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Research paper

Opportunities for green infrastructure under Ecuador's new legal framework

Anna Serra-Llobet[a,*], M. Augusta Hermida[b]

[a] Institute of Urban and Regional Development, University of California Berkeley, 316 Wurster Hall, #1870, Berkeley, 94720 CA, USA
[b] Universidad de Cuenca, Departamento de Espacio y Población, Grupo de investigación LlactaLAB-Ciudades Sustentables, Facultad de Arquitectura y Urbanismo, Av. 12 de Abril y Agustín Cueva, Cuenca, Ecuador

HIGHLIGHTS

- Ecuador's constitution recognizes ecosystem rights and quality of life for people.
- The national plan for quality of life is favorable to green infrastructure.
- We worked with agencies, academics, and practitioners to identify constraints.
- Lack of coordination among specialized expertise and agencies inhibit green infrastructure at the local scale.
- Lack of planning across urban and peri-urban areas inhibits effective green networks.

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ABSTRACT

Ecuador's new constitution recognizes "rights of nature" and peoples' right to benefit from the environment and natural resources that enhance the Buen Vivir (Quality of Life). The national plan for Buen Vivir calls for spatial planning to guarantee territorial and global environmental sustainability, increase people's safety by minimizing the impact of natural hazards such as floods. Within this context, we analyzed opportunities for green infrastructure in Cuenca (Ecuador's third largest city). We mapped existing green areas and linkages, analyzed the roles of implementing institutions with structured input from 33 government, academic, and industry experts. We found that fragmented authorities and often-contradictory mandates of different agencies prevented optimal management of open-space areas within the city. Moreover, planning efforts within the city of Cuenca are completely disconnected from the rapidly-urbanizing peri-urban areas outside the city limits, resulting in missed opportunities for connected green space for wildlife, human recreation, and water quality benefits.

1. Introduction

The term 'green infrastructure' refers both to a set of stormwater best practices that provide multiple benefits (US EPA, n.d.b), and more broadly to interconnected networks of green spaces that provide multiple benefits for wildlife, human recreation, and water quality (Matthews, Lo, & Byrne, 2015), or "natural, semi-natural, and artificial networks of multifunctional ecological systems within, around and between urban areas" (Tzoulas et al., 2007:169). In any event, management of urban stormwater is considered the best developed of the multiple functions to date (Dunn, 2010). Thus, green infrastructure can be viewed as "an approach to water management that protects, restores, or mimics the natural water cycle" (American Rivers, n.d.), while also providing open-space, air quality, and wildlife habitat benefits. Elements of green infrastructure include open areas such as urban forests, large public parks, gardens, playing fields, rights-of-way along streams and roads, and constructed features such as green roofs, permeable vegetated surfaces, swales, rain gardens, and "green streets" (Mell, Henneberry, Hehl-Lange, & Keskin, 2013; Matthews et al., 2015). Among the key concepts are strategic use of the elements, their connectedness, and incorporation of pre-existing natural elements as well as newly constructed elements.

For green infrastructure to be widely adopted, the legal framework must be encouraging, or at least not hostile (Dunn, 2010).

* Corresponding author.
E-mail addresses: annaserrallobet@gmail.com, annaserrallobet@berkeley.edu (A. Serra-Llobet), augusta.hermida@ucuenca.edu.ec (M.A. Hermida).

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Policies to encourage or require green infrastructure adopted at a national scale must be implemented at the local level by multiple agencies. The success of implementation depends not only on the strength of the national commitment, but also local governance (Douglas, 2014), as manifest in city planning, the budget to maintain infrastructure, and 'urban morphology restrictions', i.e., prior developments that now constrain options for future greening (Matthews et al., 2015).

Among institutional challenges, path dependence makes institutions reluctant to change past ways of doing business (Matthews et al., 2015). Within the modern "sanitary city" (i.e. the city form developed in response to pollution in the industrial city), each of the specializations, "sanitation, street services, planning—works in a bounded realm informed by specialised competences siloed into departments and agencies" (Pincetl, 2010: 46). Because of their "centralized, rigid infrastructures, many sanitary cities exhibit limited capacity to accommodate sustainable adaptations and practices" (Childers, Pickett, Grove, Ogden, & Whitmer, 2014). Thus, it can be difficult to work across specializations to manage systems at the network scale implicit in the green infrastructure approach.

