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Economics and Public Value of Urban Forests

Scientific understanding of how urban trees, forests and green space benefit people has expanded substantially in recent years to include social, environmental and economic domains. Despite increasing scientific evidence, there is a lag in policy response in many municipalities.

Guy Kramer

Enjoying walking under the trees

Local government policy, regulations and even departmental activities regarding trees and green space are often premised on urban planning and design traditions that regard urban nature as the "parsley around the pig." There are notable exceptions, but few local governments have developed citywide, comprehensive frameworks for planning and managing urban green to achieve specific purposes or functions.

Too often, parks, urban agriculture gardens, forests and other city green are managed on a site-by-site, haphazard basis. Urban forests (and all urban natural capital) can be thought of as green infrastructure. Research has demonstrated that forest benefits are optimised by citywide, long-term management so that urban forests attain their highest productivity. The term "public value" describes widely held public perceptions regarding the function and service contributions of any public entity (Moore 1995). Perceived public value plays an important role in strategic public services management. Urban forests (and agriculture) will be adequately planned and stewarded only if urban citizens and elected decision makers recognise and understand the full range of services that trees and green space provide. Expanded public value perceptions precede commitments of adequate budget and staff resources for urban forest infrastructure.

Urban forests are green infrastructure

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URBAN FOREST ECONOMICS

Economic valuation translates urban forest services and functions into terms that enhance public value. The urban forest is an urban resource system that can be cultivated and stewarded on all lands within a municipality, including private and public property, as well as in all socioeconomic zones. While definitions vary, this paper encompasses all trees and forests in cities, from trees placed in street sidewalks to wooded patches. Active management of the urban forest entails costs of planting, maintenance, materials and disposal. These investment costs are readily tallied and accounted for in budgets of municipal agencies or user groups.

Returns on investment are less easily calculated. Industrial forests are managed for market goods. Dynamics of supply and demand establish prices and revenues for resource products, such as timber. In contrast many "products" of urban forests are public goods. Multiple "owners" invest in a city's natural capital, generating "products" in the form of intangible functions and benefits for each resident, visitor and user. The experience of these benefits by any single person does not exclude others from experiencing similar benefits, both immediately and indefinitely. In addition, use or experience of benefits by one or multiple people doesn't diminish the encounters of others, which is considered a non-rival situation by economists (Daly and Farley 2004).

There are few private firms willing to invest in public goods, for the nonexclusive and nonrival conditions of the urban forest will rarely generate profits. Government agencies have traditionally invested in public resources that members of society intuitively accept as providing value, such as education or emergency response systems. Sustained political support of such investments is more likely if economic benefits can be demonstrated.
Economists have developed theory and methods for assessing public goods values. Many approaches were first developed to assess the economic value of non-market wildland resources, and are transferable to urban settings. Urban valuations often start with a small-scale scientific study.

Valuation studies have addressed many facets of urban forest benefits. Multiple models and methods have been applied to

Economic valuation approaches:
Economic valuation methods can be applied to a variety of situations, including planning for urban green. Here are a few key concepts about valuation:

- Use value – Goods that are harvested from green space (such as food or fuel) may have market value, or substitute for market goods.
- Environmental services – Natural areas and ecosystems provide services to society (such as stormwater reduction or air pollution mitigation) and the costs of creating such services using built systems are deferred.
- Hedonic pricing – The value of an amenity (such as the effect of a park on a home price) is determined as an increment of purchase price.
- Travel cost method – This method calculates the costs that people are willing to add to a trip to experience a desirable amenity or landscape.
- Contingent valuation – The willingness-to-pay for an actual or hypothetical change in environment, lifestyle, or landscape condition is stated by consumers, often in surveys.
- Externalities estimation – This assesses the costs of a negative consequence of a landscape condition or change, such as the health costs associated with human inactivity in cities that are not walkable.

conditions in North American cities, and adaptation to other regions is possible. Urban forest functions and benefits should be enabled in all districts of metropolitan areas for they are important to the full spectrum of socio-economic groups (Dwyer et al. 1992).

