Spring 2023

the NATURAL FARMER

Special Focus:
Water & Agriculture

Where Has All the Water Gone

By Stephen Leslie

Cows grazing mid-summer drought at Cedar Mountain Farm. Image source: Stephen Leslie.

2022 was a hot dry summer across the region, and in fact, across the Northern Hemisphere. Concerns about water availability in Vermont were recently prompted by the moderate to severe drought that began in 2020. In 2021, some wells in the northern tier of Vermont began to go dry. Last season, for many farmers, the growing season was a bust. Long-term climate modeling suggests we should anticipate more summers like this.

A recent climate impact assessment issued by the University of Vermont shows that over the last 20 years, unpredictable and unseasonable "flash droughts" have become a common feature for farmers to contend with. Although overall precipitation has increased by 20% since the 1970s and is predicted to increase another 20% by 2050, the water is tending to come all at once, in potentially destructive "precipitation events" and summer dry spells have grown longer and more severe in their impacts, not only on farms but also putting new stressors on forest ecosystems and wildlife. Additionally, shorter winters and higher summer temps increase evaporation from land and bodies of water.

In response to these drying conditions, the state of Vermont passed a new law that went into effect in July that calls on farmers to monitor their water use which requires that any agricultural operation that draws a minimum of 10,000 gallons in a 24-hour period from surface water must register with the state and record their use. The aim of the law is to make our lakes, rivers and streams more resilient in the face of climate change.

While this data will certainly be useful, measuring and regulating water use at "the tap" is starting at the endpoint.

If we want to get serious about ensuring our water supply remains stable and abundant into the future, we need to consider how to infiltrate and hold water better for resilience through all extremes.

If something like tropical storm Irene (11 inches of rain in 24 hours) hit in 1750, the old-growth forests that once covered our region would have infiltrated all that water without catastrophic flooding. Old forests hold 4 times more water than young ones and 10 times more than even healthy agricultural fields. Plus the ubiquitous bio-engineering of beavers and extensive healthy wetlands slowed water and kept aquifers replete.

The problem is, we are still quantifying and measuring water as if it were a "thing." We need to take a page from the Indigenous water protectors (who have been leading the resistance to block new tar sand oil pipeline construction on their homelands in the Dakotas and elsewhere) — when they remind us that "water is life!"

3.8 billion years ago rain used to fall on the bare rock of empty continents and run right back to the sea. It was only after fungi and algae got together to venture out of the oceans and colonize land that the soil formation process began and consequently that freshwater also gained a foothold on land (cycling through soil, plants and animals).

That original soil carbon sponge formed from the detritus of primitive plants and animals is the basis of all terrestrial life and there would be no water cycle without it. So, even though all life depends on water, water depends on soil to catch it, hold it and slowly release it again.

What can we be doing now to create fully functioning forest, farm and municipal landscapes that mimic the capacity of the ancient forest?

A secure clean water supply must begin with healthy soil.

On our small diversified farm, we are feeling the impacts of this dry summer on every front, after all, water is the essential ingredient!

For example, with the lack of precipitation, the regrowth on our hay fields has been reduced by 40% or more, which in our context means there is that much less grass for cows to graze on the fields that we fold into the grazing rotation after the first cut and a reduced bale count on the field where we typically bale second cut instead of grazing because it is some distance from the barn.

When it gets dry like this, the farmer puts in the same amount (or sometimes more, as in moving irrigation pipe) of work and energy expenditure but reaps lower returns. For us, this translates into having to spend more on bought-in hay — and we can expect the price to go up, as operating expenses have increased and yields are down across the region.

However, we are also seeing some positive results through efforts we are making to mitigate and adapt. For instance, we have a field where we grew vegetables for 12 years. When we started, the soil organic matter (SOM) in this field was 3%. By applying compost at a rate of 20 tons/acre and the extensive use of cover crops, we managed to raise the SOM to 6%.

According to the Natural Resources Conservation Service, every 1% increase of SOM in soil will hold an additional 20,000 to 26,000 gallons of water, which means in a drought, we potentially retain an additional 60,000 gallons or more per acre on this field. In our pasture system, we have identified micro wetlands, typically classified as "marginal land." By excluding cows from these zones, we have seen them jump back to life as functional wetlands, infiltrating and holding water while vastly increasing the biodiversity of the system overall. We have begun introducing trees back into our pastures. Pilot studies have shown that when planted at a density of 20 trees/acre in a silvopasture system, the cooling and soil buffering power of trees increases forage yields and livestock gains by as much as 20%.

In our market garden, we switched over to a no-till approach. When the soil is no longer disturbed through tillage, plants can re-establish a symbiotic relationship with fungal mycelium. The permanent beds are healed from compaction and the deep loamy mulch that develops holds water even on our sandy soils.

Climate scientists of the UN's Intergovernmental Panel on Climate Change tell us that we have an eight-year window to halt CO_2 emissions if we are to avoid the most catastrophic consequences of irreversible abrupt climate change. In order to meet our binding greenhouse gas emission reduc

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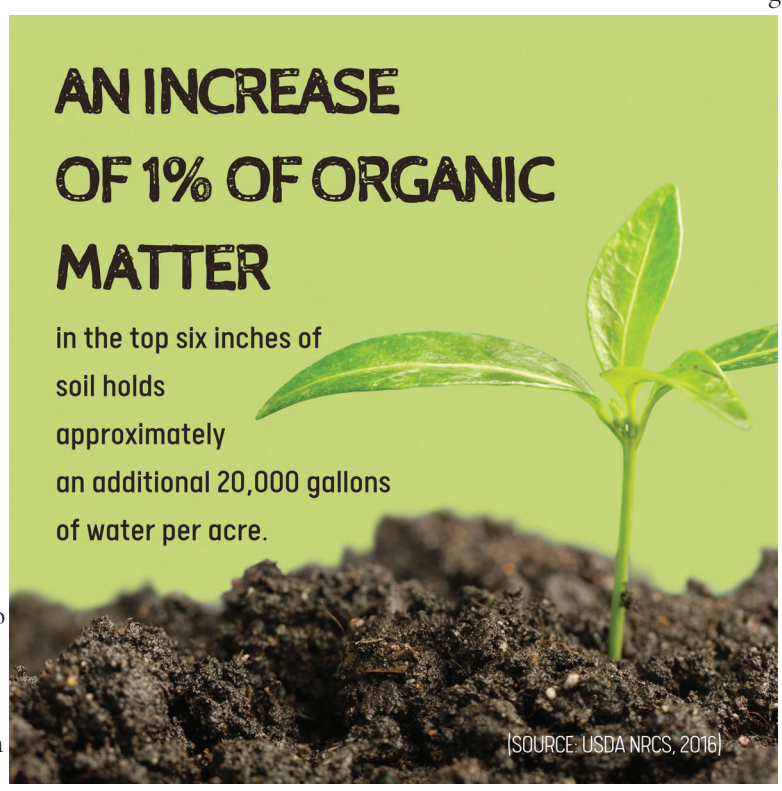


The Onondaga Nation, in Unprecedented Land Back Moment, Regains 1023 Acres of Stolen Land

Lands return to Onondaga

Reprinted from Indian Country Today

The Onondaga Nation will recover more than 1,000 acres of forest lands in the Tully Valley through a historic agreement with New York State and the federal government. This property, identified for restoration and preservation as part of the Onondaga Lake Natural Resource Damages and Restoration process, will now be returned to the care of the Onondaga Nation.

"It is with great joy that the Onondaga Nation welcomes the return of the first substantial acreage of its ancestral homelands. The Nation can now renew its stewardship obligations to restore these lands and waters and to preserve them for the future generations yet to come. The Nation hopes that this cooperative, government-to-government effort will be another step in healing between themselves and all others who live in this region which has been the homeland of the Onondaga Nation since the dawn of time," says Tadodaho Sid Hill.

Re-establishing Onondaga Nation stewardship over these lands, which include the headwaters of Onondaga Creek, is a ground-breaking opportunity to restore the land, preserve Onondaga culture, and address historic and ongoing land injustices. The benefits of this decision will accrue not only to the local ecosystem and the Onondaga Nation citizens as they reconnect with their ancestral lands, but to state and federal agencies and the general public, as they learn from cross-cultural consultation, collaboration, and educational opportunities. The Nation is deeply committed to healing and restoring this property, which has been profoundly damaged by decades of reckless brine mining by Honeywell.

For the Onondaga people, Onondaga Lake and Onondaga Creek are sacred. They are considered living relatives, central to the Onondaga worldview and spirituality. These waterways and other natural areas, like the Tully Valley, lands, provide freely-given and sustainable connections with traditional foods and medicine, support ancestral memory and cultural lifeways, and remind the Nation of their cultural and ecological responsibilities to their non-human relatives.

"The Onondaga people have a unique spiritual, cultural and historic relationship with the land, which is embodied in the Gayanashagowa - the Great Law of Peace. This relationship goes far beyond U.S. federal and state legal concepts of ownership, possession, or legal rights. The people are relations with the land, and consider themselves the land's caretakers," says Joe Heath, legal counsel to the Onondaga Nation. "It is the duty of the Nation's leaders to work for a healing of this land, to protect it, and to pass it on to future generations, while operating under an unwavering emphasis on restorative healing for communities. "

According to SUNY-ESF Center for Native Peoples and the Environment, the return of the Tully land to the Onondaga Nation provides unique public benefits. This action furthers the State of New York's obligations under its own environmental justice policy and the United Nations Declaration on the Rights of Indigenous Peoples. The Tully Valley lands will provide opportunities to restore important Onondaga cultural practices, such as fishing, hunting, and gathering plants. It begins to redress the unjust dispossession of the Onondaga Nation from their ancestral lands and the years of industrial abuse of Onondaga Lake, which previously provided a culturally important and resource-rich site for fishing, hunting, and gathering and is now too contaminated to offer these services.

The public will also benefit from the responsibility-focused stewardship practices of the Onondaga Nation. Numerous scientific studies have established that Indigenous land management practices protect biodiversity and healthy forests, preserve clean soils and waters, and better prepare communities for climate resiliency and adaptation. Across the planet, there is a significant overlap between "biodiversity hot spots" and Indigenous-held lands with Indigenous peoples caring for 80% of the world's biodiversity on less than half the land area. Indigenous-managed forests have higher levels of understory plants, more natives and fewer invasive species, and more mature forest characteristics than comparable forests managed by non-Native public agencies. Considering this successful global record of conservation, restoring Onondaga-led decisions supports the DEC's conservation mission.

The Nation appreciates the cooperation of its treaty partner, the United States, and of New York State, as these two Trustees for Natural Resource Damages have listened to Onondaga, understood the damages suffered by the Nation and its citizens from the industrial pollution of their sacred lake–Onondaga Lake, and work to respect the Nation's deep ties to these lands and the traditional ecological knowledge which will lead the future restoration of these acres. The Nation applauds the Trustees' decision to join the growing movement to restore Indigenous people to their ancestral lands and to partner with Indigenous people to restore traditional land stewardship methods.

The Nation's oral history shows that they have been present on this land for thousands of years, They were witnesses to and stewards of a historical abundance of resources, including eels, whitefish, bears, native plants, and old-growth forest, and to the destruction and contamination of those resources by generations of industrial abuse, dumping of wastes, filling of wetlands, and shoreline development. The Nation has a vision for their ancestral lands, rooted in the quality and purity of water and the respectful tending of land, wildlife, and other non-human relatives. The return of the Tully property to Nation stewardship is a good initial action in this long journey.

The Nation looks forward to further cooperative efforts to protect more land and waters by restoring Nation stewardship. Let us continue to work together to heal some of the harms of the past–the illegal takings of Onondaga homelands and the century of industrial pollution to the land and water.

Water is life.

Released June 29, 2022
Media contacts: Joe Heath, jjheath1946@gmail.com, (315) 447-4851; and Jeanne Shenandoah, jessicajshenandoah@gmail.com, 315-952-0467

Editors note: For more about land back movements and land access, please read The Natural Farmer *from Spring 2022 on our website.*

(Vermont drought - from A-1)

tion targets as established under the passage of the Vermont Global Warming Solutions Act of 2020, to clean up our rivers and lakes, and renew our agricultural economy, we need to elevate healthy soil as an essential ingredient to solve the climate and biodiversity crisis.

Winter beds mulched at Cedar Mountain Farm. Image source: Stephen Leslie

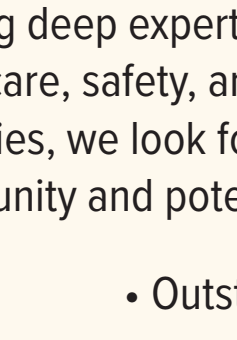
Healthy soil practices have proven to be the most cost-effective way to sequester carbon. Simply reducing GHG emissions won't be enough to halt climate change. We need to maximize the carbon sequestration and water infiltration capacity of our farms and forests.

In Vermont, we have statutes dating back to 1992 protecting public water supplies and groundwater. Soil should also be designated as a "public good." Additionally, just as air and water quality are protected by the EPA and states are mandated and funded — soil should have the same protections and funding.

Vermont can be a leader and an example to the federal system by granting equal protection to air, water and soil — by joining other states such as California, New Mexico, Maryland and New York — in passing healthy soil legislation. Soil is life!

Originally printed in vtdigger.org/2022/08/23/stephen-leslie-where-has-all-the-water-gone/

Stephen Leslie co-manages Cedar Mountain Farm and Cobb Hill Cheese, both located at Cobb Hill Co-housing in Hartland, VT.



Water Management For Every Permaculture Farm

By William Horvath

When I was a kid, my brother and I used to enjoy the winter weather at my grandparent's farm in the mountains. In a beautiful interplay of natural forces, throughout the winter and early spring, we would play in half a meter of snow, walk on frozen lakes and then run from the floodwaters once the snow had thawed.

We always looked forward to wintertime and knew what to expect. Now that we've grown, however, these natural cycles of snow, ice, and floodwater have changed significantly. It's not like they no longer exist, but everything has become so much less predictable, and so much more extreme.

This weird weather is the new normal for many of us. We all are experiencing more extreme and erratic weather cycles, with huge downpours and flash floods on the one hand and extreme droughts on the other. This is the new normal.

We have to adapt to this new reality by creating resilient extreme weatherproof systems that are able to handle either too much or not enough water, all in one growing season. In these circumstances, the plan for the control of water is critical and involves a combination of earthworks, soil-building techniques and irrigation pipes.

Water Management
Nothing defines the nature of a place more than water and water is always the number one priority for any permaculture system, as Mark Shepard, author of Restoration Agriculture, says: "No matter where you go and what mineral deficiencies you have, there are plants who can adapt to these conditions, but no plant can live without water!" That's why Permaculture design tries to harvest, retain and rescue as much water as possible before it cycles from capture.

There are two basic strategies of water conservation on a farm: storing water in the soil and the diversion of surface water to dams/ponds and tanks for later use; storing it on the surface.

First, we want to slow, spread, and sink water as it falls from the sky into the soil. You want to disperse the flow of water so it can slow down and infiltrate into the soil, enabling this runoff to soak in. Essentially, you want to make the water stroll, not run, through the landscape. Our next goals, as Ben Falk writes in *Resilient Farm and Homestead*, are to (1) capture as much water as is reasonably possible, (2) store that water for dry periods, and (3) distribute that water when necessary across the site. Whether you're going to use one or both of these strategies depends on your site conditions: climate, terrain, soil, and your land's context.

Here, I'll outline the entire process of water management for a farm:

Assessing Your Site's Water Needs and Resources
1) Your goals and context - what are your water needs, and how do you plan to use your harvested water? You'll have to be clear on what you want to achieve with your water system from the outset, because you want to know what size storage you'll have to build and, most importantly, whether it'll be possible to build due to your terrain and your budget.

First, think about how you are planning to use the water: do you need water for household use, livestock, irrigation, fish production, fire protection, or recreation? Calculate how much water you'll need for each of these activities. Finally, think about what, realistically, you can build considering your budget, available space and aesthetics.

This thought process can eliminate a great deal of unnecessary planning and will help you prioritize based on the reality of your situation. That's why we always start with being clear on your context and your goals: The best way to save money on a project is not to start it in the first place!

Terrace gardens, raised beds, sequential ponds.
Image credit, Ben Falk, the Resilient Farm & Homestead.

