An Update of the Literature Supporting the Economic Benefits of Plants: Part 1 – Methods of Valuing Benefits

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Abstract

This paper provides a review of the key research efforts that provide evidence of the economic benefits associated with plants and improved landscaped areas and the tools for assessing their monetary worth. These benefits may persuade reluctant residential homeowners to purchase plants and improve their landscapes, aid municipal leaders and policymakers in justifying green infrastructure-related funding decisions, and provide grounds for the construction industry 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 plants of high quality for these applications, but in educating stakeholders regarding the 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 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, elasticity of demand.

Significance to the Horticulture Industry

This article is the first 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 information described in this new series to strategically incorporate them 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 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 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 products and services and increase interest in horticultural careers. Each of the articles in this series focuses on different dimensions

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of economic benefits, with this first one exploring the methods in which plant benefits are monetized.

An Overview

Historically, communities have used gray infrastructure—systems of gutters, pipes, and tunnels—to move stormwater away from where we live to treatment plants or straight to local water bodies. The gray infrastructure in many areas across the country is aging, and its existing capacity to manage large volumes of stormwater is decreasing in areas across the country. To meet this challenge, many communities are installing green infrastructure systems to bolster their capacity to manage stormwater. By doing so, communities are becoming more resilient and achieving environmental, social, and economic benefits.

Green infrastructure (GI) isn't new, but the phrase is not one that often enters a conversation among commercial landscape maintenance providers. This is changing as more people recognize how nature can be harnessed to provide "services" for communities such as flood prevention, reduction in urban heat island effects, air and water quality improvements, and elevation of the overall wellbeing of humans. Green infrastructure is formally defined as an inter-connected network of open, green spaces that provide a range of ecosystem services. Ecosystem Services are commonly defined as benefits people obtain from green infrastructure and other improvements. The Millennium Ecosystem Assessment (a United Nations assessment of the condition and trends of the world's ecosystems) categorizes ecosystem services as: *Provisioning Services* or the provision of food, fresh water, fuel, fiber, and other goods; *Regulating Services* such as climate, water, and disease regulation as well as pollination; *Supporting Services* such as soil formation and nutrient cycling; and *Cultural Services* such as educational, aesthetic, and cultural heritage values as well as recreation and tourism (Harrison 2018).

Examples of green infrastructure in residential and municipal landscapes include urban forests, constructed wetlands, green and blue roofs, rain gardens, bioswales and infiltration basins, subsurface detention areas, rain barrels and cisterns, green alleys and school yards, permeable pavement, planter boxes, and green parking and other low impact development projects. Urban green infrastructure also increases building energy efficiency by providing shade and evaporative cooling during summer months, as well as a buffer from cold winds in winter months. The reduction in energy use results in a decrease in thousands of tons of pollution from power generation per year, which has savings valued in the billions of dollars. Compared to gray infrastructure, green infrastructure often has lower capital and operating costs, particularly in the area of mitigating stormwater runoff. By increasing water storage and filtration in the landscape, the amount of runoff going into sewers and wastewater facilities decreases, dramatically reducing potential damage from high-volume rain events.

The aesthetic value of green infrastructure also provides economic benefits to homeowners, businesses, and residents through the increase of property values and improved community quality of life. For example, urban forests have proven to increase property values by as much as 10 to 20 percent (Hall and Dickson 2011). Furthermore, street trees and proximity to urban green spaces, such as parks and greenways, have proven to increase rental rates for residential properties. Businesses that utilize green infrastructure also have a correlated increase in revenue. Consumers are more likely to stay longer, spend more money, and return to areas with more green space. They are also more willing to accept higher prices on goods compared to those in "less green" business districts (Hall and Dickson 2011).

Green infrastructure also generates economic benefits through increases in green jobs. According to the Bureau of Labor Statistics (BLS 2021), green jobs are either: a) jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; or b) jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources. The definition further classifies green jobs by duties/responsibilities that fall into the following groups: renewable energy production, energy efficiency, environmental management, natural resource conservation, environmental compliance/public awareness, farming, forestry, fishing, nature-based tourism, and recreation, and contributes to the health and quality of life for communities and people. Our latest economic contribution report for the green industry showed over 1.3 million jobs associated with the green industry alone (Hall et al. 2018).

