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Global environmental impact of informal settlements and perceptions of local environmental threats: An empirical case study in Suva, Fiji

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ABSTRACT

It is commonly expected that informal settlements in developing countries have a smaller ecological footprint than more economically advantaged areas because they consume fewer resources and use less energy. In this paper we examine this idea by comparing material consumption of two informal settlements to one moderate socio-economic status (SES) neighbourhood in Suva, Fiji. We use the concept of the Ecological Footprint (EF) as a metric of comparison. Using a component-based EF approach we administered a questionnaire to 150 respondents from two informal settlements and one adjacent planned neighbourhood. Total EF and separate EF components (water, food, transport, energy, clothing, and material assets) were analysed through graphs, by examination of descriptive statistics, and through the use of non-parametric inferential statistics. We found differences between the adjacent planned neighbourhood and the informal settlements for several EF components, but found no difference for other EF components (e.g. water consumption). Through questionnaires and interviews we also examined perceived level of concern for environmental threats of informal settlement dwellers and residents of an adjacent moderate SES neighbourhood who share the same geographic space, but have very different living conditions. We found that concerns about sewage, deforestation, clean water and poor sanitation were of particularly high concern in one informal settlement, but not the other, suggesting that perceptions of threat can be very different even among informal settlements. We conclude that a better understanding of the social characteristics of informal settlements is valuable for informal settlement urban planning decisions in developing countries.

1. Introduction

Throughout the developing world informal settlements comprise a distinctive component of the urban social and geographic fabric. With increasing migration of rural poor to urban centres, the number of people living in informal settlements throughout the world is expected to grow to 1.4 billion by 2020 (Cohen, 2006; UN-Habitat, 2006). Urbanisation in the Pacific region has an especially pronounced effect on the growth of informal settlements due to there being little physical space for formal development, and limited urban planning and management expertise within local governments (Jones, 2012a, 2012b). Currently approximately 50% of the population in Pacific Island Countries (PICs) live in urban areas, with an estimated percentage of urban population living in informal settlements ranging from 15% in Suva, Fiji to 50% in South Tarawa, Kiribati (Asian Development Bank, 2012; Jones, 2012b; Storey, 2006).

Often the preferred option for improving living conditions for informal settlement dwellers is through settlement upgrading (Abbot, 2002a, 2002b; Marais & Ntema, 2013; Mukhija, 2001; Patel, 2013; Walker, 2016; Wekesa, Steyn, & Otieno, 2011). The most obvious outcomes of successful upgrading are improvements in housing conditions, and basic services and infrastructure (Abbot, 2002b; Wekesa et al., 2011). Also important are issues of long-term sustainability, which can be achieved through participation by informal settlement dwellers in the upgrading process (Patel, 2013; Walker, 2016) and incorporating longer term avenues for economic development (Minnery et al., 2013). A common expectation is that environmental conditions, which are notoriously poor in informal settlements (Mukhija, 2001; Wekesa et al., 2011) will be

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improved through upgrading. By improving basic infrastructure such as potable water, storm water drainage and sewerage, many of the problems of local (*in situ*) environmental degradation and pollution can be alleviated.

While the overall goal of improving the living conditions for informal settlement dwellers is indisputably favoured (Abbot, 2002a), some have suggested that there may be global environmental trade-offs associated with raising standards of living in informal settlements (Jorgenson, Rice, & Clark, 2010). It is a common expectation that poor people use comparatively little energy and consume less water than the more economically advantaged (Plessis & Landman, 2002; Irurah & Boshoff, 2003; Goebel, 2007; Kovacic, Smit, Musango, Brent, & Giampetro, 2016). In a global study of developing country cities, Jorgenson et al. (2010) found there to be a negative association between overall energy consumption and percentage of the city's population living in urban slums. Similar conclusions were made from a longitudinal study of central and eastern European nations, demonstrating energy consumption increased with economic development (Jorgenson, Alekseyko, & Giedraitis, 2014). The trade-offs between a larger "ecological footprint" and social and physical well-being were noted by Rice (2008) who demonstrated a moderately strong negative relationship between material consumption and maternal mortality. Others have suggested, that from a global environmental sustainability perspective, informal settlements may be viewed as more ecologically sustainable because of their compactness, low-energy use and practices of reuse and recycling (Grove, 2009).

An important aim of this study is to empirically examine the idea that informal settlements have less of an impact on the global environment than formal planned communities. We do this by comparing material consumption of residents from two informal settlements to residents of one planned, moderate socio-economic status (SES) neighbourhood in Suva, Fiji, using the Ecological Footprint concept as a metric of comparison (Rees, 1992; Wackernagel & Rees, 1996). By doing so we also address the question as to whether people living in informal settlements may be applying more ecologically sustainable strategies of resource use than those in formally planned neighbourhoods. Comparing material consumption of informal settlements to a moderate SES neighbourhood within the same city is a novel way to approach this question.

