Documenting your progress toward sustainability

These practical, science-based sustainability metrics can help you and your facility measure and communicate concrete progress toward reaching sustainability goals.

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Sustainability. The word is getting a bad rap these days, and justifiably so, as it is used (and misused) for every purpose under the sun — from advertising chewing gum, to "greenwashing" environmentally damaging practices, to political campaigns and the workplace. Chances are, it even shows up in your own job goal documents. But how can you meet a goal of sustainability when its meaning has become so vague and diluted that a recent Google search on "define sustainable" yielded more than 28 million entries? How do you develop tactics, strategies and plans around an idea that no one can pin down? And how will you and your co-workers know how successful you've been without some system for measuring sustainability?

Without the ability to measure it, sustainability remains a mushy, confusing and frustratingly unobtainable goal. Without quantification, evaluating the achievement of sustainability goals becomes wholly subjective — in the eye of the beholder. Although you may think you're doing a great job, you have no way to communicate it or to prove it, unless you have some way to measure and document it.

In this article, we present several simple monitoring approaches that can help take the mush out of sustainability, and instead treat it as a measurable, science-based agronomic phenomenon. All of these procedures can easily be put into practice at your facility.

The single biggest impact on sustainability: reducing turf acreage

Decreasing the number of highly maintained acres is without doubt the most effective way to increase sustainability by reducing almost all inputs — including water, pesticides, fertilizers, labor, energy and money. A recent *USGA Green Section Record* article (2) calculated savings of $1,700 to $7,000/acre/year in water use alone for golf courses in the southwestern U.S. that have implemented turf reduction projects. Depending on the situation, superintendents have converted out-of-play areas, tee surrounds, shady locations and other turf areas to native and/or low-maintenance vegetation, mulch, non-overseeded turf or other lower-upkeep replacements.

Superintendent Sandy Clark, CGCS, of Barona Creek Golf Club in California, reduced turf acreage by 12 acres (4.85 hectares), most notably by replacing overseeded bermudagrass tee surrounds with native vegetation.

Several useful software tools can provide a hard and fast quantification on turf acreage at the start of a turf reduction program, and periodically thereafter. Free applications, such as Google Planimeter (www.acme.com/planimeter/) can quickly obtain approximate measurement of turf acreage using satellite photos from Google Maps. For more precise measurements of acreage, a superintendent can purchase a geo-rectified aerial photograph of the course that can be used with one of many geographic information system software packages, or a company such as Course Vision can use ground-based GPS systems to survey and inventory a course, and produce detailed maps and measurements for the entire property.

Fertilizer inputs: How low can you go?

We have suspected for many years that most soil nutritional guidelines (including our own) overestimated the amounts of nitrogen, potassium, phosphorus and other key nutrients needed

Barona Creek GC's overseeded bermudagrass tee surrounds (2007) (top) were removed (bottom) and replaced with native vegetation (2008), a move that decreased the turf acreage and resulted in significant savings in water and fertilizer inputs. **Photos by L. Stowell. Credits for Google Maps images: 2007 – Image ©2013 Digital Globe, ©2013 INEGI, ©2013 Google; 2008 – Image U.S. Geological Survey, ©2013 INEGI, ©2013 Google**

for turf health. The operating principle in most cases was a desire to ensure that there is never a deficit in soil nutrients. But as economic and environmental concerns have grown, the emphasis has shifted to targeting the lowest levels of soil nutrients that will provide turf performance that meets expectations. This may seem like a subtle shift in thinking, but it can have enormous impacts on sustainability, as shown below.

To find out how low we could really go in terms of soil nutrition, Pace Turf and the Asian Turfgrass Center pooled a huge database of more than 17,000 soil samples that had been collected from turf facilities over the past 20 years. Of these, we identified 1,500 samples that met our requirements (primarily that they were collected from areas where the turf was performing adequately), and then statistically analyzed the data to determine the lowest levels of each major nutrient that could predictably support good-quality turf.

The result was the Minimum Levels for Sustainable Nutrition (MLSN) soil guidelines (Table 1), which were introduced last year (4) and call for reductions of 50% or more in many key soil nutrients. Since that time, the guidelines have been adopted by turf managers around the world, many of whom have been pleasantly surprised at how low they could go in terms of soil nutrition without sacrificing turf quality or playability.

