Didi Pershouse, FAO UN World Soil Day, 2017

Preventing flooding and drought with the soil carbon sponge: the living matrix that makes life on land possible

Excellencies, distinguished diplomats, and representatives of the United Nations community and civil society, it is my honor to be here with you today. I would like to thank the co-sponsors—the Permanent Missions of Thailand, the Netherlands, Colombia, Lesotho, as well as the FAO and the UNCCD. I am especially grateful for the Kingdom of Thailand's leadership role in bringing about World Soil Day.

Several people have mentioned soil carbon today, and I would like to remind us all that even though "carbon" can sound like an inert chemical on the periodic table, soil organic carbon is actually current and past *life*, sometimes called "the living, the dead, and the very dead." We can manage soils to increase life, or not.

Soil organisms are the quiet workers of the underground world, continually building the structure and function of our soils: the basic infrastructure we all depend on for water, food, and safety. The way we treat these quiet life forms will determine our future. I am here today to give them a voice.

I come to you from Vermont: a small and mountainous rural state just south of the Canadian border. We have the second smallest population in the United States. Our focus is on dairy farming, with an increasing number of new small farms harvesting mixed vegetables, berries and other fruits, eggs, meat, and maple syrup. Many of us also hunt and gather food from the wild. Local food sovereignty is important to us, and we are blessed to have amazing meals from our farms and forests.

As Vermonters, we are learning to address our needs for clean water, food security, and resilience to flooding and drought by working with natural soil biology.

I work with the Soil Carbon Coalition and various other NGOs and agencies to community learning resources and training sessions about the potential of soil biology to improve watershed function. We have created a citizen science data-collection app (www.atlasbiowork.com) for mapping changes over time in soil carbon, infiltration, and other measures of soil function.
Many of our materials are now available for free online (http://soilcarboncoalition.org/learn) and are being used around the world, helping communities learn how to grow landscapes that naturally soak up the rain. In addition to many regions of the US and Canada, we have had requests from:

- Thailand
- Vietnam
- India
- Pakistan
- Argentina
- Uruguay
- Brazil

- South Africa
- Australia
- New Zealand
- Mexico
- Croatia
- Serbia
- Bosnia & Herzegovina
- The United Kingdom
- Italy
- and the Netherlands

I'd like to introduce you to my river: the Ompompanoosuc. We have beavers living near our rivers and streams and they help to build the structure of the land and watershed. My sons and I play at the river in every season. But beautiful rivers can become fierce when soils don't absorb rain.

I became interested in the potential of soils to create regional resilience after seeing the devastating effects of Hurricane Irene. In one night of flooding, 500 miles of roads and over 300 bridges in Vermont were damaged or washed away completely. Farmers were hit particularly hard, with whole fields disappearing down rivers, leaving only bare rocks and subsoils behind.

Flood events have increased in Vermont, even during drought conditions, as they have in much of the world. It costs our state millions of dollars to repair damages from floods. This recent one on July 1st damaged 75% of the roads in my town of 2,600 people. We won't be able to afford to repair it for a long time. With a population of just over half a million in the whole state and many miles of rural roads, this is unsustainable.

We also face a public health hazard as runoff from farms and lawns enters our streams and lakes, creating toxic algae blooms that cause neurological problems. Millions of dollars of research money is being spent on this problem as well. *Yet we already know how to prevent flooding and algae blooms.*

Think of pouring water onto a plate of flour versus a plate of bread, and you can imagine the difference between inert mineral particles and a living soil carbon sponge: created by plants and microorganisms. When it rains on the flour, the water runs off, and erodes the land. The bread soaks up rain and stays intact even when wet. This is a simple teaching tool I use to illustrate the difference between degraded soils and healthy, well-aggregated soils.

Here is another teaching tool we use: a rainfall simulator, with 3-inch tall sections of intact soil cut directly from farmland—all of the same soil type, but under different types of soil management. The trays are open on the bottom, allowing water to flow through and be caught in the jars underneath. You can see those jars in the back. The soil surfaces are at a slight angle to allow any water that isn't infiltrating to run off and be caught in the jars in front. We turn on the rain with a switch, let about four inches of rain fall on these trays, and see what happens.

In this example, on the far right you can see conventionally managed land with no cover crop, heavy tillage, and lots of pesticide and inorganic fertilizer use. The jar underneath is empty: no water is being absorbed by this landscape. Look at the jar in the front: lots of water is running off, quickly carrying silt and chemicals into streams, rivers, and lakes. Lots of soil is eroding. If you flip this tray over, the bottom will let off a cloud of dust: after all that rain, the soil underneath is completely dry. There is no water left for us or the plants.

