Think Before You Remove Your Lawn! –The Benefits of Turfgrass

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Paper Summary

Driven primarily by concerns over water supply limitations, as well as by environmental impacts such as pesticide residues in stormwater, some groups encourage the reduction or even elimination of lawn and turf areas associated with homes, as well as in public spaces. While concerns associated with water supply may be legitimate in some areas of the country, this paper argues that the push to remove grass areas can be short-sighted since such actions:

1. Do not recognize the numerous benefits that accrue from having turfgrass areas;
2. Overlook the myriad ways by which healthy turf areas can be maintained optimally with far lower water usage, thereby preserving all or most of its benefits; and
3. Rely often on erroneously based data, preconceived perceptions and emotion, which have no place in thoughtful policy making.

Indeed, after reviewing published, fact-based research, turfgrass proves itself to be much more than an aesthetic choice for homeowners and areas. In fact, turfgrass has many lifestyle and environmental benefits including the:

- Capture of Water Runoff and Dust in the Air
- Lessening of the Heat Island Effect
- Capturing and Storing of Carbon in Roots
- Boosting of One's Oxygen Footprint

Introduction

[1] Vitae provided in Attachment A

Lawn and turfgrass areas have a long history in the US.[2] While most home owners value lawns for their obvious aesthetic or ornamental values, and most citizens express a preference for turf areas in public spaces based on their visible advantages, the equally important, invisible and crucial benefits due to lawns are often not recognized or understood.

Similarly, the visible drawbacks associated with lawns, such as images of overwatering lawns on hot summer days in arid climates or obvious excessive fertilizer use, often drive knee-jerk, generalized, negative reactions to all lawns and all turf areas as being nothing more than "… water-wasting, pesticide-addicted, fertilizer-dependent, landfill-clogging, energy-consuming insults to mankind and the environment."[3]

In addition to lower water consumption, advocates of smaller (or no) lawns note that there is less yard waste, less time and energy spent on lawn maintenance, reduction in the use of herbicides, pesticides, and synthetic fertilizers, reduction in air and noise pollution caused by lawn mowers, enhanced biodiversity, and an improvement in property values.[4] Using such reasoning, often drawn from extreme ends of the misuse spectrum, critics then drive policy makers to eliminate lawns via ordinances or legislation. Usually, criticisms are unsupported by facts or are distortions, whether deliberate or unwitting. Let us briefly examine the main criticisms.

Main Criticisms of Lawns

First, many point out the excessive use of watering for lawns. However, excessive use of water and pesticides is neither necessary nor desirable for maintaining healthy turfgrass. In fact, what is often lost in the rancorous debate is that turfgrasses evolved over millions of years without irrigation systems and pesticides.

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[2] http://www.american-lawns.com/history/history_lawn.html

[3] Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes, Council for Agricultural Science and Technology (CAST), Special Publication 27, 2006, page 11. Hereafter, this critical work will be referred to as CAST 2006.

[4] http://www.eartheasy.com/article_lawn_reduce.htm

Second, many point out the emissions from lawn equipment. But, it is ironic that critics fail to note the tremendous reduction in air emissions[5] and noise emanations (equipment will be 95 percent cleaner under EPA's latest emissions standards) that have been achieved from lawn and garden equipment in recent years, and the fact that managing lawn and turf areas lead to reductions in dust pollution.

Third, the assumption of increased biodiversity due to removal of lawns is naïve given that the usual replacement of lawns and turf areas is by paved surfaces or synthetic surfaces, which do not encourage any sort of biodiversity.

Lastly, and probably the most daring claim, is that the reduction of lawn areas leads to an improvement in property values. This simply flies in the face of innumerable studies that show just the opposite – namely that lawns and green spaces *increase* property values.

Goals of Paper

Contrary to the mostly anecdotally-based criticisms noted above, this paper will briefly summarize the numerous, documented benefits from lawns. It stakes no claim to originality in this regard since most of these benefits have been noted elsewhere,[6] and in more detail. However, it does attempt to summarize such information.

This paper also recognizes that there are times and places and situations where turfgrass, or more specifically, particular types of turfgrass and/or associated turf management practices may not be appropriate. But, getting rid of all turfgrasses everywhere is not the answer.

