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ARTICLE

Ground Conditions, Clearance Greening and Socioeconomic Persistence in London Neighbourhoods, 1881–2001

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Abstract

The assessment of urban green infrastructure tends to be based on measures of parks, gardens, street trees, and open space, but the social impacts of urban greenery are additionally mediated by land form, soils, drainage, history of settlement, and metro connections. This paper focuses on London neighbourhood data for 1881-2001 to evaluate whether greening in poor slum-clearance areas was linked with lower lower-status concentration. The present study interprets the London coefficients in terms of their direction, statistical significance, and reliability for groups of variables including ground conditions and status distribution; the Slum2Green terms among cleared neighbourhoods; and the long-run socioeconomic evolution in light of centrality and the 1908 London Underground line network. In all 197 London neighbourhoods, alluvium land is positively related to lower status concentration in 1881 (0.101^{**}) and 2001 (0.024^{**}). Bed rock sand has positive correlations with upper status concentration in 1881 (0.984^{*}) and 2001 (0.390^{***}). Slope elevation has negative relationships with class v in 1881 (-4.115^{***}), and positive correlations with social classes i–ii, 2.027^{*}. The main Slum2Green coefficients by 2001 tend to be positive or close to zero, and are weakly statistically significant in all specifications except for all-clearance and MSOA. Period-specific greening indicators have mixed signs, without strong evidence of a persistent reduction in lower-status concentration due to greening. The size of clearance, proximity to central London, distance to Westminster, and distance to 1908 underground network exhibit stronger associations. The London experience, thus, suggests no evidence of class replacement in greened slum-clearance areas.

Keywords: green infrastructure; slum clearance; alluvial soil; drainage; green gentrification; socioeconomic persistence; underground access; London

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1. Introduction

Green Infrastructure has assumed an essential role in both climate adaptation and public health policy. It is anticipated that parks, gardens, street trees, green corridors, wetlands, water bodies and green space more generally will mitigate heat, regulate runoff, provide recreation opportunities, conserve biodiversity and enhance daily environmental quality. The planning literature understands green infrastructure as an urban network rather than a series of unconnected green amenities [3]. The concept of water-sensitive urban design extends this idea by considering the interconnection of vegetation, soil, buildings and drainage in one urban system [30]. Research on resilience and nature-based solutions has further drawn attention to the capacity of green-blue assets to undertake infrastructural tasks that conventional grey systems do not always accomplish effectively and equitably [1, 12, 21].

The social impacts of greening remain a topic of debate. Environmental improvements decrease the potential for heat, flooding, pollution and lack of recreation, but they also enhance neighbourhood desirability. Scholarship on ecological and green gentrification provides numerous examples where public environmental improvements are capitalized into property prices, resulting in the capture of gains by higher income individuals who displace poorer residents through rent increases [6, 8, 29]. Other research on the effects of greening shows how the outcome is contingent on housing tenure, supply constraints, redevelopment pressures, reputation effects, civic engagement and prior trends [2, 7, 25]. The social implications of greening must, therefore, be assessed in light of the particular housing market and broader urban setting.

Neighbourhood change does not hinge on a single amenity. Household residential choice takes into account housing age, income segregation, proximity to job centres, connectivity and reputational barriers. Threshold approaches to neighbourhood transition demonstrate how shifts in composition may require reaching a cumulative point in pressure while historical social dynamics and social interactions may result in persistent segregation by socio-economic status [9, 13, 24, 28]. Similarly, theories of gentrification relate the process of upgrading to financial flows, government policy, middle-class residential tastes and changes in labour market geography [11, 15, 17]. Class reorganisation in inner London has been well understood to occur in relation to central employment and housing markets and the growing importance of centrality [5, 16].

A final element pertains to the functioning of green infrastructure. Visible greenspace depends on soil characteristics, depth, porosity, drainage, bedrock, groundwater processes and topography. Studies of hydrological performance demonstrate varying results in terms of infiltration, retention, filtration and downstream impacts related to differences in ground conditions [10, 20]. Geology has long determined the layout and sanitary standards of settlements [18, 31]. The function of a green space located on sand or gravel with good drainage is likely to differ from a space with similar features, located on alluvial soil or poorly draining land. Thus, equal visibility may produce differential environmental effectiveness.

