RESILIENCE

A VOICE OF THE
NEW AGRARIANISM

Issue 44

MICROBES, MARKETS, AND CLIMATE

How microbes and managers are helping restore degraded rangelands

Community resilience and environmental justice in the aftermath of wildfire

Late night thoughts from the wind

Editor's Note

Dear *Resilience* Readers,

"How do you create resilient lands, economies, and communities?" "How does what you wear represent what you stand for?" "How might different compost microbial communities affect soil health and productivity?" "How do we connect to each other: as one person to another, as a people to society, and as a society to various cultures?" "Can the soil microbiome be engineered?" "What if lenders had to consider soil as a depreciating asset?" "Where do we start, down to the microbe, to the soil, to get to that food sovereignty?" "Is resiliency a natural capacity or a learned behavior?" "How can our economic relationships mirror the transformative give-and-take relationships that happen every day in our ecological systems?" "How do we fix what a fire burned up?"

These questions comprise a mere handful of those posed by the writers, ranchers, farmers, and scientists gathered in the forty-fourth issue of *Resilience*. Their questions are practical: tested by science, by experience, and directed toward on-the-ground solutions. Their questions are also philosophical: sensitive to contradiction, to tensions between local knowledge and global interests, and to the complexity of our human spirit. Taken together, such inquiries attest to the specificity and scale of this issue's tripartite theme: Microbes, Markets, and Climate.

Each term is inextricably linked to its companions. The fate of our climate-at-large depends as much upon the microorganismal makeup of the soil in the Embudo Valley of northern New Mexico, or the soil of the prairie in Salina, Kansas, or the soil of the rangeland in Saguache, Colorado — to name but a few of the sites in these pages — as it does upon the economic systems in whose interests our soil too often finds itself beholden.

This issue of *Resilience* untangles these strands, makes visible the cultural and ecospheric webs in which our work on the land occurs, and delineates the ways this work might contribute to meaningful change and meaningful living — at home and beyond. It is part of the pleasure of editing to shepherd such connections into print. It is part of the pleasure of reading to partake in them.

Sean McCoy
Editor

Cover photo by Minesh Bacrania

Publisher

Quivira Coalition

Editor

Sean McCoy

Copy Editor

Anica Wong

Design and Layout

Jessica Brothers, Earth Hands Co.

Printing Coordination

Rita Talbot, Artifacts

Contributors

Minesh Bacrania
Dave Carter
Anna Jones-Crabtree
Stanley Crawford
Tim Crews
Melanie Kirby
Rachael Leitnaker
Lauren Manning
Joshua McKenna
Elena Miller-ter Kuile
Bill Milton
Megan O'Connell
Julie Bethaney Rakes
Shantini Ramakrishnan
Sam Schmidt
Eva Stricker
Anica Wong

Contact Us

Quivira Coalition
1413 Second St. Suite 1
Santa Fe, New Mexico 87505

505-820-2544

resilience@quiviracoalition.org

We welcome your letters, comments, questions, and compliments.

Join and Support

Quivira Coalition publishes *Resilience* annually as a benefit of its membership program — becoming a member is one of the best ways to support our work. Additional copies are available for $15 + shipping within the U.S. We are also able to ship international.

quiviracoalition.org/join

Table of Contents

Contributors

Minesh Bacrania has established himself as an editorial and documentary portrait photographer with a deep connection to New Mexico and the Southwest. Minesh's extensive experience navigating the regional culture and geography has earned him the reputation as an expert in producing and executing challenging photographic assignments. Previously, he enjoyed a decade-long career as an experimental nuclear physicist.

Jessica Brothers is a producer, mother, and designer practicing land stewardship on her family farm in central New York. As sixth generation land stewards, she and her family raise sheep, perennial fruits, and medicinal herbs. Jessica puts her creative design skills to work designing outreach materials, products, and technical guides for Quivira Coalition.

Dave Carter is a regional director for the Flower Hill Institute's cooperative agreement program with USDA AMS, working to coordinate technical assistance for Meat and Poultry Processing Expansion. From 2001-2022, Dave served as executive director of the National Bison Association. He and his wife, Sue, are partners with two other ranching families in a herd of bison on the Savory Institute's West Bijou Ranch east of Denver, Colorado.

Anna Jones-Crabtree and her husband, Doug, are first-generation farmers in Havre, Montana. They launched Vilicus Farms in 2009 using USDA beginning farmer programs. Vilicus is Latin and translates to "stewards of the land." They take this name seriously. Their long-term and diverse crop rotations, field layout with embedded natural areas, organic and biodynamic farming system, and care for pollinators and the next generation of agrarians sets them apart. Their CSSA website can be found here: vilicusfarms.com/cssa

Stanley Crawford has lived and farmed in the Embudo Valley of northern New Mexico since 1969. He is the author of four works of non-fiction, the most recent being "The Garlic Papers: A Small Garlic Farm in an Age of Global Vampires," whose contents were the subject of a Netflix documentary. He is also the author of seven novels.

Tim Crews is a soil ecologist and lover of deep prairie roots at The Land Institute in Salina, Kansas. He is currently working to help expand research on the breeding and agroecology of perennial grains around the world.

Melanie Kirby has been keeping bees professionally for 27 years. The bees have taken her around the globe and introduced her to the broader concepts of agroecology, food systems, land stewardship, and creative cultural communication. She serves as the extension educator for the Institute of American Indian Arts in Santa Fe, New Mexico, and is the founder of Poeh Povi: The Flower Path, a collective of Indigenous matriarchs working to help regenerate wildfire- and climate-change-impacted areas in northern New Mexico. Follow online @ziaqueenbees

Rachael Leitnaker was born and raised in Ohio. This spring she moved across the country to start her first year in the New Agrarian Program, interning at Round River Resource Management, LLC., a custom cattle grazing operation located on the eastern short-grass prairie of Colorado. The seed of her interest in agriculture was planted in her as a young girl while living at her grandparents' cattle farm and spending her days outside and close to the land.

Lauren Manning, Esq., LL.M., focuses on the intersection of food, farming, and finance. She was a civil litigator before working in agrifood tech venture capital for seven years. She is an adjunct professor of law at the University of Arkansas School of Law where she also earned an LL.M. degree in food and agriculture law and policy. Lauren was a partner with Ozark Pasture Beef for nine years, raising and direct marketing grass-finished, holistically-managed beef and lamb.

Sean McCoy grew up in Arizona and has worked on ranches across the Southwest. In addition to this publication, he edits *Contra Viento*, a journal for art and literature from rangelands. Next spring he will be a visiting professor at Deep Springs College.

Joshua McKenna, raised in Colorado, developed a passion for livestock and agriculture quickly after entering the workforce. He works as an apprentice through Quivira Coalition's New Agrarian Program, further developing his skills and experience, and expanding his knowledge of food production: how it fits into our modern world, and the challenges it faces today.

Elena Miller-ter Kuile is a sixth-generation farmer working on the original lands of her Hispano ancestors; her farm, Cactus Hill Farm, still uses some of the oldest water rights in Colorado established in 1867. Elena raises sheep for grass-fed meat as well as value-added wool products, such as yarn and other products for fiber artists. Elena currently serves as a member of the Colorado Agriculture Commission.

Bill Milton and his wife, Dana, have owned and operated their current family ranch in Musselshell County, Montana, since 1978. In 2019, they were the first Montana recipients of the Aldo Leopold Award. More recently, Bill has participated as a rancher-member, and sometimes-facilitator, with several working groups in Central Montana, including the Musselshell Watershed Coalition and the Musselshell Valley Community Foundation. His practice as a Soto Zen Priest has helped inform and support his appreciation for our shared interdependence and the need to imagine solutions respectful of everyone's unmet needs.

Megan O'Connell is an ecologist and science communicator with a passion for community-led conservation. She has spent the last decade researching human impacts on ecosystem well-being in prairies, rainforests, and urban green spaces. She is also the program manager for the Carbon Ranch Initiative Program at Quivira Coalition.

Julie Bethaney Rakes is a postdoctoral researcher at the University of New Mexico, currently investigating the impact of compost on soil microbial communities. She has a background in soil microbial ecology, specializing in biocrust science and restoration.

Shantini Ramakrishnan builds capacity for New Mexican youth to lead the conservation of local landscapes through the Conservation Science Center, based at the New Mexico Forest and Watershed Restoration Institute. Since the Hermits Peak/Calf Canyon Fire, she has partnered with Luna Community College to establish the Wildfire Resiliency Training Center, which provides short courses and certifications in forest- and land-restoration, wildland and urban fire-fighting, and alternative livelihoods for post-fire communities.

Sam Schmidt is a New York City native who found his life's purpose in caring for land, animals, and people. He currently is a manager at San Juan Land & Livestock in Saguache, Colorado, with his partner, Noelle.