Just as no one would suggest that the proper response to a headache is removal of one's head, the proper strategy in minimizing drawbacks due to turfgrass is the *optimization*, not elimination.

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[5] http://www.epa.gov/OMS/equip-ld.htm

[6] See, for example, Beard, J. B. and R. L. Green. 1994. The role of turfgrasses in environmental protection and their benefits to humans. *J Environ Qual* 23(9):452–460. See also the CAST 2006 report for extensive detailed discussions of the issues discussed in this paper.

Optimization starts with proper selection of turfgrasses suitable for specific climatic regions, includes proper and appropriate cultural practices for turf maintenance including optimized watering and cuttings management, sparing pesticide use, and judicious use of technology. This requires careful consideration and weighing of the site and case-specific values of turfgrass, both positive and negative. With proper education and awareness,[7] reliance on technology,[8] and via additional research, it is now possible to retain the benefits of lawns and turfgrass areas while minimizing or eliminating the negatives associated with water overuse and other harmful practices.

Recognized Benefits of Turfgrass

A. Turfgrass as Carbon Sink

Properly managed turf areas are significant carbon sinks, even accounting for the carbon emissions associated with maintenance, such as from mowers, pesticide use, and irrigation water delivery. It has been shown that carbon sequestration in turf areas can range anywhere from four to seven times the carbon emissions, and that proper management enhances the sequestration benefit.[9]

In fact, elimination of turfgrass will result in a reversal (i.e., increase in carbon emissions that cannot be sequestered) of this benefit, adding to the atmospheric burden. Clearly, as we grapple with ways to reduce atmospheric green house gas loadings, including that of carbon dioxide, this benefit alone should cause a thorough re-assessment of any policy that encourages reduction in turfgrass areas. Arguably, this benefit should encourage the growth of properly managed turf

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[7]Most people are unaware that turfgrasses can survive on much lower amounts of water; that there are numerous turfgrass species that have good drought resistance; and therefore there are suitable and sustainable grass species appropriate to each climatic constraint. See http://www.urbanext.uiuc.edu/lawnchallenge/lesson4.html for a discussion of the proper management lawn management technique. Similar articles are available in each state, targeted at the specific geographical needs of that state or local area.

[8] CAST 2006, Chapter 13.

[9]Technical Assessment of the Carbon Sequestration Potential of Managed Turfgrass in the United States, Dr. Ranajit (Ron) Sahu.

areas. In this regard, proper management implicitly recognizes low water use and sustainable pesticide application.

B. Airborne Dust Minimization and Resulting Disease Reduction

As described in the article by Dr. Beard[10], dust -- by the hundreds of millions of tons -- circles the earth annually[11] (Garrison et al. 2003). Such fugitive[12] dust is a serious atmospheric pollutant. In the U.S. there are National Ambient Air Quality Standards (NAAQS) for various sizes of such dust, also called particulate matter (PM).[13] The adverse health effects of dust exposure, particularly those of the finer sizes (such as of less than 10 microns in diameter, PM10; or less than 2.5 microns, called PM2.5) which can be inhaled and can be deposited deep in the lungs is well known.[14]

As EPA notes, such particles have been associated with premature mortality and other health effects. In the CAST 2006 article, it is also noted that dust contains microbes[15] known to be pathogenic to humans including anthrax, aspergillosis, coccidioidomycosis, hantavirus pulmonary syndrome, influenza, meningococcal meningitis, and tuberculosis.[16] Dr. Beard then discusses the increase in dust emissions associated with China's policy of removal of grassed lawns, which were viewed as symbols of a capitalistic society in the 1960s, and its subsequent reduction by a reversal of policy (i.e., by reintroduction of turfgrass onto bare areas) in later decades.

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[10] CAST 2006, Ch. 2.

[11] Garrison, V. H., E. A. Shinn, W.T. Foreman, D.W. Griffin, C.W. Holmes, C. A. Kellogg, M. S. Majewski, L. L. Richardson, K .B. Ritchie, and G.W. Smith. 2003. African and Asian dust: From desert soils to coral reefs. *BioSci* 53 (5):469–480.

