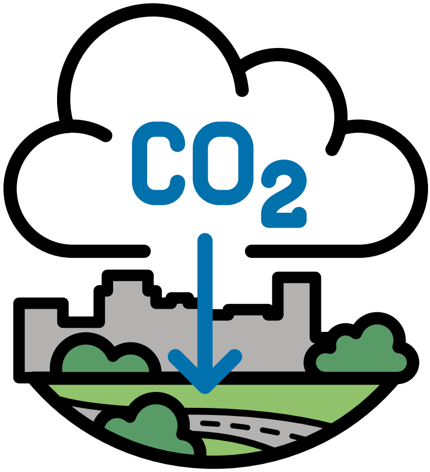

Urban Greening for Storing Carbon

Challenge

- Soil sealing due to urbanisation results in a loss of surface area and natural soil functions. This results in a smaller area over which soil carbon can be stored, either in above-ground vegetation or in soils, undermining the soil's ability to function as a carbon sink and support ecological functions[1] (see Figure 8).
- Disruption and mixing of soils is common in urban environments. This can cause substantial soil organic carbon loss, through soil removal during construction, frequent disturbance, and reduced vegetation cover. These disruptions diminish organic matter inputs, destroy soil aggregates that protect carbon and accelerate decomposition.

How urban greening protects and stores carbon

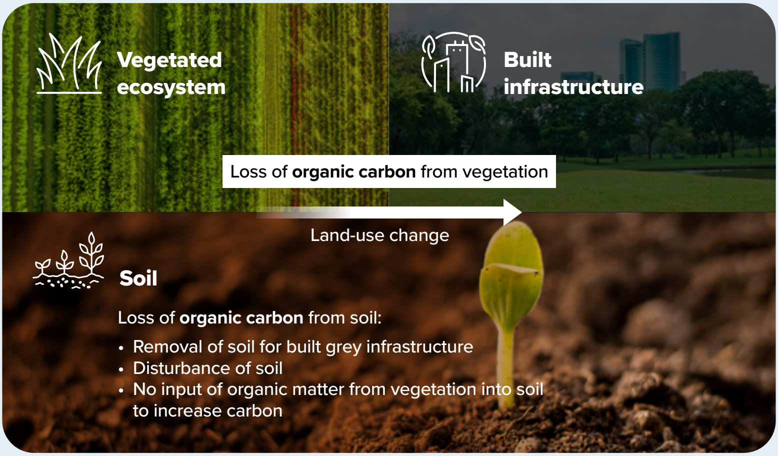

***Figure 8:** Urban expansion has negatively impacted carbon pools.*

Atmospheric carbon capture

Plants in urban green spaces absorb carbon dioxide through photosynthesis, converting it to organic compounds stored in leaves, stems, roots, and woody tissue, providing small climate mitigation benefits while improving local air quality. This carbon builds up over time in woody vegetation, contributing to stored carbon in the vegetation of our towns and cities.

Soil carbon enhancement

Urban vegetation contributes to soil organic carbon storing through root systems and leaf litter soil incorporation. Some soil types can store much more carbon than others, but ultimately most of the organic carbon in soil comes directly or indirectly from plants. In UK cities, research shows total organic carbon averages 17.6 kg/m^2 with 82% held in soils, demonstrating a significant but often overlooked carbon storing potential[2]. Urban allotments provide further evidence - comprising just 0.0006% of British land yet contributing up to 0.14% of national soil carbon stocks and storing 150% more carbon per unit area than conventional agricultural soils[3].

