Valuation of urban ecosystem services

A holistic approach on how to understand values in urban destination development

Johansson, Michael

2024

Document Version:
Publisher's PDF, also known as Version of record

Link to publication

Citation for published version (APA):
Johansson, M. (2024). *Valuation of urban ecosystem services: A holistic approach on how to understand values in urban destination development*.

Total number of authors:
1

Valuation of
urban ecosystem services

– A holistic approach on how to understand values in urban destination development

Author:

Michael Johansson[a]

[a] Department of service studies, Lund university, Campus Helsingborg, Sweden

Acknowledgements

The research behind this study was supported by Formas (Swedish Research Council for Sustainable Development) in the project “Rethinking urban tourism development: Dealing with sustainability in the age of over-tourism”, project 2018-02238.

The project embraces social, cultural, economic, and environmental sustainability of a destination. The project re-thinks the role of tourism in cities by involvement of stakeholders within and beyond the tourism industry from a multidisciplinary perspective. Rethinking urban tourism involves a shift away from mass tourism and toward more sustainable, responsible tourism practices that prioritize the needs and well-being of local communities. Rethinking urban tourism involves acknowledges that tourism can have both positive and negative impacts on urban destinations and seeks to minimize the negative impacts while maximizing the positive ones.

The picture on the front page is from Vancouver, Canada and illustrates benefits of urban vegetation in central parts of a city. Picture taken by author.

Keywords: Economic valuation; ecological valuation; ecological services; valuation; price; value; ecosystem services.

Table of content

1. Introduction

1.1. The background

Urbanization has become one of the most extensive and permanent land-use changes globally, causing increasing pressure to transform green spaces in or near cities (World Bank, 2020). However, urban greenery provides a range of social and environmental services that benefit city residents and visitors (Kabisch et al., 2015). The potential synergies and conflicts arising from the benefits of urban green areas and demand for their exploitation pose challenges for sustainable urban development and initiatives to maintain or improve human well-being. However, demands on natural capital and ecosystems services keep increasing steadily in our urbanized planet (Gómez-Baggethun & Barton, 2013).

Most often, in public policy discourse, urban ecosystems are often illustrated as “green infrastructure”. This fact captures the role that water and vegetation in or near the built environment play in delivering ecosystem services at different spatial scales such as for example mikro-geography, streetscape, neighborhood, region (Johansson & Nilsson, 2024). Hence, urban ecosystem services refer to the benefits that natural ecosystems provide to people living and visiting cities. These services contribute to the well-being, health, and quality of life of urban residents. Measuring ecosystem services in new urban tourism is essential for understanding the impact of tourism on natural environments and the well-being of both residents and visitors. Urban areas receive a variety of ecosystem services, including both positive benefits (services) and negative impacts (disservices).

To understand the importance of urban ecosystem services, various valuation methods are used. These approaches help capture the multifaceted value of urban ecosystem services. Hence, the overall concept of natural ecosystem services encompasses the delivery, provision, production, protection, or maintenance of a variety of goods and services (Norberg, 1999). The services of natural ecosystems are therefore clearly very important to our societies (Daily, 1997).

Nevertheless, many destinations are dominated by built infrastructure and has fostered the conception of an urban society that is increasingly decoupled and independent from ecosystems (Ausubel, 1996). However, demands on natural capital and ecosystems services keep increasing steadily in our urbanization processes (Ayres & van den Bergh, 2005; Guo et al., 2010). World’s population also continue to grow and live in urban areas and destinations (United Nations, 2019). Hence, the full range of benefits provided by urban green infrastructure and green space, such as trees and vegetation are often unnoticed, unappreciated, and most often undervalued in destination development.

Many destinations depend on ecosystems and their components to sustain long-term conditions for life (Odum, 1989), health (Maas et al., 2006; Tzoulas et al., 2007), security (Costanza et al., 2006), good social relations (EEA, 2011) and other important aspects of human well-being (TEEB, 2011). Loss of ecosystem services in urban areas often involves economic costs in one form or another (Escobedo et al., 2011). Social and cultural values may be difficult to capture and measure, often demanding the use of qualitative assessments, constructed scales, or narrations (Patton, 2002; Chan et al., 2012).

Therefore, ecosystem services tend usually to fall into the categories of open access and pure public services. This means that they tend to have no producer property rights, ambiguous entitlement structures and prohibitive transaction costs (Sternberg, 1996). As no one ‘‘owns’’ or has the actual ‘‘rights’’ to these services and others cannot be excluded from using or benefiting from them, little incentive exists for beneficiaries to manage ecosystem services sustainably (Dasgupta et al., 2000). Ecosystem services also in some perspectives fall outside the sphere of markets and therefore tend to be “invisible” in economic analyses.

1.2. The problematization

It is therefore believed that ecosystem service valuation can: (i) improve understanding of problems and trade-offs; (ii) be used directly to make decisions; (iii) illustrate the distribution of benefits and thus facilitate cost-sharing for management initiatives and (iv) inspire the creation of institutional and market instruments that promote sustainable ecosystem management (Sinden, 1994; Armsworth & Roughgarden, 2001; Salzman et al., 2001).

There are many reasons that green urban space is valuable, such as providing space for recreation and exercise, improving air quality, absorbing greenhouse gases and stormwater. There are many measurable economic benefits of public space, and this study makes clear the fact that investments in the public realm will pay off in some way or another. Green urban space such as for example parks generate economic value in many ways ranging from concession proceeds to savings in public healthcare costs due to opportunities to exercise. The ability to meaningfully measure these impacts varies greatly. We know for example that parks can draw visitors, bringing tourism revenue to local restaurants, hotels, shops and stores. Parks can host festivals, concerts and athletics events, bringing additional boosts to the local economy.

Studies that link the relation between values of green and blue infrastructure with cultural ecosystem services, destination development and attraction of urban tourism are scarce (Johansson & Nilsson, 2021). Existing research only weakly captures the value of ecosystem services together with green infrastructure in a tourism related perspective. It also appears to exist a scientific gap in addressing tourism issues related to already existing natural specific ecosystem services, particularly in urban areas and especially in city centers (Haase et al, 2014). Loss of urban ecosystems involve long-term economic costs and can also affect many other social and cultural values (Gómez-Baggethun & Barton, 2013).

According to Seraphin (2018) the issue of over-tourism and the survival of a destination, ecology, economics, and culture are linked to the conflict between human and natural capital. A significant part of previous research on sustainable tourism studies shows how destinations and tourism companies and management are working to change their internal activities in a more sustainable direction. Hence, a substantial part has dealt with various measures to reduce the industry's climate impact (mitigation).

However, much research focus has been on transport, which accounts for most tourism's greenhouse gas emissions. Measuring the resilience of an urban society is a complex and multifaceted task that involves assessing its ability to withstand, adapt to, and recover from various aspects of society, such as natural disasters, economic downturns, and social challenges. Resilience indicators can vary depending on the specific context and goals of the assessment. Resilience is not only used as a framework for research but is now also increasingly being applied in practice (SRC, 2021).

The scientific literature talks about four categories of ecosystem services: regulatory, provisioning, cultural and supporting (Everard, 2017; MEA 2005). Of these categories, regulatory ecosystem services are important for urban climate adaptation by mitigating the effects of climate change in the form of increased urban heating islands and stronger local extreme rainfall. The value creation of cultural ecosystem services takes the form of health-promoting recreation and rest, aesthetic experiences, and spaces for different types of outdoor activities. Cultural ecosystem services benefit both for residents and visitors. Thus, ecosystem services are all relevant for urban destination development. In this context, the green infrastructure has a dual significance of impact assessment.

