An Update of the Literature Supporting the Economic Benefits of Plants: Part 2 – Increased Property Values

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Abstract

This paper provides a review of the key research efforts that provide evidence of one of the more prominent economic benefits associated with plants and improved landscaped areas – improved property values. These benefits may persuade reluctant residential homeowners to purchase plants and improve their landscapes, may aid municipal leaders and policymakers in justifying green infrastructure-related funding decisions, and may provide grounds for the landscape and general construction industries for using biophilic design principles to ensure the built environment offers opportunities for green space interactions. In this way, the green industry can play a pivotal role not only in providing quality plants for these applications, but in educating stakeholders regarding the economic benefits discussed herein. This research should also be strategically incorporated into both industry-wide and firm-specific marketing messages that highlight the quality-of-life value proposition in order to maintain the industry's sense of value and relevance to residential and municipal landscape consumers of the future. If implemented effectively, the demand for green industry products and services may be affected positively.

Index words: economic benefits of plants, valuation methods, property values, elasticity of demand.

Significance to the Horticulture Industry

This article is the second of a series that provides a review of the substantial body of peer-reviewed research that has been conducted regarding the **economic benefits** of green industry products and services. A previous series documented the health and well-being benefits, including emotional and mental health benefits, physiological health benefits, the benefits that plants provide to society at large and the role they play in addressing critical societal issues, and an overview of resources available for green industry firms to find more detailed information on these plant-related health and well-being benefits. Industry firms should be armed with the economic benefits described in this new series to strategically incorporate these benefits into both industry-wide and firm-level marketing messages that highlight how local and regional economies are affected in order to enhance the perceived value and relevance of green industry products for municipal leaders and gardening and landscaping consumers in the future.

Introduction

In 2011, Hall and Dickson published a forum article in the Journal of Environmental Horticulture (JEH) that summarized the economic, environmental, and health and well-being benefits associated with people-plant interactions based on research completed prior to 2011. The proposition put forth in that article was that green industry firms needed to focus on these types of functional benefits in their marketing messages to consumers rather than simply base their value proposition on the features and benefits of the plants themselves (e.g., aesthetic characteristics, insect and/or disease resistance, cold or heat tolerance, salt tolerance, drought resistance, etc.). By doing so, the end consumer would better understand the inherent ways in which plants improve the quality of their lives and begin regarding plants to be a necessity in their lives rather than a mere luxury they might cast aside during economic downturns, as they did during the "Great Recession" of 2008-2009 (BEA 2021, Hall et al. 2010).

Since 2011, there has been a plethora of additional research studies conducted regarding these functional plant benefits. A total of 1,606 citations have been compiled in total and about two-thirds of those studies have been conducted since 2011. This new series of forum articles attempts to update the findings summarized in the original article by Hall and Dickson by focusing on the research (270 citations) regarding economic benefits of plants and improved landscapes. The term, landscape improvement, refers to a physical betterment of real property or any part thereof, consisting of a natural or artificial landscape, including but not limited to grade, terrace, body of water, stream, flowers, shrubs/hedges, mature trees, path, walkway, road, plaza, wall, fence, step, fountain, or sculpture. This new economic-related information provides the basis for even more innovative green industry marketing efforts, which, in turn, may positively influence the price elasticity of demand for plants in general (Hall 2010).

This series is particularly timely given the *Research Roadmap* (Owen et al. 2019) recently developed in 2019 by the **Horticultural Research Institute** (HRI) through a Research Roundtable summit. By analyzing industry-defined attributes of success along with the strengths and challenges of the current state of the industry, advisors from the industry identified four areas of focus for future research that will best assist industry profitability. Over the next few years, HRI will prioritize research funding in these four main areas to achieve the stated desired outcomes (Owen et al. 2019). The first of these, *Quantifying Plant Benefits*, focuses on research that quantifies and validates the benefits of plants on ecosystems, on human health, and on society. Armed with this information, industry firms will be able to create value propositions that boost sales of horticultural

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products and services and increase interest in horticultural careers. Each of the articles in this series focuses on different dimensions of economic benefits, with this second one exploring the contribution of green spaces, public parks, and urban forests to the increase in property values, property taxes, consumer perceptions, and overall willingness to pay.

Many different variables influence property value, making it a difficult parameter to measure and thus creating a data set of multiple levels. Care must be taken to ensure that the associated value created by independent variables is measured accurately and independently. For this reason, there is much debate in the field regarding the best pricing model and methodology to use in obtaining accurate and independent data regarding real estate price increases from environmental changes.

The first, and most common, valuation method is the Hedonic Pricing Method (HPM). Most of the existing literature primarily utilizes a form of the spatial hedonic pricing model, which combines product prices with the associated implicit value (or consumer willingness to pay) and draws conclusions of geographic consideration. The nature of this model allows for the consideration and testing of a multitude of variables that have the potential to influence price, including but not limited to, location, amenities, number of rooms, landscaping, etc. to assess value and consumer willingness to pay for properties, making it the most common application for analyzing property value (Liu and Hite 2013). Dating back to 1939, the hedonic model provides a foundation for the empirical evidence in this area of research, while the recent abilities of Geographic Information System (GIS) mapping and remote sensing have increased the reach and spatial applications of the model (Liu and Hite 2013). While the most common, the spatial hedonic pricing model does have downfalls, one being the possibility of spatial autocorrelation and spatial lag as pointed out by Tyrvainen and Miettinen (2000). Shin et al. (2011) points to the violation of the independence of the observation error of the hedonic pricing model with nested data and instead utilizes the hierarchical linear model (HLM) to overcome such an error when utilizing nested data. The HLM was originally used primarily in educational and psychological applications, and while it has been expanding to other fields, it's application in the analysis of housing and property values remains minimal.

Other deviations and/or extensions of the hedonic pricing model include a repeat-sales approach (Hoover et al. 2020), Evolutionary Polynomial Regression (Morano et al. 2019), surveying and observations (Hussain et al. 2014, Poškus and Poškienė 2015), interviews (Shukur et al. 2016), matched-pairs approach (Hobden et al. 2004), and the Fuzzy-Delphi approach (Damigos and Anyfantis 2011). The following literature review is organized based upon the individual variables measured, whether proximity to green spaces, landscape elements, or presence of natural views. *Table 1* provides a synopsis of results from each study and further information regarding their chosen methodology.

The Economic Value of Proximity to Green Spaces

Tyrvainen and Miettinen (2000) used a hedonic pricing approach, based on real estate prices and consumer willingness to pay, for the valuation of urban forest amenities in proximity to terraced housing in the town of Salò, Italy. The authors focused on the effects of four main variables on property prices: distance to the nearest wooded-recreational area, distance to the nearest forested area, relative amount of forested area in the housing district, and the view from the housing unit. Regarding proximity to forested space, a 5.9% reduction in property value was found to result from each km increase in distance from forested areas, strongest within a boundary of 300 m (984 ft) (deemed as walking distance by the authors). The presence of a forest view for the dwelling resulted in a 4.9% price increase. Distance to larger recreational areas was not found to have significant effects on apartment prices.

