Climate change and urban forests

Can urban forests help cities adapt to climate change?

Kieron J. Doick

Urban forests (Box 1) can both help reduce climate change and help urban society cope with its impacts.

As growing trees remove carbon dioxide from the air, storing the carbon in their biomass, urban forests are an important part of our response to climate change. Furthermore, urban forests provide a wider range of benefits to society (Box 2). They make towns more attractive places to live and provide habitats for a wide variety of animals, helping us stay connected to nature. They provide natural solutions to help reduce the impacts of extreme weather. While urban trees may bring disbenefits at times, these are often associated with planting the wrong type of tree for the location, and so many disbenefits can be minimised through appropriate species selection.

Box 1

The urban forest is defined as all the trees in the urban realm – in public and private spaces. It contributes to green infrastructure and the wider urban ecosystem.

Urban forests comprise four primary components:

- single trees, such as in private gardens;
- lines of trees, such as along streets, canals, or railway lines;
- clusters, such as those in parks or in larger areas of amenity landscaping;
- woodlands, including small woods.

Helping cities adapt to climate change

- Air purification: trees can remove particles and harmful gases from the air. By cooling the air (see below), urban forests also reduce air-pollutant formation.
- Flooding: trees intercept rain helping to reduce localised flooding.
- Shading and cooling: trees are the major component of greenspaces that provide urban cooling. Trees cool their surroundings by casting shade, reflecting solar radiation, transpiring, and intercepting rainfall that subsequently evaporates.

  The larger the greenspace the greater the cooling and the further this extends beyond the greenspace boundaries: a 100 ha greenspace can cool the surrounding 400 m of built-up area by up to 4°C. The cooling capacity of a greenspace is affected by: the shape of the greenspace; choice of trees, shrubs and groundcover; plant arrangement; and the built topography and natural land form beyond the greenspace.

Urban forest coverage

The extent of tree canopy cover provides a simple indication of the scale of benefits from the urban forest. Mapping the variability in coverage also helps to reveal the urban areas where more trees would be particularly beneficial.

- Tree canopy cover has been assessed for over half of the electoral wards of the UK through a citizen science engagement project (**http://bit.ly/urbancanopycover**). The project

shows that tree canopy cover in wards ranges from <1% up to 80% across the UK.

- A 2017 study of nearly 300 towns and cities in Great Britain showed that tree canopy cover ranged from 3 to 45%, with an average of 16%. Of these, only 8% exceeded 30% coverage and 62% had as little as 10–20%. Coverage was typically lower in coastal locations (up to 1 km from the coast), so the urban forest tends to play a smaller role in helping seaside towns adapt to climate change compared to inland areas.
- A few UK local authorities have set a canopy cover target, generally 20%. Internationally, targets are often 30% and higher in hotter countries to achieve greater urban cooling.

Box 2

Wider benefits of urban forests:

- Biodiversity: by providing space for wildlife, trees support ecosystems, including networks of pollinators.
- Economy: trees make places more appealing to live and work in, attracting business.
- Education: trees are a key focal point for learning outside of the classroom.
- Food provision: some trees provide edible fruits and berries.
- Health: trees encourage physical recreation and support good mental health.
- Noise: trees help to reduce noise pollution.
- Wood: trees provide wood for fuel and crafts.

Urban forest composition

Species and size composition of trees determine the extent to which an urban forest benefits society.

Species

- In principle, a diverse urban forest is more resilient to the pressures of climate change, so it is recommended that an urban forest comprises no more than 10% of any one species. A review of 12 studies across Great Britain, the most comprehensive contemporary comparison available, found that all locations, except London, had at least one species that exceeded the 10% target.
- Evergreen coniferous species are rare in the top 20 species, and yet these are especially effective at noise reduction, as well as providing an air purification service year-round.
- Tree species that grow tall or have a large canopy, especially when in a healthy condition, provide more shade than shorter trees or those with smaller canopies.
- Species with a large canopy that are pale in colour and are fast growing or tolerant to drought are most important for cooling urban areas.

Size

- Tree policies and management that promote the presence of large trees, where suitable to do so, will help to increase the benefits provided over time. An urban forest should contain 10% of trees with a trunk diameter larger than 60 cm.
  To ensure a population of young trees with the potential to grow to their full size – some greater than 60 cm in diameter – it is recommended that the size composition of an urban forest is: 40% of trees with a trunk diameter <20 cm, 30% of size 20–40 cm, and 20% at 40–60 cm. Few urban forests in Great Britain come close to this guideline composition: most have higher populations of the two smaller size classes and are particularly deficient in the largest size.
- Large canopy trees provide up to 30 times more rainfall and air-pollution interception than small canopy trees of similar age. To provide these benefits the trees need to grow to full size and remain healthy. Compared to young trees, mature trees provide on average 70 times more air purification and rainfall interception.

More information:

Further details of our work into the urban forest are available on our website:
www.forestresearch.gov.uk/staff/kieron-doick/

Find us on Twitter **@KieronDoickFR**

To discuss any aspect of Forest Research's work on urban forest ecosystem services, contact:

kieron.doick@forestresearch.gov.uk

Version 01: 19 Jan 2022

FR(GB-HM)PDF/JAN22-21/0024