

Strengthening Climate Action and Resilience Planning for Bengaluru

A SUMMARY OF KEY TAKEAWAYS FROM A SERIES OF CONSULTATIVE SESSIONS WITH EXPERTS, ORGANIZATIONS AND PRACTITIONERS IN BENGALURU

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BACKGROUND

Bengaluru is the fifth most populous metropolis (Census of India 2011) and one of the fastest-growing cities in India. The pressure of urbanization has impacted not only the natural resources and ecological networks in the city region but also the city's livability conditions in terms of deteriorating air quality, frequent floods, and rising temperature levels.

To tackle these challenges and reiterate its commitment to India's climate agenda, Bengaluru joined the C40 Cities network in 2017. Bengaluru is also the co-lead of the Global Air Quality Network and a signatory to Deadline 2020, which requires the city to achieve carbon reduction by 2030 and carbon neutrality by 2050.

As an immediate step, the Bruhat Bengaluru Mahanagara Palike (BBMP) has started preparing a Climate Action and Resilience Plan for Bengaluru (BCAP) in partnership with C40 Cities and WRI India. The plan aims to help Bengaluru city find ways to reduce greenhouse gas (GHG) emissions and to build resilience against climate-related hazards.

The intended objective of the BCAP is to add a climate lens to all the existing and upcoming sectoral and institutional efforts in a manner that is best informed by the available evidence and knowledge. A series of consultative sessions with representatives from academia, think tanks and NGOs, and practitioners were held covering sectors such as stationary energy and buildings, transportation, solid waste, air quality, water, wastewater and stormwater, urban planning and disaster resilience, green cover, and biodiversity (see Figure 1). This round of consultations was part of a series of consultations being planned and conducted for the BCAP involving

CONTENTS

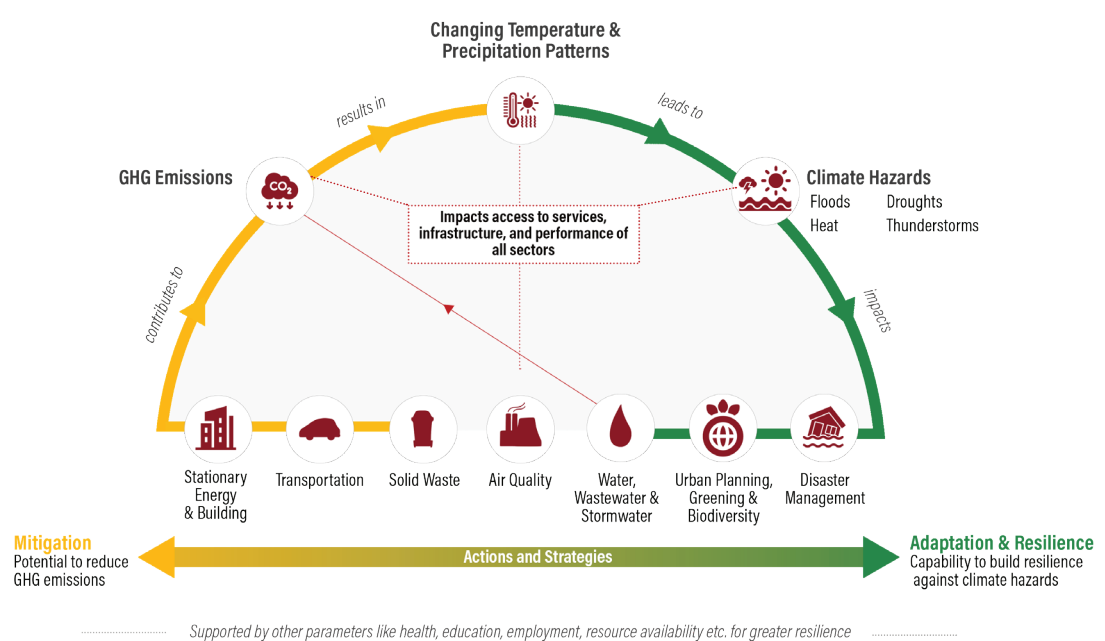
1	Background
3	Climate action opportunities, challenges, and priorities
6	Solid waste management (SWM)
9	Stationary energy and buildings
11	Transportation
14	Air quality management
15	Water and wastewater
17	Urban planning, greening, and biodiversity
22	List of participants
24	List of abbreviations
25	References
26	Acknowledgments
26	About the authors
27	About WRI India

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both governmental and nongovernmental stakeholders such as government departments, parastatals, and members of citizen and civil society groups. The discussions across sessions were framed against the following broad guiding questions:

- What are the strategic opportunities for Bengaluru in mitigation and adaptation that are ambitious, yet feasible to pursue in the short and long term?
- What are the challenges to including a climate action lens in Bengaluru’s sectoral and developmental agendas?
- What type of governance arrangements are required to successfully adopt and implement the climate action plan for Bengaluru concerning institutions and capacities, plans and policies, and processes and platforms?

FIGURE 1 | Sectoral alignment of the BCAP



Notes: BCAP = Climate Action and Resilience Plan for Bengaluru. GHG = greenhouse gas.
 Source: WRI India analysis.

IDENTIFYING CLIMATE ACTION PRIORITIES FOR BENGALURU- KEY TAKEAWAYS FROM CONSULTATIVE SESSIONS

Climate action opportunities, challenges, and priorities for Bengaluru (Session 1 | June 20, 2022)

BOX 1 | Context of climate change perspectives in Bengaluru

Because cities are on the global climate emergency frontlines, strategies must be formulated to ensure resilient and sustainable cities. The discussions around the first session emphasized the need for an action plan while covering the city's advantages and the strategies that could be adopted to achieve the goals of a sustainable and livable city for its residents.

Located in the southeastern part of Karnataka at an average elevation of 920 meters above the mean sea level, the climatic region of Bengaluru broadly falls in the tropical savanna, wet category. The Cauvery-Ponnaiyar River Basin constitutes the major drainage system of the city and its surrounding region.

The boundary considered for developing the BCAP^a is the BBMP^b jurisdiction, which has an area of approximately 713 sq. km with an approximate estimated population of more than 10 million in 2019 (23 percent growth from 2011). The jurisdiction consists of 198 wards and eight zones. Bengaluru saw steady growth in population and economic activities during the last few decades. As a result, the city's built-up footprint grew by almost 170 percent between 1990 and 2015 (see Figure 2). The city's gross domestic product is estimated to be more than Rs. 5,000 billion in 2019.^c

From a climate change perspective, Bengaluru must pay attention to both the mitigation and adaptation sides of climate action, by mitigating the contributions to climate change and building resilience against its impact, which will inevitably occur because of the irreversible changes already taking place in Earth's climate and its atmosphere. Each of the city's infrastructure and service delivery sectors has a role to play in mitigation and adaptation. The actions must be long term, progressive, ambitious yet feasible, implementable, and compatible with the city's larger planning and policy ecosystem. This requires not only progressive strategies, but also coherence between policies, programs, and the institutional ecosystem, in addition to adequate capacity.

