SOIL HEALTH

INVESTING IN INTEGRATED ORGANICS FACILITIES

FROM the blogosphere to the pages of *National Review*, parallels are being drawn between our present times and the Great Depression. Like that earlier chapter in our country's history, we are now facing both financial chaos and an environmental crisis that forces us to confront the consequences of unfettered consumption of finite resources. Many look to pin the blame squarely on Wall Street and a cast of alleged financial experts too busy marveling at the phenomenal rise of their net worth to recognize that it was not sustainable. All of us are now stuck in the gum of the burst housing bubble, which merits a look at the lessons of the past 75 years as we take stock of the present shambles of our economy and our imperiled environment, and set a new, more sustainable path for the future.

The American "Dust Bowl" resulted from a similar brand of hubris and shortsighted speculation that brought on today's housing market debacle and its attendant financial aftershocks. In the late 1920s, investors saw that a quick buck could be made by investing in dryland farming. Newly "developed" virgin prairie soils yielded unprecedented wheat harvests during a few years

Our soil will need to perform miracles in the coming decades, warranting investment at the magnitude of resources allocated during the New Deal.

Bruce Fulford

Dust storms and erosion-ridden farm fields provided a wake-up call that soil conservation was a matter of national security. (Photo source: *Compost Science*)

when rainfall briefly spiked and grain prices were high, and before the freshly exposed fragile plains topsoils had blown away. Millions of acres of grasslands were put to the plow, ignoring native wisdom and local advice as to the folly of this method. A little due diligence would have determined that the few years of high yields were an anomaly created by cyclical weather patterns, and the exploitation of 12,000 years of banked soil fertility. When precipitation returned to its normal levels, followed by an extended drought, crops died, farms failed, the wind carried billions of tons of topsoil from parts of Oklahoma, Colorado, Nebras-

I became convinced that compost was the silver bullet that could salvage our topsoil, and our civilization.

ka, Kansas, Texas and Arkansas and much of the region's population scattered.

April 14, 1934 became known as "Black Sunday" for the massive dust storm that was estimated to have carried some 350 million tons of topsoil east and blanketed cities from Boston to Washington, D.C. with choking dust. The fine particles of sand, silt and humus that sifted in through the windows of the Capitol building in Washington, D.C. delivered the unmistakable message that this was a domestic environmental catastrophe, a "clear and present danger" that needed immediate attention. This led directly to the creation of the Soil Conservation Service in 1935.

During the remainder of the 1930s and through the early 1940s, soil conservation was a matter of national security and formed the centerpiece of the New Deal. Franklin Delano Roosevelt called soil "the source of wealth and life itself," and millions of unemployed Americans were put to work on what we would now term "shovel ready green jobs." The Civilian Conservation Corps and other federal projects included developing storm water management systems to combat soil erosion through construction of ponds, contour plowing, terracing, the use of vegetated filter strips and cover crops, planting of some 2.3 billion trees and timber stand improvement on millions of acres of public and private forests. These measures produced a remarkable but short-lived victory in terms of public awareness and private soil management practices. These gains were soon eclipsed by technological and financial developments, with profound impacts on global resource management that would continue to affect generations to come.

In 1945, few people could have grasped the global consequences of the fossil-fueled growth of industry, agriculture, commerce and consumerism that resulted from massive federal support during the New Deal and World War II (WWII). The explosion of intellectual and commercial creativity, product development and industries fostered the adoption of an unsustainable model for feeding, clothing, sheltering and fueling a society. The surge headlong into industrial agriculture was a conscious and calculated adaptive strategy engineered in corporate boardrooms, the halls of Congress, and on Wall Street and Madison Avenue. The frenzied war-era production of military hardware, explosives and chemical toxins used to vanquish human foes was shifted to bombing bugs, crops and soil with modified formulations of the same chemical compounds developed for warfare.