This paper presents an opportunity for investigation in London because all of its ingredients exist in one place - nineteenth century class geography, diverse soils, substantial slum clearance programmes, extensive greening and metropolitan accessibility. This article asks the question of whether greening in low-income London neighbourhoods leads to reduced lower status concentration, or whether the key explanation is provided by soil, drainage, clearance extent and centrality. The analysis focuses entirely on the London-specific coefficients. These include alluvium, sand bedrock, impeded drainage, elevation, Slum2Green, years since clearance, clearance size, proximity to the City of London, proximity to Westminster and proximity to the 1908 underground network.

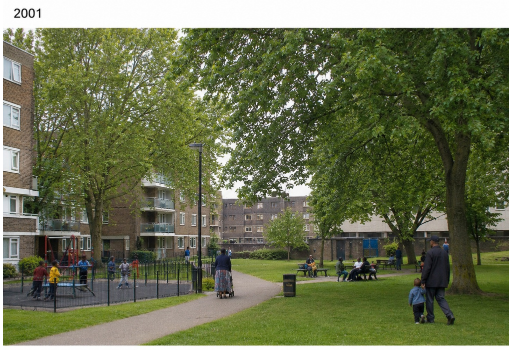
The initial figure sequence in Figure 1 sets visible greening against soil, drainage, nineteenth century street geometry and estate greenspace. The pictures validate the core hypothesis that greening is not an isolated park attribute. It emerges within a context of soil, infrastructure and class geography.

The four charts also make the time-scale of the article explicit. The historical comparison does not interpret greening as a temporary design intervention. Greening is considered along with persistent soil characteristics and transportation geography. This ensures that the coefficient interpretation will focus on the observed coefficient pattern, and not an abstract greening narrative.

(a) Metropolitan surface

(b) Ground and drainage

(c) Street environment, 1881



(d) Estate green space, 2001

Figure 1. London surface and ground context.

2. Green infrastructure, ground conditions and urban change

2.1. Environmental amenity and housing-market capture

As an element of green infrastructure, the attractiveness of green spaces lies in their capacity to combine a number of urban goals within a single plot of land. They provide shading, recreational opportunities, routes for active movement, wildlife habitat, storm-water runoff facilities, and enhanced landscape quality. Studies of hedonic and urban economics show that environmental amenities such as tree cover, water, and open space can be incorporated into property values [4, 19]. That does not mean that all forms of greening cause displacement. It means that, in the absence of effective housing market regulations, environmental improvement may facilitate residential segregation.

Such a relationship was the starting point for green-gentrification research. Early green-gentrification works emphasized the potentially exclusionary nature of environmental remediation in the context of speculative redevelopment [6, 8]. Later studies demonstrated variability in displacement risk due to different types of neighbourhoods, parks, scales, timing, and preexisting market conditions [2, 7, 25]. The concept of "being just green enough" resulted from efforts to achieve environmental improvement without further speculative repositioning [29**?**]. For the London case, it means that a reliable negative greening coefficient for lower-status concentration may suggest replacement pressure in the presence of a large clearance-size and strong accessibility effect.

The above body of work highlights the importance of continuing environmental investment in historically disadvantaged areas. Environmental justice literature has found that historically marginalized populations tend to have restricted access to environmentally desirable amenities, and increased vulnerability to environmental hazards [23, 29]. If planners expect displacement as a result of all forms of greening, historically burdened communities may miss out on cooling, stormwater, and recreational facilities. Careful interpretation of the London record requires separation between greening that contributes to displacement and greening that allows for the maintenance of locally advantageous environment.

2.2. Soil, drainage and green-space performance

Soil characteristics and drainage conditions are among the most relevant physical features determining the ability of green spaces to perform their intended functions, including storm-water infiltration and treatment. Hydrological literature has established that soil type, geomorphology and drainage conditions influence green storm-water performance and water management [10, 20]. The link to the social process is straightforward: the availability of favorable conditions for green-space performance may perpetuate existing inequalities even when green space is visible across communities.

Urban history provides a deeper background for understanding the problem. Soil conditions were considered important factors of healthy habitation in late-nineteenth-century sanitary literature. The suitability for residential use of soils and subsoils depended on such characteristics as sandiness or gravely nature, and was opposed to alluvial and poorly draining soil conditions [31]. In other words, the city was not built upon the uniform ground. Class formation, housing markets, sanitation, and infrastructure were intertwined with physical land conditions. This is an important historical backdrop for the current problem of climate adaption.

