

An Update of the Literature Supporting the Well-Being Benefits of Plants: Part 4 – Available Resources and Usage of Plant Benefits Information¹

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Abstract

This paper provides an overview of the key resources available to green industry firms that provide evidence of the health and well-being benefits associated with plants and improved landscaped areas and how they influence the physiological, psychological, cognitive, and social well-being constructs affecting quality of life. 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 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 done correctly, the demand for green industry products and services may be affected positively.

Index words: benefits of plants, information resources, elasticity of demand.

Significance to the Horticulture Industry

This article is the last of a four-part series that provides a review of the substantial body of peer-reviewed research that has been conducted regarding the health and well-being benefits of green industry products and services. While the first article focused on the emotional and mental health benefits that plants provide, the second article focused specifically on the physiological health benefits provided by plants, and the third article spoke directly to the benefits that plants provide to society at large and the role they play in addressing critical societal issues. This last article in the series provides an overview of resources available for green industry firms to find more detailed information on these plant benefits and strategies to use in strategically incorporating these benefits into both industry-wide and firm-level marketing messages that highlight how quality of life dimensions are affected in order to enhance the perceived value and relevance of green industry products for 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. 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 (Hall 2010).

Since 2011, there has been a plethora of additional research studies conducted regarding these functional plant benefits. A total of 1,348 citations have been compiled in total and about two-thirds of those studies have been conducted since 2011. Thus, 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 on plant benefits that has been conducted since 2011. By doing so, this new 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* (HRI 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 5-7 years, HRI will prioritize research funding in these four main areas to achieve the stated desired outcomes (HRI 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 has focused on different dimensions of plant-related health and well-being benefits.

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The first article discussed the emotional and mental benefits that plants (and improved landscapes) provide, including anxiety and stress reduction, attention deficit recovery, fractals and visual responses, decreased depression, enhanced memory retention, greater happiness and life satisfaction, mitigation of PTSD, increased creativity, enhanced productivity and attention, reduced effects of dementia, and improved self-esteem (Hall and Knuth 2019a).

The second article discussed the physiological responses that result from being exposed to plants in nature and improved landscapes, including better sleep, increased birthweights, decreased diabetes, decreased ocular discomfort, enhanced immunity, improved circadian functioning, improved rehabilitation, decreased cardiovascular and respiratory disease, decreased mortality, improved digestion, decreased allergies, increased physical activity, and improved cognitive development (Hall and Knuth 2019b).

The third article in the series provided an overview of the social benefits that plants and landscapes provide to society at large, including stronger place (community) attachments, reduced crime, improved disaster resilience, broader access to locally produced foods, socialization of children and improvements in their school performance, therapeutic impacts affecting communities at large, and the reduction in socioeconomic divisions in communities through the equitable distribution of green space benefits (Hall and Knuth 2019c).

This last article in the four-part series provides an overview of resources available where green industry firms might obtain more detailed information, as well as how this information can be used to influence municipal and civic leaders, homeowners, and citizens at large and their perceptions of the the importance of plants and improved landscapes in the communities in which they live, work, and play.

Resources Available

There is a plethora of resources available online regarding the benefits of plants in alternative urban and rural settings. These act as clearinghouses, of sorts, to investigate the findings summarized in the first three articles in this series in more detail.

A website called *Green Cities: Good Health* maintained by the University of Washington (depts.washington.edu/hhwb) provides benefits information for areas they refer to as “metro nature”, including trees, parks, gardens, and other natural areas. This website provides the scientific evidence that supports efforts to better plan, implement, and manage nature in cities. Research findings are sorted and summarized across benefits themes that include healing, safety, and community building. A corollary website maintained by the same entity has more of an urban forestry perspective and is called *Human Dimensions of Urban Forestry and Urban Greening* (naturewithin.info) and contains information about how urban forests influence business district visitors, the value of landscaped roadsides, benefits derived from increased outdoor activity, and information useful in urban policy and planning situations.

The *Landscape and Human Health Laboratory* website at the University of Illinois (lhlh.illinois.edu) provides findings from studies conducted in their multidisciplinary research laboratory regarding the connection between greenery and human health for elderly adults, impoverished inner-city adults and children, and sufferers from ADD/ADHD. They examine the impacts that natural green spaces have on safety, crime, violence, community cohesiveness, attention deficits, and other factors that influence learning capacity. They use their research findings to suggest locations for landscaping when the environment is most challenging and relief is most needed, as well as to aid in the design of green landscapes that are as effective in promoting human health as possible.

