, the nine CEZs will leverage \pounds 30 million of investment to realise their potential with funding from

the London Economic Action Partnership (LEAP) and the Mayor's Good Gro, a fund designed to support sustainable and inclusive growth and community development across the City. The Mayor also established the 'Creative Land Trust', assuring affordable workspaces for creative industries.

Details of one of the initiatives taken up in the South Shoreditch Conservation Area in the Burrough of Hackney (which is one of the fringe burroughs of London) are given below. The South Shoreditch Conservation Area extends to 2.72 sq. km and has 52 listed buildings. The area was a centre for manufacturing and industry, particularly production and printing, till the mid 20th century. From the mid-1980s to 2008, there was an economic boom in London, in which three elements finance, the arts, and property were driving forces. South Shoreditch was ideally located to capitalize on these trends and become attractive to creative industries for its fashionable, artistic, and culturally open reputation,



Cultural and creative industries located in South Shoreditch, London Source : Public Domain

and availability of suitable built fabric.

In 2003 the Greater London Authority (GLA), commissioned a City Fringe Urban Planning Policy Framework, including a section dedicated to South Shoreditch. This formed the basis of the South Shoreditch Supplementary Planning Document, adopted by Local Body (LB) Hackney as part of its Local Development Framework in 2006, to guide development in the area, containing detailed policies for conserving its unique architectural and historical character.

The framework supported conservation - based planning, resourced through a combination of Local Planning Authority (LPA) and English Heritage support, such as the development of couple of Elizabethan playhouses and theatres associated with William Shakespeare. As land values and rents increased, artists' studios were replaced by 'creative industries', such as designers and architects; and small IT companies ranging from financial support services associated with the city to software and games developers, which now make up a large proportion of local businesses. In addition, many former commercial premises have also been converted into residential properties.

Through a concerted effort at area regeneration, the area has emerged as home to 406 creative industries, of which 32% represent IT, software, and computer services. The site is a notable hub for IT-related businesses, with approximately 18 percent of industries representing film, television, video, radio, and photo related businesses. South Shoreditch is now the creative heart of London, central to Europe's creative, digital and tech industries. Over time, it has become the national and international destination for culture, entertainment and leisure uses, with a vibrant evening and night-time economy and a diverse mix of independent and specialist shops, restaurants, bars, workspaces, and homes.

1 (b): Barcelona, Spain – A Strategic Planning Approach to Integrating Knowledge Industries

Poblenou is a neighbourhood in Barcelona, Spain. Once a flourishing industrial town with oil, cotton and textile industries, the area experienced severe dereliction due to de-industrialization, with vacant factories, a polluted waterfront and associated socio-economic issues.

However, the fortune of the neighbourhood changed when a neighbouring area, full of empty warehouses and rundown factories, was developed as an Olympic village. The transformational success of the area led the local government to rethink Poblenou as a mixed-use area that combined affordable housing, business premises, community facilities, cultural spaces, and green areas. This was supported with a new space for innovation in energy, ICT, media, MedTech and design economy clusters.

In 2000, two parcels of land within Poblenou, with a total of 1.98 sq. km, were designated as 22@Barcelona districts. Sites within this area were allowed to rezone from "22a", which denotes industrial zoning to "22@", which enables the redevelopment of sites to the office or commercial spaces with a gross floor ratio of up to 3.0, 30% of floor space for public space had to be reserved, green areas and social housing equally. The focus was to create spaces for the strategic concentration of intensive knowledge-based activities. Through these provisions, the city created a district facilitating job growth and attracted people from all socio-economic backgrounds (Centre for Livable Cities).

Redevelopment of the area was supported through an infrastructure plan that enabled private finance mechanisms for the redevelopment of power, telecommunications, and waste infrastructure, A "Modification of the Special Plan for Historical/Artistic Architectural Heritage", was approved in 2006, which allowed preservation of 146 elements with industrial heritage or historical value (Centre for Livable Cities). These included alleyways, industrial smokestacks, residential buildings, and others. This ensured that the city's historical identity was respected and maintained for the enjoyment of existing and future residents (Centre for Livable Cities).

Since the Strategic Plan of 1999, which identified culture as a key driver of Barcelona's development, the city has put into place cultural policies for intellectual property rights, promotion of artistic creation, right of access to culture and arts education and the right to cultural participation, and emerged as a powerhouse of creative industries in the knowledge sector. To support the creative and cultural institutions in @22, the Barcelona City Council and the Government of Catalonia co-located cultural facilities of national importance, such as L'auditori (home of the Barcelona Symphony Orchestra), the TNC (Teatre Nacional de Catalunya) and the DHUB (Disseny Hub jointly formed by the Design Museum, Barcelona Design Centre, Promotion of Arts & Design, and the El Clot - Josep Benet Library) within close proximity. The Disseny Hub has been envisioned to add value to the projection of the creative industries and global dissemination of the city's heritage and culture (Ajuntament de Barcelona). Further, DHUB has collaborated with Barcelona Active, a local development agency working to enhance Barcelona's competitiveness in digital, cultural and creative economies, to map creative economies, identify the contribution of these industries and create a road map for future action.

Barcelona's decision to boost the non-traditional creative sector by creating the 22@ technology district, has propelled its emergence as the city with the highest concentration of ICT companies in Catalonia. Almost 50% of European patents requested in Catalonia are from ICT companies based in Barcelona (Adjuntament de Barcelona, 2019). 1,600 new subsidised housing complexes have been developed which are known to be among the most attractive in Barcelona. A senior citizens' centre and childcare facility was also created within a 10-minute walking catchment to ensure that people of all ages enjoy the space. Municipal-owned

spaces have been re-purposed to create three art factories to encourage artistic creation and research and advance Barcelona's vision of being a cultural centre. The presence of incubators contributes to more than 8,000 businesses, providing 93,000 jobs. Between 2007 and 2015, more than 300 delegations arrived every year to learn from the 22@Barcelona innovation district. Its concept has been replicated in Colombia's Medellín (MedellínNovation District), Tunja (Technological Innovation District) and Montreal in Canada (Quartier de l'Innovation).

The City Council has also been sensitive towards the negative impacts of regeneration such as high housing prices and gentrification, and have put into place policies such as the Barcelona Right to Housing Plan,



Map and images of @22 District, Barcelona, Spain Source: blogs.uoregon.edu

Barcelona Rent Index, facilitating purchase of flats by older residents by right of first refusal, etc.

1 (c): Mexico City, Mexico - A Business and Government Collaboration for the Rejuvenation of the Historic City Centre

Mexico City has witnessed a business and government collaboration for revitalization of a heritage precinct which had suffered extensive damage due to an earthquake. By working together, the businesses provided investment and job opportunities, while the government entities improved infrastructure and provided regulatory support, thereby revitalising a declining heritage core, and creating a vibrant community.

The regeneration of the historic centre of Mexico City is an excellent example of the convergence of the public and private sector - where a dual entity governance structure was setup that included the non-profit institution 'Fundación del Centro Histórico' which led the programming, and a private entity 'Sociedad Inmobiliaria del Centro Histórico' looking into real estate investment and its restoration and reuse. The coordinated multi-sector approach involving public works and incentives, private sector investment and philanthropic and civil society engagement resulted in significant positive impacts for the area.

The rehabilitation project covers an area of 9.2 sq. km comprised of 668 city blocks and includes 1436 landmark buildings from the 16th to the 20th century. The site is also designated as a World Heritage Site. The strategy for regeneration involves the conservation and adaptation of derelict historic structures and investment in the physical fabric to create middle-income jobs and revitalise the most historically significant part of the city. Other features of the initiative include minimal residential displacement, repurposing of empty buildings to accommodate the existing population, improved quality of life through public events, street lighting, bike lanes, monument restoration etc. Investors in the for-profit Sociedad Inmobiliaria saw the value of their shares increase by 50% within ten years and 300% in 20 years. This considerable growth in property value, complemented by the creation of new businesses and jobs in hospitality, technology, entertainment, and commerce, has increased the city's tax base and allowed the Municipality to manage the Historic Center sustainably and continue its investments in street rehabilitation and infrastructure (CHiFA, 2021).

This project led to the creation of a number of jobs, opening of new shops, establishment of study centres, art galleries and museums, with a number of new residents moving in and spurring the real estate market. The initiative leveraged 104,475.4 million pesos (US\$ 8 Billion), with private investments exceeding government



Aerial view of Zocalo square Source : Ulrike Stein/Shutterstock



Rehabilitated Streets

- Lopez Obrador (2000-05)
- Ebrard (2006-12)

Perimeter

- Mancera (2012-18)
- Sheinbaum (2018-24)

---- Perimeter A Boundary Perimeter B Boundary

Sites

- Public (GDF, INAH, UNAM, CONACULTA, Foreign Govs)
- Private (Sociedad and Fundación)
- Private (Other)
- 1. Alameda Central
- 2. Atrio de San Francisco
- 3. Palacio de Bellas Artes 4. Zócalo
- 5. Catedral Metropolitana de la Ciudad de México
- 6. Templo Mayor
- 7. Palacio Nacional

Mexico's old city plan showing perimeter A and B boundaries Source : Public Domain

investment 20 to 1. Private investors purchased 70-80 historic buildings for restoration due to the incentive offered by the City of Mexico, permitting full deduction of the cost of purchasing historic properties in one year (rather than 20-year depreciation) (CHiFA, 2021). The Atrio de San Francisco, a public space bringing art and other festivities and observances to the public, has attracted more than 10 million people to its exhibitions and activities. Furthermore, between 2000-2018, almost 50 km of streets and 200,000 sq. m. of plazas were rehabilitated, and many roads became pedestrian, reducing traffic (and associated pollution) in the area.

1 (d): Kumbh Mela and Banglanatak, India - Intangible culture tangible value

The tangible value of intangible culture refers to the benefits derived from intangible cultural heritage such as traditional music, dance, crafts, oral traditions, and other cultural expressions. Temporal events such as festivals make it possible to celebrate and experience intangible heritage within an intense timeframe, and hence cities across the world leverage festivals as potential opportunities for tourism, job creation. Two examples of how tangible value has been derived from intangible cultural heritage are presented below.

Kumbh Mela: The Indian religious festival of Kumbh Mela is one such example, attracting millions of people every four years in rotation to the cities of Prayagraj, Haridwar, Ujjain, and Nashik. The Kumbh Mela (the festival of the sacred pitcher) is one of the world's largest gathering of pilgrims, during which participants bathe or dip in a holy river. Ascetics, saints, sadhus, aspirants-kalpavasis, and millions of visitors of all castes, creeds, and genders representing individuals as well as religious groups, akhadas and ashrams make up the congregation (UNESCO, 2017).

In 2013, the festival in Prayagraj brought in US\$ 2.2 billion on an investment of around US\$ 220 million, creating 650,000 jobs. In 2019, the Confederation of Indian Industry (CII) expected the Kumbh Mela in Prayagraj, to

generate around US\$ 16.8 billion in indirect income from visitors to the area and create employment for over 600,000 workers across various sectors. The organizers earn a significant proportion of their annual revenue during the festival (UNESCO, The World Bank, 2021). Respective state and local governments support the mass gathering through a number of initiatives targeted towards improving infrastructure and leveraging the economic potential of the festival. These include development of a temporary planned city to accommodate housing for the visitors, developing internal roads and pontoon bridges, improving connectivity to the mela site, enhancing hospitality and safety facilities in the host city, overhauling of infrastructure at transit hubs like railway stations and airports, and deploying large scale administrative machinery to manage the festival and look after the design and smooth flow of various cultural events that take place during the festival.

Banglanatak: The Indian State of West Bengal, is home to Banglanatak, a social enterprise that works across India to foster inclusive and sustainable development using culture-based approaches. In 2004 Banglanatak dot com initiated an experimental "Art for Livelihood" project, targeting 3200 folk artists (Patachitra - singing stories painted on scrolls, Baul Fakiri - Sufi music of Bengal, Jhumur - tribal lifestyle music and dance, Chau tribal masked dance with martial art imbibed, Gambhira and Domni - folk theatre forms) in six economically backward districts of West Bengal. The project primarily aims at enhancing the livelihood basis of the artists while providing a new positive identity to their localities as a creative hub rather than that of impoverished rural villages. The emergence of such new rural creative hubs is gradually leading to the development of new tourism destinations to bring additional income opportunities to the so-far economically marginalized areas (ICOMOS, 2011).