Tajima (2003) used hedonic pricing methods to analyze the effect of the most expensive urban infrastructure project, the Boston Central Artery/Tunnel, on nearby property values. With a price tag of $14.6 billion, the Boston Central Artery/Tunnel, or Big Dig Project, placed Interstate 93 underground and replaced it with 30 acres of new urban green space on the surface. The author analyzed the effects of large parks, small parks, rivers, and green infrastructure in Boston to estimate the potential impact of the project on property values. Parks within one km (0.6 mile) of the housing units were classified as large parks [larger than 4,047 sq m (one acre)] or small parks (less than one acre) and their effects were analyzed on housing price. Tajima found a resulting 6% decrease in property price resulting from a doubling of distance to the nearest large park, while doubling the distance to the nearest highway increases property prices by 5%. Applying this impact to the project area, an increase of $732 million in property values can be expected from the demolition of the highway, while the creation of green space as a replacement will increase property values by a minimum of $252 million. In her analysis, Tajima also addressed the potential for negative socio-implications of these increased property values, such as the possible displacement of low-income minorities as rental rates increase as a result of the green elements.

In his second edition of his initial introduction of *The Proximate Principle,* Crompton et al. (2004) examined the capitalization of park land and green spaces to evaluate their influence on surrounding property prices and taxes, based on a higher willingness to pay for proximity due to the benefits incurred. The author addressed, explained, and provided case studies for concepts such as higher property values and taxes being used to fund parks and green spaces, possible dis-amenities resulting from proximity, and the variation of value generated from various types of green spaces in areas such as Central Park in New York and Regent's Park in London. Crompton provided a basis for the resulting increase of property value from green spaces and the capitalization of such by various entities and shareholders. The reader will note that this citation is

Table 1. Key Results from Literature Review on Influences of Public Green Spaces on Property Values

Authors	Methodology	Key Results
The Economic Value of Proximity to Green Spaces		
Tyrvainen and Miettinen 2000	Hedonic pricing model	Forest view for a dwelling resulted in a 4.9% increase in price. A one-km decrease between the dwelling and forested area resulted in a 5.9% price increase within a 300-m boundary considered to be "walking distance" by the authors.
Tajima 2003	Hedonic pricing model	Doubling the distance between a condominium and a large park decreased property value by 6% while doubling the distance to a highway increased property value by 5%. Applying this to the properties effected by the Big Dig project provides an expected increase in property values of $732 million from the demolition of the highway, while the creation of green spaces provides a minimum increase of $252 million.
Hobden et al. 2004	Matched pairs model	The addition of a greenway border increases the value of a single-family household by 2.9%, a local small park increases value by 6.9%, and a park or greenway with a pathway and minor easements increases property value by 6.5%. Authors include that while the value of greenspace borders are increasing, the price of single-family households are doing so faster.
McConnell and Walls 2005	Hedonic pricing method, contingent valuation, and contingent choice	The review of studies produced a comprehensive price premium ranging from negative to a 2.8% increase of the average house price when located 200 m closer to open space from hedonic pricing. Contingent valuation studies produced a willingness to pay for proximity to farmland ranging from $9 to $239 per household per year and $264 per household per year for proximity to urban open space, though studies vary in time periods and locations and therefore can lack potential for comparison.
Mansfield et al. 2005	Hedonic pricing model	Positive coefficients resulting from the hedonic pricing method indicate increases in sale price as a result of parcel greenness, where negative coefficients indicated value decreasing as distance to institutional or private forests increased. A location adjacent to a private forest block had the largest effect on sale price, with an associated increase of more than $8,000. The value for proximity to a forest block was smaller when the parcel had relatively more "greenness" suggesting parcel greenness as a substitution to location. Increasing the "greenness" of a parcel by 10% increased the sale price by less than $800. Greenness and forest cover on the parcel were found to increase sale price, as does proximity to private forests, though proximity to institutional forests was insignificant.
Cho et al. 2006	Hedonic pricing model	At the mean house price of $129,610, moving 1000 feet closer to water bodies and the nearest park increased the sale price of a home by $491 and $172, respectively. Decreasing the distance to the nearest greenway by 1000 feet results in an increase in home value of $368. Impairment and flood dummy variables were insignificant.
Jim and Chen 2006	Hedonic pricing model	Presence of a green space view from the dwelling increased selling price by 7.1% while proximity to a body of water increased selling price by 13.2%. Proximity to wooded space was found to be insignificant, suggesting an unwillingness to pay and lack of awareness of benefits.
Payton et al. 2008	Hedonic pricing model	A 1% increase in NDVI in the 11-acre zone resulted in a $163 price increase, thus a 10% increase brings in a premium of $1,633. Contrasting this, a 1% increase in NDVI on the immediate property only resulted in a $26.30 increase in price, making the return on investment for homeowners only 16%. Based on an analysis of willingness to pay, homeowners were willing to contribute between $26 and $52 annually for a 1% increase in neighborhood NDVI.
Voicu and Been 2008	Hedonic pricing model	Properties within the 1000-foot ring of a community garden sold for 7.5% more than those outside of the ring. They also found a steep "pre-garden" premium associated with the knowledge of a future garden, at a rate of 1 percentage point per 100 feet. In the immediate vicinity of the garden, there is an associated $3,607 price increase to properties, then growing to $6,551 five years after, based on the median property price of $88,032. The authors found stronger effects on property prices in lower income neighborhoods, raising a property's price by as much as 9.4% five years after opening.
Harnik and Welle 2009	Washington, D.C. GIS city assessment data.	Using the two metrics, the associated value of properties from proximity to public parks amounted to $1,198, 858,025 in Washington, DC. and contributes to $6,953,377 in property tax.
Conway et al. 2010)	Hedonic pricing model	A 1% increase in the amount of greenspace within a 200-300 feet buffer surrounding the house resulted in an increase of 0.07% in the sale price of homes. Considering California's Proposition 13 only allowing reassessment of property tax following a market transition, the additional property tax to be incurred assuming an increase in green space of 15% on about 60 properties would bring in resulting property tax revenue of $146,575 in 10 years.
Brander and Koetse 2011	Contingent valuation and hedonic pricing meta-analyses	Open space with average characteristics (GDP per capita, population density, and area) was valued at $1550 per hectare, per year based upon the contingent valuation meta-analysis. Additionally, they found a higher correlation of value from urban parks and green spaces than that of the urban forest, with recreational activities on these spaces further increasing value by 322%. With the hedonic pricing meta-analysis, they found an average increase in housing price of 0.01% with each 10-m decrease of distance from the parcel to open space.
Shin et al. 2011	Hierarchical linear modeling	A recent connectivity of a subdivision to a greenway with a mean area of 2000 square feet and a mean length of block of 0.5 miles was found to result in a 5.177% increase in the appraisal price of homes.
Kovacs 2012	Hedonic pricing model	A house within a half-mile radius of a nearby park resulted in a price increase between 6% and 9% from the ecosystem services provided. All homes within this half-mile radius were found to have a resulting increase in value, while the highest increase in value was found in homes that were one-third mile away from the park.

Table 1. Continued.

