Appraisal of social-ecological innovation as an adaptive response to local conditions: Mapping stakeholder involvement in horticulture-orientated green space management

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January, 2017

Summary

Previous studies have attempted to conceptualise the social and ecological potential of civic ecological approaches to urban green space management. However, little is known of the social-ecological conditions influencing their occurrence and distribution. This research explored civic ecological activity in a continuous urban landscape comprising three adjoining metropolitan areas: Manchester, Salford and Trafford (UK). Their distribution, explored with GIS and remote sensing technology, was significantly associated with degree of urbanisation and levels of social and ecological deprivation. The study presented social-ecological innovation as an adaptive response to environmental stressors, conditioned by specific social and ecological elements in the landscape.

KEYWORDS:
Social-ecological innovation; adaptive capacity; urban green space; environmental stewardship

1. Introduction

Urbanisation is an environmental process which offers some of the greatest challenges to but, also, some of the greatest opportunities for resilient ecosystem services management through innovative and adaptive management and governance tools (CBD, 2012).
Not only do cities appropriate vast ecological resources at local and global scales, but the distribution of those resources within the urban region, tend to echo familiar patterns of socio-economic inequality among the population demography (Haughton, 1999). Such inequality is often characterised by the differential access to quality environmental resources and amenities according to socio-economic group (Schweitzer and Stephenson, 2007).
Social-ecological innovation has received increasing attention as an effective and desirable contribution to natural resource management, specifically in urban areas (Olsson and Galaz, 2012). An understanding of the extent and impact of local social-ecological action, which potentially mediates the productivity of urban green space in terms of ecosystem services (Barthel et al., 2010) could inform an appraisal of the contribution of such innovation towards adaptive capacity and response diversity to social-ecological stresses.

The authors undertook an exploration and evaluation of instances of organised social-ecological innovation (OSEI) as adaptive responses to local environmental conditions. Specifically, the local contexts of sites of social-ecological innovation were explored for evidence of levels of both physical and social deprivation. The rationale was that, if such innovation can be said to comprise a coherent adaptive response to environmental pressures in the landscape, it should occur in those areas most in

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need of its potential social and ecological benefits (Olsson and Galaz, 2012). This hypothesis was tested by mapping examples of OSEI and exploring whether their distribution was influenced by separate measures of ecological and social deprivation. The study area for the research was comprised of three adjoining metropolitan districts in Greater Manchester (Manchester, Salford and Trafford) which form a coherent inner-city zone of continuous suburban areas.

2. Methods

Examples of organised social-ecological innovation in the study area were identified using a snowball sampling approach (Goodman, 1961). The use of internet search engines was followed by consultations with social-ecological actor groups in the study area until no additional projects were discovered. Once the snowballing sampling process had reached the point of data saturation sites were then mapped within ArcGIS.9.

Land cover by green space and domestic gardens (as a percentage) was mapped using the Ordnance Survey-derived Generalised Land Use Database (GLUD: ONS, 2005) at the census-level unit lower super output area (LSOA). In addition, remotely sensed Landsat 7 data (bands 3 and 4) were downloaded (NASA, July 2013) and, using ERDAS Imagine10 software, the Normalised Difference Vegetation Index (NDVI) for the study area was calculated.

Experian MOSAIC data (Experian Limited, 2007) on neighbourhood characteristics were used to categorise areas as defined by the most representative MOSAIC group per LSOA. The MOSAIC UK is a geo-demographic dataset designed to generate consumer classifications of households for commercial and research purposes. The classification is built on variables derived from demo-graphic, socio-economic and consumption, property and location data. Index of Multiple Deprivation (IMD) data were obtained (DCLG, 2010) to allow analysis of socio-economic deprivation at site localities.

Once mapped, the ArcGIS.9 *spatial join* tool was used to determine the social-ecological contexts of sites, and *select by location* was used to differentiate LSOAs with and without instances of OSEI. Attribute tables were entered into IBM SPSS.20 statistical software for analysis. Locations of sites (Group 1) were analysed through a comparison of means (Mann-Whitney U test) with that of the remainder of the study area (Group 0). Chi square test was applied to MOSIAC data and the relationship between occurrence of OSEI and local area deprivation was also explored by calculating the frequency at which the phenomenon occurred at differing levels of deprivation. Statistical analyses were carried out using IBM SPSS.20.3

3. Results

3.1 Analysis of physical (land-cover) characteristics.

Figure 1 presents the distribution of sites − plotted against the normalised difference vegetation index (NDVI) of the study area.