Banglanatak partnered with UNESCO to implement this model through the Rural Craft and Cultural Hub (RCCH) project which aimed at safeguarding and professionalising the traditional skills of the people of West Bengal and ensuring the viability of their art and craft enterprises. Additional support offered to project participants has included the facilitation of collaborations with national and international artists, as well as linking them to relevant government schemes that can support their practices and improve their socio-economic conditions. Banglanatak has also led efforts to sensitise the general population in West Bengal and throughout India, on issues of Intangible Cultural Heritage, by organising activities such as village festivals, cultural tours, and heritage education to attract wider audiences and demands (Safeguarding Cultural Heritage for Sustainable Development, 2022).

The 'Art for Livelihood' project has benefitted thousands of traditional performing artists and musicians in some of the remotest villages in multiple states. Banglanatak engages with the market to salvage musical forms through fair trade agreements, archiving and recording folk music, capacity building and marketing opportunities. The Desert Music Festival of 2011 saw the performances of traditional Manganiyar musicians with the acclaimed Vieux Farka Toure and Madou Sidiki Diabate. In 2012, Bombino and Baba Zula, with the newly created "Barmer Boys" and the Siddhis from Gujarat, created unique trans-local musical experiences. The "Manganiyar Seductions" (a musical and visual experience) drew rave reviews globally (UNDP, 2013).

This initiative has resulted in multiple states (Rajasthan and Gujarat) adopting the model for supporting creative enterprises based on local skills and benefitted 30,000 artists leading to the development of several creative hubs. The artists have learned spoken English to tell non-Bengalis their stories. Most communities now have sanitary latrines at their homes, 60 percent of HH within this community have access to electricity, and many reside in brick dwellings (ICOMOS, 2011). Women have gained the confidence to travel alone throughout the country and worldwide, enjoying greater respect and recognition. In addition, these exchanges and collaborations with international artists have fostered new partnerships (ICOMOS 2011).

1 (e): Rio de Janeiro, Brazil- An Incubator Network Approach to the Creative Economy

The creative incubator network approach refers to a network of organisations (incubators) and resources that support innovative businesses, projects, and individuals in the early stages of development. The incubators provide resources such as workspace, funding, mentorship, and networking opportunities. They also provide access to equipment and technology to foster a supportive environment for creative individuals and businesses to thrive, thereby contributing to the overall growth of the creative economy. Embedded in the approach are the principles of frugal innovation, where resources are targeted towards a cluster of individuals and businesses in specific co-working locations enabled through digital infrastructure and re-use of physical spaces.

The Brazilian Ministry of Culture, through its Department of Creative Economy, runs a national project across

13 states integrated through 'Rede de Incubadoras Brasil Criativo', a creative economy incubator network. Brazil Criativo provides space for multiple sectors and institutions to interact and enables access to training courses and consulting services. It supports strategic planning, legal assistance, marketing and communication and funding thereby bringing together governments, banks, universities, and specific segments of civil society (Pinto, 2015).

The Brazil Criativo initiative has facilitated increased interconnectedness amongst creative hubs, thereby building a new model for networked economic development. This is leading to an open culture of exchange of knowledge and information to drive cultural economies.

A former Bhering's chocolate factory building in Rio de Janeiro now hosts 50 artists and 20 small firms who have turned it into a studio for sculpture, painting, literature, photography, video, performance, installation, restoration, design, multimedia, and many other forms of art production, boasting a plurality of styles and ideas. In addition, a significant amount of space is used for co-working, and there are places for creative work and collaboration (Pinto, 2015).

Similar spaces in São Paulo are Ponto de Contato, B4i (Contact Point, B4i) and Escola São Paulo (São Paulo School) and Orbe in Recife. Also, private companies such as Garimpo de Soluções, Movimento Hot Spot and Movimento Crie Futuros supported construction and development for creative-economy projects, curatorial designs, forums, debates, and events on the subject. Artplan, a private company, is organising some of the most significant events for sectors of the Brazilian creative economy, and one of its standout events is a street carnival in Rio de Janeiro.

The Brazilian Creative Economy Observatory (OBEC), set up by the Department of Creative Economy of the Ministry of Culture, holds debates on the subject and fosters an academic-practical environment for research that comprises a network of scholars, specialists, government officials and cultural sector representatives (Pinto, 2015).

1 (f): Bandung, Indonesia-Citizen-Led Bottom-Up Initiative Leading to at the National Level

Citizen-led initiatives often manifest as movements and campaigns to bring about change or solve a specific community issue. These initiatives can influence policy formulation at the national level by demonstrating, through pilots, the public demand for issues to be addressed.

Bandung Creative City Forum (BCCF), formed in 2008, took several initiatives in collaboration with citizens and diverse communities to brand Bandung as a creative city. These include canopy walk in the Babakan Siliwangi Forest, which led to its preservation, promoting co-working spaces to boost the creative economy, and innovative urban gaming that emphasised city issues through play and games (Creative City South, 2017). The local government of Bandung, Indonesia, supports the creation of co-working spaces across many locations in the city (BCC Admin, 2022) promoting creative agencies and individuals to come together to harness their potential collectively.

Bandung has since been officially recognised as the UNESCO creative city of Design (Creative City South, 2017). Launched in 2015, the Bandung Creative Centre (BCC) functions as a hub for national and international stakeholders to foster the exchange of experiences and ideas (UNESCO, 2018). Moreover, the Bandung Creative Economy Bill 2021 ensures that the mayor must include the creative economy in the city's development agenda (G20 Insights, 2021). In addition, a Regional Development Acceleration Innovation Program (Collaborative Planning in Innovative Program of Development and Empowerment Territoriality (PIPPK) and Melati credit system were formulated to provide financial support to actors and incubate new creative industries (UNESCO, 2018).

Building on the success of community led initiatives in Bandung, the national government in 2015 set up the Indonesian Agency for the Creative Economy (BEKRAF), a non-ministerial agency, to develop and coordinate policies to leverage Indonesia's creative economy potential (Catherine Jewell, WIPO Magazine, 2019). Under the giant umbrella of tourism, BEKRAF is assisting ten major tourist destinations in leveraging their culture and developing the local creative industries such that they remain attractive to tourists. The agency covers six functions: research, development, and education; access to capital; infrastructure, marketing, and facilitation; regulation of intellectual property (IP) rights; inter-government relations; and inter-regional relations (Catherine Jewell, WIPO Magazine, 2019).

BEKRAF runs initiatives in creative sectors such as films by creating opportunities for young filmmakers to spend time at the Torino Film Lab in Italy and participate in international film festivals (Catherine Jewell, WIPO Magazine, 2019). Akatara Indonesian Creative Financing Forum is another platform where young talent can pitch their ideas to potential investors. BEKRAF has instituted the Indonesia Creative Incorporated (ICINC) to discover, promote and market Indonesia's creative talent. Musikologi is an event that brings together music professionals from across the industry and enables them to share experience and knowledge with upcoming musicians (Catherine Jewell, WIPO Magazine, 2019). BEKRAF has also developed an App that helps creative talent to understand IP rights and educates them on the application process (Catherine Jewell, WIPO Magazine, 2019).

1 (g): Cannes, France- Imparting Ecosystem approach to boost creative industries

UNESCO has recently recognised the City of Cannes, France, as a creative city in the cinema category. Cannes is now recognised as a world destination for developing creative industries in the audio-visual sector. The recognition is the result of the exemplary municipal policy for Artistic and Cultural Education (EAC) and the 'Cannes on Air' programme.

Schools in Cannes offer time to students to allow them to engage with works of art, places, professionals, debates and artistic practices. The Cannes Municipality has supported the audio-visual sector's development for several years. The 'Cannes on Air' program aims to provide the town with all the links in the audio-visual content chain. With an investment of a million euros, the programme involves the development of Georges Melies University Campus, a 2,400-seat multiplex cinema, installation of equipment and film studios, hotels and offices, and an International Museum of Cinema. The initiative's objective is to allow greater visibility to the cultural profession of cinema (CANNES COTE d'AZUR, 2022.

The Cannes City Council devotes 16 percent of its operating budget to support, create, disseminate, promote and transmit artistic and cultural activities. It also acts as a business incubator, targeting notably the audio-visual sector. The city has recently undertaken restoration work on 'La Malmaison', a contemporary art centre of 10,226 square feet that houses the International Museum of Cinema and hosts the Cannes Film Festival, as well as provides 'edutainment' experiences, offering visitors an immersive and original insight into film-making.

1 (h): Ajmer-Pushkar, Rajasthan, India- Supporting a Historic Cultural Heritage-Based Economy

Historic cultural heritage-based economy refers to using historic sites, monuments, and other cultural assets (customs, traditions and practices) to steer the local economy. Such economies can significantly benefit local communities and their art and crafts and raise awareness and appreciation of cultural heritage.

Ajmer and Pushkar are thriving pilgrimage centres for different faiths, attracting thousands of devotees throughout the year, and especially during cultural festivals. Around 1.2 million domestic and international tourists visit Pushkar for historic sites such as the world-renowned and only temple of Lord Brahma in the world, the Ghats, and Pushkar Lake. Tourists are also attracted to the mythology and spirituality associated with the place, its culture cuisine, artefacts, handicrafts and creative clusters such as Ittar-making and Gota work in Ajmer. Some of the major festivals associated with the area are Kartika Purnima, Brahma Utsav, Maha Shivratri and the annual international Camel Fair, which is one of the largest cattle festivals in the world.

The state government of Rajasthan, along with the local authorities, residents, and experts, were engaged in city-wide mapping of Ajmer's tangible and intangible heritage. The effort aimed to raise awareness of the local heritage and its relationship with the residents' way of life. This led to the adaptive reuse of buildings to showcase local art, sculptures, and traditional and contemporary performing arts from Rajasthan. A Heritage Cell has been established as part of the initiative to re-establish its cultural and historical heritage (National Institute of Urban Affairs, 2022). A number of initiatives such as improvement of tourism infrastructure, improvement of heritage areas and circuits, etc. have also been implemented under Schemes of the Central Government such as the Heritage City Development and Augmentation Yojana (HRIDAY).

These initiatives have boosted the local economy of the place through preservation of traditional skills and conservation of built heritage, such as ghats.

Key Drivers for Action

Creating robust policies for urban regeneration: Regeneration is a critical tool for revitalising derelict industrial and heritage landscapes. Cities across the world have provided significant boost to creative and cultural economies through policies that incentivise mixed use, adaptive reuse of heritage assets, redevelopment of older areas and infusion of public spaces and activities. It will also be critical to create long term strategies for regeneration of areas to enable partnerships and networks amongst businesses and local stakeholders. Heritage infrastructure is one of the key elements for creating unique local identities and requires dedicated city level policies for preservation and innovative restoration and retrofitting.

Enabling agglomeration economies: Clustering of creative industries and co-location of cultural facilities enables agglomeration benefits that help in building a strong sense of place and visibility for such economies. This requires a confluence of cultural industries as well as allied functions like museums, art galleries, markets, rental housing, etc. Festivals and events are also a powerful instrument for celebrating intangible aspects of cultural heritage and promoting a range of inter-related tourism economies during a dedicated time-frame.

Governance for culture: Establishing a dedicated body and a hierarchy of governance mechanisms at multiple levels within the government administrative system to oversee policy measures and catalyse investments through industry participation. This helps converge government policies for planning and infrastructure development, providing an impetus to cultural and creative industries, increasing private sector confidence to invest in cultural projects, and developing long term strategic plans that provide a road map for area-level revitalisation. Establishing a clear vision of growth and related strategies for the sector at the city/region level can enable aligned actions which contribute to the successful realisation and implementation of the vision i.e., strategic planning. **Mobilising communities:** A bottom-up approach coupled with a local champion (such as the mayor) and active support from local businesses, philanthropy and civil society can provide the required impetus for pushing the local economy agenda for consideration by various levels of government decision-makers. Community ownership and stakeholder participation can also result in building strong local networks, social cohesion and civic pride which are integral elements of local 'identity'.