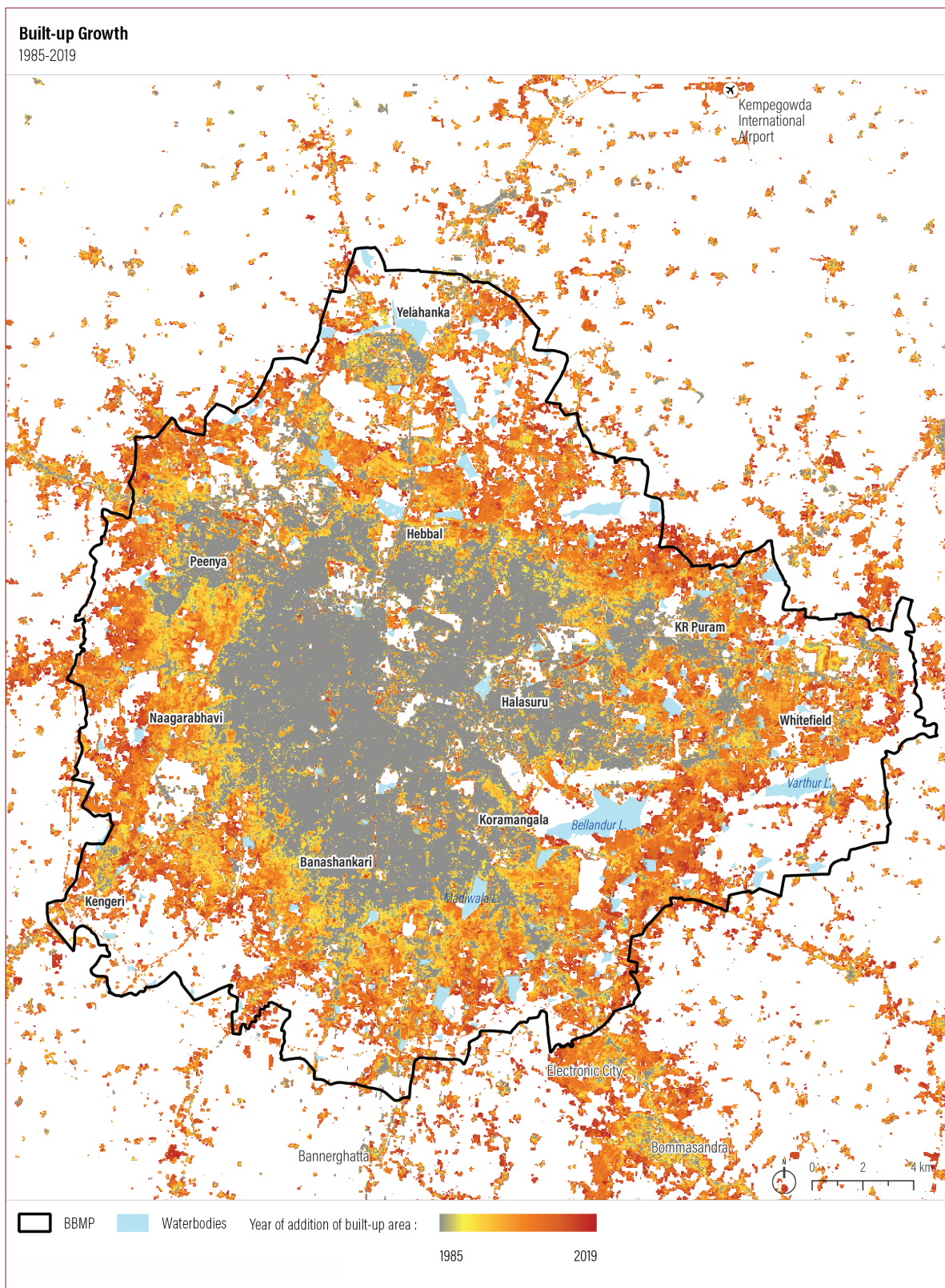
Notes and Sources :

a. BCAP = Climate Action and Resilience Plan for Bengaluru.

b. BBMP = Bruhat Bengaluru Mahanagara Palike.

c. Hindustan Times 2022.

FIGURE 2 | Sectoral alignment of the BCAP



Notes: BCAP = Climate Action and Resilience Plan for Bengaluru.

Source: WRI India analysis; World Settlement Footprint Evolution (German Aerospace Center [DLR], European Space Agency [ESA], GEE) at <https://geoservice.dlr.de/web/maps/eoc/wsfevolution>.

Session 1-Key takeaways

Overarching tenets, approach, and enablers for an implementable, inclusive, and effective climate action plan for Bengaluru:

- **Ensure an inclusive approach to climate action planning:** The climate crisis should not be looked at in isolation with a few select people. Instead, citizen groups such as resident welfare associations (RWAs), ward committees, street-level groups, school students, and trader associations should be involved in climate action. The BCAP is for all residents of the city and hence should be inclusive in its approach by considering inputs from across different groups of people with diverse demographics and socioeconomic backgrounds.
- **Maintain transparency in the planning process:** For an elaborate exercise such as formulating the BCAP, transparency is key; the entire process needs to be transparent and inclusive. Every stage of the process of formulation of the plan should be publicized so that citizens can contribute suggestions.
- **Prioritize equitable access to resources:** Although India has agreed to work toward global commitments, GHG emissions cannot be the sole priority of developing countries such as India. Instead, the city needs to prioritize better access to resources and look at emission reduction as a possibility while improving such access.

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Prioritize the problem of air pollution:** One of the prime concerns of cities in India, including Bengaluru, is air pollution. It is a serious problem that has immediate health consequences. Tackling air pollution should therefore be a priority, and it has been initiated partially through the Clean Air Action Plan. One of the major contributors of air pollution is the transport sector, and hence appropriate actions need to be taken to slowly reduce pollution from vehicular exhaust. A feasible alternative is a gradual shift toward electric vehicles (EVs), which also needs to be supported by adequate infrastructure in terms of, for example, charging stations.
- **Enhance renewable energy sources:** Electricity generation should move in an eco-friendlier direction by increasing the contribution of renewable energy. Renewables for sustainable village power (RSVP) must also be enhanced for the city.
- **Increase the city's green cover:** Bengaluru, which was once known as the garden city, has been losing its greenery with development. Increasing the city's green cover and ensuring that further development does not occur at the cost of trees and lakes is necessary in order to reduce climate change impacts at a micro level.
- **Make the city pedestrian and cycling friendly:** The city needs to be more pedestrian and cycling friendly. Pedestrianization is an important strategic opportunity as a short-term action for Bengaluru to encourage more eco-friendly modes of travel within city limits. This would greatly reduce the dependence on motorized transport, especially for shorter distances, which is currently the norm in the city.

Policies, plans, regulations, and statutory mechanisms:

- **Allocate adequate budget for implementation of the BCAP:** One of the major concerns with initiatives such as the BCAP for Bengaluru is budgetary constraints. Hence, adequate economic provisions must be made to ensure the successful implementation and monitoring of the plan.
- **Explore the potential for green jobs:** Bengaluru is an employment hub and has the potential to be a market for green jobs soon. The city also has a substantial population migrating from other regions of the country and from within the state itself. The BCAP should be inclusive and consider how these two aspects can be factored into its planning.

- **Adopt a decentralized approach to resilience building:** Climatic resilience should be addressed with focused ward-level plans that emphasize climatically vulnerable hotspots and communities. Such a focused approach would empower wards to take adequate steps toward resilience building. Moreover, a decentralized approach would also improve management.
- **Improve the quality-of-life parameters:** The BCAP should focus on improving the quality of life of city residents by putting governance, finance, environmental, and legal frameworks in place and at the same time adhere to the principles of environmental justice.

Governance systems, processes, platforms, and institutional mechanisms:

- **Set up a climate cell to ensure institutional coherence during implementation:** A prime concern would be to ensure satisfactory implementation of the BCAP, given that multiple departments and stakeholders are involved. Hence, climate cells must be set up to ensure policy coherence across sectors, stakeholders, and agencies.
- **Educate the masses regarding climate change and the need for climate action:** Environmental education plays a vital role in reducing carbon emissions. Hence, courses on environmental education should be coordinated by BBMP to create awareness among the residents of Bengaluru and encourage behavioral changes in them. Environmental education should become an integral component of the school curriculum so that the next generation will understand the need to conserve the city's environment.
- **Encourage behavioral shifts:** People must be helped to understand the concept of sustainability in a holistic manner along with how climate change is linked to their daily lives. Such an understanding is critical to encourage a much-needed behavioral shift in individuals

Climate action priorities for solid waste management (SWM) in Bengaluru (Session 2 | June 22, 2022)

BOX 2 | Context of solid waste management in Bengaluru

The municipal solid waste sector is inextricably linked to environmental outcomes and their subsequent economic consequences. The threat of climate change and its associated impacts makes the need for addressing this sector more urgent because it is an important contributor to global warming and climate hazards. Methane emitted from landfills is one of the most important contributors to GHGs due to its global warming potential, which is 28 times higher than that of CO₂ over 100 years.^a Moreover, the socioeconomic and gender inclusion aspects of the solid waste management (SWM) sector deserve specific focus. Women are involved in SWM as street sweepers and doorstep waste collectors. The informal sector is involved, along with various citizen-led groups such as RWAs, community-based organizations, nongovernmental organizations, and self-help groups. Addressing these aspects in climate action can play an important role in achieving mitigation goals through socially and economically inclusive and implementable strategies.