The *Landscape Performance Series* is an online set of resources developed by the Landscape Architecture Foundation (landscapeperformance.org) to help designers, agencies, and advocates evaluate performance, show value, and make the case for *sustainable* landscape solutions. They have developed a database of case study briefs that describe exemplary projects with specific landscape benefits quantified, along with online calculators and other tools to aid in estimating landscape performance. These calculators are focused on the areas of carbon footprint and greenhouse gas emissions (using such metrics as time-to-carbon-neutral), levels of plant and animal biodiversity (using the iNaturalist crowdsourced species identification system and organism recurrence recording tool), and an open-source tool that allows users to conduct a Floristic Quality Assessment (FQA) measuring a site’s habitat condition or a specified natural plant community’s condition on a site.

The *American Society for Landscape Architecture* has developed a series of resource guides on their website (asla.org/healthbenefitsofnature.aspx) that not only provide summaries of research-based benefits of landscapes to adults and children, but they have guides to developing policies to address: (a) changing climatic conditions using adaptation, mitigation, and resilient design principles, (b) sustainable planning and design through green infrastructure that incorporates low emission transportation infrastructures that are safe, equitable, resilient, ecological, and aesthetically pleasing, (c) residential planning guides (e.g. Sustainable Sites Initiative guidelines) to ensure ecological designs that improve water management, ensure energy efficiency, (d) the use of low-impact materials that minimize environmental externalities; (e) the development of healthy, livable communities that improve the welfare and well-being of people by expanding the range of affordable transportation, employment, and housing choices through “live-work-play” (mixed-use) developments that incorporate physical activity into components of daily life, while preserving and enhancing valuable natural resources, providing access to affordable, nutritious, and locally produced foods distributed for less cost, and creating a unique sense of community and place.

Nature Sacred is a non-profit (naturesacred.org/resource-center) whose mission is to inspire, inform, and guide communities in the creation of public green spaces (called Sacred Places) designed to improve mental health

and unify communities. Nature Sacred partners with communities across the country to infuse nearby nature into places where healing is often needed most including distressed urban neighborhoods, schools, hospitals, prisons and more. Through a collaborative, community-led process and an evidence-based design model, each Sacred Place reconnects people with nature in ways that foster mindful reflection, restore mental health, and strengthen communities. They have a resource center on their website that accumulates peer-reviewed research and reports regarding the healing aspects of nature.

The *Children & Nature Network* (C&NN) is an organization that connects children, their families, and their communities to nature through innovative youth-oriented projects, evidence-based resources and tools, broad-based collaborations, and grassroots leadership. C&NN works with strategic partners on programmatic initiatives related to early childhood education and the No Child Left Inside Act. The Research Library on their website (childrenandnature.org/research-library) contains summaries of scientific literature relating specifically to children and nature published since 2000. Articles are international in scope, represent a variety of research designs, and are drawn from the professional literature of many different disciplines, including public health, urban design, education, psychology, conservation, and architecture. In addition to providing evidence and documentation of the many benefits of connecting children to nature, articles also address issues relating to special populations (e.g. children with special needs, immigrant populations, etc.) and barriers to nature engagement (e.g. fear of nature, safety concerns, etc.).

Green Plants for Green Buildings is a not-for-profit organization whose purpose is to communicate the aesthetic, well-being, and economic benefits of nature in the built environment. Biophilic design, an extension of biophilia, incorporates natural materials, natural light, vegetation, nature views and other experiences of the natural world into the modern built environment to achieve similar health and well-being benefits experienced in the outdoor environment. The education section of their website (greenplantsforgreenbuildings.org/research) contains peer-reviewed research articles and other reports regarding the benefits of biophilic design elements in buildings and other hardscapes.

Biophilic Cities (biophiliccities.org) facilitates a global network of partner cities working collectively to pursue the vision of nature-filled cities within their unique and diverse environments and cultures. These partner cities are working in concert to conserve and celebrate nature in all its forms and the many important ways in which cities and their inhabitants benefit from the biodiversity and urban green spaces present in cities. They have developed an online video series (on their website) that showcases biophilia and biophilic design principles in case study vignettes from around the world. They also produce a *Biophilic Cities Journal* that serves as the main outreach arm of the organization.

