Question 9

How can trees and forests support sustainable and climate friendly cities?

Authors: *Clive Davies (EFI), Diana Tuomasjukka (EFI), Rik De Vreese (EFI)*

Europe's production forests are mainly situated in rural areas, but provide much of the sustainably managed timber consumed in the built infrastructure of cities. Since most European cities are growing the demand for timber will rise throughout the next century due to increasing demand from urban designers and architects looking to reduce the construction industry's embedded carbon. For example, for each tonne of wood products used instead of non-wood products, there is an average emissions reduction of approximately 2 tons of CO2 (Hurmekoski 2017; Leskinen et al., 2018). As 70% of the global CO_2 emissions is emitted by cities, the role of forests as carbon storage is a crucial service to cities (Palahí et al., 2020).

Many of Europe's cities are located on major water courses hence watershed forests protect cities against flooding through reducing the water flow and buffering precipitation in forest soil. Closer to urban areas peri-urban forests provide further flood protection, wood products and carbon sequestration as well as playing an important role in reducing the urban heat island effect and cooling the city (Hiemstra et al. 2017; Marando et al., 2018).

Within city region boundaries urban forests – including individual trees and smaller urban woods – are fundamental components of the urban fabric. They provide a multitude of climate-related ecosystem services. For example, urban forests store almost as much carbon per hectare (178 tonnes C per ha) as tropical forests (190 ton C per ha (Wilkes et al., 2018)), so their contribution to carbon storage is very significant. Research has shown that closer to urban centres there is decreasing vegetation cover, and increasing soil sealing (Haase, 2019), hence urban forests are vital to the conservation of urban soils and the associated microbiome which is in turn crucial to supporting biodiversity in urban areas. Even in the densest parts of cities, urban trees and woodlands are a resource that facilitate nutrient cycling and groundwater management. Urban forests also store carbon in their biomass but also through the soils they maintain (Richter et al., 2020).