Agricultural use of commercial fertilizers rose by 500 percent from the 1930s to the late 1950s. Hundreds of millions of acres of U.S. farmland were being treated (what a treat!) with ammonium nitrate, anhydrous ammonia and superphosphate fertilizers, organophosphate pesticides and a mad chemist's recipe of other products. Besides being dumped on our soil, these began circulating in our water, and lodging in our livers and fatty tissues. The steroidal approach to delivery of nutrients to plants was accompanied by widespread irrigation of vast tracts of cropland from Kansas to California. The almost wholesale adoption of these industrial agricultural methods and their phenomenal crop yields made the U.S. model of agriculture appear to be a marvel of mechanical and chemical efficiency.

The decades following WWII were marked by subsidized production of fossil fuel, cheap energy, the interstate highway system, the proliferation of suburban developments and a steep decline of the farming population. These developments were motivated by a blend of good intentions and naked greed, and were encouraged by civil servants and academics, industry leaders, inventors and investors. They were also heavily subsidized by American taxpayers. Now, with the clarity of Lasik-enhanced hindsight, we can clearly see the hubris that brought us to this present inconvenient truth.

COMPOST — THE SILVER BULLET

When I started composting in the early 1970s, I was inspired in part by a book called "Topsoil and Civilization," by Vernon Gill Carter and Tom Dale. I learned that modern topsoil loss was greater than during the Dust Bowl days of the 1930s. I traveled through eroded Mediterranean landscapes that once had deep topsoil that supported thriving agrarian cultures, reduced to a shadow of their former greatness. On this continent, I saw in every tilled field and timber cut woods, in every puddle, stream, river and lake the thin fertile fabric of the planet's true wealth slipping away from the crust on which we live. On hillsides from San Salvador to South Carolina, naked dirt dotted with crops washed into rivers that ran opaque in many shades of brown and red carrying our future bread and tortillas into the Chesapeake Bay, the Mississippi Delta, the Sacramento River and the Pacific Ocean.

I became convinced that compost was the silver bullet that could salvage our topsoil, and our civilization. If we could just make enough compost, we could cover the earth — like the Sherwin Williams paint advertisement, but with a healing blanket of fertile organic matter. Reading Clarence Golueke's seminal book, *Composting: A Study of the Process And Its Principles*, and discovering Jerry Goldstein's *Compost Science/Land Utilization* and *BioCycle*, provided the early intellectual fodder for what has become a career in composting. It was fantasy at the time to imagine a world where millions of tons of compost were returned to the soil every year, and an even greater stretch of the imagination to picture utility companies plastering billboards and service trucks with images of ranchers in cowboy hats proudly beholding a landscape of wind generators. Or how about one of the largest nuclear power plant developers running clever commercials during the Super Bowl, extolling the verdant virtues of its methane fueled power conversion systems? Unbelievable.

Once again, the U.S. government proposes to invest billions of tax dollars to stimulate the economy and address energy, climate change, health care and a raft of related social and infrastructural elements. The investments that we as a society make in energy development and stewardship of our soil, water and air in the next decade will have an enormous influence on the planet that our great-grandchildren will inhabit. We need to avoid selecting approaches that lock us into technologies and methods that have long-term, environmentally detrimental consequences.

There is intense financial pressure to resort to least-cost disposal of our society's waste products. There is also an unprecedented environmental and national security need to develop new sources of energy. These two forces have renewed interest in incineration of more of the waste stream, and in continued landfill disposal of mixed waste — including the organic fraction. Burying and burning much of the nutrient-rich organic fraction of the solid waste stream is a short-term approach that supports the interests of technology vendors and operators of facilities that perform those functions. The millions of tons of embodied nutrients and soil amendment contained in the organic fraction of the solid waste stream will be entombed or destroyed when these materials are landfilled or incinerated. In addition, much of the energy value contained in the organic fraction is lost through either of these practices, and total greenhouse gas emissions are many times greater than they would be if the materials were separated and managed through controlled bioconversion. (See, "Composting — Best Bang For MSW Management Buck," *BioCycle* October 2008.)