[12] "fugitive" dust is a term of art in air pollution, referring to dust that emanates from sources that are not vents or stacks. Examples include wind-driven dust from open spaces, recently disturbed soils, etc.

[13] http://www.epa.gov/air/criteria.html

[14] http://www.epa.gov/pmdesignations/faq.htm#0

[15] United States Geological Survey (USGS). 2003. African dust carries microbes across the ocean: Are they affecting humans and ecosystem health? USGS Open-File Report 03-028. 4 pp.

[16] Weinhold, B. 2004. Infectious disease: The human costs of our environmental errors. *Environ Health Perspectives* 112(1):1–5.

Diseases such as "valley fever" associated with dust are well known in the southwestern US.[17] Thus, contrary to claims by critics that lawns cause an increase in dust emissions, such as due to the presence of particulate matter in the exhaust of lawn and garden equipment, the far greater problem is the increase in dust emissions from bare ground, and the associated increases in mortality and morbidity. It is clear that dust emissions from bare ground are generally higher than that from ground planted with turf is, especially given the effect of roots in binding soil as well as the ability of turf to impede the entrainment of any particles on the ground by slowing down the air velocity at the ground.

As noted before, even arguments by critics regarding tailpipe emissions and noise are losing ground as engines become cleaner, more efficient, and less noisy.

C. The Cooling Effect of Lawns and Reduction of Urban Heat Islands

Urban areas generally have higher temperatures than surrounding rural areas - well known as the urban "heat island" effect.[18] EPA notes that "the annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C)."

EPA also notes that "heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality." The foremost approach to mitigation of this heat island effect and its resulting ill effects is via increasing trees and vegetation. EPA notes the benefits as do other researchers.[19]

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[17] http://www.mayoclinic.com/health/valley-fever/DS00695

[18] http://www.epa.gov/heatisland/index.htm

[19] EPA notes that "[T]rees, vegetation, and green roofs can reduce heating and cooling energy use and associated air pollution and greenhouse gas emissions, remove air pollutants, sequester and store carbon, help lower the risk of heat-related illnesses and deaths, improve stormwater control and water quality, reduce noise levels, create habitats, improve aesthetic qualities, and increase property values." http://www.epa.gov/heatisland/mitigation/index.htm

The substantial cooling effect, via transpiration of water from grass leaves, has been well documented.[20] The reduction in the heat island effect via increased turfgrass use is also an example of the complexities in policy development. For example, increases in water evaporation result from increases in temperature, among other causes. Thus, as the heat island effect increases, in addition to adversely affecting air quality, ozone generation, and the like, one of the direct effects is the enhanced evaporation of water from reservoirs located within such heat islands – the very resource that lawns are supposedly "wasting." Before policies that might result in turfgrass elimination are considered, these effects should be considered and quantified.

Similarly, the definition of waste should also be carefully considered. As noted above, the reduction in the heat island effect is a result of increased leaf evapotranspiration (i.e., the loss of water via transpiration and subsequent evaporation). Thus, a portion of the water used in a lawn evapotranspires, providing the cooling benefit. Is this water a waste? Or, should it be considered to be a benefit, given the benefits associated with the reduction in the heat island effect? *Clearly, simply calling it a waste does not capture the full utility of lawn watering.*

Of course, there are numerous additional benefits from reducing the heat island effect – such as reduction in the energy costs associated with cooling homes in urban areas and reduction in the incremental evaporation of water from lakes and water supply reservoirs or impoundments in urban areas.

D. Oxygen Generation

All green vegetation generates oxygen via photosynthesis. This is clearly undisputed. Thus, compared to bare ground, non-green areas, and lawn substitutes such as painted concrete, or even artificial or synthetic "grass," actual turf areas generate oxygen. In fact, a turf area 50' x 50' is

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[20] Beard, J. B. 1993. The Xeriscaping concept: What about turfgrasses. *Intl Turfgrass Soc Res J* 7:87–98.

expected to produce enough oxygen to meet the everyday needs of a family of four and each acre of grass produces enough oxygen for 64 people a day.[21]

E. Reduction in Wildfire Potential

As discussed in greater detail in CAST 2006, green grass cover retards the spread of wildfires because of its low fuel value, and it provides a defendable space around structures where firefighters can work effectively.[22] That wildfire spread is reduced or retarded by grass areas, which provide a buffer, is well documented.[23] Of course, reduction of wildfires also means reduction of damage to human life and property, which are significant.[24] Also, use of green firebreak areas might result in lower insurance costs in some areas.