As in many parts of the world, informal settlements in Fiji are often located adjacent to planned neighbourhoods (Mohanty, 2006a, 2006b). In the Pacific region, Jones (2012b) refers to urban informal settlements as "rural villages in the city" because many of the social, ethnic, and kinship connections from the village are maintained after migrating to the city. Others have noted the physical differences of informal settlements from the surrounding urban matrix (Dovey & King, 2011; Dovey, 2012; Lombard, 2014; Wekesa et al., 2011). With globalisation of the world's cities, and rising costs-of-living in urban areas of developing countries, there is a growing division between the urban poor and those who live a more comfortable urban lifestyle (Jones, 2012b; Shatkin, 2004).

A second aim of this paper is to initiate a research dialog aimed at explicitly understanding informal settlements in the context of the urban geographic fabric, and specifically in relation to adjacent neighbourhoods. We do this by examining the perceptions of environmental threats of informal settlement dwellers and their adjacent neighbours who share the same geographic space, but have very different living conditions.

1.1. Ecological footprint concept

Introduced by Rees (1992) and Wackernagel and Rees (1996) the concept of the ecological footprint (EF) is based on the idea that all human activities consume resources and produce waste (Dietz, Rosa, & York, 2007). The EF is calculated by aggregating measures of basic behaviours and converting them to a hypothetical area of land required to provide natural resources and absorb wastes as a result of the behaviours. The metric is estimated in global hectares (gha) which represents the amount of bio-productive land and water required to sustain the human activities in aggregate. An EF can be calculated at various scales ranging from nations (Van Vuuren & Smeets, 2000; Venetoulis & Talberth, 2008), to cities (Luck, Jenerette, Wu, & Grimm, 2001; Du, Zhang, Song, & Wen, 2006; Sharma, Sharma, & Mathur, 2016), university campuses (Conway, Dalton, Loo, & Benakoun, 2008; Venetoulis, 2001) and individuals or households (Haque & Roper, 2005; Turner, 2004).

There are two basic approaches to calculating the EF (UNESCO, 2010). Compound footprinting is the most robust and comprehensive approach and is typically carried out at the scale of nations. This approach involves an accounting of all the resources a nation consumes and wastes it emits. The resulting metric is a measure of the overall footprint of the nation and it's biocapacity to meet its footprint requirements. The nation is considered in ecological deficit when the EF exceeds its biocapacity. The EF for compound footprinting at the national scale can also be averaged to a per capita EF for the nation. Component-based footprinting, on the other hand, takes a bottom up approach and is most suitable for estimating the EF of individuals, households and organizations (Haque & Roper, 2005; Conway et al., 2008; UNESCO, 2010). With component-based footprinting various activities at the individual, household, or organization level are aggregated for different categories of consumption (e.g. energy, food, clothing etc.). The tool for collecting data is often a questionnaire and the result is an EF measured in global hectares (gha) per person. This is the common approach used on many websites (e.g. Redefining Progress http://rprogress.org/index.htm) aimed at encouraging people to become more conscious of their impact on the environment. An advantage of the component-based approach is that it is easy to understand and calculate and therefore provides a simple measure of an individual's ecological impact. The disadvantage of the approach is that the results are less robust due to difficulties in calibrating the model to indirect consumption components at the national level (UNESCO, 2010). Therefore comparing a per capita EF calculated with the component-based method to a calculation using the compound footprint method must be viewed with caution.

The EF concept has been used in both developed and developing countries. Van Vuuren and Smeets (2000) examined the potential for the EF as a sustainable development indicator in a comparison of EFs for Benin, Bhutan, Costa Rica and the Netherlands. They found that, as expected, the EF for the Netherlands and to a lesser degree Costa Rica, were higher than Benin and Bhutan, yet they conclude that although the EF is an effective tool for evaluating ecological impacts it is limited as a sole indicator for sustainable development because it does not consider information on economic or social development. Zhiying and Cuiyan (2011) studied effects of growing prosperity in China by calculating the EF at the household level from 1985 to 2007 and found the per capita EF to be steadily increasing with a decreasing biological carrying capacity for the same time period.

Because the EF is a relatively easy concept to understand it is often used to evaluate the impact of an organization or individual on the environment with the aim of changing behaviour (Mankoff, Matthews, Fussell, & Johnson, 2007). Several university campuses (Conway et al., 2008) have used the EF concept to evaluate their baseline ecological impact with the goal of achieving a greater level of sustainability as an organization. At an individual level, Haque and Roper (2005) evaluated the change in EF for 59 university students at the beginning and end of a semester course on