Source: a. Singh et al. 2018.

Session 2-Key takeaways

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Ensure segregation at source:** Although segregation of waste at source is mandated, it is not always done; 100 percent segregation at source and recycling or composting must be ensured. Such a process would minimize the waste entering landfills and thereby reduce emissions. Moreover, it would also improve waste management in the city.
- **Initiate scientific management of closed landfills:** Bioremediation and biomining of the older landfill sites of Bengaluru, for example, Mandur and Mavallipura, is necessary to reduce GHG emissions. This could be done by aerating the old waste dumps using the open windrow method and biotreating them to bio-dry the waste for screening. A similar approach can also be adopted for existing landfills, which could potentially reduce emissions by approximately 40 percent.
- **Install gas capture facility through scientific SWM:** A scientific landfill with a gas (methane) capture pipeline can reduce emissions, and this gas can be used as an energy source. The city could look at options such as gas capture in cylinders, thereby making it easy to transport the gas to other locations. In essence, options such as gas capture in liquid petroleum gas (LPG) cylinders from landfills, extraction of methane (CH₄), and the use of bio-compressed natural gas (CNG) as an alternative to diesel and petrol are all important solutions for mitigating solid waste generation.
- **Establish decentralized wet waste management units at the ward level:** One of the major sources of GHG emissions is wet waste. Moreover, handling and managing wet waste is a cumbersome exercise. It is hence more pragmatic to have decentralized wet waste management units. This would reduce the transport burden and ease the waste handling and management process. Alternatives for the management of wet waste are the use of in-situ composting and biogas plants as mitigators.

Policies, plans, regulations, and statutory mechanisms:

- **Utilize funds from different sources:** Coarse compost can be used in city plant nurseries and tree pits. This could be done by better utilizing funds already available in different departments that are currently being unspent. For example, coarse compost produced from decentralized wet waste units can be utilized for revegetation using unspent Mines Department Cess funds.
- **Ban single-use disposable polyvinyl chloride (PVC) items:** Currently, multiple flex banners are used by individuals or groups on various occasions. Often, people are unaware of their environmental impacts. These flex banners should be banned, and eco-friendly recyclable polyethylene material should be encouraged as a replacement. Moreover, many other single-use disposable plastic products are available in the market. A strict ban on the sale and use of single-use PVC items should come into effect.
- **Reward progressive actions in SWM:** Community action must be fostered, and, more importantly, positive action toward better SWM must be rewarded. This will enhance civic involvement and encourage community responsibility toward waste management.
- **Reduce waste generation:** The current approach toward waste is “management driven” and not “reduction driven.” A waste reduction approach is more pragmatic and reduces waste production, thereby easing the task of waste handling and management.
- **Explore the potential for adding carbon back to the soil:** Carbon must be returned to the soil. This could be done through proper waste management and could potentially unlock carbon financing to support organic farming.

Governance systems, processes, platforms, and institutional mechanisms:

- **Adopt a bottom-up approach in waste management:** Government systems need to adopt a bottom-up approach to SWM, taking into account the worker's perspective on better management mechanisms. This would also ensure a better market for upcycled waste products. It would also create opportunities for carbon financing at a local level.
- **Enforce and monitor SWM rules and regulations:** The SWM byelaws of BBMP are progressive, but they have to be enforced more rigorously. This would especially help better manage waste generated in bulk.
- **Create a market for green jobs:** There are many opportunities for green jobs in the waste management sector, such as recycling, upcycling, and composting. Creating markets and market opportunities for such products could strengthen the economy and reduce the amount of waste entering landfills. Aligning funds for these different aspects of the SWM value chain should also be considered.
- **Adopt a waste-to-resource approach:** Another aspect is the concept of “waste to wealth,” which should ideally be routed toward “waste to resource” because waste emerges from a resource and should finally terminate in a resource.
- **Acknowledge and strengthen the involvement of the informal sector:** The informal sector plays a critical role in waste management. This needs to be acknowledged, and its involvement at every stage of the sectoral work could significantly ease the management of waste generation.
- **Conduct regular training and awareness-building activities for waste handlers:** It would also be beneficial to interact regularly with pourakarmikas (civic workers) and create awareness workshops for them on SWM. Conducting format training on handling waste and using protective gear would also be a good step.
- **Implement the polluter pays principle:** We have seen protracted discussions on the polluter pays principle and its inclusion in different aspects of environmental law. This now needs greater emphasis and stronger legal backing, which would ensure that bulk generators perform efficiently.
- **Critically review the feasibility of waste to energy (WtE) plants:** BBMP is currently working at multiple levels on WtE options. This needs to be revisited because WtE is not an ideal solution. Instead, the focus should be on waste reduction.
- **Map stakeholders across the waste value chain:** Mapping different stakeholders and the waste generation process has great potential for helping understand the problems of the sector and their solutions. This could also potentially improve waste management.
- **Enhance peer-to-peer learning:** In Bengaluru, multiple organizations, nonprofits, and citizen groups are working toward better management of solid waste. There is thus great scope for peer-to-peer learning, which should be explored to create greater awareness among city residents. This would also increase the reach of business models around SWM in the city.

Climate action priorities for stationary energy and buildings in Bengaluru (Session 3 | June 24, 2022)

BOX 3 | Context of stationary energy and buildings in Bengaluru

Electricity generation is the greatest source of GHG emissions, accounting for more than 40 percent of the total emissions according to official inventories. On a positive note, Karnataka ranks first among the renewable-rich states, with an installed capacity base of 15 gigawatts (GW) and another 9 GW of green capacity under implementation.^a Bengaluru is one of the largest consumers of electricity in Karnataka. The GHG emissions from the stationary energy sector amount to approximately 12.8 MMT CO₂e (million metric tons carbon dioxide equivalent). On the other hand, the buildings sector plays a critical role in determining energy consumption. Despite heightened efforts, less than 5 percent of the total number of buildings in Bengaluru are energy-efficient green buildings.^b Critical aspects related to the implementation of clean energy pathways and the uptake of green buildings in Bengaluru need to be addressed, such as building adequate mechanisms and enablers for a just transition, financing instruments, transparent frameworks, and resilience. The sector also needs to build resilience against possible vulnerabilities from climate-change-related hazards such as flooding, temperature rise, and severe storms.

Strategically, the city needs to enhance its energy efficiency, decarbonize grid energy, and transition to cleaner fuel options while ensuring transparency in the process along with adequate financial backing. The transition also needs to be resilient, incorporating energy efficiency not just in technology but also in building architecture through green buildings.

Sources:

- a. The Hindu 2022.
- b. Salvekar 2019.

Session 3-Key takeaways

Overarching tenets, approach, and enablers for an implementable, inclusive, and effective climate action plan for Bengaluru:

- Form a “climate action group” under the principal secretary with a steering committee comprising representatives from all the departments and key stakeholders from civil societies, developers, and distribution companies.