1.3. The potential

As mentioned, urbanization affects spatial land use patterns that puts further pressure on ecosystem services functionality and human well-being (Kabisch et al., 2017). It is estimated that by 2050, 70 % of the world's population will be living in cities (Önder et al, 2017), expected to increase to over 80 % by the middle of the century. This corresponds to 36 million new urban citizens, who will need housing, employment, and care by 2050. It is therefore of high importance to assess the economic values (i.e., costs and benefits) of blue-green infrastructure in urban development processes (Wild et al., 2017). Building on previous categorizations of ecosystem services (De Groot et al., 2002) the TEEB report identifies 22 types of ecosystem services grouped in four categories: provisioning, regulating, habitat, and cultural and amenity services (TEEB, 2010). General examples of valuable services provided by urban ecosystems:

1.3.1. Water flow regulation

Ecosystems play a fundamental role in providing cities with fresh water for drinking and other human uses and by securing storage and controlled release of water flows (Higgens et al., 1997) and interception of rainfall by tree canopies slows down flooding effects and vegetation reduce the pressure on urban drainage systems by restoring water (Pataki et al., 2011).

1.3.2. Urban temperature regulation

The so-called 'urban heat island effect' consists of local rises in the temperature of city areas caused by greenhouse gas emission from heating and traffic in combination with built surfaces (Moreno García, 1994). Urban blue and green space regulate local temperatures (Hardin & Jensen, 2007). Water areas absorb heat in summer time and release it in winter (Chaparro & Terradas, 2009) and urban trees moderate local temperatures by providing humidity and shade (Bolund & Hunhammar, 1999).

1.3.3. Noise reduction

Traffic, construction and other human activities make noise a major pollution problem in cities, affecting health. Vegetation such as plants and trees can reduce noise pollution through absorption (Ling, 2003).

1.3.4. Air purification

Air pollution from transport, industry and waste incineration is responsible for increases in respiratory diseases in cities (Sunyer et al., 2002). Vegetation in urban areas improves air quality by removing pollutants from the atmosphere (Escobedo et al., 2008).

1.3.5. Climate Regulation

Urban trees and vegetation act as a sink of CO2 by storing carbon as biomass during photosynthesis (McPherson & Simpson, 1998). The amount of CO2 stored in vegetation is proportional to the biomass of urban trees (Chaparro & Terradas, 2009).

1.3.6. Recreation and cultural development

Inhabitants and visitors often choose where to spend their leisure time based in green urban environments (Chiesura, 2004). Green spaces in urban areas provide opportunities for leisure (Tyrväinen et al., 2005), and therefore urban ecosystems also play an important role in sense of place (Altman & Low, 1992).

The concept of ecosystem service value can be a useful guide when distinguishing and measuring where trade-offs between society and the rest of nature are possible and where they can be made to enhance human welfare in a more sustainable manner. This study provides history, background, and context for the purpose of both economic and ecological meanings of value, and their respective valuation methods, in a bit more comparative context. Urban ecosystems are still an open context of discourse in ecosystem service research (Gómez-Baggethun & Barton, 2013).

According to Gómez-Baggethun & Barton (2013) most studies on the topic of valuation processes have focused on single ecosystem services and/or value dimensions. For example, whereas monetary values have been broadly examined in the literature, measurement of other non-economic values remain largely unexplored (Chan et al., 2012). To address these knowledge gaps in the context of destination development, this study draws on recent developments in ecosystems service research to synthesize knowledge to classify and value ecosystem services for urban planning.

1.4. Relevance and purpose of the study

The concept of ecosystem services has shifted our paradigm of how nature matters to human societies. Instead of viewing the preservation of nature as something for which we must sacrifice our well-being, we now perceive the environment as natural capital, one of society's perhaps most important assets. But ecosystem services are becoming increasingly scarce due to overconsumption of public urban space. In order to stop this trend, the challenge is to provoke society to acknowledge the “real” value of natural capital. The concept of ecosystem services is anthropogenic. From the economic to social variables, and also in appropriating the right number of resources to green urban infrastructure. This is mainly due to the lack of policy tools that consider the actual value of biodiversity and the ecosystem services they provide in the urban environment (Chan et al, 2021).

This study is a part of the FORMAS-financed project *“Rethinking urban tourism development - Dealing with sustainability in the age of over-tourism”* which addresses the challenges caused by over-tourism and its effects on sustainability in urban destinations. Studies of urban tourism are generally underdeveloped and has not considered environmental sustainability enough. The project embraces social, cultural, economic, and environmental sustainability of a destination and re-think the role of tourism in cities by involvement of stakeholders within and beyond the tourism industry from a multidisciplinary perspective. Hence, this study is a part of the WP4 answering the overall research question *"how can ecosystem services be used to improve tourism in urban destination, and which impacts on ecosystem services should be considered developing strategies"*.

The purpose of this study in relation to the overall project aims is therefore to offer concepts of value and methods of valuation that will assist in guiding decisions making processes according to urban ecosystem services. The aim is therefore to provide an overview of this dynamic, identify value-creating functions in the form of urban ecosystem services and discuss their importance for sustainable destination development.

2. Concepts of value

The terms "value system", "value", and "valuation" have a certain range of meanings in different academic disciplines. This study provides a more practical synthesis of these concepts in order to address the overall issue of the different valuation processes of ecosystem services. Hence, in this study the term "value" relates to the contribution of an action or object to user-specified goals, objectives, or conditions (Costanza, 2000). The term "value" can in this perspective have different meanings depending on the certain context in which it is used. In general, however, value refers to the: worth, usefulness, or importance of something:

- In economics, value can refer to the monetary worth of a good or service. It can also refer to the perceived worth or usefulness of a product or service to a consumer,
- In ethics, value can refer to a moral principle or standard that guides our behavior and decision-making, and
- In personal development, value can refer to what is most important to a person and what they prioritize in their life money or time.

All of these mentioned perspectives of values can be related to the different measurements approaches to urban natural ecosystem services. The importance is how to understand different values in the urban society.

2.1. How to measure value in urban society

Measuring value can both be a subjective and complex task, as it depends on already mentioned perspectives and preferences. However, there are some more or less common methods and techniques that can be used to measure value in certain urban contexts:

Price: In economics, the value of a specific good or service can often be measured by its price. The higher the price, the more value people may perceive it to have.

Customer satisfaction: In tourism business, companies often use customer satisfaction surveys to gauge how much value their customers place on their products or services. The results of these surveys can help the company make improvements to increase value depending on output.

Time and effort: In personal development, one can measure value by how much time and effort you are willing to devote to something. For example, if you spend a lot of time and effort on a hobby or activity, it may have a high value to you for example visiting nature for different purposes.

Social impact: In a social or more ethical contexts, value can be measured by the positive impact that an action or decision has on society or on the local environment. For example, donating to a charity or reducing your carbon footprint can be seen as valuable because of their positive impact on society or the planet. It's important to remember that measuring value is not always easy and straightforward and can be influenced by a variety of different factors. Ultimately, what is considered valuable is subjective, especially speaking of measurement of urban natural ecosystem services and varies from person to person.

