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Solutions for Sustainable Urban Forest Governance and Management

Sarah Mincey
Visiting Lecturer
School of Public and Environmental Affairs
skmincey@indiana.edu

Burnell C. Fischer
Clinical Professor
School of Public and Environmental Affairs
bufische@indiana.edu

The views expressed are solely those of the author and do not imply endorsement by Indiana University or the School of Public and Environmental Affairs.

Peer Reviewers: Dr. Lynne M. Westphal, Project Leader & Research Social Scientist, Northern Research Station People and Their Environments, USDA Forest Service, and Dr. Kathleen Wolf, Research Social Scientist, University of Washington, College of the Environment

Summary

Current urban expansion is the greatest in history. By 2050, three billion additional people will live in cities. While urbanization is frequently linked to environmental problems, it also offers solutions for global sustainability if cities can move from net *consumers* to net *generators* of ecosystem services. To this end, a focus of the 2012 report *Cities and Biodiversity Outlook*, commissioned by the U.N.'s Convention on Biological Diversity, is urban forest governance. It underscores that trees in cities are, and should be managed as, ecosystem service generators. Still, urban forests are declining; in the U.S., four million city trees are lost annually, while the average city gains 2.8 percent impervious cover (e.g., roads, parking lots) (Nowak and Greenfield 2012). Not surprisingly, urban forestry professionals, academics, and agency-based managers desire a policy-based research agenda to determine adequate policy for sustaining urban trees (Wolf and Kruger 2010). But how do we develop policy to meet this end with growing urban populations and development? We argue for drawing natural resource governance lessons from rural, resource-dependent communities.

Conceptualizing Current Problems in Urban Forest Governance

Urban forests comprise all city trees including "street trees," trees in parks and preserves, and on private lands. Urban forests are social-ecological systems (SES), meaning they are systems in which social factors and ecological factors interact; they are also *nested* systems in which interactions occur at small scales (e.g., individual properties) to produce larger-scale (e.g., neighborhood or city) effects. Finally, an urban tree is both finite and for which exclusion of people's use (e.g., tree removal) is difficult. Given these characteristics, sustaining urban forests is challenging but desired, given their ecosystem services, including air pollutant removal, storm-water runoff mitigation, building energy conservation, mental health and well-being, recreation, and economic stimuli. While this "green infrastructure" is often unrecognized by urban populations, its value yields support for its maintenance; for example, in the U.S., urban forests' carbon sequestration rate is worth $460 million per year and their annual removal of air pollutants worth $3.8 billion (Nowak and Crane 2002; Nowak et al. 2006).

The delivery of these valuable services is dependent on the physical structure of urban forests determined by human decision-making. Sustainable ecosystem services emerge from high and equitable distributions of tree canopy cover, numerous tree species, a broad distribution of tree size, and good tree condition. But these characteristics depend on the collective decisions (active and passive) of people living and managing land within cities, which, in the SES context, are

influenced by the rules and norms of multiple entities that adjust the benefits and costs of individual choices. Because the majority of urban trees reside on private property, this context is well-exemplified in residential properties. For instance, municipalities enact policies that directly influence tree management actions of homeowners, but related ordinances that structure the actions of developers (let alone past owners) may have impactful legacies. Neighborhood, homeowners associations, and property management companies may enact their own policies and facilitate norms that influence management by households and landscapers. Strategies of greening nonprofits and green businesses can also influence household choices (Figure 1).

At best, these rules and norms facilitate sustainable urban forest structure through enforced regulations, effective incentives, technical support, and collaborative governance, but given the nature of urban forests and their services, common factors may overwhelm these policy strategies and contribute to their decline. Arguably, few incentives exist for private individuals to produce public goods such as ecosystem services at levels that are socially desirable, and employing policies to incentivize such behavior across a variety of land managers and scales is difficult. For instance, with no effective market for ecosystem services, property owners often manage land for products traded in existing markets (such as residential/commercial development) at the expense of trees and their services. Further, people often rely on the provision of trees and their services by others – the "free-rider" problem: If an individual pays to plant or maintain a tree, others benefit without incurring costs. Similarly, an individual's maintenance of a tree may appear to make little difference, but involving others is costly in terms of time and effort.

Thus, urban forest sustainability has largely been relegated to centralized authorities, particularly municipalities. Krause (2011) found that nearly 40 percent of 329 U.S. cities studied had adopted a tree canopy cover goal, 56 percent provided education regarding privately owned trees, and approximately 75 percent had adopted a policy specifying tree-planting or removal requirements for developers. No federal urban forestry policies exist within the U.S. and only a minor portion of U.S. Forest Service funds funneled through State and Private Forestry (S&PF) by the Farm Bill is dedicated to urban forestry (less than one-tenth of 1 percent). U.S. mayors have called for additional federal spending on urban forests and yet the proportion of funds has declined. State forestry agencies are even less likely to provide support to cities, relying on federal pass-through monies that require a 1:1 match from participating cities.