Authors	Methodology	Key Results
Liu and Hite 2013	Hedonic pricing model	Results varied by income level, providing significant coefficients at the middle- and high-income level but insignificant at lower income levels. The authors did find a resulting price premium for middle and high median income levels resulting from presence of green space. Forest cover percentage and wooded landscape is presented as having a negative effect on housing prices. The hypothesis that a wooded landscape would attract a resulting price increase, or premium, was rejected.
Melichar and Kaprová 2013	Hedonic pricing model	They found greenery to only have a significant effect on property prices when it was significantly close to the housing in question, specifically within 2000 m. All land cover types decreased price as distance increased, though agricultural land was not significant in the study. A 1% increase in urban park covering within the study area led to an increase in house price of 12,354 CZK (542.32 USD) based upon an average house price of 5,018,006 CZK (220280.43 USD). A 1% increase in agricultural land, orchards, and grasslands within the study area results in an average price increase of 11,673 CZK (512.42 USD), based on the same average house price.
Panduro and Veie 2013	Hedonic pricing model	Size and proximity to parks were found to have a significant and positive effect on house value, consistent with a 0.01% increase in price for every 1% increase in the size of park. For apartments, having a view of a park increased price by almost 6% and an increase of 1% in green common areas resulted in a 0.01% price premium on the apartment. Green buffers were found to have a negative effect on price.
Gibbons et al. 2014	Hedonic pricing model	The authors found a 1% increase in land use share of domestic gardens, green space, and areas of water to increase prices by 1.02%, 1.04%, and 0.97% respectively. Proximity to broad-leaved wetland resulted in a positive price premium of 0.36%. In regards to proximity, a 1-km increase in distance from a National Park resulted in a 0.24% decrease in home prices. Being located in a greenbelt was found to have an associated price increase of 3.25%.
McCord et al. 2014	Hedonic pricing model	Within a 250-m radius, semi-detached properties had a price premium of 15.7%, terraced properties had a premium of 41.93%, and apartment properties had a premium of 38.8%. Detached properties had an initial negative relationship of 26.77%, which then turned positive at a 500-m radius at 24.16%. These premiums decreased as radial distance was increased, yet apartment properties still had an associated premium of 13.97% at the 2,500-m radius.
Netusil et al. 2014	Hedonic pricing model	A 10% increase in the canopy of nearby green street facilities resulted in a price increase of $18,707 on home prices, though increasing as distance to the facility increased at a rate of $0.30 for every one foot.
Li et al. 2015	Hedonic pricing model	Home value was found to increase at 0.0666% and 0.0478% for each 1% increase in tree cover and irrigated grass cover, respectively, in a 200-m vicinity. A 1% increase in NDVI produced a price increase of 0.1244% when on the parcel and 0.3314% in the 200-m radius. An increase in tree cover on the parcel would negatively affect home price for 40% of the properties in the sample.
Walls et al, 2015	Hedonic pricing model	Sale prices increased from proximity to all variables (farmland, forest, and grassy lands) with the largest effect being found in farmland, with a 0.2% price increase resulting from a 10% farmland increase in a 200-m buffer zone. A significant relationship was only found relating to the views provided by farmland, with a 10% increase in a house's farmland view relating to an almost 2% increase in price. Contrastingly, forest views had a negative effect on price while grassy land lacked a significant effect.
Shukur et al. 2016	Questionnaire/ surveys	Based on responses from respondents, the most important park element to homeowners is having "good" park elements followed by (in order), design of park, nearness to park, existence of view to park, and active area of park facing house.
Morano et al. 2019	Evolutionary polynomial regression	An increase of 46.19% in prices is found resulting from the presence of resident-only green areas when a parking space and view of a tree-lined avenue are also present. This same increase is consistent with a garden present in the courtyard when the parking space and view of tree lined avenue are still present.
Noh 2019	Hedonic pricing model	A resulting 8.2% increase in the sale price of homes was found to be associated with a mile decrease in distance to nearest converted greenway, higher than the 5.95% increase in sale prices for homes that were located a mile closer to the railway, pre-conversion. Positive effects on price were found to result from decreased distance to the greenway pre-conversion and post, but the increase in price was found to be higher following the conversion to greenway. The knowledge of the future conversion of the railway brought preemptive value to residents.
Hoover et al. 2020	Repeat-sales model	No coefficients were found to be statistically significant, suggesting that residents place low value on green infrastructure improvements of local parks.
Effects of Landscaping Elements and Natural Views		
Des Rosiers et al. 2002	Hedonic pricing model	Resulting 0.2% increase in home value for every 1% increase in tree cover between the parcel and its neighborhood as well as a resulting 4% increase in home value associated with the presence of a hedge or landscaped wall. A landscaped patio was found to result in a 12.4% increase in home value and landscaped curbs were found to increase home value by 4.4%.
Behe et al. 2005	Conjoint analysis and surveying	Respondents placed a highest importance on design sophistication, at 40 to 45% of value added to home. Following design sophistication was plant size at 30% to 39%. Diversity of plant material was the least important, accounting for 20% to 24% of perceived home value. Applications of their research suggest that landscape elements could increase a home's value by anywhere from $2,375 to $3,648.
Stigarll and Elam 2009	Hedonic pricing model	A 1% increase in landscape quality was found to result in a 1.17% increase in the value of the home. A transition from "average" to "good" quality landscaping resulted in a 5.7% increase, equating to a price increase of USD $9243. An increase of tree cover from 10% to 20% resulted in a 3.2% price increase, though beyond 40% tree cover had an inverse relationship with sale price and decreased such with added tree cover.

Table 1. Continued.