Creating data frameworks: Research and evidence can help identify the economic value of 'Cultural and Creative Industries' to enable data-driven decision-making. Cultural economies, particularly in developing countries, often operate through informal and organic networks, thereby making it difficult to systematically direct technical, funding or other policy support to such sectors. Besides, the sectoral perimeter of the creative industries remains undefined in most contexts, and there is a need to map these industries to assess their impact on the economy, the inter-relationship with surrounding businesses and cultural environments (Ajuntament de Barcelona, 2022). Recognising and mainstreaming the cultural and creative industries sector will enable the allocation of funds to boost local economic development. Besides, the availability of good quality, dynamic and disaggregated data can help to develop targeted policies and strengthen inter-relationships amongst cultural sectors.





Reinventing Frameworks for Urban Governance and Planning

Abstract



Spatial patterns such as mega city-regions, peri-urban growth, conurbations, etc., have come up as a result of rapid urbanisation, giving rise to questions such as what is the appropriate scale for planning or how to manage coordination among multiple spatial/ political jurisdictions for efficient metropolitan/ regional governance. A majority of the global urban population is affected by this given that cities in developing countries will witness the most unprecedented urbanisation in the coming decades. It is critical to explore innovative frameworks for planning and hybrid governance to develop shared infrastructures (airports, frameworks for planning and hybrid governance to develop shared infrastructures (airports, landfills, water supply, regional transit, etc.) and facilitate regional economic clusters. Along-side the issue of urban expansions, livability within cities is also threatened by multiple issues including degraded built environments, disaster risks and lack of proper housing and services. These have to be tackled by developing feasible models for implementing and financing renewal of different areas in the city, creating opportunities of plugging in principles of place making, sustainable mobility, circular economy, green buildings, disaster preparedness etc. U20 is the best platform for collaborative trans-boundary learning on different approaches to adapt governance and planning frameworks to emerging challenges.

Introduction

Cities are constantly evolving and changing. However, the skills and capabilities of traditional governance structures and institutions. As per the World Bank (2023), "... Once a city is built, its physical form and land use patterns can be locked in for generations, leading to unsustainable sprawl. The expansion of urban land consumption outpaces population growth by as much as 50 per cent, which is expected to add 1.2 million sq km of new urban built-up area to the world by 2030. From a city to a metropolitan area, from a metropolitan region to an urban agglomeration - urban areas globally have grown exponentially in the past 70 years. Urban agglomerations, as a phenomenon of economic geographies, provide the background for large labour pools to be shared between industries, specialize in skills over time, and develop the required upstream and downstream linkages for complex products and processes (Giuliano, 2019). From the normative models of a city with a central business district to a polycentric model, city regions have evolved in complexity and size.

To realize a more sustainable future will require planning foresight to anticipate the nature of demographic shifts. "Recent demographic trends are harbingers of future challenges to achieving the SDGs" (UN DESA, 2022). Although, on the one hand, planned urbanization can bring health and economic benefits, it is evident from many regions around the world that unplanned and rapid spatial growth can have social, environmental and health hazards for its citizens (WHO, 2021). With rapid urbanization, population growth, changing aspirations of citizens, technological innovations etc., city functions are stretched beyond their management capacity. These problems are exacerbated by Climate Change and associated extreme weather events.

Historically, urban areas have attracted people for better job opportunities and functioned as artistic, social, religious, cultural, and learning centers. Pull factors and population growth have resulted in either densification or expansion of existing urban areas. Megacities, with a population of 10 million or more, are one of the outcomes of such urban shifts over time. Most cities with such urban growth phenomena are in Asia and Africa due to socioeconomic, demographic, cultural and technological reasons (Suhara et al, 2019). Varied sources list the total number of megacities in the world differently. For instance, the world had 33, according to the UN (UN DESA, 2018) and 44, according to Demographia in 2022 (Demographia, 2022). About half of these urban agglomerations are in China and India.

Future high-growth areas will not only require developing regional spatial planning frameworks but will also require robust governance models. This will require strategic thinking with measurable outcomes that are cognizant of a city's history, socio-cultural ecosystem, environmental and locational context etc., where past-century approaches will not work. Governance models must also consider the context and problems the city or urban area faces. For example, "Paris and London are megacities, but it is difficult to compare them demographically or economically with Jakarta or Lagos. Despite its relatively smaller population, vibrant megacities stretch out further than their poorer counterparts: Los Angeles' settlement area is four times as big as Mumbai's (Dastrup, 2019). Effective institutionalized governance in denser and larger cities will require more resources and systems to be in place compared to less dense contexts. It is expected that megacities, city regions, and multiple cities that function as a single economic/ cultural unit will increase in numbers globally. The governance of such large urban systems is complex; very few cities worldwide have institutionalised regional planning and governance.

Good planning is that which can promote or facilitate good governance and vice versa, but they are linked in a complex relationship (UN-HABITAT, 2023). One good example of governance-related goals in spatial planning is that of Singapore's Housing Development Board apartments aimed towards a slum free city. A national policy was implemented through an investment linked program that shaped most of Singapore's districts by developing townships and estates that house over 78 per cent of resident households in Housing Development Board (HDB) apartments (Dept of Stats, Singapore, 2023). A significant portion of Singapore is surrounded by HDB's 24 towns and three estates, and successive master plans of Singapore have created space and infrastructure for the coordinated development of such townships. Such strategic approaches to solving some of the most pertinent problems in cities are increasingly being adopted through strategic development planning.

New paradigms in urban governance, planning and development are being explored that emphasise non-state stakeholders (private and third or non-government organisations, including community-based organizations/ collectives) to have greater involvement. Questions regarding just and fair distribution of power notwithstanding, these developments are encouraging from the perspective of long-term sustainability, where community ownership and participation in projects will ensure that solutions are tailored, and benefits reach the right audience. The relationship between governance and planning is evolving along with our understanding of the implications of decisions made in urban areas. "Urban policies will become increasingly important for solving regional and global environmental issues. Although the current institutional setup in urban policy making is not necessarily best suited for managing such issues, an enhanced governance process such as increased public participation, networking and learning across cities can effectively mainstream these issues into urban policy" (Bai et al, 2010).



93 Urban 20 2023 Background Research

Key Aspects & Initiatives

1. Planning and Governance for emerging patterns of urbanisation

Classical spatial models of cities were used to define and predict the urban dynamic on a normative and static reality. The traditional urban models typically include the Concentric Zone with the Central Business District at the center, the Sector Model with different functions. and the Polycentric City model. However, cities have grown well beyond those traditional models and need increasingly complex means of understanding with overlapping layers of uses, functions, and densities. With the wide availability of technology, urban growth has been examined using geospatial analysis tools that map cities over time for urban sprawl. However, "For interdisciplinary urban studies and complicated urban systems, one single urban model cannot comprehensively mimic all urban activities (or contents)" (Li et al, 2016). Furthermore, most models are based on investigating land use/ land cover from remote sensing data.

Although in the nascent stages, a new approach to studying the urban dynamic is through 'urban systems'. "Urban systems, including small, large, and mega-cities as well as urbanized regions, are classic examples of complex systems exhibiting emergent properties, some of which can be difficult to explain...." (McPhearson et al., 2016). The 'urban systems' approach is promising since it avoids normative definitions and generalisations. It studies the urban dynamic within its context and is not restricted within a city's setting by evaluating real-time aspects. For the co-design of sustainable urban systems, "specific strategic focal areas are identified across scales ... such as centralised vs distributed energy, water and food infrastructure; cross-sector interactions, trade-offs and synergies (e.g., the urban food-energy-water nexus, and the urban planning/ infrastructure-transporthealth nexus; and reinforcing links from these to local and city-wide decarbonisation and climate adaptation strategies" (Web et al., 2018). Concepts such as the 15-minute city and Smart City (Maassen et al., 2019) (Deloitte, 2021) (Pobiner, 2020) can be found in the 'Urban systems' approach of studying a city.



Growth rates of urban agglomerations by size class Source - United Nations, DESA 2018

The planning community has also made many efforts in responding to climate change by (re)exploring old and new strategies and applying them to today's contexts for new areas and undertaking steps such as retrofitting, revitalizing, and regenerating existing urban areas. Many cities have shown eagerness to experiment with new solutions that can enhance the quality of life of their citizens. To implement such solutions in shorter timelines and with stretched public resources, the private sector has been increasingly involved in city development and growth functions. The agglomerative nature of large city regions also means that the public sector is too stretched and needs to rely on non-state stakeholders to fulfil some of the developmental functions. Such non-state stakeholders are finding a voice in decision-making, leading to a shift in how cities are governed.

Non-state stakeholders or organizations and entities not part of the government was usually found advocating for change in governance. However, as the magnitude and operational requirements of the state grew, these private and third-sector organizations were increasingly engaged in activities that usually were performed by the state (Colona et al., 2016). McKinsey (Khanna, 2012) highlighted that "Parastatals have clearly become the tool of choice for governments to modernize governance and manage globalization. Despite the lack of public scrutiny, they have proven an effective vehicle for harnessing scarce financial and managerial resources". These hybrid arrangements are formalized on strategic grounds with specific technical and financial parameters and goals.

Traditional models of urban governance that take the 'top-down' approach are severely lacking when operating alone. In contrast, the significance of the 'bottom-up' approach-the voice of the people in the form of participation assumes greater importance that calls to adopt different governance and planning frameworks (Healey, 2015). "With the change of cities from relatively focused metropolises to linear megalopolises, and finally to urban mega-regions (or megacity regions), the spatial scaling of government has become mismatched with the effective urban scale. Public-private partnerships have emerged as a familiar tactic in polycentric regions, as have quasi-governmental authorities" (McHale et al., 2015). While these trends are encouraging, the shrinking role of state stakeholders needs to be carefully examined for each context. A gap in decision - making and the absence of power centres can encourage interest groups to take centre stage. However, there is a consensus that the state stakeholders need to increasingly play a strategic role and be the enablers of change and development in the city. The move from regulatory to strategic planning in many cities globally is an encouraging development. This paper examines case studies from cities such as Singapore, London, Johannesburg, Mymensingh, Abidjan, Paris, Barcelona, Seoul, Abu Dhabi, Delhi, and Mumbai, among others, for various initiatives and measures in the direction of these changes.

"Hybrid governance to deliver urban Nature based Solutions has been identified as a key opportunity, for policymakers to collaborate with non-public stakeholders such as businesses, citizens and NGOs" (Toxopeus et al., 2020). Hybrid governance-based delivery of NbS in cities is especially helpful in tapping into revenue streams that state players cannot harness.

Mymensingh in Bangladesh is one of the documented examples of hybrid governance structures helping the implementation of the "Second Urban Governance and Infrastructure Improvement Sector Project (UGIIP- II)" funded by the Asian Development Bank (Yasmin et al., 2022). "The networks or stakeholder clusters (Town and Ward level committees and community-based organizations) typically consist of local community members, NGO representatives, and environmental activists. This shift is new in the context of local government agencies in Bangladesh and has opened a platform for participatory decision-making by forming new networks of diverse stakeholders" (Yasmin et al., 2022).

Enabling hybrid forms of governance will be critical for cities to enhance the sustainability of their urban systems. Such flexibility will allow newer urban planning and design concepts to flourish by exploring solutions tailored to the context and genuinely contributing to the city's Sustainable Development Goals.

2. Paradigm shifts toward Strategic Planning

Increasingly, cities are shifting from regulatory forms of planning to strategic planning, focusing on crafting a long-term vision for the city and outlining time-bound actions to achieve the vision through collaboration among several stakeholders (Clark, 2013). These frameworks have seen many new initiatives, such as sustainability and resilience, social inclusion, intelligent cities, mixed-use and walkable communities, and collaborative planning, depending on the context. A few examples of efforts towards strategic planning are given below:

2 (a): Mymensingh Strategic Development Plan 2031 (MSDP), Bangladesh

Along with the ADB-funded (UGIIP-II) projects, a strategic development plan was also developed for Mymensingh (Yasmin et al., 2022). The main objective of MSDP 2031 was to mainstream disaster management in land use planning. Key outcomes of the project include a reduction in disaster risk in urban and rural areas, development of institutional capacity, disaster preparedness, and community-level adaptation to disaster risks (Urban Development Directorate, 2016). "This long-term project aims to ensure basic services are delivered to urban communities by improving community resilience through increasing formal and informal participation and collaboration within and between government agencies, with non-government organizations (NGOs), and broader civil society" (Yasmin et al., 2022). Such initiatives helped build a platform for various stakeholders to come together and build a participatory approach towards multiple initiatives, especially disaster risk reduction.