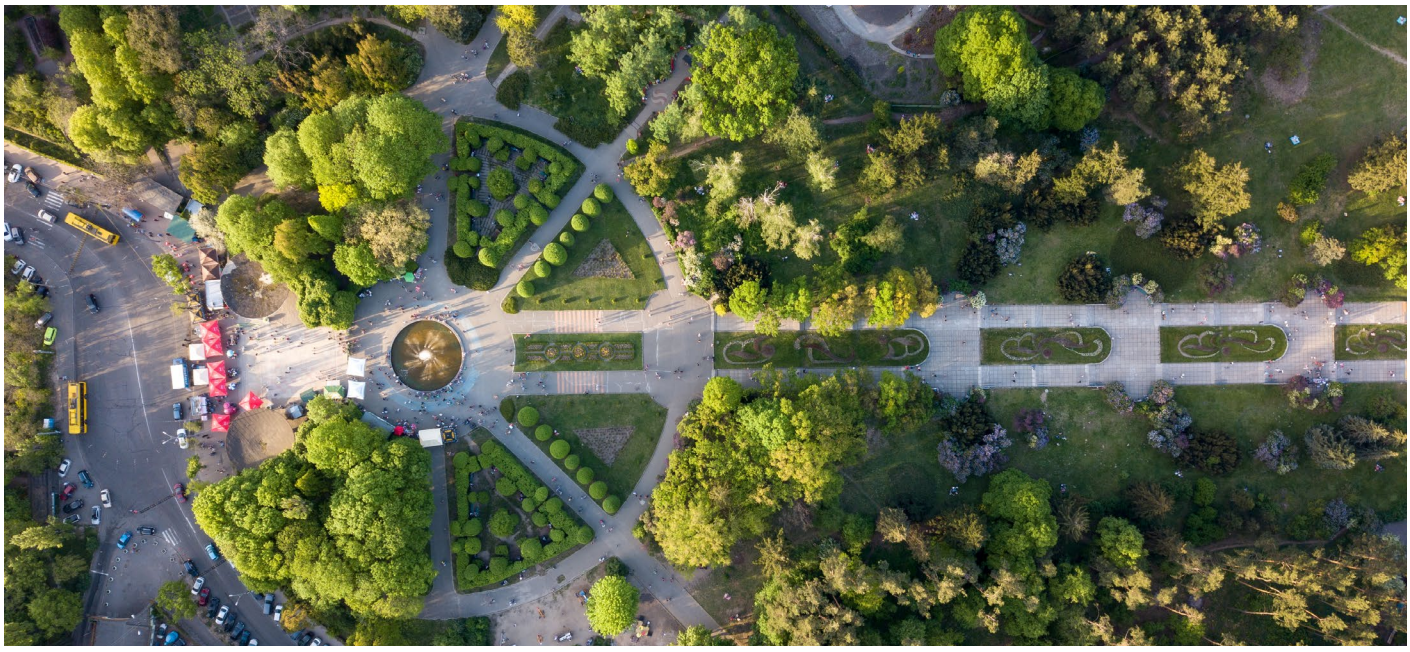

Photo: Adobe Stock

Whilst the standing volume in urban forests can be high, the wood volumes harvested are relatively low as is the quality of the harvested wood. However, to city dwellers the 'urban relevance' of trees is not measured in cubic metres but in canopy cover and distribution. A good example of this is stormwater management. Next to reducing the hazards of stormwater flows through the interception of precipitation by foliage, urban forest soils provide important 'soak away' areas for surface water and the resulting soil moisture allows trees to provide evaporative cooling. and as such contribute to mitigating the urban heat island effect (Livesley et al., 2016). The capacity of trees and forests to provide cooling through evaporation is however negatively impacted by dry periods, which have increased in Europe (Haase 2019). This accentuates the need to consider urban forestry not just as the trees but also on the quality of the substrate they grow on.

Indirectly, urban forests and urban trees reduce the use of electricity and gas for air conditioning and building heating, hence avoiding carbon emissions indirectly (Nowak et al. 2017). Shade provided by trees leads to lower indoor temperatures in summer; combined with a decreased urban heat island effect, this leads to 2 to 90% less cooling energy needed (Ko, 2018). The windbreak effects of urban forests and urban trees can lead to an energy need reduction of 20% for heating (Ko, 2018). Another indirect effect of urban trees and urban forests on climate, is related to a modal shift since attractive footpaths and cycle paths can facilitate a shift from car to walking or cycling (Langenheim et al. 2020).

Urban forests also contribute to the quality of the local human habitat (Barton and Grant 2006) by providing solutions that facilitate health and well-being improvements and increasing the quality of the natural environment which contributes to climate stability and biodiversity. Urban forests and urban trees create attractive places for living, working and spending time outdoors (Lafortezza et al., 2018), leading to curbing urban exodus and decreasing urban sprawl (Waltert and Schläpfer, 2010). Qualitative tree coverage in business districts and commercial areas can promote positive perceptions and high street image and can lead to a willingness to pay a premium of around 10% for equivalent goods and services (including for parking space on streets with trees) (Joye et al., 2010; Wolff, 2020). Combined, these impacts can lead to a more sustainable city by decreasing the need for (car) traffic, and hence a decreasing exhaust of CO_2. Also the positive impact of urban forests and urban trees on the quality of the air (Sicard et al., 2018) contributes to creating a healthier, more sustainable city.

Finally, urban forests and urban trees are also associated with disservices (Cariñanos et al., 2017; Roman et al., 2020): tree pollen can lead to allergenic reactions (Cariñanos et al., 2019); there are risks associated with falling trees or falling branches (Jones et al., 2014); and members of the public complain about nuisances created by trees, such as fallen leaves, fruit and branches; shade; or diverging opinions on aesthetics or tree management (Davies et al., 2017).

Photo: Adobe Stock

References

Barton H. & Grant M. (2006). A health map for the local human habitat. The Journal for the Royal Society for the Promotion of Health, 126 (6).252-253.

Cariñanos, P. et al. (2017). The cost of greening: disservices of urban trees. The Urban Forest. Springer, Cham,79-87.