2) Identify the sources of water. Once you have an idea of your water needs and how you plan to use your harvested water, see what water sources are available to your farm. What is my average annual rainfall? How is that precipitation distributed throughout the year? Is it being delivered in heavy downpours, only during the winter, or equally distributed throughout the year?

Your water systems will be completely different based on the answers to these questions. The precipitation and its distribution will be the foundation for your planning, and you can find this crucial information easily on the Internet just a few clicks away. Now, for other sources of water on your property and beyond, you'll have to do some detective work.

Locate any streams that are running across your property. This flowing water is essentially runoff from outside the boundaries of your property and within your watershed. You can't control how this water gets onto your site, but you can use it for your water needs if necessary (be sure to check your stream's class classifications first though, and DEC restrictions on pumping from streams if you plan to use substantial water). That's why you need to know the precise reliability of your water source. Is it perennial or just seasonal? Can you count on it when there is a drought? Is the water clean enough for your purposes or contaminated in some way?

Consider if there is water underground that's available to you. While you can't reliably tell how much water is under your feet unless you drill a lot of wells, you can determine your site's watershed.

3) Watershed - determining your place in the hydrologic cycle and your site's watershed. Every piece of land belongs to a watershed, and it's defined as an area of land that drains runoff from rain or snow downhill from the highest geographical barriers, such as hills, ridges and mountains, to a specific low point, generally a tributary outlet to a larger river or a lake.

On a larger scale, your land is almost sure to be a part of a regional watershed that drains thousands of square miles or kilometers of land, creating streams and rivers. Although knowing your regional watershed might not have an immediate use to you, I would recommend looking at the broader watershed to understand the ultimate source and destination of your water as well as how it moves.

Water movement on your site or within your area is a function of where you are in the overall watershed. For example, if you're high in the hills, you'll have a small flow of water, probably some small creeks, but on the other hand, if you're low in the landscape, there may be lots of water, probably rivers rather than creeks.

However, to access your site's actual water resources, you'll have to look at your site's watershed or the sub-watershed. You might belong to an extensive watershed, but the precise quantities will depend on the local site's terrain. Nothing can be more critical to this process of identifying your site's watershed than understanding the land patterns represented by topographical maps. For this, you'll have to be able to recognize the contours for their definition of ridges, saddles and valleys/gullies. This is essential for the effective calculation of catchments.

To start assessing your site's watershed, you'll have to define the boundaries of your property and the watershed directly affecting your site. You can do this by looking at a topographic map and identifying the divide lines (or center lines) on the ridges. The lines located at the tip of the ridges determine if water is flowing toward or away from your location. Once you know where they are you'll have an idea of the boundaries of that catchment and, by using simple math or online tools, you'll get an estimate of the size of this surface area. You'll then need to calculate your site's rainfall volume - your water budget. You can read basic instructions on my website or check out Darren Doherty's article and tables at *regrarians.org*.

Storing Water in the Soil
The cheapest place to store water is in the soil - it's the largest storage resource available on most sites. Maybe you have big plans for an interconnected network of cascading ponds, but let's first cover the essentials that won't cost that much money. Our initial efforts should always be to get water into the ground and store it there.

To store water in the soil you have to focus on two objectives. The first is to slow, spread and sink the rainfall so that the water takes the longest possible path across your land, running over as many things as possible, spreading where it's needed, and giving it time to infiltrate before it eventually leaves your site and drains away.

Your second objective is to build the soil's organic matter. Organic matter acts as a sponge and absorbs the water that's slowly moving across the landscape. You'll also need to shape the land in such a way as to slow-spread and sink water for that sponge to absorb. To do this you can use two very famous techniques: 1. keyline plowing/subsoiling and, 2. Swales on the contour.

Keyline plowing /Subsoiling
The concept of keyline agriculture emerged from the drylands of Australia thanks to P.A. Yeoman. Yeoman shaped how we permaculturists think about managing water on the farm. While keyline agriculture contains many concepts, the most fundamental is to spread the abundance of water from where it is concentrated in wet areas to areas that are consistently too dry. Normally water flows from ridges into valleys. The ridges stay dry, and the valleys accumulate moisture. However, by using a keyline cultivation pattern, you can channel the water away from the valleys and towards the ridges, and in the process distribute it evenly over the land and increase the infiltration. This is achieved by using the tractor and ripping lines (opening up furrows in the soil) with a keyline plow parallel to the keyline.

(continued on next page)

(Water Management - from B-4)

Keyline Plow. Photo Credit: Connor Stedman.

These small water channels in the soil, these hundreds of small drains, will then intercept water that flows down toward the valleys and move it in the other direction, toward the ridges. The net effect is that rip lines hold water for infiltration, instead of the water running down the slope. With more water in the soil, plant growth and soil microbes increase.

Keyline cultivation is also a soil improvement system, as it promotes rapid topsoil formation. As you create furrows in the soil and rip the subsoil you allow water and air to infiltrate deeper into the soil where they can be used by plants. This can break up the hard pan and build rich fertile soils, and, as you already know, as soil becomes fertile, more water can be absorbed and stored. Read more in P.A. Yeoman's book *Water For Every Farm*.

Swales on Contour

Your second strategy for storing water in the soil is by using swales. Swales also help us to slow, spread, and sink water, allowing us to hold off the runoff water and allowing it to seep into the soil, thus storing it there.

In his book *Gaia's Garden*, Toby Hemenway describes a swale as "a shallow trench laid out dead level along the land's contours". It can be anything from one to several feet across, a foot to several feet deep, and whatever length is necessary. The earth dug from the swale is piled on the downhill side to make a raised mound or berm.

During a rain event, once the soil can't absorb the falling rain any longer, overland flow occurs. Whatever water the soil can't absorb flows downhill as runoff. As that surface water and rainwater runs downhill it is intercepted by the swale, spreading it out along its length, and slowly it percolates into the soil. This underground water then seeps downslope, forming a lens of moisture. The stored water creates an underground reservoir that aids plant growth for tens of feet below the swale. Most importantly, swales are tree-growing systems; by planting trees or other crops on the berm on the downhill side of the swale (or just below it) they'll be able to take advantage of this soil moisture during dry periods.

We primarily use swales for this purpose, but swales also prevent gullies from forming by intercepting rainwater, slowing it, spreading it, and essentially decreasing its erosive potential. Swales also trap organic matter and the ditch becomes a rich, thick layer of humus that holds a considerable volume of water.

Now I know that after hearing about swales, you'll be eager to implement them on your land, but would they work on your property? Swales are the most widely used and abused permaculture water-management technique. There are many factors that influence whether or not you swale your site depending on your slope, soils, hydrology, type of management, ecosystem's condition and resource base.

Generally, swales are most appropriate for slopes of 5% or less. The size of the watershed, the climate, the soil type, and the land use determine how much water flows off the land and into swales. Small watersheds, sandy soil, and forested areas won't produce much runoff. Conversely, large watersheds, and soils with clay and loam, shed more water. A location's climate also plays a part, because some areas are more likely to experience intense storms with more runoff.

Storing Water on the Surface

Once you're done storing water in the soil, let's move to storing water on the surface. The cheapest way of storing large volumes of water (more than 100,000 liters) is in a water-storage dam or pond. (Your local Soil & Water District and NRCS offices can be a great resource for pond design, safety considerations, construction and - in some cases - approval.) In a changing climate, a pond is an enormous asset to have. You can use it for many different purposes at once - aquaculture, irrigation, stock and domestic storage, wildlife habitat, recreation and more.

Generally speaking, there are two types of ponds/dams - an embankment pond and an excavated pond. An embankment, as the name suggests, is made by building an embankment or dam across a stream or watercourse where the stream valley is depressed enough to permit storing reasonable amounts of water.

An excavated pond is made by digging a pit or dugout in a nearly level area. Because the water capacity is obtained almost entirely by digging, excavated ponds are used where only a small supply of water is needed. Some ponds are built in gently to moderately sloping areas and the capacity is obtained both by excavating and by building a dam.

Now, what type of a pond you'll be able to construct and, most importantly, where, depends on your site's terrain. Different pond types and locations have different storage ratios (the volume of excavation versus the volume of storage) and this is the most important factor in determining how viable a potential site will be. When constructing a pond, you want to make a minimal investment in both time and earthworks for a maximal amount of storage.

The type and dimensions of the pond will also depend upon the climate and the amount of average evaporation losses. With this in mind, here are different pond types from the most economical and easiest to the more expensive ones that require more extensive earthworks. The first rule of working with water is to keep it in its place of highest potential on the landscape, up high if it can be economically placed there. So, we'll start from the locations up the hill and go downhill.

- Gully/Keypoint Ponds: These are probably the most common of all dams, one of the easiest storage options and most economical options. They are constructed by building an embankment in a gully or drainage depression capable of keeping the water in a gully/valley behind it. The main use for keypoint dams/ponds is to store irrigation water. This irrigation water is then generally released though a large pipe going underneath the dam's wall.

- Saddle Pond: A saddle is a topographic feature - a dip or break along a level ridge crest. Since it's on a ridge, this is the high ground and the highest available water storage in the landscape. This pond has a much smaller watershed than a gully/valley pond, but still can collect water runoff from both sides of the ridge crests. The primary use of a saddle dam is for wildlife and domestic stock, not as much for irrigation.

- Hillside/Contour Ponds: Contour or hillside ponds are built on the side of hills and usually have a three-sided or curved bank or long, curved bank straight across the hillside slope (on the contour). The best way to locate these types of dams is to look at your topographic map and check for any widening of the contours along the hillside. Widening means that the terrain is flattening and this might be a good location for the pond. These ponds are relatively expensive to build since you have to do more digging for less water storage, but they'll still provide you with gravity storage. They are usually filled by diversion drains or graded catch drains and have the same use as a saddle dam - wildlife and domestic stock.

Ponds for flat sites: Excavated tanks, Ring tanks, and 'Turkey's nest' ponds are suitable for flat sites, and since they cannot capture runoff, they need to be filled by external sources. In excavated tanks, the excavation becomes the water storage, below the surface level. Earth removed is stockpiled nearby, unless additional dam walls are constructed for additional storage above ground level. Ring tanks are constructed by using earth from inside the ring (circular or shaped to suit topography) to build the surrounding embankment. Water is generally stored above the natural surface. 'Turkey's nest' dams are a variation of the ring tank where the borrow pit is located outside the embankment. Water is stored above ground level.

Water Harvesting

You can fill your ponds with water from a well, but ideally, you use surface flows and rainfall runoff. You can capture water with water-harvesting drains that will divert the runoff, stream flow or pump water into your ponds, and subsequently tanks. You can think of diversion drains/ditches as being giant earthen gutters placed across the landscape to harvest and move water in a manner similar to rain gutters on a house. They differ from swales in that they are built to flow after rain and, unlike swales, which are normally built on permeable soils, diversion drains work better when the base and sides are clay-lined.

(continued on B-9)

Should I Swale That?

More appropriate		Less appropriate
Slope grade 3-15%	SLOPE	Slope grade less than 3% or more than 15%
Shallow depth to bedrock, relatively impermeable/compacted High water table	SOILS	Erosion prone/unstable, fertile, deep, well drained soil ("ag" soil)
Brittle landscape & precipitation event severity high	HYDROLOGY	Non-brittle landscape & precipitation event severity low
Perennials Less mechanized	MANAGEMENT	Annuals, hay, pasture More mechanized
Earlier succession (e.g. "old field")	ECOSYSTEM CONDITION	Later succession (e.g. "old growth" forest)
More time, currency, energy, machinery, skills, tools, etc.	RESOURCE BASE	Little time, energy, currency, tools, skills, other resources

These are guidelines and criteria for decision-making, not strict rules nor an exhaustive list.
Each project involves unique contexts which need to be considered to understand the appropriateness of any technique.
Swale: a water-spreading, slowing and infiltration earthwork - e.g. ditch on contour (or close to contour such that water is slowed in it's movement down slope). An anti-conveyance landform.

Should I Swale That. Credit: Ben Falk, Whole Systems Design..

I Love my Drip Irrigation. My Plants do Too.

By Richard Robinson

There are three major reasons I love to use drip irrigation in the garden: It puts water where it does the most good, it puts enough of it there to really make my plants happy, and it allows me to set it and forget it for the rest of the summer - a real benefit to a busy, lazy farmer like me.

Image 1. Irrigation at Hopestill Farm.

Drip systems got their start in the desert, and that's where I first learned about them. But they are useful wherever plants need more water than the sky will supply.

There are many types of drip emitters, but for gardeners, the most common and most useful is drip tape - thin tubing with regularly spaced slits. Laid in straight lines down the planting bed *(image 1)*, drip tape weeps water that percolates down into the root zone, allowing the plant's roots to dive deep for water (and bring up nutrients from there as well), rather than spread wide and stay shallow.

The end of the drip tape can be closed off by folding it back on itself and sliding a 3" sleeve over it *(see image 2)*.

Drip tape will also deliver much more water than most gardeners will have the patience to water in by hand. Ten minutes of hand watering is a lovely interlude; an hour is much, more time than I'm willing to spend, but certainly, less than my large garden wants in June to really allow my plants to grow. But if I turn on my drip system, I can walk away and come back in an hour or three to find the soil evenly moist and wet down where it really counts.

Image 2. Closing off drip tape.

But what really makes the drip system superior for me is that I can set the whole thing up on a timer and not think about it again all summer. Not only does it save me dozens of hours when I don't have to be watering - it saves me dozens of hours when I don't have to think about whether I should be watering. And if I want to take a few days away, I can leave knowing my plants will be perfectly watered without me.

The standard set-up includes a spigot, Y-splitter, timer, filter, and pressure reducer *(image 3)*.

When you first open a drip irrigation catalog, like that from Dripworks (which I heartily recommend), it can seem a little intimidating—there are lots of options, lots of different parts, and some initially confusing lingo. But a great system for your garden is really pretty simple.

It starts with a spigot or faucet. It's best to attach a Y splitter so that the drip system can use one arm of the Y and you can still attach a hose to the other.

Image 3. Standard set-up at hydrant.

Next in line is a timer (optional, but highly recommended). After that comes a filter. Next is a pressure reducer, which takes house or city pressure (usually 30-60 pounds per square inch, or psi) and steps it down to somewhere around 8-12 psi.

After the pressure reducer comes "mainline" tubing, black plastic tubing ½" in diameter.

That gets the water to your beds. Off of the mainline tubing comes drip tape, which runs down the beds. The exact configuration of mainline tubing and drip tape is entirely up to you.

You can buy some drip supplies at your local home center, but I strongly recommend beginning with Dripworks, which has a well-deserved reputation for great customer service. They will spend time on the phone with you to help you get the parts you need, and avoid the ones you don't.

Richards is a farmer at Hopestill Farm in Massachusetts.

Farming with Less Clean Water

By Dan Pavich

20+ years in the agriculture industry and mostly in the regenerative ag sector, you see some stories and are occasionally reminded that "it can be done and it should be done." Recently I was reminded of this life maxim as an article was squarely dropped in my inbox. The sender didn't know that I was going to be so impacted by this article. In fact, the sender could not have been sure that I would even open the email. And yet I did.

The article was a story about a farmer in west central Indiana who has, for all intents and purposes, escaped the use of nearly all chemical inputs on his 8000-acre row crop operation. He's free. More importantly, he's using less water while, at the same time, building up his soil.

For years, when I speak with farmers, the saying routinely comes from my mouth, "you cannot get there from here, at least not in one season." What do I mean by that? Well, it's really about two things.

First, the difference between a water-conserving regenerative ag system and a water-shedding degenerative ag system on a farm resides mostly in a six-inch space between the farm manager's ears. And second, the change to a regenerative system from a degenerative system takes time. Converting to this water-conserving regenerative system is a marathon, not a sprint.

The change to a regenerative system is worth it though. It's a chance to be free from the bank, after all. Allow me to lay out just a few of the benefits and since you've probably heard them before, I'll add a little bit of the science behind the benefits. If nothing else, you will learn some information to wow your friends and family.

Regenerative systems are more biological in nature than they are chemical. I say this tongue-in-cheek. The research I've done indicates soils that possess an Organic Matter Percentage (OM%) above 3% are driven mostly by biology. Soils that possess OM% below 3% are typically driven by chemistry. My reference to OM% in the scope of this writing represents water-holding capacity.

You may be sitting on light sandy soil and now you are thinking "Great, so what you're saying is that I'm stuck using chemistry forever." The Land Grant Universities tell you that a single OM% takes 100 years to build.

I'm here to offer you hope.