F. Reduction in Soil Erosion and Flooding

The negative effects of soil erosion, both urban and on agricultural lands, are discussed in detail in numerous publications including a US Department of Agriculture article.[25]

In urban areas, soil erosion can cause increased fugitive dust mitigation as well as poor water quality via increased solids loadings in storm water and it sinks. Surface soils are a vital resource – that is without dispute.

As is discussed in CAST 2006, a cost-effective means of controlling soil erosion is a live, functioning grass cover, including urban lawns. The superior aboveground shoot density of mowed turfgrasses—from 185 million to 49 billion shoots per acre (75 million to >20 billion

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[21] http://www.turfgrasssod.org/lawninstitute/environmental_benefits.htm

[22] Youngner, V. B. 1970. Landscaping to protect homes from wildfires. *California Turfgrass Culture* 20(4):28–32.

[23] McKell, C. M., V. Stoutemyer, C. Perry, L. Pyeatt, and J. R. Goodin. 1966. Hillside clearing and revegetation of fire hazard areas. *California Agric* 20(12):8–9.

[24] http://www.businessinsurance.com/cgi-bin/article.pl?articleId=26594

[25] See for example, the summary by the US Dept. of Agriculture article at http://www.sc.nrcs.usda.gov/news/curdev_2001_2002/cd_soil_erosion.html.

ha-1), depending on the species, plus 890 to 26,785 pounds per acre (1,000 to 30,000 kilograms [kg] ha-1) of leaf/stem biomass[26]—provides substantial resistance to lateral surface water movement that slows otherwise erosive water velocities. Consequently, there is a major decrease in eroded soil sediments entering rivers, lakes, and seas.[27]

Basically, turfgrass functions as a sponge that traps water and increases vital groundwater recharge. Additionally, turfgrass areas can be designed with contours to temporarily hold water, (i.e., swales) thereby decreasing storm-water runoff. The water-retaining properties of turfgrasses contribute to decreased storm flow via grass waterways and associated flooding, as well as minimize the need for costly mechanical-concrete, water-control structures in urban areas.

Finally, the below ground characteristics of grasses also are important. A grass root system is one of the most effective in soil stabilization because of the fibrous, dense character of the roots. For example, Kentucky bluegrass (*Poa pratensis* L.) has a root biomass of 9,790 to 14,329 pounds per acre (11,000 to 16,100 kg ha-1).[28]

G. Reduction in Urban Pollutant Loadings in Storm Water

Due to its lack of percolation ability, impervious areas cause greater runoff water from intense rains as compared with turfgrass lawns. Runoff associated with rain events, particularly in the initial periods of rain (the first flush), is not benign. Runoff carries organic pollutants such as oils, greases, fuels, paint thinners, organic preservatives, and solvents[29] (Schuyler 1987).

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[26] Lush, W. M. 1990. Turf growth and performance evaluation based on turf biomass and tiller density. *Agron J* 82:505–511.

[27] Gross, C. M., J. S. Angle, R. L. Hill, and M. S. Welterlen. 1991. Runoff and sediment losses from tall fescue under simulated rainfall. *J Environ Qual* 20:604–607.

[28] Boeker, P. 1974. Root development of selected turfgrass species and cultivars. Pp. 55–61. In E. C. Roberts (ed.). *Proceedings of the Second International Turfgrass Conference*. International Turfgrass Society, American Society of Agronomy, and Crop Science Society of America, Madison, Wisconsin.

[29] Schuyler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments, Washington, D.C.