Authors	Methodology	Key Results
Damigos and Anyfantis 2011	Fuzzy-Delphi Approach	Urban parks were the third most influential view when it comes to increasing property value, second to the sea and significant archaeological sites. They found respondents to associate an increase in property value from urban parks of 8% to 30%, but likely under 18%. In contrast, a view of a small, uncontrolled disposal site was estimated to have the largest, negative effect on property prices.
Hui et al. 2012	Spatial Durbin Model	All landscape factors were found to be significant, with a garden view being just as preferable as a sea view, increasing the condominium price by 5.94%. Avenue and street views were found to have negative impacts on condominium prices. Vertical spatial heterogeneity was present with the sea, avenue, and street views due to climatic factors (wind from the sea) as well as noise and air pollution.
Kadish and Netusil 2012	Hedonic pricing model	An optimal amount of vegetation was found to be 32.12% for high structure vegetation (tree cover) and 5.54% for low structure (bushes, shrubs, etc.). An increase from the study average of high structure vegetation (26.07%) to the optimal amount increases a property's sale price by 0.049%, equating to $155 based on the mean sale price. All models showed a statistically significant increase of property value based upon the increase of high structure vegetation in the buffer surrounding the property.
Saphores and Li 2012	Hedonic pricing model	More than 88% of the properties in the study area would benefit from the addition of irrigated grass on the parcel while 89% would benefit from additional irrigated grass in the neighborhood. Parcel trees were found to decrease the value of 40% of the properties, while the addition of trees in the neighborhood increased the value of 97% of homes.
Pandit et al. 2013	Hedonic pricing model	The presence of broad-leaved trees on the street verge had the potential to increase the median home value by 4.27% or AU$16,889 ($12,695.71 USD) while palm leaves had no significant effect on the sales price of homes, regardless of location. Similarly, broadleaved trees on the property or neighboring properties lacked a significant effect on price, suggesting the costs incurred from privately owned and maintained trees can counteract homeowner benefits.
Pandit et al. 2014	Hedonic pricing model	Tree cover on adjacent public spaces was found to have a significant and positive effect on home value while adjacent private tree cover had a significant and negative effect. Tree cover on the property itself was found to lack a significant effect. The home price increase from a 10% increase of tree cover on an adjacent public space equates to AU $14,500, while a 10% increase of tree cover on an adjacent private parcel decreases home value by AU$6,100.
Hussain et al. 2014	Questionnaire surveys and observations	The most frequent criteria from respondents was comfort in landscape design, followed by feeling of safety and security, and then privacy. Fountains were the most frequently preferred landscape element followed by gazebos and plants. 90.4% of respondents believed that landscape design can increase the value of a property.
Poškus and Poškienė 2015	Questionnaire and online survey	In the first study, "expensive greenery" had the highest ratings for aesthetics, prestige, perceived value, and perceived safety. The last variable, coziness, was found to be highest for neglected greenery followed closely by plain grass. In contrast, the second study found "plain grass" selected most frequently as most valuable, most prestigious, and safest while "expensive greenery" was most frequently chosen for coziness and aesthetics.
Escobedo et al. 2015	Hedonic Pricing Model	A one-unit increase in Tree Leaf Area Index resulted in a property value increase of $9,348 while an increase of one tree increased property value by $1,586. In contrast, an increase in maintained grass cover was found to decrease property values.
Freybote et al. 2016	Interviews and hedonic pricing method	The authors found key components of commercial curb appeal to be cleanliness, social aspects, signage and architecture, and authenticity of restaurants in San Diego and Los Angeles, California. Overall curb appeal was found to significantly correlate with an increase in sale price. The authenticity component was found to be insignificant while cleanliness and safety (atmospheric elements) and architectural features were found to have the biggest effect on the increase of sale price.

omitted from Table 1 because of the lack of primary research-based numerical values.

Differing from the popular hedonic pricing method, Hobden et al. (2004) used a matched-pairs methodology in an attempt to achieve less bias when analyzing the effect of connecting corridors of green space on the value of single-family homes. Data was collected from 4 different neighborhoods in the City of Surrey, British Columbia from 1980 to 2001. Classifying variations of greenway border based upon their size and elements allowed for conclusions to be drawn relative to specific size categories. The addition of a greenway border to a single-family property increased value by 2.9%, a small park border increased property value by 6.9%, and a park with a pathway and minor easements allowed for a 6.5% increase. The authors add that while the value of greenspace borders is increasing, the price of single-family homes is doing so faster.

McConnell and Walls (2005) provided a review of empirical studies regarding the associated price premiums from proximity to various green spaces. Citing studies spanning from 1967 to 2003 and in various countries, the authors reported findings of price increases from proximity to parks, nature preserves, forests, wetlands, and agricultural lands. Consistent with the known complexity of the valuation of open space, they report a variety of associated amenities and price changes, mostly positive though some negative, such as odors from proximity to farmland. The authors cited studies using models including the hedonic pricing method, contingent valuation, and contingent choice (both revealed preference and stated preference methods). Though difficult to synthesize due to variations

in green space and services provided, the hedonic pricing results produced a comprehensive price premium ranging from negative price effects to a 2.8% increase of the average house price when located 200 m (656 ft) closer to open space. Contingent valuation studies produced a willingness to pay for proximity to farmland ranging from $9 to $239 per household per year and $264 per household per year for proximity to urban open space, though studies vary in time periods and locations and therefore can lack potential for comparison. The authors also highlight the benefit of combined results from stated and revealed preference methods in terms of avoiding multicollinearity and providing more observations, though still addressing the inconsistency produced in studies to date.

In addition to the use of the hedonic pricing model, Mansfield et al. (2005) used geographic information systems (GIS) and the normalized difference vegetation index (NDVI) to analyze the contribution of tree presence, whether on a parcel of land or in neighboring areas, to the value of single-family housing in the Research Triangle in North Carolina. These tools were used to determine the relative "greenness" of sites in the study area to allow for the analysis of its contribution to a premium on housing prices. In addition to the determined "greenness", study sites were also organized based on the type of forest cover: institutional forests, private forests, and blocks of development. The authors were able to draw conclusions based upon correlations of these variables and property value. The authors found an associated price increase of more than $8,000, based on the median home price, when adjacent to a private forest. Proximity to an institutional forest (owned by the forestry sector) was also found to increase price, though the finding was insignificant. A higher property value was also found to correlate with parcels themselves having a higher level of greenness. Increasing the greenness of a parcel by 10% was shown to increase the home value by slightly less than $800. Proximity to a forest block was also found to have a smaller effect on price when the parcel had relatively more "greenness", suggesting that parcel greenness could provide a substitute for proximity to forests.

Addressing the resulting value from proximity to bodies of water, parks, railroads, and greenways, Cho et al. (2006) used a locally weighted regression approach to the hedonic pricing method to address stationarity and spatial autocorrelation critiques. A total of 15,500 of the 22,704 single-housing sale transactions occurring between 1998 and 2002 were randomly chosen and utilized for the study. The authors found that a 305 m (1000 ft) reduction in distance to a public park resulted in an average increase in home price of $172, while a 305 m (1000-ft) reduction in distance to a greenway brought upon an increase of average home price by $368, based upon a mean house price of $129,610. The increase in house price as a result of proximity to a greenway is consistent with the results of (Hobden et al. 2004). The variable for size of park was proven to be insignificant, allowing for conclusions to be drawn based upon presence of a park and proximity to a park only. The largest marginal effects were found to occur in denser populations, leading authors to believe that public parks might be valued more in downtown areas with smaller lots.

Jim and Chen (2006) explored and analyzed different environmental elements and their relation to property prices in Guangzhou, China. The authors identified the effect of the presence of green views as well as proximity and access to green spaces on property prices. Two different hedonic pricing models were utilized, linear and semi-log, in the analysis of four different private housing estates. The semi-log model brought about stronger explanatory power and reliable estimation. A view of green spaces contributed to an increase in housing value of 7.1% and proximity to water contributed to a 13.2% increase. Contrary to expectation, the analysis of proximity to forested areas with no public access did not have a significant positive effect on housing value. The lack of public access brings a distinction from this analysis in comparison to the increase in value from public green spaces found by Mansfield et al. (2005) and Tyrvainen and Miettinen (2000), where significant proximal effects were found from nearby forested areas. This specification of public and private access brings about possible further research opportunities and necessary considerations when developing value propositions and predicting expected price premiums on real estate.

Similar to that of Mansfield et al. (2005), Payton et al. (2008) used geographic information system technology, normalized difference vegetative index (NDVI), and a spatial hedonic pricing model (OLS) to estimate associated property value increases due to vegetation on properties and in neighborhoods to identify the value placed on green spaces by homeowners in Indianapolis, Indiana. The authors implemented a spatial lag regressor to address the possible spatial autocorrelation in the OLS hedonic pricing model. The authors found that a 1% increase in an 44,515 sq m (11 acre) NDVI results in a $163 price increase for the average home in the study area, thus allowing for a $1,633 price premium on the average property with a 10% evenly distributed 11 acre NDVI increase. An individual parcels' change from the average NDVI to the lowest NDVI level was found to result in an 8% decrease in price, equivalent to over $7,000 based upon the mean sale price.