2.2. The value of urban space

Public spaces are spaces that are open and accessible to the public. Examples are neighborhood parks, parklets, urban forests, trails, and playgrounds. These spaces are usually owned by municipalities and managed, and open for use by anyone (Kohn, 2004). Spaces considered to be public if social groups view the place as public; if the place serves a function for public use; or if it is managed for a range of uses and activities by different social groups (Varna & Tiesdell, 2010).

There is sufficient evidence to conclude that urban public spaces influence the value of nearby private property (Voicu & Been, 2008). Public spaces in good condition are associated with increased property values, while public spaces in poor condition are associated with decreased property values. Many different factors affect the value of the private property: type of public space (park, water, streetscape, etc.), size of public space, ease of access, pollution of soil and water, condition, and maintenance (Mell et al, 2016).

These conclusions are based on a vast amount of literature on green spaces, parks, trees, and improvements to public space and how these factors affect private property value. Much of this literature consists of strong cross-sectional studies as well as a few strong review papers looking at how the value of properties varies with proximity to public space.

While most of the literature focuses on positive effects correlated with proximity to attractive public spaces, some studies point out important concerns with social equity (Wolf, 2007). Homeowners and landlords can see increased property values due to improvements in public spaces (Kovacs, 2012). Many studies also show that the closer private property is to a public park, the greater the property value (Cebula, 2009).

Other studies look at the effects of different types of public spaces, such as vacant lots, gardens, stadiums, and sidewalks. In particular, the attractiveness of the public space is important for property value (Hamilton & Morgan, 2010). Multiple studies indicate that parks attract tourists, leading to a positive economic impact. Economic impact can be defined as the net economic change in the income of host residents that results from tourist spending (Crompton, 2000).

2.3. Environmental factors of public space

While there is extensive research on whether urban vegetation and green infrastructure can effectively reduce air pollution, evidence of their effects depends on many factors and therefore evidence is limited. These factors include plant or tree species, micro-geographic conditions, spatial arrangement or placement, and climatic conditions (Sæbø et al, 2012). Trees bearing leaves with larger surface areas, longer lifespans, and rougher leaf textures have higher pollutant uptake capacity (Beckett et al, 2000).

Coniferous trees are those that bear cones and needles or scaled leaves throughout the year; deciduous trees shed broader, flatter and hairy or waxy leaves annually. While coniferous trees are better at removing particles, deciduous trees are better at absorbing gases from the air (Bolund & Hunhammar, 1999). One study estimated that pine trees in Los Angeles, California remove almost half of ambient concentrations in nearby air pockets, thereby reducing 10% of regional atmospheric ozone (Dwyer et al, 1992).

Currie and Bass (2008) concluded that in most cases shrubs, grasses, and engineered green spaces also act as sinks for pollution, albeit not as effectively as trees. Carbon-containing gases, such as carbon dioxide and monoxide, are also captured differently by different plants. Besir and Cuce (2018) studied the retained carbon content of various vegetation types and found trees and shrubs to contain the highest level of carbon at around 50 %, carbon levels in grass to be around 45 %. Tree or vegetation placement and air movement is another key factor in the removal of pollutants from air.

Coniferous trees are better suited to capture and retain particulate matter (PM) from the air, especially in high windspeed (turbulent) conditions. In contrast, turbulent air can flow easily past smooth leaved trees, reducing or preventing particulate deposition altogether (Beckett et al., 2000). There are mixed findings on whether near-roadway vegetation barriers, green walls, greenbelts, and a single row of trees can remove urban air particulate and gaseous pollutants (Setälä et al, 2013). Near-roadway vegetation’s influence on dispersion and airflow also impacts the location and life of pollutants.

Trees in urban streetscape can either increase or decrease air pollution concentrations, depending on spatial positioning (Amorim et al, 2013). Abhijith et al. (2017) likewise found that trees in urban streetscapes retain pollutants and therefore allowed concentrations to remain constant. One study found that ozone concentrations were higher under tree canopies than in less-vegetated open areas and those located alongside roads. In contrast, low-level hedges and shrubs enabled more airflow above green infrastructure and streetscape, therefore enabling concentrations to decrease (Fantozzi et al, 2015).

The size of parks or urban forests plays a role in pollution removal. Parks that are less than, let’s say 100 meters in length or width may not make any significant reduction to pollutants within the park (Xing & Brimblecombe, 2019). In larger parks or urban forests, dense vegetation can reduce wind speeds, which can prevent the penetration of air with high PM concentrations to reach forest interiors (Setälä et al., 2013). The evidence on whether trees and vegetation in public spaces emit pollutants or allergens is limited because very little research on emissions from vegetation has been conducted specifically in public spaces. In addition, there is insufficient research in some areas, and conflicting findings in other areas.

Greenhouse gases, including nitrous oxide, can be produced in significant quantities by certain urban vegetation. Lawns, turfgrass, and other common urban plant types can produce relatively more of these gases than natural ecosystems (Pataki et al., 2011). Additionally, changing climate and other disturbances can encourage higher emission rates and decreasing air pollutant uptake and deposition capacity (Pataki et al., 2011).

There is sufficient evidence that hard surfaces increase air temperature, contributing to urban heat island (UHI) effects. UHI is a term for the higher atmospheric and surface temperatures that occur in urban areas compared to rural areas due to urbanization/human activity. However, there have been few studies conducted specifically in public spaces other than streets and highways. Green spaces offer shade and cooling that lower surface temperatures and reduce cooling costs in nearby or attached buildings. The benefits derived from these spaces depend on the vegetative species, vegetative placement, underlying land cover, and size. Developing, improving, and maintaining these green spaces has been shown to reduce the intensity of thermal effects in urban environments (Arnfield, 2003). In Tokyo, research looked at the heat storage of various materials including asphalt, blacktop concrete, soil, and sand. Asphalt heats considerably more than the other materials (Asaeda et al, 1996).

Hence, parks can have the most profound effect on air and land surface temperatures in cities, depending on the park's size, and on the vegetation and biodiversity supported within them. Parks have cooling effects that are enhanced by the extent of vegetative cover, number of trees, larger size, and improved irrigation (Shashua-Bar & Hoffman, 2000). Park size is correlated with the associated cooling effect (larger park size indicates increasing returns) (Cao et al, 2010).

Tree clusters in parks with short ground vegetation have higher cooling effects than single trees, grass, and water bodies. Irrigation provides greater cooling effect in these settings but of course involves greater maintenance costs (Amani-Beni et al, 2018). Parks offer clear benefits not only within their boundaries, but in the surrounding areas as well. One study investigated the cooling effects downwind from a PCI and found that at noon, the park could cool areas 1 kilometer downwind by up to 1.5°C (Ca et al, 1998). These studies suggest that parks' cooling effects depend on park size, geometry, type of vegetation, and upkeep; and that parks have cooling effects beyond their boundaries (Napoli et al, 2016).

Street trees reduce daytime indoor and outdoor temperatures, but since they can reduce air circulation, can also cause an increase in nighttime indoor and outdoor temperatures (Morakinyo & Lam, 2016). Targeted tree placement to provide shade over walkways and other pedestrian spaces can improve outdoor comfort the most by reducing air temperatures (Johansson & Emmanuel, 2006).

3. Valuing ecosystem services in urban areas

Traditionally, access to public spaces by residents has been determined by how close a resident lives to the space (i.e. proximity). However, additional research suggests that simply living near a public space does not make it accessible to all residents (Koohsari et al, 2013). For instance, a park that is congested with many users may not be able to adequately serve all local residents, or a playground with broken equipment may not be safe for children to use. Research on accessibility highlights its multiple dimensions: proximity to public space, ability to use resources within a space, ability to access public spaces that contain high-quality resources, and sense of belonging. Proximity does remain an important component of accessibility to public space (Bryson, 2013).