Eva Stricker is a microbial ecologist with dual appointments at University of New Mexico (research assistant professor) and Quivira Coalition (director of the Carbon Ranch Initiative). She enjoys putting her research and learning into action by helping restore and steward her dad's land in northern New Mexico. She also appreciates her city life, exploring Albuquerque from the Bosque to the Sandias.

Anica Wong is a journalist by training and has more than a decade of communications and marketing experience; she is currently the communications director at Quivira Coalition. Her great-grandfather and grandfather were part of a long line of vaqueros in northern New Mexico and her dad spent his entire career in the Forest Service working to help all people access the outdoors. She and her partner own an urban farm in the Denver-metro area.

SOULS OF THE SOIL

Microbes and Managers Helping to Restore Degraded Rangelands

Dr. Eva Stricker

Dr. Julie Bethany Rakes

Dr. Megan O'Connell

with photos courtesy of Eva Stricker

When Lucas looks across the northern New Mexico ranch that his family has stewarded for generations, he can see what could be. He'll point to a creek and show where he wants to divert water to restore productivity in a degraded pasture. He'll pull up the drone footage and explain how he mapped out contours to try keyline design using a Yeoman's plow he built at the Cruces Creative's makerspace. We'll drive to an upper pasture, and he'll point to where their souped-up bus/camper can sit beside an area that will be fenced to keep the deer out of their homestead garden. He'll point to a flat area and talk about friends who can camp out and share stories around the fire while their dogs snooze.

Lucas knows that this vision won't appear overnight, that planning and implementation take time, that seeing the effects of his actions takes time, and that there's no time like the present to start making changes to move the world toward his vision. As part of that planning, he has been engaged with two research projects that our team (Megan from Quivira Coalition, and Julie at the University of New Mexico, and myself, Eva, with a dual appointment) has been working on. We have been researching how organic amendments — such as compost, biochar, and mulch — might help jumpstart the restoration of degraded rangelands. Previous research has shown that organic amendments are promising for building soil carbon sequestration potential in rangelands (Kutos et al. 2023). Our team aims to understand two questions:

1) How might different compost microbial communities affect soil health and productivity?

2) How might mulch or compost amendments augment existing methods to restore degraded hydrological function?

Ideally, answering these questions can help Lucas meet his goals effectively and efficiently. If we understand which microbes are introduced and persist and what they are doing in the soils, we can provide land managers with guidance on which amendments and methods of application may best meet a producer's specific needs. So gather around the fire with me, Megan, Julie, and Lucas, and we'll share a couple stories about what we've discovered so far.

Our team is fascinated by how soil microbial communities, such as fungi and bacteria, interact to affect biogeochemical processes in drylands and how we can manage those communities to enhance range functioning. Microbes provide crucial services, such as nutrient- and carbon-cycling, and stabilize soil via their hyphae and excretions. At Lucas' ranch, some of the microbial communities are visible to the naked eye; photosynthetic lichens and colonies of cyanobacteria can be found scattered between plants. We also know that others, which we can't see, are living symbiotically with the plants, sometimes acting as parasites or causing disease, and sometimes acting as mutualists helping these plants access scarce resources. Although soil microbes continue to be studied across the globe, and momentum keeps growing for the use of organic amendments to build soil health, we still know relatively little about the impacts of organic amendments on dryland soil microbial communities, and in turn how these changes affect important characteristics like soil moisture.

Lucas and friends divert water to see how it will flow across the pasture before trying keyline design.

To answer our first question, we selected the types of composts that Lucas would be able to make or purchase locally. In rural northern New Mexico, manure- and food-based composts are the most readily-available options for producers and, importantly, we found that they have different chemical and biological characteristics. For example, the phosphorus availability in food-based compost is often lower than in manure-based compost, and food-based compost is home to far more rare fungal taxa (Figure 1) than compost made from manure.

Beginning in the summer of 2021, we applied a thin and consistent top dressing of both types of compost

to three small plots on a pasture at Lucas' ranch, as well as two other ranches in central New Mexico. We then measured soil health indicators, like aggregate stability (indicating resistance to erosion), infiltration rate of water into the soil, nutrient content, vegetation biomass, and community composition.

For small-scale experiments, a shovel and wheelbarrow ensure even distribution of compost in the study plot. This is not a recommended method for amending large areas.

After one year, we revisited the sites to resample our soil health measures and speak with the land managers about their observations of the plots. Interestingly, using state-of-the-art DNA sequencing to identify the bacterial and fungal communities, we found that native and compost-treated soils housed very different microbial communities than those in the composts alone (Figure 1). We also discovered that the microbial communities in the composts alone (both manure- and food-based) were more diverse, and rare organisms were more relatively abundant compared to the microbial communities in the native soils. Interestingly, many of the dominant microbial groups from composts did not persist in strong relative abundance after being added to the soil. After one year, the microbial communities of the compost-treated plots were similar to the control plots, suggesting that the microbes unique to compost were not able to colonize the soil to the same extent as the compost, perhaps due to competition from better-adapted native microbes, though this hypothesis remains to be tested. However, the total microbial biomass was over 50 percent higher in the food compost plots than in the control, with manure compost biomass intermediate between the two. This trend indicates that while the relative abundance of different microbial groups did not change dramatically, compost amendment did increase the biomass of microbes in the soil, which may lead to increased activity of the various functions that microbes play in the environment.

Zooming out from the microbial world to the responses of the plants and soil, we wanted to hear what the ranch managers noticed as well as see what our measurements showed. One manager from Armendaris Ranch noted that cattle were congregating on compost plots and preferentially grazing these amended locations. Zach Withers from Polk's Folly Farm noted that the compost plots "greened up" earlier, though on inspection, this effect was mostly due to small annual forbs, rather than desirable forage grasses. Still, in degraded rangelands, managers seemed happy to be building up soil cover regardless of plant functional group. Lucas also observed slower snow melt on compost plots compared to the native soil; we don't know the mechanism for why that would be the case, but it's a neat observation. In addition to these valuable anecdotal results, at Lucas' ranch, we found that not only did vegetation biomass increase by 155 percent, but infiltration rates were up to 200 percent faster on food-based compost plots compared to control plots. Here was some of our first evidence that organic amendments do address intersecting biogeochemical cycles of carbon and water in New Mexico rangelands. It's too early to tell if the increases we found in microbial biomass are correlated with the responses of plants and soil, but we're hoping that the second year of data we are currently collecting will provide clarity.

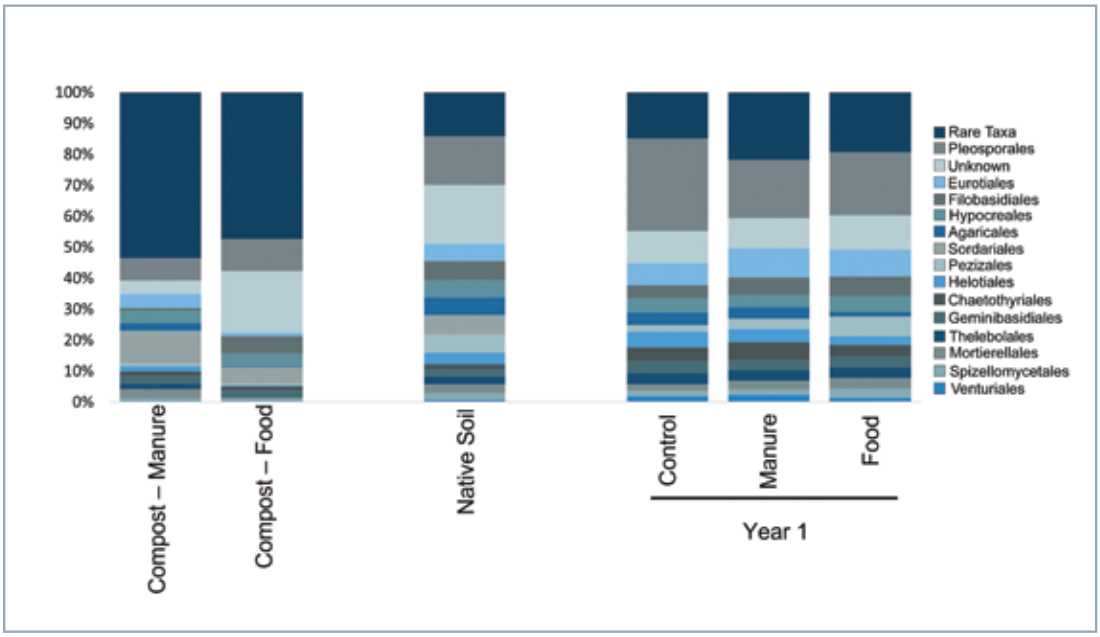


Figure 1. *Relative abundance of soil fungal communities grouped by order (remember the levels of classification of life? Kingdom, Phylum, Class, Order, Family, Genus, Species) in compost, in native soil communities prior to amendment, and one year after treatment.*

To answer question two (how can mulch or compost improve existing methods for restoring degraded hydrological functions?), we focused on Lucas' interest in redirecting water flow to reduce soil erosion. He showed us an area where erosion is threatening a major ranch road up a hill and other places where soil has been lost as headcuts creep up the valley. Monsoon seasonal rains in New Mexico sometimes provide up to 60 percent of a year's annual rainfall in just four months (July-October), meaning that dry and exposed topsoils are easily washed away, making this kind of erosion (sheet erosion), one of the top four management concerns for rangelands in New Mexico (NRCS CEAP-Grazing Lands). Erosion control practices are not new in the conservation world, but we wanted to view this problem as a soil health issue, because exposed and eroding soils cannot support viable plant communities, sustain healthy soil microbial communities, or effectively sequester carbon. Having investigated how organic amendments, like compost, can improve soil and plant community health, we wondered how organic amendment additions might improve erosion control outcomes to create lasting impacts on rangeland health.

