

Research Brief

natural
capital
PROJECT



JUNE 2019

Valuing Urban Nature – Implications for Air Quality, Heat Mitigation, and Emissions Reductions

ISSUE OVERVIEW

Poor air quality and extreme heat are serious public health concerns for cities around the world. Of the possible solutions, urban nature has the potential to improve air quality and mitigate heat as well as provide a number of other benefits for urban populations such as enhancing physical and mental health and promoting social and cultural well-being. However, a true value has not yet been placed on urban ecosystem services.

In a new study, scientists of the Natural Capital Project developed a framework for assigning a value to urban nature, examining several factors including: social, ecological and technological context; equity and access; and comparative benefits versus other non-nature based approaches. This brief is part of a series based on this research which looks at nature's ability – primarily through trees – to improve air quality, capture carbon, and reduce heat stressors in urban settings.



RECOMMENDATIONS AND POINTS FOR DECISION-MAKERS – AIR QUALITY

Trees or vegetated barriers can have positive, neutral, or negative effects on air pollution, depending on design characteristics. To maximize air purification, practitioners should:

- Select tree species with low volatile organic compound (VOC) emissions, low allergen emissions, and high potential for pollutant removal. Seasonality should also be considered as air quality impacts of deciduous varieties are minimal in dormant seasons.
- Consider potential negative air flow effects of urban vegetation in heavily traveled street canyons with high vehicle and pedestrian traffic. Trees should be planted strategically for the greatest potential to trap air pollutants while not impeding ventilation.
- Couple tree planting with point-source reductions or other interventions that reduce pollutant concentrations.
- Target tree planting to areas where the most vulnerable populations such as children, the elderly, and those with health issues are at greatest risk to exposure. Tree planting near schools, nursing homes, and hospitals ensures that benefits provided by trees are delivered to the populations that stand to benefit the most from improved air quality.

RECOMMENDATIONS AND POINTS FOR DECISION-MAKERS – CARBON CAPTURE

While tree planting to directly capture and store carbon is negligible in comparison to the magnitude of carbon emitted from cities, trees may enhance a city's capacity to offset urban carbon emissions by bolstering energy efficiency of buildings. To maximize carbon benefits, practitioners should:

- Select tree species with high woody composition, capable of thriving in the local environment. Avoid long-lasting and dominant species (e.g. American Elm and Green Ash in the Midwest region of the United States) given their potential loss associated with disease and death could leave important gaps in the urban forest structure and increases maintenance costs and associated emissions.
- Ensure the harnessing of energy-savings benefits from urban trees by carefully considering the local climate, building design, and their exposure to the elements. In the United States, Tree Community Guides are available on the U.S. Forest Service website, which cover multiple states in specific climate zones.
- Devise a low carbon or carbon neutral maintenance program to achieve carbon sinks in urban forests.
- Influence local decision-makers, neighborhoods, and environmental organizations to set up tree planting campaigns to provide energy-savings benefits, especially in low-income areas.
- Cultivate tree stewardship values in neighborhood associations and individual residents through economic

incentives and educational programs that inform on the full set of co-benefits of urban canopy in cities beyond just carbon sequestration.

RECOMMENDATIONS AND POINTS FOR DECISION-MAKERS – EXTREME HEAT MITIGATION

Urban green space has high potential to provide considerable cooling benefits, decreasing the impacts of extreme heat and the Urban Heat Island effect, both locally and regionally. In summary, practitioners should:

- Prioritize tree planting and other urban greening initiatives in areas where heat vulnerability and risk are the highest. Communities that lack urban tree canopy, accessible parks, or home cooling systems should be targeted.
- Consider that in order to achieve the most shading and cooling from trees, plantings should cover at least one to five acres and be arranged closely together.
- Choose tree species that have the largest leaves, as those trees have the greatest shading and evapotranspiration benefits which provide the greatest cooling effects.
- Choose trees that need less water, often native trees, which are ideal to avoid high watering costs. Refer as much as possible to tree-planting community guides that offer climate-specific guidelines to select tree species with the most shading benefits. For example, U.S. Tree Community Guides specific to climate zones are available on the U.S Forest Service website.



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- Ensure good growing environments to support photosynthetic activity of trees—especially light availability and water supply, which influence evapotranspiration and, consequently, the degree of cooling benefits.
- Consider involving local neighborhoods in tree planting campaigns in early stages and cultivating stewardship, especially where street tree care is the responsibility of homeowners, to enhance tree care and successful cooling benefits.

BACKGROUND

Two out of every three people will live in urban areas by 2050, so the continued development of cities will increasingly shape human well-being. Many of our greatest social and environmental challenges, such as climate change, public health, and resource availability will be determined by the form, pattern, and function of urban environments and will require massive financial investments. An estimated \$50–64 trillion will be invested globally in new urban infrastructure by the year 2030, with an additional \$2.4 trillion per year needed to implement the United Nations Sustainable Development Goals.

With rapid urbanization and growing needs for infrastructure, the paths taken for urban development in the next decade will have implications for both social and natural systems. This is reflected in the inclusion of ‘sustainable cities and communities’ as one of the 17 Sustainable Development Goals for 2030. Addressing the challenge of sustainable development in cities requires balancing multiple, often conflicting, objectives



with limited resources: equitable communities, economic development, sufficient food, water and energy, opportunities for recreation and renewal, and reduced risks to disasters.

Poor air quality, urban heat island effects, and heavy greenhouse gases emissions are attributes most often associated with urban areas. In fact, a growing number of cities have identified air quality as a key benefit associated with urban green space while climate models predict that nearly every city will become hotter on average, with increases likely in the frequency and intensity of heat waves. In response, there is growing interest in the potential for urban nature to reduce the urban heat island effect in order to mitigate negative impacts of extreme heat, such as heat related mortality and morbidity. Heat waves are among the deadliest natural hazards in the United States and avoiding negative health impacts associated with heat and heat waves is increasingly a priority in city decision-making across the globe.

While cities suffer more from air pollution and heat than their rural counterparts, they are also a major source of carbon dioxide emissions, contributing 75% of global emissions. Within cities, fossil fuel use and coal-based energy production are the dominant emission sources. The urban tree canopy has only negligible effects in directly sequestering carbon in cities, but trees can deliver other co-benefits, including energy savings in buildings and improved environmental justice implications, if taken into consideration in the distribution of trees.

ABOUT THE STANFORD NATURAL CAPITAL PROJECT AUTHORS

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This research brief is based on the study, *Social-ecological and technological factors moderate the value of urban nature* published in the journal *Nature Sustainability*.