

I dig dirt

Soil is as essential a natural resource as air and water. Yet we're running out of healthy, fertile dirt at an alarming rate. One man's odyssey to retrace and reduce his soil footprint. By Larry Gallagher

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OHN JEAVONS IS saving the planet one scoop of applesauce at a time. Jeavons stands at the front of the classroom at Ecology Action, the experimental farm he founded on the side of a mountain above Willits, in Northern

California's Mendocino County. For every tablespoon of food he sucks down his gullet, he scoops up six spoonfuls of dirt, one at a time for dramatic effect, and dumps them into another bowl. It's a stark message he's trying to get across to the 35 people who have come from around the country to get a tour of his farm—simplified, to be sure, but comprehensible: For every unit of food

For every unit of food we consume, six times that amount of topsoil is lost; annually, that works out to 12,000 pounds (5,443 kilograms) per person of topsoil

we consume, using the conventional agricultural methods employed in the U.S., six times that amount of topsoil is lost. Since, according to the U.S. Food and Drug Administration, the average person eats a ton of food each year, that works out to 12,000 pounds (5,443 kilograms) of topsoil. John Jeavons estimates that using current farming practices we have 40 to 80 years of arable soil left.

If you don't already know the bad news, I'll make it quick and dirty: We're running out of soil. As with other prominent resources that have accumulated over millions of years, we, the people of planet Earth, have been churning through the stuff that feeds us since the first Neolithic farmer broke the ground with his crude plow. The rate varies, the methods vary, but the results are eventually the same. Books like Jared

Diamond's *Collapse* and David Montgomery's *Dirt: The Erosion of Civilizations* lay out in painful detail the historic connections between soil depletion and the demise of those societies that undermined the ground beneath their feet.

According to the International Soil Reference and Information Centre (ISRIC), as of 1991, human activity has brought about the degradation of 7.5 million square miles (19.5 million square kilometers) of land, the equivalent of Europe twice over. The Food and Agriculture Organization of the U.N. has estimated that the value of lost soil nutrition in South Asia amounts to some \$10 billion a year. Each year, says Montgomery, the world loses 83 billion tons of soil.

Still, these abstract facts have a way of eluding our comprehension. When we put

2009, the Associated Press reported a 19 percent increase in residential seed sales in the U.S., a bump known in the business as "recession gardening." When the Obamas planted a garden on the White House lawn, it was at once an economic, environmental and spiritual gesture—a nod, if nothing else, to the primacy of dirt.

Like most everybody else on our little planet, save for a few hunter-gatherers and breatharians, I have been a silent accomplice in this process. So I have decided to take matters into my own hands, largely figuratively and more than a little bit literally, and see what I can do to minimize my soil footprint. In the course of this exploration, I will follow my interaction with dirt as it moves in a cycle, through the food I eat, as that food leaves my body, and, ultimately, as I myself leave my body.

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ITH THIS IN MIND, I made the pilgrimage up from San Francisco to sit at the feet of John Jeavons, who has probably spent as much of his life thinking about building soil as anyone who has ever lived. Jeavons started his career in the 1960s as a systems analyst at Stanford University. When the spirit moved him to pursue agriculture as a vocation, he brought that kind of analytical thinking with him. These are the questions that drove him: How many calories does a person need to survive? What is the smallest plot of land needed to grow those calories for one person for one year? How much land do we need to feed all the people on the planet?

Jeavons has devoted his career to answering these questions and spreading that information around the globe. A small but significant chunk of that learning can be found in his book *How to Grow More Vegetables Than You Ever Thought Possible on Less Land Than You Can Imagine*, first published in 1974, which has sold half a million copies and gone through multiple editions.

The premise from which Jeavons operates is that nearly all farming on the planet, be it organic or conventional, First World



or Third, takes more than it gives. Most organic farming, for example, borrows soil nutrition, in the form of compost or manure that has been generated elsewhere. Jeavons' standard for sustainable land stewardship proposes a very simple, obvious benchmark: It must generate at least as much topsoil as it uses. And as the world grows smaller and each scrap of arable land becomes less expendable, borrowing nutrition from some other piece of land is not solving the problem, he argues, but simply moving it around.

You can get much of this out of his books, but to get a direct transmission it helps to visit the farm when it is operating in full force. Ecology Action sits 700 feet (213 meters) up on the edge of a ridge, with a sumptuous view of the Willits Valley. There are many reasons Jeavons ended up on this particular plot of land, but none has to do with the quality of the soil, which was judged marginally acceptable for grazing when he picked it up in 1982. He enjoys working with the challenges of suboptimal soil and limited sunlight, and is upfront about the fact that, by the standards of Grow Biointensive, as he calls his system, the gardens here are only moderately productive.

