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Economic, Environmental, and Health/Well-Being Benefits Associated with Green Industry Products and Services: A Review[1]

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Abstract

Green industry firms have competed for decades on the basis of quality and service. While these competitive dimensions are still important, the industry has continued along its path of maturation and firms must incorporate other factors into their value proposition in order to be successful in this hypercompetitive market. Given the recent economic downturn of 2008–2009, consumers are more value-conscious than ever, but are still willing to consume, and pay premiums for, products and services that enhance their quality of life. This paper summarizes the peer-reviewed research regarding the economic benefits, environmental benefits (eco-systems services), and health/well-being benefits of green industry products and services that serve to enhance the quality of life for consumers.

Index words: quality of life, human-plant interactions, value proposition, monetization of landscapes.

Significance to the Nursery Industry

This paper provides a review of the substantial peer-reviewed research that has been conducted regarding the significant benefits of green industry products and services including economic benefits, environmental amenities in the form of eco-systems services, and health and well-being benefits. This research should be strategically incorporated into both industry-wide and firm-specific marketing messages that highlight these quality of life dimensions in order to maintain the industry's sense of value and relevance for gardening and landscaping consumers of the future.

Introduction

The green industry complex includes manufacturers and distributors of input supplies; production firms such as nursery, greenhouse, and sod growers; wholesale distribution firms including importers, brokers, re-wholesalers, and transporters; horticultural service firms providing landscape and urban forestry services such as design, installation, and maintenance; and retail operations including independent garden centers, florists, home improvement centers, and mass merchandisers or other chain stores.

There is little doubt that the green industry supply chain has experienced unprecedented growth, innovation, and change over the last several decades. However, recent slower growth in demand and tighter profit margins point to a maturing market (46). Survival in the next decade will require a progressive mindset and a willingness to strengthen existing core competencies or develop entirely new ones, which may involve greater firm-level risk. While the outlook may be somewhat unclear in terms of the outlook for industry growth and the nature of consumer demand, it is clear that the development of innovative management and marketing strategies will continue to be a requisite skill in ensuring the survivability and profitability of green industry firms in the future. Stated slightly differently, if 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*, that is the best mitigation strategy against recession and weather-related risks it can employ.

This positioning strategy warrants further examination. The value proposition (or differentiation strategies) for all firms in the green industry in the future must focus on the unique ways in which *quality of life* is improved for its customer base. 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 (46). For example, although the economic downturn has increased anxiety on the part of Baby Boomers regarding 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 is just beginning their adult lives and facing lots of firsts — their first home, first job, and most importantly, first independent income. They 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 (46).

All of these generational attitudes are related in one key aspect — all of these demographic segments are interested in enhancing quality of life through health/well-being enhancements, ecosystems services benefits (also referred to as environmental amenities), and economic paybacks. The objective of this study was to provide documentation of these benefits by conducting an extensive literature review of the

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peer-reviewed research that has been conducted regarding the benefits of plant-human interactions.

Dimensions of quality of life

Concepts of quality of life (or life satisfaction) emerged in the realms of medicine, health, and social sciences in the 1950s. Although the issue of quality of life has been of increasing interest among social scientists, there has been little agreement as to the clarity and definition of the concept and how to measure it. Most recently, an integrated model of quality of life was developed that consists of six major life domains including: social well-being, physical well-being, psychological well-being, cognitive well-being, spiritual well-being, and environmental well-being (56).

Each of these domains can be divided into several subdimensions in order to operationalize the concept of quality of life so that a common standard of useful measurement can be used. Some examples of indicators include: social supports, such as family and friends, which are indicators of social well-being as one dimension of quality of life; health status and functional ability, which are indicators of the physical well-being dimension of quality of life; self-esteem or level of life acceptance, which are signs of psychological well-being; judgment and thinking skills, which are indicators of cognitive well-being; personal values and morals are indicators of spiritual well-being as another dimension of quality of life; and living arrangement (such as one's own home or an institution) and appearance and safety of surroundings, which are indicators of the environmental well-being dimension of quality of life (56).

Intuitively, these quality of life components overlap and impact each other. There is no set boundary where one dimension ends and the next begins. No prioritization of importance has been established for these quality of life dimensions in this writing, however, it will become readily apparent that people-plant interactions (and the benefits derived from them) intersect each of the six quality of life domains.

Economic benefits

Beautification draws customers, reduces shopper stress, and enhances store appeal. In today's economic climate, businesses are seeking out new methods to effectively maintain their customer base. What few businesses realize is that the simple addition of landscaping to a store front can make a significant difference in how a customer perceives the store. The positive environment created by aesthetically-pleasing landscaping not only welcomes customers inside, but also enhances their perception of the level of quality of products and services offered by that store. Consumers are willing to pay higher prices, travel further to, and shop longer in a store that they perceive to be a quality establishment. Adding flowers or shrubs to the exterior of a business can boost sales and widen the consumer base to include more customers. In addition, ornamental plants are an effective way to revitalize a stale business, bring in additional customers, and improve the overall environment of the store. Furthermore, the presence of ornamental plants reduces shopping-related stress and customers feel more at ease in a store, which is a leading factor in increasing the total amount of time they spend shopping. Landscaping is an effective way to invite more customers to a store and to keep them coming back to experience the positive environment they encountered there (5, 55, 83, 122, 127).

Boost occupancy rates. Landscape amenities represent an effective tool to boost the occupancy rate of apartments and other commercial buildings. People enjoy aesthetically-pleasing areas and are much more likely to choose to live and work in buildings with attractive landscapes, so there is a high correlation between nice landscaping and high occupancy rates of buildings. It therefore becomes more economically feasible to invest money in landscaping because the return in the number of tenants and amount of rent money they represent far exceeds the cost of installing ornamental plants (68, 125).