Voicu and Been (2008) analyzed associated property value from urban green spaces, specifically that of community gardens. The authors estimated resulting increases in New York City property values from nearby community gardens as a means of providing possible financing options for community development by repurposing vacant lots. These community gardens are welcomed as a tool used for the revitalization of marginalized communities. The authors found a resulting 11.1% increase in property value when within 305 m (1,000 ft) of the median community garden. The authors also found that these percentages began to decrease following the opening of the community garden, falling to only 3.7% after the first 5 years. The dollar value of the garden continued to increase though, starting at $3,607 at opening and growing to $6,551 five years following opening. The additional property tax revenue estimated to be incurred was approximately $2 million per garden, in 2003 dollars,

within a 1,000-foot ring. The authors also found a more dramatic, positive effect of gardens in lower income populations than in more affluent neighborhoods.

In a report focused on the economic benefits of public parks, Harnik and Welle (2009) quantified seven major monetary benefits that parks bring to communities, one of those seven being an increase in property value and property tax. The authors assumed an average park contributed 5% to home values. The authors then applied this 5% contribution to all properties in Washington, D.C. within 500 feet of a park. They found that the total increase in property value from park proximity was just slightly under $1.2 billion, attributing to an additional $6,953,377 in property tax to the city in 2006 from the value of parks.

Conway et al. (2010) assessed the contribution of urban green space to the hedonic value of single-family residences in the Vermont Corridor of Los Angeles between 1999 and 2000. Measures of various green spaces (parks, sports fields, lawns, etc.) were obtained and used in conjunction with aerial geographic reference photos. A 1% increase of green space within a 61 to 91 m (200 to 300 ft) perimeter of a property was found to have the potential for a 0.07% increase in the sales price of the house, attributing to an additional $171 in the median price. The homes in the study site could also generate an additional property tax revenue of $146,575 in 10 years. To demonstrate feasibility and application of these changes, the researchers found that a mere 1.5 m (5 ft) increase of a sidewalk parkway can contribute to a 3% increase in green space.

Providing two meta-analyses of studies using the contingent valuation method and the hedonic pricing method, Brander and Koetse (2011) collected and synthesized results regarding the value of open space and what characteristics (physical, socio-economic, and study) influence such. In their analysis of contingent valuation literature, they found a positive and significant relationship of open space on housing prices with average characteristics (GDP per capita, population density, and area), bringing in around $1,550 per ha (2.5 acre) per year. The authors also found a stronger correlation between urban parks and green spaces on housing price than that of the urban forest, showing a higher value associated with such. The presence of recreational activities on these spaces was also found to increase value by 322%, everything else held constant. Population density was found to increase these metrics, with a 10% increase in population density increasing the value of open space by 5%, similar to the findings of Cho et al. (2006). Additionally, 52 different hedonic pricing studies were collected dating back to 2000. Of those collected, 12 were chosen for the study with 11 of them conducted in the United States. They found that on average, for each 10 m (33 ft) decrease in distance to open space, there was a resulting 0.01% increase in housing price. Expanding on such, they found this price effect to decrease when placed further away from open space. Socio-economic variables were found to have an impact as well, with the effect of distance being more dramatic with higher income levels and a higher population density, as aforementioned.

In another deviation from the hedonic pricing method, Shin et al. (2011) used the alternative hierarchical linear model due to its ability to accurately handle nested data and multiple levels of variables, as the authors explain. The study was conducted in College Station, Texas and included all single-family residences within the city limits. Utilizing the random-coefficient regression (RCR) and intercepts- and slopes-as-outcomes model (ISO), they assessed the effect of various housing variables on housing price. For the sake of this review, we focused on greenway connectivity and park connectivity. The former was significant, exhibiting a 5.177% increase in the appraisal value of the home with a recent connectivity of the property to a greenway.

Kovacs (2012) utilized the hedonic pricing model as well as the recreation demand model to jointly analyze the economic benefits of two regional parks (Forest Park and Mount Tabor) from a random sample of 1,200 proximal single-family residences in Portland, Oregon. Recreational surveys were mailed and used to identify sales prices, structure characteristics, recreational uses, and socio-economic characteristics of the homeowner to contribute to the hedonic pricing model. Based on the economic model, proximity within half a mile to a nearby park resulted in an increase of housing price between 6% and 9% from the ecosystem services provided. All homes within this 0.8 km (half mile) radius were found to have a resulting increase in value, while the highest increase in value was found in homes that were within a 0.5 km (one-third mile) perimeter of the park. This suggests the presence of possible externalities (dis-amenities) resulting from close proximity to a park such as traffic, noise, and crime.

Providing a qualitative analysis of the importance of various park elements to residents and stakeholders, Shukur et al. (2016) utilized surveys and questionnaires to gather information on the variation of preferences for parks in proximity to houses. The surveys were carried out in Shah Alam, Selangor and consisted of interviewing heads of the Sales and Marketing, Property Development, and Environmental Management Departments as well as 288 residents from a pool of 448. The study selected five attributes as being the most important to residents; good park elements, design of the park, proximity to park, view of the park, and active area of the park facing the property, the most important of these being good park elements. This study provides literature supporting the importance of park planning to prevent "dis-amenities" and negative perceptions to the surrounding population.

Liu and Hite (2013) offered a potential expansion upon the hedonic pricing model with quantile regression, economic indices, and the incorporation of a spatial-lag term to thoroughly understand variation in the effect of green spaces on housing value. They found their results to deviate by income level and classification of green space. Higher premiums were found to result from proximity to green space for middle to higher median homes, with lower median levels of income lacking statistical significance. The percentage of forest area was found to have a negative effect on prices while nearby woodland had a positive

effect, though houses near wooded areas were still found to incur negative amenities from the proximity, consistent in all quantiles. The authors rejected the hypothesis that the attractiveness and presence of wooded landscaping would incur a premium on nearby housing prices, perhaps reflecting a preference for savannah types of landscapes with prospect views.

Melichar and Kaprová (2013) used the hedonic pricing model to evaluate the distance-size effect, an expansion of the proximate principle, in considering value added to 8,568 apartments resulting from the size and proximity to nearby greenery in Prague, Czech Republic. The authors studied large urban forests, agricultural land, and small protected areas for their contribution to a price premium on nearby residences. They found green spaces to possess a clear effect on housing prices only up 2,000 m (6561 ft). Agricultural land lacked a significant effect on price, with specially protected areas only exhibiting an effect on price from proximity to residences but lacking any effect from size. The authors found a 1% increase in urban park area over the study site to bring a resulting average increase consistent with 12,354 CZK (about $550.13 USD) while a 1% increase in forest area results in an average increase of 3697 CZK (about $166.37 USD).