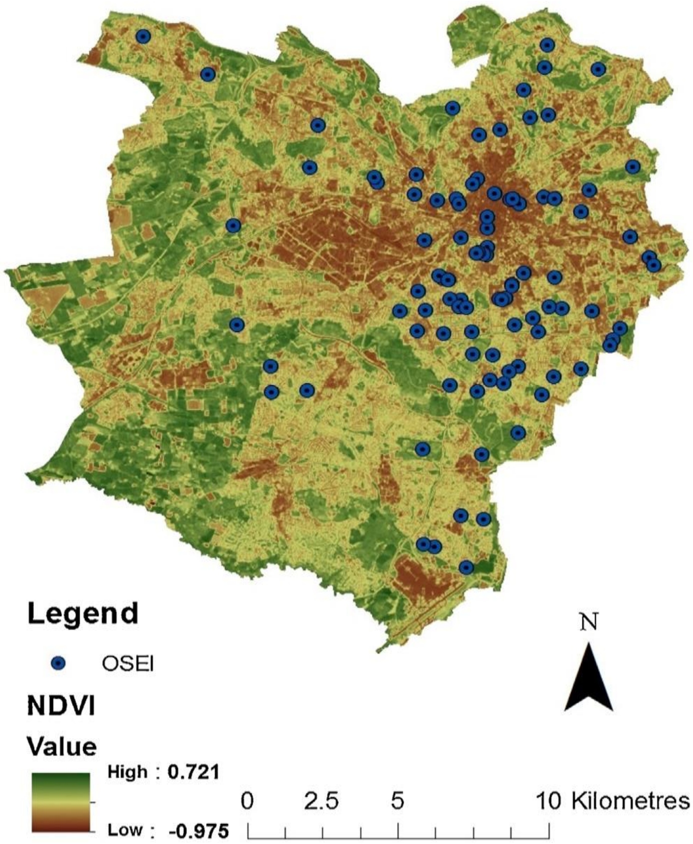

Fig.1. OSEI distribution and normalised difference vegetation index (ONS, 2001; NASA, 2013).

Many sites appeared to occur in areas of low vegetation cover/high levels of urbanisation. Mean land cover by domestic gardens differed significantly ($p < 0.001$) between group 0 (mean = 29% ± 15%) and group 1 (mean = 22% ± 14%). In terms of public green space, however, groups were not significantly discrete ($p = 0.255$). Fig. 2 presents a summary of site frequency with level of domestic garden cover.

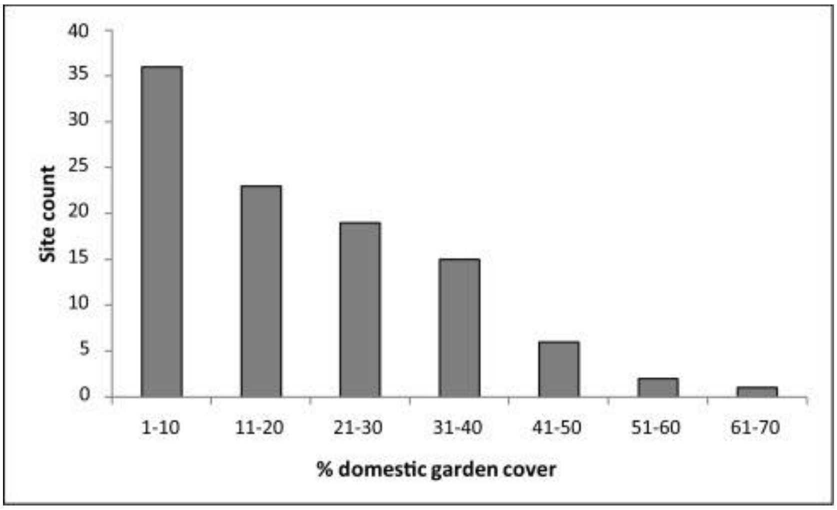

Fig. 2. Distribution of OSEIs by domestic garden cover (r^2 linear = 0.95; $p < 0.001$).