Mymensingh Strategic Development Plan 2031 (MSDP), Bangladesh

Source - MSDP 2011-2031

2 (b): Spatial Development Framework 2040, Johannesburg, South Africa

The Spatial Development Framework 2040 (SDF) was prepared taking into aacount several issues, such as a spatially divided city, infrastructure deficiencies in deprived areas, legacies of the apartheid era, urban sprawl and pressure on the natural environment (SDF 2040, 2016). Some of the strategies included transportation corridors connecting the compact polycentric fabric proposed for the city (Magni, 2013), transit-oriented development, infrastructure provision and connectivity to integrate the city and overcome spatial divides (Harrison et al., 2019). Key features of the project included pedestrian and cycling networks, traffic-calmed streets, and mixed-use neighbourhoods.



Spatial Development Framework 2040, Johannesburg, South Africa

Source: SDF 2040, City of Johannesburg Metropolitan Municipality

2 (c): The London Plan 2021

The Greater London Authority (2023) developed a strategic plan for London metropolitan area in 2021 that sets the framework for development for the next 20-25 years. Some of the strategic areas addressed include housing shortage, climate change, open/green spaces for a healthy city, enhancement of character and heritage, and recovery from COVID-19. The plan aims for 50 per cent of new homes to be within the affordable category, 80 per cent of trips to be taken by walking/ cycling/ public transport by 2041, recycling of 95 per cent of the construction/ demolition waste, and all significant new development should be net zero. The plan was developed with 4,000 consultation responses and extensive public participation and scrutiny.

2 (d): Urban Master Plan for Greater Abidjan, Ivory Coast

Abidjan is the economic capital of Cote d'Ivoire or Ivory Coast in West Africa. The Japan International Cooperation Agency (JICA, 2015) sponsored the preparation of the Urban Master Plan for Greater Abidjan, which is also the central port city for the inland nations of Niger, Mali, and Burkina Faso. Along with a focus on multi-stakeholder engagement in the development process, the strategic planning objectives include a sustainable live-work-play environment, compact developments to combat sprawl, hierarchy of urban centres, knowledge/ high-tech clusters, transit-oriented development, promotion of tourism through waterfront development, and redevelopment of older industrial estates for clean industries.

2 (e): OneNYC 2050, New York

In 2007, the City of New York released PlaNYC 2030, a strategic plan. The plan is based on recognising existing challenges to society and the nation as a whole and building upon the city's strengths. It highlights critical values that inform the various strategies in the plan, such as democracy, vibrant neighbourhoods, efficient mobility, modern infrastructure, a liveable climate, healthy lives, and an inclusive economy. Some strategic directions include carbon neutrality by 2050, introducing congestion pricing, people priority zones etc. The city's performance is evaluated regularly, and progress on the plan is recorded (City of New York, 2019).

2 (f): City of Sao Paulo Strategic Master Plan

Prepared and adopted as law in 2014, the strategic master plan for Sao Paulo was prepared after extensive online public hearings and consultations with over 25,000 people. The project adopts several measures that aim towards guiding the urban form and promoting key strategies such as "fighting vacant land, which doesn't comply with its social function; implementing housing policies for those who need the most; incorporating the environmental agenda; improving urban mobility; guiding growth near public transportation; improving urban life in neighbourhoods; promoting economic and social development; reordering metropolitan dynamics; preserving heritage, enhancing cultural experiences; and strengthening public participation in the decisions about the future of the city" (The City of Sao Paulo, 2014).

Source: NIUA Newsletter

2 (g): Master Plan for Delhi 2041

The Master Plan for Delhi 2041 (MPD) significantly differs from previous master plans. It clearly defines strategic objectives and outlines strategies for achieving those objectives. Corridors of growth and development are identified based on strategies that help to focus the direction of policies. The six goals of the plan are ' prioritising environmental sustainability", "facilitating development", economic "enhancing heritage, culture, and public life", "improving housing and social infrastructure", "moving towards low-carbon mobility", and "developing resilient physical infrastructure". "The Plan promotes private sector-led development through joint action of various stakeholders (pooling, amalgamation, joint planning, and execution). This is a significant paradigm shift where development of new areas and regeneration of older brown-field areas shall be implemented through the private initiative", which shows that the government can be an enabler or facilitator.



3. Urban Design and Urban Regeneration to implement planning outcomes

The vision and goals detailed in a city plan can be achieved by translating those into strategic projects and area level improvements/ retrofit/ regeneration. The concept of 'redevelopment' is increasingly being replaced by 'regeneration', as the former entails complete replacement of existing built stock whereas the latter reuses good-quality existing built stock.

Alpopi (et al., 2013) researched several European countries for trends in urban regeneration and concluded that "sustainable urban rehabilitation is an absolutely necessary and irreversible process for, revitalizing urban structure, rehabilitation of public use areas, rehabilitation of entire urban infrastructure, of residential buildings, including the rehabilitation of their total energy, of the monuments and historical areas, of collective use equipment, and improving mobility and urban transport too". A World Bank report (2013) describes urban regeneration as a means of rejuvenating old city centres and combating urban decay. Typically, such projects are undertaken with private sector participation due to financial considerations. One of the case examples studied in the report is the Sabarmati riverfront rejuvenation in Ahmedabad, Gujarat, India. The project involved transportation, redirecting sewage inflows, housing for resettlement, creating parks, and rejuvenating a weekly bazaar. The report notes that a "one-size-fits-all" approach cannot be adopted for regeneration projects, and each context needs to be carefully considered. Also, there are varied perspectives and opinions about the objectives of such regeneration, and projects are not void of criticism. However, the social, economic, and environmental benefits of urban regeneration outweigh any form of inaction.

Urban regeneration can occur at varied scales and must align with the overarching vision of the city. A few urban regeneration initiatives undertaken by different cities are given below.

3 (a): Paris - the 15-minute city

The concept gained ground, especially post-COVID-19, where supply chain disruptions became challenging for people locked up in control zones or homes. The idea of compact, walkable neighbourhoods gained momentum and became a rallying cry for urban regenerative efforts. Paris is a pioneer in adopting the concept even before the pandemic and implementing it in response to the pandemic conditions. The pedestrianisation of streets, availability of amenities at shorter distances etc., has helped residents to wean off cars and adopt healthier means of commuting for shorter trips, resulting in improved overall quality of life. Local governance has responded to the scale of interventions and improved services in such service radii (Gongadze et al., 2023).



The 15-minute Paris City Source - Paris En Commun

3 (b): Innovation Districts, U.S.A

Inner-city areas in cities in the US reached their economic maturity and were seeking new uses and activities. The concept of creation of Innovation Districts in these very areas resolved the issue to a large extent (Katz et al., 2014). The main physical attributes of innovation districts are that they are compact, connected, walkable, and mixed-use in nature, allowing different compatible activities, including residential, to coexist in a tight network of spaces with even vertical mixing of uses. One of the prime examples of innovation-related conglomerations is the Kendall Square in Cambridge, anchored by the Massachusetts Institute of Technology (MIT). University City in Philadelphia is "leveraging its teaching, research, and medicine assets to become a hub of innovation and entrepreneurship" (Katz et al., 2014). Other examples include Cortex in St Louis, Detroit Innovation District, South Lake Union in Seattle, Boston Innovation District, and Research-Triangle Park in Raleigh-Durham. Singapore established the Jurong Innovation District in 2014, anchored by the Nanyang Institute of Technology at one end and a mixed-use industrial estate with large office campuses at the other. Incorporating the latest urban design trends, Jurong Innovation District is highly connected and has



All innovation districts contain economic, physical, and networking assets

Source - Bruce Katz and Julie Wagner, The Brookings Institution 2014

conceptualized an elevated 'mobility deck' with a futuristic autonomous people mover system (JTC, 2023).

Most of these innovation districts are urban regeneration projects where existing uses were replaced or reinvented to allow space for offices, industry, housing, and coworking. City plans that have clear policies and regulations for regenerations have enabled such projects that leverage the synergy between academics, the service sector, and manufacturing by co-location for economic development.

3 (c): Living With Water, New Orleans

Cities along water are especially susceptible to adverse effects of climate change. New Orleans suffering from the impact of Hurricane Katrina, took steps to redefine its relationship with water being a 'city in a delta' (Waggonner & Ball, 2013). The city prepared and implemented an 'Urban Water Plan' that revisited the complete drainage system and use of water within the city. "The Urban Water Plan proposes a new investment model for public works such as streets, canals, pump stations, and storm water detention basins to enhance public spaces and yield economic growth and development opportunities. Proposed retrofits strengthen existing water systems, use undervalued water assets, enhance key corridors, and broaden the hurricane protection concept of "multiple lines of defence". The five core principles of Living with Water are 1) Slowing and storing storm water 2) Circulating and recharging surface waters and groundwater, 3) Building with nature, 4) Designing for adaptation, 5)

Working together" (Scenario Journal, 2023).





Greater New Orleans will have public plazas, parks, wetlands, and streets to safely hold water and make it available for ecological, recreational, and industrial uses.

Public plazas, park, wetlands and streets in Greater New Orleans safely hold water and make it available for ecological, recreational, and industrial uses.

Source - MSDP 2011-2031

3 (d): Zero Carbon or Net Zero City, Masdar, UAE

The 'Net Zero' city is an umbrella concept applicable to new urban development as well as retrofitting/ regeneration of an existing urban area. The concept was mainstreamed during and after the Paris Agreement (COP21). Several efforts have been made towards finding solutions for creating a net zero city. Masdar City in the United Arab Emirates (UAE) was designed as a low-carbon city, with various technological and planning solutions such as no fossil fuel vehicles at street level, 200m walking distances to the nearest transport links, and shaded pedestrian streets (Foster + Partners, 2023). The World Economic Forum (2023), in collaboration with Accenture, has developed a "Toolbox of Solutions" with over 300 entries under their "Net Zero Mission". The "Toolbox of Solutions" is open access, with each solution explained by an accompanying example.

3 (e): The Superblocks Approach, Barcelona

The concept is not new but has gained widespread acceptance, much like the 15-minute city concept. The Superblock is conceived as a 400 x 400 m unit with no cars, prioritizing pedestrian space over vehicular. The idea has been adopted in a big way by the city of Barcelona, with 503 Superblocks throughout

the city (Postaria, 2021). As an urban regeneration/ redevelopment strategy, the Superblock concept allows for reinvention of smaller areas, as a vehicular traffic and increase in green space (Mueller et al., 2020)





After adopting Superblock approach



Black routes allow public transport and cars at 50km/h, while green routes only allow private vehicles at 10km/h to prioritise pedestrians and cycling

Source: The Guardian, Illustration - BCNecologia

3 (f): Urban Nature-Based Solutions (NbS)

These are emerging as initiatives that facilitate regeneration, NbS would constitute an umbrella of systems that are put in place for enhancing, managing, and co-existing with natural ecosystems. Some projects where such strategies have been incorporated demonstrated the direct relationship between an urban NbS and resulting urban regeneration in surrounding areas. As per World Bank (2023), "Nature-based solutions are actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, simultaneously providing human well-being and biodiversity benefits". A WWF (2021) report on urban NbS identifies case examples such as greening building terraces and facades, restoring ecosystems and tree canopy interlocking, and Water Sensitive Urban Design (WSUD) and others.

Urban NbS for food production applied at the neighbourhood level can help reduce dependence on supply chains and provide food security. The 32Ha neighbourhood of Augustenborg in Malmo (Sweden) has applied Urban NbS to preserve local ecosystems, manage water systems, and use Urban NbS for composting and rooftop food production (WWF, 2021). Another example is the "Incredible Edible Project" in Todmorden, England (Cabral et al., 2017). The townsfolk use available spaces for community gardening. "The initiative's success has brought nearly 120 Incredible Edible groups in the UK and more than 700 worldwide to the network" (Cabral et al., 2017).

To ensure urban regeneration and growth, the key for development practitioners will be to unlock the scalability of these concepts, including widespread adoption to achieve a meaningful contribution to climate change and carbon neutrality (Keith et al., 2020).

4. Towards Outcome-based Planning and Regeneration

Many cities are integrating new and innovative strategies through less regulatory and more impact-based development frameworks. These frameworks aim to be less prescriptive by allowing greater flexibility for compatible uses to mix instead of creating segregated zones or functions. These frameworks can support new forms of spatial patterns and urban growth and, at the same time, provide enforceable strategies for effective regeneration of built-up areas within cities.