Let me start with the obvious contradiction. If you want to "reduce" your soil OM% by 0.5%, go out and plow or work your fields right after a rain event. Your organic matter will go down. So if OM% can change downward in a single season, it only makes sense that it can be increased in a similar time frame. So what is the secret to increasing OM? (Seriously, if you figure it out, let me know. In fact, let everyone know.) There is no magic powder or solution in a bottle for this.

Without sounding too pat with the answers, it really does hinge on a regenerative system. It's a mechanism that I like to call a "biological cascade." One event triggers another and another and so on.

Plants have a unique mechanism for filling the soils with polysaccharides, amino acids, lipids, and ultimately humus. This mechanism begins with only one aspect, really good photosynthesis. Stimulate the plants with a "biostimulant" to increase productivity and efficiency of your plants during daylight hours. There are many "biostimulants" on the market, certainly more today than when I started speaking about this 23 years ago. More on "biostimulants" later, first let's discuss this biological cascade.

The biological cascade looks like this: plants that photosynthesize better because they've been stimulated, produce more sugars. Not just any sugar - well, ok - it's just glucose $C_6H_{12}O_6$. What you don't see here are any plant nutrients. So what is attracted to simple sugar? Did you say bacteria? Correct. The bacteria cannot live on sugar alone, so they will mineralize plant nutrients into their system from the surrounding soil. They cluster together, as bacteria are prone to do and the plant does something that we never conceived of until just a few years ago - The plant roots will eat an entire cluster of bacteria and all the minerals therein. Does this suggest the idea that plants can be carnivores? Not a discussion for today.

The bacteria contain amino acids that are a highly available nitrogen source for the plant and the attached minerals are just what the doctor ordered when it comes to growth. This phenomenon is studied in the field called Rhizophagy.

The plant uses these amino acids in the bacteria just as it would use nitrogen to build proteins. There is a major difference in this particular form of nitrogen though. The plant can utilize it far more efficiently and can actually create proteins much faster because half of the protein is already built for the plant. The plant now has excess energy to play with and plants will do exactly the same thing that you and I would do. It has excess energy, it wants to store it for later. How exactly does it store that excess energy? If you guessed Lipids (fat), you were correct. The plant will send lipids down to the root system to store excess energy. While bacteria cannot digest lipids, it turns out that fungus can. A flush of fungus begins when the plant feeds with these surplus lipids. From there, the fungal colonies create a process of "humification" and this is the soil process we are after. While humus contains very little nutrition, the micro pores in humus retain water, and nutrients and house many microbes.

This humification process is at the heart of creating soils that simply require less fresh water.

We can measure the increase in plant lipid production with a phospholipid fatty acid test (PLFA test). Better yet, there is a portable test that uses the camera on your phone and an App. You can get fungal-to-bacterial ratio results on your soil in 20 minutes. The cost is about $12 per test. It's worth the time to learn to measure your foliar program's effectiveness using a test such as the microBIOMETER test. At the end of the day, more fungal colonies indicate that your plant is producing more lipids, and more humus and operating at a higher level.

It takes plants between 7 and 14 days to make these adjustments and the soil microbes to respond. The method is simple. Pull a sample pre-foliar spraying and measure your bacterial-to-fungal ratio. Foliar spray some plants and wait 7-14 days and pull another sample from around the root zone of the same plants. Record the difference.

So now that I've touched briefly on some of the science, let's circle back and talk about how healthy soil ties into the original thought of removing your farm operation from the clutches of the bank.

It turns out that biologically driven soils cost far less to maintain. These soils hold far more rainwater (for each 1% OM increase, you can count on approximately 1" or 21,600 gallons of rainwater retained per acre, dependent on soil textures). These soils can be disease suppressive (of course, some restrictions do apply here). The best part about all of this is that you can use your existing crop to help create the soil goals you are trying to reach.

As stated previously, I do intend to address the idea of choosing a proper biostimulant, mostly because they represent the fastest way to build OM% and give a farmer higher-producing, more efficient soils.

There are a few categories of biostimulants. There are the biostimulants that stimulate biological growth, whether that be in the rhizosphere (root zone) or the phytosphere (leaf surface) and biostimulants that act as direct plant stimulants such as Induced resistance (active), Acquired resistance (passive), PGR effect (stimulate hormone production) or provide a colonization effect (direct seeding of microbes).

Whichever biostimulant you choose, be sure to try some on your crop before you write the big check. On a sunny day, measure the brix prior to applying, apply and then measure the brix 2 hours after you apply. If the brix does not go up (I like to see at least a 2-point increase), keep your checkbook in your pocket. You can make some fairly significant decisions before lunch using such a technique and minuscule quantities of product. Also, remember that your plants' needs change throughout the growing season. A biostimulant that has no effect one day, can be just the stimulant needed on another day.

Remember the prize. Higher OM% soils hold water, nutrients and biology far better. Keep your eye on the prize.

I wish you the best of luck this 2023 season and many blessings.

Dan Pavich has a BS in Chemical Engineering from Purdue University. He's been a self-taught agronomist since graduating and has served in the agricultural community as a consultant for 23 years. He's the creator of a biostimulant called Symbiosis AGx. His website is symbioticag.com.

The Problem is the Solution, A Wellspring of Opportunity

Working with Water at Wellspring Forest Farm

By Steve Gabriel

From the moment we stepped onto the land that became our farm and livelihood, water was a central element. We found ourselves on about ten acres of old hayfield in central New York that had been harvested and compacted for decades, and the effects of it were evident - the smallest rainfall event caused water to pool everywhere. Before our driveway was installed, we had to park at the property line and walk up the hill to our yurt (our home the first four years we lived on this land) because the slick mud wouldn't even give our four-wheel drive vehicles any traction. In our first year here, we tried drilling a well but after 80 feet pulled the rig back, as the drillers were only finding water veins laced with thick clay sediment. Erosion and gullies abounded on the slopes and low-lying areas of the landscape, and sediment was actively washing downhill and into our shared 2-acre pond - one of the major elements that drew us to this land in the first place.

It was because of these layered forces that our eventual farm name, Wellspring Forest Farm, emerged. Definitions for 'wellspring' include "an original and bountiful source of something" and "a source of continual supply," with the origin being old English welspryng that more directly references a living spring, fountainhead. For us, this word spoke both to the abundant and overwhelming force water offered the landscape, as well as the recognition of the creative and proactive thinking and design we would need in order to work with (not against) water to build our farm and home.

We consciously embraced the attitude that water was not a problem, but a gift, part of a solution - it just needed some direction. For several decades, the previous farmer clearly had no interest in working with or harnessing the water in positive ways. For us, beyond the functional or productive elements of water, we also saw it as an important element - just like soil - to caretake as responsible stewards of the land.

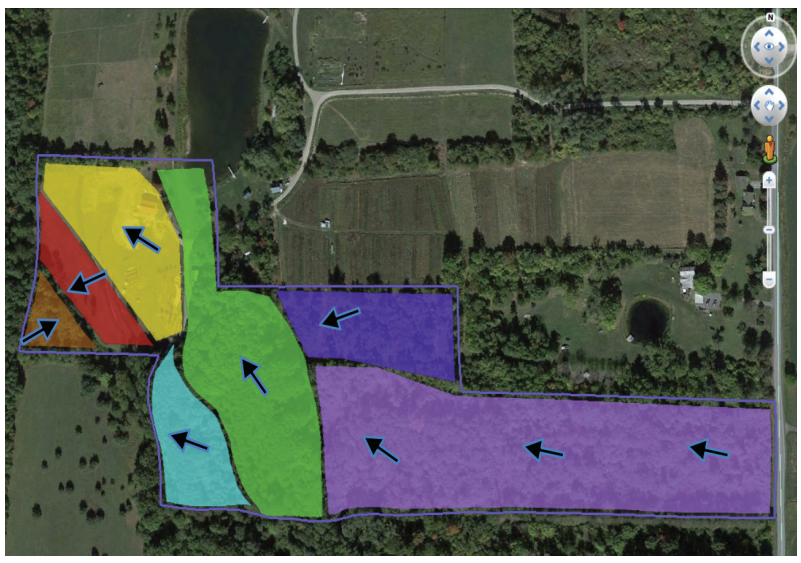
Our farm is located on the traditional lands of the Gayogo̱hó:nǫ' people (named Cayuga by colonizers), and I was fortunate to have the opportunity a few years ago to attend a language class and not only learn some of the language, but also some cultural perspectives around land and culture. I was able to ask our instructor, Steve Henhawk, as well as chief Sam George about what they wanted to see of people who find themselves tending to traditional homelands of the Gayogo̱hó:nǫ'. Their requests included caring for the sacred waters we encounter, and to speak words of their Indigenous language to the earth and the waters. We feel a deep honor and responsibility in upholding these requests, along with other acts we try to do to support their ongoing struggles as a community and in response to the history of settler colonialism and continued racism.

In our early days on the farm, when we had almost no infrastructure, we focused first on our own needs for domestic water. Since the well was a bust, we decided to try living off rainwater collection as a source of water. This meant that every roof we built had a plan for harvesting water and that systems would need to keep water as clean as possible. Water from the sky is essentially distilled, quite clean and usable for potable demands. But once that water hits roof materials, flowed into gutters and collects into tanks, it's exposed to all sorts of contaminants.

The easiest and most cost-effective approach was a rain gutter off the yurt roof, with a first flush that diverts the initial rainfall that "washes" the roof of sediment and separates it from the water being stored. After the first flush, rainwater was piped to an underground 2,000-gallon cistern - we essentially used a common septic tank but outfitted it with potable water seals and fittings. This proved to be a very cost-effective way to capture water and meet our humble personal needs (at that time, we used about 90 gallons every two weeks for domestic needs in the yurt), but as we got into livestock and other farming requirements demand began to climb.

There were many inspirations and influences that helped us think broadly about water and to design approaches to working with it. We employed the permaculture practice of observation and mapping - observing before making changes - into our decision making. We also benefited from the concept of "catch it, store it, sink it" - slowing the flow of water and sinking it into the soil as much as possible. While this is the ideal, in many cases draining water to another location quickly is important, it just needs to be done thoughtfully.

We took time to learn about the larger watershed we're in. We sit at the top of our local watershed, which drains to the north, eventually over Taughannock Falls (the tallest waterfall east of the Mississippi) and into Lake Cayuga, which then flows north to Lake Ontario and out the St Lawrence Seaway. We walked the land frequently and noted the smaller 'micro' watersheds, the sources and sinks of water and problem areas that needed attention. Another resource of great help was the writings in both of Brad Landcaster's *Water Harvesting for Drylands* books, which focus on a climate much different than ours but still offer the foundational elements of good water planning for anywhere. Taking the time to learn and build relationship with the land is especially important with water since the subtle details are so key to finding solutions that will really last in the long term.



Simple mapping of micro watersheds at Wellspring Forest Farm.

As we moved into action, it was clear that many things could be done, but that some were more expensive than others. The cheapest approach for improving water on the landscape as a whole is to support the soil to hold more of it, in other words, to increase the organic matter content and decrease compaction. We have been pleasantly surprised at how quickly this has been achieved with the combination of committing to maintaining permanent pasture, planting trees, and engaging in rotational grazing of sheep and poultry. The number I have seen is that each 1 percent increase in soil organic matter helps soil hold 16,500 gallons more water per acre.

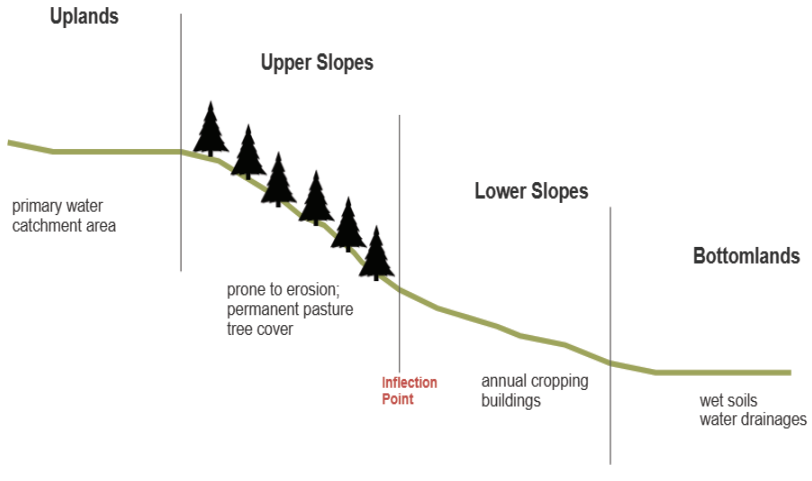
It has been our experience that grazing our small flock (20-25 ewes, about 40-50 sheep per season) is a barely profitable enterprise in terms of dollars earned, but it has been exceptional in building biological health on the landscape - increasing ecosystem services with multiple benefits to the farm and land. The soil now readily soaks in rainfall in most places that we've rotationally grazed since 2014. We've seen soil organic matter increase in soil tests, and vegetation both forage and trees thrive. Animals truly are a force to heal the land at broadscale and have been a very worthwhile investment of our limited time and energy.

Beyond this foundational approach, we have also done a fair amount of moving earth - by hand and machine - and reshaped aspects of the land to catch and infiltrate water, as well as move it along when necessary. Almost annually since we started in 2011, we've rented an excavator from a local dealer, an approach that is still more cost-effective than purchasing and maintaining a large piece of equipment that we only need for a week each year. My learning curve using this machine efficiently and for more good than destruction was steep in the beginning, but now, the confidence and skill I have with a mini excavator saves significant money compared to hiring a contractor to do this work - plus, the contractor won't have the vision and familiarity of the landscape as I do.

For earthworks, where moving earth efficiently is the name of the game, I highly recommend a mini-excavator over a common approach many farmers try - using a backhoe PTO attachment on a tractor. The excavators offer many advantages over tractor-mounted units, including the presence of rollers with tracks on them, which decreases the chances of getting stuck and helps in the final grading and compaction of elements, the 360-degree spin and adjustment capabilities for digging, and the ability to move the machine forward, backward, and sideways quickly add up to substantial time savings for a project. (I must add that whenever working with a machine like a mini-excavator, which can cause destruction and always creates bare ground, I strongly recommend you take time to map and design the project first using a laser lever and contour maps, and to be prepared with cover crops and straw to cover the worked area when done.)

For the design of earthworks, the Volume 2 calculations, which Brad Lancaster has been generous to offer free on his website, have been essential. Take some time to understand the runoff coefficient. We also benefited from the work of the *Regrarians Platform* for planning, which includes elements of keyline design.

While our farm's context lends itself less to a landscape scale keyline type plan, it's been helpful to focus on inflection points, from one micro watershed to the next. These are points in the landscape useful as a starting point for water planning. Above the inflection points are the main catchments for water to fall and flow, and also the areas more prone to erosion. Lower than the inflection point are areas for water use, distribution, and connection to drainages such as creeks, streams, and ditches. Keep in mind that this pattern repeats at various scales. For instance, our whole farm is part of the "uplands" portion of the larger Taughannock Creek drainage, but within the farm boundaries, we find each of the four landscape elements (uplands, upper slopes, lower slopes, and bottomlands) showing up.



As an example of how we used this tool concept to implement earthworks on our farm, we found an inflection point in the slope close to our current home site. From this point, we used a laser level to map contour lines at and above this point, to see where they ended up. Maps are useful but there is nothing like ground truthing to get a real sense of the land. We found a contour line just above the inflection point that curiously connected without much elevation change to the emergency spillway of the large

(contined on next page)

(Wellspring - from B-8)

2-acre pond. This meant it would be easy to direct the overflow of that pond and send water across the landscape into another micro watershed, via a swale or a pipe with a siphon. At the inflection point, we dug a small pond for aesthetic value, wildlife, and to act as a temperature moderator for the house, which faces south and in the direction of that pond. The overflow from this small pond flows into a 275-foot swale that is slightly sloped downhill (1" drop every 50 feet) to the south. On the berm of this large swale, we planted willow.

Full swale at Wellspring Forest Farm, soon after installation.