In this sense, the London coefficients are directly informative. Not only do they provide information about green-space presence in historically disadvantaged areas. They reveal the connection between the presence of alluvial or poorly draining soil and class concentration. From the planning perspective, this implies that a plot of green infrastructure placed on an alluvial or poorly draining piece of land may require additional resources to provide the desired performance.

2.3. Centrality and transport access

Another factor limiting the interpretation of greening as a primary driver of change is centrality and transport accessibility. Urban economic theory and gentrification studies have recognized the potential for changes in the housing market demand due to centrality, transport access, or evolving labor-market conditions [4, 16, 27]. In the context of declining neighborhoods, older housing may suffer from devaluation, while the proximity to the CBD may increase its value due to changing demand [26]. In this scenario, greening may accompany, but not cause, neighborhood change.

Transport infrastructure makes this consideration particularly relevant for the London case study. Proximity to the City of London, Westminster, and early public transportation routes created a unique geographical context of opportunity and competition in London. This context has shaped long-term housing-market development and the stability of residential class formations. Greening should therefore be evaluated in combination with centrality and transport distance measures.

In light of the existing evidence, the London coefficients require careful interpretation. For example, the presence of a reliable negative greening coefficient would suggest that displacement may occur after greening, although not necessarily because of it. A weak or positive greening coefficient and reliable positive coefficients for centrality or accessibility imply a different conclusion: greening may coexist with lower-status persistence, while centrality explains more of the change.

3. London neighbourhood evidence and analytical procedure

3.1. Variables and empirical coverage

The numerical evidence is provided for the purpose of interpreting London class-concentration coefficients for the period of 1881–2001 according to Nygaard's estimates of green infrastructure and lower-status concentration [22]. Three sets of coefficients are provided based on: 1) class concentration in relation to soil conditions, 2) slum clearance and greening, and 3) long-run class concentration. No additional data (e.g. on households, rents, and parcels) are used.

The first set examines lower-status and higher-status concentration in 1881 and 2001. Lower-status concentration is defined using social class v (1881) and class 7 (2001). Higher-status concentration uses social classes i–ii (1881) and classes 1–2 (2001). The explanatory variables are distances to the City of London and Westminster, elevation, alluvial land, sand bedrock, impedded drainage, and interactions between drainage and ground type.

The second set evaluates class concentration in relation to slum clearance and greening. The specification includes 2001 period variable, Slum2Green, Slum2Green interaction with 2001, time-period specific interactions with Slum2Green, years since slum clearance, interaction between Slum2Green and years since clearance, clearance size, and distances to the City of London and Westminster. The set of coefficients distinguishes slum clearance, slum clearance by period, areas of high lower-status concentration, and the MSOA scale.

The third set examines class concentration change from 1881 to 2001. Variables include socioeconomic-status z-score in 1881, distance to the underground 1908 network, elevation, distance to the City of London and the squared term of this distance, distance to Westminster, slum size, and Slum2Green.

3.2. Coefficient signs and reliability levels

Coefficients are evaluated by their sign and significance level. Three asterisks mark high reliability; two asterisks mark moderate reliability; one asterisk marks limited reliability; lack of asterisks indicates very weak support. Coefficients can be expressed using a shorthand notation:

$$C_i = \text{sgn}\hat{\beta}_i w_i, \tag{1}$$

where $\hat{\beta}_i$ is the coefficient, and w_i is the weight associated with the significance level of the coefficient.

The notation does not estimate the relationships again, nor change the sample and variable specification. It is merely a convenient tool for assessing the consistency of coefficient signs across soil, greening, and accessibility variables. The coefficient interpretation follows the dependent variable. For lower-status outcomes, a reliable negative greening coefficient would indicate reduced lower-status concentration after greening. Depending on the housing market mechanism, it may correspond to displacement, upgrading or replacement pressure. A positive greening coefficient implies persistent lower-status concentration. Weaker greening coefficient neither suggests upgrading nor replacement.

Positive alluvial or drainage coefficients for lower-status outcomes indicate that lower-status concentration correlates with soil and drainage conditions. Positive sand-bedrock or elevation coefficients for higher-status outcomes indicate the presence of a similar correlation in the opposite direction. Positive coefficients for the distance to the underground, the City of London and Westminster imply less favorable socioeconomic changes in more distant parts of London.

4. Empirical findings

4.1. Soil and drainage gradients in class concentration

Historically, alluvial land coincides with lower-status concentration. In 1881, alluvial coefficient for social class v is 0.101^{**} with a standard error of 0.051. In 2001, the alluvial coefficient for social class 7 is 0.024^{**} with a standard error of 0.010. Although the 2001 magnitude is smaller, the sign and reliability stay positive for two time points. Thus, alluvial land plays an important role in long-term class distribution.