Tourism revenue. Parks and botanical gardens have been shown to be effective tourist attractions in both large and small cities, and consequently, a strategic source for generating tourism revenue. Tourist expenditures on food, transportation, lodging, etc. represent additional sources of revenue for local businesses that provide these services. Moreover, new revenue from outside the region adds to the overall financial prosperity of a city's economy. Admissions and ancillary dollars from botanical parks also augment municipal revenue through the community's attendance at special events and recreational attractions held on park premises. This revenue gets filtered back into the economy and adds to the financial prosperity of the community (15, 44, 48, 125).

Job creation. Creating and maintaining urban green spaces requires a certain degree of manual labor. Therefore, green industry jobs must be created in order to meet this labor demand. The creation of new jobs not only helps keep members of the community employed, the associated payrolls also boost the local economy through increased spending and the income taxes that are generated, helping to ensure municipal financial solvency. Moreover, employed consumers generally utilize their disposable income to consumer goods and services, putting money back into local businesses and keeping the local market economy healthy (95, 98).

Reduced health care costs. Through the direct use of the free or fee-based recreational services, residents of an area with urban green spaces benefit from improved physical fitness. Residents are much more likely to exercise if there is an aesthetically-pleasing community park or other green space nearby for them to utilize. Healthy people spend less money each year on medical and other associated health care costs, and thus have more disposable income. By saving money on health care, residents tend to increase their spending on other services and goods (44, 48).

Increased property values. Home improvements can add significant value to a property, but may not always yield a 100% return on money invested, with the exception of landscaping. Landscaping yields, on average, a 109% return on every dollar spent, much more so than other home improvements. Home buyers respond positively to homes with professionally landscaped and manicured lawns, and consequently perceive a higher property value. With landscaping, it is possible to increase its value to potential buyers and receive a significant positive monetary return on this

external home improvement investment (8, 15, 23, 26, 44, 74, 83, 100, 126).

Tax revenue generation. Properties that are close to parks, botanical gardens, and other urban green spaces generally have a significantly increased property value compared to properties that are not. As such, they indirectly increase municipal revenues generated through its property tax base. The amount of additional property tax revenue generally means that urban green spaces are self-sustaining since cities can use the additional property tax income to pay for upkeep and improvements (22, 23).

Reduced street repairs. Planting trees along paved residential roads reduces temperatures on the ground and helps increase the longevity of the asphalt. When asphalt gets continually heated by the sun causing high temperatures, it tends to break down faster, requiring more frequent maintenance that can cost a great deal of money, and be a source of inconvenience for residents. The simple installation of shade trees greatly reduces the sun's effect on the asphalt, lowering the temperature of the ground and lengthening the asphalt's life span. This ensures that streets stay well-paved and usable for longer periods of time, saving the city money on maintenance costs, and providing residents with shade over pedestrian walkways (82, 90).

Environmental (ecosystems services) benefits

Carbon sequestration, improved air quality. Trees and other ornamental plants are crucial to the sequestration of carbon from the earth's atmosphere and play an important role in reducing the urban and rural carbon footprint. Research has shown that large trees can absorb significant amounts of carbon from the atmosphere each year, as the tree absorbs carbon dioxide and release oxygen through respiration. As such, trees and other landscape plants serve as an important tool in improving air quality in cities. Trees and landscaped areas absorb particulate matter in the air that would otherwise pollute the atmosphere. Increasing urban green spaces will also help to mitigate a city's already existing poor air quality, which can oftentimes be so poor that it adversely affects the population. Trees and landscape plants also help to absorb odors and potentially harmful chemicals in the air (15, 48, 74, 77, 78, 83, 84, 85, 88, 89, 122, 131, 132).

Attract wildlife and promote biodiversity. Cultivating urban green spaces is an effective way to help wildlife thrive in otherwise inhospitable areas. Providing animals a natural refuge away from highly populated areas minimizes the likelihood of animal populations being adversely affected by urban sprawl and vice versa. Maintaining urban biodiversity is an important aspect of keeping a city environmentally friendly and this biodiversity is sustained through the balance between ecosystems, populations, and their habitats, and ensuring that local animal populations have a place to live is a key aspect of sustaining this biodiversity (1, 15, 18, 24).

Energy savings. Planting trees and other ornamental plants around a building can significantly reduce the sun's radiation effect on the temperature of the outer walls and lower the associated cost of energy for heating and cooling. In turn, this means that heating and cooling the building will require less energy, reducing the environmental impact that the building will have on the community. Thus, planting trees around a building or business is not only a positive step towards reducing energy consumption, but it also has a significant financial benefit as well (7, 14, 28, 74, 80, 105, 108).

Reduce heat and cold damage. Trees offset the effects of heat waves and cold air, creating barrier between the walls of the building and the elements. Not only does this affect the building's temperature, it also reduces the effects of other negative effects of the weather, such as gradual wearing away of the walls. Surrounding a building with trees and landscaping is an effective way to protect it from the elements and, at the same time, lower heating and cooling costs (12, 41, 42, 81, 105, 107).

Offset heat islands. Most cities are largely composed of cement and asphalt, which absorb heat from the sun's rays during the daylight hours. This can make city life uncomfortable and hot, especially for people who choose to walk along pedestrian walkways. The inclusion of urban green spaces in a city's landscape can offset the urban heat islands that often occur. Trees and other landscaping plants absorb heat and sunlight, reducing cooling costs and creating a much more enjoyable urban environment for residents of a community (13, 14, 40, 73, 91, 108, 128).