We tested various soil amendment and seeding regimes alongside traditional rock-based erosion control structures on ranches throughout New Mexico, each experiencing erosion issues. Our objective was to ameliorate several active erosion zones on all Lucas' and the other four participating ranches using rock run-downs combined with organic amendment additions (mulch vs. compost), to find the optimal combination that quickly improves soil health while reducing erosion.

however, these projects are a step on the path of helping Lucas discover how best to reach his vision. Lucas and the other ranchers all mentioned that they would implement the rock run-down structures again in the future, and further experiment on their own with the best combination of amendments for their specific sites.

While this research has spanned institutions, years, and diverse domains of life, the human connections are what made the work most worthwhile. For the erosion control experiment, Quivira Coalition hosted a camping event work party where participants from New Mexico, Colorado, and Arizona came together to learn

A compost plot (number 308) uphill of the erosion control structure holding snow. Rock run-downs are particularly useful in erosion zones where headcuts, or a zone of steep, quick elevation changes cause water to move more rapidly downstream. By building ramp-like structures with stones, we can slow the movement of water through and reduce erosion. Note also the extent that silt has already accumulated in parts of the rock structure indicating that soil is held high on the land and not sloughing off downstream. Check out Quivira's erosion control technical guide for details.

Though our team is still in the throes of fully analyzing the myriad metrics measured in 2021 and 2022 from all five ranches, hopeful patterns are beginning to emerge for how amendments build soil health. Figure 2, for example, shows the (statistically non-significant) trend that the organic carbon content of soil increased and was more variable in the compost plots compared to the control plots at Lucas' ranch. The ranchers also noticed sediment accumulation in the rock structures after the first several precipitation events, and were pleased to observe that their soil was staying on the land — rather than being carried away downstream.

Scientific research is conducted with specific methods by people who care. Our methods are designed to keep us from reaching a conclusion that we "hope for." For example: because we have developed a relationship with Lucas, we want the time and effort that he contributed to building rock structures or adding compost to have a beneficial effect, and not to cause harm; but the preliminary data shows that responses are highly variable, and may therefore not be statistically significant. Far from being a failure,

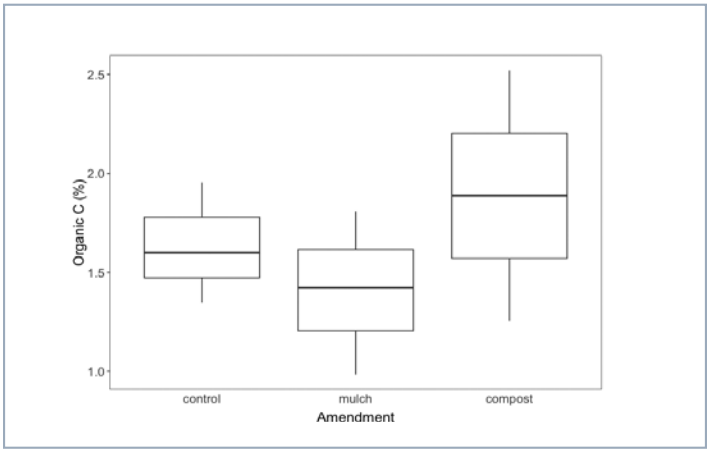


Figure 2. *Soil organic carbon content after one year of organic amendment treatments applied; differences between amendments are not statistically significant.*

Compost and mulch are great examples of how to make agricultural waste valuable again. This fireplace was another example of this concept because it was made out of an old washing machine.

about erosion control techniques by building structures like those mentioned above. Lucas' vision came to light as we sat around the fire getting to know each other and eating green chili stew made from local ingredients. At the end of the day, people shared how they might use what they learned on the lands that they steward, from building rock structures to thinking about starting to compost. This cycle of research, education, implementation, and sharing is what makes science human, and shows that everyone can be involved in learning-by-doing.

The future of healthy rangelands, soils, and ecosystems in the arid Southwest rests in the hands of those who manage them; work like this puts these managers on the frontline of discovery and the development of best practices. Like the spread of water through the soil column, we view each of our participating land managers as a conduit for the knowledge we have collaboratively grown, sharing it throughout their communities and fortifying the collective resilience-building knowledge in their region and beyond.

THE FEEL OF DIRT

Stanley Crawford

photo by igoriss / Getty Images Pro

I have farmed my two-acre plot of bottomland in the Embudo Valley of northern New Mexico, altitude 6,000 feet, since 1961, a little over 50 years. In the course of that time, I have repeatedly walked over every square inch of my land, kneeled on it, hoed and hand-weeded it, crawled over it. Plus tilled it countless times with both a tractor-mounted rototiller and a two-wheel rototiller. Mowed it. Manured it. Mulched it. Planted it in garlic, onions, shallots, winter squash, greens of all descriptions, carrots, beets, turnips, marigolds, zinnias, and cover crops of rye, buckwheat, Sudan grass, and millet. My land is an extension of the back of my hand. Though not registered as an organic operation, I farm by organic principles: no chemical fertilizers, herbicides, or pesticides. Or no herbicides or pesticides period.

My land is an extension of the back of my hand.

There could be no greater contrast than the huge wheat and canola station, or "farm," I visited some years back between Sydney and Melbourne, owned by the daughter and husband of my late Australian wife's best friend. At one point, my host, Charlie, took me to his massive John Deere on which were mounted spray booms that extended 70 feet to one side and the other. These he uses to spray Roundup on wheat that is emerging too early. It takes him eight days of spraying to cover the whole farm.

Charlie's farm and countless others like it serve the global food market. My market, the Santa Fe Farmers' Market, is 50 miles south of my farm. Occasionally, I mail a few pounds of garlic to customers around the country. In a good year, I grow about a ton of garlic, plus a few hundred pounds of onions. Diesel and gasoline use on the farm is negligible; driving my F-150 to market and back costs, at most, $100 a month during the growing season.

The world is largely fed by large agribusiness farms using what many consider to be unsustainable methods, which are both fossil-fuel dependent and environmentally destructive. Agribusiness is dependent on the low cost of fuel for both farm operations and global transportation; increasingly, the carbon footprint of agribusiness is coming under scrutiny.

About seven years ago, my little farm came into direct conflict with large agribusiness. In brief, with the help of a trade attorney friend, I filed an "Administrative Request for Review" with the U.S. Department of Commerce, asking them to review all Chinese garlic importers. The object of this was to subject the largest importer of Chinese garlic to import duties, which it had succeeded in evading for the past 15 years. In response, the importer, Harmoni Spice, sued my attorney and me for racketeering (in reality, a strategic lawsuit against public participation, a SLAPP suit). It dragged on for five years. Fortunately, we had Chinese allies who picked up the massive legal bills. We took our case to the Court of International Trade in New York City and the DC Federal District Court, but lost everywhere. The racketeering suit against us was finally dropped. The only good thing that came out of the exercise was my book, "The Garlic Papers: A Small Garlic Farm in an Age of Global Vampires" (Leaf Storm Press, Santa Fe; 2019). Also episode three, "Garlic Breath," of the first season of the Netflix series "Rotten," which was mostly filmed at my farm and the Santa Fe Farmers' Market.

My farm can't feed the world, but by the same token, it is not destroying the world through excessive fossil fuel consumption —

or marginalizing operations that can't or won't participate in the global agribusiness market. It's no secret, of course, that USDA crop subsidies enable commodity exporters to undercut local producers everywhere, leading to a flood of rural refugees trying to enter the U.S.