Despite calls for resource management inclusive of local strategies for urban forest sustainability (Clark et al. 1997), urban forestry literature is limited in detailed information on the variety of local policies and their relative success in various community contexts. Moreover, urban forestry research that might inform policy-making tends to frame analysis narrowly. Only a handful of studies consider urban tree policies in detail and yet Young and Wolf (2006) find that researchers are increasingly engaged in policy prescriptions; nearly three-quarters of the papers they examined specified the entities best positioned to effect change but without clarity on how policies were analyzed. Without such evidence, local policymakers are left with questions: What do we truly know about what influences private, individual decision-makers? Are municipal policies imposed on private property-owners enough for achieving sustainable outcomes? Lack of answers leaves urban forests vulnerable.

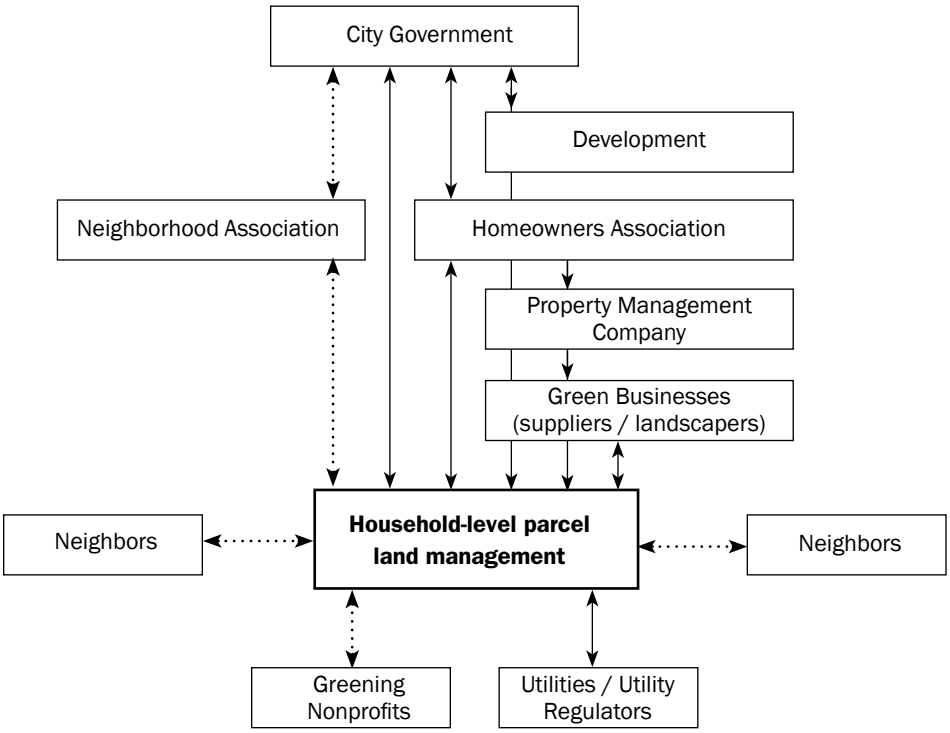

Figure 1. Common actors and types of policy arrangements affecting parcel land and tree management in cities. Solid lines represent formal policies or rules, while dashed lines represent informal policies, or norms of behavior / strategies. Arrows indicate the primary direction of influence (Mincey et al. 2013).

A Framework and Relevant Theory for Urban Forest Governance Solutions

A wealth of understanding that can be adapted to sustaining urban forests through governance and management policies has been undertaken in largely *rural, resource-dependent* social-ecological systems by the late Nobel Laureate Elinor Ostrom and colleagues. Her research framed both formal and informal policies, along with the biophysical and the social characteristics of a community, as the primary factors that structure the context in which humans make decisions, act, and influence outcomes. From her research in numerous systems, Ostrom (1990) utilized policy analysis framed in this manner to categorize policy characteristics associated with sustainable natural resource management. These Design Principles (Table 1) have proven robust across natural resource sectors and over time (Cox et al. 2010), warranting the exploration of their application to urban forest governance to determine effective strategies and inform policy.

Researchers in the Bloomington Urban Forestry Research Group (BUFRG), affiliated with the School of Public and Environmental Affairs (SPEA) at Indiana University Bloomington, have utilized these approaches in analysis of urban forest governance in Bloomington and Indianapolis, Indiana. BUFRG worked in Indianapolis with Keep Indianapolis Beautiful (KIB), a local nonprofit partnering with city government to increase tree cover. Investigators examined neighborhoods that participated in KIB's tree planting program in which residents collectively plant and water neighborhood trees and determined that Design Principles unintentionally in-place supported high tree survival rates. In neighborhoods where residents monitored tree watering (Principle 4A, B) and sanctioned residents failing to water their assigned trees (Principle 5), trees were significantly more likely to have survived. By working alongside neighborhoods to plant free trees and providing them watering information, KIB and neighborhoods worked as nested enterprises – sharing the burden of a complex resource management undertaking (Principle 8). By allowing neighborhoods to choose their watering strategies, KIB supported that rules should fit local conditions (Principle 2A) and recognized the rights of the communities to devise their own rules (Principle 7). Ultimately, this case research underscores the application of the Design Principles to sustaining urban trees (Mincey and Vogt [in review]).