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Implement demand-side management strategies:** A system for implementing demand-side management strategies for both consumers and utilities is needed. Reducing heat island effects in the central business district areas of Bengaluru could also reduce the energy demand. Because the upward mobility of economic classes has increased their purchasing power, formulating a single customized strategy for promoting energy efficiency is a challenge that needs to be addressed.
- **Encourage energy-efficient buildings:** Promoting building materials that consume less energy and exploring the option of retrofitting existing buildings could help reduce the overall energy consumption of buildings. Low-rise buildings with white or green rooftops will reduce cooling needs drastically and improve biodiversity. The municipal authorities need to demonstrate the concept of smart buildings to their citizens by ensuring that new upcoming municipal buildings will be energy efficient and low carbon, and converting all their existing buildings to energy-efficient and low-carbon buildings.
- **Enhance energy saving in service delivery:** Effective rainwater harvesting (RWH) systems will reduce excessive dependence on Cauvery water and also reduce emissions because less potable water will need to be pumped.

- **Transition to new and renewable energy:** Setting up EV charging stations is challenging for building developers because their transformer capacity is fixed. At the same time, the cost, space, and electricity sanctioned by the municipal authorities to developers are limited.

Policies, plans, regulations, and statutory mechanisms:

- **Explore pricing/market for solar rooftops:** The Ministry of New and Renewable Energy's (MNRE's) new approach of making consumers choose developers to set up rooftop solar plants has created a new hurdle in terms of pricing. Private developers are charging about 70 percent of the MNRE's benchmark prices.
- **Explore a mix of financial/taxing instruments:** Imposing a housing tax based on the number of people living per square meter provided that its impact on citizens makes it feasible. Subsidizing EV charging infrastructure or improving the existing infrastructure to accommodate the additional load due to the projected growth in EVs could encourage their adoption. Incentivizing citizens to opt for energy-efficient choices is another option. Developing new and improved tariff mechanisms that allow all consumers to favor green tariffs could help increase green energy uptake. Finally, instituting an additional tax-saving provision for second or third homeowners and providing incentives for both buyers and developers to invest in green buildings could be beneficial.

Governance systems, processes, platforms, and institutional mechanisms:

- **Make better data available:** The healthy growth of the city is impacted by rapid urbanization and unprecedented migration. Urbanization and migration growth are outpacing the registered data, and the city is falling behind in assessing growth accurately and failing to adopt suitable measures. Matching the property tax records with the Bangalore Electricity Supply Company's (BESCOM's) account records is critical in determining the actual generation capacity of a rooftop solar system.
- **Ensure financial feasibility and manage conflicts of interest:** Solar rooftop promotion will have negative implications for a utility's revenue generation, owing to the high levels of aggregate technical and commercial losses and to the inability of the utility to recover the cost of supply with power tariffs. Hence, it is important to develop a framework that incentivizes utilities to support large-scale deployment. A method must be devised to remove the obligatory payment that a distribution company (discom) must make to power-generating companies even when no power is purchased.
- **Adopt a better assessment mechanism:** The green energy transition for manufacturing industries must be assessed. Transitioning to a low-carbon economy will require significant changes across economic sectors. At present, mandatory energy audits are not performed for medium and small-scale industries; they are performed voluntarily, which may need to be changed.
- **Conduct information, education, communications (IEC) campaigns to initiate a behavioral shift:** Better awareness and education campaigns are required to address the following issues and initiate a behavioral shift: the lack of awareness among consumers of energy-efficient appliances and their reluctance to adopt them due to price sensitivity, the lack of easily accessible information on energy efficiency programs and energy-efficient appliances to help the public make informed decisions, and driving behavior change actions among citizens.

Climate action priorities for transportation in Bengaluru (Session 4 | June 27, 2022)

BOX 4 | Context of transportation in Bengaluru

The transport sector's role in society and the economy is indispensable. However, it remains one of the major concerns from an environmental perspective for its contribution to global warming and its exposure to climate hazards. The threat of climate change and its impacts make the need to address this sector more urgent. It is one of the major contributors of greenhouse gas (GHG) emissions worldwide, accounting for about 23 percent of global CO₂ emissions.^a In addition to CO₂ emissions, another significant consequence of vehicular emissions is air pollution, which is globally responsible for seven million deaths per year.^b However, transportation is also key to accessing employment opportunities, education, healthcare, and other services, and is therefore an important determinant of the quality of life of its users. The vital role that the transport sector plays in the development of a region and its interlinkages with other sectors imposes a greater responsibility on this sector to prepare itself for a changing future. It is hence critical to acknowledge, evaluate, and prioritize action on both the mitigation and adaptation aspects of climate change impacts in this sector. The transition toward a sustainable transport system is also an opportunity to reduce inequality and to ensure that the benefits and costs of decarbonization are shared fairly.

In Bengaluru, the public infrastructure, especially public transport, has not been able to keep pace with the blistering growth of the city. One of the reasons for this is the lack of first and last mile connectivity, which has led to a decline in the use of public transport for urban commuting. The existing infrastructure for non-motorized transport modes is minimal, and the share of freight vehicles in the city is increasing at a significant rate. Hence, the city faces multiple challenges on many fronts. Strategically, the city therefore needs to better prepare for both mitigation and disaster preparedness from a climate action perspective.

Sources:

a. The Hindu 2022.

b. Salvekar 2019.

Session 4-Key takeaways

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Adopt a multipronged transport sector mitigation action combining avoid-shift-improve strategies:** Instead of focusing on only one strategy, a combination of all strategies is needed for a climate-progressive transport sector. This essentially implies the implementation of strategies that reduce the need to make trips or that avoid trips altogether; a shift to more sustainable modes of transport such as public transport and non-motorized transport (NMT); and the use of improved fuels and non-fossil-fuel-based transport modes such as CNG, EV, hydrogen, and so on, for passenger and freight transport.
- **Use a systems approach, strategic thinking, and improved modeling techniques in transport sector mitigation action planning:** A systems approach is needed while developing mitigation strategies to understand the interrelationships between different activities and how they interact with the transport sector. The use of modeling for transportation improvement projects can also help embed a systems approach in planning and evaluating the potential for competitive options.
- **Improve the efficiency of public transport along with a push and pull strategy:** This includes efficiency in terms of their connectivity, service availability, frequency, accessibility, safety, comfort, and so on; route rationalization; and improvement in fuel efficiency by reducing congestion and incentivizing a cleaner fleet and cleaner fuel transition plans in the long term such as switching from fossil fuels to EVs. A push and pull strategy including a reduction in the ticket fares of public transport is needed to effectively induce a modal shift. The pull strategies include efficiency in terms of their connectivity, service availability, frequency, accessibility, safety, comfort, and so on; route rationalization; and improvement in fuel efficiency by reducing congestion and incentivizing a cleaner fleet and cleaner fuel transition plans in the long term such as switching from fossil fuels to EVs. Push strategies could include disincentives such as strict norms on pollution control, parking, congestion pricing, and so on.

- **Focus on adaptation strategies in the transport sector along with mitigation:** Plan for better land use transport integration to improve travel efficiency and reduce motorized trip demand. Invest in robust infrastructure that can withstand extreme climate events. Delivering adequate, timely information to citizens and transport users can significantly enhance the resilience of the city and help it adapt to the impacts of extreme climatic events such as floods and extreme heat.
- **Ensure better travel demand management:** Travel demand management along with demand-responsive transport planning can help improve the effectiveness of transport infrastructure and services, and thus help achieve both mitigation and adaptation goals.
- **Adopt suitable urban planning measures for a more climate-progressive and inclusive transport sector:** First, promote higher mixed land use to reduce the need for trips. Second, insist on a minimum of 20 percent low-income housing in every new housing complex to accommodate household help. Gated communities should allow public thoroughfares to adjoining areas to reduce travel distances. Implement regional-scale urban planning to support peri-urban commuters. To achieve this, efficient and affordable public transport connectivity should be planned for. Plan green ribbons along every seasonal watercourse. These can become traffic-free walk and bicycle paths, which should help keep them free of debris and garbage. Finally, walk paths need not run parallel to roads. Instead, they can be linked park-to-park or lake-to-lake with usable walkways alongside stormwater drains where construction setbacks are now required. These can also act as overflow swales during floods. By implementing these recommendations, urban areas can become more sustainable, livable, and accessible for all.
- **Improve road and traffic infrastructure and identify congestion zones:** Improving traffic signaling mechanisms and road conditions can help manage the traffic flow more efficiently and improve the disaster response. Identifying congestion zones can help identify traffic and air pollution hotspots, which can then be addressed with appropriate solutions.