When his system is operating at peak productivity, John Jeavons of Ecology Action can grow food and increase topsoil at 60 times the rate of nature

By the standards of the average visitor, however, the garden is exploding with life. Rye grass and Jerusalem artichoke wave across at beds of quinoa and amaranth. What looks like a casual paradise is actually a closely monitored science project. Every leaf that leaves the premises is weighed and recorded. Interns from around the world buzz through like bees, tending beds and fruit trees. The catch, if indeed it is a catch, is that Jeavons' methods work best on a small scale, on relatively small plots of land, executed by people who are paying attention and care enough to expend the necessary labor. And while he believes his methods can be scaled up, his philosophy in general is that civilization needs to scale down, localize, put more elbow grease and less fossil fuel into the food chain.

At the heart of Jeavons' system is a maniacal focus on composting. Now, when he uses the term he is not merely referring to the quaint recirculation of leftover bits of lunch. Jeavons recommends that a gardener devote a full 60 percent of planting space to growing crops the principal purpose of which is to add biomass to compost piles. Cereal grains, giant overgrown daikon gone to seed and six-foot-tall (two-meter-tall) cardoons are among the many plants born to die and rot untasted, cut down and fed through the system, capturing more carbon with each generation.

On average, around the world, it takes 500 years for nature to produce an inch of topsoil. Number crunchers claim modern farming techniques increase erosion at 10 to 40 times the rate of nature. When his system is operating at peak productivity,



THE JEPSON PRAIRIE ORGANICS' COMPOST PROCESS: ORGANIC MATERIAL SUCH AS FOOD SCRAPS AND YARD TRIMMINGS (1) IS PROCESSED AND FED INTO A GRINDER (2), WHERE IT IS MIXED AND MADE READY FOR MICROBIAL DECOMPOSITION. THE BLENDED MATERIAL (3) IS PUSHED INTO A COMPOSTING SYSTEM OF PLASTIC PODS WITH FEEDSTOCK, WHERE IT REMAINS FOR 60 DAYS. THE COMPOST IS THEN PLACED IN WINDROWS SO IT CAN AGE. LARGER PIECES (4) ARE SEPERATED FROM THE COMPOST, WHICH IS MIXED AGAIN (5). THE END RESULT: NITROGEN-RICH COMPOST (6), READY TO BE SHIPPED TO CUSTOMERS.

Jeavons can grow food and increase topsoil at 60 times the rate of nature.

After I left Ecology Action, I began to see soil nutrition everywhere. The stalks of feral fennel growing in the middle of the road, the otherwise-useless clumps of bamboo decorating my front yard: All started looking like more carbon sources for my compost pile. A bushy tomato planted too late to fruit, a radish gone to seed—what I used to see as gardening failures, I now see as dinner for the next generation of plants.

AT 7:42 A.M. ON FRIDAY, IN Vacaville, California, Truck No. 17246 backs onto the ramp at Jepson Prairie Organics and regurgitates its contents into a massive heap. The sight of a 24-ton trailer tilted up on end, spewing rotten vegetables, cardboard and yard trimmings into a small hill stirs me on many levels: mechanical, biological and olfactory. This is the first of some 400 tons of organic material hauled out from San Francisco each day and put through the composting mill. At the end of 60 days, most of the resultant matter will be trucked to vineyards in Napa and Sonoma counties. Some small percentage of it will

make it to organic farms in the area.

Jepson is a subsidiary of Recology, the waste management company that hauls away my trash in San Francisco. The folks at the composting facility have worked too long tweaking their system to turn their secrets over to their competitors, so they're cagey about revealing the details of their process. All you and I need know is that they sort, they grind and they blow the green waste into long windrows, which they aerate each day with a huge industrial windrow-turner. The combination of central valley sunshine and bacterial action helps get the row hot enough to break down in 30 days. The compost is given another month to cool and age before it is carted to its next destination.

Walking through the massive windrows, I get a chance to talk to Bob Shaffer, a composting guru who works as a consultant to both Jepson and the wineries who use its product. He's been a student of the soil since he began gardening for himself 35 years ago. Shaffer explains it is not simply the sheer volume of soil that is at issue, but the quality of that soil. He gives me a quick lesson in soil mechanics: "Plants, in conjunction with microbes in soil, produce what are called polysaccharides. These

polysaccharides can loosely be called gums, glues and gels. They stick the soil together, make it harder for water and wind to blow it away."

The hidden story in farming, says Shaffer, is the decline of soil health in general. "It adds up over years and ends up in soil erosion," he says, "kind of like the buildup to the dustbowl. As the humus level—the amount of the degraded organic material in the soil—drops and drops, the polysaccharide content drops and drops, and finally the soil loses its ability to adhere and stay in place even if we have mulches and ongoing measures to prevent it."