An individual's ability to utilize resources in the public space is therefore an important aspect of accessibility. A park that lacks wheelchair ramps will not allow an individual in a wheelchair to access the space (Lara-Valencia & Garcia-Perez, 2018). Additionally, fear of crime may also limit visitors ability to utilize resources within a certain public space (Carro et al, 2010). The quality and conditions of the resources provided within public spaces can also shape who uses the space (Rigolon, 2016).

Maintenance of public spaces is often uneven due to limited resources available at the city level, and there is an increasingly heavy reliance on community members to maintain their public spaces (Dempsey & Burton, 2012). This reliance on community members contributes to uneven public space quality, since some communities may have resources—such as time or money—in greater supply than others. Finally, sense of belonging impacts who may be able to access public space (Perkins, 2013).

3.1. Economic values

Loss of ecosystem services in urban areas often involves economic costs in one form or another (Escobedo et al., 2011). Avoided cost methods, for example, show that loss of urban vegetation leads to increased energy costs in cooling in the summer period (Chaparro & Terradas, 2009). Likewise, loss of water regulation services from land-use change in the city demands construction of very costly water purification systems (Daily & Ellison, 2002). Additional economic costs also come from health problems related to loss of ecosystem services like for example air purification (Escobedo & Nowak, 2009).

Nevertheless, it should be noted, however, that when playing the role of economic values, serious economic analysis should not only consider benefits from ecosystem services, but also the economic costs from ecosystem disservices i.e. the monetary effect on not having ecological services (Gómez-Baggethun & Barton, 2013). See also chapter 4 that it is of high importance using a combination of different valuation methods to address ecosystem services. Avoided expenditure or replacement costs are often used to address values of for example regulating services of trees such as air purification and climate regulation (Sander et al., 2010). However, analyses conducted by other authors, show that hedonic pricing (HP) and stated preference methods (SP), in particular contingent valuation, have been the methods most frequently used to value ecosystem services in cities (Boyer & Polasky, 2004; Kroll & Cray, 2010; Brander & Koetse, 2011). A few broad conclusions can be drawn from the literature (Gómez-Baggethun & Barton, 2013) that stated preference methods are potentially applicable at all scales, although their main use has been at regional scale. Travel cost methods application seems also limited by the large number of alternative modes of travel to urban recreation sites. Ecological benefits therefore refer especially to the positive impacts that actions or policies can have on the natural environment and the ecosystem within urban areas and destinations such as:

1. Biodiversity conservation: Protecting the diversity of plant and animal species and helps to maintain the balance of ecosystems, which can lead to benefits such as increased pollination, soil fertility, and pest control,
2. Carbon sequestration: Trees and other plants absorb carbon dioxide from the atmosphere and store it in their tissues. This helps to reduce the amount of greenhouse gases in the atmosphere, which can mitigate climate change on a local scale, and
3. Water quality: Protecting wetlands and other sensitive habitats can help to improve water quality by reducing sedimentation, nutrient pollution, and other contaminants by purification processes.

3.2. Social and cultural subjective values

Social and cultural values arisen from urban environments most often reflect emotional, affective, and symbolic views attached to urban nature that in most cases cannot be captured by monetary values (Martínez-Alier et al., 1998). Social and cultural values are most directly associated to the category of cultural ecosystem services, and may include place values, sense of community and identity, physical and mental health, social cohesion, and educational values (Chan et al., 2012). Sense of place is according to scientific literature a source of social cohesion, shared interests, and neighborhood participation (Gotham & Brumley, 2002). Social and cultural values may be difficult to capture and measure, often demanding the use of qualitative methodology or narrations of a certain destination (Chan et al., 2012).

Social benefits therefore refer to the positive impacts that actions or policies can have on society and human well-being i.e., cultural ecosystem services. These benefits can range from improving the quality of life for individuals to promoting social cohesion and reducing inequality such as for example:

1. Improved health: Access to healthcare, clean air and water, healthy food, and safe living conditions can all contribute to better health outcomes, reducing disease and improving well-being,
2. Enhanced education: Providing access to quality education can help to promote social mobility and reduce inequalities, as well as foster innovation and economic growth, and
3. Increased social capital: Investing in community infrastructure, such as parks and community centers, can help to build social connections and promote social capital, which can contribute to a more cohesive and resilient society.

4. Valuation methods

4.1. Different common valuation approaches

The process of ecological valuation typically involves several steps. First, the specific ecosystem is studied and its various components, including biodiversity, nutrient cycling, and water quality, are analyzed. Next, the services that the ecosystem provides, such as carbon sequestration, flood protection, and recreation opportunities, are identified, analyzed, and then quantified (Johansson, 2024).

Once the services provided by the ecosystem are identified, their economic value is estimated. This can involve using various economic valuation techniques, such as different stated preference surveys or cost-benefit analysis, to determine how much people are willing to pay for the ecosystem services or how much it would cost to replace them if they were lost (see later chapters for examples). The results of the ecological scenario valuation analysis can then be used to inform policy decisions, such as whether to protect or restore an ecosystem, and also to prioritize conservation efforts based on the economic and social benefits of each urban ecosystem.

Ecological valuation can also be applied to urban ecosystems, which provide a wide range of valuable services to people living in cities. Urban ecosystem services include things like air and water purification, carbon sequestration, climate regulation, and recreational opportunities. The process of ecological valuation of urban ecosystem services is like that used for natural ecosystems, but with some key differences. In an urban context, there may be more emphasis on the economic value of services like improved property values or reduced healthcare costs associated with access to green spaces.

Additionally, in urban areas, the valuation of ecosystem services may need to consider other relevant factors such as population density, land use patterns, and infrastructure i.e., factors relating to urban planning and local development. For example, an analysis of the economic value of urban trees may need to consider the cost of maintaining the trees and the benefits they provide in terms of reducing energy costs for cooling buildings, improving air quality, and reducing stormwater runoff.

The results of an ecological valuation of urban ecosystem services can also be used to inform decisions about land use planning, green infrastructure development, and urban policy. For example, a study may find that preserving or expanding green spaces in a particular neighborhood would provide significant economic and social benefits, which could inform decisions about where to invest in green infrastructure or prioritize conservation efforts.

Therefore, valuing ecosystem services can also be a challenging task, as they are often not reflected in market prices and can have both direct and indirect benefits to society. Overall, valuing ecosystem services is a complex process that requires a multidisciplinary approach and a range of methods. It is important to recognize that the value of ecosystem services can be both tangible and intangible, and that the full value of these services may not always be reflected in market prices. Nevertheless, there are several more or less common approaches that can be used to estimate the value of ecosystem services:

4.1.1. Exchange value approach

Exchange value refers to the value of a good or service that is determined by its market price, or the amount of money that a buyer is willing to pay for it. It is the value that is exchanged between the buyer and seller in a market. Exchange value is often contrasted with "use value", which refers to the value of a good or service based on its usefulness or the satisfaction it provides to the user. Use value is often subjective and can vary between individuals, while exchange value is determined by market forces and can be influenced by external factors such as supply and demand, economic conditions, and competition.

In economics, exchange value is an important concept for understanding market transactions and the allocation of resources. It is often used in conjunction with other measures of value, such as labor value or ecological value, to provide a more comprehensive understanding of the value of goods and services in an economy. How is exchange value related to urban vegetation?