Policies, plans, regulations, and statutory mechanisms:

- **Create bottom-level plans and ensure policy coherence:** Local-level plans involving the transport sector should be prepared in consultation with ward committees. More consistent policies across sectors with transport sector policies such as comprehensive mobility plans and master plans are required for the effective implementation of recommended actions and targets. A shift in problem-solving is needed from bottom-up solutions (e.g., reducing congestion) to tackling bigger challenges such as reducing the total distance traveled by vehicles and decreasing the dependence on motorized modes (or fossil fuels). Resilience and efficiency are sometimes conflicting goals, which could also lead to institutional conflicts of interest. These conflicts could result in redundant infrastructure and require a common mandate for climate action in the ecosystem.
- **Include social and gender-inclusive policies:** Women travelers across income groups contribute less to GHG emissions. The socioeconomic cost burden of economic and regulatory policies could be disproportionately higher for low-income women travelers, a problem that needs to be tackled using better-designed policies.
- **Enact progressive legislation:** The Bengaluru Metropolitan Land Transport Authority (BMLTA) Act and the Active Mobility Bill must be pushed through and the operations and services of private buses legalized and regulated. The number of private buses in the city is significant (almost half the total number of buses), but they operate illegally, and hence, their services are not regulated.
- **Enforce compliance with climate-friendly measures:** Enforce on-site parking with stringent measures such as cutting off power or water supply for noncompliance. Make 100 percent plastic road resurfacing and pothole repair mandatory. Such repairs should be independently verified by third parties throughout the BBMP jurisdiction at least, if not the Bangalore Development Authority (BDA) and Bangalore Metropolitan Region Development Authority (BMRDA) jurisdictions too.

- **Institute taxing and incentivizing/disincentivizing mechanisms:** The RTO tax rules could be modified to help reduce the number of vehicles on the road. For example, removing the penalty on private corporate buses that ferry schoolchildren (even for free) at the tail of half-empty employee pickup or drop routes or between shifts as a corporate social responsibility effort could be explored. The RTO can be compensated for the loss of commercial tax rates if such a loss is unavoidable. Greater incentives are to be provided to people to make public transport more affordable and attractive. Disincentivize private vehicles and incentivize NMT. Impose annual license fees on private vehicles.
- **Mandate improved norms:** Vertical exhaust on all heavy vehicles should be raised above the current level to prevent the exhaust from settling on pedestrians and other road users at that level. Retrofitting buses and trucks could be a solution, provided they are regularized and supported by an appropriate ecosystem.

Governance systems, processes, platforms, and institutional mechanisms:

- **Establish both tactical and operational mechanisms to implement climate actions:** Tactical mechanisms would include institutional arrangements for deciding how an action should be implemented, whereas operational mechanisms would include the incorporation of tools, standards, and procedures (such as development control regulations and road hierarchy protocols) for embedding climate imperatives.
- **Establish monitoring and evaluation mechanisms facilitated by improved data:** To establish a comprehensive tracking mechanism for transport projects, it would be beneficial to link each project with its potential for reducing GHG emissions and its ability to contribute to adaptation goals. Conducting audits for NMT facilities at the local level could provide insight into their functionality and identify areas for improvement. Intelligent transport systems (ITSs) could be utilized for better traffic management and data analysis, and a regularly updated central transport database would be essential. Continuous performance measurement and reporting for all transport projects and parameters would be necessary to ensure that progress is being made. Additionally, promoting research and development in monitoring and evaluation, especially in the application of improved technologies and techniques, would be valuable. Finally, it would be important to set a time frame for achieving agreed-upon targets to ensure that progress is being made toward the intended goals.
- **Delegate risk management responsibility to BBMP:** Even though the transport sector has multiple stakeholders, BBMP should be the agency responsible for managing risks. This is because all the core infrastructure is under BBMP.
- **Establish better project management and enforcement protocols:** An integrated project planning and management approach that utilizes technology could be a valuable tool in coordinating with multiple departments and managing multiple projects. To ensure the successful implementation of a transport project, creating operational non-negotiables could be useful in guaranteeing that critical aspects are executed in accordance with the design. It is important to acknowledge that education and enforcement issues within the transport sector cannot be tackled solely through engineering solutions. Instead, addressing these problems through education and enforcement measures themselves would be more effective. Finally, implementing an effective emissions compliance system would be essential to mitigate the negative environmental impact of transportation.
- **Build capacity and facilitate a behavioral shift:** To promote sustainable transportation, it is essential to build capacity across various levels. This involves providing training and skill development programs not only for construction workers but also for department heads and decision-makers. In addition to capacity building, it is crucial to foster a behavioral shift toward NMT, such as walking and cycling. This can be achieved by creating a culture that encourages and supports these modes of transportation.
- **Create funding:** Exploring newer funding opportunities for public transport operations is critical to support a climate-progressive and resilient transport sector.

Climate action priorities for air quality management in Bengaluru (Session 5 | July 7, 2022)

BOX 5 | Context of air quality in Bengaluru

Deteriorating air quality and climate change are often seen as two separate facets of the same problem, that is poor management of harmful substances by allowing them into our environment. In urban areas, air quality management is becoming one of the most critical problems due to its severe impact on a city's public health, economy, and quality of life.

Between 2030 and 2050, the health impacts of climate change caused by an increase in GHG (CO₂, CH₄, and N₂O) emissions are expected to cause approximately 250,000 additional deaths per year in India from malnutrition, malaria, diarrhea, and heat stress.^a According to the World Bank, the entire population in India is exposed to unhealthy levels of ambient PM2.5, which is considered the most harmful pollutant emanating from multiple sources. Ambient and indoor air pollution is estimated to have caused 1.7 million premature deaths in India in 2019. Air pollution has other socioeconomic consequences. India witnessed lost labor income due to fatal illnesses and health issues caused by PM2.5 pollution in 2017.

In India, 131 non-attainment cities have been identified for the National Clean Air Program, and Bengaluru is one of them.^b Studies show that the transport sector is one of the key contributors to air pollutants in the city. Tackling air pollution is thus a priority from multiple points of view such as climate change, public health, and livability.

Sources:

a. WHO n.d.

b. MoEFCC 2019.

Session 5-Key takeaways

Strategies and methods for inclusive climate change mitigation and adaptation/ resilience building:

- **Explore opportunities for emission trading schemes:** Explore emission trading schemes or private finance to top up the existing departmental finance, because the budget allocated for the NCAP is tight and is also performance based.
- **Switch to cleaner fuels:** A slow shift toward cleaner fuels is underway; however, the pace needs to increase. Transitioning to cleaner fuels such as LPG, piped natural gas, and electricity from solid fuels are alternatives that the city can explore.

Policies, plans, regulations, and statutory mechanisms:

- **Identify interlinkages between different plans:** Many programs and schemes at both the central and state levels target air pollution. Understand how a micro plan for controlling air pollution and a clean air action plan will be aligned with a climate action plan. Identify the common mitigation measures and define a reduction target that benefits both the plans.
- **Establish efficient monitoring systems:** Currently, the city does not have an expansive and comprehensive monitoring system across all regions. Instituting a robust tracking system for the proposed mitigation measures, policies, and interventions and assessing their performance will improve productivity and the likelihood of achieving long-term goals. One option could be to create monitoring networks and stations measuring SLCPs (short-lived climate pollutants).