The economic benefits associated with flowers, shrubs, trees, and other green infrastructure elements in residential and municipal landscapes can be classified into two major categories: (1) those that result in additional revenues in the form of economic development mechanisms, and (2) those that result in cost savings mainly through the substitution of green infrastructure for gray infrastructure (Table 1). Each of these types of benefits will be discussed in this series, with concluding articles on the issues of gentrification associated with increased property values and the role that plants and improved landscapes play in the resiliency of urban and rural communities. *Resilience* is the capacity of a community's systems, businesses, institutions, communities, and individuals to survive, adapt, and grow, no matter what chronic stresses and acute shocks they experience. The valuation of these economic benefits has been the subject of dozens of research projects over the last two decades, though this study focuses on those conducted over the most recent decade.

Valuation of Benefits

Green infrastructure's value as a municipal or private investment depends in part on its effects on local ecosystems (beyond water management) and upon a community's ability to model and measure these additional values. Short of conducting an intensive study (and calculation) of actions in a specific community, municipalities have generally lacked the tools to determine green infrastructure's multiple economic benefits. While some

Table 1. Categories of economic benefits associated with the use of plants in residential and municipal landscapes.

Revenue-generating benefits resulting from economic development mechanisms	Costs-savings benefits resulting from substituting green infrastructure
Increased property values	Reduced pollution-related costs
Increased occupancy rates	Reduced costs of stormwater mitigation
Stimulated commerce	Reduced construction costs (biophilic design)
Tourism revenue	Reduced infrastructure maintenance costs
Job creation	Reduced health care costs
Tax revenue generation	Energy cost savings
Cross-cutting benefits	
Economic advantages of maintaining biodiversity	
Economic benefits derived from maintaining community resilience	

cities have begun to explore GI within their own municipal infrastructure, no general method for estimating or documenting such benefits has yet emerged.

Due to these gaps in information and methodology, decision-making regarding stormwater infrastructure investments has generally lacked recognition of the monetary benefits that GI provides communities. With limited ability to quantify GI's benefits, municipalities have often favored single-purpose gray infrastructure projects. However, any cost-benefit analysis comparing gray infrastructure with green infrastructure would be incomplete without factoring in the multiple benefits green infrastructure can provide. In making decisions about infrastructure investment, the value of a given set of possible investments is typically expressed monetarily.

One challenge inherent in valuing services provided by green infrastructure is that many of these services are not bought and sold. Fortunately, techniques have been developed to economically value nonmarket ecosystem services provided by green infrastructure. In other words, it is not necessary for ecosystem services to be bought and sold in traditional markets in order to measure their value in dollars. What is required is a measure of how much purchasing power (dollars) people are willing to give up in order to obtain the service(s) provided by the ecosystem, or how much people would need to be paid in order to give it up, if they were asked to make a choice similar to one they would make in a market. There are three generally accepted approaches to estimating monetary values of ecosystem services provided by green infrastructure that incorporates plants of all types:

1. Revealed willingness to pay

The values of some ecosystem goods or services can be measured using market prices since some (such as fish or wood) are traded in markets. Thus, their values can be obtained by estimating consumer and producer surplus, as with any other market good. Other ecosystem services (such as clean water) are sometimes used as inputs in production of other goods and their value may be measured by their contribution to the profits made from the final good.

Some ecosystem services (e.g., aesthetic views or recreational experiences) may not be directly bought and sold in markets. However, the prices people are willing to pay in markets for related goods can be used to estimate their values. For example, people often pay a higher price for a home with a view of the ocean, or they will take the time and incur travel expenses to travel to a special spot for fishing or bird watching. These kinds of expenditures can be used to place a lower bound on the value of the view or the recreational experience.

Revealed preference methods are used to identify the underlying preferences, and thus demands of individuals, based upon the choices each reveals in their consumption. Thus, if bundle of goods "A" is bought when another bundle of goods "B" is available and affordable, then bundle A is revealed to be preferred to bundle B. Revealed preference methods are preferred by most economists since they rely on real actions that people make and do not rely on hypothetical situations, i.e., the actions leave a "behavioral trace" that economists can directly observe. In essence, revealed preference methods are based on activities in which individuals expend actual dollars. Examples of revealed preference methods include the productivity method, hedonic pricing method, and travel cost method

The *Hedonic Pricing Method* assesses the value of an environmental feature (e.g., clean air, clean water, serenity, view) by examining actual markets where the feature contributes to the price of a marketed good. For example, using the hedonic pricing method one can estimate the monetary contribution of ocean views or proximity to parks on home prices. The monetary contribution of the environmental amenity is usually determined by a regression of the price of the marketed good against attributes of the good, including the environmental attribute in question.

