



Rivers as municipal infrastructure: Demand for environmental services in informal settlements along an Indonesian river



Derek Vollmer^{a,b,*}, Adrienne Grêt-Regamey^b

^a Future Cities Laboratory, Singapore-ETH Centre for Global Environmental Sustainability, 1 CREATE Way, #06-01 CREATE Tower, Singapore 138602, Singapore

^b Chair of Planning of Landscape and Urban Systems, ETH Zurich, HIL H 51.4, Wolfgang-Pauli-Str. 15, 8093 Zurich, Switzerland

ARTICLE INFO

Article history:

Received 8 April 2013

Received in revised form 23 September 2013

Accepted 2 October 2013

Keywords:

Environmental services

Rivers

Informal settlements

Vulnerability

Indonesia

ABSTRACT

In many developing world cities, where municipal infrastructure lags urban growth, lower-income communities may compensate by relying on local waterways to meet basic needs for water, sanitation, and recreational space. Access to these environmental services is possible because residents settle in floodplains, but thus entails elevated exposure to several water-related hazards, especially flooding. We examine this complex relationship in the neighborhoods of Bukit Duri and Kampung Melayu on the Ciliwung River in Jakarta, Indonesia. Based on a spatially referenced household survey, we analyze and map the patterns of use of six environmental services provided by the river: direct sanitary use, recreation, harvesting plants, groundwater use, solid waste disposal, and sewage disposal. Using spatial interpolation and regression methods, we identify the most probable areas where services are being used and analyze possible influences on this behavior. We find that proximity to the river significantly influences households' behavior toward the river, as do infrastructure-related variables and neighboring households' behavior, while household demographic factors appear less significant. These results indicate that many households rely on multiple environmental services, and that residents most reliant on these services are also at greater risk of water-related hazards, service disruption (e.g., a decline in water quality), and potentially, eviction. This pattern of floodplain development is prevalent in many low-income countries, and a better understanding of how informal settlements rely on environmental services can be used to assess their vulnerabilities and inform more sustainable courses of development.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Rivers and their floodplains provide fertile land for agriculture, water for consumption and irrigation, and a means of transporting goods and discarding waste. We refer to these as environmental services, the benefits that humans derive, directly and indirectly, from hydrologic systems (Daily, 1997; Brauman et al., 2007). Most cities have come to depend on hydrologic or watershed services in some form, and certain urban infrastructure can be thought of as a means to replace or more efficiently harness these naturally provided services (Lee, 2006; Gómez-Baggethun and Barton, 2012). Urban planners now incorporate green spaces, such as urban forests and riverside parks, as a form of “green and blue”

infrastructure that supports public and ecosystem health (Tzoulas et al., 2007). Yet physical and psychological distance between urban residents and environmental services is predicted to increase with time as suggested by Carpenter et al. (2006): “[u]rban migrants will consume ecosystem services via longer supply chains, and they will experience greater separation from nature (p. 29).” In other words, built infrastructure is expected to replace many of the functions that ecosystems have long provided.

Yet most urban population growth will take place in so-called “mega-deltas” in Africa and Asia, where cities are ill-equipped to address competing challenges of surging populations and environmental change (Seto, 2011). In these rapidly growing cities, where municipal infrastructure often lags urban growth (Crane and Daniere, 1996; Roberts and Kanaley, 2006; Schäffler and Swilling, 2013), we posit that lower-income communities might be relying more directly on environmental services to meet basic needs. This is particularly relevant in cities' informal settlements, colloquially referred to as ‘slums’, which are responsible for housing roughly 40% and over 60% of urban residents in Asia and sub-Saharan Africa, respectively

* Corresponding author at: Future Cities Laboratory, Singapore-ETH Centre for Global Environmental Sustainability, 1 CREATE Way, #06-01 CREATE Tower, Singapore 138602, Singapore. Tel.: +65 8198 2124.

E-mail addresses: vollmer@arch.ethz.ch (D. Vollmer), gret@nsl.ethz.ch (A. Grêt-Regamey).

(Un-Habitat, 2009). Urban informal settlements exist in a gray area between legal and illegal status (Roy and Alsayyad, 2004) and, consequently, often lack municipal public goods such as water supply, waste collection, and park space. Growth rates for informal settlements have been comparable or only slightly below overall urban growth rates in most of Asia and sub-Saharan Africa, and so even if a greater proportion of urban residents are extended basic services over time, this “urban divide” is likely to be persistent for some time (Un-Habitat, 2010). A substantial share of informal settlements exist along riverbanks and urban waterways (Un-Habitat, 2003) since these areas are regarded as unsuitable for development and thus present a comparatively lower risk of eviction.

In the case of urban settlements in flood plains, exposure to flood risk and other water-related hazards is increased (through decreases in elevation, primarily) in exchange for cheaper land or improved access to other services along waterways. We should emphasize that such tradeoffs are implicit, that is, a number of socio-economic determinants lead to residents settling in flood plains; their use of, or demand, for environmental services is rather an adaptation to the particular environment. Importantly, this relationship between human settlements and demand for environmental services tends to be heterogenous at a fine scale (Cadenasso et al., 2007) and is often spatially dependent and involves tradeoffs between and among services (Nelson et al., 2009). Depicting these sorts of spatially dependent relationships requires fine-scale data and a geographic information system (GIS). Spatially oriented analytical methods, from interpolation to spatial-weighted regressions, can help further investigate this heterogeneity (Anselin, 1992) and refine our understanding of these complex social–ecological systems.