If this swale were to overflow, it would trickle downslope and into another swale, running back across the contour the opposite way, to the north, in a 450-foot swale. Since both swales are more or less on contour, they have the effect of taking any concentrated water sources flowing down the slope and distributing them evenly across the landscape, giving them time to infiltrate into the soil and creating a net positive benefit. When we sized the swales they felt a bit too large - the basin was about 3 feet wide and 1.5 feet deep. But, in the more extreme rain events of the last decade with 3 - 4" of rain, these swales are full to the brim. This isn't the type of rainfall we routinely get, but is common more and more with the erratic rainfall patterns coming to our regional

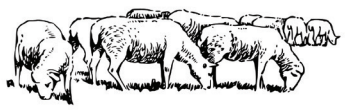
While that project took significant planning and design, we've done plenty of "hack" jobs to work with the flow and concentration of water on the landscape over the years too. These have mostly been based on observation and trial and error, directing the flow of water to places where it can pool, and away from costly infrastructure such as roads, buildings, paddocks, and parking. We work from the overall goal of slowing down and spreading water out, and giving it space to be itself and do what it wants to do, rather than just trying to get rid of it - as so much "water management" tries to do.

The concept of "vernal pools" in forests has been inspiring to us, and a good reflection since water is not always abundant. Much of the design we all need to be thinking about for the coming decades is how our landscapes can best respond to the ebb and flow of water, with the gap between the frequency and intensity of floods and droughts increasing. Vernal pools are rich habitats for wildlife and yet come and go, filling as snowmelt and rainfall in the spring overwhelm the landscape and emptying to dry in the hotter summer months. To support this natural pattern, we dug some simple pools in our woods. When we had ducks on the farm, we took advantage of times when the pools were full to give the water-loving animals access and watched them play and enjoy. These pools can also be thought of as critical elements to catch and slow water, allowing sediment to deposit before the water eventually moves on - in our case, several of the larger pools we made are upstream from the 2-acre pond. Over time, some have worked well, and some were definitely not adequately sized. We try things, observe, and adjust. The important thing is we are moving in the right direction.

We still have a ways to go, and much to learn. There are also many aspects of water management planning that fall far outside our abilities. To that end, we've been working with local USDA NRCS and Soil and Water folks to explore possibilities. We have roughly 3 acres of wetland that could be restored and some creekbed restoration efforts are very much needed for the drainage that leaves our site. The technical support and potential funding to do these projects from state and federal resources are helpful, but not without headaches. Navigating these programs and the bureaucracy of these offices takes not only time and determination, but also it's important to find program staff who support the land improvement work we're trying to do.

Steve Gabriel co-stewards Wellspring Forest Farm with his family Elizabeth, Aydin, and Maiya. The farm produces mushrooms, pastured lamb, elderberry, maple syrup, and nursery trees while engaging in research and education efforts. He is the author of Farming the Woods *(2014) and* Silvopasture *(2019) and works as a consultant on farm and land stewardship projects, helping support people to find solutions at the intersection of their goals and the restorative needs of the land.*

Resources:
Regrarians Platform: *regrarians.org/about/the-regrarians-platform*
Brad Lancaster's website: *harvestingrainwater.com*



(Water Management - from B-5)

However, swales or ditches on contour can also harvest water for you, and if they are connected to your pond, as they fill up, will overflow into your ponds. Also, if you have a series of ponds connected with swales, then the overflow of one pond enters the feeder channel/swale of the next. Having a spillway for a pond is a must and this way you'll once more be slowing, spreading and sinking water across your landscape.

Any roads on your landscape are a very important and efficient water-harvesting system since they are compacted, graded and often made of impervious materials. The roads and adjacent water collection drains can be integrated with other harvesting drains and/or swales, contributing to the overall hydration of the farm.

Conclusion
Managing water is crucial in designing and setting up a farm. No site has been properly planned unless it first considers how to use the available water resources. The water systems you establish become a permanent feature of the new landscape and the base of permaculture land development planning. All the water lines: diversions, swales, terraces, dams/ponds, and channels should form the foundation that other infrastructure components (structures, farm roads, fencing) follow.

William Horvath, the founder of the Permaculture Apprentice website.

The full version of this article can be found on the Permaculture Apprentice website, permaculturepprentice.com/permaculture-water-management. *The article was reprinted with permission from the author.*

How to Minimize Irrigation Even in the Hottest of Summers

By Christine R. Nelson

The height of the 2022 growing season will be remembered for the undesirable combination of heat and drought, with all areas of Massachusetts experiencing some severity of drought. As a grower, you may have felt compelled to irrigate – a lot. But irrigation has serious downsides: the loss of a precious resource, energy, money and time. And not everyone has access to a dependable source of water for irrigation.

There are local farmers finding ways to adapt to increased heat and drought with minimal to no irrigation. Julie Rawson, co-owner of Many Hands Organic Farm located in Barre, MA, describes her 2022 farming season, despite the challenging weather, as "good, one of her best". Her irrigation practices are notable because they don't irrigate. Crops are watered once - at the time of transplant - with a hose. Crops also receive regular foliar nutrient sprays. Despite the lack of watering, Many Hands Organic Farm is still able to grow a full diversity of high-quality produce for their customers.

"We used to irrigate everything with drip tape and fertilizer once a week. Four years ago, I realized that this wasn't necessary. So, we stopped." Rawson credits her soil health practices for making that change possible.

Many Hands Organic Farm's soil practices that directly affect soil moisture include:

- Applying deep mulch to most crops (except for lettuce and radishes which get damaged by a deep mulch), usually with several inches of straw or other organic matter.
- Not tilling. "We have been no-till since 2014 which has made a huge difference in our soil health. We no longer destroy with each tilling the mycorrhizal fungi that carry water and nutrients to our crops", explains Julie. No-till practices also maintain good soil structure, enabling soil pores and aggregates to hold onto water.
- Continuously adding organic matter. The farm uses the various types of organic matter available to them: wood chips (that Julie says are great for worms and mycorrhizal fungi), straw, hay, leaves, and manure from their own animals. Compost is not used.
- Leaving plant roots in the ground, unless being harvested for eating.
- Using cover crops, such as clover planted between crops, is another way the farm adds organic matter and keeps the soil covered, limiting evaporation.
- Spraying plants with a foliar nutrient blend at Many Hands Organic Farm.

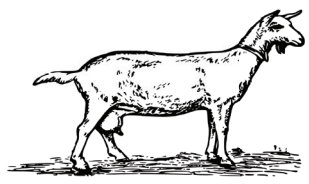
Mulched Beds, Many Hands OG Farm.

The farm's soil organic matter measures out at an impressive 9-10%. They have built that up over the years from the land's original 5% soil organic matter. Increased soil organic matter means more stored water. Soil scientists at USDA tell us that for every 1% increase of organic matter in the soil, there will be an additional 25,000 gallons of available soil water per acre.

Healthy soil practices transform soil over time, allowing it to retain more water. Needing less irrigation can be a game changer for growers. We can add this benefit to the long list of soil health benefits that we regularly discuss, such as improved fertility and disease and pest resistance. Admittedly, healthy soil practices are not a quick fix to our watering woes. But done consistently, we can see improvements every year, with dramatic changes over time. More importantly, these practices enable growers to be more adaptable and still grow successfully, even in an insufferable summer.

Originally printed in nofamass.org/articles/2022/11/how-to-minimize-irrigation-even-in-the-hottest-of-summers/

Christine is a former intern at NOFA/Mass



How the Maya Community is Redefining Farming in Nebraska

By Noah Wurtz

Maya farmers in Nebraska.

In 2019, a bomb cyclone tore across Nebraska, submerging the state under the worst flood it had seen in 50 years. "All of our soil was flowing into the Nebraska River," recalled Graham Christenson, a leader in the Nebraska regenerative farming movement, and founder of GC Resolve, an organization dedicated to expanding regenerative agriculture in the Midwest. The storm hit Midwest farmers hard, foreshadowing future weather events whose size and intensity will be magnified by changing climate.

Less than a year later, the Maya community of Omaha, Nebraska, gathered to discuss plans for the future. Since 2007, the Nebraska-based non-profit Comunidad Maya Pixan Ixim (CMPI) has been dedicated to empowering the 4,000 Q'anjob'al Maya people living in Omaha, Nebraska. Communidad Maya regularly holds community meetings where the community can have a direct say in the organization's initiatives. This time, the Maya had gathered to talk about land.

With the support of Agrarian Trust, Communidad Maya is planning to acquire 310 acres of farmland in Eastern Nebraska. Their new initiative, Maya Regeneration Project, aims to provide Maya farmers with both economic opportunities and a space to reconnect to their cultural and spiritual traditions. It seeks to actively heal the land by building on the latest regenerative agriculture with centuries of Maya agrarian knowledge.

As climate events like the 2019 bomb cyclone grow in size and number, projects like Maya Regeneration Project will play a key role in creating a more resilient and just food system. Creating land access for farmers - especially those who have been historically excluded from land ownership - is a critical piece of this work. Agrarian Trust is helping CMPI acquire and conserve the land in the form of a pioneering model of community land ownership known as Agrarian Commons.

For the Nebraska Maya, access to land means an opportunity to heal after a history of violence and displacement. Between 1980 and 1983, at the peak of a state-led genocide against Indigenous people, 1.5 million Maya fled Guatemala. Today, thousands of Maya are still forced to flee discrimination, lack of economic opportunity, and state violence in their home country and seek refuge in the United States where they are confronted with a new set of challenges, including food insecurity, depression, alcoholism, and spiritual loneliness.

According to Luis Marcos, the executive director of Communidad Maya, this cycle of displacement has led the roughly 8,000 Maya living in Nebraska, 4,000 of whom live in Omaha, to seek out new sources of economic opportunity and spiritual belonging.

"Since the 1980s, we've been talking about how we articulate our presence here," said Marcos. "We always talk about our collective rights, and we always talk about keeping our identity, and our inherent right to self-determination." To this end, Communidad Maya leads educational programming centered on transmitting Maya culture to future generations, as well as a public health initiative tailored to the Maya community. Maya Regeneration, Communidad Maya's latest project, is aimed at revitalizing the community's connection to Earth.

"As the Maya nation, we do have a spiritual relationship with Mother Earth," said Marcos. "We really believe that Earth is our mother, not a resource. And as a displaced Indigenous nation, when we are forced to come into metropolitan areas, we lose that spiritual connection with Mother Earth. Maya Regeneration is this attempt to go back to that spiritual relationship with Mother Earth."

According to a statement released by Maya Regeneration, the land will provide: 1) A training center for Maya farmers, 2) Maya Center for multi-institutional and interdisciplinary soil, water and human health research, 3) a Center for cultural exchange and eco-tourism (local, national and international) 4) a Center for Spiritual and Mental Health, and 5) a revenue-generating business entity. In addition, the land will be community-led and operated according to the principles of regenerative agriculture.

The Regeneration Maya Project comes at a turning point in US agriculture, as regenerative farmers like Graham Christenson are sounding the alarm on the unsustainable practices of conventional farming. According to a 2014 statement from the United Nations, at the current rate of soil erosion, the world may only have 60 harvests left.

In Nebraska, the consequences of imposing industrial farming methods onto prairie ecologies are literally carved into the landscape with the remaining prairie land sitting, on average, one foot above neighboring prairie land. A 2022 study uses these 'escarpments' to estimate that, in the past 160 years, the Midwest has lost 50 billion tons of soil.

Tillage-based farming, a lack of cover cropping, and other conventional farming techniques are largely to blame. Tillage, which turns the soil to prepare it for seeding, breaks the soil apart, releasing organic material, and reducing its structural capacity to hold water and nutrients. This degraded soil is especially vulnerable to rain and wind erosion. According to Christenson, Nebraska loses 3 tons of soil per acre per year to wind and rain erosion.

The destruction of healthy soil has wide-ranging repercussions, including on the state's water supply. Run-off from artificially fertilized land pollutes the state's water supply, while the aquifer that supplies farmers with water is rapidly being drained. A study by the University of Nebraska posits a link between increased cancer rates among children and high levels of nitrates, a component found in artificial fertilizers, in the state's drinking water. This extractive ethos is not sustainable for the soil, or for farmers.

The Maya Regeneration Project, on the other hand, relates to the land with the same healing spirit that animates its work with the Maya community. By building on regenerative agriculture with Maya spiritual and cultural tradition, Maya Regeneration will actively restore the soil and resilience of the land's ecosystem. The organization is already in close collaboration with Christenson to convert part of the 310 acres of land into a regenerative food forest, where they will plant food-bearing native trees and perennial bushes to hold and restore the land to its full potential.

This land acquisition is possible in part through Maya Regeneration's partnership with Agrarian Trust. Since 2020, Agrarian Trust has helped communities found Agrarian Commons, local non-profits that hold land in perpetuity in the interest of the community for regenerative agriculture. Agrarian Commons also gain access to Agrarian Trust's national fundraising network when acquiring land. Maya Agrarian Commons, which will hold the land and provide Maya Regeneration Project with a 99-year lease, will receive the full support of Agrarian Trust in acquiring the land and permanently removing it from the marketplace.

Less than two percent of farmland in the United States is currently owned by Indigenous farmers - in Nebraska, the figure is just 0.1 percent. Supporting land access for Maya Regeneration means addressing centuries of harm against Indigenous peoples by Western settler colonialism, and elevating the voices of Indigenous stewards to their rightful place at the head of the regenerative agriculture and food sovereignty movements. We encourage you to stay tuned for our upcoming fundraiser, and this unique opportunity to support Indigenous land access and leadership in the regenerative agriculture movement by visiting agrariantrust.org and signing up for our newsletter.

Noah Wurtz, they/ them, works with Agrarian Trust. They submitted this article to highlight an inspiring new project led by Maya farmers in Nebraska, and the mission of Agrarian Trust to expand land access in the United States.

Introducing Commons Groundswell, the Agrarian Trust Podcast

If there's one thing I've learned in my time working on farms and gardens, it's that podcasts fill a special niche in the agrarian ecosystem. Spending hours trimming suckers off tomato plants can be an opportunity to reflect on the immensity of Time and Being, but sometimes it's more pleasant to put in a pair of headphones and enjoy some informative audio content. If you're on the lookout for new podcasts to get you through the spring planting season, or morning commute—you're in luck.

On February 23, Agrarian Trust launched the first episode of *Commons Groundswell,* our new podcast that examines human relationship with land through inspiring conversations with leaders, changemakers, and Agrarian Trust collaborators.
~ Noah Wurtz

Water and Earthworks

By Ben Falk

A resilient homesteader and designer must be a water process facilitator. Through an awareness of how water affects living systems, we must orchestrate the interplay of systems in a manner that is vitalized rather than limited by its presence.

An Agriculture as Diverse as the Landscape
Only about 10 percent of the state in which I live, Vermont, is composed of "agricultural" land, while the vast majority of the state is too wet, dry, steep, shallow soiled, or infertile to reliably support conventional field-based crop production, though it's been tried before. Vermonters once farmed much of the state's non–"ag' land, clearing about three-quarters of the state by the mid-1800s, mostly for pasture. Devastating soil erosion resulted, along with rapidly decreasing yields.

As we enter the twenty-first century, land that is still clear of forest represents Vermont's most forgiving landscape—generally, low-angle slopes with deep, well-drained soils supporting (usually with constant inputs) pasture and annual row crops such as corn and grass for hay. Currently, nearly all of Vermont's food production is derived from one-tenth of its land base, and this land's capacity shrinks in both area and output each year. "Prime soil" lands, having been abused for nearly two centuries, continue to lose significant production capacity each year as mechanized, tillage-based farming compacts soil structure, exposes the soil to erosion, and damages soil health through continual inputs of liquid fertilizer. The actual acreage of "prime soil" land is also shrinking under the influence of suburban sprawl and transportation developments.

As the need to establish a more resilient, sustainable, local, and secure resource base becomes increasingly clear, we are confronted with the need to produce a reliable supply of food and fuel from the vast majority of our landscape that we have not yet managed to utilize productively without incurring significant damage. In a future of diminishing resources and increasing stressors such as climate change, sociopolitical instability, and economic insolvency, we will need to generate value sustainably on the majority of our landscape without depending upon one unit of production's sustaining nine units of consumption.

How do we produce lasting value on challenging landscapes with poorly drained, droughty, or degraded infertile soil? Fortunately, this has already been done to a large extent in other parts of the world. Both degraded and inherently challenging landscapes can be regenerated and maintained as highly productive, low-input, no-till, perennial agricultural systems offering yields of fruits, nuts, fiber, fuel, meat, milk, and even perennial grains and vegetables.