The association is reinforced by impeded drainage. The impeded drainage coefficient is 0.052^{*} for social class v in 1881, and the alluvial by impeded drainage interaction is 0.046^{**}. The results suggest that lower-status concentration is strongest where alluvial soils and impeded drainage overlap. Impeded drainage in 2001 is negative, although weaker, while the positive correlation between alluvial land and lower-status remains intact. Impeded drainage is more relevant to the older class pattern, while alluvial land is correlated with lower-status concentration throughout the entire period.

For higher-status concentration, the relationship to soil characteristics is reversed. Sand bedrock is significant for both social classes i–ii in 1881 (0.984^{*}), and social classes 1–2 in 2001 (0.390^{***}). Also, elevation is significantly positive for social classes i–ii in 1881, 2.027^{*}, and negatively significant for social class v (-4.115^{***}). The negative effect of the sand-bedrock by impeded drainage interaction -0.038^{*} means that drainage conditions diminish the positive effect of sand bedrock on higher-status settlement.

(a) Alluvial district, 1881

(b) Alluvial district, 2001

(c) Elevated sandy district, 1881

(d) Elevated sandy district, 2001

Figure 2. Ground conditions and settlement form.

The paired scenes in Figure 2 translate the coefficient pattern into a material contrast. The alluvial panels show a lower, wetter and more constrained urban setting, while the elevated sandy panels present a more favourable residential environment. The images do not substitute for the estimates; they help explain why equal green-space area cannot be assumed to provide equal environmental performance across different ground conditions.

The coefficients for Table 1 also indicate that the ground-class pattern is connected with centrality. Both lower-status and higher-status concentrations have a significant distance-to-Westminster positive coefficient in the former period and a distance-to-Westminster negative coefficient in the latter period. For example, the distance-to-Westminster coefficient is 1.211^{***} for the 2001 lower-status concentration, while it is -3.258^{*} for the 2001 higher-status concentration. The distance-to-City-of-London coefficients differ significantly in sign because of the historical connection between centrality of low-status housing and centrality of employment areas. Soils do not account for all spatial variability, but their signs are sensible despite the inclusion of centrality.

Table 1. Soil, drainage and centrality coefficients.

Variable	Social class v, 1881	Social classes i–ii, 1881	Social class 7, 2001	Social classes 1–2, 2001
Distance to City of London, ln m	-2.665^{***} (0.757)	1.261 (1.241)	-0.634^{*} (0.337)	1.705 (2.760)
Distance to Westminster, ln m	3.002^{*} (1.543)	-2.908^{**} (0.952)	1.211^{***} (0.345)	-3.258^{*} (1.674)
Elevation, ln m	-4.115^{***} (1.222)	2.027^{*} (1.087)	-0.002 (0.339)	0.437 (1.141)
Alluvial, %	0.101^{**} (0.051)	–	0.024^{**} (0.010)	–
Sand bedrock, %	–	0.984^{*} (0.514)	–	0.390^{***} (0.578)
Impeded drainage, %	0.052^{*} (0.028)	0.014 (0.044)	-0.003 (0.009)	0.008 (0.031)
Alluvial × impeded drainage	0.046^{**} (0.018)	–	–	–
Sand bedrock × impeded drainage	–	-0.038^{*} (0.022)	–	–
Constant	18.239 (13.801)	24.361^{*} (12.577)	3.161 (3.822)	65.764^{**} (24.509)
N	197	197	197	197
R^2	0.198	0.047	0.070	0.069

This information has implications for green infrastructure planning. It indicates that green equity cannot be achieved by surface area alone. The soil characteristics of alluvial sites and those constrained by drainage will be costlier to manage, improve, and populate with trees. Given the stability of the alluvial pattern from 1881 to 2001, green equity must address issues at least as long-term as site design issues.

4.2. Impact on lower-status population from greened slum-clearance sites

Coefficients for the greening impact on lower-status population are inconsistent with an impact through replacement of lower-status populations with greening. In the all-clearance specification, the Slum2Green interaction by 2001 is 0.175 with low significance. In the high lower-status specification, the interaction is 0.092 with low significance. In the MSOA specification, the interaction is 0.039 and low significance. Since the outcome is lower-status population concentration, a stable negative coefficient would make more sense.