The U.S. farmers market movement began in the late sixties and took off in the 1990s. There are now close to 9,000 farmers markets in the country, with more being added each year. It can be fairly assumed that most farmers markets restrict sales to local producers, though no doubt some are lax in this respect. But the point is that farmers markets encourage local production and by doing so, help strengthen local economies and provide a degree of food security to their service areas — besides generally establishing a sense of community between urban shoppers and rural agricultural producers. Again, farmers markets can't feed the world, but they provide a more ecologically-sustainable alternative to the global agribusiness system, reducing fuel dependence and supporting smaller farmers who are more likely to eschew the use of pesticides. I have often argued that if consumers paid the full price for gas or diesel that includes the externalized costs of pollution (say, $25 a gallon), then I could easily compete in price with Wal-Mart and the big box grocery chains. Similarly, if the government subsidies supporting low commodity prices and petroleum production were instead directed toward small, local producers and farmers markets, we would see a massive change for the better.

I have often argued that if consumers paid the full price for gas or diesel that includes the externalized costs of pollution (say, $25 a gallon), then I could easily compete in price with Wal-Mart and the big box grocery chains.

Hypotheticals aside, there are some real cracks in the agribusiness monolith. Food stamps, whose official name seems to change every year, can now be used at most farmers markets, after a long period when, having gone digital, farmers had no way of accepting them. There has also been an increase in USDA programs benefiting small farmers; a few years ago, the USDA Natural Resources Conservation Service paid for a large part of a major irrigation project on my farm, which included a 10,000-gallon storage tank, a new pump and filters, and underground feeder lines. The Santa Fe Farmers' Market Institute, a 501(c)(3) extension of the Santa Fe Farmers' Market, offers a microlending program, which I have used several times to expand my photovoltaic system, rebuild an attached solar greenhouse, and buy a four-row automatic garlic planter from Poland.

Small farmers have also seized on innovations to increase yields and extend the growing season — such as drip irrigation, unheated hoop houses, and heated greenhouses — to the point that the Santa Fe Farmers' Market never closes (except on Christmas and New Year's weekends). Its permanent site on the Railyard in Santa Fe, which includes a large interior market hall, upstairs office space, and downstairs retail spaces, was funded through municipal, state, federal, and foundation grants, and numerous individual contributions. A relatively small mortgage remains on the multi-million dollar facility. It stands as a testament to a community's willingness to invest in small-scale local agriculture. Big ag is not yet quaking in its boots, but rumor has it that the Santa Fe Whole Foods moved to its current location next to the Railyard because of the farmers market.

As I survey my various small fields of garlic every day to assess their progress toward maturity, I am hopeful, encouraged. True, I live in the largely benign bubble of the Embudo Valley, enclosed in turn by the larger bubble of much of northern New Mexico. There are flaws, there are problems — mainly the high price of land for younger farmers — but one does what one can to provide a model for how it might be done more widely. Three of my former farm interns from UMass/Amherst and Colorado College have taken up farming.

The appeal of feeling the dirt, soft and spongy, underfoot, the feel of it to hands while weeding, crouching along a foot at a time, is perhaps universal, at least to those who have not become too urbanized to feel more than hard, slick surfaces.

I hope I will never lose that sense.

Image by DAPA Images / Canva Pro

WHEN THE LAND CALLS YOU BACK

Melanie Gonzales and Her Journey Through Soil

Anica Wong
with photos by Megan O'Connell

Melanie Gonzales holds soil found on the campus of Southwestern Indian Polytechnic Institute.

For Melanie Gonzales, the soil is the beginning and middle of her story. It has strung all of the chapters of her life together and will play a role in how the rest of her story unfolds. And she's hoping to help others see how soil health ripples across people's lives, cultures, and the environment so that they will have a vested interest in making soil part of their story as well.

Gonzales' family has lived in Corrales, New Mexico, for about 300 years; her dad's side is Spanish and her mom's side is part of the Choctaw Nation of Oklahoma. Her family members were farmers and ranchers, people deeply connected to the earth. From a young age, Gonzales picked wild asparagus along the Rio Grande, and drove a truck out in the field while the rest of her family loaded bales of alfalfa into the back — a common memory for many in rural New Mexico and other southwestern states.

"My grandma Josie, who lived with us, was in the garden every day during summer," said Gonzales. "She taught me how to hoe the rows, add manure, sow seeds, water and take care of them. My first crop was carrots. I was about eight years old and so proud of my little funny-shaped, but tasty, carrots. I still have my grandma's straw hat she always wore and think of her teaching me."

Gonzales' background and culture predicted that she would find herself in the agricultural world somehow. Life decided otherwise. She became a single mother who put herself through school to become a vascular sonographer. It was a good job, but it was hard on the body, especially during the COVID-19 pandemic. As she started to experience musculoskeletal problems, she realized that she needed to pivot. And the land called her back.

She wanted to take a look at the whole picture, to see where everything starts and understand how to support life from the ground up — literally.

"Land is a living, breathing entity. And that's something we need to help nurture as it nurtures us," Gonzales said. "As I'm growing older, I'm seeing things change. I've had the experience of what Corrales used to look like, [what] the bosque used to look like, [what] the river used to look like. I just think we have a great opportunity to start making changes here at home, and then we can help even further out."

At the age of 48, Gonzales enrolled in the natural resources management program at Southwestern Indian Polytechnic Institute (SIPI) in Albuquerque, New Mexico. She took various courses in biology, soil health, and sustainable agriculture. She liked the narrow focus of certain classes like Fish and Wildlife, but she wanted to take a look at the whole picture, to see where everything starts and understand how to support life from the ground up — literally.

In another one of her classes, Gonzales was tasked to come up with an agricultural management plan for a particular field on SIPI's campus. At the time, it was a bare field with exposed soil and very little vegetation growing on it. Her goal was to understand how it had gotten to that state and create a plan that would bring it back to life.

"I started interviewing the people that had the history of it and realized, in the past, that it was actually an alfalfa field where they also grew corn and all kinds of vegetables. Local tribes would be able to get this produce. And the students would be out there learning to work the land, learning what good soil health is, and how to keep the soil covered," she said. "And it's just gone downhill since then."

The plot, which is about 40 acres, also used to be a huge habitat for sandhill cranes, providing a spot for community members to bird watch. Now, in its bare state, it's become an eyesore when you first enter the SIPI campus.

This project became a big part of the middle of Gonzales' story, as a student and advocate.

"Where do we start, down to the microbe, to the soil, to get to that food sovereignty?"

—Melanie Gonzales

"I did the work for the class, but then I became really passionate about recognizing the decline. It's time to get back to the land again, get it back to being healthy," she said. "We need to do our part, especially as native people. For many of us, it's so important to take care of our land and be one with the land, and we're not doing that here."

Gonzales took soil samples from the field for lab analysis. With that data, and guidance from Quivira Coalition's Carbon Ranch Initiative team, she created an agricultural plan to update and improve the irrigation system, improve soil health with cover crops, and reduce the invasive weeds. She also hoped that some of those migratory birds would return, in response to increased habitat, if she was successful in implementing her plan.

The next step became the biggest hurdle — getting SIPI to consider the work she was proposing. She was up against an academic institution that didn't have soil health at the forefront of its priorities. This frustrated Gonzales because SIPI, one of 37 tribal colleges and universities in the nation, is also a land grant institution, a type of school that was originally designated to focus on agricultural and science education, starting all the way back in 1862.

Photos top: Land on SIPI's campus that was once sandhill crane habitat. Photo bottom: Melanie measuring the soil infiltration rate on SIPI's campus. The infiltration rate is a measure of how fast water soaks into the soil.

"That's one of the reasons I got so passionate about it. In looking at SIPI's mission statement, they're not living up to that," she said. "A lot of our ancestors were put on reservations in places where nobody wanted that land. And now we're not being good stewards of this land, and we're not setting a good example for the rest of the tribal community and the community around us."

Gonzales believed SIPI should be invested in soil health, down to the microbe level, nurturing the building blocks of a healthy planet. But how do you bring together the facilities department in charge of a large campus, the natural resources department — which is trying to provide educational opportunities for students, like Gonzales, to make a difference in the natural world around them — and the always busy president's office in such a way that they can successfully collaborate around a plot of so-called dirt?