In America, however, we have few examples of such systems and need to look elsewhere to find truly sustainable cold-climate agricultural systems. Permaculture, with its emphasis on low-input, self-fertilizing, diverse crop arrangements (otherwise known as "guilds") and no-till approach, is particularly suited to producing food and fuel crops on degraded and sensitive landscapes (which is most of America) that reliably fail under large-scale, mechanized, input-dependent, soil-exposing, tillage agriculture. Land design needs to continually adapt to America's hill lands, cold climate, and abused soils.

Successful versions of "agriculture for the hills" from elsewhere - such as the oak, walnut, and chestnut pasture agroforestry systems of the Mediterranean - are not likely to succeed here by simply attempting to replicate them. Establishing reliable, sustaining, and regionalized food systems is an innovative process requiring researching and developing techniques that function across the majority of our landscape. Here in Vermont, that means a "new-old" hybrid agriculture for rocky, thin, infertile, seasonally inundated land. This involves at least three primary strategies:

1. Identifying and breeding new plant and animal varieties (and reviving formerly used heirloom varieties) that are optimized for the diverse conditions of the cold climate landscape
2. Developing cultivation techniques such as contour swale-mound planting that help buffer both droughty and inundated land conditions to allow the production of a much wider array of plants than would otherwise be possible in the same location
3. Changing the scale and mechanics of production systems from large to small, and mechanized to human and animal-powered, and making other adaptations in the ways we can produce on the vast variety of land types

Terraced rice paddies. Image by Ben Falk from the Resilient Farm & Homestead.

Relocalization in the cold-climate regions of the world will involve the skillful use of the incredible diversity that our landscape contains, from the acidic conditions of a pine plantation to the anoxic clay soils of a wet, abandoned field to the thin, dry, dead soils of an abandoned steep pasture.

Utilizing "marginal" lands requires significantly more skill and care than "prime" agricultural lands with erosion, infertility, or simply lack of production easily resulting from their mistreatment. "Marginal" lands also represent some of the most important and sensitive ecosystems on the planet, while containing possibilities for some of the highest crop yields possible anywhere—the largest food staple in the world is rice grown in poorly drained wet soils. Use of these landscapes must be undertaken with careful planning and a great understanding of the existing opportunities and challenges of the site.

Fortunately, gleaning yields from these ecosystems can be done in ways that not only promote the health of the natural ecosystem but offer human yields as well. Site-specific by necessity, agriculture for "marginal" lands must be highly diverse—given the astounding variation in landscape conditions present beyond the typical large, flat agricultural field. Farming landscapes other than typical "ag" land not only require it but benefit from humans working in synergy with the local ecosystem as beneficial members of the site's living community to support ongoing fertility development and long-term yields. I'll now outline approaches particular to several commonly found growing conditions.

Droughty and Rocky Land
Land that is dry and sloped presents an interesting challenge for agriculture in the cold climates of the world and elsewhere. Overall strategies for dealing successfully with these conditions involve the following:
• Species selections for plants that can not only handle but actually thrive in dry, poor soil and improve the soil for different future plants. Rocky soils, in particular, are most suited to a perennial-focused agriculture. Example species include sea buckthorn (Hippophae rhamnoides), black locust (Robinia pseudoacacia), buffaloberry (Shepherdia argentea), and various other berry and nut shrubs and trees. All three of these species are nitrogen-fixing landhealing plants.
• Earthworks such as on-contour swaling, in which ditches are dug along contour to slow and trap water as it travels across the slope. This allows water infiltration into the soil horizon, where it irrigates deepening plant roots and delivers oxygen and nutrients. Both the swales/ditches and the mounds below are planted with nitrogen-fixing plants and dynamic accumulators, helping to build soil structure and soil biology, creating conditions that eventually support a larger array of plants to thrive in the same location. After an initial establishment period with "heavy giving" plants (as opposed to "heavy feeding" plants), species that would otherwise not be supported on such sites can thrive. These include more sensitive fruit trees, berries, and other multi-use food and fuel trees and shrubs.
• Mulching with fungi-inoculated wood chips helps keep soil moisture optimal, build healthy soil biology, and suppress weeds.
• Drip irrigation systems that allow a very small amount of water and energy to be applied precisely across a landscape at timely intervals allow the establishment of plants that would otherwise be unable to survive.

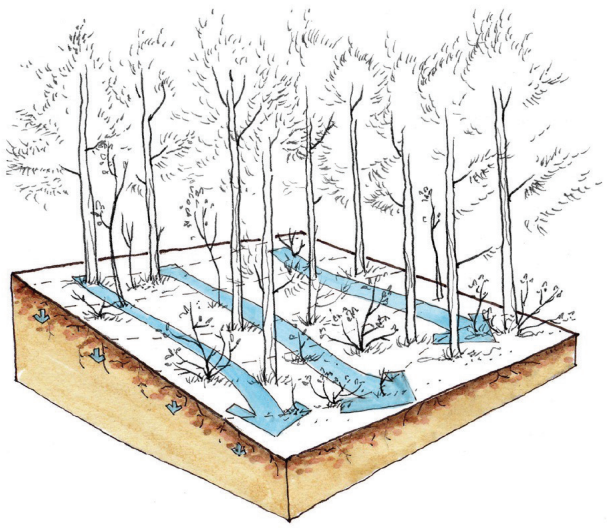
Seasonally Inundated Land
An enormous amount of Earth's landscape is underutilized because of perched water tables and low-angle slopes underlain by poorly drained clay soils. Useful responses to such conditions involve similar approaches: for one, selecting species that are well suited to perennially or seasonally wet conditions and inundated conditions. Species particularly well adapted to wet conditions include currants and gooseberries (Ribes spp.), elderberries (Sambucus canadensis), cranberries (Vaccinium spp.) and highbush cranberries (Viburnum spp.), Chokecherry (Aronia spp.), willow (Salix spp.) and alder (Alnus spp.) for fuelwood and craft wood, and many others. Other useful strategies include grafting non-wet tolerant species onto wet-tolerant rootstock, such as pears onto hawthorn or quince.

In addition, on-contour swales and island mounds (at various scales) simultaneously lower the water table in the immediate area of a crop plant while raising up the plant itself. Systems in Europe have practiced tree-based agriculture in wetlands for thousands of years under the name hugelkulture, in which they utilize woody debris to help form the raised planting mounds. Gradually, the woody material breaks down into soil, feeding the plant over time while catching leaves and other nutrient-rich debris that circulate via wind currents in the area.

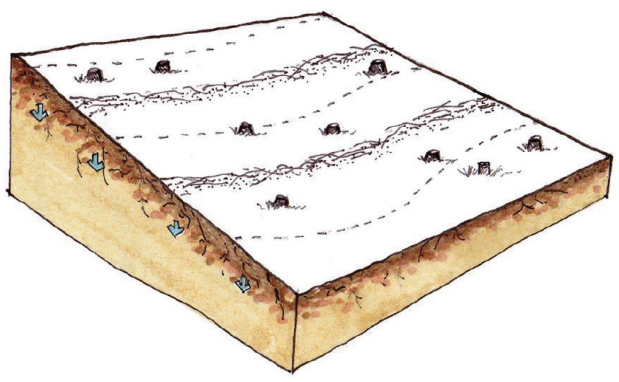
Swales and Mounds
We call the wave pattern of mounds and ditches running with the contour "swales." They can be made of woody debris (a hugelkulture strategy), earth, or some combination of the two. The effects they have on water movement down a slope are desirable and the same: They check water's movement as it descends and forces it to stop or slow, allowing it time to infiltrate into the ground below. At the Whole

(continued on next page)

LAND TRANSFORMATION WITH SWALE BUILDING.
Forest to perennial crop succession is accelteration through the use of earthworks, planting, and grazing.
(Read the process in more detail in The Resilient Farm & Homestead.



1. Suboptimal Forests



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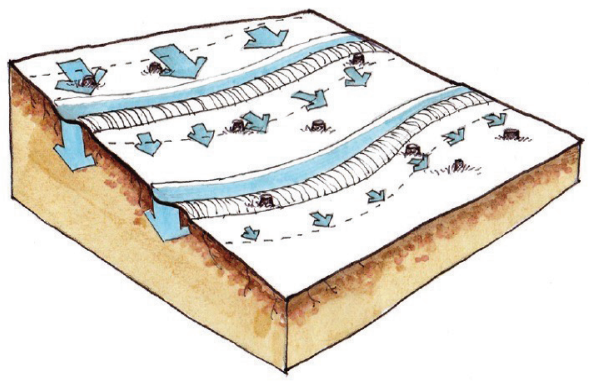
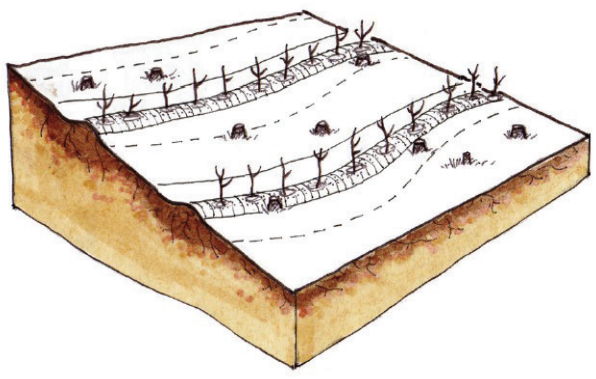
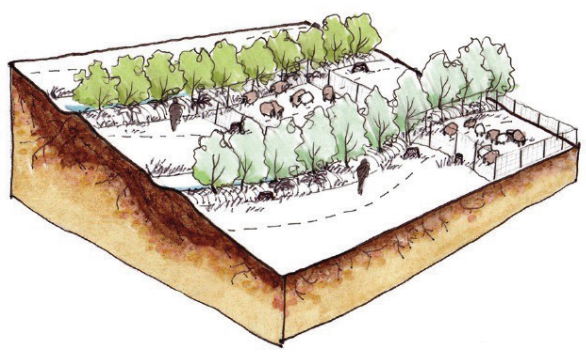


4 & 5, Swales Cute & Shaped, Swale Infiltration.



6. Planting



7 & 8. Perennial Plant & Grazing Succession

(Earthworks - from B-14)

Systems Research Farm, we make swales with the native earth on-site by pulling earth from uphill downhill, forming a mound. We then use these high surface area drier locations for cropping. A swale "waters" the area immediately below the mounded location and, depending on soil type and rainfall amount, can disperse water that would have run off the surface into the soil well below the swale—five, ten, even twenty feet downhill. This "capture, store, and even out" of moisture is one of the reasons swales are such a soil- and plant-regeneration tool.

The productivity of swales and mounds is astounding. We have noticed that all species of plants respond positively to being on a mound, and the increase in growth and health seems to vary from moderate to extreme. On average it can be said that a given plant at the research farm will grow at least half again as fast as the same plant rooted in flat, unmounded, and unswaled earth nearby. Often, we've seen plants respond with twice the growth rate, including species such as black locust, goumi, elderberry, currant, gooseberry, cherry, peach, and apple. The pattern seems to exist across all species except truly wet-loving plants such as sedges—and we don't really want to grow sedges.

Why do plants prefer a swale or mounded location? The answer seems to come in two parts. The first has to do with our wet climate and high water table; in desert climates, a mounded planting would be much more drought stressed because it's "high and dry"—the land on a mound is more exposed to the drying effects of the atmosphere (wind and sun). Such plants in a dry climate would often do more poorly. In this climate, we have found that getting above the high water table and periodic inundation caused by rainy periods and snowmelt is of prime value.

The second reason is more universal: A flat piece of ground has less surface area than a wave-shaped piece of ground. Biological activity and soil health is concentrated most heavily in the upper layers of the soil at the land-atmosphere interface—this is where organisms have the highest capacity to metabolize, where roots are most perfuse, and where organic matter is highest as a result. So this is where most plant feeding occurs. When we contour a piece of ground and turn a flat patch of ground into one wave or a mound shape, we instantly add surface area and soil-area interface. This relates back to a primary permaculture design strategy: The edge is where the action is. Swales and mounds create edge - highly productive edge, and we get more land from making them: Literally, our acreage is increased when we contour the land. This last reason is profound, and the results we've witnessed are surprising.* We now only wish we had contoured nearly the entire farm in the early years. Hindsight is always 20/20, to be sure.

Water Ridges with Valleys: Keyline Agriculture
The concept of keyline agriculture in modern form emerged from the drylands of Australia. Farmers there, most notably P. A. Yeomans, discovered a simple and glaring truth: that aridity limited land productivity over large acreages while, simultaneously, certain areas of the same region were literally swamped with water. While keyline agriculture contains many concepts, its most fundamental is this: Spread the abundance of water from where it is concentrated in wet areas to those areas that are consistently too dry. Keyline is based on the understanding that water is often the most severe limiting factor to plant (thus animal) productivity.

This is such a basic fact that it's often overlooked. Think of your nearest pasture or yard. In it you will find microvalleys and microridges—areas of consistent wetness and consistent drought. Depending on your location you will most often find that the ridges are poorest in productivity. The drier your location, the more productive the valleys will be. In many climates, there is a sweet spot just uphill of the valleys that is most productive. The goal of a resilient agriculture from a keyline perspective is to make as much of your land be like that sweet spot, hydrologically, as possible. That's why we spread the water from the valleys toward the ridges.

Ponds
The rain woke me up this morning, again. Falling now in sheets across my ponds, fruit trees, and vegetable beds, drenching the sheep and the ducks alike, is the seventeenth or eighteenth inch of rain that's fallen this spring, and we still have more than a month to go.

What do ten-plus inches of rain in a month mean for us? For me as a homesteader and small farmer, it means some washed-out vegetables - my cabbages are looking somewhat poor in their low-lying bed - and slow starts to other vegetables; luckily, many are in a raised cold frame, but my beans may now be rotting in the soil after sitting there for the better part of a week with no sun to warm the soil for sprouting. Yet my rice paddies have just started overflowing, the ponds are brimming, and the ducks are finding slugs and snails wherever they look. This rain is very good for the perch and bluegill in my ponds, for the ducks that make eggs and meat, and for the now fast-growing rice crop that thrives in water-logged conditions. Another foot of rain doesn't hurt a crop that's already flooded and liking it.

My pasture also looks great - with every inch of rain, it seems to grow two to four inches this month, and the sword of clover, vetch, and rye is thicker every day. The sheep seem to tolerate the cool rain, thankful for the bounty of fresh grass it delivers. Pasture growth in May is normally about three times faster than July growth largely because of moisture. If it keeps raining the pasture will keep on growing rapidly. The tree and berry crops look fantastic as well. We've earthworked the landscape of this research farm so that our perennial plantings are on top of mounds running sideways across the slope "on contour." These plants have all the access to water they could want in the bottoms of these swales but are free from inundation, being planted up high on each mound.

Since rain pulls down significant quantities of nitrogen from the atmosphere as it falls (washed from the air at greater rates than any other time in the historical record), it stimulates plant growth; it's literally liquid fertilizer. Accordingly, rainforests, the rainiest environments in the world, have the fastest biomass production. So plant crops that can avoid inundation because of their growing situation, along with those that don't mind the lack of sunshine and heat, are thriving. Along with the fish, ducks, and pasture, this includes the perennial crops: apple, pear, plum, cherry, quince, peach, walnut, hickory, chestnut, oak, blueberry, aronia berry, seaberry, honeyberry, gooseberry, currant, and a score of other permanent producers. Some aspects of this farm system are actually greatly benefiting from this cool wet weather, while conventional fields of corn and other fragile bare-soil annuals sit mired along the river bottoms, now too soft for machinery to deal with.

Ponds, swales and paddies have been a part of the working landscape since agriculture emerged, especially on sloped lands. Since water is the basis of productive biological systems, retaining and distributing this storehouse of fertility and life within a landscape is key to the success of any living landscape. The climate, topography, and soils, along with the ease of access to machinery and cheap energy (for now), in the northeastern United States offer a particularly timely opportunity to capture, store, and distribute water via ponds on farms.

Ponds, paddies, and swales in this climate can be cropped for a variety of outputs, most established of which are fish, rice, and berries, respectively. Shallow water systems such as paddies have the unique ability to be fertigated easily (nutrient-rich water delivery), which allows rapid growth of heavy-feeding plants in an otherwise poor fertility situation. These systems can also be perpetually productive on account of water being the nutrient delivery mechanism: Witness paddies that have produced a staple rice crop over centuries upon centuries in sloping landscapes. It is likely that other cropping possibilities beyond rice will emerge with continued innovation of fertigation in both paddies and swales in the coming decades.