Urban regeneration is one of the most effective tools to ensure public outcomes through planning and urban design. Every regeneration project can contribute towards filling up the gaps of services and amenities in nay area such as increasing green and open spaces, installing decentralised water recycling and reuse systems, providing affordable housing for the poor and carving out community spaces, to name a few.

Following are examples of a few projects and strategies that are a result of 'outcome based planning frameworks':

4 (a): City level FAR of 1.0, Sao Paulo

One of the innovative measures implemented in Sao Paulo is allowing "free development rights" of FAR1.0 on the entire city. Any additional FAR will attract a fee which will go to the "Urban Development Fund (FUNDURB)", which will invest in social housing, environmental conservation, social facilities, and public transportation, among others. The spatial plan identifies neighbourhoods and heritage precincts where development is restricted to 1.0 FAR. Thus, while other areas are permitted to develop beyond FAR 1.0, the extra development rights are chargeable and different area have different area caps depending on local contexts. The strategy of FAR 1.0 has been judiciously applied to guide the volume and density of development.

4 (b): Form-Based Code (FBC)

Initiated in the United States of America, many cities have applied FBC in their contexts. FBC allows for form regulation rather than use and moves away from conventional planning that segregates uses. FBC has proven to promote mixed-use environments with minimal control and regulation limited to the compatibility of services (Singh, 2010).

4 (c): Corridor Densification

As an outcome of the concept of transit-oriented development, the focus is on the creation of high-density mixed land use development in the influence zone of transit stations, i.e., within walking distance of (500-800 m) transit station or along the corridor in case the station spacing is about 1km. Together with other strategies, this can significantly enhance various measurable parameters in the city, including reducing vehicular traffic, promoting a compact city, and enhancing the sustainability of the transit line itself (MoHUA, 2021).

4 (d): i-Garden Air in Lidabashi, Tokyo

A mixed-use development that consists of office, retail. and residential spaces on the site of the former Lidabashi Station. Through comprehensive design and district planning, the project has created generous green spaces on the ground level, forming a green belt that connects nearby gardens and shrines. The development area, situated between the Nihonbashi River and a densely built district, has undergone significant transformations. In the South Block, multiple properties were unified, creating a pedestrian promenade adorned with trees that provide shade and a pleasant atmosphere. Across the street in the Central Block, a historical path leads to a main plaza, offering a peaceful retreat for office workers, residents, and visitors. The project's success is attributed to the combination of the Comprehensive Design system and the Combined Site System, which prioritized open spaces and community involvement. Ongoing cooperation between developers and local residents supports the continued growth and vitality of the area



i-Garden Air three blocks - North, Centeral, South Source: Book 'Urban Activity' Nikken - re-thinking livable place making

Key Drivers for Action

Reinventing framework of Governance and planning in response to contemporary challenges would require adequate policy response and implementation strategies taking into account spatial and social realities such as:

- multiple jurisdictions working as a single regional economic cluster or cultural hub.
- strategic planning to provide for specific requirements of a city.
- outcome based urban regeneration to fulfill needs at the local level such as more green spaces or decentralised wastewater recycling etc.

Some key drivers of action include:

- Reinventing Governance structures need to be nimble and smart to address prevalent and foreseeable future urban challenges. This requires creation of entry point for citizen and non-state actors to becme part of governance processes. Hybrid models of governance such as inter-states/ multi-city/ regional agencies of service delivery and even public-private partnerships need to be enabled.
- The techno-legal regime of planning needs to be strengthened in order to deliver strategic outcomes that fulfill increasing and changing requirements of space in cities, allow for agglomeration and sharing of infrastructure and economic benefits at a regional scale and can be zoomed in to area level contextual solutions of urban design and regeneration.
- Changing techno-economic scenarios and the challenge of Climate Change have prompted cities to (re)explore various old and new concepts of urban planning that need to be implemented, with an inclusionary process. Allowing greater participation of the non-state stakeholders in governance can

help enhance the effectiveness of the planning and implementation efforts. In addition, in response to the present ecological challenges, many cities have explored concepts where past practices are now being rediscovered to reduce the carbon footprint and enhance the citizens' quality-of-life.

- Planning at regional level is imperative for economic, ecological as well as social benefits, given the regional interdependence of closely placed urban areas in terms of sharing of resources, work-home relationships as well as for leveraging the economic value of the entire cluster.
- The strategic master planning approach indicates common co-design and co-creation themes through participatory planning methods, environmental sustainability, promoting carbon neutrality, economic development, and better urban and transport relationships.
- Urban morphology and growth are complex, and predicting the same is challenging. At the same time, cities need to be nimble and keep innovating. Hence, a one-size-fits-all approach is replaced with multiple actionable strategies to target contextual issues and achieve targeted goals. Urban design and regeneration can act just like targeted medicine to cure a specific ailments and leading to overall well-being. These are the most effective tools to implement contextual solutions and enhance quality of life in a city piece by piece.





Catalysing Digital Urban Futures

Catalysing Digital Urban Futures | 106

Abstract



Digitalisation is providing the impetus to bring about transformational changes in governance, service provision and almost all aspects of urban living. Given that we are living in the urban century as well as the digital age, digital applications and technologies have permeated the daily lives of urban dwellers and the COVID-19 crisis intensified this dependence. Digitalisation has immense benefits and can enable informed governance and decision making. However, issues of unequal access to technology, barriers to data sharing and lack of opportunities to encourage digital innovations have to be addressed. As countries adopt instruments like large scale digital payment systems Direct Benefit Transfers, social inclusion should be ensured exspecially for informal sector businesses. Digital platforms can connect citizens directly to governments thereby enhancing transparency and accountability and enabling evidence-based policies, programs, and projects. India has made giant leaps in digitalisation and digital innovations through various initiatives. U20 is the best platform to discuss how data and technology can be best utilised for making city management more effective.

This Status paper explores how harnessing the benefits of digitalisation is critical to delivering growth and well-being in ctities across the world. The array of sub themes covered under this paper encapsulates all aspects of digitalisation including digital ecosystems, connected devices, data driven decision-making, development of digital platforms, sharing of data and exploring new technologies. It takes stock of digitalisation initiatives across the G20 countries, to help understand various models and strategies adopted by different countries/ cities and identify key drivers of change that can steer digitalisation in cities.

The first part of the paper delves into the concept and journey of digitalisation in cities. The second part assesses some of the key trends, main opportunities and challenges and highlights a range of interventions and frameworks that have been implemented around the world by governments in G20 countries. The third part identifies critical areas for deliberation by U20 cities and G20 leaders to accelerate the adoption of digital technology to make cities more inclusive, sustainable, and livable for citizens.
Digitalisation in Urban Areas

Trends in urbanisation pose a need for strategic, tactical, and innovative approaches to urban planning, design, governance, and management, and the use of Information and Communications technologies will play a major role in improving efficiencies across these aspects. The realm of digital technology is expanding rapidly, influencing the way we conceptualise and design cities of the future. Over the last decade, cities worldwide have built digital infrastructure and embedded digital technologies into urban services. Recent advances in Internet of Things (IoT), Machine Learning (ML), big data, and analytics, Artificial Intelligence (AI), among others, are opening new opportunities to create more liveable, sustainable and efficient urban environments. The digitalisation of any city has the potential to positively stimulate and accelerate development and improve residents lives by better management of energy, economic development and housing, community engagement, mobility, waste management, healthcare, and resource management. Hence, digitalisation of multiple domains is a necessity. In addition, digitalisation is advancing the achievement of Sustainable Development Goals (SDGs) and addressing cross-sectoral concerns in the urban domain. The McKinsey Global Institute, 2018 estimates that effective use of the existing generation of smart city applications may support the cities in achieving 70 per cent of the Sustainable Development Goals.

The power of digitalisation can only be realised when the data generated through various devices (such as sensors, devices, cameras, etc.) is utilised to transform cities. The smartness of a city can be observed across three layers:

- The technology base layer including smart sensors and devices connected by high-speed communication networks that collect data.
- Layer of applications for generating insights and alerts from the collected data
- Adoption and usage of applications by the public by providing transparent information leading to informed decisions and behaviour change

All three layers of "smartness" in a city need to function synchronously to help cities make evidence-based decisions.

Digitalisation can be leveraged to substantially improve livability and sustainability across multiple



Layers of smartness Source : McKinsey Global Institute, 2018

domains. Digitalisation can pave the way for seamless inter-operability in the urban ecosystem with self-sustaining energy grids, advanced multi-modal transit systems, clean and safe neighbourhoods for women and children, integrated municipal services, and easily accessible amenities.



Applications of Technology across various domains Source: Author compilation





(McKinsey Global Institute, 2018)

Catalysts for Digitalisation

35

There are multiple factors that contribute to the growth and proliferation of digitalisation in cities across the world. The global market for connected devices is increasing at a fast pace and with increasing urbanisation, it is expected to grow even further. IoT connections may include smart home devices, sensors, connected field devices, and connected industrial equipment. Non-IoT connections include devices such as laptops, smartphones, and computers. This is leading to a huge economic impact in both the Global and the Indian markets.

In India, the cost of internet data has fallen to USD 0.2 in 2022 from USD 0.7 for 1 GB in 2020 (Neogi, 2022). This has resulted in a 48.7 per cent internet penetration and 692 Mn internet users in 2023 (Kemp, 2023), with an average



Internet of Things (IoT) Active and non-IoT Active Device Connections (in billions) (Source: Watters, 2022)

USD 0.9-1.7 Tn

USD 5 Bn

USD 9.3 Bn

2025

78.3%

annual potential economic impact of IoT in Cities by 2025. (FutureIoT Editors, 2022)

IoT market size in India (FutureIoT Editors, 2022)

2020

of global urban population using the internet at start of 2023. (Kemp, 2023)

Internet of Things: Global Statistics

monthly data consumption per unique connection of 8.3 GB (2018) (Kaka, et al., 2019). An exponential increase in access and affordability of the internet has increased the penetration of digitisation initiatives across India and the world alike that are also resulting in achievement of key development outcomes.

The expected increase in the global quantum of data from 2018 to 2025 is 33ZB to 175ZB (Reinsel, Gantz, & Rydning, 2018). As more and more data gets generated in cities, the publicly available data may be leveraged to make informed decisions.

The global smart cities market size is growing at a CAGR of 24.1 per cent with an estimated market size of USD 1.2 Tn in 2022, which is expected to rise to USD 7.2 Tn by 2030 (Predence, 2023). Additional areas being explored include the use of emerging and other innovative technologies to create new forms of urban engagement. India launched the Smart Cities Mission in 2015 to "promote cities that provide core infrastructure, clean and sustainable environment and a decent quality of life to their citizens through the application of 'smart solutions' " (Smart Cities Mission, n.d.). Integrated Command and Control Centres (ICCCs) have been created under this Mission to address urban challenges in real and near real-time across multiple sectors of mobility, environment, health, water, sanitation, solid waste management, etc.

One of the best examples of multi-functional use of existing infrastructure is when about 45 cities across India, converted their ICCCs to act as COVID-19 War Rooms to monitor the city-level emergency response including the effective implementation of lock-down (Sharma, 2020). Technology-based smart solutions have helped cities in contact tracing, testing, isolation, treatment and enforcing the lock-down thereby enabling information collection, crisis management, effective communication, and predictive modeling. The smart infrastructure and solutions adopted by cities facilitated their response to the COVID-19 pandemic, using data analytics for evidence-based decision-making, including predictive modeling.

Several factors like increase in quantity of digital devices, increasing use of data, growing market for smart cities as well as the COVID-19 pandemic, have contributed to increased acceptance and adoption of digital initiatives and a surge in digitalisation across the globe. However, there have been divergences between the Global North and South, historically characterised by major gaps in the access to resources required for crucial development outcomes. Unequal access to technology, data access and availability, security and privacy concerns, cyber threats, and lack of skilled personnel, among others, are barriers to the utilisation of data and technology in cities. Overcoming these obstacles necessitates a comprehensive approach encompassing technical proficiency, robust governance and active participation from the community.