We believe that most superintendents can make significant reductions in the total nutrients applied at your location by using MLSN as a guide. To participate in the effort to identify more sustainable turf nutritional guidelines, read about the Global Soil Survey for Sustainable Turf (Page 82).

Measure total pounds and toxicity levels of pesticides applied

Reducing the total pounds or kilos of pesticides used is a good goal, but reducing the toxicity of the pesticides applied is equally important.

Determining the weight of pesticide (insecti-

Minimum Levels for Sustainable Nutrition soil guidelines

Nutrient	Analytical test	Conventional guideline (ppm)	MLSN guideline (ppm)
Phosphorus	Olsen	>12	6
Phosphorus	Bray 2	>75	25
Phosphorus	Mehlich 3	>50	18
Potassium	Mehlich 3	>110	35
Calcium	Mehlich 3	>750	360
Magnesium	Mehlich 3	>140	54
Sulfur	Mehlich 3	15-40	13
Nitrate (nitrogen)	KCl	3-20	1-10
Ammonium (nitrogen)	KCl	<7	0-7
Total nitrogen	KCl	<20	3-10

Table 1. The Minimum Levels for Sustainable Nutrition (MLSN) soil guidelines, developed jointly by Pace Turf and the Asian Turfgrass Center, suggest that most key soil nutrients can be reduced by 50% or more without significant changes in turf quality and playability. The nitrogen requirements above are best determined based on turf growth potential, which incorporates site-specific weather and turf type to calculate nitrogen demand (1). The values provided above can be used in the absence of growth potential data.

U.S. EPA toxicity categories

	Toxicity levels			
	High	Moderate	Low	Very low
Label signal word	DANGER	WARNING	CAUTION	none required
Category	I	II	III	IV
Acute oral LD_{50}	0–50 mg/kg	50–500 mg/kg	500–5,000 mg/kg	>5,000 mg/kg
Inhalation LC_{50}	0–0.05 mg/liter	0.05–0.5 mg/liter	0.5–2 mg/liter	>2 mg/liter
Dermal LD_{50}	0–200 mg/kg	200–2,000 mg/kg	2,000–5,000 mg/kg	>5,000 mg/kg
Primary eye irritation	corrosive or corneal involvement or irritation >21 days	corneal involvement or eye irritation 8-21 days	corneal involvement or eye irritation 7 days	minimal effects
Primary skin irritation	corrosive	severe irritation at 72 hours	moderate irritation at 72 hours	mild or slight irritation at 72 hours

Table 2. U.S. Environmental Protection Agency Pesticide Toxicity categories (5). The label signal words can be found in prominent positions on each pesticide label; the toxicology information can be found on the MSDS (Material Safety Data Sheets) that accompany each product. Keep in mind that the terms LD_{50} (lethal dose) and LC_{50} (lethal concentration) refer to the amount of pesticide that causes death in 50% of the treated animals. The lower the dose or concentration, therefore, the more toxic the product is.

cide, fungicide, herbicide, nematicide, etc.) used is simply a matter of keeping track of the pounds or kilos of pesticide active ingredient applied over the course of a year. Every pesticide label contains the information necessary to calculate how much of each pesticide active ingredient is present in the jug or bag of formulated product. Using a spreadsheet to keep track of these amounts is not only the easiest method for keeping records safe, but also the most efficient in terms of comparing totals from one year to the next.

To keep track of the toxicity of the products used, make a separate column on the spreadsheet for each pesticide toxicity class, and track the pounds or kilos of pesticide active ingredient used for each of these toxicity classes. In almost all countries, pesticides are separated into three or four toxicity classes, ranging from very low toxicity to high toxicity, based on the result of laboratory animal testing. These tests usually include oral, inhalation, dermal and eye exposure. The scheme used by the U.S. Environmental Protection Agency employs the use of four toxicity classes, from Category I (most toxic) to Category IV (least toxic) (see Table 2).

To find out which toxicity class any given product falls into, the pesticide label is the best guide. Products labeled with a "CAUTION" signal word are regarded as the least toxic products, while a "WARNING" signal word indicates increased toxicity and "DANGER" indicates the highest toxicity product. The Material Data Safety Sheet, or MSDS (in some cases known as the Safety Data Sheet, or SDS), also contains useful information on pesticide toxicity.