Urban vegetation sequesters carbon dioxide (CO_2) from the atmosphere and this carbon storage has exchange value in terms of mitigating climate change. Urban vegetation also positively influences when mentioned property values located near parks, green belts, or tree-lined streets tend to have higher market prices. Homeowners and real estate developers recognize this exchange value when pricing properties. Also once again mention that urban vegetation provides shade and reduces the urban heat island effect creating an exchange value associated with energy savings.

4.1.2. Consumer sovereignty approach

Consumer sovereignty is an economic concept that refers to the power that consumers have in determining the production and allocation of goods and services in a market economy. It is based on the idea that in a free market, consumers can express their preferences and make choices about what goods and services they want to consume. In a market economy, producers are motivated to produce goods and services that consumers are willing to buy, to generate profits. Consumers, in turn, have the power to decide which goods and services they want to purchase, based on their own preferences, needs, and budget constraints. This interplay between consumers and producers is what drives the allocation of resources in a market economy.

Consumer sovereignty implies that consumers are in charge of the economy, since their decisions about what to buy and what not to buy ultimately determine which goods and services are produced and how resources are allocated. This approach is important for understanding how markets work and how prices are determined, as well as for evaluating the effectiveness of government policies that aim to regulate or influence market outcomes. It is worth noting that consumer sovereignty is not absolute, as consumers are often subject to external influences and constraints that can limit their ability to make fully informed or autonomous choices (Norton et al., 1998).

4.1.3. Avoided cost approach

Avoided cost is another economic concept that refers to the cost savings that result from avoiding the negative impacts of a particular activity or project. In the context of environmental economics, avoided cost is often used to quantify the economic benefits of avoiding or reducing pollution or other environmental damage. For example, if a company invests in pollution control equipment that reduces its emissions of harmful pollutants, the avoided cost would be the cost savings resulting from the reduction in pollution. This could include savings in health care costs associated with treating illnesses caused by pollution, as well as savings in the cost of cleaning up polluted sites or restoring damaged ecosystems.

Avoided cost is typically calculated using a cost-benefit analysis approach, which involves comparing the costs of a particular activity or project to the benefits it generates, both in terms of direct monetary benefits and the avoided costs resulting from environmental damage. This approach can help to provide a more comprehensive picture of the true costs and benefits of different activities and policies, and to identify opportunities for cost savings and efficiency improvements.

The approach of avoided cost is important for understanding the economic value of environmental protection and sustainability, and for making more informed decisions about how to balance economic growth with environmental protection. By quantifying the avoided costs of pollution and other environmental damage, policymakers and businesses can better understand the true economic costs and benefits of different activities and policies, and work to maximize the benefits while minimizing the costs. Other examples of services allow society to avoid costs that would have been incurred in the absence of those services; flood control avoids property damages or waste treatment by wetlands avoids health costs.

4.1.4. Replacement cost approach

Replacement cost is an economic approach that refers to the cost of replacing an asset with a new one of similar quality and functionality. This approach is often used in insurance, accounting, and financial management to estimate the value of assets and to determine the appropriate level of insurance coverage or depreciation.

For example, if a business owns a building that is destroyed by a fire, the replacement cost would be the cost of rebuilding the same building from scratch, taking into account the cost of materials, labor, and other associated costs. Similarly, in the context of financial management, replacement cost is used to estimate the value of assets such as machinery, equipment, or vehicles, taking into account factors such as depreciation and inflation.

Replacement cost is typically calculated using market-based valuation methods, which estimate the cost of acquiring or constructing a new asset of similar quality and functionality. This approach is based on the assumption that the value of an asset is determined by its ability to generate income or provide utility, and that the cost of replacing the asset with a new one is a good proxy for its value.

The replacement cost is an important approach for valuing assets and for making decisions about insurance coverage, financial planning, and asset management. By estimating the cost of replacing an asset with a new one, businesses and individuals can better understand the true value of their assets and make more informed decisions about how to protect and manage them.

4.1.5. Travel cost approach

Service demand may require travel, whose costs can reflect the implied value of the service. Recreation areas attract distant visitors whose value placed on that area must be at least what they were willing to pay to travel to it. The travel cost method is an important tool for valuing recreational services provided by natural ecosystems, and for informing decisions about resource management and conservation. By estimating the economic value of these services, policymakers and resource managers can better understand the benefits provided by natural ecosystems and work to ensure their long-term sustainability.

Travel cost is also an economic approach that refers to the costs that individuals incur to travel to a particular destination, such as a park, beach, or other recreational area. In the context of environmental economics, travel cost is often used to estimate the value of recreational services provided by natural ecosystems, such as hiking, camping, fishing, and wildlife viewing. The travel cost method is a commonly used non-market valuation technique that estimates the economic value of these recreational services based on the costs that people incur to access them. The basic idea is that people are willing to pay for the opportunity to engage in these activities, and the amount they are willing to pay is reflected in the costs they incur to travel to the destination.

The travel cost method typically involves collecting data on the number of visits to the recreational area, as well as the distance traveled, and the costs incurred for transportation, lodging, and other expenses. These data are then used to estimate the demand for recreational services, and to calculate the economic value of these services based on the travel costs incurred by visitors.

4.1.6. Hedonic pricing approach

Hedonic pricing is an economic approach that refers to the use of market data to estimate the implicit value of specific characteristics or attributes of a product or service. In the context of environmental economics, hedonic pricing is often used to estimate the economic value of environmental amenities or disamenities, such as air and water quality, noise levels, scenic views, and access to recreational opportunities.

The basic idea behind hedonic pricing is that the price of a product or service is determined by a set of underlying characteristics, and that these characteristics can be disaggregated and quantified to estimate the implicit value of each one. For example, in the housing market, the price of a house may depend on factors such as its location, size, age, and condition. By analyzing the prices of a large sample of houses with different characteristics, researchers can estimate the implicit value of each characteristic, including environmental amenities such as access to parks, water views, or clean air.

4.1.7. Contingent valuation approach

Contingent valuation is an economic method used to estimate the value that people place on a non-market good or service, such as environmental amenities, cultural heritage, or public health initiatives. The method involves asking people how much they would be willing to pay (WTP) for a hypothetical change in the availability or quality of the good or service, or how much they would require as compensation for its loss (willingness to accept, or WTA).

Contingent valuation is often used in environmental economics to estimate the value of environmental goods and services, such as clean air and water, endangered species, or protected natural areas. The method can also be used to estimate the value of cultural heritage sites, public health initiatives, and other non-market goods and services.

4.1.8. Market-based approach

This approach estimates the value of ecosystem services based on the market prices of comparable goods or services. For example, the value of timber from a forest can be estimated by looking at the market prices for timber.

4.1.9. Cost-based approach

This approach estimates the value of ecosystem services based on the cost of providing the same services through human-made systems. For example, the cost of building and maintaining a water filtration plant can be compared to the value of the water filtration services provided by a wetland.

4.1.10. Surrogate market approach

This approach estimates the value of ecosystem services by using a surrogate market, such as recreational activities or tourism, to measure the value that people place on the services. For example, the value of a national park can be estimated by looking at the revenue generated from tourism.

4.1.11. Stated preference approach

This approach estimates the value of ecosystem services by asking people how much they are willing to pay for them or how much they would be willing to accept as compensation for their loss. For example, people may be asked how much they would be willing to pay for cleaner air or water.