Reduce noise pollution. Trees and urban green spaces can help to reduce the amount of noise in neighborhoods, benefitting both human and animal populations. Noise and light pollution can cause animals to shift activity patterns, urban noise pollutants can cause physiological stress, and the loss of top predators can cause mesopredator release. Landscaped areas absorb noise pollution (sound waves considered to be abrasive and annoying to residents). By installing natural landscaping, noise pollution levels can be significantly reduced. This improves the quality of life for both the human population in a community and the local wildlife who may be affected by unwanted noise (11, 33, 133).

Reduce soil erosion. Planting trees and cultivating landscaped areas is an effective way to reduce the amount of soil lost due to erosion. Tree and other ornamental plant roots create an infrastructure below the surface that helps anchor the soil in place during torrential downpours and holds twenty times more soil than traditional tilled soil. Above the surface, plant foliage and surface cover helps to reduce the wind's negative effects on topsoil, reducing the amount of soil lost as dust in the air. Urban green spaces also protect the fertility of the soil, ensuring that it remains sufficiently supplied with nutrients and minerals that enhance plant life (21, 34, 123).

Reduce storm water runoff/improved water quality. Green spaces absorb water in two ways: above the surface through the leaves and below ground through the root system. By absorbing water, trees and plants reduce the amount of runoff that the city has to deal with, pump out, or purify after significant rainfall events. This reduces the cost of storm water treatment plants and saves the city money. Landscaping is a natural solution to reducing storm water runoff. Landscaping also improves water quality by reducing the amount of dirty storm water that a city has to purify makes current purification methods more effective. Moreover, landscaping absorbs

some of the pollutants in the water, meaning that there is less pollution in the water that the city has to purify. Plants and trees improve water quality by ensuring that current purification methods can effectively treat reasonable amounts of runoff (6, 34, 53, 92, 104, 115, 129, 130).

Reduce urban glare. Urban glare is the excessive reflection of sunlight off of reflective surfaces such as windows and buildings. Green spaces reduce urban glare in cities by absorbing light, strategically placed landscaping becomes an important tool for city planners to capture the light and deflect it so that the light is not so harsh and unpleasant for residents and drivers, improving the quality of life in the community (106).

Windbreak. Urban green spaces can reduce the harmful effects of wind in cities by slowing the wind and greatly diminishing its strength, helping to preserve delicate natural environments which could be harmed by high speed winds. Minimizing wind strength also reduces soil erosion due to wind gusts, keeping soil healthy and hospitable for new growth. Moreover, it reduces the need for extensive heating and cooling in buildings by moderating the effects that wind would have on temperature (69, 72, 73).

Well-being benefits

Concentration and memory. The calming influence of natural environments is conducive to positive work environments by increasing a person's ability to concentrate on the task at hand. Work performed under the natural influence of ornamental plants is normally of higher quality and completed with a much higher accuracy rate than work done in environments devoid of nature. The influence of plants can increase memory retention up to twenty percent, stimulating the senses and improving mental cognition and performance (50, 99, 100, 124).

Learning. Keeping plants in a child's learning environment enhances learning capabilities by helping them to focus and concentrate. This improves their ability to learn new things and makes it easier for them to absorb and retain information. Ornamental plants are conducive to generating a positive learning environment, reducing children's tendency towards distraction and helping them to be better able concentrate on school work. Specifically for children with problems paying attention, adding plants to the classroom can have a dramatic positive effect on the way they learn. For example, for children with Attention Deficit Disorder, learning in a natural environment can help them to engage more in the classroom, improving their focus and concentration on the task at hand. The soothing effects of natural aesthetic beauty help to minimize the distractions that would otherwise occupy their minds. By altering the environment in which children learn, plants can help them to learn better (20, 25, 47, 87, 109, 119, 120).

Educational programs/special events. Botanical gardens and other entities utilizing naturalized green spaces often create educational programs for children (and adults) in order to teach them the value of being environmentally-conscious and conserving the environment. Parks and gardens foster an appreciation for nature that often instills in residents a sense of responsibility for the caring of and protection of the environment (25, 27, 71, 75, 76, 87).

Flowers generate happiness. Natural aesthetic beauty is soothing to people, and keeping flowers in and around the home and workplace environments is an excellent way to lower levels of stress and anxiety. People who keep flowers in their home feel happier and more relaxed. As a result of the positive energy they derive from the environment, the chances of suffering from stress-related depression are decreased as well (20, 31, 111, 112, 113, 114).

Reduce stress. Participation in gardening and landscaping activities is an effective way to reduce levels of stress. Studies have shown that people who nurture plants and garden have less mental distress than others. Gardening provides people with a positive way to channel their stress and frustration into something beautiful that provides them with comfort and joy. Part of the effects of gardening come from the satisfaction people get from nurturing and helping a living thing grow. Plants and gardening soothe people because they help them turn their stressful feelings into something positive which gives them pleasure. By helping them transform their stress into a more positive emotion, gardening also gives people an excellent coping mechanism for their daily frustrations. Nurturing plants reduces stress levels and gives people a way to cope with their negative feelings (2, 16, 21, 52, 66).

Health and recreation. Parks and urban green spaces impact people's health by providing them with an inexpensive (often free) and convenient recreational service. There is a positive correlation between the presence of a park in a neighborhood and the level of physical activity of the residents; people are much more likely to exercise when there is a no-cost, aesthetically pleasing area or facility for them to use. As a result, residents of neighborhoods with beautiful parks are more likely to be healthy since their increase in exercise makes them less susceptible to physical ailments and more resilient against minor illnesses. As a result, these residents do not spend as much each year on health care and medical treatment because they require fewer of these services. Healthy people are happier people; residents who exercise often have excellent overall health and therefore have a more positive mental outlook (1, 20, 21, 32, 36, 39, 45, 51, 57, 58, 59, 63, 64, 79, 93, 101, 102, 116, 117).