In the US, a 1987 amendment to the Clean Water Act (CWA) of 1972, requires municipalities to obtain permits to discharge stormwater (US EPA, n.d.a), and green infrastructure is increasingly encouraged in this context. For example, the San Francisco Bay Regional Water Quality Board's order renewing the regional municipal stormwater permit requires local governments to develop green infrastructure plans indicating how low-impact design (LID) will be incorporated into public and private streets, parking lots, and other facilities (SFBRWQB, 2015). In addition, the plans must include methods to prioritise green infrastructure projects such as retrofitting areas of impermeable surface over the coming 5-, 10-, 25- and 50-year time frames. Increasingly, US cities are implementing LID to meet more stringent requirements, for both cities with combined storm and sewerage systems and those with separated systems (Green Nylen & Kiparsky, 2015).

In the European Union (EU), adoption of the Water Framework Directive (WFD) in 2000 created a systematic assessment and planning process to protect and improve the quality of waters throughout the EU (Kaika, 2003). The EU's (2013) *Strategy on Green Infrastructure* promotes and encourages the use of green infrastructure, notably in water (especially through the WFD and the Floods Directive). Examples of best practices include the Copenhagen Cloudburst Management Plan, created in response to destructive floods in 2011 (City of Copenhagen, 2012).

In North America and Europe most infrastructure has already been built, so adoption of green infrastructure commonly requires retrofitting existing 'grey infrastructure' (stormwater pipes and engineered channels). Childers et al. (2014) refer to this as the transition from the "sanitary" to "sustainable" city. In much of the developing world, however, the majority of water infrastructure has yet to be built, and there is potential for newly-built infrastructure to skip the stage of traditional "grey-only" infrastructure and proceed directly to a water management approach incorporating green infrastructure elements. Unfortunately, few cities have taken the opportunity to go directly to green infrastructure, and with the few documented examples being in wealthy nations (Childers et al., 2014).

As Latin American economies continue to grow, their cities expand, and living standards increase, we can foresee extensive infrastructure investments in the next two decades. How can these countries most effectively take advantage of their opportunities to implement green infrastructure? To date, there has been practically no implementation of green infrastructure documented in Latin America, save for some examples in Brazil and Argentina (Frischenbruder & Pellegrino, 2006; Tucci, 2007).

Table 1
Institutions represented in expert workshop on green infrastructure in Cuenca.

National/Regional Government
National Secretary for Water (Senagua) Region 6
National Secretary for Planning and Development (Senplades) Region 6
Environment Ministry of the Azuay Province
Local Government
Municipality of Cuenca Agency for Telecommunications, Water Supply, and Sanitation (ETAPA) (3)
Municipality of Cuenca Environmental Management Commission (2)
Municipality of Cuenca Foundation for the Barranco district (3)
Municipality of Cuenca Secretary for Planning (3)
Academia
University of Cuenca faculty (4)
University of Cuenca research staff (2)
University of Cuenca graduate students (5)
Catholic University of Cuenca faculty
Technical University of Loja faculty (3)
University of California Berkeley faculty
Consultancies & NGOs
Engineering
Landscape Architecture and Planning
International Watershed Partners NGO

Notes: where institutions were represented by more than one participant, the number is given in parentheses. Senagua and Senplades are national agencies with regional offices.

2. Objectives and methods

Ecuador stands out for its potential to implement green infrastructure because of its new constitution (adopted in 2008) and subsequent legislation, as well as its thriving economy, growth of its urban centers, and rising expectations for environmental quality of its growing middle class. The purpose of this study was to explore opportunities to implement green infrastructure under the new legal framework. Towards this end, we analyzed specific relevant Ecuadorean national legislation in light of potential green-infrastructure opportunities, and evaluated the structure of local and cantonal government agencies to implement these policies. In addition to drawing upon our experience with green infrastructure planning, we convened a panel from government agencies, academia, and consultancies with expertise in relevant fields and on-the-ground knowledge of Cuenca, Ecuador's third largest city, to identify roadblocks to implementing green infrastructure at the local level (Serra-Llobet and Hermida, unpublished data). The capital of the Azuay province, Cuenca is 300 km south of Quito, at 2500 m elevation. Thanks to its wastewater treatment plant (the first in Ecuador), the four rivers crossing the city have good water quality, encouraging human uses.

We identified municipal and national/regional agency staff to participate in the workshop based on the relevance of their responsibilities within their respective agencies and their experience relevant to green infrastructure implementation. In total, 14 government agency staff, 11 academic faculty and staff, two professional consultants, and one NGO representative participated, supported by five graduate students (Table 1). The workshop involved participants from all relevant agencies except the Risk Management Agency of the Azuay Province (unable to participate due to schedule conflicts). We asked participants to identify sites within the city and region suitable for inclusion within a green infrastructure network, to identify constraints on effective implementation of green infrastructure, and to propose steps to overcome these constraints to achieve a more integrated and effective green infrastructure network. Participants spoke frankly on the condition that we not attribute specific quotes directly to individual participants. We incorporated suggestions from the participants