When I hear "dustbowl," I tend to think of a past problem, sepia tints of Okies squinting in the wind. But China has been working on its own massive dustbowl for years, overgrazing and overfarming in fragile grasslands resulting in the displacement of millions of people and in annual dust storms that blow through Beijing like a plague.

Before things get to that point, Shaffer says, more communities need to start closing the loop, to bring as much organic material as possible back to the farms. The Environmental Protection Agency estimates that nearly a quarter of all municipal



NIGEL WALKER OF EATWELL FARM, HAPPY CONSUMER OF JEPSON PRAIRIE ORGANICS' COMPOST.

waste comes from food scraps and yard trimmings. (Organics buried in landfills also generate methane, which is 23 times as potent a greenhouse gas as carbon dioxide.) "It's not the whole solution," he says, "but it's a start."

BORDERS USUALLY GET FUZZIER the closer you get to them, but in this case the contrast couldn't be more stark. I am ambling around the perimeter of Nigel Walker's humble organic spread in Dixon, California, also known as Eatwell Farm. The fields of sunflowers that lie to the north unfold in perfect rows, not a single weed in evidence, on a laser-leveled flat that stretches as far as the eye can see. While the immaculateness of this conventionally grown field holds some initial allure, the effect gradually begins to feel spooky, manifesting a degree of order not found in the rest of nature.

Things are wilder on Walker's side of the line: pigweed and lamb's quarter competing with cabbage and potatoes and onions. Eatwell's acreage is subdivided into six fields, each growing a variety of crops, divided by windbreaks of tall poplars.

"I am a soil custodian on your behalf,"

"When you see that the bay is brown, that's your soil and your grandchildren's soil being washed out to sea" Nigel Walker, Eatwell Farm

says Walker. "A steward of this 105-acre piece of California." Eatwell Farm has been providing my wife and me with a weekly box of produce for seven years, but this was my first chance to set foot on the land. I had read that small, organic farms tended to be more soil-friendly than big, conventional farms, but I wanted to find out from Walker exactly what he was doing in this regard.

Walker takes a few minutes out of his insanely busy day to walk around the farm with me. The issues of soil and water are inextricably entwined, he explains. "When I first took over the land in 1999, it was a plain, brown field. When the winter rains came, the water ran off, and it was brown, and it collected in a catchment pond. And when the pond was full it was pumped into a drainage ditch, and it eventually ended

up in San Francisco Bay."

This is erosion at its most conspicuous, the physical transportation of earth via wind or water. Farming on hillsides, logging and road building all minimize the land's ability to hold moisture, and when the water runs off it takes the land with it on a one-way slide downstream. In his book *The Food Revolution*, John Robbins calculates that every year, the equivalent of 165,000 Mississippi River barges full of soil is flushed out of Iowa alone. "When you see that the bay is brown," says Walker, "that's your soil, and your grandchildren's soil, being washed out to sea."

What he has been doing to prevent this is textbook organic farming: planting cover crops, avoiding compacting the soil with heavy equipment, rotating chickens through the fields. The deeper he can keep



A HUMANURE COMPOSTING TOILET CAN HELP FIGHT SOIL DEPLETION.

the structure of the topsoil, the more roots he can extend into the ground, the more water the land will hold and the less of it there is to run away with his soil. "Since that first year, not a drop of water has rolled off this land," he boasts.

Nevertheless, Walker still has to import soil nutrition in the form of compost to make up for the tons of nutrition that he exports weekly as fruits and vegetables. As it happens, the farm lies just 15 miles (some 25 kilometers) up the road from Jepson, and receives some 400 tons of its product every year, so theoretically some atoms from my hedge trimmings and dead

CLIMB OUT OF BED AT 6 A.M. on a Sunday. The air is still and cool, two desirable attributes when you've got a smelly project in your backyard and don't want the neighbors to get a whiff of it. I have eight buckets filled mostly with ground coconut hulls, buried in which is also a month's worth of human excretion from my household. I crack the lids on the buckets one at a time and quickly dump the contents into the nest of straw I have constructed inside a steel cage. Within two minutes, the offending material is transferred and buried under a layer of soil and straw, the cloud

de-chlorinated and condensed into a material that the industry likes to call "bio-solids," but everyone else prefers to call by its old name: "sludge." Most of this sludge ends up covering over the layers of garbage in landfills, contributing to the aforementioned methane problem. Then there is the dubious practice of soiling and cleaning our drinking water in an increasingly thirsty world.

On top of this, the nutrients contained therein are effectively lost forever. According to John Jeavons, all but a tiny percentage of the minerals necessary to produce a year's worth of food for one person can be found in a year's worth of that person's waste.