As discussed above, since turfgrasses are effective in decreasing runoff water, they can also trap or filter out significant quantities of associated organic pollutants, thereby providing protection to receiving waters. Additionally, the trapped pollutants are not merely stored in turfgrass. The large, diverse microbial population in the turfgrass/soil ecosystem is one of the most active biological systems for the decomposition of organic pollutants washed from hard-surface, urban areas. The average microbial biomass pool for arable, forest, and grassland systems is 625, 759, and 973 pounds of carbon (C) per acre (700, 850, and 1,090 kg C ha-1), respectively.[30]

Thus, the microbial activity in a turfgrass ecosystem serves a valuable function in the decomposition of trapped organic pollutants.

H. Additional Benefits of Turfgrass

In addition to the benefits discussed above, there are numerous additional benefits briefly described below. Although several of these benefits may seem qualitative, that does not mean that quantification is impossible. Certainly, qualitative does not mean zero benefit. Policy decisions that are associated with or that might lead to the reduction of turf areas should consider these benefits, to the extent possible in a quantitative manner, so that the resulting decision is well supported.

The table below, taken from the CAST 2006 report, groups benefits broadly into three categories: functional, recreational, and quality of life or aesthetic.

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[30] Smith, J. L. and E. A. Paul. 1990. The significance of soil microbial biomass estimations. Pp. 357–396. In J. M. Bollag and G. Stotzky (eds.). *Soil Biochemistry, Vol. 6.*Marcel Dekker, New York.

Functional	Recreational	Quality of life
Soil erosion control	Low Cost Surface	Mental Health
Dust Prevention	Physical Health	Physical Activity
Disease Prevention	Mental Health	Social Harmony
Natural Water Filtering System	Decreased Injury Risk	Community Pride and Ownership
Buffer Area	Family Lawn Activities	Human Productivity
Flood Control	Community Recreational Activities	Property Values
Organic Pollutant Decomposition	Community Sports	Complimentary with various landscape materials, trees and shrubs
Bioremediation	Spectator Entertainment	Individual Expression / Creativity
Soil Restoration		
Carbon Sequestration		
Ground Water Recharge		
Heat Dissipation		
Air Pollution Control		
Fire Barrier		
Glare Reduction		
Roadside Safety		
Crime Control / Prevention		
Nuisance Animal Reduction		
Wildlife Habitat		
Pollen/Weed Control		
Oxygen Production		
Lower Energy Use for Cooling		
Reduced Evaporative Losses		

(Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes, Council for Agricultural Science and Technology (CAST), Ames, Iowa)

Although additional research may be needed to fully quantify a specific benefit in a specific setting, there is no dispute regarding the many benefits listed above.

Conclusion

In summary, there are numerous and significant benefits associated with lawns and turfgrasses. While considerations of water availability are real and important, it is possible to have both water conservation and health green areas. Thus, the either/or choice in this regard is a false dichotomy. Policy makers should carefully consider the myriad benefits in developing policy that either directly or indirectly might result in the reduction of turf areas.

Additional research in key areas is needed, such as the:

- quantification of outdoor water use,
- apportionment of outdoor water use to specific uses such as lawns,
- waste versus useful consumptive use argument considering all of the beneficial uses of lawns,
- potential energy-cost savings resulting from reducing or eliminating heat-islands, including reduction in evaporation water loss from reservoirs serving urban areas;

- groundwater recharge capacity of turfgrass- versus asphalt-covered areas;
- enhanced use of recycled water;
- sequestration of atmospheric carbon;
- fire-buffering capabilities of nondormant turfgrass;
- long- and short-term psychological and physical fitness relationships of turfgrass areas in a community;
- local economic impacts resulting from the production, installation, maintenance, and use of turfgrass.

Educational campaigns by industry and government directed at best management practices for lawns should focus on optimized lawn selection and judicious watering and fertilization approaches.

The benefits of turfgrass are numerous and alternatives are often simply not realistic (xeriscaping or vegetable gardening), and in many instances far worse (artificial grass or paved surfaces). With proper education and awareness, it is now possible to retain the benefits of lawns and turfgrass areas while minimizing or eliminating the negatives associated with water overuse and other harmful practices – leading to an experience that affords aesthetic, lifestyle and environmental benefits.