ECONOMIC DEVELOPMENT SERVICES

Urban forests can be planned to directly affect the economic development of a municipality or region. The most *direct valuation* is to estimate marketable goods, or the value of purchase substitutes. For example, urban agroforestry practices can produce human and animal foods and medicinal materials, thus contributing to urban food security. Localised food production reduces the costs of distribution systems needed if food is transported from rural areas. Useable non-timber forest products include animal fodder, building materials, fuels, and handicraft materials. Aging trees will be removed to prevent injury and property damage; urban wood utilisation programmes provide materials to artists, furniture makers and homebuilders. Diverse forest products can be inventoried across a city, and *use values* then compiled, based on prevailing market prices. Regions with a tourism industry can use visitor surveys to tally expenses incurred by forest and green space users using the *travel cost method*. Users living nearby may spend little, while others may travel some distance, and their spending on meals, fuel, accommodations and souvenirs can be pro-rated depending on the amount of time dedicated to a park or forest visit as part of a total trip.

Hedonic or amenity pricing is the measurement of a price increment that correlates to a desirable condition or situation. Numerous studies (in North America) have concluded that a quality forest or green space has a positive economic ripple effect on nearby properties (Crompton 2001). Appraised property values of homes that are adjacent to parks and open spaces are typically about 8 to 20 percent higher than those of comparable properties elsewhere. These values are capitalised by a municipality when property taxes are assessed, or when taxes are paid on a property sale. One study found that rental rates of commercial office properties were about 7 percent higher on sites having a quality landscape, including trees.

Studies on how trees affect shoppers' behaviour in retail business districts employ the *contingent valuation method*. Consumers claim they are willing to pay about 9 to 12 percent more for products in downtown shopping areas with trees, versus in comparable districts without trees. Customer service, merchant helpfulness, and product quality are all judged to be better by shoppers in places with trees.

ENVIRONMENTAL SERVICES

Ecological systems provide a myriad of services to human societies. Ecological economists have applied valuation models to the environmental services that are provided by the world's forests, wetlands, oceans and other natural areas (Daily 1997). Most of these calculations have addressed non-urban situations, but recent work is city based. Using digital satellite imagery and aerial photographs, the extent of historic and current levels of urban forest canopy cover have been calculated for thirty North American cities (American Forests 2004). Based on modelling of air pollution and stormwater mitigation and energy impacts the annual values of urban forest services are estimated. For instance, the Urban Ecosystem Analysis of the Washington, D.C., metropolitan area concluded that tree cover had reduced stormwater storage costs by US$4.7 billion and generated annual air quality savings of $49.8 million. Micro-scale studies focus on street tree costs and benefits. Costs include tree planting, irrigation, pruning and other maintenance. Calculated benefits include energy savings, reduced atmospheric carbon dioxide, improved air quality, and reduced stormwater runoff. This economic data is mathematically combined to generate per tree net benefits figures. For instance, a 2002 analysis for Seattle (U.S.A.) indicated that per tree average annual net benefits were $1 to $8 for a small tree, $19 to $25 for a medium-sized tree, and $48 to $53 for a large tree (CUFR 2002).

Environmental benefits modelling is often based on deferred costs; that is, if trees were not present, property owners or the government would have to invest in additional engineered infrastructure or equipment to remedy environmental problems. For instance, a tree canopy intercepts rainwater, thereby reducing the amount of water falling to the ground and running off into stormwater collection systems, thus saving a city the construction costs of greater capacity pipes and storage facilities.

Valuation models incrementally include additional environmental functions. Dysfunctional urban natural systems impact the lives of millions of people. Tree planting and management can be

Property values of homes in or adjacent to parks are higher

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used to stabilise soils, reduce erosion, prevent floods, reduce particulate air pollutants and improve groundwater recharge – all with economic consequences.