3.2 Socio-economic analysis

A comparison of mean Index of Multiple Deprivation scores for Group 1 LSOAs (mean = 39.03 ±17.06) and Group 0 (mean = 32.56±19.84) demonstrated a high degree of statistical significance (*p*

= 0.004). Fig. 3 contains a summary of the frequency of sites occurring at each level of Index of Multiple Deprivation score for the study area. The data in Fig. 3 demonstrate that the occurrence of sites increased with growing severity of deprivation up to IMD scores of between 30–40 (study area mean = 33.51). Above this threshold, however, examples of OSEIs continued to occur but with lower frequency before reducing dramatically ($< 2\%$ of the total) in areas with deprivation equal to 70 or over (study area max = 81.58).

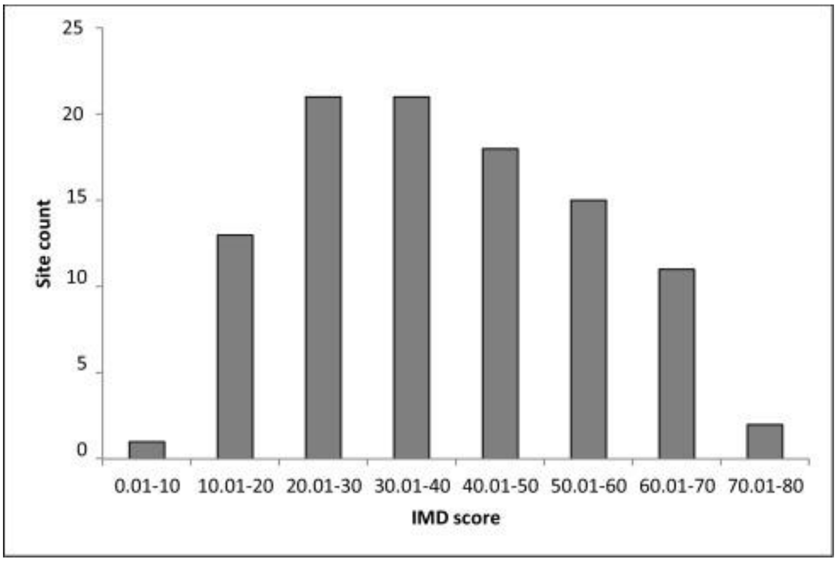

Fig. 3. Frequency of OSEI occurrence relative to IMD score (r^2 quadratic = 0.94; $p = 0.001$).

Chi-squared test on Experian MOSAIC data revealed that the two groups were statistically discrete in terms of the most representative MOSAIC household category ($p < 0.001$). These data are summarised by MOSAIC category (as percentage make-up of each group) in Fig. 4.

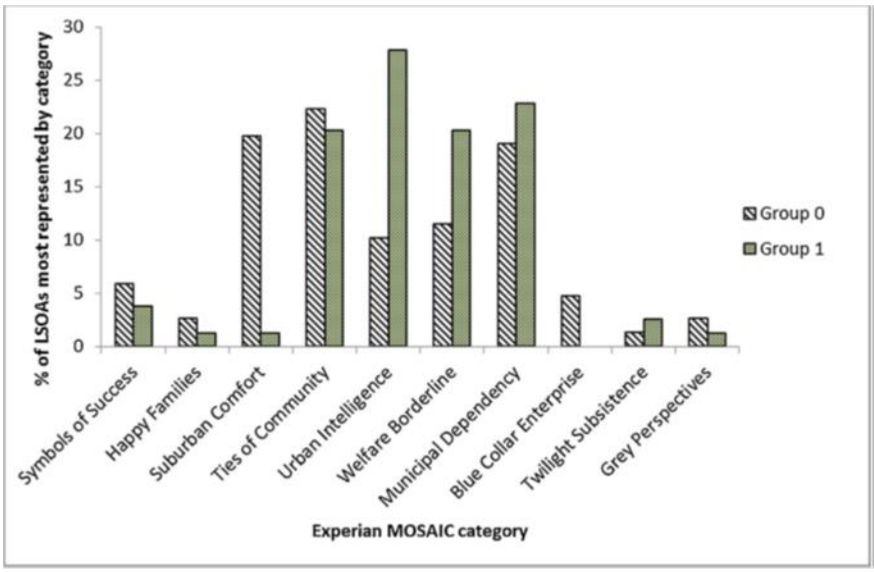

Fig. 4. Most representative MOSAIC households in LSOA groups 0 and 1.

