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Urban Biodiversity, Ecosystems and Well-being

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Urban Biodiversity, Ecosystems and Well-being

Ecosystem services are essential to cities. Planning for a sustainable city requires identification of the benefits that nature provides and understanding their value. This special issue delves into the role of urban biodiversity and its relationship to ecosystem services and community well-being. The papers published in this issue were presented at the 3rd International Conference on Urban Biodiversity held at the Indian Institute of Technology Bombay, in Mumbai, India in October, 2012.

Keywords
urbanism, sustainable cities, green infrastructure, TEEB

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URBAN BIODIVERSITY, ECOSYSTEM SERVICES AND WELL-BEING

Historically, human societies were predominantly rural. Mega-urbanism is relatively new phenomenon and a central characteristic of the Anthropocene. As industrial societies increasingly relied on technology and specialized factors of production, their economies became more agglomerated and decoupled from ecosystems, allowing for migration from rural areas to cities. The geographical expansion of urban areas has altered physical topography and land cover, resulting in fragmentation and isolation of urban green spaces from rural open space. This fragmentation “driver” can impact the original biodiversity and ecosystem services of an area due to changes in ecosystem structure, function, spatial distribution of species, and ecological resilience (Niemela et al. 2010).

Though modern cities and their associated technologies isolate their human inhabitants from natural areas, their dependence on the affiliated ecosystem services has increased faster than the actual physical rate of urban growth. The Millennium Ecosystem Assessment (MEA 2005) discussed how ecosystems contribute to human well-being through a suite of services: provisioning (e.g. food, fuel, raw materials, drinking water), regulating (e.g., carbon sequestration, hydrological flows, waste recycling), supporting (e.g., soil formation) and cultural (recreational, aesthetic). The research initiative, The Economics of Ecosystem and Biodiversity (TEEB), established that human recognition, demonstration, and capture of the values of ecosystems and biodiversity can help improve decision-making (Ten Brink 2011; Wittmer and Gundimeda 2012; Bishop 2013).

The TEEB approach highlighted various examples of how explicit recognition of nature values helped forge better policy decisions regarding ecosystems. For example, in an urban setting there are always trade-offs to be considered in land management decisions. The choice between conserving a wetland for the ecosystem services it provides and using the land for agriculture should consider the societal trade-offs in draining versus maintaining the wetland. While stakeholders may understand the value of tilling the land for agriculture, they may not understand the ecosystem services provided by the wetland. Stakeholders may not ask questions like, “In what way do we depend on the wetland?”, “What does the wetland provide us?”, or “What alternatives do we have if we drain the wetland and what are the net costs and benefits of the two actions?”. There exists an information asymmetry between the two different land uses. Clear information on the benefits provided by the wetland is lacking while information on the value of agriculture is perfect. Wetlands provide many ecosystem services, the primary one being waste water recycling, which if replaced by a technological alternative (water filtration plant) is much more expensive (fixed and operational costs) than the natural form (in addition to various ecosystem services provided by the wetland). The missing information often prevents stakeholders from making informed decisions, which may trigger the loss in ecosystem services and reduction in human well-being. In another example, the decision is between allowing a marine aquatic species to be removed from the ocean for consumption versus protecting the species for its cultural value. A fisherman would see the immediate value of receiving revenue based on the catch. The ecosystem services provided by leaving the fish in the ocean include recreation and tourism value. However, the beneficiaries are not the same in both cases. In the first case, it is the fishermen and in the second, it is the local government or the national government that gets the share of the surplus. Divergent interests and beneficiaries may lead to conflicts of interest in conserving the species unless proper revenue sharing arrangements are in place. It is critical that societies incorporate the value of ecosystem services in decision-making, as degradation of ecosystems beyond reparable threshold will have disastrous consequences for human beings.

As modern cities became more complex, they self-organized as nodes of intense economic activity. Drawing in matter and energy from surrounding areas and casting a huge ecological footprint, the area required to supply its citizens with resources and services from the environment was much larger than the area of the city itself (Wackernagel and Rees 1997). Cities also release their waste into the environment over areas often disproportionally large compared to the area of the city. As pointed by Ayres (1994), cities are entropic black holes drawing in energy and matter from all over the ecosphere and returning it in degraded form back to the ecosphere until a state of equilibrium is reached in which "nothing happens or can happen". In addition to the threat imposed by the loss of ecosystem services, climate change is predicted to have massive ecological decline from floods, storms, droughts, and heat waves. Climate change is both a driver and phenomenon as humans alter climate and climate impacts their well-being.

Approximately 75% of all humans are expected to reside in urban areas by 2050 (United Nations 2010). Spatial planning models can serve as a way to reverse the impact of urban areas on the environment by integrating and supporting the biodiversity and ecosystem services inherent to built environments. Provision of ecosystem services depends on various aspects of biodiversity - e.g. species diversity and composition, population densities, species interactions, habitat quantity and quality, as well as species mobility between habitats. Thus it is vital to map the nature of ecosystem services demanded by urbanites and the supply of ecosystem services. Zari (2015) lists 17 distinct ecosystem services that can be easily integrated into built environment design and evaluation. These are: 1) provisioning of food; 2) biochemicals; 3) raw materials; 4) fuel/energy; 5) fresh water; 6) genetic information; 7) regulation of pollination and seed dispersal; 8) biological control; 9) climate regulation; 10) prevention of disturbance and moderation of extremes; 11) decomposition; 12) purification, and 13) supporting services such as formation and retention of soil; 14) fixation of solar energy; 15) nutrient cycling; 16) habitat provision; and 17) species maintenance.