Period-specific coefficients further demonstrate that no significant greening effect exists. Pre-WW1 greening has a coefficient of -0.210, the 1919–1939 term has a coefficient of -0.019, the 1945–1955 term has a coefficient of 0.066, the 1956–1965 term has a coefficient of -0.142, and the 1966–1972 term has a coefficient of 0.085. Coefficients alternate by sign, and none is significant. This fact highlights the importance of not aggregating across clearance years to find a greening impact.

The period scenes in Figure 3 show why the coefficients should be read historically rather than as one uniform greening event. Interwar gardens, postwar estate greens and later open spaces belong to different planning moments. None of these periods yields a reliable negative interaction on lower-status concentration. The visual sequence therefore supports a cautious interpretation: greening was present in the redevelopment story, but it was not the dominant signal of lower-status replacement.

The most reliable signals in Table 2 are not the greening interactions. Clearance size is positive and reliable in every column: 0.079^{***}, 0.078^{***}, 0.073^{**} and 0.050^{**}. Distance to the City of London is positive and reliable in the all-clearance, period-term and high lower-status columns, with the largest value in the high lower-status specification, 0.474^{***}. Distance to Westminster is reliable in the high lower-status column, 0.391^{**}. These values show that clearance scale and metropolitan position carry more consistent information than the greening interaction.

(a) Pre-WW1 **(b)** 1919–1939

(c) 1945–1955 **(d)** 1956–1965

(e) 1966–1972

Figure 3. Cleared neighbourhood greening periods.

This evidence does not justify an interpretation in which low-income slum-clearance greening independently reduces lower-status presence. Lower-status persistence is more closely associated with clearance size and distance from central urban cores. Greening may still have improved local environmental welfare, but the coefficients do not show a stable class-replacement pattern.

The conditions shown in Figure 4 correspond to the variables that carry stronger reliability than the greening interaction in the lower-status specifications. Large clearance estates, peripheral distance and long post-clearance duration are not background details. They are the urban settings in which lower-status persistence is measured. The images explain why greening should be interpreted as part of a redevelopment and location structure rather than as a single independent cause.

Table 2. Greening, clearance and centrality coefficients.

Variable	All slum clearance	Period terms	High lower-status concentration	MSOA scale
Year 2001	-0.426^{**} (0.187)	-0.414^{**} (0.255)	-1.017^{**} (0.276)	-0.082 (0.373)
Slum2Green	0.087 (0.074)	0.087 (0.074)	0.177 (0.108)	0.306^{*} (0.174)
Slum2Green × Year 2001	0.175 (0.237)	–	0.092 (0.325)	0.039 (0.534)
Pre-WW1 Slum2Green × Year 2001	–	-0.210 (0.340)	–	–
1919–1939 Slum2Green × Year 2001	–	-0.019 (0.197)	–	–
1945–1955 Slum2Green × Year 2001	–	0.066 (0.255)	–	–
1956–1965 Slum2Green × Year 2001	–	-0.142 (0.127)	–	–
1966–1972 Slum2Green × Year 2001	–	0.085 (0.169)	–	–
Years since slum clearance	-0.004^{*} (0.002)	-0.004^{*} (0.002)	-0.004 (0.151)	0.002 (0.006)
Slum2Green × years since clearance	-0.004 (0.005)	–	-0.002 (0.006)	0.002 (0.008)
Size of slum clearance	0.079^{***} (0.024)	0.078^{***} (0.024)	0.073^{**} (0.035)	0.050^{**} (0.017)
Distance to City of London	0.199^{**} (0.074)	0.199^{**} (0.074)	0.474^{***} (0.114)	0.021 (0.195)
Distance to Westminster	0.144 (0.112)	0.144 (0.112)	0.391^{**} (0.175)	0.284 (0.226)
N	1994	1994	892	278
Groups	10	10	10	10
Wald χ^2 p-value	0.000	0.000	0.000	0.000

(a) Large clearance area

(b) Distance from the City

(c) Distance from Westminster

(d) Long after clearance

Figure 4. Clearance scale and centrality settings.

4.3. Accessibility and 1881–2001 socioeconomic change

The long-run change specification strengthens the accessibility interpretation. Initial socioeconomic status has a negative coefficient of -1.088^{***}, indicating convergence from the starting distribution. Distance to the 1908 underground network is positive and reliable, 0.267^{***}. Neighbourhoods farther from the early underground network are therefore associated with stronger lower-status persistence or less favourable long-run socioeconomic change. This is central because it places transport access beside greening rather than treating green space as a self-contained amenity.