4. Discussion

The contexts of examples of social-ecological innovation, presented the phenomenon as being, from a land-scape scale view, responsive to social-ecological conditions. The emergence of sites was likewise subject to the potential traps in adaptive cycles. Specifically, although increasing in number with heightening socio-economic deprivation, site occurrence dropped sharply beyond IMD scores of 40 with very few in LSOAs subject to IMD scores over 70. According to the theory of adaptive cycles, such areas represent “poverty traps” (Carpenter and Brock, 2008) where high levels of system stress, unfavourable circumstance or lack of leadership prevent innovation. Horticulture with an emphasis on urban agriculture appeared to be an effective vehicle for the establishment of social-ecological engagement, confirming similar assertions in previous research (Francis, 1987).

5. Biography

Dr Matthew Dennis is an early career researcher in Geography at the University of Manchester. His research concerns the contribution of social-ecological movements within urban environments towards increasing adaptive capacity in the management of ecosystems and the relationship between green space and human health.

Dr Richard Armitage is a senior lecturer in GIS at the University of Salford. His research interests centre round the application of GIS and earth observation methods to the characterisation of the environment. Recent work focusses on fire risk in upland areas and characterising forest canopies using terrestrial laser scanning.

Prof. Philip James is a professor of ecology at the University of Salford. His expertise lies within the disciplines of landscape ecology and environmental management. Research focusses on urban ecology, habitat restoration and ecosystem services, informed by an Ecosystem Approach to understanding the links between environmental and human well-being.

References

Barthel, S., Folke, C. and Colding, J. 2010. Social-ecological memory in urban gardens: retaining the capacity for management of ecosystem services. *Global Environmental Change*. **20**(2): 255-265.

Carpenter, S. and Brock, W. 2008. Adaptive capacity and traps. *Ecology and Society* **13**(2): 40. [online] Available at: http://www.ecologyandsociety.org/vol13/iss2/art40/

CBD (Convention on Biological Diversity). 2012. *Cities and Biodiversity Outlook*. Montreal. Secretariat of the Convention on Biological Diversity.

DCLG (Department for Communities and Local Government). 2010. *English Indices of Deprivation 2010* [computer file]. Downloaded from: https://data.gov.uk/dataset/index-of-multiple-deprivation. Licensed under: https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3.

Experian Limited. 2007. *Experian Demographic Data, 2004-2005 and 2008-2011*. [data collection]. UK Data Service. SN: 5738. Downloaded from: http://dx.doi.org/10.5255/UKDA-SN-5738-1.

Francis, M. 1987. Meanings attached to a city park and a community garden in Sacramento. *Landscape Research*. **12**(1): 8-12.

Goodman, L. 1961. Snowball Sampling. *Annals of Mathematical Statistics*. **32**(1): 148-170.

Haughton, G. 1999. Environmental Justice and the Sustainable City. *Journal of Planning Education and Research*. **18**(3): 233-243.

NASA Landsat Program, 2013. Landsat 8 scene LC82030232013196LGN00. OLI/TIRS. Sioux Falls. USGS. 15.07.13.

Olsson, P. and Galaz, V. 2012. Social-ecological innovation and transformation. In Nicholls, A. and Murdock, A. eds. *Social innovation: Blurring Boundaries to Reconfigure Markets*. Hampshire. Palgrave Macmillan. pp. 223-247.

ONS (Office for National Statistics). 2001 Census: Digitised Boundary Data (England and Wales) [computer file]. UK Data Service Census Support. Downloaded from: http://edina.ac.uk/census. Licensed under the terms of the Open Government Licence [http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2].

ONS (Office for National Statistics). 2005. Generalised land use database statistics for England [computer file]. London. Downloaded from: http://data.gov.uk/dataset/land_use_statistics_generalised_land_use_database Licensed under the terms of the Open Government Licence [http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3].

Schweitzer, L. and Stephenson, M. 2007. Right answers, wrong questions: Environmental Justice as Urban Research. *Urban Studies*. **44**(2): 319–337.