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GUEST EDITORIAL

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We live in difficult times. The Intergovernmental Panel on Climate Change (IPCC) Special Report warns of a 1.5°C rise in global warming between 2030 and 2052, putting human and natural systems at high climate risk. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), in its 2019 Global Assessment Report, states that close to a million animal and plant species are under threat of extinction.

Both climate change and biodiversity loss are closely linked to the rapid urbanization taking place in many regions of the world. In India, projections indicate that 416 million dwellers will be added to our cities by 2050, bringing the urban population of the country to over 50%. Among the global Sustainable Development Goals, Goal 11 focuses on building ‘Sustainable Cities and Communities’. Translating this Goal into practice can help address some of the challenges of achieving sustainable development and economic growth, without worsening the ongoing climate and extinction crises. Some actions within Goal 11 include reducing the environmental footprint of cities, making green spaces accessible and inclusive, and protecting urban natural heritage.

Indian cities are not devoid of biodiversity. Cities of brick and asphalt, including Mumbai, Kolkata and Chennai, were developed on fertile coastal mangroves and floodplains rich in biodiversity. Many Indian cities are greener than their immediate countryside, having been planted with trees over centuries by both kings and commoners. They are rich in flora – native, naturalized and exotic – and in fauna ranging from the endangered slender loris to the common bonnet macaque, as well as reptiles, amphibians, birds, insects and spiders.

Not only are we unaware of the ecological diversity of Indian cities, we also know very little about the importance of urban nature for human health and well-being. Urban planners, architects and builders overwhelmingly focus on designing built space, while ecologists often ignore cities, missing the biodiversity within, while they focus on forests and protected areas.

Biodiversity in cities provides us with food, energy and herbal medicines necessary for survival of the urban poor. Our cities are not only expanding, but they are also becoming highly unequal spaces. The poor in city slums and distress migrants from rural areas, struggle to survive in cities and meet their very basic needs. These vulnerable populations often depend on city trees as sources of

food, fuel and medicine. Drumstick trees are commonly found in South Indian slums. The flowers, leaves and pods of drumstick tree provide a rich source of nutrition at no cost. Trees such as banyan and neem on roadsides are used as home remedies to cure minor ailments, saving on medical costs. Fruiting trees such as jamun, jackfruit, tamarind and mango are climbed by children for entertainment, exercise and nutrition, while migrants collect fuelwood and make oil from seeds of *Pongamia pinnata* tree.

The role of nature goes well beyond the tangible. Children growing up in cities spend most of the day indoors glued to the virtual world, prone to behavioural and health issues. Nature acts to calm children who are hyperactive and have attention deficit issues, providing them and their parents with welcome relief. Nature deficit disorder is a mental disorder that comes from being distanced from nature.

Exposure to nature in cities, even a single tree, helps in relieving stress and reducing the risk of lifestyle disorders. Studies have shown that being in the presence of nature improves well-being considerably – not only is recovery from illness faster, but it also makes us calmer, happier and more relaxed. Many hospitals are now trying to integrate greenery into their surroundings to help patients heal faster.

Urban residents also develop lifelong affinities with specific trees as a result of childhood memories of a favourite tree, or because of the tree’s cultural significance. Living close to parks and other spaces of nature helps in reducing obesity, and decreasing the likelihood of lifestyle disorders such as diabetes and elevated blood pressure. Trees also provide a place for community gathering. In Indian cities, it is common to see people coming together under the shade of a peepal or neem tree on a raised platform, often with snake stones at the base, which provides a place for street vendors to sell fruits, children to play a game of cricket, women to sit down for a chat, men to get together over a game of cards or chess, and the elderly to take an afternoon nap under the tree canopy. In fragmented cities where people have lost touch with their neighbours, one tree can provide a gathering point for collective action.

The increasingly sedentary urban lifestyle places adults and children at risk from obesity, high blood pressure and stress-related mental health disorders. Studies have

shown that being in the presence of nature improves recovery from illness. Apart from anecdotal reports, we know very little about how people relate to nature in cities in the Indian context, and even less about how it can help in relieving psychological stress, and improving physical and mental health and well-being.