My first step was to get a copy of *The Humanure Handbook*, published in 1995 by Joseph Jenkins, a slate roofer in western Pennsylvania. The Jenkins method is the model of simplicity. One merely expresses oneself into a bucket and covers it over with a carbonaceous material such as sawdust or rice hulls or ground coconut hulls or even finely ground leaves. Each bucket is then added to a compost heap, which is monitored with a thermometer to see that the pile generates enough heat to destroy any pathogens. After a year, the pile is closed down and a new one started, and after the second year the first year's contents are ready to feed to plants.

I won't lie to you: It took some skill and some tools to build my rodent-proof urban composting cage. Nor will I pretend that maintaining the system is as easy as pushing a little lever. There is significant hauling of buckets in and out of my house these days. I had to find straw to line the cage and I may spend the rest of my life on the prowl for suitable carbon-heavy cover materials.

The latter is crucial to the process for two reasons. First, its small particles cover your effusions, all but eliminating the stink factor. Then, when they are dumped into the compost pile, the dry carbonaceous stuff balances the wet nitrogenous stuff that comes out of your body, creating the ideal environment for the thermophilic bacteria already present in your gut to thrive. The fury of bacterial activity drives

PHOTOGRAPH: WESSEL KOK



THE WOODLAND BURIAL AREA OF CARLISLE CEMETERY IN THE U.K., WHERE BODIES ARE INTERRED WITHOUT EMBALMING, IS THE FIRST OF ITS KIND.

the temperature of the pile high enough to kill off pathogens. It takes 24 hours at 122 degrees Fahrenheit (50 degrees Celsius) to kill all the bad bugs. At 115 degrees Fahrenheit, 46 Celsius, it takes a week.

The path of humanure is not one of instant gratification. Jenkins recommends you wait two years before feeding your plants, three if your pile did not get hot enough for long enough. For the time being, my reward came when I uncovered mine after a few weeks and discovered that every last vestige of stink had been gobbled up. What remained was the benign, earthy smell of a forest floor in spring. It will be years before the contents return as apples or tomatoes, so until then, this will have to do.

OUTSIDE OF FISSION AND collapsing stars, it is impossible to create or destroy atoms. So on one level, no matter how my body is disposed of, there will be no getting rid of me. The typical burial in the U.S. tries to slow down the inevitable with embalming fluids, concrete vaults and thick caskets. Cremation, with its energy usage and its air pollution, is differently

indefensible. "Green burial," which has been around for some time but has started to catch on in mainstream circles, speeds the process, using shrouds, biodegradable caskets and memorial parks that serve as land trusts.

After I shed this mortal coil, I would like to get back into the mix as directly as possible. I call Cynthia Beal, who runs a company called Natural Burial that sells products and services to assist in the effort to reintegrate with the planet in a more orderly fashion. "It's all about dinner," she says. "In this case, you're what's for dinner. You will be the life of the party—literally." She says the fastest way to dispose of your body is not to bury it at all, although for obvious reasons she is not recommending this. Next best is a shallow grave, 20 to 24 inches (a little more than 50 centimeters) deep, since this is where many of the organisms that will be eating you are living. The rest you are already carrying around with you in your gut.

In Germany, for example, it is the custom to use the earth to "clean the bones," as it were. Bodies are buried for 15 to 20 years, during which time the decompos-

ition process breaks down all but the skeleton, which can be returned to the family of the deceased and the plot resold to the next customers. Driven by economic forces more than anything else, a number of small farms in the U.K. have taken to selling burial plots. Beal is working with some small farmers in Oregon to bring this phenomenon to the U.S.

I ran the idea past Walker at Eatwell, who was daunted by the bureaucratic implications of securing approval from the authorities. "And I don't think we have enough land to offer this service to all our subscribers," he said. Still, he thought it was a great idea, one that he personally hopes to employ for his own disposal. "With all the time I've put into this place, I would love to be pushing up figs when I'm done."

As I have no immediate plans to die, I figure this gives Walker some time to work out the details. Remember, man, that I am dirt, and unto dirt I shall return. ■

LARRY GALLAGHER is a journalist who in more than 20 years of magazine writing has never written a dirtier piece.

Every day, millions of tons of potential soil nutrition are sent downstream to treatment plants

flowers come back to me as tomatoes and swiss chard.

The hole in the loop, he points out, is the digested remains of all that good food he sends away. "I should make you show up with a bucket of waste each week you pick up your box." He's joking, but only kind of. Organic certification standards prevent him from doing anything of the sort, but it's one of the ways we deplete the soil each year.

As it turns out, it's one avenue in which I can make the biggest difference.

of stink dissipated, the cage closed and no one the wiser.

Yes, you read that correctly. I have been composting my own dung in my backyard. Like many advances in human technology, the hegemony of the flush toilet is not forever, and as the planet has grown increasingly crowded, more people are re-evaluating its merits. Every day, millions of tons of potential soil nutrition are sent downstream to treatment plants, where they are mixed with industrial effluent and spent pharmaceuticals, chlorinated,