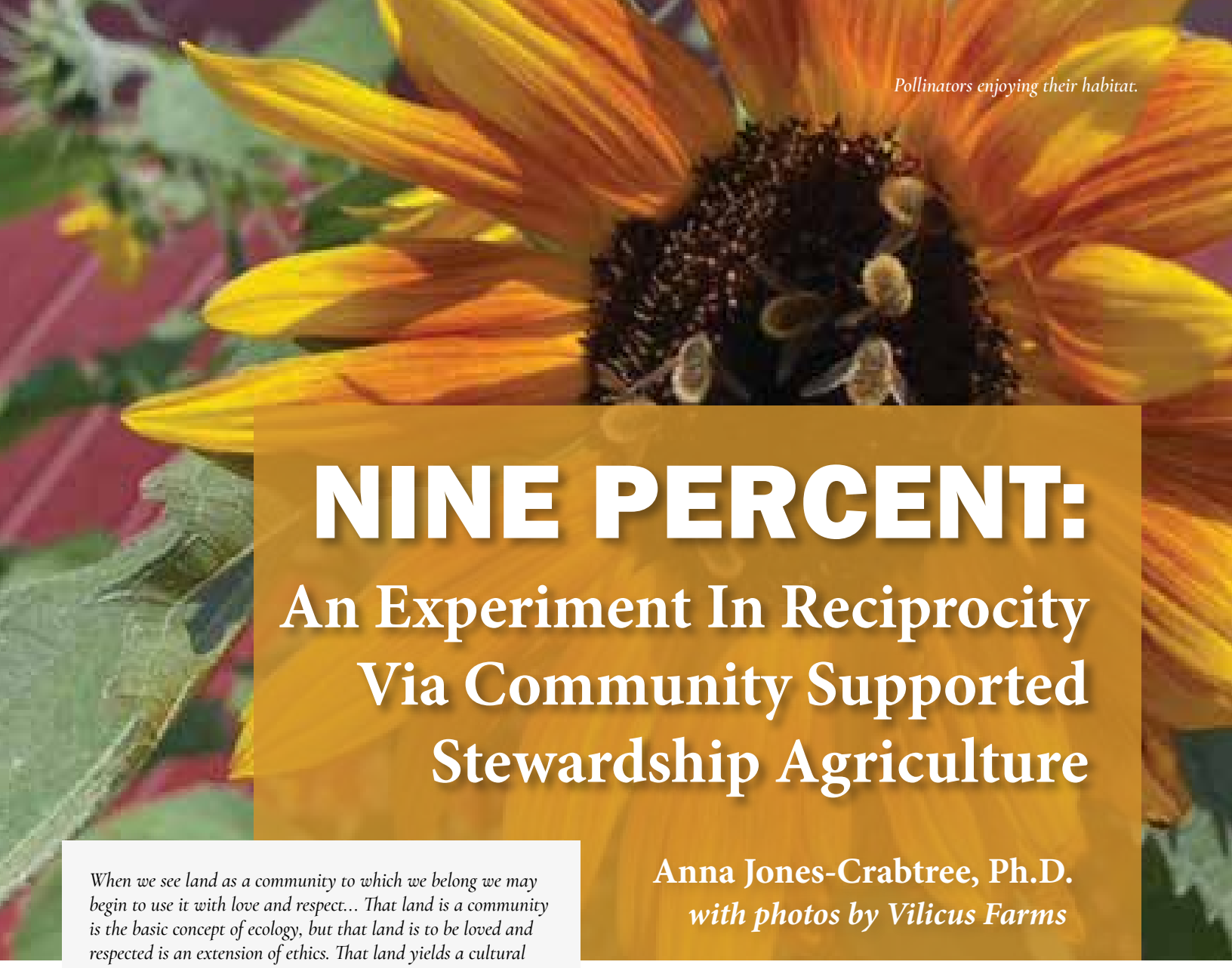
Throughout this process, Gonzales had to deploy a lot of the soft skills that aren't often highlighted in conversations about science and agriculture. Yes, she spent time in the lab analyzing samples. But she also spent a lot of time meeting with people, offering presentations of her proposal, and utilizing language that helped the lay person understand why the health of the soil is important.

One of the unexpected positives that came from creating this agricultural plan was the experience of collecting soil samples with her Indigenous classmates who might not have as many connections to the land as Gonzales.

"One of my classmates is Cheyenne but she didn't grow up on the reservation, she's urban," said Gonzales. "Yes, we all share the essence of Mother Earth, we are one with everything in nature and that is reciprocal. But some of my classmates haven't been able to put that into practice. This specific classmate is interested in food sovereignty but hasn't had a chance to learn the basics of it: where do we start, down to the microbe, to the soil, to get to that food sovereignty? From there, they can learn that they can make a difference, when individuals come together with other natives, and work together to have a voice."

Gonzales is still very much in the middle chapters of her story. She graduated from SIPI in the summer of 2023 but has been asked to make a presentation of her agricultural plan to SIPI's administration. She is going on to the University of New Mexico to continue her education. And while she doesn't know exactly what her future in agriculture or natural resources looks like, she does know that so much of what she learned by creating the agricultural plan at SIPI will be utilized on some of the same land that she grew up on.

"I've already started taking what I've been learning through this process and [begun] to evaluate my family's land," she said. "As I continue with my career and, eventually, as I live there and take care of that land, I want to also have that for my children. It's very personal in that sense, too, because I'm taking everything I've learned to the land that my family's had for 300 years."



Pollinators enjoying their habitat.

NINE PERCENT:

An Experiment In Reciprocity Via Community Supported Stewardship Agriculture

Anna Jones-Crabtree, Ph.D.
with photos by Vilicus Farms

When we see land as a community to which we belong we may begin to use it with love and respect… That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known, but latterly often forgotten.

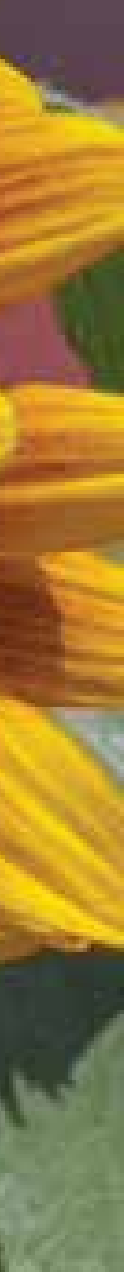
—Aldo Leopold

Ecological restoration is an act of reciprocity, and the Earth asks us to turn our gifts to healing the damage we have done. The Earth-shaping prowess that we thoughtlessly use to sicken the land can be used to heal it. It is not just the land that is broken, but our relationship with land. We can be partners in renewal; we can be medicine for the Earth.

—Robin Wall Kimmerer

Nine percent. That was the percent of our average annual crop production our farm harvested in 2022. No matter how you measure it — pounds, bushels, or kilograms — it wasn't enough. We harvested less seed than we planted. And we thought 2021 was bad, at 34 percent of our average production. Welcome to life on a planet with an unstable climate. Is a good year possible anymore?

The answer is uncertain because organic regenerative farms are not businesses. They are living, breathing organisms. Like diminishing coral reefs and polar bears, the ability for any one farm organism to be resilient is increasingly challenged (even overrun) by circumstances outside its control. Inside our farmgate, we do all we can on a daily basis "to withstand or to recover quickly from difficulties; [and display] toughness," which is the definition of resilience according to the Oxford Language Dictionary. Toughness isn't our problem. Most people don't have half the chutzpah we do. Our challenge is that reciprocity is not in the equation for success outside of the farmgate. Planetary care isn't included as part of the profit-and-loss statements in our world at large, where selling more and better products is the sole mechanism to recover from difficulties. What happens when you still did all the work but there isn't anything to send out to the world? This increasing risk — of working without guaranteed income — is probably why less than one percent of our population attempts to make a living from production agriculture, and less than one percent of our agricultural land is farmed under an organic system of management. Organic regenerative farmers know that overstepping



nature's gifts of sunlight, soil, and seeds puts us and our planetary system in peril. Few others fully understand the conundrum this presents to those of us doing the work: how to support ourselves economically, while simultaneously supporting the earth beneath our feet.

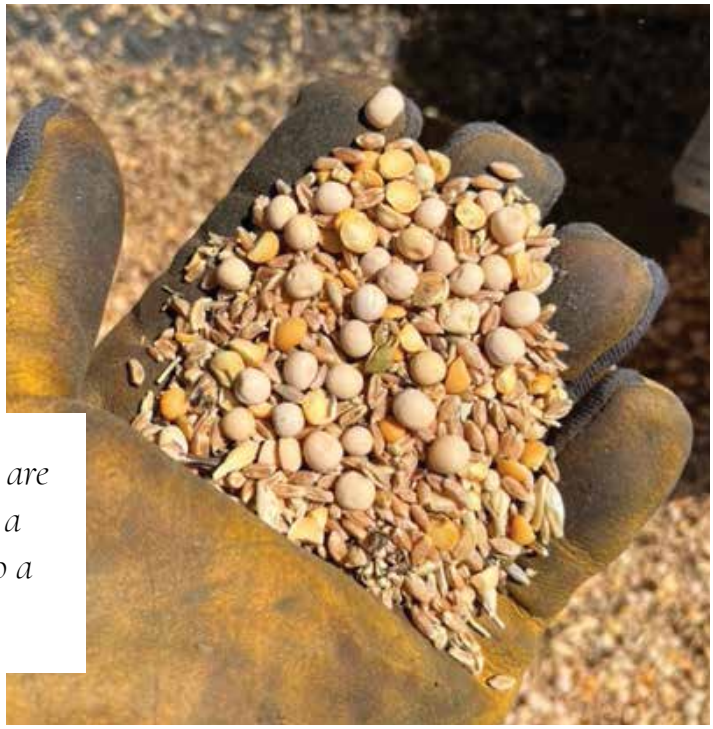
The regenerative community's approach to building resilience has too often been focused exclusively on soil health. This isn't wrong, but this focus alone ignores the larger impacts of our economic circumstances, which are becoming more precarious due to climate variability. The myopic focus on soil health alone can come with an unspoken assumption: *If farmers just do all the right ecological things, supportive economics will follow. The right farm practices lead to a direct increase in production and higher markets.* Inherent to this assumption is the idea that there will always be production; therefore, it lets everyone else in our food and agriculture system off the hook for fundamental change. Consumers keep buying beautifully-packaged products to improve their health, and profits stay with the retail stores. Processors add their standard mark-ups to higher-priced goods and reap the benefits. Financers amass returns on impact loans, as they only work on projects that assure repayment. In other words, everyone is paid except the farmer — no matter how much it rains.