Opposing the common uniform treatment of green spaces in hedonic valuation, Panduro and Veie (2013) categorized green spaces into eight different categories and analyzed their effect on housing values. These eight types of green spaces were rated based upon maintenance, accessibility, and neighboring negative land use to identify their effect on houses and apartments in Aalborg, Denmark. The various green spaces were categorized into parks, lakes, nature, churchyards, sports fields, common areas, agricultural fields, and green buffers. Size and proximity to parks were found to significantly increase house values, consistent with a 0.01% increase in price for every 1% increase in size of park. For apartments, having a view of a park increased price by almost 6% whereas proximity to a common area increased value by 0.01%.

Gibbons et al. (2014) utilized the hedonic pricing method to assess the marginal value from proximity to natural amenities in England. The study data consisted of 1 million housing transactions taking place from 1996 to 2008. The authors found a resulting 1% increase in home value with a 1 percentage point increase in domestic gardens, green space, and areas of water. Proximity to broad-leaved wetland resulted in a positive premium of 0.36%. Regarding proximity, a 1 km (0.6 mile) increase in distance from a National Park resulted in 0.24% lower housing prices.

Using 3,854 sales transactions of properties in Belfast, Northern Ireland, McCord et al. (2014) used the hedonic pricing method to analyze the effect of proximity to urban green spaces on housing value. Four different property types were considered including detached, semi-detached, terraced, and apartment style. Within a 250 m (820 ft) radius, semi-detached properties had a price premium of 15.7%, terraced properties had a premium of 41.93%, and apartment properties had a premium of 38.8%. Detached properties had an initial negative relationship of 26.77%, which then turned positive with a 500 m (1,640 ft) radius at 24.16%. These premiums decreased as radial distance was increased, yet apartment properties still had an associated premium of 13.97% at the 2,500-m radius. While varying, the results show an associated price premium with green space, consistent with past research. The authors pointed out lower premiums for detached and semi-detached properties are likely due to the larger lot sizes and access to private garden space, therefore local public space could possess less value to such properties.

Netusil et al. (2014) analyzed single-family housing in Portland, Oregon to determine the effects of proximity, characteristics, and abundance of green street stormwater facilities (sidewalk bioswales, grassy bioswales, curb extensions, etc.) on housing value using the hedonic price method. They found that a 10% increase in the tree cover of nearby green street facilities resulted in an estimated price increase of $18,707 for nearby homes in the study site. In contrast though, the price of housing increased as distance to the facility did, with a 0.3 m (1 ft) increase resulting in a $0.30 increase in price. This study countered past research by showing how certain green street infrastructure facilities, lacking aesthetic appeal, can present dis-amenities to nearby residents. “Greening” these facilities via tree cover did increase property values, but the distance effect still showed that home prices benefit from distance between the parcel and the facility. The distance effect is small, but the possibility of improving the aesthetics of the stormwater facilities through canopy and tree cover offset the potential dis-amenities.

Li et al. (2015) also utilized normalized difference vegetation index (NDVI) with the hedonic pricing model in analyzing economic benefits of amenities provided by urban green space. A total of 20,243 single family housing transactions taking place from 2003 to 2004 in Los Angeles were considered using classified land cover (CIC) data and NDVI. Looking at six different land covers, the authors found a housing price increase resulting from a 1% increase in tree cover and irrigated grass cover, at 0.07% and 0.05% respectively. A 1% increase in NDVI also produced a price increase of 0.12% when located on the property and 0.3314% when within the home’s 200 m (656 ft) radius. Interestingly, they found instances of additional tree cover decreasing home values when located on the parcel, with about 40% of homes in the sample exhibiting this effect. This is likely due to the costs incurred from private ownership such as watering, maintenance, and upkeep. Trees located on neighboring properties, however, increased the values of almost all homes in the sample.

Walls et al. (2015) utilized the hedonic pricing model and geographic information systems (GIS) in considering the effects of natural landscape views and proximity on housing values in St. Louis County, Missouri. Regarding proximity, they found increases in sale prices to result from proximity to all variables (farmland, forest, and grassy lands) with the largest effect being found in farmland, with a 0.2% price increase resulting from a 10% farmland increase in a 200 m buffer zone. In consideration of natural views, the authors found a significant relationship only related to the views provided by farmland, with a 10%

increase in a house's farmland view relating to an almost 2% increase in price. Contrastingly, forest views had a negative effect on price, while recreational grassy land lacked a significant effect. The authors indicate this could be due to the relatively flat landscape of the study site, creating a preference for landscapes with heightened visibility, or due to the observed increase in forestland relative to the decrease in available agricultural land as a result of development.

Morano et al. (2019) used evolutionary polynomial regression (EPR) in considering the effect urban green space has on housing prices in the Flaminio District of Rome, Italy. An increase of 46.19% in selling price was found to result from a view of a tree-lined avenue, when a parking space and a garden in the courtyard were also present.

To identify potential price premiums of single-family houses from nearby converted abandoned railways, now deemed greenways, Noh (2019) used two hedonic pricing models: a before and after spatial regression, as well as the adjusted interrupted time series-difference in differences (AITS-DID) model. The author's study of sales transactions from 2005 to 2012 in Whittier, California found a resulting 8.2% increase in the sale price of homes located 1.6 km (a mile) closer to the converted greenway. The author also found price effects prior to the conversion of the greenway, with a 5.95% increase in price being found for homes located 1.6 km closer to the railway site, pre-conversion. The study showed a resulting price premium from the conversion as well as evidence that knowledge of the *future* conversion of the railway also brought preemptive value to residents.

Expanding on the price effect from proximity to parks, Hoover et al. (2020) analyzed the economic impact of green infrastructure changes in local parks on single-family homes in Omaha, Nebraska. The authors used a repeat-sales model to analyze changes in property value between sales, utilizing transactions occurring from 2000 to 2018. The authors did not find any coefficient to be statistically significant regarding the changes in prices from green infrastructure amendments in local parks.

Effects of Landscaping Elements and Natural Views

Utilizing 760 different housing transactions and considering 11 different landscape attributes, Des Rosiers et al. (2002) analyzed the effects of landscaping choices on the value of single-family homes in Quebec with a hedonic pricing model. They found all 5 landscape descriptors tested had a significant effect on property prices: percentage of tree cover and percentage of those age 65 and up, percent of ground cover on bungalow (one story and detached), percent of ground cover on cottage (multi-story and detached), difference in the % of tree cover between the property and neighborhood, and presence of a hedge. The ground cover and percentage of tree cover interactive variables produced absolute interactions in the model, providing further detailed insight to understanding resulting value propositions. A 1% increase in parcel tree cover compared to its neighborhood produces a 0.2% increase in home value while a 1% increase in bungalow or cottage ground cover also produces a 0.2% increase. A landscaped wall or hedge was found to result in a 4% increase in home value. The inclusion of demographic factors (age, gender, etc.) in the interactive variables provide further specificity in the understanding of implicit value placed on landscape elements, specifically showing a higher resulting value placed by those over 65 for neighborhood trees.