Accelerates healing process. Plants and ornamental shrubs and flowers have a practical application in hospitals: the presence of plants in patient recovery rooms has been shown to reduce the time necessary to heal. The soothing effects of ornamental flowers and plants are so great that simply having daily views of flowers and other ornamental plants in landscaped areas outside patient recovery room can also significantly speed up recovery time. Another technique to decrease recovery time is horticulture therapy, where patients care for and nurture plants themselves. Many patients who physically interact with plants experience a significantly reduced recovery time after medical procedures (65, 93, 97, 102).

Therapeutic effects of gardening. Gardening can have therapeutic effects on people who have undergone either mental or physical trauma. The act of nurturing a plant can

provide victims with a way to work through difficult issues and heal their wounds. Gardening is a therapeutic tool that can be used to help put people in a better psychological state during recovery and help them to work past the mental barriers that could impede their healing (2, 3, 17, 37, 38, 54, 96, 97, 109).

Improves relationships/compassion. Ornamental plants affect the level of compassion that people feel towards others. Studies have shown that people who spend more time around plants are much more likely to try and help others, and often have more advanced social relationships. People who care for nature are more likely to care for others, reaching out to their peers and forming shared bonds resulting from their common interests. Extended exposure to nature and wildlife increases people's compassion for each other as it increases people's compassion for the environment in which they live. In short, being around plants improves relationships between people and increases their concern and empathy toward others (4, 103).

Improved human performance/energy. Spending time in nature gives people an increased feeling of vitality, increasing their energy levels and making them feel more animated. Their performance levels are, in turn, increased by this improved state of mind. Natural environments induce a positive outlook on life, making people feel more alive and active. Plants can help people to improve their performance at work and at home by increasing their perceived vitality and giving them more feelings of added energy (5, 94, 100).

Medicinal properties. One of the more obvious benefits of plants and trees is that many of them have valuable medicinal properties. Cultivating plants provides opportunities for additional scientific studies of the possible positive medicinal values of plants. Natural herbal remedies are simple and holistic methods for treating common illnesses and maladies. By cultivating plants we can continue to cultivate our knowledge of the natural world and arm ourselves with more defenses against disease and infection (121).

Mental health. People who spend more time outside in nature have a significantly more positive outlook on life than people who spend a great deal of time indoors. Living in naturalized settings increases people's feelings of vitality and energy, and consequently has a large positive effect on their overall mental health (2, 17, 30, 35, 49, 50, 59, 70, 118).

Reduce community crime/community cohesion. When residents feel greater pride in the beauty of where they live, they are much less likely to detract from it (either by graffiti or endangering people within it). Communities that choose to clean up their parks and beautify crime-ridden neighborhoods have less crime and fewer criminals to deal with. Parks can positively affect the community be reducing criminal acts and bringing residents together. Cohesion in the community is critical to the success of the community as a whole, and this can be achieved through unifying people around a park or botanical garden. Parks decrease incentives for people to commit crimes in the community, and at the same time help to bring neighbors together. They can also increase local political activism. Urban green spaces inspire people to come together and fight for what they know is holding them together as a community (19, 29, 43, 58, 59, 60, 61, 62, 67, 110, 134).

Traffic safety/driver satisfaction. Beautifying traffic medians not only improves the aesthetics of the roadways, it also affects driver attitudes. Studies show that drivers are more at ease on roadways with natural landscaping, and are much more inclined to think positively about the community that they are driving through if the roadways are beautiful. Furthermore, adding trees to roadways creates a sort of natural obstruction which could reduce the likelihood of cars crossing medians into oncoming traffic lanes. This improves driver safety and makes the community a safer place for everyone to live (10, 90, 94, 86).

Upgrade effect. As more businesses and neighborhoods take on the task of beautifying their surroundings, other competing areas will be forced to follow suit. In other words, as a community works to better itself, other parts of the area will be forced to upgrade as well to keep drawing people in; this phenomenon is known as the upgrade effect. The upgrade effect positively affects everyone, because it keeps communities from ignoring the benefits of landscaping and developing green spaces, it forces competition and keeps the area looking beautiful. Neighborhoods will be encouraging each other to keep beautifying the landscaping, setting off a cycle of self-improvement that has positive ripple effects outwards to all sectors of the community (9, 122).

Summary

Post-recession consumers are willing to undergo greater search, acquisition, and learning costs in making decisions regarding purchases of big-ticket items (such as landscaping). They have, however, 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 paper has demonstrated that substantial peer-reviewed research has been conducted that illustrates the manner in which green industry products and services enhance the quality of life for consumers by providing significant economic benefits, environmental amenities in the form of eco-systems services, and a plethora of health and well-being benefits. This research should 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 for consumers of the future.

Literature Cited

1. 2008. Ecosystems and human well-being: Biodiversity synthesis. *In*: Bledzki, L. (ed.), Encyclopedia of Earth. World Resources Institute. http://www.eoearth.org/article/Ecosystems_and_Human_Well-being:_Biodiversity_Synthesis_full_report. Accessed December 15, 2010.

2. Adachi, M., C.L.E. Rohde, and A.D. Kendle. 2000. Effects of floral and foliage displays on human emotions. HortTechnology 10:59–63.

3. Aldous, D.E. 2000. Perspectives on horticultural therapy in australia. HortTechnology 10:18–23.

4. Andrews, M. and B. Gatersleben. 2010. Variations in perceptions of danger, fear and preference in a simulated natural environment. J. Environ. Psychology 30:473–481.

5. Appleseed, Inc. 2009. Valuing Central Park's contributions to New York City's economy. http://www.appleseedinc.com/reports/centralpark-may2009.pdf. Accessed December 15, 2010.

6. Baron, J.S., N.L. Poff, P.L. Angermeier, C.N. Dahm, P.H. Gleick, N.G. Hairston, R.B. Jackson, C.A. Johnston, B.D. Richter, and A.D. Steinman. 2002. Meeting ecological and societal needs for freshwater. Ecological Applications 12:1247–1260.