HUMAN SERVICES

Human health can be assessed for economic value in two domains – physical and mental conditions. Urban people lead more sedentary lives, which increases the numbers of urban dwellers who are overweight or obese. These conditions contribute (over the life of the average person) to increases in chronic disease, such as diabetes, and traumatic diseases, such as cancer and heart disease. National health organisations in the U.S. have conducted baseline studies on personal activity levels, and how to motivate people to engage in basic physical activities, such as walking and biking. Other research explores how enabling forms of urban design (such as street layout, the presence of sidewalks and the proximity of parks) encourages activity.

The economic consequences of routine, mild exercise are enormous, when aggregated across entire cities or nations (CDC 2004). Again, deferred costs are possible, as medical expenses are lower for people who engage in routine physical activities and exercise. The youth are particularly at risk in the U.S. Estimates for obesity-associated annual hospital costs for youths averaged about $35 million between 1979 and 1981, and nearly tripled to $127 million during 1997-1999. Weight-related medical expense trends for adults are equally alarming. Inactive adults who increase their participation in regular moderate physical activity may save about $1,000 per year.

Mental health is a second arena of health benefits with economic consequences. The presence of trees and "nearby nature" in human communities generates numerous psychosocial benefits. Kuo and partners (2003) have found that having trees within high density neighbourhoods lowers levels of fear, contributes to less violent and aggressive behaviour, encourages better neighbour relationships and better coping skills. School children with ADHD show fewer symptoms and girls show more academic self-discipline if they have access to natural settings. Hospital patients recover more quickly and require fewer pain-killing medications when having a view of nature. Office workers with a view of nature are more productive, report fewer illnesses, and have higher job satisfaction. These are important, but often unnoticed, effects for urban people who have views of trees and nature in the course of their normal, everyday activities and experiences. Although much work remains to be done, in theory all of these scientific findings could be translated to economic values.

GREEN INFRASTRUCTURE STRATEGY

Elevating the status of trees and green space in municipal leaders' agendas and budgets depends on making the case that nature's assets, if well managed, provide favourable economic returns for the entire community. This outlook contrasts with the attitudes in many jurisdictions that trees and green space are discretionary spending items, and are of low priority when measured against other municipal needs that are assumed to more directly address human health, safety and welfare. Repositioning the political status of urban forests has to be followed by supportive actions and a consistent supply of resources for implementation. Optimisation of benefits and values requires a comprehensive and systematic, or green infrastructure, approach to conserving, creating and stewarding urban forests.

A citywide assessment of tree and forest occurrence is an essential activity. Even the most rudimentary inventory will enable strategic improvements. Knowledge about forest resources and land use enables planning for multi-purpose use of urban lands to multiply economic returns. For instance, lands that are dedicated to other infrastructure purposes, such as power line corridors, can be managed to grow products for nearby neighbourhoods, from fuel wood to food. In Japan urban green spaces are planned for both recreational use and as staging areas for disaster relief services, if ever needed.

In the best of situations urban forestry involves an ecosystem approach of urban tree management encompassing long-term planning, interdisciplinary professional coordination and local participation. Ultimately the aim is to secure the health and vitality of urban forest resources, and, thereby the sustained delivery of benefits for current and future generations of urban dwellers.

The economics of wild land renewable resources and ecological systems has received much attention in recent years. Valuation of the services of regional and even global ecosystems has expanded social perceptions of nature and of how the production capacity of ecosystems far exceeds the traditional market commodities that may be associated with them. Fewer comprehensive studies have been done regarding the public goods of urban resource systems. While theory and valuation approaches may be similar, city settings can be more complex landscapes, making it more difficult to isolate the specific economic contributions of nature. Yet the effort continues, providing compelling reasons for cities to justify continued and consistent investment in urban trees and green space.

A city would never build a road, water or electrical system piece by piece, with no advanced planning or coordination. Green infrastructure is the idea that nature in cities should be administered in an integrated way, just as grey infrastructure systems have been.
Green infrastructure planning includes: identification of elements and functions; needs and desired services; adequate mapping and monitoring; cost/benefit assessment; and strategic planning of nature capital improvements, in phases if necessary (more information at: www.greeninfrastructure.net)

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