4.1.12. Ecological production function approach

This approach estimates the value of ecosystem services by measuring the relationship between the quantity and quality of an ecosystem and the services it provides. For example, the value of carbon sequestration by a forest can be estimated by measuring the amount of carbon stored in the forest.

5. Conclusions

By understanding the benefits provided by green urban infrastructure, it can help to develop sustainable cities, but also inform land use changes and reduce any potential impact through planned intervention to avoid a loss of important urban ecosystem services. Such information can be used to help make better management decisions. In most cases the benefits provided by such urban ecosystem services is often poorly understood.

Consequently, these benefits from ecosystem services are often undervalued in decision making processes. As many of the benefits provided by urban ecosystems are often not marketable, they are generally undervalued. Inventories on the green urban infrastructure are limited. This may lead to wrong decisions being made about the management and maintenance of important urban green infrastructure especially in destination development. Ecosystem services include benefits like clean air, water purification, recreational spaces, and climate regulation. Involve local communities, tourists, and relevant stakeholders in the valuation process and assess the economic value of ecosystem services using methods like contingent valuation, travel cost analysis, or hedonic pricing. Consider non-monetary valuation approaches, such as stated preference surveys or other qualitative assessments. Decide whether non-monetary evaluation suffices or if monetary valuation is worth the effort.

Ecological valuation is an important tool for understanding the value of ecosystems and the services they provide, and for making informed decisions about their conservation and management. The study shows that there is growing evidence on the positive impacts of urban ecosystem services, especially on quality of life in cities. Both regulating and cultural services, including air purification, noise reduction, urban cooling, runoff mitigation, recreation, and contributions to mental and physical heath, shows to be of very special importance in urban contexts.

Public spaces located within green infrastructure bring people together. Even informal green spaces, such as community gardens on vacant land, provide a space for community members, often from similar social and cultural groups, to convene. Many cities have therefore become more attractive through constantly developing green urban values, upgrading quality of services, and consequently enhancing their competitiveness (Richards, 2014). Public spaces present an opportunity to preserve and improve the environment in cities by lowering local temperatures, reducing stormwater runoff, and creating habitats to promote biodiversity. It is well-documented that green public spaces, especially those that offer shade, have cooling effects on surface and air temperatures. Reducing air temperatures is important, particularly with climate change and predicted increases to the number and duration of extreme heat events in many cities.

Public spaces continue to reduce challenges to certain environmental concerns, such as stormwater runoff and biodiversity. Impervious surfaces negatively impact aquatic and coastal ecosystems primarily via stormwater runoff, which causes increased sediment as well as chemical, bacteria, nutrient, and thermal loads. Streetscape, parking places, rooftops, and transportation networks and related infrastructure are the primary surfaces that negatively impact habitats and biodiversity. Cities are pursuing various forms of green infrastructure on public land to mitigate stormwater runoff; this is another way in which public space can improve local environments.

6. Summary

From the drawn conclusion, it can be summarized that a valuation of ecosystem services provides valuable insights for decision-makers and urban planners to make informed choices that balance sustainable development goals with the preservation of ecosystem services in urban areas and surroundings. Performing ecological valuation for urban ecosystem services therefore involves assessing the potential impacts of different scenarios on the environment and valuing the associated ecosystem services. Understanding related values and services provided by urban ecosystems is essential for also understanding the impact of tourism on natural environments and the well-being of both residents and visitors.

A couple of main insights can be extracted from this study about valuation of urban ecosystem services – a holistic approach on how to understand values in urban destination development:

- in line with previous literature on the topic of valuation of ecosystem services, the study shows that there is growing evidence on the positive impacts of urban ecosystem services on quality of life in cities and destination development,
- loss of ecosystems in urban environments may involve high long-term economic costs and impacts on social and cultural aspects associated to ecosystem services. Also, economic costs from the loss of urban ecosystems derive from the need to restore and maintain public services provided by urban green infrastructure are lost, and
- values and benefits sustained by urban ecosystems is expanding rapidly, it also reveals knowledge in our capacity to understand and capture specific types of ecological values.

The study therefore outlines following considerations for measuring ecosystem services in destination development:

- clearly define what "green values" mean in the context of your specific destination development,
- identify key components such as environmental sustainability, community engagement, cultural preservation, and economic benefits,
- identify and engage stakeholders including local communities, businesses, government bodies, environmental groups, and tourists,
- consider their perspectives on green values and incorporate their input into the measurement framework.

7. References

Abhijith, K. V., Kumar, P., Gallagher, J., McNabola, A., Baldauf, R., Pilla, F., Pulvirenti, B. (2017). Air pollution abatement performances of green infrastructure in open road and built-up street canyon environments–A review. Atmospheric Environment, 162, 71-86.

Amani-Beni, M., Zhang, B., Xie, G.-d., & Xu, J. (2018). Impact of urban park's tree, grass and waterbody on microclimate in hot summer days: A case study of Olympic Park in Beijing, China. Urban forestry & urban greening, 32, 1-6.

Amorim, J. H., Rodrigues, V., Tavares, R., Valente, J., & Borrego, C. (2013). CFD modelling of the aerodynamic effect of trees on urban air pollution dispersion. Science of The Total Environment, 461, 541-551.

Armsworth, P.R., Roughgarden, J.E., 2001. An invitation to ecological economics. Trends in Ecology and Evolution 16, 229–234.

Arnfield, A. J. (2003). Two decades of urban climate research: A review of turbulence, exchanges of energy and water, and the urban heat island. International Journal of Climatology, 23, 1-26.

Asaeda, T., Ca, V. T., & Wake, A. (1996). Heat Storage of Pavement and Its Effect on the Lower Atmosphere. Atmospheric Environment, 30(3), 413-427.

Ausubel, J.H., (1996). Can technology spare the Earth? American Scientist 84, 166–178.

Ayres, R.U., van den Bergh, J., (2005). A theory of economic growth with material/energy resources and dematerialization: interaction of three growth mechanisms. Ecological Economics 55, 96–118.

Beckett, K. P., Freer Smith, P. H., & Taylor, G. (2000). Effective tree species for local air quality management. Arboricultural Journal, 26(1), 12-19.

Besir, A. B., & Cuce, E. (2018). Green roofs and facades: A comprehensive review. Renewable and Sustainable Energy Reviews, 82, 915-939. doi:https://doi.org/10.1016/j.rser.2017.09.106

Bolund, P., & Hunhammar, S. (1999). Ecosystem services in urban areas. Ecological Economics, 29 (1999), pp. 293-301.

Boyer, T., & Polasky, S. (2004). Valuing urban wetlands: a review of non-market valuation studies. Wetlands, 24 (2004), pp. 744-755.

Brander, L.M., & Koetse, M.J. (2011). The value of urban open space: meta-analyses of contingent valuation and hedonic pricing results. Journal of Environmental Management, 92 (2011), pp. 2763-2773.

Brownlow, A. (2006). An archaeology of fear and environmental change in Philadelphia. Geoforum, 37(2), 227-245.

Bryson, J. (2013). Greening urban renewal: Expo'74, urban environmentalism and green space on the Spokane riverfront, 1965-1974. Journal of Urban History, 39(3), 495-512.

Byrne, J., Wolch, J., & Zhang, J. (2009). Planning for environmental justice in an urban national park. Journal of Environmental Planning and Management, 52(3), 365-392.

Ca, V.T., Asaeda, T., & Abu, E.M. (1998). Reductions in air conditioning energy caused by nearby park. Energy and Buildings, 29, 83-92.