7. Barradas, V.L. 2000. Energy balance and transpiration in an urban tree hedgerow in mexico city. Urban Ecosystems 4:55–67.

8. Behe, B., J. Hardy, S. Barton, J. Brooker, T. Fernandez, C. Hall, J. Hicks, R. Hinson, P. Knight, R. McNiel, T. Page, B. Rowe, C. Safley, and R. Schutzki. 2005. Landscape plant material, size, and design sophistication increase perceived home value. J. Environ. Hort. 23:127–133.

9. Benedict, M. and E.T. McMahon. 2003. How cities use parks for green infrastructure. American Planning Association.

10. Blaha, K. 2005. How cities use parks for smart growth. American Planning Association.

11. Bolund, P. and S. Hunhammar. 1999. Ecosystem services in urban areas. Ecological Economics 29:293–301.

12. Bonan, G.B. 2008. Forests and climate change: Forcings, feedbacks, and the climate benefits of forests. Science 320:1444–1449.

13. Bowler, D.E., L. Buyung-Ali, T.M. Knight, and A.S. Pullin, 2010. Urban greening to cool towns and cities: A systematic review of the empirical evidence. Landscape and Urban Planning 97:147–155.

14. Bradshaw, J. and L. Tozer. 1993. Enviroscaping to conserve energy: A guide to microclimate modification. University of Florida, Gainesville, FL.

15. Brethour, C., G. Watson, B. Sparling, D. Bucknell, and T.-L. Moore. 2007. Literature review of documented health and environmental benefits derived from ornamental horticulture products. Agriculture and Agri-Food Canada Markets and Trade, Ottawa, ON.

16. Bringslimark, T., T. Hartig, and G.G. Patil. 2007. Psychological benefits of indoor plants in workplaces: Putting experimental results into context. HortScience 42:581–587.

17. Bringslimark, T., T. Hartig, and G.G. Patil. 2009. The psychological benefits of indoor plants: A critical review of the experimental literature. J. Environ. Psychology 29:422–433.

18. Burghardt, K.T., D.W. Tallamy, and W.G. Shriver. 2009. Impact of native plants on bird and butterfly biodiversity in suburban landscapes. Conservation Biology 23:219–224.

19. Chon, J.H. and C.S. Shafer. 2009. Aesthetic responses to urban greenway trail environments. Landscape Res. 34:83–104.

20. Collins, C.C. and A.M. O'Callaghan. 2008. The impact of horticultural responsibility on health indicators and quality of life in assisted living. HortTechnology 18:611–618.

21. Criley, R.A. 2008. Ornamentals — more than just beautiful. Proceedings of the International Workshop on Ornamental Plants 788:23–28.

22. Crompton, J.L. 2005. How cities use parks to promote tourism. American Planning Association.

23. Crompton, J.L. 2004. The proximate principle: The impact of parks, open space and water features on residential property values and the property tax base. National Recreation and Park Association, Ashburn, VA.

24. Dearborn, D.C. and S. Kark. 2010. Motivations for conserving urban biodiversity. Conserv. Biol. 24:432–440.

25. DeMarco, L.W., D. Relf, and A. McDaniel. 1999. Integrating gardening into the elementary school curriculum. HortTechnology 9:276–281.

26. Des Rosiers, F., M. Thériault, Y. Kestens, and P. Villeneuve. 2002. Landscaping and house values: An empirical investigation. Journal of Real Estate Research 23:139–161.

27. Dobbs, K., D. Relf, and A. McDaniel. 1998. Survey on the needs of elementary education teachers to enhance the use of horticulture or gardening in the classroom. HortTechnology 8:370–373.

28. Donovan, G.H. and D.T. Butry. 2009. The value of shade: Estimating the effect of urban trees on summertime electricity use. Energy and Buildings 41:662–668.

29. Donovan, G.H. and J.P. Prestemon. 2010. The effect of trees on crime in Portland, Oregon. Environment and Behavior. doi: 10.1177/0013916510383238.

30. Dravigne, A., T.M. Waliczek, R.D. Lineberger, and J.M. Zajicek. 2008. The effect of live plants and window views of green spaces on employee perceptions of job satisfaction. HortScience 43:183–187.

31. Dunnett, N. and M. Qasim. 2000. Perceived benefits to human well-being of urban gardens. HortTechnology 10:40–45.

32. Elings, M. 2006. People-plant interaction — the physiological, psychological and sociological effects of plants on people. Farming for Health: Green-Care Farming Across Europe and the United States of America 13:43–55.

33. Elmqvist, T., J. Colding, S. Barthel, S. Borgstrom, A. Duit, J. Lundberg, E. Andersson, K. Ahrne, H. Ernstson, C. Folke, and J. Bengtsson. 2004. The dynamics of social-ecological systems in urban landscapes — Stockholm and the national urban park, Sweden, p. 308–322. *In*: AlfsenNorodom, C., B.D. Lane, and M. Corry (eds.), Urban Biosphere and Society: Partnership of Cities.

34. Endreny, T.A. 2004. Storm water management for society and nature via service learning, ecological engineering and ecohydrology. Internat. J. Water Resources Devel. 20:445–462.

35. Evers, A.-M., L. Linden, and E. Rappe. 2000. A review of human issues in horticulture in finland: Urbanization motivates a renewed appreciation for plants and nature. HortTechnology 10:24–26.

36. Fjeld, T. 2000. The effect of interior planting on health and discomfort among workers and school children. HortTechnology 10:46–52.

37. Flagler, J.S. 1992. Master gardeners and horticultural therapy. HortTechnology 2:249–250.

38. Fried, G.G. and M.J. Wichrowski. 2008. Horticultural therapy: A psychosocial treatment option at the Stephen D. Hassenfeld Children's Center for Cancer and Blood Disorders. Primary Psychiatry 15(7):73–77.

