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Environmental and resource burdens associated with an urban community and its surrounding bioregion

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Abstract

Environmental or 'ecological' footprints have been widely used in recent years as partial indicators of sustainability; specifically of resource consumption and waste absorption transformed on the basis of the biologically productive land area required by a defined population. The carbon and environmental footprints of the Unitary Authority of Bath & North East Somerset (*Bathnes*) in the South West of England (UK) have been determined. It represents an example of sustainability assessment on an urban and bioregional scales from which lessons can be drawn in a wider context of strategic planning for low carbon development. *Bathnes* covers an area of 352 km^2, of which two thirds is so-called 'green belt' land. The UNESCO World Heritage City of Bath is the principal settlement in the district, but there are also a number of smaller urban communities scattered amongst its surrounding area ('hinterland' or bioregion'). The environmental footprint has been computed in terms of global hectares (gha) required *per capita*. Thus, the overall footprint for *Bathnes* was estimated to be 3.77 gha *per capita* (gha/cap), which is well above its biocapacity of 0.67 gha/cap and the 'Earthshare' of 1.80 gha *per capita*. *Direct Energy* use was found to exhibit the largest footprint component (a 31% share), followed by *Materials & Waste* (30%), *Food & Drink* (25%), *Transport* (10%), *Built Land* (4%), and then the *Water* footprint (~0%). Such data provides a baseline against which to assess their planning strategies for future development. Cities and towns require resources from beyond their geographic boundaries, but rural communities also take advantage of the modern infrastructure and services typically provided in an urban setting.

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Keywords: Cities; Environment; Footprint analysis; Low carbon development; Sustainability; Urban and bioregional planning

1. Introduction

1.1 Background

Environmental or 'ecological' footprints have been widely used in recent years as indicators of resource consumption and waste absorption transformed on the basis of biologically productive land area required *per capita* with prevailing technology. They represent a partial measure of the extent to which the planet [1], its nations [1,2], or communities [3-6] are moving along a sustainable development pathway. Such footprints vary between populations at different stages of economic development and varying geographic characteristics [2]. Cities have been shown to be unsustainable in the sense that their footprints greatly exceed, or overshoot, their biocapacities by typically 15 - 150 times [3]. Sustainable development is desirable and, hopefully, attainable on a global scale. However, it is less obviously applicable on a city scale [3], where the term 'sustainable cities' is sometimes used synonymously with concepts such as urban autonomy, self-reliance or self-sufficiency. Cities only survive because they are linked by human, material and communications networks to their hinterlands or bioregions [3].

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The notion of sustainability can only be realistically applied in this wider geophysical perspective, where the urban-rural interface might play an important role in land use planning. Doughty & Hammond [3] recommended that sustainability assessment, planning and monitoring should therefore be undertaken at the bioregional scale or beyond. This would be aimed at reducing environmental footprints by encouraging greater self-reliance and low-impact development across regions, whilst protecting indigenous ecosystems.

1.2 The Issues Considered

'Ecological' or environmental footprints (and related parameters) represent, albeit partial, sustainability indicators [2]. Resources used and wastes produced by a defined population are converted to a common basis: the area of productive land and aquatic ecosystems sequestered (in global hectares) from whatever source in worldwide terms. This footprint is illustrated schematically in Fig. 1, where the various constituent elements are depicted [7,8]. Previous research conducted by *Friends of the Earth* [9] and Wackernagel & Rees [10] found that most western lifestyles, such as those in Europe and North America, have consumption patterns that result in footprints which are far greater than the amount of geographically available land. In the case of cities, this 'overshoot factor' [8] amounts to some 20 times the urban area for Bath [3], 125 times for London [4], 16 times for Santiago de Chile [6], and more than 200 for Vancouver [10]. These factors, which Rees & Wackernagel [9] suggest are representative of a 'sustainability gap', do not correlate directly with urban population size or geographic land area, but depend largely on economic wealth *per capita* and building density [3,8]. Much clearly needs to be done in terms of significantly reducing the environmental footprints of communities as part of the overall sustainability agenda.

Doughty & Hammond [3] used the technique of *environmental footprint analysis* (EFA) to study the sustainability of cities by placing them in their broader geographic context. In the present study, the carbon and environmental footprints of the Unitary Authority of Bath & North East Somerset (*Bathnes*) in the South West of England (UK) have been estimated. The area covers ~35,200 ha and extends some 36 km east to west and 17 km north to south. Its geographical position lies between the Cotswold and Mendip Hills giving it a diverse and complex character. It is drained primarily by the River Avon. It represents an example of sustainability assessment on an urban scale, together with the surrounding 'bioregion'. A mixed 'compound'/'component' approach to footprint accounting was adopted, where the footprint components (such as energy, transport, food, materials and waste, and water) represented broad policy-making categories [3,8]. This component-based approach has enabled the examination of the *Manufactured* and *Natural Capital* elements of the 'four capitals' model of sustainability quite broadly, along with specific issues. The data utilised was based on both proxy, or 'top-down', data extracted from national statistics and local, or 'bottom-up', data provided by local organisations. Thus, the uncertainties and deficiencies of using environmental footprints (and related parameters) as sustainability indicators are examined, including problems of urban and rural boundary definitions, data gathering, and the basis for weighing the various consumption and associated impacts.

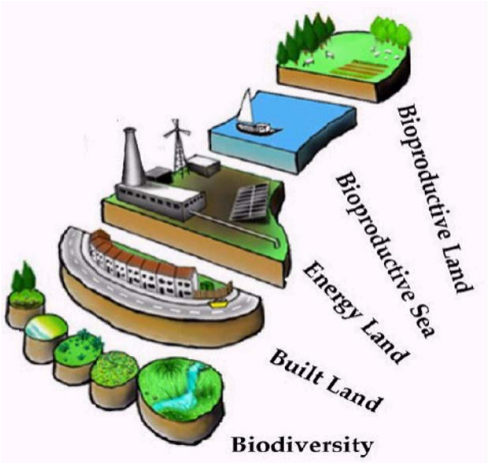

Fig. 1. Schematic representation of the environmental footprint, and its land types. *Source:* Eaton *et al.* [8]; adapted from Chambers et al. [7].

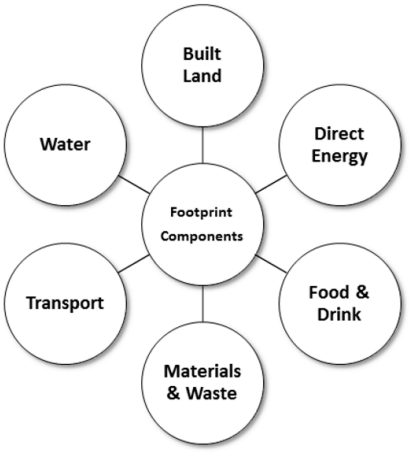

Fig. 2. Schematic representation of the component-based approach to environmental footprint analysis. *Source:* adapted from Simmons *et al.* [16].