We have failed to recognize that our farmers are stuck in the impossible position of nurturing a cycle of life, while also forcing that cycle into a capitalist system of extraction.

Our society asks its farmers to carry the outsized burden of ecological repair, and pay for the privilege of doing it. Collectively, we have ignored the fact that a farmer can't build life-giving soil on quarterly profit reporting cycles; we have failed to recognize that our farmers are stuck in the impossible position of nurturing a cycle of life, while also forcing that cycle into a capitalist system of extraction. Business decisions are driven by the rules of the broader United States Department of Agriculture and Farm Bill support structures, which underpin non-organic agricultural operations — rather than what makes sense ecologically or agronomically. Crop insurance requires putting what you can in a bin, so you go through the motions of harvest. Subsidies diminish and USDA farm programs become more complicated when choosing biodiversity as a guide, growing 20 things instead of one or two. Unlike the relationships between our cover crops and cows and our team here at Vilicus Farms, our economic relationships are not very reciprocal. This is because they are not real relationships; they are transactions that ignore the realities of what the land can sustainably provide, and the well-being and capacity of the people doing the land care.

Achieving planetary ecological resilience is dependent on creating new methods of relating to each other — specifically, I am talking about methods that more equitably distribute and share the risks and rewards in our unstable climate. What if building resilient relationships based on our care for each other became the basis for our economic transactions? Could that be a mechanism for shifting us into an economy based on reciprocity and investing in our shared future? How can our economic relationships mirror the transformative give-and-take relationships that happen everyday in our ecological systems?

As first-generation farmers with 15 seasons of experience, my husband Doug and I have concluded that for agriculture to work



A recent harvest on Vilicus Farms.

better for everyone (farmers, eaters, soil, wildlife), the long-term service-work of land stewardship must be decoupled from the income stream of annual farm production. In years where climate change impacts our cropping, we have still done the work of stewardship and incurred the expenses associated with providing that service across our 12,508 acres. Cover crops were still planted. Cattle were still grazed. Pollinator habitat was still planted and maintained. People were still paid to make all that happen.

Over the last five years at Vilicus, after we compare our expenses against our income (including that derived from crop insurance, conservation payments, and subsidies), we have, on average, a $22-per-acre gap. We don't have an expense problem. Neither Doug nor I take a salary. I work an off-farm job, like at least one partner on 80 percent of farms. The revenue from the farm pays for our cell phones, some utilities, and a few groceries. That's it. We have the privilege of taking care of a land base that is worth close to $12 million. A 2020 estimate of the social cost of carbon (which is an estimate of the economic costs, or damages, of emitting one additional ton of carbon dioxide into the atmosphere) embedded in our cropland was $16

million. That's not including the value of our pollinator habitat, our biodiversity, or the hours we've put into the education of apprentices. If we were managing some financial asset fund of equivalent size, you can be sure we'd be well compensated.

After much research, one idea that seemed promising to deal with our economic-gap situation was the concept of ecosystem service payments. Surely we could be paid for the nature-based solutions we employ everyday, such as sequestering carbon or enabling biodiversity. After all, people are buying credits to offset their carbon footprint when they board an airplane. But when we attempted to find purchasers, we were told that our diverse and multifaceted operation was "too complex to model," and therefore the measurement and verification of the quantity of services wasn't worth the potential payments.

Pollinator habitat on Vilicus Farms.

There seemed to be no ready-made solutions to our economic-gap challenge. As a food producer, I want to tell you that funding is like the cloud formation virga. Virga is defined by the National Weather Service as "streaks or wisps of precipitation falling from a cloud but evaporating before reaching the ground." You see it on the horizon, and sense it's there, but the money doesn't reach the ground and the people doing the work.

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report defines resilience as "not just the ability to maintain essential function, identity, and structure, but also the capacity for transformation." If resilience is about creating this capacity for transformation in the face of adverse circumstances, perhaps we could close our gap by cultivating more transformative relationships. Most of our population has no direct connection to agriculture. The community of people engaged in land care that is integrated with food production should be global. This belief sparked a question: if we provided an opportunity for more direct ways to participate in and understand what it takes to produce healthy food and thriving ecosystems, would that lead to greater understanding and appreciation of the actual work of land stewardship, and in turn benefit the stewards?

In 2022 we launched our Community Supported Stewardship Agriculture (CSSA) program as a solution to this problem of participation — a way to surround our farm with more intimate and powerful support for the daily stewardship work we undertake, regardless of crop production or climate conditions. Inspired by the successful history of the Community Supported Agriculture movement, it works like this: instead of members purchasing a share of farm produce (thereby pre-financing and stabilizing the farm's planned income from the sale of food, regardless of production), our members specifically pay to support the farmers' labors of land stewardship (this makes the nature of our relationship more explicit, and changes its narrative). Essentially, our members pre-finance what's needed to take care of the land, regardless of production. In return, they become part of a community rooted in a relationship that more deeply understands an organic, regenerative farm, and the work it entails. As we grow our direct-sales capacity, our CSSA members will have first dibs on buying the production off the farm. We have essentially decoupled the income stream of the farm from a sole reliance on food production. Our CSSA members understand the true cost of the stewardship behind their food and its impact on the land.

We have calculated $100 per-acre as the annual cost of our land stewardship practices, which include: planting and maintaining pollinator habitat, caring for cattle in hot and arid conditions, intentional crop planning and farming practices (which prioritize building soil health over profit), and nurturing our small community of fellow humans in this part of the country, where you encounter fewer than five people per square mile. Our shareholders allow us to continue prioritizing what matters most to us and them, and keep us in business, though climate variability persists. Our CSSA is about creating a new economy grounded in reciprocity and relationships.

The drought in north-central Montana isn't over. Our economic gap hasn't magically been closed. But we are in this for the long run, and one year later we have 65+ CSSA shareholders from the Netherlands to New York to California, each of whom is also in it for the long run at our side. In return for our work of stewardship, they provide money, which is as important as water, sustaining life and hope. Although shares currently support stewardship on only a bit over one percent of our acreage, our members continue bringing others into this circle. Nature starts small with seeds. We follow her lead. Together we hold space for an ecological-based food-and-farming system, in which every farm thrives and therefore so do you.

One acre, one relationship, one seed, one hundred dollars, one bucket of water at a time.

We invite you to join us. Our CSSA website can be found here: vilicusfarms.com/cssa

CATALYZING NATURAL SYSTEMS IN THE SAN LUIS VALLEY

Sam Schmidt

For many first-generation ranchers and farmers, agriculture has an ethical draw. Growing up in New York City, I had no connection to agriculture through family or community; rather, it was the desire to undertake purposeful, meaningful work that brought me to where I am today: San Juan Land & Livestock (SJL&L) in the San Luis Valley of Colorado. Prior to my arrival here, I saw agriculture at the confluence of so many social, political, and environmental ills that we grapple with as a society, and speculated that — perhaps naively — it could thus offer potential solutions to these problems.

While all of this still rings true, the more involved I am with the realities of sustaining a ranching business, the more I find myself weighing what feels good — or is exciting from a values perspective — against what is practical from an economic perspective. In a nutshell: I want to push the envelope in terms of ecological benefit and at the same time create a sustainable business model. This is the challenge for regenerative managers everywhere, but these two goals needn't be mutually exclusive. To that end, at SJL&L, we are always looking for levers we can pull to catalyze natural systems and (hopefully) produce cascading and compounding benefits to ecosystem health (thus overall production and resilience on the ranch) — all while maintaining low costs and improving the bottom line. Our efforts toward achieving these ends start small, with experiments designed to show potential benefit while avoiding large capital investment as a hedge against lackluster results.