Behe et al. (2005) analyzed three different landscape components (plant diversity, size, and design sophistication) for their resulting effect on perceived home value. The authors obtained consumer perceptions of value from study participants looking at images with varying landscape components. The dollar value associated with the landscaped home was used to define the preference for different landscape elements. Using conjoint analysis to determine perceived value from landscape visuals, the authors were able to test variations in landscape design sophistication, diversity of plant material, and plant size to understand resulting changes in perceived home value. Respondents placed the highest importance on design sophistication, contributing an average of 41.7% to added home value. Following design sophistication was plant size at an average of 35.9% added home value. Diversity of plant species was the least important landscape attribute, accounting for an average of 22.4%, roughly about half of the contributed value of design sophistication. All three elements had instances of increasing perceived home value, with large plant sizes increasing home values in all states, the most sophisticated landscape design increasing perceived values by an average of 1.9%, and evergreen or deciduous plants and a brick wall entrance increasing home values the most in all states. Overall, results depict a preference for sophisticated and colorful landscape designs, with a potential to increase a home's value by anywhere from $2,375 to $3,648 USD.

The effects resulting from changes in home landscape quality and tree cover were analyzed by Stigarll and Elam (2009) in Lubbock, Texas. Individual characteristics of housing and landscape quality were used with the hedonic pricing method on 75 different home sale prices. A 1% increase in overall landscape quality was found to result in a 1.17% increase in the value of a home in the study site. Furthermore, a transition from "average" to "good" quality landscaping resulted in a 5.7% increase, or $9,243 USD, while a transition from "good" to "excellent" resulted in a 10.8% price increase, or $17,513 USD. Regarding percentage of tree cover, there was only a marginally significant coefficient, with a 10% to 20% increase of tree cover resulting in a 3.2% increase, or $5,197 USD, with the price effect diminishing as tree cover percentage increased. Beyond 40%, tree cover had an inverse relationship with sale price, with price dropping as tree cover increased. The authors derived an overall value-to-cost ratio of 1.35, indicating a $1.35 return for a $1 landscape investment.

Damigos and Anyfantis (2011) analyzed the effect of pleasant and unpleasant views (green areas, monuments, cemeteries, etc.) on nearby property prices using the Fuzzy-Delphi approach, combining the Delphi method and the Fuzzy Theory. Providing an alternative approach to the

difficult monetary valuation of property value increases, the Fuzzy Delphi method uses expert opinions to estimate increases of property value based on property views. A questionnaire was given to assess which views would create a perceived increase in property value as well as which views were stronger indicators of value increases. Results pointed to urban parks as the third most influential view in terms of increasing property value, following ocean views and significant archeological sites. The authors found an associated increase in property value of 8% to 30% on properties with views of urban parks, on average about 18%. High-rise apartment views of urban parks and built environment resulted in between a14% and 19% increase in value.

Hui et al. (2012) used a spatial Durbin model to assess the effect of landscape views and story levels on the prices of condominiums in Tai Koo Shing, Hong Kong. The authors analyzed the resulting effects from the presence of sea views, garden views, avenue views, and street views in 2,375 transactions spanning from 2008 to 2010. All landscape factors were found to be significant, with a garden view being just as preferable as a sea view, increasing the condominium price by 5.94%, which was slightly below that of a sea view. Avenue and street views were found to have negative impacts on condominium prices. Vertical spatial heterogeneity was present with the sea, avenue, and street views due to climatic factors (wind from the sea) as well as noise and air pollution.

Kadish and Netusil (2012) analyzed the impact of trees, shrubs, water, and impervious surfaces on the sale price of single-family homes in Multnomah County, Oregon with the hedonic pricing method. They found an "optimal amount" of high structure vegetation (tree cover) and low structure (shrubs and lawns) at 32.12% and 5.54%, respectively. An increase from the parcel study average of high structure vegetation (26.07%) to the optimal amount (32.12%) increased property value by 0.049%, which equates to $155 based upon the mean sale price of $317,652 USD. An increase in high structure vegetation also significantly increased sale price in all models of the study when on surrounding buffers of 0.4 km (¼ mile) and 0.8 km surrounding the parcel, though a diminishing effect was seen with the 0.8 km (½ mile) buffer, as it exhibited a smaller price increase.

The hedonic pricing method was also used by Saphores and Li (2012) to assess the effect of urban trees and grass (irrigated and non-irrigated) on single-family homes in Los Angeles, California. They used a geographically weighted regression (GWR) model and a Cliff-Ord Hedonic model to assess changes in the price of homes from 2003 to 2004 due to changes in green space on the property or neighboring area based upon elasticities. When considered as a substitute for the presence of neighborhood trees, proximity to the nearest green space or body of water was found to have a negative relationship with price, meaning that as distance between the home and green space/body of water increased, the property value decreased, showing evidence of additional home value resulting from proximity to green space. The authors found that more than 88% (GWR) and 97% (Cliff-Ord) of the properties in the study area would benefit from an increase of tree cover in the neighborhood. The addition of irrigated grass in the neighborhood would benefit 89% (Cliff-Ord) and 75% (GWR) of the homes in the study area. In contrast, the increase of tree cover on the individual parcels would decrease the value of 39% of the homes in the study, indicating an unwillingness to incur private costs of maintenance. The addition of neighborhood trees, however, was found to increase the value of 97% of homes in the study area, providing an alternative to parcel trees to mitigate the private costs incurred.

Pandit et al. (2013) analyzed the effect of broad-leaved and palm trees on the home value of single-family homes in 23 different suburbs in Perth, Western Australia. Using the traditional spatial hedonic model with ordinary least squares (OLS) and Box-Cox Transformations, the authors valued the placement of trees on a parcel as well as on nearby private and public spaces, such as neighboring lots and street verges. A broadleaved tree placed on a public street verge was found to increase the value of the properties nearby by 4.27%, equal to $16,889 AU, based on the median price of homes in the study area. Broad-leaved trees placed on the property or on neighboring, private properties were not found to have a statistically significant effect on price. These trees are still believed to bring benefits to homeowners, but the incurred costs of maintenance and care can counteract such benefits, again consistent with Saphores and Li (2012). Palm trees lacked a statistically significant effect in all locations.

In another study by Pandit et al. (2014), the variation in contributed value of private and public tree cover was further explored using the hedonic pricing model with OLS estimation in Perth, Western Australia. The authors analyzed the effect of tree cover on a parcel, neighboring property, and public space on the sale price of 5,606 single-family homes sold in 2009. Tree cover on adjacent public spaces was found to have a significant and positive effect on home values while adjacent private tree cover had a significant and negative effect. The authors add additional reasoning as to the resulting negative price effect such as aesthetic and safety concerns (falling limbs, blocking of view, etc.). This negative effect is found to diminish though as distance increases. Tree cover on the property itself lacked a significant effect. The home price increase resulting from a 10% increase of tree cover on an adjacent public space was AU $14,500, while a 10% increase of tree cover on an adjacent private parcel decreased home value by AU$ 6,100. These results remain consistent with Saphores and Li (2012) though provide further specificity in the consideration of public and private placements.

Hussain et al. (2014) used observations and a questionnaire survey to identify criteria, preferences, and property value effects of landscape attributes to identify the needs and preferences of consumers. The authors found the most frequently preferred criteria for landscape design to be comfort, followed by a feeling of safety and security, and then privacy. Regarding preference of landscape elements, fountains were the most frequent followed by gazebos and plants. A total of 90.4% of participating respondents said that the design of the landscape can increase the value of a

property and 68.2% believed that landscape design could influence their decision in purchasing or renting a home.