Trees also play an important role in reducing air pollution, a growing danger to urban residents in India's increasingly polluted cities. They cool the air and the road asphalt, which is important during extreme heat waves such as those currently sweeping across most of North India. The cooling effect that trees provide is particularly necessary for those who are most at risk – construction labours, street vendors and domestic workers, who spend a lot of time outdoors during the peak midday heat. At the time when cities like Delhi and Bengaluru are felling pollution-controlling trees on the highways, and installing smoke-scrubber towers to reduce air pollution, the irony of these misguided planning interventions is striking. We urgently need research to understand which tree species are best suited for future urban planning, being pollution-resistant as well as heat-tolerant. In the era of the Anthropocene, this is important, as trees in hot cities (which encompass most of India) will be subject to increasing rates of mortality because of a 'wicked' interconnected nexus of urban heat island and global warming effects.

Another important area of emerging research is on tree communication. We know from recent studies that trees in forests communicate with each other, emitting chemicals into the air, and through an underground network of fungal mycelia. Scientists have termed this the 'wood wide web'. Through this underground network, trees of the same species, and even of different species, support each other in forests, by sharing food and information of pest attacks. How does this tree communication work in a city, where trees are planted in rows? Can such a mycelial network develop under a surface of concrete and tar?

Similarly, research on the wood wide web has found that 'mother trees' – the oldest trees in a grove or forest patch – are important for neighbouring trees. These neighbours, who are often genetically related in a forest, provide greater support to other family members, with the mother tree forming the critical central node. In Indian cities, we can speculate that these mother trees are often the largest and oldest. If so, these are the trees at most risk – city planners tend to cut them, claiming they are 'over mature' and pose a threat to people and property. What are the consequences of removing such mother trees, to the interconnected network of trees in the urban landscape? We do not know the answer as no studies have been done so far. We do not have the faintest idea of how, or indeed whether such tree communication would work and is ongoing in Indian cities. Surely, over-ground communication through chemical signalling must be ongoing as well.

As the discussions above indicate, trees in cities provide multiple directions for fascinating areas of research

that demand well-designed, long-term urban ecological research stations. Yet, there is a severe lack of such research in India – whether on trees, or on other aspects of urban sustainability. A recent analysis of the top 1000 most cited papers on urban sustainability from 2008 to 2017 (Nagendra, H., Bai, X., Brondizio, E. S. and Lwasa, S., *Nature Sustain.*, 2018, 1, 341–349) demonstrated that only 10 of these papers were from India. Sadly, most of the knowledge we use to govern our cities from the standpoint of urban sustainability comes from research in the US, Europe and China. However, these cities represent very different ecological, cultural and developmental contexts from the Indian cities. We cannot transport research frameworks and solutions from cities elsewhere in the world to the political, economic, ecological and institutional context of India, and expect them to work just as well. Sadly, this is just what most Indian cities seem to be doing.

Research is essential, but not enough by itself. Along with stepping up research on urban ecology, Indian scientists need to reach out to communicate with urban residents, working with them for change. One way to do this is to capitalize on the growing interest in citizen science in India. Season Watch is a nationwide programme in India, where people select a tree and observe phenological changes such as fruiting and flowering throughout the year. Not only are they contributing to the collection of important scientific data, but in process also helping adults and children to reconnect with nature. The Urban Slender Loris Project in Bengaluru is an excellent example of another citizen science project, focused on a rare endangered primate species.

There has been a resurgence of popular books on trees around the world (Haskell, D. J., *The Songs of Trees: Stories from Nature's Great Connectors*, Penguin Viking, 2017; Wohleben, P., *The Hidden Life of Trees: What They Feel, How They Communicate – Discoveries from A Secret World*, Greystone Books, 2016). There is a similar need for diverse science-based books for the Indian public, adults and children, on a range of ecological and environmental issues such as conservation, extinction and climate change. This will help engage individuals, schools, colleges and communities with public science and citizen science (Nagendra, H. and Mundoli, S., *Cities and Canopies: Trees in Indian Cities*, Penguin Random House India, Delhi, 2019). There is also a need for cross-collaborative networks of research on urban ecology for understanding how to ecologically design Indian cities for human well-being.

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