Centrality also matters. Distance to the City of London is 0.726^{**}, and the squared City-distance term is -0.072^{***}, indicating a nonlinear distance relationship. Distance to Westminster is 0.196^{**}. Slum size is positive and reliable, 0.061^{**}, and Slum2Green is 0.561^{***}. Because the outcome reflects change in socioeconomic status relative to the lower-status direction used in the table, this positive greening coefficient does not support a displacement interpretation. It is more consistent with continued lower-status presence in greened clearance areas when the wider urban system is considered.

Table 3. Long-run socioeconomic-change coefficients.

Variable	Change in SES, 2001–1881
SES 1881, z-score	-1.088^{***} (0.666)
Distance to underground 1908, ln m	0.267^{***} (0.079)
Elevation, ln m	-0.028 (0.060)
Distance to City of London, ln m	0.726^{**} (0.256)
Distance to City of London squared	-0.072^{***} (0.021)
Distance to Westminster, ln m	0.196^{**} (0.091)
Slumsize, %	0.061^{**} (0.022)
Slum2Green	0.561^{***} (0.149)
Constant	-4.547^{***} (1.119)
N	197
Adjusted R^2	0.617
Heteroscedasticity p-value	0.983

The explanatory strength of Table 3 is substantial, with an adjusted R^2 of 0.617 and a heteroscedasticity p-value of 0.983. The coefficient pattern shows that long-run differentiation is strongly tied to distance from early underground access, distance from central urban cores and historical clearance scale. The greening term remains positive in this setting, so Slum2Green areas are not portrayed as places where lower-status concentration was reliably reduced.

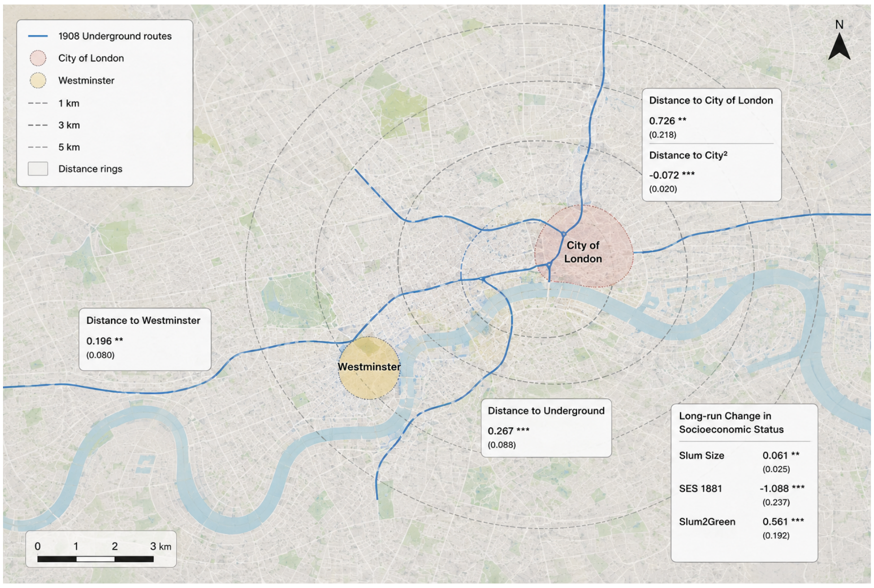


Figure 5. Centrality and underground access.

Figure 5 represents the urban-system variables driving the long-run change specification. The City of London, Westminster and early underground network are integral to the greening outcome; they are the urban structure giving the process social meaning. The key variable is the City non-linear distance term; it demonstrates that distance effects operate independently of any simple straight-line gradient away from the centre.

5. Interpretation

5.1. Land conditions and functional equity

London's experience reveals that below-ground conditions are socially significant over a long period of time. There is a positive association between alluvial land and lower-status concentration in 1881 and 2001, as well as a positive association between sand bedrock and lower-status concentration in both periods. It does not mean that soil types are determinative factors of class composition on their own. Material land conditions are represented in the coefficients as an inheritance of the urban settlement structure. In the nineteenth century, drainage and sanitation judgement defined the desirable status of the neighbourhood. In the twenty-first century, land conditions relate to storm-water management, tree viability and maintenance costs.