Governance systems, processes, platforms, and institutional mechanisms:

- **Ensure interdepartmental coordination:** Coordination with different departments for both the BCAP and the NCAP is critical. Creating a platform that brings together all the key stakeholders of the BCAP with the existing key stakeholders of the NCAP will help create opportunities and ease implementation of the developed strategies.

- **Encourage behavioral shifts:** One of the key determinants of cleaner air is the behavior of the city's residents. Developing communication strategies that nudge behavioral changes is a must because Bengaluru has proactive citizens.
- **Create awareness about the health impacts of air pollution:** Creating awareness and educating people about the health impacts of high-level exposure to air pollution is needed. Most people are aware that short-term pollution exposure can cause minor ailments. However, the intensity of the ailment may increase with extended periods of exposure. This is especially true for people living close to busy roads and traffic congestion zones.
- **Develop a comprehensive framework for addressing air pollution:** Develop a framework that promotes the safety of vulnerable people staying in identified air pollution hotspots by reducing their exposure. This has to be supplemented by a collective effort to implement long-term mitigation measures. This will be useful to tackle air pollution and its impact on citizens, especially on marginalized and vulnerable communities.

Climate action priorities for water and wastewater in Bengaluru (Session 6 | July 8, 2022)

BOX 6 | Context of water and wastewater in Bengaluru

Water is one of the most critical resources that has come under severe stress in the city regions of India over the past few decades because of rapid urbanization. Climate change and its impacts are likely to exacerbate the situation. India is ranked 13th among the world's 17 extremely water-stressed countries and has been categorized as having extremely high levels of baseline water stress.^a This has implications at multiple levels: access to water for drinking, cooking, basic hygiene, livelihood, and so on.

Wastewater and stormwater management is another facet of the urban water cycle that has an important role in climate change action. Wastewater treatment emits greenhouse gases (GHGs) into the atmosphere, and unscientific wastewater management has severe public health consequences. According to GHG Platform India's 2015 report, domestic wastewater contributes to approximately 2 percent of GHG emissions. On the other hand, ineffective stormwater management not only leads to urban flooding events causing loss of lives, property, and economic losses but also misses opportunities for RWH and groundwater (GW) recharge.

In Bengaluru, despite piped water supply from the Cauvery River, 40 percent of the population depends on GW.^b This has led to overexploitation of GW and water inequity. On the other hand, reuse of wastewater remains limited. Sustainable water management is therefore an important component of Bengaluru's climate action.

Sources:

a. WRI 2019.

b. CGWB 2017.

Session 6-Key takeaways

Overarching tenets, approach, and enablers for an implementable, inclusive, and effective climate action plan for Bengaluru:

- **Prioritize effectiveness over efficiency in climate action:** Effectiveness should be prioritized over efficiency in dealing with infrastructural provisions. Also, all sectors are essentially interlinked and need to hence be looked at holistically.

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Construct groundwater (GW) recharge pits:** Dig GW recharge pits every 20–30 meters throughout BBMP, BDA, and BMRDA areas to reduce the water volumes reaching low-lying spots during cloudbursts. They will also raise GW levels and prevent soil subsidence. Mini spillways can turn them into detention basins or retention basins (with a GW recharge pit upstream of each spillway).

- **Ensure universal access to water:** To address vulnerability issues, water availability is crucial. Universal access to water for all with 100 percent coverage is a must.
- **Address energy and the water–wastewater nexus:** Conducting energy audits for the water supply system will help understand the efficiency of the system and how it can be improved. Anaerobic wastewater treatment facilities with biogas capture will reduce emissions and produce energy.

Policies, plans, regulations, and statutory mechanisms:

- **Implement RWH and GW recharge across the city:** RWH and GW recharge would be extremely critical for the climate change and water strategy for Bangalore. Although there is a mandate in place for citizens' role in RWH, a similar initiative should also be taken up by the government. A net metering system for RWH is also essential.
- **Manage GW better as a resource in public places:** GW as a resource is available everywhere, and its recharge is also potentially possible in a vast expanse of land. This should be taken up largely in public spaces. GW as a resource should be augmented and managed in roads, parks, and so on, by government departments.
- **Encourage the use of eco-friendly cleaning liquids and detergents:** Limiting phosphate content in detergents would reduce excess growth of organic vegetation in water bodies because phosphates tend to cause extensive vegetation growth. Cleaning liquids that claim to kill over 99 percent of microbes tend to kill useful microbes too. These microbes help convert human waste into an environmentally acceptable liquid, a natural process that has been undermined by the excessive usage of such chemicals

Governance systems, processes, platforms, and institutional mechanisms:

- **Create incentives for realizing the economic benefits of water and wastewater management:** Elaboration of the economic benefits of various wastewater management initiatives could encourage more industries to take them up. The entire process of wastewater reuse needs to be made commercially viable for companies if it is to be taken up on a large scale. The lack of an attractive pricing structure is preventing commercial entities from moving into this segment to help solve the city's water and wastewater management problem. Therefore, the pricing must be matched, and government policies must mandate that industries need to buy some amount of reused water.
- **Reduce dependence on conventional water sources:** Three approaches to wastewater reuse could potentially reduce water dependence on conventional sources: parks and green cover, recharging aquifers (improving the groundwater level), and reuse of treated wastewater by construction industries.
- **Apply a social equity lens to water resilience; do not consider GHG emissions alone:** One needs to look at the action plan with a social equity lens. The goal is not just to reduce GHG emissions, because the contribution of the water/wastewater sector to GHG emissions is minimum and the social cost of not having access to reliable water and wastewater services is enormous. Hence, water accessibility and water resilience become important aspects of the action plan. Water resilience and water reuse should be part of the mandate. Preparation of water resilience plans at the ward level is crucial for citizen empowerment.
- **Plan for better and future-aware water resource management and city planning:** Water resource management within the city limits is needed. Urban planning and population density planning must set some limits for expansion based on water availability.
- **Consider easy categorization of water:** Instead of having multiple categories of water (such as wells, borewells, and gray water), we should have just two categories such as potable and non-potable water. This dual classification scheme will make it easier to assign a commercial value to water as a resource.

- **Establish better data compilation and management protocols:** Availability of, and access to, data is critical for better management of the resource itself. Better data availability would improve management of resources and planning to meet demand requirements. Hence, spatial mapping and data management play a crucial role in enhancing data management practices. Comprehensive GW maps and city-level aquifer recharge plans are also essential.
- **Create a city-level GW department for Bengaluru:** The city currently does not have a dedicated department to evaluate, monitor, and manage GW resources. A dedicated organization to manage GW in the city and prevent excessive exploitation of the resource is crucial. In addition, a single overarching body to manage water (both surface and groundwater) in the city is required.
- **Explore the decentralized system of wastewater management:** A decentralized system of wastewater management could improve long-term water efficiency.

Climate action priorities for urban planning, greening and biodiversity for Bengaluru (Session 7 | July 11, 2022)

BOX 7 | Context of urban planning, greening, and biodiversity in Bengaluru

Cities are on the frontlines of the global climate emergency. Although cities occupy only 2 percent of land area, they consume over two-thirds of the world's energy and account for over 70 percent of global GHG emissions worldwide.^a Land use patterns and urban form can strongly impact an urban community's contribution to climate change through the production of greenhouse gas (GHG) emissions. Key contributors to a city's climate footprint include the physical arrangement of streets, public transportation infrastructure, building types, and land uses that influence both vehicle use and energy consumption in buildings. Hence, the contribution of urban planning to the mitigation side of climate change is crucial. Urban planning also has a key role to play in mitigating the growing climate-related risks and building resilience to climate hazards. Climate-resilient development in cities is crucial to adapting to climate change, improving the well-being of its residents, and increasing the life opportunities of future generations. Spatial planning can reduce climate risk not just by influencing the exposure but also by addressing social vulnerability.