Just making compost — any compost, by any means necessary — is not a sustainable alternative. Poorly operated composting facilities and low quality products are not uncommon in our industry, and provide proponents of incineration and landfilling with compelling arguments against composting. Low quality compost that fails to deliver promised benefits to consumers undermines public acceptance and reduces the potential revenue stream for all composters by driving down product value. When coupled with stiff competition for disposal fees in a sour economy, these shortcomings are a major disincentive to generators and haulers to divert organic material to facilities that could recover the greatest environmental and societal benefit from it. If composting, anaerobic digestion (AD) and other bioconversion processes for organic wastes are to be more broadly adopted, our industry must have more progressive facility models and higher performance and product quality standards than presently prevail.

SUSTAINABLE PROCESSING INFRASTRUCTURE

The short-term gains made during the Depression to foster soil conservation practices were akin to applying a tourniquet to a severed limb. Presently, although applying compost to soil is an important approach, the magnitude of the changes that we are facing in climate, ecosystems, energy and agriculture require more integrated solutions. The process of aggregating and managing organic materials and deriving bioenergy from wastes can play a far greater and more beneficial role in how we derive food, fuel and fiber from the soil we are endowed with. Choosing the right blend of technologies, tools and implementation models is critical. There is no single system, no piece of eco-hardware or best management practice to adopt; numerous technologies and practices are already in use, and new ones are continually being developed that can be combined and adopted in a wide variety of settings to great effect.

One of the key components of a sustainable organics processing infrastructure is to manage more of our organic wastes near the point of generation and produce more bioenergy close to where it is used. In order to do this, organics processing facilities of the future need to turn perceived, and real, liabilities of the composting process into assets.

Manage the smells: I still believe that compost is a beautiful thing, but I also know that beauty is in the nose of the beholder. I like many of the smells associated with my chosen profession. I appreciate the subtle difference between oak and maple leaves in early-phase thermophilic decay, and find that most herbivore manures produce a pleasant smell. However, my wife and one of my kids express a very different opinion about the natural cologne I sometimes come home with. Odors are often the hallmark of inefficiency in process management, and can turn the public's opinion of compost. When sensitive neighbors are nearby, it is critical to prevent or capture and treat odorous compost exhaust gases.

Increase energy-efficiency: There has been remarkably little attention devoted by our industry to promoting energy-efficient composting. And composting requires significant energy inputs for turning, blending and providing aeration, with the attendant environmental impacts associated with each gallon of fuel or kWh used. Thus far, these functions have almost exclusively been fossil-fueled. Diesel fuel at $4.50/gallon and power at 25¢/kWh will force or encourage changes in many organics management operations.

Harness the energy: A facility model that derives benefit from harnessing the energy — whether through wood or other biomass combustion, AD and methane recovery, and/or biothermal reuse technology — is likely to make better process containment and management more affordable. Wastewater treatment facilities, for instance, have for decades used methane from AD processes to generate electricity and power the pumps, managing the energy intensive pro-

We need to manage more of our organic wastes near the point of generation and produce more bioenergy closer to where it is used.

cesses that it takes to separate water from sewage and convert our societal effluent into benign and beneficial products. After decades of European experience, AD is finally receiving serious consideration in North America, and is attracting significant attention from advocacy organizations and the research community. AD systems are proliferating at dairies and increasing at hog farms, where the systems are very compatible with the characteristic manures generated by these operations.

Recover heat: The aerobic composting process has been estimated to generate between one and two million Btus/ton. At that rate, a 100,000 tons/year composting facility will release the thermal energy equivalent of somewhere around a million gallons of oil. Systems that recover and productively use biothermal heat and CO_2 have demonstrated beneficial application in numerous small-scale settings, and hold promise for much greater commercial adoption. Aerobic composting also liberates somewhere around 300 to 500 or more lbs. of CO_2 per ton, which means a 100,000 tons/year composting facility will probably release more than 20,000 tons of CO_2 annually. Directing some of that CO_2 to horticultural reuse with proper filtration, controls and photosynthetic capture has been proven feasible, and commercial systems of capturing and converting that heat for practical benefit are now available. Given the concentrations and the potential value of biothermal heat and CO_2 generated from the composting process, these systems merit greater investment and consideration in new and retrofit facility designs for the organics industry.