Cao, X., Onishi, A., Chen, J., & Imura, H. (2010). Quantifying the cool island intensity of urban parks using ASTER and IKONOS data. Landscape and urban planning. Landscape and urban planning, 96, 224-231.

Carro, D., Valera, S., & Vidal, T. (2010). Perceived insecurity in the public space: Personal, social and environmental variables. Quality & Quantity, 44(2), 303-314.

Cebula, R. J. (2009). The Hedonic Pricing Model Applied to the Housing Market of the City of Savannah and Its Savannah Historic Landmark District. The Review of Regional Studies, 39(1), 9-22.

Chan, K.M.A., Satterfield, T., Goldstein, J., (2012). Rethinking ecosystem services to better address and navigate cultural values. Ecological Economics 74, 8–18.

Chaparro, L., & Terradas, J. (2009). Ecological services of urban forest in Barcelona. Institut Municipal de Parcs i Jardins Ajuntament de Barcelona, Àrea de Medi Ambient (2009).

Chiesura, A. (2004). The role of urban parks for the sustainable city. Landscape and Urban Planning, 68 (2004), pp. 129-138.

Costanza, R., (2000). Social goals and the valuation of ecosystem services. Ecosystems 3, 4–10.

Costanza, R., Folke, C., 1997. Valuing ecosystem services with efficiency, fairness and sustainability as goals. In: Daily, G.C. (Ed.), Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington DC, pp. 49–68.

Costanza, R., Wilson, M., Troy, A., Voinov, A., Liu, S., & D'Agostino, J. (2006). The Value of New Jersey's Ecosystem Services and Natural Capital. Gund Institute for Ecological Economics, University of Vermont for New Jersey Department of Environmental Protection (2006).

Crompton, J. L. (2000). The impact of parks and open spaces on property values and the property tax base. In: Division of Professional Services, National Recreation & Park.

Currie, B. A., & Bass, B. (2008). Estimates of air pollution mitigation with green plants and green roofs using the UFORE model. Urban Ecosystems, 11(4), 409-422.

Dahmann, N., Wolch, J., Joassart-Marcelli, P., Reynolds, K., & Jerrett, M. (2010). The active city? Disparities in provision of urban public recreation resources. Health & place, 16(3), 431-445.

Daily, G.C., & Ellison, K. (2002). The New Economy of Nature. The Quest to Make Conservation Profitable. Island Press, Washington, DC (2002).

Daily, G.C., (1997). Nature's services: societal dependence on natural ecosystems. Island Press, Washington, DC.

Dasgupta, P., Levin, S., Lubchenco, J., (2000). Economic pathways to ecological sustainability. BioScience 50, 339–345.

De Groot, R.S., Wilson, M., Boumans, R., (2002). A typology for the description, classification and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393–408.

Dempsey, N., & Burton, M. (2012). Defining place-keeping: The long-term management of public spaces. Urban forestry & urban greening, 11(1), 11-20.

Dobbs, C., Escobedo, F.J.W.C. Zipperer, (2011). A framework for developing urban forest ecosystem services and goods indicators. Landscape and Urban Planning 99, 196–206.

Dryzek John, S., (1987). Rational Ecology: Environment and Political Economy. Basil Blackwell, New York.

Dwyer, J. F., McPherson, E. G., Schroeder, H. W., & Rowntree, R. A. (1992). Assessing the benefits and costs of the urban forest. Journal of Arboriculture, 18, 227-227.

EEA (European Environmental Agency), (2011). Green infrastructure and territorial cohesion. The concept of green infrastructure and its integration into policies using monitoring systems. EEA Technical report, 18. European Environment Agency.

Egerer, M., & Fairbairn, M. (2018). Gated gardens: Effects of urbanization on community formation and commons management in community gardens. Geoforum, 96, 61-69.

Escobedo, F.J., Kroeger, T. & Wagner, J.E. (2011). Urban forests and pollution mitigation: analyzing ecosystem services and disservices. Environmental Pollution, 159 (2011), pp. 2078-2087.

Escobedo, F.J., Wagner, J.E., Nowak, D., De La Maza, C.L., Rodriguez, M., Crane, D.E. (2008). Analyzing the cost-effectiveness of Santiago, Chile's policy of using urban forests to improve air quality. Journal of Environmental Management, 86 (2008), pp. 148-157.

Fantozzi, F., Monaci, F., Blanusa, T., & Bargagli, R. (2015). Spatio-temporal variations of ozone and nitrogen dioxide concentrations under urban trees and in a nearby open area. Urban Climate, 12, 119-127. doi:https://doi.org/10.1016/j.uclim.2015.02.001

Fishkin James, S., (1991). Democracy and Deliberation. Yale University Press, New Haven.

Freeman III, A.M., 1993. The Measurement of Environmental and Resource Values. Resources for the Future, Washington DC, USA.

Garrod, G., Willis, K.G., 1999. Economic Valuation of the Environment. Edward Elgar Publishing Ltd., Cheltenham, UK.

Geoghegan, J., 2002. The value of open spaces in residential land use. Land Use Policy 19, 91–98.

Gómez-Baggethun, E., & Barton, D.N., (2013). Classifying and valuing ecosystem services for urban planning. Ecological Economics, Volume 86, Pages 235-245, ISSN 0921-8009, https://doi.org/10.1016/j.ecolecon.2012.08.019.

Gotham, K., & Brumley, K. (2002). Using space: agency and identity in a public-housing development. City and community, 1 (2002), pp. 267-289.

Guo, Z., Zhang, L., Li, Y., (2010). Increased dependence of humans on ecosystem services and biodiversity. PLoS One 5, 1–7.

Habermas, J., (1984). The Theory of Communicative Action. Beacon Press, Boston MA.

Hamilton, S., & Morgan, A. (2010). Integrating lidar, GIS and hedonic price modeling to measure amenity values in urban beach residential property markets. Computers, Environment and Urban Systems, 34, 133-141.

Higgens, S.I., Turpie, J.K., Costanza, R., Cowling, R.M., Le Maitre, D.C., Marais, C., Midgley, G.F. (1997). An ecological simulation model of mountain fynbos ecosystems: dynamics, valuation and management. Ecological Economics, 22 (1997), pp. 155-169.

Johansson, E., & Emmanuel, R. (2006). The influence of urban design on outdoor therma comfort in the hot, humid city of Colombo, Sri Lanka. International Journal of Biometeorlogy, 51, 119-133.

Kabisch, N., Qureshi, S., Haase, D., (2015). Human-environment interactions in urban green spaces - a systematic review of contemporary issues and prospects for future research. Environ. Impact Assess. Rev., 50 (2015), pp. 25-34

Kesselmeier, J., & Staudt, M. (1999). Biogenic volatile organic compounds (VOC): an overview on emission, physiology and ecology. Journal of atmospheric chemistry, 33(1), 23-88.

King, D.A., Sinden, J.A., 1988. Influence of soil conservation on farm land values. Land Economics 64, 242–255.

Kohn, M. (2004). Brave new neighborhoods: The privatization of public space: Routledge.

Koohsari, M. J., Kaczynski, A. T., Giles-Corti, B., & Karakiewicz, J. A. (2013). Effects of access to public open spaces on walking: Is proximity enough? Landscape and urban planning, 117, 92-99.

Kovacs, K. F. (2012). Integrating property value and local recreation models to value ecosystem services from regional parks. Landscape and urban planning, 108, 79-90.