Also utilizing questionnaires and surveys, Poškus and Poškienė (2015) analyzed the effects of different types of greenery variables, including what they deemed as plain grass, expensive greenery, granny's garden, and neglected greenery, on perceptions of multi-story buildings. The study was carried out through two means, the first being a questionnaire containing pictures of the four different types of greenery with questions relating to its perceived value, safety, prestige, coziness, and aesthetics to determine perceptions of residential housing. The second was an internet survey addressing preferences in landscape design through asking respondents which picture they deemed to be most expensive, safe, cozy, and prestigious. In the first study, "expensive greenery" had the highest ratings for aesthetics, prestige, perceived value, and perceived safety. The last variable, coziness, was found to be highest for neglected greenery followed closely by plain grass. In contrast, the second study found "plain grass" to be deemed most frequently in terms of value, prestige, and safety while "expensive greenery" was most frequently chosen as being most cozy and most aesthetically appealing. These results suggest that a plain lawn has a similar effect on landscaping perceptions as does expensive greenery when communicating value, prestige, and safety. This provides further insight as to the communicated value of various landscape elements, providing consumers with a simple option for landscape investment (such as a plain lawn) to improve the value, prestige, and safety of their home.

Escobedo et al. (2015) utilized an explanatory hedonic pricing model (OLS) to analyze the effect of the presence of subtropical urban forest elements on single-family and multi-family residential homes in four different regions in Florida. The author's explanatory model utilized past literature to identify a small set of variables regarding urban forest structure and residential property variables to assess their effect on home value. Their only significant variables were number of trees, leaf area index (LAI), and maintained grass cover. A one-unit increase in tree leaf area index was found to result in a property value increase of $9,348 USD, while an increase of one tree had an associated property value increase of $1,586 USD. In contrast, an increase in maintained grass cover from 25% to 75% decreased property values. They also found that replacing tree cover with grass cover contributes to lower value, providing contrast to the results of Poskus and Poskiene (2015) of which a plain lawn was found to communicate similar perceived value as does more expensive greenery.

Freybote et al. (2016) developed a tool for the measurement of curb appeal to assess its effect on commercial real estate values. The authors conducted interviews to determine key components of curb appeal, arriving at 4 dimensions: cleanliness, social aspects, signage and architecture, and authenticity of restaurants in San Diego and Los Angeles, California. Based upon average scores for each component of curb appeal, the hedonic pricing model with a generalized spatial two stage least square (GS2SLS) model was used to identify price correlations between curb appeal and sale price of the restaurants. Variables included an overall sum of curb appeal, combining all three dimensions, as well as each individual dimension to analyze the effect each has on sale price of the restaurant. Overall curb appeal was found to significantly correlate with an increase in sale price. The authenticity component was found to be insignificant while cleanliness and safety (atmospheric elements) and architectural features were found to have the biggest effect on the increase of sale price. Though not specific to green elements and landscaping qualities, the results provide implications for increasing overall curb appeal utilizing various attributes, of which green space remains a powerful tool.

Conclusion and Discussion

The breadth of these various studies provides empirical evidence of the economic benefits to be expected from the implementation of various types of green space. The specificity exhibited, such as the distinguishing of public and private ownership of landscape elements such as trees, as well as variations in the size and quality of parks gives the horticulture industry an in-depth understanding of potential value enhancements, as well as possible externalities or costs incurred to residents. The value propositions documented by these different studies regarding additional price premiums for property overall supports green space amenities as favorable private and public investment opportunities, due to the demonstrated price premiums. These premiums stimulate the real estate market and local economy, increase the willingness and desire of consumers to live in such areas, and even increase perceptions of safety and community.

Aside from the real estate industry, the horticulture industry benefits as well through the monetary depiction of value to these green spaces and an understanding of the benefits to be incurred through horticultural investments. This not only supports public spending on horticultural elements and green spaces, but also provides financing opportunities through the associated price premiums and increases in value. In addition, these value propositions depict the importance of green space, especially in urban settings, thus decreasing consumer price elasticity, encouraging perceptions of horticultural goods and natural elements as necessary and valuable investments in real estate and landscape design.

It is necessary to continue to increase and include specificity in methodology, with differentiation in public vs private ownership, premiums on homeownership vs rental rates, and specific attributes and qualities of parks. These traits have all been proven to determine variable price increases and therefore should be distinguished in future studies. The inclusion of socio-economic and demographic factors also allows further application and consideration of the value propositions depicted in such studies. For example, price premiums were found to be more dramatic in denser populations (downtown) and in areas of smaller lot sizes. The inclusion of these factors allows for expansive consideration regarding neighborhood change,

using these public spaces as tools for revitalization in communities, and increasing public access to green spaces and the environmental services they provide.

While the economic stimulation and generated revenue from property prices and property taxes work conjunctly to benefit the horticulture industry, real estate market, and private companies with autonomy over rental rates, there are possible negative effects from these increased property values as well. These studies show that an increase of green space and landscaping elements, on the parcel and in surrounding areas, have been proven to increase not only single-family home values, but rental rates too, encapsulating the benefits and ecosystem services reaped by the property owners in a monetary matter.

These increased property values, especially in cases of increasing rental rates, could also bring about potential negative ramifications for the individual property owners. While many of these models utilize a consumer willingness to pay to value these benefits, whether revealed, imputed, or stated, not all consumers have this same willingness or *ability* to pay. Furthermore, consumers in areas of changing green spaces and green infrastructure might not possess the same willingness or ability to sustain the value propositions being reflected in the price premiums. Simply put, they can no longer afford the property or surrounding area due to the environmental changes.

It is also important to note that studies such as Voicu and Been (2012) have found a more dramatic, positive effect of gardens and other public green spaces on home price when located in lower income demographic areas rather than more affluent populations. Therefore, in some cases, these property premiums do not depict benefits received by the original owner, but rather decreasing affordability for the original inhabitants. This creates as opportunity for neighborhood change as these individuals move out and those with the means to afford higher prices move in. This influx of wealthier individuals and outflux of the original inhabitants due to increased property values from public green space and amenities has been deemed as *ecological gentrification* by Sara Dooling originally in 2005. The definition has since expanded in the literature to include *green gentrification* and *environmental gentrification*. As an increase in public green spaces is often seen as a favorable tool amongst municipal leaders and city planners for marginalized areas seeking revitalization, this possibility for resulting gentrification must be well understood and mitigated through careful implementation and planning efforts, policy implementation, and community discussions and cohesiveness. If these green spaces continue to be utilized as tools, without a complete understanding of possible negative implications, they can push out the individuals they were created to benefit, thus missing the mark in their goal of implementation.

Green gentrification warrants further research in order to better understand how to identify resulting neighborhood change from the increased use of green spaces, as well as methods and models to predict these neighborhood changes following revitalization efforts. A complete understanding of contributions to gentrification in addition to tools to predict such changes will aid in the success and efficiency of developing and implementing mitigation policies.

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