Terrapin Bright Green (terrapinbrightgreen.com/publications) is a private company that consults in the

area of biophilic design, but they have collaborated with researchers from diverse fields ranging from psychology to materials science to publish reports, white papers, and articles to engage the architectural and construction sectors in bringing together human well-being, the built environment, and the life sciences to create innovative biophilic solutions for a changing world.

Lastly, the *Plant Benefits* section of the website for the Ellison Chair in International Floriculture at Texas A&M University (ellisonchair.tamu.edu/benefitsofplants) serves as a repository of information that is organized by type of benefit – economic benefits, environmental benefits, and health and well-being benefits. Each section contains up-to-date literature citations along with the abstract or executive summary of the research studies.

The Benefit of Emphasizing Benefits

The green industry is currently in what is considered the mature stage of the industry life cycle, meaning that year-over-year growth has slowed, and any increases are happening at a decreasing rate (Hall 2010). This stage is critical because any economic disturbances may lead to shakeout (firms exiting) as we saw during the Great Recession. During the subsequent recovery, it took until 2016 for the industry to sell as many flowers, seeds, and potted plants as it did prior to the recession, according to data from the Bureau of Economic Analysis (BEA 2019), even though consumers were spending more on non-plant-related goods and services, in total, than they were before the recession. This means that consumers were “trading off” spending on flowers, seeds, and potted plants and opting to purchase something else. This indicates that our current value proposition of providing high quality plants (with quality being defined by their unique features or attributes such as bloom time, color, pest and disease resistance, drought tolerance, etc.) at reasonable prices is not compelling enough to convince consumers to buy plants to the degree they once did. In short, the industry needs a more compelling value proposition. We propose that all of the plant benefits summarized in the first three articles in this series would provide such a compelling value proposition, but the facts contained in them will remain static knowledge, unless action is taken by participants in the green industry supply chain to articulate them to end users (residential homeowners, municipal and civic leaders, etc.) through various advertising vehicles such as social media and point of purchase materials. Previous research has shown that targeted messaging through these media can be quite effective in influencing consumers (Behe et al. 2014, Khachatryan et al. 2018, Knuth et al. 2018, Khachatryan et al. 2017, Rihn et al. 2016, Khachatryan 2014).

Successful product differentiation exists when customers, under conditions of competitive supply and faced with a range of choices, perceive that products being offered for sale do not have the same (equal) value and they are prepared to pay unequal (usually higher) levels of price in acquiring as many of the available offerings as they wish. Customers (both end consumers and business-to-business) generally trade off five major attributes in making a

decision about what products to buy and from whom to buy them from, including quality, price, service, convenience, and selection (Hall 2010). Value represents the tradeoff between the benefits derived from this varying mix of attributes relative to the sacrifices (dollars) made in getting them. Therefore, one key for enhanced profitability for firms in the green industry is to provide greater perceived value to customers for products through successful differentiation (i.e. emphasizing relevant benefits in the mind of the customer).

Economists characterize the demand for a product by a concept called the *price elasticity of demand*, which measures the nature and degree of the relationship between changes in the quantity demanded of a product/service and changes in its price. An important relationship to understand is the one between elasticity and total revenue for the firm. The demand for a product/service is considered relatively inelastic when the quantity demanded does not change much with a corresponding price change. What this effectively means is that firms can actually raise their prices, and though they might sell fewer units, total revenue for the company still goes up.

How does a firm go about making the demand in its respective trade area more inelastic? By distinguishing itself somehow in terms of perceived value (e.g. the mix of quality, price, service, convenience and selection attributes described earlier). That is why marketing efforts are so important; they are the key to successful differentiation. Thus, there is an opportunity for green industry firms to raise prices if firms successfully differentiate their products in the mind of the customer in terms of the benefits that customers will derive from those products.

What matters most, then, is the message that is being communicated through a firm's marketing tools. Post-recession consumers are willing to undergo greater search, acquisition, and learning costs in making decisions regarding their purchases. They have exhibited a willingness to purchase and, in some cases, pay a premium for products and services that enhance their quality of life in terms of social well-being, physical well-being, psychological well-being, cognitive well-being, spiritual well-being, and environmental well-being. This bodes well for plants since they affect every one of the elements that influence quality of life (Hall and Dickson 2011).