Ecosystem services are essential to cities (TEEB 2011). Planning for a sustainable city requires identification of the benefits that nature provides and understanding their value. The TEEB study illustrated several practical suggestions through examples of how maintaining the function of ecosystems is the most cost-effective solution to meet human needs. An in-depth understanding of the extent and nature of ecosystem services, human dependence on them, and their vulnerabilities to various anthropogenic and natural factors is essential. Highlighting the dependence of urban dwellers on biodiversity and ecosystem services, understanding the implications of loss of ecosystems and biodiversity on human well-being, and measuring the impact of human activities and urbanization is a crucial part of this intervention. Green infrastructure and design offers huge potential for biodiversity, conservation, and adaptation to climate change. Urban areas can be effective laboratories for experimentation and implementation of innovative financial mechanisms to achieve the delicate sustainability and growth balance.

ABOUT THIS SPECIAL ISSUE

This special issue delves into the role of urban biodiversity and its relationship to ecosystem services and community well-being. Urban green and blue spaces play a very important role in providing ecosystem services. The paper by Banerjee and Dey shows the dependence of the city Kolkata, home to around 6 million permanent and temporary residents, on the East Kolkata wetlands for disposing their sewage. The city generates around 1.1 billion liters of sewage per day and faces huge challenges in managing, disposing, and treating wastewater. The East Kolkata wetlands are a designated Ramsar site: a wetland of international importance under the Ramsar Convention, an intergovernmental environmental treaty established by UNESCO in 1971. These wetlands serve as natural sewage treatment plant and an example of integrated aquatic ecosystems where the sewage treatment process and water aquaculture are connected. As a designated Ramsar site, livelihood dependence through wise use practices evolved around sewage fed fisheries and organic waste based farming practices. The paper clearly demonstrates our dependence on wetland ecosystems as well as the strengths, weaknesses, opportunities, and threats to the wetlands. Wetlands are valuable and effective conservation measures and should be enhanced with the help of local participants.

The paper by Matsui and colleagues shows the dependence of human activities on ecosystem services within a large metropolitan region for Osaka Province in Japan. The study quantified the nature and the externalities associated with city's dependence on forest ecosystems. The data show that despite being a highly developed society, Osaka prefecture still relies heavily on rural ecosystem services, especially the carbon sequestration services provided by forests. The study suggests making the Prefecture a sustainable self-sufficient city and argues for effective biodiversity conservation to meet societal needs.

Khew and Yokohari show that effective biodiversity conservation requires that planners take a pro-active role in facilitating public acceptance towards biodiversity habitats within urban areas. The study quantifies the biodiversity conservation potential of four different landscapes - naturalistic landscapes (both primary and secondary vegetation), manicured landscapes, and urban areas in Singapore. The study clearly showed that naturalistic landscapes harbored more conservation target species than manicured landscapes and urban areas. As the preference for manicured landscapes increased, the role of biodiversity design and adaptation is the key to ensuring that societal preferences and biodiversity conservation are enhanced in tandem.

The built environment in cities is responsible for substantial emissions of Green House Gases, and globally the construction sector is expected to emit between 11– 15.6 GtC by 2030 (IPCC 2007). The construction sector also has the greatest potential to reduce the build up of Green House gases and facilitate adaptation to climate change. As economies grow, construction activity is projected to rise - especially in developing countries. Urban design has a key role to play in reducing GHGs through effective design using low emitting materials with and emphasis on building green infrastructure. The shift to more environmentally conscious construction and design (green buildings) so as to minimize the environmental impact and resource efficiency offers a key potential to achieve the targets. This is made possible through the use of low carbon footprint building materials, more efficient energy and water equipment, heat/power recovery, renewable energy supply systems, choice of site of the building, and location of the site. The paper by Abraham and Gundimeda shows that despite the potential for win-win scenarios, several barriers arise due to inherent complexities and high degree of conflicting priorities often come in adoption of green infrastructure. The authors pointed out different barriers that hinder effective adoption and diffusion of buildings with superior environmental performance and prioritized the barriers.

WAY FORWARD AND ISSUES

Biodiversity is important for human welfare. The loss of biodiversity will negatively impact human access to provisioning, regulating ecosystem services with greater impact on the poor (see Diaz et al (2006). As the world is increasingly being urbanized, the repercussion of this loss of biodiversity due to improper planning would be immense. Urbanization not only manifests this by increasing the population density but also impacts the land and environment.

Cities are deemed sustainable and exemplary if they succeed in promoting growth without compromising the quality of environment. Thus the need to enhance the quality of life through greening the urban areas is prescient. The economies of scale, the concentration of decision-making power, the combination of skills and cultures that ferment in a city, and the unique technological resources that urban citizens have at their disposal makes it feasible for those solutions to appear (as they have) and to be replicated at much larger scale (Braulio F. de Souza Dias 2012, CBD Secretariat's address at the 3rd conference on Urban Biodiversity and Design, Mumbai 2012).

Barton et al. (2009) discusses the need for some fundamental changes for a human health and well-being perspective to biodiversity conservation in cities. This will require new methods and approaches that consider not only the complexities of urbanization but also the interdependencies between drivers, impacts, and responses to these dynamics (Haase et al. 2014). Integrating ecosystem services into urban planning is a way to enhance the quality of urban dwellers along with conserving urban biodiversity. It will be important to develop new tools and indicators to measure and map biodiversity and ecosystem services. Incentive-compatible mechanisms or economic mechanisms can be worked out to encourage investments in urban biodiversity and ecosystem services provision. Valuation of biodiversity and ecosystem services could enable better management of biodiversity. Finally, improved governance and a change in mindset will be necessary to enable the integration of ecosystems into urban planning and policies.

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