Soil access is an equity issue for urban climate resilience

Uneven access to unsealed soil surfaces in LA County's residential areas

Adam Berland[1], Dustin Herrmann[2], Dexter Locke[3], and Kirsten Schwarz[4]

BALL STATE UNIVERSITY

Introduction

Nature-based solutions (NBS) are used to build urban climate resilience by employing natural features and processes. Implementing NBS in urban residential areas relies on the availability of unsealed soil surfaces. For example, trees can only be planted to reduce urban heat island effects if there is adequate unpaved soil surface. In this study, we investigate how soil is distributed at fine spatial scales across Los Angeles County to examine the potential for NBS to be realized equitably.

Methods

We randomly selected 1-hectare hexagons distributed across southern LA County that contained predominantly residential land. Within those hexagons, analysts used GIS and high-resolution air photos to draw polygons representing soil, buildings, impervious surface, and water.

We calculated four soil metrics to quantify the abundance and configuration of soil surfaces in delineated hexagons. We counted the number of soil patches, and we calculated the proportional area of the 1-ha hexagon that was classified as soil. The largest patch captured the size of the largest soil polygon, including portions of the polygon that extended into the surrounding 2-ha hexagon when applicable. Finally, we computed the mean perimeter-area ratio for soil patches to characterize the complexity of soil patch shapes; larger perimeter-area ratios indicate more irregularly shaped patches. These metrics capture the overall availability, fragmentation, and configuration of soil.

Finally, we compared soil patch metrics to the US CDC/ATSDR Social Vulnerability Index to explore dimensions of equity related to soil availability. The index ranges from 0 (lowest vulnerability) to 1 (highest vulnerability)

Results

- Soil metrics ranged widely across the 172 hexagons we delineated. For example, hexagons contained between 1-66 soil patches (median = 16), and soil covered 5.6-100.0% of the area (median = 46.8%).
- Soil metrics were significantly associated with the Social Vulnerability Index.

Conclusion, Application & Future Opportunities

We observed significant correlations among four metrics describing soil abundance and configuration in residential areas. These soil metrics were also significantly associated with social vulnerability, where high-vulnerability areas had soil surfaces that were less abundant, more irregularly shaped, and more fragmented.

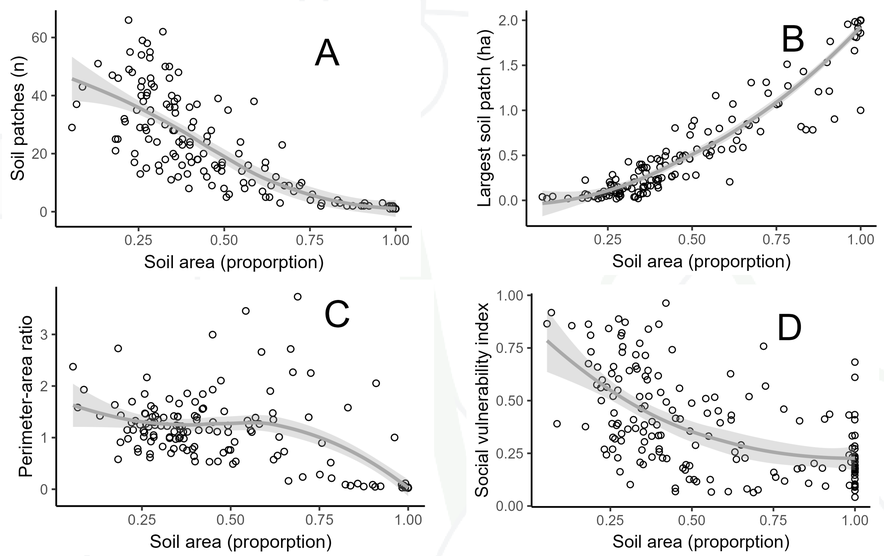
The availability of unsealed soil surfaces is a basic prerequisite for implementing NBS, but one that limits the expansion of NBS into high-vulnerability communities likely to experience disproportionate negative effects of climate change. Successfully implementing NBS may require more extensive changes to urban policy & planning to reimagine and transform areas with limited soil access.

Data

Example hexagons with soil polygons in yellow.

Metric	Left image	Middle image	Right image
Social vulnerability Index	0.08	0.39	0.86
Soil patches	7	40	51
Total soil area (ha)	0.70	0.27	0.13
Largest soil polygon (ha)	0.52	0.16	0.02
Soil perimeter-area ratio	0.24	1.31	1.42

Relationships between proportional soil area and (A) number of soil patches, (B) largest soil patch, (C) soil mean perimeter-area ratio, and (D) Social Vulnerability Index (SVI).



1. Department of Geography and Meteorology, Ball State University
2. TreePeople
3. Northern Research Station, U.S. Forest Service
4. Luskin School of Public Affairs, University of California – Los Angeles

TreePeople ARLA