Bengaluru has seen a 170 percent increase in built-up area over the past 25 years (1990–2015),^b which has had a cascading effect on increased GHG emissions along with other climatic variations such as temperature rises and variations in rainfall. Typically, it is the more vulnerable sections of society that are first affected in such a scenario, and preemptive planning ensures better preparedness, thereby reducing damage and losses when any unprecedented weather events occur. Moreover, strategic actions within the urban planning, greening, and biodiversity domains would help protect the city and its residents from the consequences of climate change and prepare for a resilient future.

Sources:

a. World Bank 2021.

b. WRI India analysis; see Figure 2.

Session 7-Key takeaways

Overarching tenets, approach, and enablers for an implementable, inclusive, and effective climate action plan for Bengaluru:

- **Climate actions need to be built on the three tenets of climate, nature, and human well-being, and the interactions between them:** Although there is an urgent need to reduce emissions to control global warming and at the same time take adaptive measures to cope with climate-related hazards, it is equally important to ensure that the most essential human needs are met and a robust ecosystem is created for the overall health of all the components of Earth's environment.

- **Building resilience must be at the heart of planning and designing for cities:** Cities need to be prepared for any kind of disaster, whether it is climate related, a pandemic, or a natural disaster. In this regard, building social, economic, environmental, and institutional resilience is important if a city is to thrive.
- **A system of systems approach is essential to address climate-change-related issues:** Cities do not function in sectoral or institutional silos, but they are a complex system consisting of multiple systems interacting with each other in many ways and with varying intensities. The lack of a system of systems approach in city planning has been one of the gaps in how plans are formulated. Climate change is a challenge that cuts across sectors; thus, the BCAP provides an opportunity to acknowledge and embed a system of systems approach in designing climate actions.
- **A bottom-up approach is needed in climate action planning to galvanize political will:** Involving the lowest tier of governance, elected representatives, and citizen groups in taking the BCAP forward would be key for its success. It would be useful to take the plan down to the ward level, present it to ward committees, and then collectively envision the climate actions for 2050. Given the present state of ward committees in Bengaluru (most of them function only partially), now is the time to motivate them to rise above grievance redressal and prepare them to perform more planning functions. It is also important to galvanize political will to implement interventions at a workable smaller scale.
- **Need for legal backing/statutory mechanism for the BCAP to be effective:** A statutory mechanism is needed that can ensure that BCAP imperatives and recommendations trickle down and inform downstream policies and regulatory instruments. These include all sectoral and city development plans and implementation/regulatory instruments (such as the Master Plan and BBMP building bylaws). The BCAP could be given statutory backing after due deliberations.

Strategies and methods for inclusive climate change mitigation and adaptation/resilience building:

- **Encourage and incentivize compact urban development:** Compact urban development has multiple benefits for both climate change mitigation and adaptation. These benefits include reduced emissions due to fewer motorized trips, enhanced space for green cover, and retention of blue-green networks, which are key elements in resilience building and adaptation to counter climate change impacts such as floods and heat islands. Encouraging well-planned high-density clusters within the city, especially near public transit corridors, by allowing a higher floor space index (FSI) can reduce sprawl. The higher built spaces and reduced built footprint will benefit the city and allow it to function efficiently.
- **Design and enforce demand-side management strategies for water along with efficient monitoring for a sustainable and equitable future:** Water as a resource is emerging as a growing pain point for Bengaluru. Keeping in view a resource-constrained future and inequity in access to scarce resources, the existing benchmarks for per capita water requirement need to be revised and lowered (say, from 135 lpcd to 95 lpcd). This will result in multiple benefits such as water sustainability, less carbon emissions from the water supply, and space savings in terms of the size of overhead tanks and other infrastructure. Private borewell construction should be strictly prohibited. Activating the GW authority is a must for efficient monitoring of the GW situation and enforcement of a ban on private borewells. The complete responsibility of water supply to the citizens should be taken by the Bangalore Water Supply and Sewerage Board (BWSSB), which can prepare a futuristic water master plan for the city in consultation with reputed institutions. Mapping groundwater aquifers with better technology and recharging them with rainwater would be efficient. Net metering is also required to reduce the burden on citizens and manage transmission and distribution losses.
- **Adopt an integrated approach to water management with a focus on repurposing/reusing treated sewage water and innovative financing mechanisms:** Treated sewage water can revive lakes. The effectiveness of the existing measures, especially sewerage treatment plants (STPs) in private complexes and their impact on nearby water systems and water supply networks, must be evaluated. To improve efficiency, centralized STPs across the city could be considered, with the STPs built at the entry points

of lakes on the high flood level of the lake itself, which would not require much extra space. Innovative financing mechanisms can be devised where the builders pay the capital cost and the users' operational cost could be considered. This is a challenging task that will need multi-agency coordination.

- **Incentivize construction of green buildings:** Construction of green buildings is more expensive because it requires specific skills. A few states in India have incentivized green buildings by providing a higher FSI, and a similar approach could be adopted in Bangalore.
- **Create zonal waste management facilities:** Large zonal waste management facilities for the city could be constructed to handle mixed waste. WtE/biofuel production facilities could also be incorporated if feasible. Every zone should also have provision for construction and demolition waste management.
- **Incorporate green and blue spaces effectively into all levels of plans and infrastructure projects for the city:** This is to ensure that the functions of micro-climate regulation, namely, preventing urban heat islands, addressing water scarcity, mitigating urban flooding, and so on, are addressed. Green and blue spaces include lakes and wetlands, ponds, wells, tanks, parks, wooded groves, avenue trees, and urban forests. The plans that should effectively incorporate blue-green spaces include all land use plans (such as master plans and neighborhood-level plans), developmental plans and strategic guidance plans (such as regional plans), and sectoral plans (such as stormwater management, water and wastewater management, and so on). Adopting nature-based solutions and hybrid infrastructure designs rather than hard infrastructure could provide opportunities for regenerating urban blue-green spaces by making them a part of the solution instead of restricting them to blanket conservation efforts.
- **Recognize urban ecosystems as urban commons:** Urban ecosystems should not only provide ecological benefits that mitigate the impacts of climate change but also build the resilience of local communities that are dependent on these ecosystems for livelihood and subsistence, especially the urban poor and vulnerable communities. Thus, lakes need to be revived and maintained, and a variety of livelihood and human uses such as grazing, fodder collection, fuelwood collection and fishing, washing, and other domestic uses need to be allowed. Urban foraging practices should be allowed around lakes and in any kind of green space.
- **Make urban greening and ecosystem conservation a part of all sectoral development/built area conservation efforts:** Several spaces in cities that are often ignored in ecosystem conservation but that are thriving heritage ecosystem spaces should be considered for urban greening efforts (such as the premises of places of worships, barren spaces, unused spaces such as the areas below flyovers, open spaces near bus stands, empty plots, spaces around playgrounds, and spaces adjacent to railway lines or below high-tension wires). Wherever possible, greening practices should be encouraged in public spaces and on land that serves public needs (such as in slums, government schools, anganwadis, government educational institutions, and government housing projects), and in private homes, apartments, and layouts. A shared vision of integrating urban green areas must be developed and integrated with the local culture and heritage, and such areas must be used productively through coordinated, participatory urban design efforts.
- **Enhance the effectiveness of urban greening strategies with organized, scientific, data-based, and inclusive practices:** Trees used for urban greening must be carefully chosen to ensure sustainability, robustness, and effectiveness. Native species should be encouraged. Appropriate species should be planted in the appropriate places to maximize their effectiveness and impact on the local biodiversity (including considerations such as the size of the canopy; the width of the trunk; whether it is fruiting or flowering, deciduous or evergreen, has high or low pollen; and which animal species depend on them for habitat). People living in and adjacent to areas that are to be greened (such as in slums) must be able to express their preferences and participate in long-term greening and protection of greenery.
- **Design an urban employment scheme with the three-pronged objective of economic development, ecological protection, and employment generation:** The objectives of the scheme would be to provide employment opportunities to the urban poor as well as those with some higher education who are unable

to find employment, which will in turn improve the economy of the city. It is important to focus on works that can create ecological assets in cities and also protect urban ecosystems. Examples of such works include cleaning the lakes and raja kaluves, tending to urban greens, creating urban agriculture, and engaging in environmental monitoring activities across sectors.