Ponds, especially, have many uses beyond what can actually be produced inside them, and it is these uses that make them an especially attractive working landscape feature. These include:

• Microclimate enhancement: Water bodies capture

(continued on B-17)

Climate Change Hits Home: Adapting for Greener Pastures at Vollinger Farm

By Jacob Nelson

Hay wagon, 2022. Image source: Jacob Nelson

Scientists can give us a 30,000-foot view of how climate change is now impacting our planet. Bob Vollinger can tell you how that translates to daily life at Vollinger Farm in Florence, MA. Some of the repercussions are unexpected. "I've never seen it so dry," he said last summer, before the recent rain. "Right now, I'm having a hard time even keeping my cows inside the electric fence. There's not enough moisture in the soil for the grounding rod to work properly, so they push right through."

Vollinger Farm is built around grass and cows. Vollinger cuts and sells hay, mostly to other local animal farms, and raise their own beef cattle. Bob also grows winter squash and fall flowers he sells at a farm stand at 460 North Farms Road.

Any farm, unless it's indoors, is beholden to seasonal weather patterns, which are in turn controlled by long-term climate trends. This is especially true for places like Vollinger Farm, where everything relies on grass growing well, and little can be corrected when the weather doesn't cooperate. The cost of irrigating or draining that much pasture is a non-starter.

So, with too much rain in 2021 and little in 2022, Vollinger's hay harvest has struggled. In New England, most farmers get two or three harvests, or "cuttings,' out of a healthy field. This year Vollinger's first cutting went well, but then production plummeted. "Normally for a second cut, you should get at least 50 bales per acre," Vollinger says. "This year, on one of my fields, we got 11 bales an acre. One farmer I know is washing his equipment and putting it away for the winter now because there's nothing worth cutting in his fields."

Rising costs of fuel and labor are also eating into Vollinger's earnings, and so are his cows – literally. Grazing pastures are so parched he's already feeding hay intended for sale. "Meanwhile, I'm noticing the calves aren't growing as quickly as they should," he says. "I think it's because the quality of grass isn't there, along with there not being enough."

For Vollinger, this year's drought is one chapter in a larger story of change. "We've always had variability," Bob says, "but over the last 8-10 years it's been getting more extreme between drought or too much water. You never know what to expect. That's what we're experiencing with climate change."

Vollinger Farm is just one of thousands of pasture-based farms across the country affected by climate change cranking up the dial on weather variability. When these farms can't rely on consistent conditions, their income and viability are threatened, as is the fate of the land they steward. In New England, pastureland used for grazing or haying covers about 450,000 acres, according to Food Solutions New England. That's 8 times the footprint of the city of Boston, or 26,000 Gillette Stadiums if you prefer. "If farms weren't here, we would grow less food, development would move in, and we wouldn't have this quiet space and natural habitat to enjoy. I don't know if people get that," says Vollinger.

When stewarded well by thriving farms, this land feeds millions of New Englanders. It accounts for much of the region's open space, which benefits everyone through increased habitat diversity, water quality and other ecosystem services. For many, pastureland is also central to the region's aesthetic and rural character.

How are farms adapting to the added pressures of climate change to keep their pastureland open and productive? In his case, Vollinger is diversifying his business while investing in the health of his land to build resilience. "All this variability is partly why I started into beef eight years ago," he says. "The market for hay wasn't good, I had the pastureland already, and I thought maybe this was a way to branch out." Initially, Bob raised cows to sell to other farms. Now he's starting to sell his own beef directly to customers, with hopes of expanding his farm stand to carry beef and products from other nearby farms.

Before the beef cattle arrived, some pastures had been grazed years ago when the farm kept a dairy herd, but many were choked with invasive species that cows don't eat like oriental bittersweet and multiflora rose. "I reached out to NRCS (Natural Resource Conservation Service) and got funding and guidance through EQIP (their Environmental Quality Incentives Program) to clear that and open up a lot more grazing space," Vollinger continues. After reclaiming those pastures, Vollinger decided to graze his cows rotationally through smaller areas rather than letting them browse freely. Depending on how it's managed, this type of grazing can promote better soil health, healthier and more diverse forage, and could even help sequester more carbon in the soil. "Eventually we'll have 12-15 paddocks, and we'll move the cows every 2 weeks," he says. "I've noticed a real difference since we started doing it. The cows eat the pastures down more evenly and the grass grows back better."

Vollinger has also tapped back into an old water source – not enough to water a hayfield, but enough for his cows to drink. "There used to be an old uphill spring house that brought water down to the cows and house, but over time most of the pipes broke and we abandoned it," he says. "Then during another drought a few years ago, I re-dug a catch basin up at the spring and ran some new pipe." Together with NRCS, he's designed a system that will collect and distribute water to each grazing paddock, but nothing is built yet.

Farmland preservation programs are another tool many farmers use to keep their businesses afloat and land in farming. Often administered by the state or federal government, these programs compensate farmers financially for restricting development and committing their land to agricultural use, either for a set number of years or in perpetuity. Each has its pros and cons.

Currently, Vollinger has enrolled 80 of his 240 acres in the Massachusetts Department of Agriculture's Farm Viability Enhancement Program. "I agreed to a development lock-out for five years, and in return got money I could use to buy a new haybale wrapper and mower," he explains.

He's also working with Kestrel Land Trust, the City of Northampton, and NRCS's Agricultural Conservation Easement Program to permanently preserve another 150 acres for agricultural use. "Farmers get a bigger chunk of money through the program," says Vollinger, "but once you enroll your land, that's it." There's no going back, and no more preservation revenue available.

The driving force behind all these changes is Vollinger's hard work and ingenuity. He's farmed his whole life, and for several years also worked full-time at Smith Vocational and Agricultural High School. Alongside family and community support, governmental programs that advise and compensate farmers for stewarding resources have also been crucial. The NRCS EQIP, designed to guide and pay farmers to maximize the public environmental benefits their farms provide, has funded many of Vollinger's projects from the initial design through installation, including the cost of labor. He does have to invest his own money upfront, but NRCS reimburses him.

Funding for NRCS conservation programs is usually controlled by the Farm Bill, federal legislation that's updated every five years. However, the recent Inflation Reduction Act also funded a $20 billion investment in these programs between 2023-2026, amounting to a significant yearly increase. While that investment is good for local farmers, it's worth noting that most NRCS funding is directed towards states where agriculture has more economic and political sway. For example, between 1998 and 2015, Massachusetts farmers earned $36 million in EQIP support, while farmers in Iowa received $235 million. California farmers got $602 million.

Meanwhile, Massachusetts farmers contend with rising labor costs and the 5th highest cost of farm real estate per acre in the country, per the US Department of Agriculture. Extreme weather and inflation only erode their slim profit margins further. "I can't emphasize this enough," says Vollinger. "If it wasn't for some of the funding programs we have, I'd never have been able to clear out all these invasive species, put fences back up, and start raising grass-fed beef along with the hay, squash, and flowers we're doing here today. We'd never be able to afford to invest in our land for the future like this."

Jacob Nelson is Communications Coordinator for CISA (Community Involved in Sustaining Agriculture). As a frontline supporter of local food and farms in western Massachusetts, CISA helps farmers get the help and funding they need to thrive. Learn more at buylocalfood.org.

Debunking the Trump Administration's New Water Rule

By Ryan Richards

Introduction by Elizabeth Henderson
In December 2022, the Environmental Protection Agency (EPA) released a new version of the rule to revise the definition of "Waters of the United States" (WOTUS) under the Clean Water Act (CWA) first passed in 1972. The definition is central to the implementation of the CWA because only those waterbodies designated as WOTUS receive CWA protection. While few sustainable agriculture organizations have spoken up on this issue, the Farm Bureau conducted a loud and insistent campaign against the 2015 Obama administration rewrite that led the Trump administration to rewrite the definition yet again. This campaign aroused fear among farmers that the EPA would insist on elaborate permitting for all and any farm operations, even plowing, if farmers dug ditches that might drain into ditches that drain into a stream or wetland protected by CWA. The underlying threat was that the government might limit the use of toxic materials that might seep into the waters. With this new rule, the Farm Bureau is beating its drums of fear once again. In a February 2023 statement, the Farm Bureau wrote: "Everyday activities such as tillage, planting or fence building in or near ephemeral drainages, ditches or low spots could trigger the CWA's harsh civil or even criminal penalties unless a permit is obtained. Farmers need to apply weed, insect and disease control products to protect their crops. Fertilizer application is another necessary and beneficial aspect of many farming operations that is nonetheless swept into the CWA's broad scope (even organic fertilizer, i.e., manure)."

A January 5, 2023 update on WOTUS on the National Agricultural Law Center website clarifies that "the 2022 WOTUS rule maintains two exclusions relevant to agriculture: prior converted cropland and waste treatments systems that are otherwise designed to meet CWA requirements. Prior converted cropland is defined as any area that was drained or otherwise manipulated to make the production of agriculture possible prior to December 23, 1985. 40 C.F.R. § 120.2(3)(ix). If the area becomes unavailable for the production of agricultural commodities, it loses its prior converted cropland status. Other exceptions found in the 2022 WOTUS rule include ditches that do not carry a relatively permanent flow of water, artificially irrigated areas that would revert to dry land if irrigation stopped, and various artificial ponds and pools."

The Farm Bureau regarded the Trump water rule as yet another success in their ongoing efforts to prevent the regulation of farms for the pollution they may be causing. Hoping to appease its critics, in a press release issued by EPA, the Agency stated that it hoped the new rule would create a "durable definition" of WOTUS that would reduce "uncertainty," the code word for anything that might disrupt business as usual.

A new Trump proposal would strip protections from half of the nation's wetlands and nearly one-fifth of its river miles.

In February, the U.S. Environmental Protection Agency (EPA) released its revised "Waters of the United States" (WOTUS) rule. The proposed rule dramatically restricts what falls under the purview of the Clean Water Act, the environmental law that has led to the cleanup of thousands of rivers and lakes in the United States. The U.S. Geological Survey has estimated that the rule would remove federal protections for 18 percent of stream and river miles and 51 percent of wetlands in the United States, putting protections at their lowest levels since the Reagan administration and leaving millions of Americans vulnerable to polluted water.

Despite EPA Administrator Andrew Wheeler's claim that the changes were made to simplify what waterways are covered by the Clean Water Act, a close reading of the rule suggests that the changes add little clarity. In fact, experts have pointed out that the definitions used in the new rule are so general—and stray so far from sound science—that consultants may be required to determine whether a water body falls under federal jurisdiction. This would place further stress on farmers and landowners who are making good-faith efforts to follow the law.

While Wheeler recently claimed that "access to clean drinking water worldwide is 'the biggest environmental threat'," the rule appears to be yet another gift from Trump's EPA to polluters, especially the coal and hard-rock mining industries that have already benefited from myriad Trump administration policies. The proposed rule's shift away from science will seriously undermine water quality improvements that have been achieved since the Clean Water Act became law. Not only will the rule's narrowed definitions overwhelm states with new regulatory responsibilities, but the rule will also kneecap the booming restoration economy. This has been key to drawing billions of dollars in private investment to support environmental restoration and protection.

What counts as WOTUS?
Passed in 1972, the Clean Water Act gives the EPA and the Army Corps of Engineers the responsibility to regulate water pollution. The agencies have written several rules since 1972 to define the bodies of water they must oversee, with new rules being promulgated in response to court decisions. The most recent case, Rapanos v. United States, was decided in 2006; the decision was 4-1-4 and defined federal jurisdiction as applying to traditionally navigable waters as well as other waters with a "significant nexus" to navigable waters. The latter refers to those water bodies that affect the chemical, physical, or biological health of navigable waters.

In 2015, the EPA concluded a four-year scientific review of the nation's rivers and wetlands to determine what counted as a "significant nexus" under the Rapanos decision. It also released a rule that applied this definition to water bodies. However, industry opposed the rule, and over the subsequent years, litigation limited its implementation to 26 states.

Instead of fighting for rulemaking and ensuring strong protections against water pollution, the Trump administration has continued its track record of supporting industry interests at the expense of the American public. The proposed new WOTUS rule eliminates the categories introduced in the 2015 rule, limiting federal protections to broad categories of "traditional navigable waters"—seas, lakes, permanent or intermittent rivers, and wetlands that either feed into or out of these water bodies. The proposed rule also explicitly excludes ephemeral streams, which flow during and shortly after precipitation events, and wetlands without surface connections to traditional navigable waters. The proposed rule also leaves open the option of removing intermittent rivers and streams before its finalization.

The new rule benefits industry at the expense of public health.

A close reading of the proposed rule shows that it includes a big exemption that benefits mining companies. Specifically, it excludes "water-filled depressions created in upland incidental to mining or construction activity." While the 2015 rule excluded dry land depressions created by mining or construction activity, it clarified that ephemeral and intermittent streams could still be considered waters of the United States, even if they were dry for part of the year.

Ephemeral and intermittent streams are a critical part of hydrology in much of the country, where seasonal rainfall means that many streams and rivers do not flow year-round. One example of this is an arroyo in the American Southwest, a stream that flows only during and after rains, not permanently, because the region receives so little precipitation. Including these seasonal streams under the WOTUS rule is essential, as mining activities in these areas have a major effect on the quality of water downstream.

Yet mining groups have been quietly advocating for a new WOTUS rule. While farm groups opposing WOTUS have received most of the media attention, lobbying records indicate that since 2017, the National Mining Association alone has spent $3.5 million on lobbying activities related to the new WOTUS rule.

(continued on B-19)

(Earthworks - from B-15)

and store solar energy and release this heat slowly, especially in the autumn, to the adjacent area. In our testing on the Whole Systems Design Research Farm, this effect varies from year to year with the severity of the fall's first frost: Our three ponds will often not buffer against frost if the first freeze is about 27F or less yet will extend the growing season by weeks if the first frost in the fall is a mild one, which is usually the case.

• Wildlife: There's perhaps nothing we can do to enhance the biodiversity of species in our landscapes than by creating water bodies. In addition, amphibians are in need of particularly strong support, given the decline in the health of their populations in recent years. Ponds with large wetland edges are ideal—and often rarely found—habitats in many areas of the Northeast. Each time we've built a pond, at least three species of frog and two species of salamander arrive on-site within weeks. The values ponds offer for beneficial insects, birds, and mammals can also be observed in short order.

• Storage for Distribution: Large water storage is invaluable for fire control and irrigation, as well as for drought-proofing a landscape over time. It takes two to three days or fewer to make a pond that can hold a hundred thousand gallons or more, making it the most economical means of storing large quantities of water. Farms with a need for irrigation often recognize the opportunity to gravity feed such water via a supply located high in the landscape such that its water can be fed to the entire farm without pumps or electricity.

Capturing surface water from as many acres as possible is important for farms wishing to be adaptive to shifting climate conditions and the adverse effects of drought punctuated by intense rain events. A well-sited and properly integrated pond can be the most crucial "shock absorber" farms have for large precipitation fluctuations. Ponds in this capacity serve like batteries, storing excess energy (water) when it is abundant so it can be distributed slowly over a long period of time (drought).

• Other: Recreation, food storage, and increasing radiative light for crops and building interiors are several other important side benefits of well-integrated ponds, which demand more space to discuss than is possible here but are worth mentioning.

Management over time is more involved than the scope of this chapter permits, but the following guidelines are basic ground rules for ecologically enhancing multipurpose ponds:

• Don't mow to the water's edge. That's the best way to wreck the most abundant wildlife habitat a pond offers. If you must make access via a mower, do so in limited areas along its perimeter.

• Seed any bare areas that are not greened up every spring through early summer until there are none left—this can take two to three years or more, depending on vigilance and weather.

• Keep a watchful eye on overflow spillways (recommended) and drainage fixtures/pipes (not recommended) to prevent clogging and the waterline from rising to a dangerous point.

Ponds, swales and paddies are some of the most important features we can install today to ensure a more productive, multifunctional, and resilient landscape tomorrow. Well-designed and constructed water-retaining and distribution systems such as these can help homes and farms become more fit for a future that is likely to bring with it adverse conditions, including drought, flood, increased pest pressures, increased costs of inputs, and other stresses that only highly resilient, low-input systems will handle successfully.

Ben Falk started Whole Systems Design LLC which designs landscape and infrastructure systems that become adaptive, resilient, and relatively secure in a future of climate instability and is the author of The Resilient Farm & Homestead.