66 India is the 2nd fastest digital adopter among 17 major digital economies with 15.6 per cent CAGR growth in digital economy between 2014-2019

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(Kaka, et al., 2019, Economic Times, 2022)

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Challenges for digitalisation Source: Author compilation

The United Nations Agenda for Sustainable Development has outlined certain goals to help cities become more open, safe, resilient, and sustainable. SDG 11 "Sustainable cities and communities" emphasises digitalisation as a means of addressing implementation processes, designing and feeding indicators, and monitoring SDG targets.

In this background, the G20 countries are adopting programs and mechanisms like data-driven governance, use of analytics and emerging technology etc., leading to the creation of digital ecosystems that deliver accessible, inclusive, efficient, citizen-centric governance, thus paving the way for improving ease of living for citizens. Data shows that digital engagement levels are often higher in emerging economies than in developed ones. This trend is evident in both e-participation on government portals and in online public comfort indicators.

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(Digital Cities Index 2022, 2022)



Embracing Digitalisation for Revolutionising the Urban Domain

As cities are becoming increasingly complex, today we are seeing only a preview of what technology could eventually do for improving the urban environment. Members of G20 Countries have taken focused initiatives that effectively leverage digitalisation to boost citizen well-being and deliver more efficient, sustainable, and inclusive urban services and environments as part of a collaborative, multi-stakeholder process.

Some key developments at national and local level

across the countries that have embraced digitalisation for improving cities are highlighted in this paper.

These initiatives span across multiple sectors like Disaster Risk Reduction, Safety and Security, Municipal Service Delivery, Citizen Engagement, Climate Change, City Planning, Open Data and Data Sharing. The case studies have been presented under 6 thematic verticals as indicated below.



Source: Author compilation

1. Creating favourable ecosystems

Countries have taken an initiative towards digital transformation by adopting national-level programs that can foster development of a data and technology-driven urban ecosystem solving urban challenges.

1 (a): Creating an urban data culture across 100 smart cities with the Data Smart Cities (DSC) Initiative, India

With the deployment of IoT devices, sensors, and other methods to 'sense' the city, as part of the Smart Cities Mission launched in 2015, the sources and size of the data generated in a city were increasing every day (Smart Cities Mission, n.d.). However, the functions integral to the working of a city were being performed by different departments and agencies with a lack of standardised data management leading to a lack of data usage. The DataSmart Cities (DSC) initiative was conceptualised to successfully institutionalise a "culture of data" in cities. This promoted data-driven governance and policy formulation, data sharing and exchange, and multi-disciplinary research to achieve co-creation and open innovation, thus leading to improved service delivery and cohesive city operations.

The DSC initiative in India was launched across 100 Smart Cities in 2019. The initiative uses the People, Process and Platform approach to imbibe a culture of data in the city functioning as below:

- 'People' pillar focuses on the appointment of skilled personnel that can support the implementation of data-driven solutions
- 'Process' pillar focuses on the formulation and institutionalisation of data policies and alliances for identification, publishing, sharing, and procuring of datasets and data feeds
- 'Platform' pillar focuses on the usage of digital platforms needed for the management, analysis, sharing and use of data

DSC also provides a conceptual framework for integration and collaboration between three different levels of government in India i.e., City, State and Centre.



DSC approach Source: Author compilation

Outcome

Over time, DSC has been able to imbibe a culture of data in cities and is now supporting an urban data ecosystem of 100 City Data Offices, 50+ data policies, 0.1 million+ aggregated datasets across its' data platforms (e.g. India Urban Data Exchange), etc. (Ministry of Housing and Urban Affairs & Smart Cities Mission, Data Smart Cities - Empowering Cities through Data, 2019).

The approach followed in DSC towards the establishment of an institutional structure and governance mechanisms can be replicated across countries to imbibe a culture of data in their cities. This coupled with the use of digital platforms, the adoption of strategies for emerging technologies such as AI/ML and Blockchain can aid in evidence-based planning and management to improve the quality of life of citizens.

1 (b): Developing a holistic Artificial Intelligence ecosystem in the country - Singapore

The National AI Strategy, Smart Nation Singapore was conceptualized to make Singapore a leader in developing and deploying impactful AI solutions that are scalable, in sectors of high value and relevance to their citizens and businesses. Singapore started by focusing on projects, ecosystem enablers and collaborations to deliver strong social and/or economic impact.

The initial tranche of 5 National AI Projects was finalised to guide investment in AI research, generate demand, anchor talent and capabilities in Singapore, and build the supporting digital infrastructure. These include 5 critical **Ecosystem Enablers** to enhance AI innovation and adoption and generate sustained benefits from AI.



Initial tranche of 5 National AI Projects Source: Author compilation

Partnerships were established with multiple organisations to set up initiatives such as OneService Municipal Service Office, Al Singapore, Enterprise Singapore, Digital Industry etc. Launched in May 2017, Al Singapore has brought together all Singapore - based research institutions and the vibrant ecosystem of Al start-ups and companies developing Al products to use-inspired research, grow knowledge, create tools, and develop the talent to power Al efforts. Some of its programmes include Al Research, Al Governance, Al Technology, Al Innovation, Al Products and Learn Al

Outcome

Several AI based interventions that have been developed in Singapore are:

- Singapore Land Transport Authority (LTA) has created an automated enforcement system that uses AI technology to monitor traffic conditions on roads and expressways.
- The government's CIO office GovTech developed a video analytics system to develop the Safe Distance @ Parks portal which provides live crowd density data in parks, gardens, and nature reserves across the island.
- AI-based facial recognition is helping retailers identify customer demographics and behaviour patterns to improve their marketing strategies, and chatbots, which provide instant customer service



Five critical ecosystem enablers to enhance AI innovation Source: Author compilation

2. Connected Devices

Urban data infrastructure is a combination of digital assets, processes and agents that facilitate the flow of data within an urban area. A new juncture concerning urban data infrastructure has been reached with digital systems, such as the Internet of Things (IoT), embedded sensors, Wi-Fi, smartphones, 5G, fibre network, increased storage, and cloud systems. Cities have started deploying devices and field sensors to 'sense' the city and use them for improving city functioning across multiple domains:

- Security: Closed Circuit TeleVision (CCTV), Video Surveillance System (VSS), Motion Detection Sensor
- Mobility: Vehicle Detection Sensors, Global Positioning System (GPS), Speed Detection Cameras
- Water: pH sensors, Flow meters, Water quality sensors, Turbidity sensors, Dissolved oxygen sensors
- Waste: Radio Frequency Identification (RFID), Waste bin capacity sensors, Global Positioning System Sensors
- Environment: Air Quality Monitoring sensors, Rainfall and Humidity sensors

However, certain factors must be considered regarding digital infrastructure such as expense in infrastructure across cities and obsolescence owing to rapid technological evolution. Additionally, the entire supply chain for adoption and operationalising IT infrastructure requires multiple regulatory approvals, and establishment of institutional processes including procurement, deployment, operations and maintenance of the networked devices, monitoring and evaluation etc. thereby increasing the investment manifold. Further, syncing of technologies between the networked devices and interoperability is a major concern with rigid and complex legacy IT infrastructures.

Smart devices and field devices can be deployed for various purposes to understand practices in the city and may help monitor multiple sectors simultaneously. Data collection through devices has helped cities build upon the data and use platforms and analytical tools to shift through the large quantum of data and information.

2 (a): Utilising IoT for data collection and decision making -Barcelona, Spain

Barcelona has harnessed the power of data and technology to transform itself by deploying smart devices to collect data across multiple domains. The Smart City Barcelona team identified 12 areas for intervention and initiated 22 programs, encompassing 83 distinct projects across urban systems.

The projects took advantage of 500 kilometres of fibre optic cable within the city, which serves as a backbone for integrated city systems. The city installed:

- smart meters to monitor and optimise energy consumption
- smart bins to monitor waste levels and optimise collection routes
- sensor system to guide drivers to parking spaces
- sensors to monitor rain, humidity, and air quality
- smart lighting

Such devices are being utilised to drive efficiency across various services. For instance, IoT technologies have been deployed to remotely sense and control park irrigation and water levels in public fountains in 68 per cent of public parks, which helped the city achieve a 25 per cent increase in water conservation, for savings of approximately USD 555,000 per year. A dashboard for one of these public parks is depicted on the adjoining page.

Outcome

Through investments in IoT for urban systems, Barcelona has saved the city money and reduced the consumption of valuable resources like energy and water. It is estimated that the IoT system has helped:

- increase parking revenues by USD 50 million per year
- save USD 58 million on water management
- produced 30 per cent energy savings including USD 37 million annual savings through smart lighting

Barcelona's commitment to producing smart urban infrastructure is improving the quality of life for residents and visitors.



Visualizer for dashboard developed by Barcelona Council and Wonderware Source : Saving water with Smart Irrigation System in Barcelona

2 (b): Smart Bins to manage solid waste - Melbourne, Australia

Context

The city of Melbourne has been dedicated to maintaining beautiful clean streets and getting people involved with recycling their waste. Melbourne collects close to 4800 tonnes of waste every year through a system of street bins. There was a need to ensure efficiency in collections so that bins would not be collected unless they are full.

Description

The city introduced smarter, more innovative ways of managing waste and recycling, helping to keep streets clean, reduce litter in busy city locations and promote a circular economy. By placing sensors in rubbish bin lids and combining them with IoT. Solar Bins Australia developed a world-leading solution for efficient and sustainable waste management operations.

In 2017, Solar Bins Australia deployed 450 solar smart bins at strategic locations. These bins have sensors that can monitor the fill-level rates, temperature, and fullness of rubbish bins. These bins alert waste collectors when they are 80 per cent full and require collecting. The data from these devices is sent to a waste management dashboard and mobile phone application to provide analytics and reports for waste managers. (Solar Bins Australia, 2017)

Outcome

There have been various impacts of introducing smart bins.

- improved waste collection efficiency
- increased deep-waste data capture
- reduced public complaints
- fewer waste trucks needed to empty the bins helping reduce traffic congestion



Solar smart bins dashboard Source : Solar Bins, Australia

Special Mentions

- Smart Water Management, Cape Town The city implemented the "Smart Water Meter Challenge" to monitor water usage in real-time, detect leaks, and reduce water consumption which helped successfully reduce citywide consumption by 15 per cent and up to 40 per cent in some neighbourhoods, while improving overall water management efficiency (Ernstzen, 2019).
- Advanced Integrated Real-Time Control of Combined Urban Drainage Systems using MPC, Badalona: Combined Urban Drainage System (CUDS) collects both wastewater and rain water through sewer networks and conveys the water to wastewater treatment plants

(WWTP) before releasing to the environment. During stormy weather, rain and wastewater can overload the capacity of the CUDS and/or the WWTPs, producing combined sewer overflows (CSO). In order to improve the management efficiency of CUDS, advanced real-time control (RTC) of detention and diversion infrastructures in the sewer systems has been proven to contribute to reducing the CSO volumes. This work considers the integrated capacity of sewer network and WWTPs based on model predictive control (MPC) and taking into account the water quality as well as quantity. This minimizes the environmental impact of CSO on receiving waters.

3. Digital Platforms

Digital Platforms form a key component of any digital infrastructure that provide a digital space comprising facilities for users to collaborate, interact or transact digitally. Platform performs many functions such as visualisation, application enablement and data management. These platforms are deployed in a private, public, or hybrid cloud, via a remote server, or on-premises and can be licensed or open source. They may act as a seamless interface for data providers and data users to share, request, and access datasets related to cities, urban governance, and urban service delivery.

Governments are increasingly providing multi-channel access through websites and mobile applications to provide citizens with choice, thereby ensuring faster and more efficient service delivery, payment of taxes and fees and grievance resolution. Digital delivery of government-to-citizen (G2C) services has demonstrated how technology can be used to improve urban services and quality of life. However, these projects tend to be top-down and technology-driven and can benefit from public participation. For the next wave of digital city innovations to be effective, citizen involvement is vital. Citizen-to-government (C2G) interactions need to be emphasised so that citizens participate in government processes and have an opportunity to contribute during policy formulation and implementation. Citizen participation can make city planning more inclusive, transparent and facilitate interactions and transactions between stakeholders.

Effective digital service delivery and two-way communication ensure that the interaction of citizens

with municipal corporations becomes seamless and may result in a reduced need for physical interfacing. In addition, governments are increasingly using crowd-sourced data to gain real-time detailed information on public service delivery and infrastructure needs and facilitate appropriate real-time responses. These digital platforms can be replicated across cities and in multiple service delivery domains depending on the functions being performed by cities. The data generated through the digital infrastructure can be accessed through these platforms, which also can act as systems for analysing data and generating actionable insights for evidence-based decision-making and governance.