Whether one is a member of the Baby Boomer, Gen X, or Gen Y generation, quality of life is a higher order need that is important to them. For example, although the last economic downturn increased anxiety on the part of Baby Boomers nearing retirement, they are nevertheless proactive in seeking innovative solutions to dealing with aging. They view their new stage of life as one of activity and fulfillment rather than idleness. Members of Gen X are the most "time-starved" generation, often juggling career and family obligations, but they maintain a strong commitment to work-life balance in their lives. The Gen Y generation are facing lots of firsts (e.g. their first home, first child, etc.) and are trying to find the right balance between spending for necessities and spending for entertainment. This generation is concerned not just with function and utility but also with style. All of these generational attitudes are

related in one key manner – all demographic segments are interested in enhancing their quality of life. As far as the green industry is concerned, it might as well be through health/well-being enhancements, ecosystems services benefits (also referred to as environmental amenities), and economic paybacks (Hall 2010, Hall and Dickson 2011).

For example, some of the economic benefits of associated with flowers, shrubs, and trees are that they beautify and help draw customers to shopping districts, reduce shopper stress while they are there, enhance overall curb appeal for local businesses, boost apartment and commercial building occupancy rates, increase revenue from tourism, create local jobs (from various landscape design, installation, and maintenance activities), increase residential and commercial property values, and even reduce the costs of street repairs from the reduced temperatures resulting from shaded roadways and sidewalks (Hall and Dickson 2011).

While the list of environmental amenities, otherwise known as ecosystems services, is quite exhaustive, it is impressive to consider a mere subset of them such as the amount of carbon that is sequestered by plants, the volume of oxygen that is generated, wildlife that is attracted, biodiversity that is enhanced, the heat islands that are offset, the air, noise and glare pollution that is reduced, soil erosion that is mitigated, storm water runoff that is more efficiently handled, wind damage that is minimized, and the reductions in energy use that arises from the temperature buffering that plants provide around buildings. Needless to say, many of these environmental amenities translate into substantial economic contributions to local economies as well (Hall and Dickson 2011).

While these economic and environmental 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 first three articles in this series – 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 (similar to the *Got Milk* program) 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.

One industry-wide effort that is already in place that has shown to be quite effective in conveying this message is America in Bloom (AIB), a non-profit whose purpose is to encourage beautification in communities across the country (americainbloom.org). The program has not only conveyed

the industry's message of beautification, but one of economic development, provision of environmental amenities, and enhancement of health and well-being as well. Over 300 cities and several million citizens have been exposed to AIB's message, not only benefitting local citizens but the countless local businesses in those trade areas.

In summary, as we move into the future, even more aggressive marketing will be needed to ensure that plants/landscapes are considered as *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.

Literature Cited

- Behe, B. K., Campbell, B. L., H. Khachatryan, C. R. Hall, J. H. Dennis, P. T. Huddleston, and R. T. Fernandez. 2014. Incorporating eye tracking technology and conjoint analysis to better understand the green industry consumer. *HortScience* 49(12):1550–1557.
- Bureau of Economic Analysis (BEA). 2019. Table 2.4.3U. Real Personal Consumption Expenditures by Type of Product, Quantity Indexes. <https://apps.bea.gov/itable/index.cfm>. Accessed November 3, 2019.
- 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, 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, C. 2010. Making cents of green industry economics. *HortTechnology*. 20(5):832–835.
- Horticultural Research Institute. 2019. Strategic research focus: What we fund and why. <https://www.hrresearch.org/sites/default/files/HRI-ResearchRoadmap.pdf>. Accessed Nov. 3, 2019.
- Khachatryan, H., A. Rihn, B. Campbell, B. Behe, and C. Hall. 2018. How do consumer perceptions of 'local' production benefits influence their visual attention to state marketing programs? *Agribusiness: An International Journal*. DOI: 10.1002/agr.21547.
- Khachatryan, H., A. Rihn, B. Campbell, C. Yue, C. Hall, and B. Behe. 2017. Visual attention to eco-labels predicts consumer preferences for pollinator friendly plants. *Sustainability* (9)1743; doi:10.3390/su9101743.
- Khachatryan, H., C. Yue, B. Campbell, B. Behe, and C. Hall. 2014. The effects of consideration of future and immediate consequences on willingness to pay for eco-friendly plant attributes. *J. Environ. Hort.* 32(2):64–70.
- 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.
- Rihn, A., H. Khachatryan, B. Campbell, C. Hall and B. Behe. 2016. Consumer preferences for organic production methods and origin promotions on ornamental plants: evidence from eye-tracking experiments. *Agricultural Economics* 47:1–10.