To understand the details of some of these projects — all premised on the interconnectedness of the health of an operation's land, livestock, and balance sheet — it's important to explain the ecological context of our ranch. We are located at the northern end of the San Luis Valley, a high desert steppe environment that receives only seven inches of precipitation in an average year. The growing season is short, from May through August. Given the natural aridity, much of the agriculture in the valley relies on groundwater for irrigation. After decades of heavy pumping in the valley without sufficient recharge (due to the adoption of high-efficiency sprinkler irrigation), the aquifer has been significantly depleted; a decade or so ago, a court order mandated that the aquifer be returned to 2002 levels, or an increase of at least 400,000 acre-feet, with the onus on valley irrigators. This led to the formation of sub-districts within the valley to create and enforce sustainability plans for the aquifer's rehabilitation. One of the main tools employed by sub-districts to curtail over-pumping is the pricing of every acre-foot pumped, with a punitive increase in that price for water pumped above an operation's surface water credit. Despite these efforts, little progress has been made toward the rehabilitation of the aquifer, with a 2031 deadline looming. If voluntary approaches prove ineffective, San Luis Valley water users are looking at state-mandated groundwater use curtailment and/or cessation.

Mentor George Whitten shows apprentice Sam Shmidt the ranch. Photo courtesy of San Juan Ranch.

Here at the ranch, we rely on groundwater pumping to produce enough winter feed for our cows. Over the past few decades, George Whitten and Julie Sullivan, my mentors and the owners of SJL&L, have utilized a combination of careful water management and creative forage production strategies to mitigate the ranch's water use. For example, rather than baling the hay, we rake our windrows into piles, which we leave in the field and dole out to the cows throughout the winter, using temporary electric fence to control their access. Through the cows' consumption of the hay piles, and the inevitable deposition of their manure and urine back onto

the fields from which the piles were cut — a consistent cycling of nutrients into these meadows — we have fostered a vibrant and thriving underground ecosystem. This has paid major dividends: most pertinently, increasing the water-holding capacity of our soils. In a present where water has a real economic cost, and a potential future where groundwater may be severely limited, this emphasis on doing more with less water is critical to the viability of the ranch. This technique also requires significantly less machinery to produce and feed hay, further reducing our carbon footprint.

Over the last year, we've trialed three new approaches to improving soil health in our meadows, taking the same slow, experimental approach. Patience can be frustrating at times, but it is essential. While each trial is distinct in terms of specific mechanisms and intended outcomes, they are all predicated on the same general assertion: through improving and sustaining microbial diversity below ground, we can benefit several key production metrics to this operation, namely: (1) water-holding capacity, (2) forage quality and quantity, and (3) reduced reliance on fossil fuels and machinery.

Sam and a colleague fix a float valve on a cattle tank. Photo by Taylor Muglia.

Our "cut-and-pile" method is important not only because it provides substantial cost savings, but also because it confers a competitive advantage to the ranch economically. If we can run a cow more cheaply during a time of year when feed costs are typically high, that translates directly into greater profitability from our cow herd. This doesn't exclusively apply to our own herd, either; dormant-season custom grazing of other people's cattle is one of our most profitable enterprises. What we charge for managing other people's cattle during the winter is significantly higher than the going rate for summer grazing, but compared to the price of hay, it's a major cost-savings for our clients. Furthermore, given the low labor demand for this kind of winter feeding compared to feeding hay bales, the costs associated with this enterprise are minimal, which improves the margin on this enterprise even more.

While the "cut-and-pile" method has become a foundational ecological and economic practice for our ranching operation, it wasn't a given from the outset. The method was trialed on a small acreage at first, and, over time, replaced the conventional hay production on the ranch. Because it's not a one-size-fits-all strategy, it took multiple seasons of trial and error to figure out how the approach could be effectively applied to this particular operation in this particular ecosystem, and to prove the hypothesis that it would improve the ranch's ecological and economic bottom lines.

Natural systems have evolved for millions upon millions of years to carry out the same tasks that modern agriculture has replaced with chemical and mechanical solutions. Our intention here is to catalyze the former in order to avoid the latter; if we can support healthy and functional energy-, nutrient-, mineral-, and water-cycling through improving the biological systems that naturally fulfill those roles, we can reduce or even eliminate the need for external inputs. It's worth noting that I include time as an input as well. The way I see it, there is a significant opportunity cost to trying to replace the jobs that soil biota carry out with human effort. Every hour spent in that capacity is an hour that could have been spent observing and managing the whole system, which is what our roles as humans should be.

We devised three trials to elucidate strategies to move us toward our goals. Each focuses on plant diversity, the bacterial-to-fungal ratio of the soil microbiome, and biological decomposition, with the intention of producing cascading, system-wide improvements through single, or at least infrequent, application.

Interseeding: Our first trial was to interseed our native meadows with non-native yet well-adapted plant species that could increase overall diversity and forage production. An increase in diversity of grasses and forbs corresponds to an increase in root structures,

and thus, more diverse habitat for below-ground life. Furthermore, introducing well-adapted varieties can improve forage production and quality without necessitating the use of more water or fertilizers, making the system efficient from a ranching perspective. Using an ATV-mounted broadcast spreader, we seeded Garrison Meadow Foxtail (a water-loving, rhizomatous grass), AC Saltlander (a saline-tolerant hybrid of bluebunch wheatgrass and quackgrass), and a variety of legumes (including birdsfoot trefoil and falcata alfalfa) into our meadows last November. We took advantage of the trampling effect that occurs when strip-grazing cattle on hay piles; these seeds were incorporated into the soil via hoof power, that is, without the use of heavy and costly machinery. This project was funded through Colorado's STAR Plus program, which offers matching grants for soil health-related projects. This allowed us to implement the experiment without the risk of paying completely out of pocket. Through forage monitoring, and the comparison of grazing records from before and after seeding, we will document any changes in plant composition and forage production. We'll also do economic analyses on our winter forage production and winter-feeding enterprises to chart how much value the initial investment in seed creates over time. Our hope is that after this initial seeding, these species will self-perpetuate and spread, supported by our grazing management, so there will be no need for further seeding in the near future.

Natural systems have evolved for millions upon millions of years to carry out the same tasks that modern agriculture has replaced with chemical and mechanical solutions. Our intention here is to catalyze the former in order to avoid the latter.

Compost spreading: Through grants provided by Zero Foodprint and the LOR Foundation, we were able to spread Johnson-Su bioreactor compost onto approximately 50 acres of meadow. This static, highly fungal compost has been shown to profoundly improve a variety of soil health metrics, including water-holding capacity. According to soil health experts, such as Dr. Elaine Ingham, a primary culprit/expression of soil health degradation is the combined lack of fungi and the proliferation of bacteria, especially in perennial grasslands. We spread the compost at approximately 250 pounds-per-acre on one of our most productive areas, as well as a field (newly under our management) that has been historically continuously grazed. In the productive field, our hope is to improve our forage productivity while further reducing the field's total water requirements. In the less productive field, our hope is to jumpstart the soil biology and to accelerate the rate of improvement in land health beyond what we would see from simply changing our grazing management. Similar to the interseeding project, we will use soil tests, grazing records, and forage production data to compare the trajectories of the treated meadows to similar fields where compost has not been applied.

Effective Microorganism (EM): Given the aridity of our environment, the decomposition process for organic material is primarily one of oxidation, rather than biological digestion. Instead of being digested by microbes, fungi, or insects, manure breaks down due to weathering from the elements — a process that can take years in certain places. This process is particularly slow for manure pats deposited in the winter; by the time soil biology wakes up from its dormancy, the pats have dried out and are no longer biologically active. At SJL&L, this poses a problem in our irrigated meadows. Due to our strip-grazing method over the winter, lots of cow manure is deposited on these meadows in high density. Left as they fall, these manure pats can stifle plant growth in the spring. Historically, our solution has been a mechanical one: every spring, we drag our meadows with a harrow that breaks up the old manure without disturbing the soil below the surface. While effectively breaking up the manure, this practice relies on firing up a tractor and burning diesel, which can be costly in terms of fuel, wear and tear on machinery, and labor — as well as potentially compacting the soil. In exploring an alternative to this practice, we stumbled upon Effective Microorganisms, a biological preparation derived from the Korean Natural Farming method. Essentially a variety of lactobacillus microbes and yeasts, these Effective Microorganisms accelerate the breakdown of organic matter. We started small, leaving approximately one half acre un-harrowed as our trial plot. Then, using an ATV-mounted spray rig (available at any farm supply store), we applied the EM to that one-half acre and the adjacent one-half acre where manure had been broken up using a harrow. Through photo-point monitoring, we'll monitor the decay of the intact manure on both the treated side and the untreated side, and hopefully show that this biological input can be a lower-cost alternative to our current mechanical approach.