Cariñanos, P. et al. (2019). Estimation of the allergenic potential of urban trees and urban parks: towards the healthy design of urban green spaces of the future. International journal of environmental research and public health 16.8 (2019): 1357.

Davies, H. J., Doick, K. J., Hudson, M. D., & Schreckenberg, K. (2017). Challenges for tree officers to enhance the provision of regulating ecosystem services from urban forests. Environmental research, 156, 97-107.

Haase D. (2019). The Rural-to-Urban Gradient and Ecosystem Services. Atlas of Ecosystem Services. Springer, Cham, 141-146.

Hiemstra, J. A., Saaroni H., & Amorim J.H. (2017). The urban heat island: thermal comfort and the role of urban greening. The Urban Forest. Springer, Cham, 7-19.

Hurmekoski E. (2017). How can wood construction reduce environmental degradation?. European Forest Institute, Joensuu.

Jones, R. M., Instone, L., & Mee, K. J. (2014). Making risk real: Urban trees and the ontological politics of risk. Geoforum, 56, 211-225.

Joye Y., Willems K., Brengman M., & Wolf, K. (2010). The effects of urban retail greenery on consumer experience: Reviewing the evidence from a restorative perspective. Urban Forestry & Urban Greening, 9(1), 57-64.

Ko Y. (2018). Trees and vegetation for residential energy conservation: A critical review for evidence-based urban greening in North America." Urban Forestry & Urban Greening 34 (2018), 318-335.

Lafortezza R, et al. (2018). Nature-based solutions for resilient landscapes and cities. Environmental research 165: 431-441.

Langenheim N. et al. (2020). Right tree, right place, right time: A visual-functional design approach to select and place trees for optimal shade benefit to commuting pedestrians. Sustainable Cities and Society 52 (2020): 101816.

Leskinen P. et al. (2018). Substitution effects of wood-based products in climate change mitigation. From Science to Policy 7. European Forest Institute. https://doi.org/10.36333/fs07

Livesley S.J., McPherson EG. & Calfapietra C. (2016). The urban forest and ecosystem services: impacts on urban water, heat, and pollution cycles at the tree, street, and city scale. Journal of environmental quality 45.1: 119-124.

Marando F. et al. (2019). Regulating ecosystem services and green infrastructure: assessment of urban heat island effect mitigation in the municipality of Rome, Italy. Ecological Modelling 392: 92-102.

Nowak D.J. et al. (2017). Residential building energy conservation and avoided power plant emissions by urban and community trees in the United States. Urban Forestry & Urban Greening 21: 158-165.

Palahí, M., Pantsar, M., Costanza, R., Kubiszewski, I., Potočnik, J., Stuchtey, M., ... & Dixson-Declève, S. (2020). Investing in Nature to Transform the Post COVID-19 Economy: A 10-point Action Plan to create a circular bioeconomy devoted to sustainable wellbeing. The Solutions Journal, 11(2).

Richter S. et al. (2020). Carbon Pools of Berlin, Germany: Organic Carbon in Soils and Aboveground in Trees. Urban Forestry & Urban Greening 54: 126777.

Roman, Lara A., et al. (2020). Beyond 'trees are good': Disservices, management costs, and tradeoffs in urban forestry. Ambio, 1-16.

Sicard, P., Agathokleous E., Araminiene V., Carrari E., Hoshika Y., De Marco A., & Paoletti E. (2018). Should we see urban trees as effective solutions to reduce increasing ozone levels in cities?. Environmental Pollution, 243, 163-176.

Waltert F. & Schläpfer F. (2010). Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. Ecological Economics, 70(2), 141–152. doi:10.1016/j.ecolecon.2010.09.031

Wilkes P., Disney M. I., Boni Vicari M., Calders K. & Burt A. (2018). Estimating urban Above Ground Biomass with multi-scale LiDAR, Carbon Balance & Management, doi: 10.1186/s13021-018-0098-0.

Wolf K. L. (2020). The Urban Forest and Shopping Environments. In Handbook of Research on Retailing Techniques for Optimal Consumer Engagement and Experiences (pp. 233-256). IGI Global.