39. Frumkin, H. and M.E. Eysenbach. 2003. How cities use parks to improve public health. American Planning Association.

40. Gallo, K.P., A.L. McNab, T.R. Karl, J.F. Brown, J.J. Hood, and J.D. Tarpley. 1993. The use of a vegetation index for assessment of the urban heat-island effect. Internat. J. Remote Sensing 14:2223–2230.

41. Georgi, N. and K. Zafiriadis. 2006. The impact of park trees on microclimate in urban areas. Urban Ecosystems 9:195–209.

42. Gómez-Muñoz, V.M., M.A. Porta-Gándara, and J.L. Fernández. 2010. Effect of tree shades in urban planning in hot-arid climatic regions. Landscape and Urban Planning 94(4):149–157.

43. Gorham, M.R., T.M. Waliczek, A. Snelgrove, and J.M. Zajicek. 2009. The impact of community gardens on numbers of property crimes in urban Houston. HortTechnology 19:291–296.

44. Grimm, N.B., D. Foster, P. Groffman, J.M. Grove, C.S. Hopkinson, K.J. Nadelhoffer, D.E. Pataki, and D.P.C. Peters. 2008. The changing landscape: Ecosystem responses to urbanization and pollution across climatic and societal gradients. Frontiers in Ecology and the Environment 6:264–272.

45. Grinde, B. and G.G. Patil. 2009. Biophilia: Does visual contact with nature impact on health and well-being? Internat. J. Env. Res. Pub. He. 6:2332–2343.

46. Hall, C.R. 2010. Making cents of green industry economics. HortTechnology 20:832–835.

47. Hamilton, S.L. and K. DeMarrais. 2001. Visits to public gardens: Their meaning for avid gardeners. HortTechnology 11:209–215.

48. Harnick, P. 2002. How cities use parks for community revitalization. American Planning Association.

49. Hartig, T., M. Mang, and G.W. Evans. 1991. Restorative effects of natural environment experiences. Environment and Behavior 23:3–26.

50. Haviland-Jones, J., H.H. Rosario, P. Wilson, and T.R. McGuire. 2005. An environmental approach to positive emotion: Flowers. Evolutionary Psychology 3:104–132.

51. Hull, R.B. and R.S. Ulrich. 1992. Health benefits and costs of urban trees. Proceedings of the Fifth National Urban Forest Conference, p. 69–72.

52. Iles, J.K. 2003. The science and practice of stress reduction in managed landscapes. Environmental Stress and Horticulture Crops, p. 117–124.

53. Jackson, R.B., S.R. Carpenter, C.N. Dahm, D.M. McKnight, R.J. Naiman, S.L. Postel, and S.W. Running. 2001. Water in a changing world. Ecological Applications 11:1027–1045.

54. Jarrott, S.E., H.R. Kwack, and D. Relf. 2002. An observational assessment of a dementia-specific horticultural therapy program. HortTechnology 12:403–410.

55. Joye, Y., K. Willems, M. Brengman, and K. Wolf. 2010. The effects of urban retail greenery on consumer experience: Reviewing the evidence from a restorative perspective. Urban Forestry & Urban Greening 9:57–64.

56. Kelley-Gillespie, N. 2009. An integrated conceptual model of quality of life for older adults based on a synthesis of the literature. Applied Research in Quality of Life 4:259–282.

57. Kohlleppel, T., J.C. Bradley, and S. Jacob. 2002. A walk through the garden: Can a visit to a botanic garden reduce stress? HortTechnology 12:489–492.

58. Kuo, F.E. 2003. The role of arboriculture in a healthy social ecology. J. Aboriculture 29:148–155.

59. Kuo, F.E. 2004. Horticulture, well-being, and mental health: From intuitions to evidence. Expanding Roles for Horticulture in Improving Human Well-Being and Life Quality, p. 27–34.

60. Kuo, F.E., M. Bacaicoa, and W.C. Sullivan. 1998. Transforming inner-city landscapes — trees, sense of safety, and preference. Environment and Behavior 30:28–59.

61. Kuo, F.E. and W.C. Sullivan. 2001. Environment and crime in the inner city — does vegetation reduce crime? Environment and Behavior 33:343–367.

62. Kuo, F.E., W.C. Sullivan, R.L. Coley, and L. Brunson. 1998. Fertile ground for community: Inner-city neighborhood common spaces. American Journal of Community Psychology 26:823–851.

63. Kuo, F.E. and A.F. Taylor. 2004. A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study. Am. J. Public Health 94:1580–1586.

64. Kuo, F.E. and A.F. Taylor. 2005. Mother nature as treatment for adhd: Overstating the benefits of green-response. Am. J. Public Health 95:371–372.

65. Kwack, H.R. and P.D. Relf. 2002. Current status of human issues in horticulture in Korea. HortTechnology 12:415–419.

66. Kweon, B.S., R.S. Ulrich, V.D. Walker, and L.G. Tassinary. 2008. Anger and stress — the role of landscape posters in an office setting. Environment and Behavior 40:355–381.

67. Landscape and Human Health Laboratory. 2003. How cities use parks to create safer neighborhoods. American Planning Association. http://www.planning.org/cityparks/briefingpapers/saferneighborhoods.htm. Accessed December 15, 2010.

68. Laverne, R.J. and K. Winson-Geideman. 2003. The influence of trees and landscaping on rental rates at office buildings. J. Aboriculture 29:281–290.

69. Lehvävirta, S. 2007. Non-anthropogenic dynamic factors and regeneration of (hemi)boreal urban woodlands — synthesising urban and rural ecological knowledge. Urban Forestry & Urban Greening 6:119–134.