How to Host Your Own Seed Swap

& grow so much more than gardens

By Petra Page-Mann (in grateful practice and conversation with countless seeds and swappers)

The fact of a seed.

Nothing new and nonetheless miraculous: All fall and across the long winter we've watched squirrels move acorns, munching as they go, new oaks soon sprouting from this dance and happenstance, millions of years unfurling.

Since their earliest existence on planet Earth 400 million years ago, seed-bearing plants have gifted the world with lush, delectable diversity, as fluid and free as water and air to move in the world, becoming and abundant everywhere they land.

As robins sing and snows melt, let us remember that we, too, are harbingers of spring both in vision as well as the material world.

For 10,000+ years our ancestors have shared, swapped, sowed and grown alongside seeds; only recently have we left this 'to the professionals' as Will Bonsall says, as seed moved from a commons (can you imagine 'owning' air?) to a commodity. Rowen White, Mohawk mother, seedkeeper and storyteller, reminds us that, '150 years ago seed companies didn't exist. If we do our work well, they won't need to exist in 150 years.'

Friends, we are the seeds.

We are the ones we've been waiting for.

Like tucking our children into bed each night, let's not leave our relationship with seed 'up to professionals.'

This looks like a thousand things: planting a seed in the soil, giving thanks with a song, sharing a bouquet of flowers on the doorstep of a friend. One of my favorites, ever and always, is 'swapping seeds' in community with friends old and new, in gatherings large and small, and here are a few tips so we might all participate, host and celebrate seeds shared for generations to come.

Before we begin:

There is no one way to be and do anything in this world, so resist the illusion of perfection. Like each seed, each seed swap will be unique and invite us to trust ourselves, our community and the process unfolding. Explore! Experiment! Play! Learn! Repeat!

How to Host Your Own Seed Swap
1. Explore what local and/or regional seed swaps already exist.
Great minds think alike and if you're thinking it's time your community swap seeds, you're not alone. If one is already happening, are there ways you can support the event before, during or after? If there is no seed swap close by, here are some keys to keeping it simple.

2. Who might be fabulous co-organizing companions/organizations?
As seeds teach us, we are only as resilient as the world around us. Who will enthusiastically dream and bring a new seed swap to life by your side? Friends, libraries and community gardens are all extraordinary places to start.

The annual Rochester Seed Swap *(join us Friday, March 31st)* began with three friends and their organizations partnering (490 Farmers, Taproot Collective and Fruition Seeds) with other individuals and organizations adding layers of accessibility, capacity and joy.

3. What space might be beautiful & accessible for a Seed Swap? How many people would you love to attend?

(continued on B-20)

(WOTUS - from B-17)

Several coal and hard-rock mining companies also list millions of dollars in WOTUS advocacy in their lobbying reports. Given the unequivocal link between mining and water contamination, these groups have a clear incentive to advocate for the narrowest definition of "waters of the United States."

Trump's 2019 "Economic Report of the President" confirms that the proposed WOTUS rule is intended as a handout to the mining industry, calling it one of "the most economically significant deregulatory actions for energy" currently underway. This aligns with the Trump administration's stated priorities to support coal and extractive industries; it also follows ongoing efforts to weaken environmental and public health standards to benefit these interests by weakening EPA rules on mercury pollution and supporting the successful nullification of the Department of the Interior's Stream Protection Rule under the Congressional Review Act.

The new rule leaves states holding the bag
Instead of empowering states, the proposed rule appears to be an end run to gut environmental protections at all levels of government.

By removing federal oversight of clean water in many areas, the proposed rule punts a significant amount of responsibility to individual states, many of which are under-resourced and legally unprepared to take on permitting and enforcement. In fact, fewer than half of states have their own permitting programs for protecting wetlands, with many of the remaining states relying on federal standards or joint programs with the Army Corps of Engineers for monitoring and enforcement. Even where these programs exist, it is not guaranteed that states will have the staff capacity to ensure that similar levels of protection are maintained. A 2015 survey by the Association of State Wetland Managers finds that only 10 states have more than 20 staff members devoted to wetlands-related regulatory or monitoring work.

States' lack of staff and funding to regulate water quality, combined with the Trump administration walking away from its responsibilities, means that it simply won't get done—and that communities will be left vulnerable to water pollution. The Trump administration's redefinition of WOTUS is part of a broader effort to eliminate large portions of the EPA's historical responsibilities, ostensibly handing them off to state and local agencies. However, the administration's talking points run counter to the decadeslong history of federal-state cooperation that has improved water quality across the country.

The new rule hamstrings private investment in conservation innovation
The rollback of federal protections also threatens to undercut some of the most successful examples of using market-based tools to improve environmental quality. Mitigation—the restoration or improvement of habitats to compensate for the impacts of development—was pioneered under the Clean Water Act to address the effects of infrastructure on wetlands and streams.

The mitigation banking system has boomed in the past decade. It grants private businesses credits for investing in restoration; businesses can then sell these credits to developers who need to compensate for the impacts of development. More effective than requiring developers to oversee on-site restoration projects, the mitigation banking industry now dominates the emerging restoration economy—a sector that employs 126,000 people and generates $9.5 billion annually. More than 1,800 banks are approved to sell credits for wetland and stream restoration, and the practice has cut permitting times in half for development projects.

Because the proposed rule cuts 50 percent of wetlands and nearly 20 percent of stream and river miles from consideration under the Clean Water Act, the mitigation banking industry would face severe uncertainty if the rule were to be finalized. As discussed above, states are unlikely to fill the gap in protections that the proposed rule creates, so the change would effectively eliminate a large portion of the demand for the mitigation credits that fuel the industry. Turning off the tap for private investment in conservation is bad for business. Mitigation banks often invest in conservation easements and restoration projects years before any credits are approved for sale, so the proposed new rule would negate significant investments in bodies of water that are no longer regulated.

Conclusion
Despite the administration's claims, the proposed Waters of the United States rule would not simplify the regulatory process or provide any clarity for farmers. Instead, it appears to be a giveaway to the mining industry that would hamstring efforts to effectively protect the nation's waters from pollution and would place an undue burden on states. The new rule would also stifle the booming restoration economy and limit safeguards for some of the most toxic forms of development. Congress should press the EPA and the U.S. Army Corps of Engineers to ensure that the rule reflects the best science—and it should hold the administration accountable for this blatant attempt to give handouts to favor big polluters at the expense of public health.

In 2019, Ryan Richards was a senior policy analyst for Public Lands at the Center for American Progress and now holds a position as a policy analyst in the Office of Policy Analysis of the US Department of the Interior.

This articles was reprinted with permission from the Center for American Progress, americanprogress.org/article/debunking-trump-administrations-new-water-rule/, March 27, 2019.

(Seed swaps - from B-19)

Libraries are amazing! What other municipal spaces might be available? Do you have a local Grange Hall? A church with a cozy basement? As lovely as exchanging seeds under the sky is, the slightest breeze will send seeds flying, so finding a welcoming indoor space makes all the difference.

Whenever possible, find a home for your seed swap that is as passionate about the event as you are and perhaps will even host for free, trusting there is much more to generate beyond dollars with such a gathering.

How large a space do you need? Depends on how many people attend. Ten friends can likely be cozy at your kitchen table. If you're hoping thirty-ish folx come, plan on at least five tables (see key #5). If you're hoping for one hundred or more people, plan for a table for each 'seed type' and/or seedkeeper. It's easy to overthink this step if it's your first time. As best we can, let's trust the seeds and our communities to learn as we go in celebrating the abundance shared.

4. Set the date & spread the word!
After you've set the date (late winter and early spring are fabulous seasons), spread the word.
This is sometimes the hardest part and also the most fun! If your goal is small and sweet, a few phone calls and follow-up texts among friends are likely all you need. If community building is part of your goal, lean into networks: social media, email, text and calling, always inviting friends to bring more friends. Is there local radio that might air a conversation about seeds and swapping? What community calendars exist in your area, online or in person? If making flyers to post around town sparks joy, don't resist! Bringing and building community is a fine art; as you're considering collaborative partnerships, keep these skills in mind.

5. Organizing Seeds for Swapping
Friends, it's worth repeating: There is no one way to be and do anything in this world. Seeds enthusiastically swapped may hail from home-saved as well as commercial seed packets, so here are approaches to keep seed swapping simple with plenty of opportunities to make your own magic. No two seed swaps will be the same!

Sharing Seeds in Commercial Packets
Though the vast majority of seeds shared in the last 10,000 years have not been sold or otherwise commercialized, many of us only have access to seeds from seed companies these days. As the pendulum shifts, let us be clear: Like each of us, all seeds are sacred and have stories to share — there is genius and generosity in every seed! — so let us share joyfully both the seeds we harvest from our own gardens as well as those we've found in packets.

Swapping commercial packets on wide-open tables is marvelous, especially with ample space to loosely organize them by seed type. These categories may be specific (tomato) and/or general (roots) with simple signs to accompany them. Or not so simple! Chloe Smith of 490 Farmers in Rochester (a grassroots project building community, providing land access, and addressing food insecurity through urban agriculture and mutual aid) created gorgeous watercolors for the Rochester Seed Swap of about twenty crop types — an ear of corn, a slice of melon, a vivid zinnia — dangling from the ceiling above their corresponding tables. Creating collages from seed catalogs is another fun way to make signs, too. Perhaps Martha Stewart's vote for most quaint: Attaching the crop-type sign to a pencil-sized branch tucked in a small terracotta container with potting mix. Also, consider making a 'miscellaneous' section: Most of us don't fit neatly into categories and neither do seeds.

If you're bringing seeds to a seed swap that are meaningful to you, consider tucking a label on each packet with your name and contact info: seeds grow so much more than gardens and these connections and community are the foundation of resilience as well as deliciousness.

As people arrive, invite them to place their seeds on tables with their corresponding categories.

Also, scatter empty envelopes and pens throughout the swap so seed can be shared even more abundantly!

Sharing Seeds in Communities of Seedkeepers
If your community has many seedkeepers, how marvelous and oh our hearts sing! Absolutely include them in the planning from the very beginning. They'll likely have experienced at least a few seed swaps and have great wisdom to share. In our experience, it's dreamy to give each seedkeeper their own table to share seed from.

Many Canadian communities share a marvelous late winter tradition of annual 'Seedy Saturdays' or 'Seedy Sundays' where all are welcome to share in the joy and abundance of seeds. At these events, home-scale seedkeepers as well as small seed companies are also there to sell seeds, as well.

No matter where the seeds come from in your swap, find ways to keep the stories of relationship and kinship beyond species at the center.

6. Centering Connection & Gratitude: Let Seeds Grow Us
There are as many ways to swap seeds as there are seed swappers: Keep it as simple or as structured as sparks joy! Trust that gratitude and connection inherently infuse seed swaps. We can also intentionally cultivate nodes of interdependence and awareness, deepening the capacities of seeds to nourish us.

Here are just a few of the many ways to center seeds, connection and respect in seed swaps:

a) Welcome folx at the door. Especially in larger seed swaps, a helpful, convivial 'greeter' answering questions as folx arrive 'seeds' connection and displays the community care so many of us dream of.

b) Consider name tags for both humxns and seeds. At the Rochester Seed Swap, we have classic adhesive name tags and markers for people to share their names and pronouns as well as a button maker with dozens of seed catalogs so folx can create less disposable name tags, as well. We also have a stack of Avery labels so people can label seed commercial packets with hints, sentiments and contact information if they wish.

c) Center 'Mindful Encouragements for Seed Swapping.' Detailed below, infuse these and other guiding sentiments into promotions for the swap. Make little signs to scatter throughout the event. Chloe Smith painted a magic banner to welcome folx to the Rochester Seed Swap with these invitations. Read them aloud for all swappers to hear! What is the magic and medicine you bring to the world? How can you let these gifts shift our culture toward collective care and abundance shared, like the seeds we share?

d) Pause the swap for a moment of connection and reflection. The potential to invite a powerful moment of reflection together is vast and worth considering, whether it's a moment before 'swapping' begins or mid-flow once most attendees are present.

Here is a simple flow to create a magic moment of deeper meaning and connection: Gather in a circle. A few moments of shared pause and silence are often powerful, as are a few words of gratitude. Consider thanking ourselves, thanking each other, thanking the seeds and the land, the ancestors and all abundance and generations yet to come. Perhaps read a Mary Oliver poem. Quote Leah Penniman. Perhaps share a simple call-and-response song. Consider asking a few people to speak so people hear from several voices. Know your audience, keep it short, and sweet and close the moment with a collective cheer.

e) Center the Stories. Consider inviting a few folx to stand up (even hopping on a mic!) to share a few minutes of a seed story. Perhaps a poem. Perhaps a song! How might we together nourish a culture where we celebrate seeds as muses, teachers, friends and adaptive allies?

f) Center Seedkeeping Skills. Seed swaps often inspire curiosity about seedkeeping and if there are folx in your community open to being asked questions or even leading a conversation about seedkeeping large or small, open the door!

However you invite opportunities for connection and gratitude to bloom in your seed swap, know you're courageously rehydrating a vast lineage of seeds and people embodying resilience.

Let the swapping begin!

7. Finding a Home for Surplus Seeds
One of the many magical elements of a seed swap is witnessing all the abundance shared and almost always there is an impressive amount of seed that hasn't been swapped by the event's end. Before the swap, make a plan for where these seeds will go next. Seed libraries often love to welcome such seed. Community gardens will be over the moon. What other mutual aid networks exist in your community? Who often receives such abundance? Who does not? Let this be not an afterthought but an active way we imagine, plan for and live into the abundance of the world.

8. What's Next?
Sharing seeds has the potential to grow so much more than gardens. From a few friends to a few hundred strangers sharing space together, seeds remind us that we are in community and that what we tend to grows. In the spirit of connecting with like-minded community members for future events, consider collecting emails and always bcc in such invitations to respect privacy. Creating a Facebook group or hashtag is another option. If you would love to learn more about seedkeeping (or seed saving, who's saving who?!), there are a thousand places to begin. Fruition Seeds shares seedkeeping info on every seed we share, including in-depth Growing Guides and a free online course, Saving Our Seeds, Saving Ourselves, to surround us all with abundance for generations to come.

6 Mindful Encouragements for Seed Swapping

1. There are no 'rules' beyond being respectful of life and amplifying collective abundance.
2. All are welcome!
3. Everyone is encouraged to bring seeds home, even (especially!) if you don't have a single seed to offer.
4. Take only what you need: Be generous & embody the abundance of the seeds, our 400 million-year-old teachers.
5. Encourage care and intentional connection: Many of us learned scarcity & transactional patterning around seeds and, well, everything. How might we learn new patterns of abundance and deepen our relationship with seeds and with each other, at Seed Swaps and beyond?
6. Say hello to new or unfamiliar people and seeds: They are a part of you that you do not yet know!

**Folx is a gender neutral term emphasizing the fact that we intend the word to include all people.*
**Humxn is a gender neutral term expanding the masculine histories of 'human.'*

Resources:
Seed Savers Exchange shares a more comprehensive guide at *seedsavers.org/site/pdf/Start-Seed-Swap.pdf*

Also, if you'd love to share our beautiful postcard-sized planting calendars at your swap, we'd love to send you some, compliments of Fruition! Send a sweet ask of an email to *support@fruitionseeds.com* and they'll soon be winging your way.

Here's to seeds growing us even before we grow them!

Sow Seeds & Sing Songs,

Petra Page-Mann is co-creator of Fruition Seeds, in Naples, NY.

Lessons from the Land & Other Musings

Carrot Harvest

Something happens every time we go in the carrot field that I come out more myself than I went in. These past few weeks we have been harvesting about a bed of carrots each week. Harvesting carrots is hard work. We fork the carrots, taking care not to stab them or snap them as we ease them out of the soil. a team of us follow the forkers. We twist the green tops from the bottoms and toss them into bins of firsts (for all of our customers) and seconds (for horses, ourselves, and anyone else). There are always carrots that didn't get freed from the soil by the fork. those, we dig out by hand or pull them slowly from their snug pockets in the dirt. They slide out with a pop, which is satisfying. sometimes we find 5 carrots bundled together, carrot legs twined around carrot torsos and carrot arms tangled in a dirt-crusted embrace.