The *Productivity Method*, also referred to as the "net factor income" or "derived value method," is used to estimate the economic value of ecosystem products or services that contribute to the production of commercially marketed goods. It is applied in cases where the products or services of an ecosystem are used, along with other inputs, to produce a marketable good. If a natural resource is a factor of production, then changes in the quantity or quality of the resource will result in changes in production costs, and/or productivity of other inputs. This in turn may affect the price and/or quantity supplied of the final good. It may also affect the economic returns to other inputs. For example, water quality affects the productivity of irrigated horticultural crops, or the costs of purifying municipal

drinking water. Thus, the economic benefits of improved water quality can be measured by the increased revenues from greater horticultural productivity, or the decreased costs of providing clean drinking water.

The *Travel Cost Method* (TCM) is used to "estimate economic use values associated with ecosystems or sites that are used for recreation" (e.g., public gardens) (Grafton 2001). It assumes that the value of a site can be deduced from how much people are willing to pay to travel to visit the site. It is important to note that if the proximity to a site greatly influences property values and/or local economic activity, the TCM may not be sufficient to capture the full non-market value of the resource in question. For example, the best surf spots in California greatly increase the value of adjacent property; yet most of the users of the sites do not travel very far to get to them, but they value the resources very much (which is reflected in the high costs of housing in these areas). *Expenditure analysis* is used primarily to examine indirect expenditures that are tied to environmental resources, which are often left out of many traditional analyses; but it is commonly employed in the travel cost method.

The *Random Utility Model* (RUM) is a model of consumer choice in which the consumer is assumed to have perfect discriminative capability between goods or activities in order to maximize their 'utility' (relative attractiveness of competing alternatives). However, generally there is incomplete and imperfect information about the variables that influence the evaluator's decision-making. The RUM method uses statistical techniques that take into account the random nature of the data that is observed. RUM's are common in revealed-preference research such as studies employing the travel cost method.

2. Imputed willingness to pay

The value of some ecosystem services can be measured by estimating what people are willing to pay, or the cost of actions they are willing to take, to avoid the adverse effects that would occur if these services were lost, or to replace the lost services. For example, constructed wetlands often provide protection from floodwaters. The amount that people pay to avoid flood damage in areas similar to those protected by the wetlands can be used to estimate willingness to pay for the flood protection services of the wetland. These methods include the damage cost avoided, replacement cost, and substitute cost methods.

The *Avoided Cost Method* calculates the economic value of benefits that an ecosystem provides that would not exist without the ecosystem in place, and therefore, would represent an added cost to society if this environmental service no longer existed. For example, the constructed wetland example (mentioned above) that supplies flood protection provides the "avoided cost" of having to invest in additional flood protection measures such as additional levees. The *Damage Assessment Method* is much like the avoided cost method in that the model uses a damage function to calculate the environmental and social costs of alterations that may occur to the natural environment. This is also often referred to as the *Replacement Cost Method*, which is determined by how much people are willing to pay to avoid the loss or damages (the cost of replacing and/or substituting services, or the cost of paying for replacement services that perform the same functions and provide the same benefits).

The *Benefit (Value) Transfer Method* estimates economic values of ecosystem services provided by green infrastructure by transferring existing benefit estimates from studies already completed for another location or issue. For example, if a study is conducted on the economic value of a beach in Florida, it may be possible to transfer some of the study's findings to beaches along the Georgia or South Carolina coast, given reasonable changes in the weightings based on the differences among the beaches. This method is popular because it does not require the expense of conducting new studies, but given that environmental values can change dramatically based on local conditions, it lacks the robustness that comes from original research based at the site in question.

3. Stated (or expressed) willingness to pay

Many ecosystem services are not traded in markets and are not closely related to any marketed goods. Thus, people cannot "reveal" what they are willing to pay for them through their market purchases or actions. In these cases, other tools can be used to ask people directly what they are willing to pay, based on a hypothetical scenario. Alternatively, people can be asked to make tradeoffs among different alternatives, from which their willingness to pay can be estimated.

Stated preference methods are employed when actual data on behavior with regards to a certain environmental good or service are not available, or where it is impossible to obtain these values (e.g., when trying to estimate the "existence value" that individuals ascribe to resources that they will never visit). Individuals are typically provided with hypothetical scenarios, based on plausible outcomes and options, and their choices are used to determine the value of the environmental good or service in question. Contingent valuation is a common stated preference method, aligns with referendums, conjoint analyses, and discrete choice experiments. Stated and revealed preference methods may also be combined, often using a random utility framework (RUM).