BUFRG research in Bloomington utilizing Ostrom's framework demonstrated the importance of nested policies on sustainable urban forest structure in neighborhood and homeowner associations. Through household surveys, private parcel tree inventories, and analysis of rules, researchers determined that *both* city policies and association rules are significant relative to other social and biophysical factors in determining tree species diversity and can have unintended consequences. Lower tree species diversity was associated with parcels where tree and landscaping rule compliance was important to residents. While rules attempted to avoid negative structural characteristics of trees (e.g., conflicts with easements, potentially invasive non-native species), they reduced the area and species available for planting. Without any complementary rules incentivizing species diversification or planting, the existing policies led to unintended consequences (reduced diversity), researchers theorized. This research demonstrated the nested nature of urban forest governance and the importance of considering the suite of policies impacting parcel-level decision-making (Mincey et al. 2012).

Table 1. Ostrom (1990) Design Principles as modified by Cox et al. (2010) and adapted here.

Principle	*Description*
1A	User boundaries: Boundaries between legitimate resource users and nonusers must be clearly defined.
1B	Resource boundaries: Clear boundaries are present that define a resource system and separate it from the larger biophysical environment.
2A	Congruence with local conditions: Rules fit local social and environmental conditions.
2B	Appropriation and provision: The benefits obtained by users from a common-pool resource (CPR), as determined by use rules, are proportional to the amount of inputs required in the form of labor, material, or money, as determined by provision rules.
3	Collective-choice arrangements: Most individuals affected by rules can participate in modifying rules.
4A	Monitoring users: Monitors, accountable to the users, monitor the use levels of the users.
4B	Monitoring the resource: Monitors, accountable to the users, monitor resource condition.
5	Graduated sanctions: Appropriators who violate rules are likely to be assessed increasingly harsh sanctions by other appropriators, by officials accountable to the appropriators, or by both.
6	Conflict-resolution mechanisms: Users and their officials have rapid access to low-cost local arenas to resolve conflicts among users or between users and officials.
7	Recognition of rights to organize: The rights of users to devise their own policies are not challenged by external governmental authorities.
8	Nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested initiatives.

Policy Implications

Given the important role urban forests play in facilitating sustainability, yet observing their decline, it is not surprising that a policy-based research agenda is desired to determine adequate regulations for sustaining them. To do so, we must pinpoint the barriers to developing this agenda. Current urban forest management policies, local and potentially diverse, are difficult to analyze given a lack of support for their assessment and a limited approach to their study. Overall, this leads to an inability to offer policy recommendations, or at worst, misguided policy prescriptions.

One direct resolution is increased funding for management and policy assessment that reflects the principles of nested enterprises. Not surprisingly, large advocacy organizations like the Sustainable Urban Forestry Coalition have recently argued for increased federal support as the 2012 Farm Bill is reconsidered. The organization claims that "Congress should ensure that the USDA Forest Service places a high priority on urban-forest research that develops best-management practices as well as technical tools and information to assist local partners" to "help local policymakers establish priorities and direct resources and help assure more efficient use of federal funds." Additionally, local partnerships with nonprofit organizations and/or universities may offer an efficient policy assessment strategy by cities. Nonprofits' accountability to their supporters requires assessment of outcomes, thus partnerships with cities that address the effectiveness of strategies meant to produce urban forest benefits will help inform municipalities. University service-learning and research efforts, as demonstrated by BUFRG, also provide assessments to cities and nonprofits.

Given the lack of information about what constitutes effective policy for urban forests, it is appropriate to derive lessons from sustainability science developed in similar systems – both in terms of framing future research and applying theory for current policy tactics. The work from Ostrom, particularly the Design Principles, is such a resource. As greater pressure is placed on cities to become net generators of ecosystems services both for urban residents and global sustainability, Ostrom's theory drawn from resource-dependent communities becomes increasingly salient for consideration in urban resource governance.

Finally, initial policy recommendations reflecting Ostrom's approach (and emulated in BUFRG research) would suggest that while municipal governments play an important role in establishing urban forest policy, they cannot be the only players. Forging stronger relationships across government scales is a broad strategy particularly for funding. But nested management efforts through nonprofits like KIB and smaller-scale governance efforts through neighborhood and homeowner associations represent important partnerships for influencing private-property decisions that scale-up to determine the overarching structure of urban forests. As key sources of ecosystem services for livable cities and global sustainability, urban forests require such creative policy solutions for their sustainability.

Resources

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