This interpretation shifts our focus on the issue of greening-equity. The greening-equity audit that counts green spaces or measures distances to them ignores performance differentials, where one area with the equivalent amount of visible greening experiences greater performance benefits than another neighbourhood. As a result, social equity in relation to green infrastructure implies not just distribution of investment but also performance-adjusted investment. Areas with difficult land conditions will need further investments such as soil remediation, drainage, longer maintenance schedules, monitoring and surveillance systems to achieve benefits that come naturally in more fortunate sites.

The finding also extends the current discussion about green gentrification, where the focus is generally limited to issues of who has access to a park or who can live in an improved environment. Social inequality in green space provision also involves the material ability of the land to generate the claimed benefits of greenspace provision. Low-income neighbourhoods may receive greening, but poor ecological performance could persist if the underlying ground is difficult. The London coefficients illustrate that the problem of environmental disadvantage is embedded in alluvial and drainage difficulty.

5.2. Greening without a stable replacement signal

The greening coefficients fail to act as a reliable displacement signal. The main interaction between Slum2Green by 2001 and lower-status concentration is positive and weak in almost all lower-status specifications. Period specific interactions do not show consistent negative coefficients with significant effects. Although it does not demonstrate that households did not face pressure in greened neighbourhoods, it shows that the neighbourhood level evidence does not exhibit a consistent trend of lower-status concentration decline due to greening.

The conclusion is critical for planning in general and urban planning in particular. In certain neighbourhoods, especially where affordable housing is scarce, greening may contribute to land-value capture, displacement, and exclusion. In London slum-clearance evidence, there are no consistent trends to suggest that greening in this case leads to replacement of disadvantaged households. The reliable signal is provided by clearance sizes and centrality variables.

Weak greening interactions in the left panel suggest that greening is not responsible for reduced lower-status concentration. Positive greening-related coefficients in the middle panel are associated with continuation of lower-status population. Reliable coefficients of the right panel indicate that the urban system variables drive the lower-status concentrations. Thus, the London evidence suggests a stronger link between greening and persistence rather than replacement.

The evidence implies certain policy choices. Avoiding greening in disadvantaged areas on grounds of generalized fear of displacement is unjustified. Instead, it would be wise to provide greening while ensuring that greening benefits persist through tenure security, affordable housing options, local stewardship and financial support of maintenance. When greening is undertaken in high-demand central neighbourhoods, more safeguards are required due to the combination of market pressure and improvement of the environment.

5.3. Centrality as the stronger spatial influence

The findings concerning the urban system demonstrate that transport and accessibility are not ancillary controls. Distance from the 1908 underground network, distance to the City of London, and distance to Westminster have significant effects in the long-run change specification. The variables are connected to the research on metropolitan restructuring, where centrality is related to residential demand driven by proximity to high-value jobs and amenities [4, 16, 27]. In this case, greening is one of many characteristics of the neighbourhood.

The Slum2Green positive coefficient in the long-run change specification is especially telling. If greened slum-clearance areas were experiencing high lower-status replacement, the effect would be a move toward lower-status concentration decline with a significant negative coefficient. The absence of that trend indicates the importance of persistence or continuation of lower-status population in greened neighbourhoods. The most likely explanation in the London case is found in material land conditions and accessibility to urban opportunities.

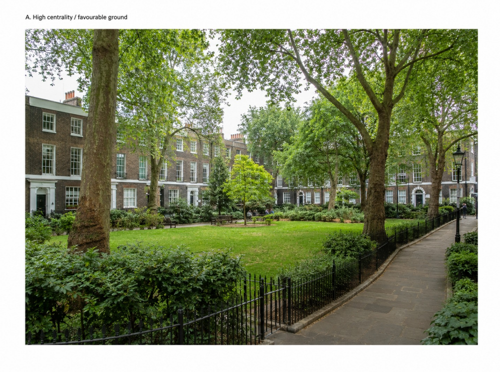
The accessibility effect highlights the need for policy differentiation across neighbourhoods. Green infrastructure investments in centrally located and highly demanded neighbourhoods require safeguards to protect the resident population from displacement. In contrast, green infrastructure investments in less central neighbourhoods would require a different set of priorities. Instead of displacement assessment, benefit retention, ecological performance, and stability of maintenance would be more appropriate focuses of the policy.

6. Planning relevance

Three major planning principles follow from empirical evidence. First, green infrastructure investments should be based on needs. Investment in sites of alluvial or impeded-drainage land would require greater expenditures to deliver storm-water, cooling, and vegetation services at the comparable level as other sites. Second, greening investments in disadvantaged districts need to be supplemented by measures that enable persistence and continued access to the benefits. Security of tenure, affordable housing, local maintenance, and community management are indispensable elements of the policy. Third, displacement risk depends on neighbourhood centrality and accessibility to high-demand employment.