The *Contingent Valuation Method* (CVM or CV) usually takes the form of a survey questionnaire, which elicits values for environmental goods and services based upon hypothetical situations. CVM may be the only means of estimating certain classes of non-market values (e.g., non-use or passive-use values) for environmental goods and services. For example, after the Exxon Valdez oil spill the only way to estimate the harm to the public of the damage to Prince William Sound was to employ the CVM method and ask respondents how much they would be willing to pay to prevent future oil spills of a similar magnitude. Because the CVM relies on hypothetical situations, it is more controversial than most other valuation methods. However, the U.S. Federal Courts have ruled that under certain conditions, it is a reliable source of information on otherwise unknowable environmental values.

The *Referendum Method* is a survey method commonly used in contingent valuation surveys in which the respondent is asked to respond 'yes' or 'no' to a hypothetical tradeoff between some amount of environmental good or service and something else of value (typically money). The referendum method is the principal method employed in the contingent valuation studies because it closely mimics the real choices individuals face when confronted with ballot initiatives that ask them to vote 'yes' or 'no' for a new environmentally-related programs or law.

Conjoint Analysis is a statistical technique used to determine how people value different features that make up an individual environmental good or service and it can be used to determine the monetary and relational values attributed to different dimensions of an environmental resource. For example, by examining the choices people make when faced with the possibility of visiting different beaches, some with good wildlife viewing and others without, the value of wildlife viewing can be inferred.

Choice Experiments test assumptions about human behavior and decision making against standard economic precepts. They estimate economic values for virtually any ecosystem or environmental service by asking people to make tradeoffs among sets of ecosystem or environmental services or characteristics. Choice experiments do not directly ask for willingness to pay; this is inferred from tradeoffs that include cost as an attribute.

The *Discrete Choice Method* uses models of consumer choice in which the environmental good or alternative chosen by the consumer is available only in discrete (integer) units. For example, discrete choice can be useful in determining the relative preferences of beach runners for different route characteristics (e.g., separate path, compact sand, or hills). One advantage of discrete choice models over other methods is that the tradeoffs between attributes can be more easily quantified.

In contrast to the direct values people derive from using or experiencing environmental resources, *non-use or passive-use values* are indirect values that are often classified as existence value, bequest value, and option value (Grafton 2001). Existence value refers to the value that people get from simply knowing that an environmental resource is conserved; e.g., knowing that the Amazon Rainforest is protected even if you live in the U.S. and don't ever plan on visiting there. Bequest value refers to the value that individuals gain from being able to pass a resource on to future generations even if they may not ever directly use or experience the resource themselves. Option value refers to the value individuals receive from reserving the option of utilizing a resource in the future, e.g., there is a value gained from protecting whales if people want the option of being able to go whale watching sometime in the future.

The Benefit of Emphasizing Benefits

In addition to the economic benefits associated with ecosystems services resulting from the inclusion of green infrastructure, a plethora of social benefits are also derived from improved residential and municipal landscapes. These social benefits are a direct result of the multitude of ways that ecosystem services improve human wellbeing, both individually and from a community-wide perspective. Knowledge about these effects therefore strengthens the understanding of the link between human-wellbeing and ecosystems.

These social benefits range from palpable effects like *therapeutic benefits* (the provision of medicines, clean air, water and soil, space for recreation and outdoor sports and general therapeutic effects of nature on people's mental and physical well-being) and *economic opportunities* (sustaining one's livelihood by providing an income through natural areas such as hunting, trapping, or fishing) to less tangible benefits like *amenity benefits* (importance of nature for cognitive development, mental relaxation, artistic inspiration, aesthetic enjoyment and recreational benefits such as the mental relaxation through a hike), *heritage appreciation* (the importance of nature as reference to personal or collective history and cultural identity, also for educational purposes such as the cultural identity cultivated by passing along knowledge and traditions), civic pride (the sense of place or attachment derived from the way we perceive places such as streets, communities, cities or ecoregions), *spiritual enhancement* (the religious awareness through sacred sites), *existence value* (the moral satisfaction people obtain from conserving a local ecosystem they themselves may never experience, often referred to as intrinsic value) to rather abstract categories like bequest value (the importance people attach to nature for inter-generational equity) and option value (the importance people attach to having the option to use ecosystem services in the future, within their own lifetime) benefits. Notice the latter three are often referred to as values rather than benefits. Also of note is that each of these social benefits lead to subsequent indirect economic contributions in either the near-term or long-run or both (Schmidt 2016).