- **Long-term carbon storage in trees**
  Urban trees, particularly in parks and woodlands, provide substantial carbon storage in woody biomass. When protected from removal, these trees represent stable carbon reservoirs that can persist for decades while providing multiple additional benefits.
- **Interactions with climate**
  Urban vegetation reduces the urban heat island effect through shade and evapotranspiration, lowering surface temperatures and energy demands for cooling. This indirect carbon benefit may reduce fossil fuel consumption.
- **Soil resilience**
  Whilst directly storing carbon, the roots of urban plants also physically protect soil from erosion, compaction, and degradation. By maintaining soil structure and enhancing biodiversity, urban greening creates more resilient ecosystems that can better withstand climate stresses while preserving carbon stocks.
- **Water cycle improvements**
  Urban vegetation and healthy soils increase water infiltration and retention, reducing runoff and enhancing groundwater recharge. This improved water management supports drought resilience and protects water.

Recommended Actions

Prioritise GI types that have higher carbon storage potential.

- **Urban trees and woodland** are the most effective for vegetation carbon storage compared to grassland.
- **Wildflower meadows and allotments** store >150% more carbon per unit area than conventional agricultural land and amenity grassland[4].
- **Incorporate shrubs and trees** into amenity grassland, lawns or gardens to increase carbon storage while supporting multiple ecosystem services.

- **Consider key factors** affecting carbon storage: vegetation input, soil type, disturbance frequency, plant community diversity, climate conditions and management intensity, cutting frequency and management.

Implement sustainable soil management practices.

- **Regularly introduce organic matter** (compost, manure, mulch) to enhance soil carbon content and improve soil structure[5].
- **Minimise soil disturbance** through reduced mechanical disturbances and maintaining continuous vegetation cover to preserve soil structure and protect existing carbon stocks.
- **Promote community-based urban agriculture** and gardening practices that naturally incorporate carbon-building techniques.
- **For areas with suspected contamination or legacy pollution**, implement professional management practices including appropriate soil testing, long-term monitoring and specialised planting strategies to avoid contaminant remobilisation and ensure public safety.

Protect urban greenery from the pressures of urbanisation.

- **Safeguard** green and blue infrastructure through conservation zoning, mapping existing and aspirational wildlife connectivity to protect and enhance these corridors, development restrictions, and buffer zones to prevent carbon loss.
- **Limit impervious surface expansion** in gardens and public spaces to maintain active urban soils and green spaces that can actively contribute to carbon storage and the other important benefits by soils and vegetation.

Further Insight

Capitalise on the potential of food production in urban environments.

- Urban horticulture is increasingly viewed by international organisations as a facet of ensuring future food security, and it has proven potential to provide 15-122% of a city's residents with fruit and vegetables if all available land was cultivated[3].
- Increasing urban greening for food production would enhance access to locally produced healthy food while potentially improving both soil health and urban biodiversity when following best recommended practices for urban gardening; however, this approach will have limited effects on carbon storage in urban vegetation.

Support local research efforts in urban greening to fill current knowledge gaps.

- Research is needed to develop urban soil carbon monitoring programmes that track changes over time, quantifying how different greening strategies affect carbon stocks and providing the evidence base needed to confidently integrate carbon goals into urban planning policies. Furthermore, systematic documentation of comparative local implementation studies across various urban greening approaches is essential to determine their relative impacts on their ability to store carbon, over timescales.

References

[1]Zhang et al. (2015). Effects of forest type and urbanization on carbon storage of urban forests in Changchun, Northeast China. *Chinese Geographical Science*, 25, 147-158. [2]Edmondson, J.L., et al. (2012). Organic carbon hidden in urban ecosystems. *Scientific Reports*, 2, 963. [3]Dobson, M.C. et al. (2021). An assessment of urban horticultural soil quality in the United Kingdom and its contribution to carbon storage. *Science of the Total Environment*, 777, 146199. [4]Davies, Z.G., et al. (2011). Mapping urban ecosystem services: quantifying above-ground carbon storage at a city-wide scale. *Journal of Applied Ecology*, 48, 125-1134. [5]Edmondson, J.L., et al. (2014). Urban cultivation in allotments maintains soil qualities adversely affected by conventional agriculture. *Journal of Applied Ecology*, 2, 963.