Another option is combined heat and power (CHP) to produce electricity and thermal energy. Numerous large-scale industrial generators of waste wood and other biomass, including paper mills, furniture factories and lumber yards, are utilizing their by-products for CHP at U.S. installations. Highly efficient combustion and effective air emissions control technologies have been employed in Europe for years, and more recently adopted at North American biomass facilities. There will be increased competition for biomass feedstocks, but sensible policy and practice should be able to accommodate and encourage biomass energy development that is not at the expense of the soil. Biomass derived electrical power for organics management facilities should be considered as part of integrated facility development.

Capture greenhouse gases: A significant investment in basic and applied research needs to be performed to determine best management practices for managing greenhouse gas emissions from composting. Well-designed and constructed AD systems capture most of the methane (CH_4) given off from feedstocks, and can also be used to capture CO_2 for productive reuse. A properly managed aerobic composting process eliminates the formation of CH_4 from decaying organics, particularly manures and food wastes. However, composting also produces gaseous forms of nitrogen including nitrous oxide (N_2O), which is 240 times more harmful than CO_2 in contributing to global warming. At present, there is little research on the management of nitrogen gases during composting.

Composting operations that control materials balances and employ systems that manage the rates of aeration, moisture conditions and temperature and permit filtration of exhaust products are likely to afford the best opportunity to minimize evolution of N_2O and lend themselves to means of scrubbing, capture and reuse of these emissions. Building and operating organics management facilities that are more effective at preventing off-site environmental impacts, whether it is odors or greenhouse gases, will not come cheap, but are an eventual and unavoidable cost of doing business.

Choosing the right blend of technologies, tools and implementation models is critical.

NEXT GENERATION FACILITIES

We need to invest in a new generation of integrated organics facilities — hybrid bioenergy and organics processing operations that directly benefit their host communities. These facilities will generate and use bioenergy to power their process equipment, create superior quality composts, mulches and soils, and nourish a vibrant and more locally based agriculture. Of course this will not be necessary, practical or possible in every composting operation. Model hybrid facilities in high profile settings will demonstrate the possibilities and serve as leadership examples to drive new policies, inspire improved practices and open new markets.

The soil conservation successes and public works investments of the New Deal were eclipsed by the raw deal for the global ecosystem that rapidly followed WWII. We are once again poised to make monumental investments in our infrastructure, energy future, and educational and health care systems. The soil is arguably our most precious and imperiled infrastructure, and warrants investment at least on the magnitude that was made during the New Deal. Our soil will need to perform miracles in the coming decades. It will be providing more and more fuel, along with greater demand for food and fiber for an expanding domestic and global population. How we conserve and cultivate, replenish or exploit our soils will have enormous influence on climate change, energy use, water and air quality, human health and the economy. It is of utmost importance that we do not squander this opportunity to address fundamental environmental and economic problems that are rooted in our soil. We can make powerful and long-lasting contributions by integrating progressive organic waste management practices with bioenergy production and more locally based agriculture. ■

Bruce Fulford is Principal of City Soil & Greenhouse Co., and cofounder of Green PowerPlant, Inc. Bruce has been working with compost and implementing progressive agricultural systems for more than 30 years. He can be contacted at: bruce@compostgreen.com.

Reprinted With Permission From:
April, 2009
BIOCYCLE
ADVANCING COMPOSTING, ORGANICS RECYCLING & RENEWABLE ENERGY
419 State Avenue, Emmaus, PA 18049-3097
610-967-4135 • www.biocycle.net