This sort of soil management is exactly why flooding and drought often go together, and why droughts continue even after it rains.

The tillage has chopped up and destroyed the natural soil structure, the pesticides have killed off much of the life needed to build new structures, and the bare soil cannot feed or protect any organisms that remain, so the whole structure and function collapses. This management choice is expensive, high tech, and the cause of many of our current troubles. As agronomist Ray Archuleta says: “The land is naked, hungry, thirsty, and running a fever.”

Are there other choices? Yes, there are. As you go from right to left in the soil samples in this rain simulator, the soil gets healthier and healthier. On the far left, you can see a system with no tillage, no inputs, and year round plant cover. There is no runoff or erosion in the jar in front. It is empty. Now look how the jar underneath is filling with clean water! In a full landscape this water would continue to move down, replenishing plant roots, drinking wells, and aquifers. What is going on underground here?

The living plant roots are feeding about half of the sugars they make to the soil organisms in exchange for nutrients. The soil organisms stick tiny rock fragments together (particles of sand, silt and clay) with slimes, glues, and threads, creating a living, breathing, sponge-like matrix. Earthworms, beetles, and small mammals make larger passageways through the sponge. This “soil carbon sponge” soaks up rain, filters water, and keeps landscapes cool, moist, and intact. Just exactly what we need.

Without a living sponge, most life on land will die from heat and dehydration.

With it, we thrive.

This living soil matrix is the basic infrastructure for all of life: and this presents us with a grand opportunity. A handful of healthy soil contains billions of organisms, ready and willing to help us build what we need, for free. We can shift our management to grow a living sponge, even from a desertified landscape, as this sheep farmer has with Holistic Land Management.

The principles for improving soil health are obvious if you observe a thriving natural landscape.

- **Keep soil covered with plants or mulch year-round** to protect soil life from heat and pounding rain.
- **Keep living plants in the ground as long as possible** so that plant roots can actively feed soil life with liquid carbon—sugars—in exchange for other nutrients.
- **Reduce or eliminate tillage**, to preserve soil structure.
- **Use plant diversity** to increase biological diversity.
- **Avoid chemical stresses on soil life**.
- **Integrate and welcome grazing animals, small mammals, birds, and beneficial insects into farming systems**: Nature never farms without animals.
- Every landscape and community has unique strengths and vulnerabilities. **Get to know the context of the land around you.**

It only takes a few days to teach communities these soil health principles, and how to accurately measure, and map changes in infiltration rates, compaction, and structural integrity of soils.

By teaching principles, which are universal, rather than trying to develop Best Management Practices for every possible situation, we can empower communities to develop their own innovative approaches to soil regeneration.

Creative farmers, ranchers, herders, and others around the world are turning degraded landscapes into a fertile soil sponge without using chemicals or technology, simply by working with natural processes and community decision making. This is an example of two sheep farms in the Karoo, differently managed. Imagine yourself standing there, and ask yourself some questions:
Where will water evaporate more quickly?
Which side would be hotter to stand on?
Which sheep farmer is experiencing a drought?
Which side of the fence do you want to live on?

Abe Collins, the founder of LandStream—an Vermont startup company developing on-farm environmental monitoring systems—suggests that if regions hire farmers to rebuild deep topsoil watersheds we can double farmers' incomes, reduce externality costs, and grow the natural infrastructure we need. (Our neighbors in New York have modeled this well in the proactive ways they care for the living watershed that provides drinking water for much of the state's population.)

The Vermont-based non-profit, The Grace Initiative (which is also registered in Colombia) promotes agricultural practices as a component for building peace, and I appreciate the chance to collaborate with them in this event. You can see why a lush restored landscape like the one on the left could have a more peaceful society with fewer conflicts over resources.

Many groups—such as the Soil Carbon Coalition, Soil4Climate, Regeneration Vermont, Rural Vermont, the Northeast Organic Farming Association, the Center for Sustainable Agriculture at University of Vermont Extension, the Vermont Grass Farmers Association, and the Rich Earth Institute—are working

on soil health initiatives in our state. The Vermont Healthy Soils Coalition brings together all the other groups so that we can work together to restore climate resilience and the function of our watersheds. We hope every region and every nation will join us in creating a Healthy Soils Coalition.

The soil health movement provides an opportunity for all people to improve conditions in the land around them, and to understand the power of community, systems thinking, and interconnectedness on many levels—from microscopic to world-wide. Sometimes the power to create real change is hidden in surprising places. I see that power in soil life; in farmers, ranchers, and herders who work with nature's patterns; and in small rural communities like mine, around the world.

Thank you, from the bottom of my heart, for your kind attention.