70. Lewis, C.A. 1996. Green nature/human nature: The meaning of plants in our lives. Urbana and Chicago: University of Illinois Press.

71. Lohr, V.I. and C.H. Pearson-Mims. 2005. Children's active and passive interactions with plants influence their attitudes and actions toward trees and gardening as adults. HortTechnology 15:472–476.

72. Long, A.J. and P.K.R. Nair. 1999. Trees outside forests: Agro-, community, and urban forestry. New Forests 17:145–174.

73. MacDonald, J.A. 2007. How cities use parks for climate change management. American Planning Association.

74. Maco, S.E. and E.G. McPherson. 2003. A practical approach to assessing structure, function and value of street tree population in small communities. J. Aboriculture 29:84–97.

75. Matsuo, E. 2000. Education, research, and use of human-horticulture relationships in japan and korea. HortTechnology 10:14–17.

76. McDaniel, A. and D. Relf. 1998. Master gardener judges in state and national horticulture career development events. HortTechnology 8:71–74.

77. Mcpherson, E.G. 1988. Functions of buffer plantings in urban environments. Agr. Ecosyst. Environ. 22:281–298.

78. Mcpherson, E.G. 1992. Environmental benefits and costs of the urban forest. Proceedings of the Fifth National Urban Forest Conference, p. 52–54.

79. Mcpherson, E.G. 1993. Monitoring urban forest health. Environ. Monit. Assess. 26:165–174.

80. Mcpherson, E.G. 1994. Using urban forests for energy efficiency and carbon storage. J. Forestry 92:36–41.

81. Mcpherson, E.G., L.P. Herrington, and G.M. Heisler. 1988. Impacts of vegetation on residential heating and cooling. Energy and Buildings 12:41–51.

82. McPherson, E.G. and J. Muchnick. 2005. Effects of street tree shade on asphalt concrete pavement performance. J. Arboriculture 31:303–310.

83. McPherson, E.G. and J.R. Simpson. 2002. A comparison of municipal forest benefits and costs in modesto and santa monica, california, USA. Urban Forestry & Urban Greening 1:61–74.

84. McPherson, E.G., J.R. Simpson, and K.I. Scott. 1996. "Bact" analysis: Are there cost effective air quality benefits from trees? Ninth Joint Conference on Applications of Air Pollution Meteorology with A&WMA, p. 355–359.

85. McPherson, G., J.R. Simpson, P.J. Peper, S.E. Maco, and Q.F. Xiao. 2005. Municipal forest benefits and costs in five us cities. J. Forestry 103:411–416.

86. Mok, J.H., H.C. Landphair, and J.R. Naderi. 2006. Landscape improvement impacts on roadside safety in texas. Landscape and Urban Planning 78:263–274.

87. Moore, R. 2003. How cities use parks to help children learn. American Planning Association.

88. Newell, R.G. and R.N. Stavins. 2000. Climate change and forest sinks: Factors affecting the costs of carbon sequestration. J. Environ. Econ. Mgmt. 40:211–235.

89. Nowak, D.J. and D.E. Crane. 2002. Carbon storage and sequestration by urban trees in the USA. Environmental Pollution 116:381–389.

90. Nowak, D.J. and G.M. Heisler. 2005. Trees in the city: Measuring and valuing the urban forest. NE Forest Science Review 4:1–6.

91. Nowak, D.J., R.A. Rowntree, E.G. McPherson, S.M. Sisinni, E.R. Kerkmann, and J.C. Stevens. 1996. Measuring and analyzing urban tree cover. Landscape and Urban Planning 36:49–57.

92. Panno, S.V., V.A. Nuzzo, K. Cartwright, B.R. Hensel, and I.G. Krapac, 1999. Impact of urban development on the chemical composition of ground water in a fen-wetland complex. Wetlands 19:236–245.

93. Park, S. and R.H. Mattson. 2009. Ornamental indoor plants in hospital rooms enhanced health outcomes of patients recovering from surgery. J. Alternative & Complementary Medicine 15:975–980.

94. Pauleit, S. 2003. Urban street tree plantings: Indentifying the key requirements. Proceedings of the Institution of Civil Engineers-Municipal Engineer 156:43–50.

95. Platt, R.H. 2004. Regreening the metropolis: Pathways to more ecological cities. p. 49–61, Urban Biosphere and Society: Partnership of Cities.

96. Predny, M.L. and D. Relf. 2000. Interactions between elderly adults and preschool children in a horticultural therapy research program. HortTechnology 10:64–70.

97. Raanaas, R.K., G.G. Patil, and T. Hartig. 2010. Effects of an indoor foliage plant intervention on patient well-being during a residential rehabilitation program. HortScience 45:387–392.

98. Rexhausen, J. and A. Dubey. 2007. The economic impact of the cincinnati zoo & botanical garden on greater Cincinnati. Economics Center for Education & Research, University of Cincinnati.

99. Rishbeth, C. and N. Finney. 2006. Novelty and nostalgia in urban greenspace: Refugee perspectives. Tijdschr Econ. Soc. Ge. 97:281–295.

100. Ryan, R.M., N. Weinstein, J. Bernstein, K.W. Brown, L. Mistretta, and M. Gagne. 2010. Vitalizing effects of being outdoors and in nature. J. Environ. Psychology 30:159–168.

101. Sallis, J.F., P.R. Nader, S.L. Broyles, C.C. Berry, J.P. Elder, T.L. Mckenzie, and J.A. Nelson. 1993. Correlates of physical-activity at home in mexican-american and anglo-american preschool-children. Health Psychol. 12:390–398.

102. Sherman, S.A., J.W. Varni, R.S. Ulrich, and V.L. Malcarne. 2005. Post-occupancy evaluation of healing gardens in a pediatric cancer center. Landscape and Urban Planning 73:167–183.