One of my favorite things about carrot harvest is that we sit together. Gathered around a messy pile of leaves and roots, I pull on one end or another to extract one carrot from the chaos, trim it, and sort it. We chat as we work, tell stories, hold space for our collective being. In the carrot bed, nothing we harvest is done solo. what someone else forked, I may pull. What I pull, someone else will top and sort. The carrots I missed when pulling, someone else will notice and uproot. Later, another person will wash the carrots by sending them through the root washer. It's different from harvesting peppers or lettuce, which involves more individual tasks. When we harvest carrots, we work as a collective.

Just as we transform the carrot bed and help transition a carrot plant to a carrot that is food, the harvest transforms us. I can feel us aligning with each other during carrot harvest. I find out one of my coworkers is having a hard day or got exciting news. We take turns forking because it's more physical than sitting and sorting. any preconditioning we have to feel individual responsibility for tasks and our labor starts to morph into a shared responsibility and caretaking. I like this feeling. to me, this is what it means to be able to work with the land. I am in continual transition and transformation by and with the land and my community.

Katharine Constas, all pronouns,
Rock Steady Farm, Millerton NY

To Fledgling Farmstead (Tunbridge)

By Kristianne Gale

Passing among dim forest sounding
Soft, infrequent low music of hot afternoon
In no particular rhythm to our footfalls.
Ants too small to see,
And brief, buzzing passersby, infinitesimal as one,
Mighty in their self-guided choruses,
Extinguished by hungry birds.
Their worth is known through wordless spiders,
Through high, peeping songsters
And the raucous night callers sleeping now
Below litter in hollows chiseled out by
Avid, speckled foragers.

Treading carefully as voltage is cut
To reach longly toward hot-bodied, lowing Gouda
Swatting and shaking woven swaths
Of blood-hungry sippers.
Her calf nearing ready for milking, the promise of the morrow
Holds a heady draught readily
Drained by hungry hands.
With ones who dine on riches of soft-spoken pastures,
Deep humming soils
Hosting nimble-footed ewes, shorn, black-cheeked
Across hillsides grown wild, woolied by
Warm, summer rains

We reach hill's top, wood smoke ushering
Us like a sonnet into richly uncomplicated affections.
A soft-faced carpenter turns roasting veal
Over smoking ashes.
Tables being readied for feasting, we spy home-baked bread
Greens tossed with herbs and vivid flowers.
We fill our cups with homemade mead,
With the reveling of black-smiths, carvers and weavers
Of iron and
Sumac dyed linens, with hand-hewn scythes
Hanging under eaves of sapling cabins
Warmed by a black-bellied stove.

Kristianne Gale, Nona Lea
Family Homestead

Under Stone Moon

By Rebecca Canright

autumn invites good earthy reflection

Kousa dogwood yields fruit
for us, food for twilight hours.

As full moon rises
We rest ourselves down on summer's
Moss, tiny forests that beckon
Promising us they can take our weight. O we drink pine tree's

Sweet sap-nectar whilst opening
Fern's window. Stars invite us
To count them and we bob our heads
In and out of creek's cold wetness while tasting
Stones between our teeth. White calla lily
Begins to sing as dusk
Sways, a veil is thinning and she
Knows it. We tremble a little as
Tree-spirits emerge to tell us their secrets and we know

This night is young.

All ingredients are here and ocean
Is our soup our god our mystery
Not ours at all. We indeed are pieces of yarrow-quilt,
Gentle on this earth

Owl listens to universe's sounds now
she
Bathed yesterday in ocean
while Great Wheel kept turning

Rebecca Canright, she/her,
Comeback Farm Organic Produce, Asbury NJ

A Gift of Garden

By Carl Garguilo

Wintered under straw
Awakening spring rain
Kiss of summer sun
Boldly phoenix rise
Dance in the wind
Tended care

Adorning the door latch
Twine bound bowed by
Soil worked hands
Green stalks firm ripe
Cloves sun lit garlic
Gifted grace

In kitchen aromas
Dishes fragrant flavor
Succulent sweet
Savored over dinner
Gratefully remembered
A Gift of Garden

Carl Garguilo, Skyberry Farm in Westminster Vermont

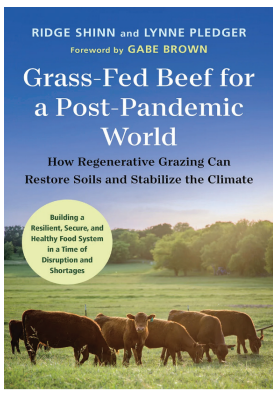
Lessons from the Land are nonfiction, *personal essays* about you and your relatonship with the land or your farm.
Submit your 400 - 800 word story at *www.TheNaturalFarmer.org.*

Book Reviews

Grass-Fed Beef for a Post-Pandemic World: How Regenerative Grazing Can Restore Soils and Stabilize the Climate

By Ridge Shinn and Lynne Pledge
Chelsea Green 2022, $24.95

Reviewed by Jason Detzel



The book is split into three parts. The first and largest section, "Impacts of Regenerative Grazing," outlines the proven regenerative methods and advantages that can exist for both growers and consumers. These chapters consist of broad explanations and examples of how regenerative agriculture is currently integrated (or not integrated) into our existing food system. The chapter goes on to demonstrate how regenerative methods can continue to gain ground, and most extensively and importantly, it outlines how the typical domestic consumer is currently being sold a product that likely is not what it says, did not come from where they think it does, doesn't meet the indicated nutritional and environmental criteria espoused by the label, and is a net loss for the animal, the consumer, and the grower. Shinn and Pledger are spot on with this analysis and this is an excellent starting point for those who would like to learn more about how most beef gets to the kitchen table.

The first half of this section is in line with the title of the book, and I feel that Shinn and Pledger achieve their presumed goal of providing a 30,000-foot understanding of the production and consumer issues in regenerative grazing. This book is very good at introducing the talking points necessary to understand this issue from a consumer standpoint. I can agree with most things in this book, and it is refreshing that they provide many footnotes to back up the claims in the chapters. The authors provide science-based evidence for the benefits of regenerative agriculture. In other words, if you (as I do) feel that meat is an integral part of existing as a human being, the authors systematically outline why you should choose animals raised in this manner, counteract the misinformation surrounding current ruminant production on earth, and offer a roadmap to understand the applied methods of regenerative grazing.

The second half of the section is dedicated to the health benefits of eating grass-fed animals and the unique animal welfare issues inherent in growing animals for food. There is no doubt that there are both environmental and health benefits to eating regeneratively produced food, but I found myself skipping through the chapter to wonder what happened to the outrage and inspiration that peppered the first half of the book. I thought, what does healthy eating have to do with the post-pandemic world or with building a secure food system? It is all too easy to judge someone based on what they eat, and you are what you eat is more than a saying, it is a limitation since what you eat is more often a function of what you can afford and have access to than what is healthy. I don't judge anyone for eating twinkies or conventional beef, but I fear that this type of fact-bombing about the benefits of a product that is largely out of reach for most of the population can devolve into discrimination.

I felt the same way about the animal welfare section. This is well-worn territory and as a grower and consumer with a keen interest in grass-fed beef and politics, I found this section to be preaching the same info to the same choir. Animal welfare, ruminant sense, and the cognitive function of animals are vital to understanding our agricultural system; but I am not sure I understand the function of this particular topic here in the book. Just because you claim a ranch is regenerative does not mean the animal was raised humanely or that the product will deliver any health benefits.

I fear that the authors may be selling the word regenerative as a solution to the world's bad beef in this section. The footnotes and commitment to citing sources and providing additional materials are a great addition, but the source material is a bit outdated and redundant. There are all kinds of global growers providing input and experimenting with low-stress livestock handling and regenerative practices. I feel like a focus on these new ideas and techniques (e.g. fence line weaning) would go a long way in helping the reader understand that grazing is not a static topic.

The second section, "Keys to Success" provides basic best practice procedures for those who take the plunge into ranching. Farming is a demanding and difficult business enterprise as the farmer is charged with both production and marketing of the products. Add breakdowns, payment processing issues, and the cattle getting out at three am on a Sunday night (I assure you, as I do with all farmers and ranchers, that it will happen) and you have a perfect recipe for burnout. The authors provide some applied tips from both the production and marketing sides of grazing.

The chapters include a general discussion on profitability, winter feeding, finishing cattle on perennial plants, as well as fencing, and pasture management. This section serves as a primer for those who are interested in learning some of the salient husbandry issues necessary to raise livestock. It serves the reader in that it illuminates many issues that farmers must deal with, but these topics are vast and varied. Moreso, they are unique to every single different piece of property and grazing personality.

When I taught our comprehensive grazing courses at Cornell, these topics would take hours to cover. Here, Shinn and Pledger complete the topic in one paragraph. This is just enough to signal to the reader that this is a vital applied aspect of the grazing program but not enough to initiate the personalized decision-making process that every farm must face. This book is not built upon a functional backbone because it was never meant to cover all that information. This book covers the big picture and the authors have done their best to condense this expansive topic. I appreciate the theme and presentation that the authors have provided, but I worry that someone who is in that dreaming of farming phase will pick up this book looking for answers.

The final section of the book is labeled "Remaining Challenges." This was my favorite chapter of the book. Here lies a blueprint for a call to action for those who wish to eat better for the better. Shinn and Pledger do excellent work in this breakdown and analysis of the current issues that are holding regenerative grazing in the niche. This is also the area where the pandemic finally makes a palpable impact. Many routine procedures such as the timely processing and delivery of animals were severely impacted by the pandemic. Most of our State and Federal systems were stressed to the point of ineffectiveness (many would argue this problem began decades ago). Despite the lag in regulatory information for farmers, folks still need to eat and consumers were forced to seek food from outside their typical channels farmer's markets and on-farm stores were ready and able to step up and fill the gap. Sounds easy right?

From the 30,000-foot view, it seems that the cards are stacked against the small grower. The authors do a great job of explaining the many roadblocks and issues that stymy farmers and ranchers. Lab-grown meat, Country of Origin labels, processing bottlenecks, and a pacified and busy public all contribute to the demise of the small farmer and rancher. This section shines and the authors hit their stride by presenting the big-picture view of our failed agricultural state and offering some solutions. Shinn and Pledger are at home here in the muck but work in tandem to counteract the seemingly hopeless situation run by politics and big business to move the reader a step in the right direction.

This is an excellent book If you are seeking a global understanding of regenerative grazing and how this recent pandemic exacerbated our system which is built on efficiencies rather than qualities and consequences. The authors touch on the fact that not all grass-fed meat is alike and that big business has already latched onto and adjusted many of these ag buzzwords to drive up profits. Ultimately, I agree with the authors in their sentiment that we can all improve this world and those who live in it.

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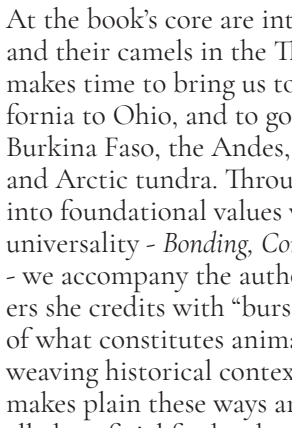
Hoofprints on the Land

By Ilse Köhler-Rollefson
Chelsea Green 2023, $22.95

Reviewed by Bec Sloane



"Documenting traditional knowledge does not really preserve it - it needs to be lived, applied, revised, adapted." - I.K.R.

Hoofprints on the Land is a smartly bundled parcel from which to sample polyculture (and polyspecies) wisdom, decolonized science and actionable solutions. Without any hyperbolic narrative, her observations from among the Raika camel herders of northern India - and her research into transhumanism worldwide - paint a sprawling scroll conveying the historic, present and future relevance of pastoralism.

Köhler-Rollefson specializes in ethnoveterinary medicine, the integration of traditional knowledge, animal science and anthropology. Throughout her book, she cites the legitimacy and urgency of this knowledge gleaned from a myriad of cultures amidst our crises of climate variability, a vulnerable food system and increasing proximity to disease. She honors the fact that this insight and relationship with animals coalesce only after generations of knowledge sharing and, importantly, evolve alongside interactions with our changing world. Reading *Hoofprints*, one gains a solid understanding that such expertise is grounded in knowing how ecological systems - soils, plants, animals, people, weather - "articulate and influence" each other.

At the book's core are interactions among the Raika and their camels in the Thar Desert, but the author makes time to bring us to follow herds from California to Ohio, and to go to Mongolia, Switzerland, Burkina Faso, the Andes, Portuguese oak forests and Arctic tundra. Through chapters broken down into foundational values which themselves convey universality - *Bonding, Communication, Nourishment* - we accompany the author and the activist researchers she credits with "bursting our confined horizons of what constitutes animal husbandry." Seamlessly weaving historical context throughout the book, she makes plain these ways are tried and true, and mutually beneficial for herd and herder alike. Illuminating the reverence toward animals within these societies, Köhler-Rollefson notes how the herd's guide, unfamiliar with the territory, deferred to the camels and "came to understand the area through their eyes." She writes of sleigh drivers who observe their reindeer's behavior and who invite them to map out the best route. Collaboration, above all, is the message this book carries:

"It's a dance with the unpredictability that is the core characteristic of the system."

Powerful takeaways in *Hoofprints* stem from placing value on animal autonomy and on rural livelihoods. Camels, the author's creature of choice, feed and medicate themselves, locate forage where no edible plants abound for humans, and produce highly nutritious milk. The proteins and micronutrients they conjure from harsh environments are more wholesome to malnourished human populations than carb-based foods. Köhler-Rollefson frequently touts this something-from-nothing phenomenon. She cites herders producing hundreds of thousands of pounds of protein from sparse vegetation, on land unsuitable for cultivation and without non-renewable resources like chemicals, tractor fuel or transportation.

(continued on next page)

(Reviews - from B-22)

Köhler-Rollefson insists upon reframing the widespread perception of herders as poor, backward and uneducated in all realms - social, scientific, and economic - as it remains a professional disincentive. Pastoralism, she stresses, combines biodiversity conservation with food production; it ought to be framed as a desirable career path with high status and a decent income. The book does cite initiatives around the world that are making moves to instill this desire at both grassroots and national policy levels to preserve pastoralism, stimulate rural development and integrate cultural heritage. One of the ways to support these livelihoods is by elevating the status of rural career paths. Among the Raika, if a man returns discontented from city life, community members each gift him a sheep so that he may reconstitute a flock and carry on as a herder. The author notes this was of major significance amid the pandemic; as young Raika lost city jobs and resumed herding, many found they thrived being their own master rather than a menial worker.

"Our problems with livestock started when we began to treat animals as if they are plants."

Readers of *Hoofprints* may also appreciate a well-done debunking of cattle shaming in regard to their CO_2 emissions, among other basic yet profound paradigm shifts. Exercising her breadth of understanding and experience, Köhler-Rollefson invites us to challenge - yet not abandon - academic approaches to science and welcome true systems thinking already upheld by the practitioners she spotlights. Often glossed over are disconnects between Indigenous nations and environmental groups who, in respective efforts to vie for the public's support, fall into conflict. Likewise, animal scientists are led astray by a tangle of disjointed hyperspecializations lacking an underlying value system at their core. In *Hoofprints*, Köhler-Rollefson steps into the ring to stand between herders and well-intentioned stakeholders and lays down facts to speak for themselves. Pastoralists are pushed off land to make way for sanctuaries - land which they are best equipped to sustain.

"Biodiversity thrives," in these places where humans and animals work harmoniously with nature, and such millennia-old ethics "form an antithesis to the dominant concept of land as an asset."

Köhler-Rollefson links the rapport among herders and their animals to that of any relationship - romantic, familial, professional - as something to be shaped over time and nurtured in order to thrive. And accepting approaches such as cryoconservation - a process where biological material (cells, tissues, or organs) are frozen to preserve the material for an extended period of time - as a backup, she asks whether it wouldn't make more sense to apply resources and support the living systems already raising resilient breeds who we may come to depend on. Gene banks require immense amounts of energy, infrastructure and expenditure over an indefinite stretch of time, and, as the author points out, once genetic material is frozen, it is frozen in time. As new diseases and weather patterns take hold, reconstituted species will not have been present to evolve alongside them or glean essential knowledge from their elders. Species are, after all, "never static, but always a work in progress." *Hoofprints in the Land* reminds us of the value in pastoralists' knowledge, of the growing efforts to revitalize it, and of our role in sustaining it.

Featured Photos

Submit your seasonal photos by visiting thenaturalfarmer.org

Illustration by Bec Sloan, Inspired by Hoofprints on the Land.

First of the year. Photo Credit: Jason Welch

Old pump by Kristianne Gale.

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