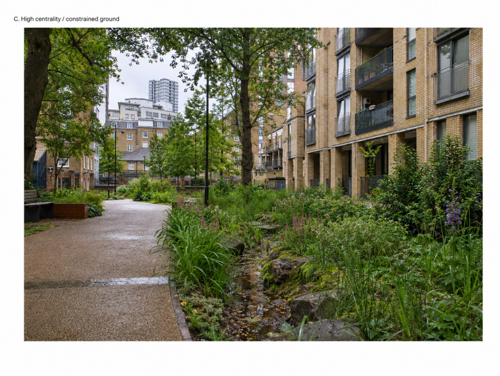
The four combinations in Figure 6 map the coefficients onto differentiated greening planning contexts. Land-value safeguards are required for central areas because the environment and accessibility could compound each other. Local benefits need to be protected in peripheral areas because strong environmental performance might be coupled with relatively weak economic pressure. Both drainage investment and tenure safeguard are needed in central constrained areas. Long-term maintenance and hydrological improvements are necessary in peripheral constrained areas or else the visible greenery will be less effective.

Such an interpretation steers clear of two weak claims: greening is unconditionally positive; and greening is always dispossessive. The London evidence requires a conditional interpretation because the risk of socio-spatial displacement arises from the combination of ground characteristics, accessibility and public investment in the face of housing market pressures. The greening policy needs to respond to such conditions.



(a) Central favourable ground

(b) Peripheral favourable ground



(c) Central constrained ground

(d) Peripheral constrained ground

Figure 6. Neighbourhood planning conditions.

7. Boundary conditions

The findings apply to neighbourhood-level variables. Individual movements and rents, evictions and tenure changes, household turnover and internal neighbourhood heterogeneity have to be addressed using the individual and parcel-level data sets. Alternative spatial configurations and control variables could be tested in addition to those shown in the London estimates, but that is beyond the scope of this analysis. The findings should thus be seen as evidence on the long-run effect of neighbourhood association, not directly on households' movement within their neighbourhoods.

The second limitation of significance markers as classification criteria for reliability should be mentioned. These work reasonably well for interpreting the coefficient tables. However, it may be better to conduct further tests based on raw observations and confidence intervals rather than significance criteria. Full household, parcel, tenure and rental histories could reveal whether some groups remain, others depart and how greenery interacts with changing housing markets. The study makes a contribution to the literature through its careful selection of key coefficients. The finding is that the long-run impact of the London ground conditions, clearance scale and accessibility on socio-spatial change is stronger than that of the interactions.

8. Conclusion

The London coefficients meet the core objective of the paper: greening is not linked to a stable reduction in lower-status neighbourhood concentration. Slum2Green interactions during 1946–2001 are either insignificant or positive, and period-specific greening terms are unreliable and mixed. Slum2Green in the long-run change specification is significant and positive, making the displacement hypothesis less credible.

Instead, the answer lies in the combined effect of ground conditions, clearance scale and accessibility. Alluvial ground is positively correlated with lower-status concentration in both 1881 and 2001, and the conjunction of alluvial soil and poor drainage is associated with greater lower-status presence in the historical city. Sand bedrock is positively correlated with upper status in 1881 and 2001, and higher status is associated with higher elevation in 1881. Larger clearance area is positively correlated with lower-status concentration, and the 1908 Underground proximity, distance from the City of London and Westminster are critical to the long-run change specification.

The findings apply only to the London case study. There is no reason why greening should be avoided in historically disadvantaged areas because greening alone will inevitably trigger socio-spatial displacement. Nor should greening projects be assumed to have unconditional positive social effects. The social effects depend on the ability of the ground to perform, the place of the neighbourhood within the metropolitan hierarchy and the protection of resident interests. Planning needs to combine greening with drainage-sensitive investment, long-term maintenance, tenure safeguards and strategic land-use policies.

The final integrated summary in Figure 7 closes the discussion by highlighting the strongest empirical signals in a single graph. They include alluvial and sand bedrock conditions, clearance scale and underground proximity as well as the Slum2Green interaction, since there is no evidence to suggest one cause at play. The social significance of greening depends on the material and metropolitan context in which it takes place.

Figure 7. Synthesised London evidence.

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