While these economic, environmental, and social benefits may not come as much a surprise, the plethora of health and well-being benefits might. That's one of the main reasons for publishing the four-part series that appeared in JEH previously (Hall and Knuth 2019a, 2019b, 2019c, 2020) – the plethora of health benefits provided by flowers, shrubs, and trees is not common knowledge, let alone ingrained in modern day American culture. Humans often have difficulty in even seeing (cognitively) the flowers or plants in the environments where they work, live, and play, much less connecting plants to tangible benefits – a phenomenon called plant blindness (Hall and Dickson 2011). In other words, for most people, flowers and other plants are a part of the subconscious 'backdrop' of mental life, not the 'main actors' in the playing out of our everyday lives. Thus, green industry firms at all levels of the supply chain need to emphasize these types of messages in the marketing efforts of their individual companies. Since previous efforts on the part of the industry to provide a united voice through a generic advertising campaign have been met with less-than-enthusiastic response, this may be the best (and least

expensive) alternative to propagate the quality-of-life value proposition.

In summary, as we move into the future, even more aggressive marketing will be needed to ensure that plants/landscapes are considered as *essential necessities* in end user lives and not mere luxuries. Now is the time for the industry to make strategic marketing investments, both as individual firms and through industry-wide efforts, to emphasize the functional (health and well-being) benefits of those plants/landscapes. If, through unified messaging, the green industry can position itself in such a way that its products/services are considered to be necessities in people's lives and not mere luxuries, it may be the best mitigation strategy against recession and weather-related risks it can employ. The next article in this series will focus on one of the more important revenue-generating benefits of plants and improved landscapes – improved property values.

Literature Cited

Bureau of Economic Analysis (BEA). 2021. Table 2.4.3U. Real Personal Consumption Expenditures by Type of Product, Quantity Indexes. https://apps.bea.gov/itable/index.cfm. Accessed November 3, 2021.

Bureau of Labor Statistics (BLS). 2021. Measuring green jobs. https://www.bls.gov/green/home.htm. Accessed December 7, 2021.

Grafton, R.Q., Pendleton L.H., and Nelson H.W. 2001. A Dictionary of Environmental Economics, Science, and Policy. Edward Elgar, Northampton, MA. 416 p.

Hall, C. and M. Dickson. 2011. Economic, environmental, and health/well-being benefits associated with green industry products and services: A review. J. Environ. Hort. 29:96–103.

Hall, Charles R., Alan W. Hodges, Hayk Khachatryan, and Marco A. Palma. 2020. Economic contributions of the green industry in the United States in 2018. J. Environ. Hort. 38(3):73–79.

Hall, C. and M. Knuth. 2019a. An update of the literature supporting the well-being benefits of plants: A review of the emotional and mental health benefits of plants. J. Environ. Hort. 37(1):30–38.

Hall, C. and M. Knuth. 2019b. An update of the literature supporting the well-being benefits of plants: Part 2 physiological health benefits. J. Environ. Hort. 37(2):63–73.

Hall, C. and M. Knuth. 2019c. An update of the literature supporting the well-being benefits of plants: Part 3 Social benefits. J. Environ. Hort. 37(4):136–142.

Hall, Charles and Melinda Knuth. 2020. An update of the literature supporting the well-being benefits of plants: Part 4 Available resources and usage of plant benefits information. Journal of Environmental Horticulture. 38(2):68–72.

Hall, C. 2010. Making cents of green industry economics. HortTechnology. 20(5):832–835.

Harrison, P. A., R. Dunford, D. N. Barton, E. Kelemen, B. López, L. Norton, M. Termansen, H. Saarikoski, K. Hendriks, E. Gómez-Baggethun, B. Czúcz, M. García-Llorente, D. Howard, S. Jacobs, M. Karlsen, L. Kopperoinen, A. Madsen, G. Rusch, M. Van Eupen, P. Verweij, R. Smith, D. Tuomasjukka, and G. Zulian. 2018. Selecting methods for ecosystem service assessment: A decision tree approach. Ecosystem Services. 29(481-98). DOI: 10.1016/j.ecoser.2017.09.016.

Horticultural Research Institute. 2019. Strategic research focus: What we fund and why. https://www.hriresearch.org/sites/default/files/HRI-ResearchRoadmap.pdf. Accessed Nov. 3, 2019.

Knuth, M., B. K. Behe, C. R. Hall, P. T. Huddleston, and R. T. Fernandez. 2018. Consumer perceptions, attitudes, and purchase behavior with landscape plants during real and perceived drought periods. HortScience 53(1):49–54.

Schmidt, Katja, René Sachse, and Ariane Walz. 2016. Current role of social benefits in ecosystem service assessments. Landscape and Urban Planning. 149:49–64. DOI: 10.1016/j.landurbplan.2016.01.005.