3 (a): Urban Platform for delivery of Online Governance (UPYOG) – India

UPYOG is an initiative under the National Urban Digital Mission of Government of India, which aims to assist municipal bodies across India to improve service delivery mechanisms, achieve better information management and transparency, and ensure citizen's involvement in participatory governance. This will provide a non-proprietory digital framework to states that are in different stages of development and digitilisation, thereby reducing cost associated with development, and addressing issues related to licensing, capacity constraints, interoperability, etc. 66

Many municipalities in Brazil switched to open-source software in the early 2000s because "estimates at the time concluded that across the country, nearly USD 200 million per year was spent on licensing fees to service provider alone and, by switching, USD 120 million could be saved" (Shaping Europe's digital future, 2021)

UPYOG is a free and open-source software, available for states and cities including cloud services. States/ Cities can either implement the centrally hosted instance, focusing mainly on configuring the platform and solutions or create their own instance as per their needs. (NIUA, 2021)

It is the national reference platform for e-governance services which utilises principles under the National Urban Innovation Stack (NUIS) to offer a cost-effective solution with 10 reference applications (NIUA, 2021) -Property Tax Assessment and Payment, Online Building Plan Approval System, Public Grievance Redressal, Trade License Issuance and Payment, No-Objection Certificate Issuance, Water and Sewerage Connection Management, NMAM- Compliant Municipal Accounting and Finance, Birth and Death Certificates, Faecal Sludge Management and Miscellaneous Collections.

Additionally, the National Urban Real-Time (NURT) Dashboard is being offered for data aggregation in the States thus, contributing to data-based reporting and governance.

Outcome

The mission enhances ease of living by providing equitable access to online Government to Citizen (G2C) and Government to Government (G2G) municipal services in all towns and cities. Further, it also enhances Ease of Doing Business (EoDB) by providing hassle-free, one stop access to online Government to Business (G2B) municipal services in all towns and cities. The States and their ULBs have the choice of using any / all modules being offered to deliver urban / municipal services digitally.

99

Further, the Mission is developing and promoting adoption of standards in digital delivery of urban services for interoperability, baselining, and monitoring of KPIs on common benchmarks. The UPYOG platform is also GIS enabled for property mapping and city planning and other related urban services. Currently 28 States and Union territories have signed Memorandum of Understanding with the NUDM and implementation of UPYOG modules



Source: Author compilation

is underway in 6 States. 3 States have utilized the NURT Dashboard for data aggregation. Remaining States / UTs are currently in the process of assessing their existing IT infrastructure by utilizing the NUDM Assessment Framework to finalise the future course of action.

3 (b): Crowdsourcing ideas through Citizen Participation for the Constitution – Mexico City, Mexico

To recover the population's trust in the constitutional process, Mexico City adopted Crowd Law practices - enabling ordinary citizens to participate. The Mayor established a Working Group, composed of 30 leading citizens from different spheres of city life and instructed Laboratorio para la Ciudad - Mexico City's creativity and experimentation office- to develop a platform to channel popular opinions and proposals from citizens to the working group.

The platform offered four different options for the user to participate, depending on their interest in the matter, time availability, and level of knowledge about specific affairs (Crowdsourcing Mexico City's Constitution (n.d.)). One was the survey Imagina tu Ciudad, designed to elicit the citizen's hopes, expectations, challenges, and ideas for the future of the city. This mechanism led to 31,000 geo-tagged submissions.

- Draft an online petition via Change.org ensuring commitment to specific actions depending on the number of signatures the petition would gather.
 Petitions that surpassed a 50,000-signature threshold would be explicitly included in the constitutional draft to be debated and discussed.
- A collaborative drafting platform allowed people to annotate and comment on essays written by

the members of the Working Group dealing with constitutional theory, technical proposals, and academic papers.

Registration for any event organised related to the Constitution.



Kiosks where citizens can participate Source: Image by Mexico City

Outcome

The initiative was able to successfully engage a substantial number of citizens. 64.41 per cent of participants were between 18 and 34 years old, with 69.9 per cent of visits to the platform made from a mobile device, 25.31 per cent from a desktop, and 4.7 per cent from tablets. Number of Change.org users following Constitución CDMX updates rose to 479,212 with 35.8 per cent of the supporters signing more than one petition and 341 proposals having more than 400,000 unique followers. 30,000 geo-tagged answers under the Imagina tu Ciudad Survey represented 1,474 neighbourhoods, accounting for 90 per cent of all the neighbourhoods in the city.

The final document is the most progressive constitution in Latin America, and it has been recognised by the United Nations as "a guide to fulfilling the universal, indivisible and progressive nature of human rights, the Sustainable Development Goals, and the 2030 Agenda"

Special Mentions

- MyLA 311 City App in Los Angeles (US): The Mobile Application, provides more than 1,500 city services online (MyLA 311, n.d.)
- **Digital Signage System in Seoul (South Korea):** The Digital Signages give commuters engaging, easy-to-access real-time information about traffic, transit routes and local amenities (Mutter, 2015)
- Electronic Graft Management Project (Kenya): The Project uses channels that offered more privacy through which the citizens could report corrupt practices and set corruption reporting facilities like Internet Cafe and e-Touch centres in 6 towns for citizens to access and report such occurrences. The Electronic Graft Management Centre filtered all sources of information electronically and forwarded it to the relevant public authorities for action.

4. Data-driven governance

The growth of networked devices deployed across urban ecosystems results in explosive growth in the amount of data generated. This data can provide actionable insights and intelligence for improved planning and policymaking. Software and analytical tools are helping cities and administrators sift through tons of data and information and generate actionable insights. The use of data analytics is increasingly seen to provide unparalleled ways to address a range of concerns facing cities today. Geographic Information Systems (GIS) and spatial analysis are being widely used to visualise, analyse, and manage the urban environment and support city planning. Spatial analysis supports forecasting disasters, early warning systems etc. The emergence of data as an omnipresent reality of modern cities means that a comprehensive data culture is becoming increasingly important.

Cities, well versed in systems and capacities, can use data and set up operation centres to track movements, enhance security, prevent congestion, predict natural disasters, nudge tourists into less congested areas, reduce waste, and become energy efficient. Driving governance decisions more effectively is becoming pertinent with the urban ecosystem becoming a 'system of systems' for handling the day-to-day exceptions and helping in efficient city functioning.

Currently, the data being generated and owned across departments, agencies and institutions is stored in silos and not shared effectively leading to inefficiencies. With enormous data being constantly generated, it is essential for cities to manage it, which includes processes for proactively collecting, organising, protecting, storing, and sharing data. While many cities have powerful systems and platforms, most lack the required internal skill sets and capacity. There are also risks and concerns over security and privacy that can be mitigated by having robust ecosystems. This highlights the need for improved methods to reduce the risk of cyber breaches, wherein in 2020, municipalities were the target of 44 per cent of ransomware attacks globally (Verizon, 2022).

4 (a): Disaster Risk Reduction and Management using Data - Rio de Janeiro, Brazil

In April 2010, Rio de Janeiro suffered heavy rains (over 304mm in 24h) and 68 citizens died due to landslides. Moreover, 22.7 per cent of the city's population (around 1.47 million) lives in vulnerable low-income communities, most of which are located on slopes. Rio Operations Center was set up with a goal of increasing the city's resilience (Rio Operations Center, n.d.).

Rio Operations Centre was developed as an "information architecture" by gathering existing information – both from the private and the public sectors – that was relevant to disaster risk management. The initiative is based on three pillars:

- collection of data from sensors such as radar sensors, rain gauges, GPS systems, social networks, images, and other sources
- analysis of information to carry out operational decisions
- dissemination of information to the citizens, alerting citizens of disasters or other problems

Outcome

At present, emergencies, disasters, public utility problems and public transit issues are managed from the Rio Operations Centre, which has three key components (Rio Operations Center, n.d.):

- The Control Room where 200 controllers, in three shifts, monitor the city 24/7 in real time, receiving images from over 900 cameras, through 30 km of fibre-optic cable on a 60 sq.m. video wall consisting of 80, 46-inch monitors.
- The Crisis Room is used for emergency meetings amongst various departments and is also connected to two other small crisis rooms, one at the mayor's official residence, and the other at the Civil Défense Service.
- The Press Room is where communication with all media outlets takes place in a two-way exchange of information that amplifies the communication of the municipal authorities' messages and the media.

4 (b): Data-driven decision making through Integrated Command and Control Centres (ICCCs) - India

The rise of smart cities in India has helped in bringing data-centric solutions to urban challenges. Under the Smart Cities Mission, the Ministry of Housing and Urban Affairs has facilitated the setting up of Integrated Command and Control Centres (ICCCs) that are being used to enable collation of information and collaborative monitoring, thus helping in the analysis of data for quicker decision making. The use of ICCCs has been encouraged to address urban challenges like women and child safety, mobility, water management, waste management, environment management, etc. across 100 cities under the Smart Cities Mission. More than USD 2 Bn have been invested in setting up these ICCCs and a Maturity Assessment Framework has been established to enhance the application of data in improving city functioning. Two use-cases of ICCCs are detailed below.

Vadodara City Administration used its ICCC for ambulances and other emergency vehicles while minimally disrupting the existing traffic on the road to save the lives of citizens in the first critical hour (IUDX, Ministry of Housing and Urban Affairs, & Smart Cities Mission, 2021). This green corridor has helped improve the travel time of the emergency vehicles by effectively coordinating vehicle location, route navigation and traffic lights. In case of a medical emergency, a patient's health status and hospital information are integrated to provide the required help in time.

Sagar City Administration integrated the Nirbhaya mobile App for Women Safety with the ICCC. This ensures an increase in safety & security for women and can be used in case of emergency, threat, or any untoward incident. The ICCC receives information through mails and calls, and alerts the police department, which can track the location, phone number, and E-mail address of the woman who is in trouble. The automatically captured front and back camera images by the phone of the woman in trouble are also received. Women can also see of the city marked in the application which is continuously monitored in the ICCC and can access the safe routes for travelling purposes. (Ministry of Housing and Urban Affair, n.d.)



ICCC at Sagar Smart City Source: Website - https://iccc.smartcities.gov.in

Outcome

ICCCs have been acting as the brain and nervous system for cities and receive real-time data from different departments/ sensors/ social media and other sources across India. This information is processed and analysed to build situational awareness and decide on any necessary action to take in near real-time. All decisions are then communicated to the relevant front-line departments, entities or the public.

5. Data Sharing

Data sharing is a key element in cross-sectoral collaborations for solving urban challenges while maintaining transparency in cities. There is increasing acknowledgment of the need to share data and develop a more people-centric, sustainable urban environment through advanced urban digital transformation. With data-sharing, the systems in cities can operate more efficiently.

In cities, datasets can be used, reused, and shared to encourage stakeholders across the urban ecosystem, including academia, businesses, and start-ups, to co-create innovative solutions and use emerging technologies across sectors. Developing alliances and an open data platform for data sharing can help cities

Special Mentions

- Disaster forecasting by Indian National Centre for Ocean Information Services - A near real-time system for Disaster Risk Reduction that provides risk forecasts in coastal areas and pinpoints vulnerable buildings. Real-time earthquake indicators are derived within 15-20 minutes of the incident (Aggarwal, 2018).
- Spatial Planning using PM GatiShakti Portal, India - City Officials in India can integrate their geospatial data on the PM GatiShakti Portal and create a decision-making system that enables analysing of data and formulation of a city-level masterplan to enable better city planning.

become more transparent and get innovative solutions across sectors from multiple stakeholders.

The value of public access to open data and collaboration within and between cities; between private-public agencies-citizens; and at national-regional-local scales cannot be underscored. Some countries and cities have started sharing non-sensitive data on open data portals. By making urban datasets available and accessible, city administrations are becoming more transparent and accountable to citizens.

The establishment of digital alliances across urban stakeholders (comprised of local, regional, and national governments, private-sector partners, start-ups, not-for-profits, citizens, think-tanks, etc.) is becoming popular for knowledge sharing and peer learning. It also helps with faster replication and scaling of digital solutions.