Kroll, C.A. & Cray, A.F. (2010). Hedonic Valuation of Residential Resource Efficiency Variables. A Review of the Literature. The Center for Resource Efficient Communities (CERC), University of California, Berkley (2010).

Langlois, R.N., (1998). Rule-following, expertise, and rationality: a new behavioural economics. In: Dennis, K. (Ed.), Rationality in Economics: Alternative Perspectives. Kluwer Academic Publishers, Dordrecht, pp. 55–78.

Lara-Valencia, F., & Garcia-Perez, H. (2018). Disparities in the provision of public parks in neighbourhoods with varied Latino composition in the Phoenix Metropolitan Area. Local Environment, 23(12), 1107-1120.

Ling, D.L. (2003). Investigation of the noise reduction provided by tree belts. Landscape and Urban Planning, 63 (2003), pp. 187-195.

MA, Millennium Ecosystem Assessment, 2003. Ecosystems and human well-being. A framework for assessment. Island Press.

Maas, J., Verheij, R.A., de Groenewegen, P.P., Vries, S., Spreeuwenberg, P., (2006). Green space, urbanity, and health: how strong is the relation? Journal of Epidemiology and Community Health 60, 587–592.

Martínez-Alier, J., Munda, J., & O'Neill, J. (1998). Weak comparability of values as a foundation for ecological economics. Ecological Economics, 26 (1998), pp. 277-286.

McPherson, E.G. (1998). Atmospheric carbon dioxide reduction by Sacramento's urban forest. Journal of Arboriculture, 24 (1998), pp. 215-223.

Mell, I. C., Henneberry, J., Hehl-Lange, S., & Keskin, B. (2016). To green or not to green: Establishing the economic value of green infrastructure investements in The Wicker, Sheffield. Urban forestry & urban greening, 18, 257-267.

Morakinyo, T. E., & Lam, Y. F. (2016). Simulation study on the impact of tree-configuration, planting pattern and wind condition on street-canyon’s micro-climate and thermal comfort. Building and environment, 103, 262-275.

Moreno García, M.C. (1994). Intensity and form of the urban heat island in Barcelona. International Journal of Climatology, 14 (1994), pp. 705-710.

Napoli, M., Massetti, L., Brandani, G., Petralli, M., & Orlandini, S. (2016). Modeling Tree Shade Effect on Urban Ground Surface Temperature. Journal of Envrionmental Quality, 45(1), 146-156.

Norberg, J., 1999. Linking Nature’s services to ecosystems: some general ecological concepts. Ecological Economics 25, 183–202.

Norton, B., Costanza, R., Bishop, R., (1998). The evolution of preferences: why ‘sovereign’ preferences may not lead to sustainable policies and what to do about it. Ecological Economics 24, 193–211.

Odum, E.P., (1989). Ecology and Our endangered Life Support System. Sinauer Association, Sunderland.

Pataki, D.E., Carreiro, M.M., Cherrier, J., Grulke, N.E., Jennings, V., Pincetl, S., Pouyat, R.V., Whitlow, T.H., Zipperer, W.C. (2011). Coupling biogeochemical cycles in urban environments:

ecosystem services, green solutions, and misconceptions. Frontiers in Ecology and the Environment, 9 (2011), pp. 27-36

Patton, M.Q., (2002). Qualitative Research and Evaluations Methods, 3rd edition. Sage Publications, Thousand Oaks, California.

Pearce, D., Markandya, A., Barbier, E.B., 1989. Blueprint for a Green Economy. Earthscan Publications Ltd., London, UK.

Perkins, H. A. (2013). Consent to neoliberal hegemony through coercive urban environmental governance. International Journal of Urban and Regional Research, 37(1), 311-327.

Portney, P., 1994. The contingent valuation debate: why should economists care? Journal of Economic Perspectives 8, 3–17.

Rigolon, A. (2016). A complex landscape of inequity in access to urban parks: A literature review. Landscape and urban planning, 153, 160-169.

Sæbø, A., Popek, R., Nawrot, B., Hanslin, H. M., Gawronska, H., & Gawronski, S. W. (2012). Plant species differences in particulate matter accumulation on leaf surfaces. Science of The Total Environment, 427-428, 347-354. doi:https://doi.org/10.1016/j.scitotenv.2012.03.084

Salzman, J., Thompson Jr., B.H., Daily, G., 2001. Protecting ecosystem services: science, economics and law. Stanford Environmental Law Journal 20, 309–332.

Sander, H., Polasky, S., Haight, R.G. (2010). The value of urban tree cover: a hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA. Ecological Economics, 69 (2010), pp. 1646-1656.

Setälä, H., Viippola, V., Rantalainen, A.-L., Pennanen, A., & Yli-Pelkonen, V. (2013). Does urban vegetation mitigate air pollution in northern conditions? Environmental Pollution, 183, 104-112.

Shashua-Bar, L., & Hoffman, M. E. (2000). Vegetation as a climatic component in the design of an urban street: An empirical model for predicting the cooling effect of urban green areas with trees. Energy and Buildings, 31, 221-235.

Sinden, J.A., (1994). A review of environmental valuation in Australia. Review of Marketing and Agricultural Economics 62, 337–368.

Spash, C.L., (2000). The Concerted Action on Environmental Valuation in Europe (EVE): an introduction. Environmental Valuation in Europe (EVE), Cambridge Research for the Environment, UK.

Sternberg, E., (1996). Recuperating from market failure: planning for biodiversity and technological competitiveness. Public Administration Review 56, 21–34.

Sun, Z., Niinemets, Ü., Hüve, K., Rasulov, B., & Noe, S. M. (2013). Elevated atmospheric CO2 concentration leads to increased whole-plant isoprene emission in hybrid aspen (Populus tremula× Populus tremuloides). New Phytologist, 198(3), 788-800.

Sunyer, J., Basagaña, X., Belmonte, J., & Antó, M. (2002). Effect of nitrogen dioxide and ozone on the risk of dying in patients with severe asthma Thorax, 57 (2002), pp. 687-693.

Taha, H. (1996). Modeling impacts of increased urban vegetation on ozone air quality in the South Coast Air Basin. Atmospheric Environment, 30(20), 3423-3430. doi:https://doi.org/10.1016/1352-2310(96)00035-0

TEEB (The Economics of Ecosystems and Biodiversity) (2010). The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan, London (2010).

TEEB (The Economics of Ecosystems and Biodiversity), (2011). Manual for Cities: Ecosystem Services in Urban Management. UNEP and the European Commission.

The World Bank (2020). Data, Population http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS. Accessed Jan 13th 2021.

Tyrväinen, L., Pauleit, S., Seeland, K., & de Vries, S. (2005). Benefits and uses of urban forests and trees. C. Konijnendijk, K. Nilsson, T. Randrup, J. Schipperijn (Eds.), Urban Forests and Trees, Springer (2005).

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A., Niemela, J., James, P., (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: a literature review. Landscape and Urban Planning 81, 167–178.

Varna, G., & Tiesdell, S. (2010). Assessing the publicness of public space: The star model of publicness. Journal of Urban Design, 15(4), 575-598.

Voicu, I., & Been, V. (2008). The Effect of Community Gardens on Neighboring Property Values. Real Estate Economics, 36(2), 241-283.

Wolf, K. L. (2007). City Trees and Property Value. Arborist News.

Xing, Y., & Brimblecombe, P. (2019). Role of vegetation in deposition and dispersion of air pollution in urban parks. Atmospheric Environment, 201, 73-83.