- **Introduce innovative methods and tools to create a baseline and benchmark urban greening:** Innovative methods and tools (such as the Urban Greening Factor in the London Plan, the green plot ratio, and the leaf area index) that cannot be embedded at the level of the BCAP can be taken up with the master plan as the base and implemented at the local area planning level. However, these tools cannot be looked at in isolation; they should be a part of an integrated and systemic approach where the master plan can play a pivotal role, and the BCAP must acknowledge that. Newer methods/indexes are needed that can effectively capture social, economic, and ecological values and allow them to be attributed to green spaces/urban commons.

Policies, plans, regulations, and statutory mechanisms:

- **Create adequate statutory provisions to ensure the adoption of the BCAP in the master plan and other regulatory instruments:** Master plan zonal and development control regulations are the only—and most powerful—regulatory instruments for controlling and envisioning the spatial development of the city, and they can effectively embed the BCAP imperatives. Therefore, the master plan for the city needs to be revised urgently and dovetailed with an economic development plan for the city and region. To integrate these plans, the urban planning statutory provisions must be suitably amended.
- **Create a convergent and climate-aware spatial planning act:** The existing Karnataka Town and Country Planning (KTCP) Act cannot do justice to the challenges of cities, which have to remain functional, inclusive, and productive while moving toward becoming carbon-neutral and adapting to climate change impacts. The immediate need is for a revised KTCP Act that embeds the essence of climate action and provides for the necessary horizontal and vertical convergence between plans within and across sectors.
- **Make provisions for micro-level/area-level planning:** Cities in Karnataka, including Bengaluru, do not have any provision for creating micro-level plans (such as ward-level plans or area-level plans). The BCAP has to be embedded into the master plan, with climate action included at different scales. Although planning is generally done at the city level, the gap is in actions at the local, ward, and micro levels. In the absence of this layer, larger city-level plans such as master plans often fail to achieve their desired intent, and their implementation cannot be monitored. Creating micro-level plans that involve citizens and ward committees can be an effective instrument for implementing the essence of the BCAP.
- **Revise building bylaws to address challenges posed by climate change:** Model building bylaws in their present form are inadequate and need to be amended to positively impact the social, ecological, and economic facets of the city. Regulatory mechanisms to address climate change impacts such as heat island effect could be considered.

Governance systems, processes, platforms, and institutional mechanisms:

- **Practice proactive urban planning, and support it by leveraging data and innovation:** Urban planning practice needs to shift from a reactionary to a proactive mode, which can reduce the risk of damage from climate change impacts such as floods, droughts, and heat islands. Apart from human resources, this change requires enablers in the data ecosystem, such as ease of access, transparency, and innovation in data sourcing and analytics. Leveraging data and innovation could facilitate new forms of measurement efficient monitoring of targets, and create feedback loops.
- **Create a bottom-up participatory urban planning process:** While it is imperative to embed BCAP recommendations into the master plan, at present there is a gap in planning at the local, ward, and micro levels. It is at these levels that we need the mechanisms and capacity for bottom-up planning and to both capture and embed the essence of the BCAP at the bottom level. A bottom-up participatory process helps

develop a shared vision between multiple actors, such as citizen groups, ward committees, and elected representatives, that is grounded in the principles of ecological sensitivity, social justice, and inclusivity. Such planning could ensure that we capture the on-ground experiences and challenges faced where the impact of climate change is most visible, and bring a human dimension to planning. This planning process will ensure inclusion and capture aspirations and challenges, especially those of the marginalized sections of society.

- **Adopt a systems approach to urban planning:** Different sectors interact as systems. Indicators must be developed that can map these changes periodically and focus on the drivers that initiate these changes. This will help identify the changes/interventions required in the policy and institutional aspects of planning. Data convergence will be an important lever in achieving this.
- **Establish an umbrella organization/nodal agency and mechanisms to ensure institutional and data convergence:** Embedding a climate lens across multiple departmental agendas and the implementation of the BCAP requires convergence and coordination across multiple actors and agencies. The creation of a nodal agency (such as a Climate Action Cell) will be essential to coordinate the implementation and monitoring of the BCAP. The cell must be empowered to manage conflicting/divergent interests and parallel initiatives at varied spatial scales. Mechanisms to resolve conflicting/divergent interests, misaligned values, and goals by tracing backward (i.e., goals and targets are set first, then traced back to understand what kinds of behavioral attributes are required to achieve those targets) could be explored. This type of tracing can be done not only between government departments and public organizations but also between public and private organizations, private and private organizations, and so on. At the local level, the differences—both individual and collective—with respect to these organizations' rights in the city must be reconciled. This approach addresses the problem of multiple scales of decision-making, institutional variety/conflicting values, and capacity.
- **Make agencies accountable and build capacity:** Making agencies accountable will be key to the implementation and long-term success of the BCAP. This will necessitate amendments to the mandates of various stakeholder agencies, leadership, and adequate capacity not only in human resources, skills, and funding but also in the quality of governance. It will be necessary to build the ecosystem capacities of multiple actors. Hence, a nodal agency can become a significant enabler.
- **Establish new spatial scales of governance:** The administrative jurisdictions used for urban planning preclude consideration of the various other boundaries or spatial frames that exert important influences on the city and its consumption and resilience. These boundaries include both natural boundaries such as resource sheds (i.e., watersheds), as well as human-induced spatial connections such as corridors of growth and city regions. It is important to acknowledge and create mechanisms to incorporate these new spatial scales of governance in plan-making, especially in the BCAP, which is greatly impacted by boundaries far beyond its implementation jurisdiction (such as the BBMP area). At the same time, it is equally important to consider smaller workable scales of interventions that fall outside the purview of the present system of plan implementation and municipal budgeting mechanisms (such as creating localized facilities for RWH and permeable surfaces). These interventions will require the capacity at the local level to apply for budgets, and political will to make and sustain these interventions at newer scales.

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LIST OF ABBREVIATIONS

BBMP	Bruhat Bengaluru Mahanagara Palike
BCAP	Climate Action and Resilience Plan for Bengaluru
BDA	Bangalore Development Authority
BESCOM	Bangalore Electricity Supply Company Limited
BMA	Bangalore Metropolitan Area
BMLTA	Bengaluru Metropolitan Land Transport Authority
BMRDA	Bengaluru Metropolitan Region Development Authority
BMTC	Bengaluru Metropolitan Transport Corporation
BSWML	Bengaluru Solid Waste Management Limited
BUD	Bengaluru Urban District
BWG	Bulk waste generator
BWSSB	Bangalore Water Supply & Sewerage Board
CH₄	Methane
CNG	Compressed natural gas
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalent
EV	Electric vehicle
FSI	Floor space index
GHG	Greenhouse gases
GW	Groundwater
IEC	Information, education, communications
ITS	Intelligent transport systems
KTCP	Karnataka Town and Country Planning
LPG	Liquid petroleum gas
MNRE	Ministry of New and Renewable Energy
NCAP	National Clean Air Programme
NGO	Nongovernmental organization
NMT	Non-motorized transport
PVC	Polyvinyl chloride
RE	Renewable energy
RMP	Revised Master Plan
RSVP	Renewables for Sustainable Village Power
RTO	Regional Transport Office
RWA	Resident welfare association
RWH	Rainwater harvesting
SLCP	Short-lived climate pollutants
STP	Sewage treatment plant
SWD	Storm Water Drains department
SWM	Solid waste management
WtE	Waste to energy

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ABOUT WRI INDIA

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organisation. Know more: www.wri-india.org

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to inform government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



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