103. Shoemaker, C.A., K. Randall, P.D. Relf, and E.S. Geller. 1992. Relationships between plants, behavior, and attitudes in an office environment. HortTechnology 2:205–206.

104. Shuster, W.D., R. Gehring, and J. Gerken. 2007. Prospects for enhanced groundwater recharge via infiltration of urban storm water runoff: A case study. J. Soil and Water Conservation 62:129–137.

105. Simpson, J.R. and E.G. McPherson. 1998. Simulation of tree shade impacts on residential energy use for space conditioning in Sacramento. Atmospheric Environment 32:69–74.

106. Smardon, R.C. 1988. Perception and aesthetics of the urban environment: Review of the role of vegetation. Landscape and Urban Planning 15:85–106.

107. Spronken-Smith, R.A. and T.R. Oke. 1999. Scale modelling of nocturnal cooling in urban parks. Boundary-Layer Meteorology 93:287–312.

108. Spronken-Smith, R.A., T.R. Oke, and W.P. Lowry. 2000. Advection and the surface energy balance across an irrigated urban park. Internat. J. Climatology 20:1033–1047.

109. Stoneham, J.A., A.D. Kendle, and P.R. Thoday. 1995. Horticultural therapy: Horticulture's contribution to the quality of life of disabled people. p. 65–75. Horticulture in Human Life, Culture, and Environment.

110. Sullivan, W.C., F.E. Kuo, and S.F. DePooter. 2004. The fruit of urban nature — vital neighborhood spaces. Environment and Behavior 36:678–700.

111. Taylor, A.F. and F.E. Kuo. 2009. Children with attention deficits concentrate better after walk in the park. J. Atten. Disord. 12:402–409.

112. Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2001. Coping with ADD — the surprising connection to green play settings. Environment and Behavior 33:54–77.

113. Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2002. Views of nature and self-discipline: Evidence from inner city children. J. Environ. Psychology 22:49–63.

114. Taylor, A.F., A. Wiley, F.E. Kuo, and W.C. Sullivan. 1998. Growing up in the inner city — green spaces as places to grow. Environment and Behavior 30:3–27.

115. Tyrvainen, L. 1997. The amenity value of the urban forest: An application of the hedonic pricing method. Landscape and Urban Planning 37:211–222.

116. Ulrich, R.S. 1986. Human responses to vegetation and landscapes. Landscape and Urban Planning 13:29–44.

117. Ulrich, R.S. 1990. The role of trees in human well-being and health. Proceedings of the Fourth Urban Forestry Conference, p. 25–30.

118. Ulrich, R.S., R.F. Simons, B.D. Losito, E. Fiorito, M.A. Miles, and M. Zelson. 1991. Stress recovery during exposure to natural and urban environments. J. Environ. Psychology 11:201–230.

119. Waliczek, T.M., R.D. Lineberger, and J.M. Zajicek. 1998. Studying children's perceptions of garden benefits using the internet. HortScience 33:504-c.

120. Waliczek, T.M., R.D. Lineberger, J.M. Zajicek, and J.C. Bradley. 2000. Using a web-based survey to research the benefits of children gardening. HortTechnology 10:71–76.

121. Warber, S.L., M.D. Fetters, and P.B. Kaufmann. 2003. Environmental ethics: Finding a moral compass for human-plant interaction (reprinted from creating a sustainable future: Living in harmony with the earth, 2001). Altern. Ther. Health M. 9:100–105.

122. Werner. J.E.B., J. Raser, T.J. Chandler, and M. O'Gorman. 1996. A study of the economic impacts of trees and forests in the commercial districts of New York City and New Jersey. New York Street Tree Consortium, Inc.

123. Wessel, W.W., A. Tietema, C. Beier, B.A. Emmett, J. Penuelas, and T. Riis-Nielsen. 2004. A qualitative ecosystem assessment for different shrublands in western Europe under impact of climate change. Ecosystems 7:662–671.

124. Wilson, P., C. Coffield, and J. Haviland-Jones. 2006. Floral odor prompts positive emotional searches. Chem Senses 31:A142–A142.

125. Wolf, K.L. 2004. Nature in the retail environment: Comparing consumer and business response to urban forest conditions. Landscape J. 23:40–51.

126. Wolf, K.L. 2005. Business district streetscapes, trees, and consumer response. J. Forestry 103:396–400.

127. Wolf, K.L. 2005. Trees in the small city retail business district: Comparing resident and visitor perceptions. J. Forestry 103:390–395.

128. Xian, G. and M. Crane. 2006. An analysis of urban thermal characteristics and associated land cover in tampa bay and las vegas using landsat satellite data. Remote Sensing of Environ. 104:147–156.

129. Xiao, Q. and E.G. McPherson. 2002. Rainfall interception by santa monica's municipal urban forest. Urban Ecosystems 6:291–302.

130. Xiao, Q., E.G. McPherson, J.R. Simpson, and S.L. Ustin. 2007. Hydrologic processes at the urban residential scale. Hydrol. Process. 21:2174–2188.

131. Yang, D.S., S.V. Pennisi, K.-C. Son, and S.J. Kays. 2009. Screening indoor plants for volatile organic pollutant removal efficiency. HortScience 44:1377–1381.

132. Yang, J., L. Zhao, J. McBride, and P. Gong. 2009. Can you see green? Assessing the visibility of urban forests in cities. Landscape and Urban Planning 91:97–104.

133. Younis, A., M. Qasim, and A. Riaz. 2008. Case study: Impact of a well-planned landscape in delivering quality of life to city dwellers. Acta Hortic:147–154.

134. Zampini, J.W. 1992. Down to earth benefits of people-plant interactions in our community. HortTechnology 2:177–179.