A more detailed evaluation of pesticide toxicity, known as the Environmental Impact Quotient (EIQ), incorporates the results of toxicology testing, leaching potential, soil and plant half-life, farmworker and consumer risk and overall ecological risk (3). An equation that measures the impact of each of these factors is then used to generate an EIQ value for each pesticide, with lower values indicating lower overall toxicity. EIQ values for most commonly used pesticides are available online (www.nysipm.cornell.edu/publications/eiq/files/EIQ_values_2012entire.pdf) courtesy of Cornell University.

Whichever method is used to characterize the toxicity of pesticides used at a facility — the simpler method described here or the more comprehensive EIQ approach — the bottom line is to keep careful records. Recording the changes in total pounds of all pesticides used, as well as the ways that you have shifted the types of pesticides used — from more toxic to least toxic — will

Global Soil Survey for Sustainable Turf

Pace Turf and the Asian Turfgrass Center have teamed up to administer a citizen scientist project known as the Global Soil Survey for Sustainable Turf.

The survey hopes to enlist the participation of superintendents from around the globe in an effort to validate and expand on the Minimum Levels for Sustainable Nutrition (MLSN) soil guidelines described in this article and, in so doing, contribute to positive changes in the way turf is fertilized.

Participants in the survey will receive a sampling kit that allows them to collect soil samples from three areas of good-performing turf at their facility. These samples will be analyzed by Brookside Labs for nutrient content, and the data will be sent in a report to the participant. The data will also be added to the Pace Turf/Asian Turfgrass Center database. The result will be new and improved sustainable guidelines for turf nutrition that will be publicly shared with the turf community.

Read more about the global soil survey at www.paceturf.org/journal/global_soil_survey and on Page 38 in the October *GCM*.

The research says

→ Superintendents should document their efforts to improve the sustainability of their golf course.

→ Reducing turf acreage will have the greatest impact on a course's sustainability.

→ In many cases, nutrient inputs can be reduced by as much as 50% or more by following the Minimum Levels for Sustainable Nutrition.

→ Keeping records of the total number of pounds and the toxicity levels of the pesticides applied will show how changes in pesticide use have improved the sustainability of a course.

→ Water usage can be reduced by using recycled/reclaimed water, improving irrigation efficiency, using new water technologies, avoiding overseeding, using drought-tolerant turf cultivars and reducing turf acreage.

→ Superintendents should also keep track of fuel costs and volumes, labor hours, and kilowatt hours and electrical costs.

provide excellent documentation on your progress toward more sustainable practices.

Water usage

Although fresh water is technically a renewable resource, humans are currently using it at a much faster rate than it is being replenished by nature. As a result, experts have voiced concern that competition for water can become serious enough in the near future to be the source of violent conflict — the so-called water wars.

While agriculture is by far the greatest user of water worldwide, golf courses can certainly do their share to decrease water usage in some of the following ways.

- Take advantage of recycled (reclaimed) water if it is available. To evaluate the quality of potential new water sources, and to understand the impact they may have on turf quality, see these irrigation water-quality guidelines (www.paceturf.org/journal/irrigation_water_guidelines).
- Improve irrigation efficiency through periodic catch-can testing or professional irrigation audits. Water savings and turf-quality improvements can be significant when irrigation systems are maintained properly.
- When possible, switch to drought-tolerant varieties, avoid overseeding or completely remove turfgrass from certain areas.
- Keep abreast of new water-saving technologies such as subsurface irrigation, wetting agents and monitoring with soil moisture meters.

Track water volumes in gallons or liters on a spreadsheet so that consumption can be compared from one year to the next.

Staying on track

Once you've got those spreadsheets going, why not keep track of other inputs that can contribute to your sustainability profile?

- fuel costs and volumes
- hours of labor
- kilowatt hours and electrical use costs

Each sustainability parameter should be measured at the start of the sustainability plan and at periodic intervals thereafter so that progress can be easily tracked.

Whether it's Jan. 1, the start of the fiscal year or your birthday, select a date for annual assessment of sustainability progress using the parameters above, and hopefully, some additional ones that you identify on your own. By monitoring parameters that have hard and fast numbers attached to them, you will have a clear and easy way to communicate your progress as a means of motivating your employees, highlighting it in your job review, and publicizing it in your clubhouse, your newsletter or your website. You, your crew and your facility should be able to take pride in contributing to both a more economically and environmentally sustainable operation.

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