However, data sharing raises concerns on privacy and security of the citizens' data. Effective data management necessitates standardisation of data, secure storage, analysis, accuracy, and verification of its accuracy, as well as management of personal data and sensitive information. Data retention and deletion, data ownership, encryption, and secure storage require attention and awareness of all stakeholders. Many cities do not have processes in place to ensure they follow such data management principles.

5 (a): A Free and Open Data-sharing Portal - London, United Kingdom

The Greater London Authority has created the London Datastore as the first step towards making London's data more open. The aim is to let everyone access the data that all public sector organisations hold, and to use that data however they see fit - for free. London Datastore is a repository of data, metadata, and visualisations spanning a wide range of sources including central government, the Greater London Authority, local authorities, and utility companies. The platform includes an open data platform and a closed platform for secure data sharing. (Greater Manchester. (n.d.)).

Based on data available in the data store, the department has identified issues related to gas heating, and charging EVs in the city. It also provides a public-facing dashboard with an overview of key information on public services, transport, the environment, health, housing, and demography. Datasets containing underlying data in 18 categories are included separately. These portals have proven their usefulness by empowering people, increasing transparency, and enabling innovations (Greater Manchester. (n.d.)

Outcome

The Datastore hosts over 6,000 datasets across various sectors consumed by approximately 60,000 users each month. With 10+ lakhs API hits per day, the platform allows file downloads, querying tables and programmatic updates. It is supporting innovative applications being developed, including those by start-ups.

For example, a start-up, City mapper Limited has developed 'City mapper' a transport app for residents, visitors, and commuters to help them move around London. It includes travel information on buses, trains, tubes, trams, ferries, and cycles, along with the best walking and driving routes. The underlying data is pulled from various sources, including open data from transport authorities from London Datastore and local transit authorities. The start-up has now expanded and as of 2021, provided its services to 50 million users across 80 cities.



Number of cities with open-data portals by region

Source: Using digital technology for green and just recovery in cities, 2022

5 (b): Digital Public Goods Alliance (DPGA)

Digital Public Goods Alliance is a multi-stakeholder initiative with a mission to accelerate the attainment of the SDGs in low and middle-income countries by facilitating discovery, development, use of, and investment in digital public goods. This alliance has been part of the response to the global call to end poverty, protecting the planet, and improving the lives and prospects of everyone, everywhere (Digital Public Goods Alliance: 5 Year Strategy (2021-2026), 2021).

The DPGA relies on engagement and leadership from private sector technology experts, think tanks, governments, philanthropic donors, international implementing organisations, and the UN.

Digital public goods can be defined as open-source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable laws and best practices, do no harm by design, and help attain the SDGs (Digital Public Goods Alliance: 5 Year Strategy (2021-2026), 2021). In 2020, DPGA also established the foundational tools meant to help achieve their mission, including the DPG Standard and DPG Registry.

Outcome

DPGs are open-source solutions that can be used to build communities, share knowledge, and foster joint approaches and actions. Some of the DPGs showcased on the portal are (Registry, n.d.):

- Climate Information Platform: Provides easy access to pre-calculated climate indicators of weather and water for better climate adaptation and mitigation planning.
- Consul Democracy: A citizen participation tool for an open, transparent, and democratic government.
- Data Observation Toolkit: A toolkit that can be used to screen data as it's collected and flags problems with data integrity, data quality, protocols, outliers, etc.
- Accessible Kazakhstan: A model of an online map with information on public facilities that enables people with limited mobility to navigate public space.



Snippet from the website of London Datastore Source: Website (https://data.london.gov.uk/)

Special Mentions

- CitySDK (City Service Development Kit) by the EU - The Kit provides shared application development tools and involves multiple cities for sharing, reusing, and transferring solutions like the OpenData Globe application that visualises data.
- Open Data Portal of Sydney, Australia The data portal provides access to data for creating maps/APIs and analysing and discovering trends (City of Sydney Data Hub, n.d.).

6. Emerging Technologies

Cities are using technologies such as artificial intelligence, machine learning, Cyber Physical Systems IoT, and big data to carry out predictive analytics that help in informed decision-making. Combining emerging technologies to create a sustainable ecosystem is dramatically improving how cities can mitigate problems of traffic, energy crisis, climate change, water scarcity etc.

Use of emerging technologies needs skilled personnel who can implement these to automate processes, analyse large amounts of data, and forecast and plan for future urbanisation trends. With vast amounts of data being generated daily, with personal and non-personal information, the ethical use of AI also becomes critical.

6 (a): Using Artificial Intelligence for Forecasting Pollution under the Green Horizons Project – Beijing, China

It is estimated that around 70 per cent of China's population will live in cities by 2050, with more than 200 million people moving to urban areas. In an effort to improve the quality of life of citizens in these urban areas and reduce health issues related to air pollution, a project was launched by a leading technology provider, 'Green Horizon Project' to support China's clean air action plan with next-generation pollution forecasting.

The Green Horizon Project uses real-time data to give accurate predictions using Artificial Intelligence (AI) on where pollution will be generated and how it will spread. The data is compiled from multiple sources including environmental monitoring stations, traffic cameras, weather stations, meteorological and environmental satellites, social media, and portable sensors. Machine learning and other cognitive technologies are used to analyse the data in a model that makes highly accurate predictions about pollution 72 hours in advance and predicts trends over the next 10 days. Using these predictions, the government can make more informed, timely choices on air quality control policies.

Outcome

Based on the information from the Green Horizon Project, the city has developed policies related to traffic, construction, and industry. Beijing's Environmental Protection Bureau also uses the data to power a coloured alert system that warns people when harmful levels of pollution are expected. The Green Horizon project helped Beijing's government reduce ultra-fine particulate matter, the most dangerous type of air pollution, by 20 per cent in less than a year (Guay, 2017). The project has been further expanded to cities in, Japan, South Africa, the UK, and the US.

6 (b): Use of Block-chain for Land Transfer Records - Sweden

The World Bank estimates that 70 per cent of the world's population lacks access to land titling (Wong, 2017). This can be a challenge for ensuring efficient and transparent land markets, and has implications for the urban economy. Real estate in Sweden is currently worth approximately USD 1.2 trillion, around three times the value of Sweden's GDP. Despite the tremendous economic importance of land transactions, existing land transfer processes were slow, vulnerable and susceptible to human errors. There was an urgent need to reform the land titling and transfer processes.

The Lantmäteriet, the official Swedish Land Registry committed to leveraging new technology to improve its services and processes regarding transfer of land. In the 1970s, it digitised its land registry. However, the land transfer process was not digital, and hence, entries in the land registry tended to be missing, incomplete, or wrong. The volume of documentation required and the amount of duplication of data entry increased the risk of error, and between 4-7 per cent of applications needed to be re-submitted.



Beijing air quality index dashboard Source : Webstie (https://aqicn.org/city/beijing/)

In 2016, the Government, along with a telecom and a blockchain start-up, began to explore potential blockchain applications for transfer of property in Sweden. The consortium developed a prototype in which land related transactions are put on the blockchain the moment an agreement to sell is reached and remain until the land title is transferred to the concerned authority.

Users can navigate the blockchain through an app, with differing interfaces for different classes of users. End users like buyers and sellers can use a dedicated mobile application. End users can see the status of the contract and are prompted when action on their part is needed. Professional users, such as banks, realtors, and the government can also access the contract in a professional interface, which can be integrated with their own systems and processes.

Outcome

The project sought to limit information asymmetries by allowing all parties – banks, land registry, brokers, buyers, and sellers – to monitor the progress of the transaction, and potentially produce cost savings of more than €100m a year (McMurren, Young, & Verhuls). The project has already successfully concluded their third testing phase with a full demonstration (Kim, 2018).

Special Mentions

 Smart Traffic Technology in Pittsburgh (USA)
 The data coming from the traffic sensors are analysed using Artificial Intelligence to streamline the traffic optimally by generating a signal timing plan in real time. The system cuts down travel time by 25 per cent, braking by 30 per cent and

idling by more than 40 per cent (Snow, 2017).

 E-governance in Estonia – Estonia uses blockchain through its e-Law system that allows public access to every draft law submitted since February 2003, and blockchain-based e-Health Records (How Emerging Technologies Are Boosting E-Governance in Estonia, 2021).

Key Drivers for Action



Key drivers to propel digitalisation efforts in cities Source: Author compilation

Strengthening Digital Infrastructure

Setting up appropriate digital and technology infrastructure will be critical to enable smart digitalisation of cities. Cities should prioritise and allocate resources and investments towards digital infrastructure and building infrastructure for a network of urban data in the city.

Some of the platforms that enable data sharing between multiple key stakeholders are Smart Cities Open Data Portal (India), data.europa.eu (EU), City Dashboard (Australia), etc. wherein high-value datasets are available in an open format and can be used for analysis and research purposes.

Cities can also look at deploying advanced energy-efficient devices/ sensors for collecting data on aspects like air quality, rainfall, traffic conditions, etc. Data platforms/interfaces that can be used across various levels of government to collect, analyse, and generate insights that can help maximise use of data. These can also act as an analytics platform for researchers, academicians etc., by being selectively accessible to other stakeholders. Developing data exchange tools and frameworks, addressing the concerns of data privacy and data ownership, enable sharing of data will help to unlock productivity, increase efficiency and boost research and innovation.

Restructuring Governance Mechanisms

Creating and adopting planning and development standards for the multi-functional use of data and technology is a key requirement to promote interoperability across platforms, processes, and data related to various smart services and city operations. This will have to be complemented by a data management strategy that sets out protocols and processes for collection, organising, protecting, storing and sharing of data collected from various sources. Policies for sharing or monetisation of non-sensitive data can help further research, innovation and wider stakeholder participation in the long run. It will also be critical to adopt laws and regulations that protect privacy rights of citizens. Lastly, it will be critical to adopt emerging technologies like big data and AI/ML to automate processes, analyse large amounts of data, and forecast and plan for future urbanisation trends. Several of the already available international and national standards, such as those from ISO, IEEE, ITU-T, NUDM Knowledge Standards, etc. may be adapted to create national/local guidelines and ensure consistent data management and development of ecosystems.

Implementation of monitoring and evaluation systems including the use of IoT technologies and data-gathering processes to improve performance and accountability at all levels of governance may be considered.

A variety of tools have already been developed by international institutions, including World Bank (Digital Government & Open Data Readiness Assessment Toolkit, UN (United for Smart Sustainable Cities Framework for SDGs), European Commission (CITYkeys indicator framework for smart cities) and several countries like India (Data Maturity Assessment Framework, NUDM Action Framework), and may be referenced/adopted by nations and cities according to their needs.

Enhancing Digital Capacities

Cities need to invest in building the capacity and skills of its personnel to efficiently manage technology, handle data with due process, integrity and ethical considerations, and importantly apply data and analytics to improve operational efficiencies, planning and service delivery.

Equally important would be to support creation of digital skills across the education system and industry. This will not only result in widespread digital literacy but also boost technical skills in the workforce.

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An OECD-Bloomberg Philanthropies Survey on "Innovation Capacity" across 80+ cities shows that just under 17 per cent conduct a systematic and comprehensive assessment of their innovation outcomes, while half of them reported that they do evaluate some elements of their innovation strategy or outcomes.

Enhancing Innovation Capacity in City Government, OECD 2019

Encouraging Innovative Urban Solutions

Cities have an important role to play in facilitating new innovators, entrepreneurs and startups to build smart solutions and encourage disruptive technologies that can transform the urban space. This can be in the form of funding, setting up of dedicated innovation units within the city administration, supporting the formation of digital clusters, or facilitating the creation of incubators. Cities will also have to encourage use of emerging technologies like big data and AI/ML to automate processes, analyse large amounts of data and forecast and plan for future urbanisation trends and needs.

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A leading technology provider has partnered with the Ministry of Skill Development and Entrepreneurship (MSDE) and Capacity Building Commission (CBC) to help India's civil servants develop digital skills. The collaboration aims to enhance the functional computer literacy of nearly 2.5 million civil servants across the country.

National Skills Network, 2022)



Digital alliances between urban stakeholders (like local and national governments, private-sector partners, start-ups, non-profits, citizens, etc.) are essential for sharing knowledge, enhancing interoperability and peer learning. Several global alliances have been established to maximise the use of data and digital by supporting knowledge sharing and innovation such as the G20 Global Smart Cities Alliance on Technology Governance (WEF), Smart Cities Council, G20 Digital Innovation Alliance (India), etc.

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