To our knowledge, little empirical analysis has been done on the interactions between urban informal settlements and the environmental services they demand. Victor Savage (Savage, 2006) coined the term “ecosystem people,” typified by urban canal dwellers in Thailand meeting their daily needs through locally available ecosystem services, but he did so to make a broader point about consumption disparities in Southeast Asia. Field studies from the developing world on the link between environmental services and livelihoods typically focus on mangroves (Badola and Hussain, 2005; Barbier, 2007; Das and Vincent, 2009; Conchedda et al., 2011), forests (Kosoy et al., 2007; Meyfroidt and Lambin, 2008; Engel and Palmer, 2008; Chhatre and Agrawal, 2009; Sodhi et al., 2009; Jaung and Bae, 2012), or agro-ecosystems (Alpizar and Madrigal, 2008; Li et al., 2011; Arias et al., 2012). In each of these studies the primary environmental issue is whether the community can maintain a productive stock of locally harvested marketable goods without sacrificing the ecosystems’ regulating functions. In their study of risk perception and vulnerability in mangrove ecosystems in East Africa, Crona et al. (2009) extend this analysis to a peri-urban context, examining the conflict between outlying communities’ harvesting activities and central cities’ use of the mangroves for treatment of urban sewage.

A small minority of papers focus exclusively on environmental services and urban informal settlements, but generally in the context of informal land conversion’s impact on environmental service provision (Aguilar, 2008; Zeilhofer and Topanotti, 2008; Aguilar and Santos, 2011; Mendoza-González et al., 2012; Harriden, 2012). Jayawickreme (2011) documents Sri Lanka’s urban wetlands becoming unregulated solid waste dumps and notes that the lack of sanitary infrastructure is threatening biodiversity along the island’s western coast. And surveys such as Resosudarmo et al. (1997) and Winayanti and Lang (2004) in Jakarta, Noosorn and Niamkamnerd’s (2009) work in Thailand and Seftyono’s (2011, 2012) recent work in another Indonesian city, Yogyakarta, provide limited empirical evidence of how riverside

residents use nearby urban rivers, though that is not the primary focus of any of their research.

By studying informal settlements along the Ciliwung River in metropolitan Jakarta, Indonesia, we aim to investigate the relationship among proximity to the river, household demographic characteristics, and use of environmental services, using spatially explicit data. In the midst of this dense urban settlement, it is apparent that a substantial share of residents still rely directly on the river to meet basic needs. In light of rapidly changing land use within the catchment, and the possibility that climate change could exacerbate flooding and low-flow events, a better understanding of this relationship has implications for planning and resource management. First, the spatial dimension of this relationship is underresearched, and spatially explicit information can help support context-appropriate, targeted planning or design interventions. Second, such research provides insight into critical issues regarding longer-term river rehabilitation programs in the developing world. Jakarta, like many other cities, is facing growing demands to improve conditions of its waterways, and the fate of informal settlements along these waterways is central to the debate.

We begin by framing our fieldwork in a global context, with an exploratory spatial analysis of urban population density trends along waterways in different countries from 1990 to 2000. Though our population data in this case are restricted to density and proximity to waterways, we hope to demonstrate that the phenomena we observe in detail in our subsequent case study of an urban river in Jakarta may be symptomatic of a broader global trend. We then elaborate on the spatially explicit methods we use to obtain and analyze our data, which allows for a more nuanced understanding of how residents engage with the river. We conclude with a discussion of the multiple facets of vulnerability many of these households are facing with respect to the river, and the implications of these findings for similar settlements in rapidly urbanizing Africa and Asia.

2. Setting the scene: from global to local

2.1. Global context

As many post-industrial cities have only recently begun to rehabilitate degraded waterways to meet environmental or economic development goals (Findlay and Taylor, 2006), rapidly growing cities in the developing world are at a relatively early stage of exploiting and managing their urban streams and water bodies. Furthermore, the demands on their waterways are comparatively more complex (Marcotullio, 2007), with pressures to increase exploitation for social and economic development while, paradoxically, maintaining ecological functionality in the name of sustainability (Mcgranahan, 2007) or resilience (Palmer et al., 2008). This is further complicated by the fact that population density in African and Asian settlements is typically 2–3 times greater than their Western counterparts (UNDESA, 2012). *Ceteris paribus*, more people means more environmental pressure, a larger population at risk of perturbations, but also a larger potential demand for environmental services. Anecdotal evidence suggests that many urban migrants, particularly low-income residents, are settling in floodplains and other environmentally sensitive areas, but there is a lack of data that would help us interpret the global significance of this trend.

Thus, as a first step, we analyzed changes in population density in proximity to urban waterways across the top 20 countries in terms of urban population growth between 1985 and 2000 (UNDESA, 2012). Countries were classified into three income groups based on Gross National Income (GNI) per capita, year 2000 (current US\$), using the World Bank’s cut points (World Bank,

Download English Version:

<https://daneshyari.com/en/article/10505028>

Download Persian Version:

<https://daneshyari.com/article/10505028>

[Daneshyari.com](https://daneshyari.com)