For each of these projects, the decision-making and implementation framework was the same: (1) identify areas where intervention could produce significant and long-term benefit to the ranch by leveraging biological solutions to problems; (2) design an experiment where the efficacy of the intervention could be measured; and (3) implement the experiment on a small enough scale and with creative funding so that the financial risk is not carried entirely by the ranch.

While these are all exciting projects and will hopefully benefit the ecological and economic bottom lines of our operation, it bears mentioning that, although input-driven approaches have their place, in my opinion they should not, and in fact cannot, serve as a strong foundation for a truly resilient agricultural operation. As humans, we are innately drawn to "silver-bullet" solutions, telling ourselves that if we just buy this new product, plant this new variety, or use this new piece of equipment, our problems will disappear. This reductionist trap threatens regenerative operations just as much as conventional ones; spreading expensive compost and buying seed isn't going to do much without good grazing and water management. Management, not a medley of inputs, is the real lever that ecologically-focused agriculturalists can use to improve ecosystem health and an operation's bottom line. Used judiciously and intentionally, and ground-truthed through safe-to-fail trials — as I believe we are doing on our operation — prudent inputs have a place in regenerative agriculture. Just don't forget the cows!

RESILIENCY: IT'S NOT ABOUT YOU — OR IS IT?

Bill Milton
with photos by Moria Perez

Region of the Milton Ranch the family calls 'Little Switzerland.'

Bill with his working dogs

As owner-manager of Milton Ranch, I try to cover the basic ranch chores on holidays to let our apprentice and employee enjoy themselves and celebrate. Today is July 4th and I have been covering since the 2nd. I am hoping for a smooth morning cow move so I can enjoy a relaxed late-morning breakfast, as is my routine. Ever since the ranch agreed to be a host for the Quivira Coalition's New Agrarian Program four years ago, having a highly motivated, young, regeneratively-oriented human being at my side has propelled our grass-based cow-yearling enterprise to adopt daily moves. This allows the ranch the opportunity to leverage the power of stock density and long recovery periods, which builds resiliency into our soil and plants, and by extension, our family business.

Before I can begin the chores, I need to head to town with my visiting daughter to lead a 4th of July Bird Walk at our river park. So, chores will start with some delay. And before that, I will sit with my adopted Zen sangha for 30 minutes following my daily 108 bows.

❖

The primary reason I took on the challenging request to write about resiliency is that I realized I am not sure I know what it is, or even what resilience looks and feels like in action — in real time.

❖

I return from a lovely walk with nature-minded folks to commence with the chores. I move the cow mob: check. Then I arrive at the yearlings, ready to move their temporary fence: lo and behold, there is a bull. Yikes. Fuming, I know that on foot I cannot expect to separate this lone bull from 150 heifer-yearlings and trail him three miles back to the

corrals. In a fit of vented fury, I leap out of my truck — leaving it running with my working dog inside — and holler at the errant bull. Surprisingly, the bull responds by heading in the right direction: away from the heifers and toward the long path home. I follow on foot in pursuit, wondering if luck, divine intervention, or maybe a touch of stockmanship might have aligned for a best possible outcome. After calmly walking through three one-wire electric fences, the bull and I arrive at the group of grass-fed dries where there is now another bull. Together, we walk to the corrals, despite the new bull's determined efforts to hold the cows in place. With utmost forbearance, we reach our destination. I catch a ride back to retrieve my still idling truck.

This is a simple, silly story — yet real and likely relatable to many. Certainly not the exception to the rule, but rather the rule itself. I could share darker examples of things gone awry, but the main question is: how do we manifest an appropriate response in the moment when faced with chaos, uncertainty, and even anger before additional harm is inflicted on ourselves or others? What is it about our behavior and conditioning that allows for a resilient response to potential disasters that arise so frequently?

❖

Quivira's magazine is titled "Resilience," and Quivira's registration invitation for its REGENERATE 2023 conference concludes with the following sentence:

With this conference, we will synthesize the knowledge of our many innovative community members to help create resilient lands, economies, and communities, scaling solutions across microbes, markets, and climate.

Webster's Dictionary has this to say about resilience: 'an ability to recover from or adjust easily to misfortune or change.'

As I proceed to wrestle with the mystery of resilience, I do not expect or even seek agreement with you, my reader, but rather hope my inquiry inspires your own.

❖

What is it about our behavior and conditioning that allows for a resilient response to potential disasters that arise so frequently?

How do you create resilient lands, economies, and communities? Those of us who see our efforts as regenerative presume the results of our work will contribute to realizing a healthier and more adaptive world. To become resilient or to act more resiliently seems inherently empowering. Who would not wish that their individual well-being, their family, their business, their community, and, by extension, the planet, all benefit by scaling our collective capacity to be substantially more resilient?

Writing affords an opportunity to test my capacity to articulate, from personal experience and my own perspective, all the multiple and nuanced layers, activities, tangible things, and attributes of behavior that in their aggregate comprise an ability to live in this world.

❖

Can an interdependent co-arising being, like me, like a dung beetle, like a cow, like an apprentice, like a cloud, like an organization, embody a unique independent capacity to survive and even prosper in an environment inherently uncertain and changing?

Is being resilient a personal thing or a team thing? Is resiliency a natural capacity or a learned behavior? Is it realized through personal training and experience or does it arise in community via collaboration and mutual support?

❖

Roshi Bernie Glassman, a Zen priest and social activist, believed in three important points of engagement with life: one, to appreciate not knowing; two, to honestly bear witness to what is happening all around you; and three, to make an appropriate response. Alan Sanauke, a Zen priest, when reviewing of Glassman's book, "Bearing Witness: A Zen Master's Lessons in Making Peace," offers the following insight:

When we live out of unknowing we're shedding our suit of armor. Each time we let go of our fixed ideas about ourselves and others, we're letting go of our individual system of survival. For these syst ems may have once helped us survive, but now they are destroying us. They are destroying our ability to act spontaneously, to respond directly, to take care of any situation that arises.

❖

Thus, maybe a one-word definition of resilience could be *vulnerability*.

❖

Allowing and admitting this 'not knowing' in the here and now invites a space for the next unrealized opportunity. I remember early on some useful advice given to me: if you want to challenge the status quo, take a leap of faith. No one will know to come to your aid unless you publicly jump. The metaphor I recall is to step off the roof into thin air, so someone knows you are falling and then can reach out to catch you. There is some common sense at play here. The pertinent point is that doing something different to build capacity (resilience) into this life requires taking risks and trusting that others, respecting the merit of your intention, will reach out and offer aid.

❖

I keep returning to the notion that resilience is not entirely personal; in fact, it is mostly collective. Our individual actions find traction through community.

❖

Landscape health is as much a function of strategic human care as it is an inherent capacity embedded in the ecosystem itself. Another paradox where two distinct realities are both separate and not separate. Not one and not two. We humans have always been woven into the fabric of the whole. Now in this age of the Anthropocene, we are driving the evolutionary bus; we are the designer and designed at the same time. While we really don't own our lives, our actions still matter.

How do we engage with the world, remain resilient, and be available to care for ourselves and all sentient beings? How do we cultivate flexible, adaptive, collaborative, and imaginative responses to the foreseen and unforeseen?

❖

For better or for worse, to bring some grounding to these questions and observations, I have chosen to highlight a diversity of attributes, quotes, experiences, and outcomes of engaged resilience.

❖

Just say yes to everything. To practice resilience, this aspiration is foundational. To accept our life — the double notion that we own and do not own it — means never to turn away. Impermanence is the way, and to resist this essential understanding is to invite all manner of negative emotions, often led by anger and rooted mostly in fear. In the last two years, we have had over five percent of our calves die within 24 hours of birth. For some reason, their lungs were seriously compromised. We are pursuing many paths to trace the cause. Each time I arrive to find a wonderfully-conditioned cow awaiting a sign of life from her new calf, I want to scream. And sometimes I do. Yet the next task is ahead of me, and the people who depend on me, and I on them, cannot respond if I (we) turn away.

❖

The cure for the pain is the pain. You will quickly observe these shared 'rules of the road' are often just different points of perspective on the same thing. This universal truth is captured in the following poem by Rumi, a 13th century Sufi mystic:

Lovers think they're looking for each other,
But there is only one search: wandering
this world is wandering that both inside one
transparent sky. In here
there is no dogma and no heresy.

The miracle of Jesus is himself, not what he said or did
about the future. Forget the future.
I'd worship someone who could do that.

On the way you may want to look back, or not,
but if you can say There's nothing ahead,
there will be nothing there.

Stretch your arms and take hold of the cloth of your clothes
with both hands. The cure for the pain is the pain.
Good and bad are mixed. If you don't have both.
you do not belong with us.

When one of us gets lost, is not here, he must be inside us.
There's no place like that anywhere in the world.

❖

We are all dependently co-arising, like cows and grass. Disturbance can strengthen both, including the pastoralist whose practice guides the outcome. I often explain to our apprentices that the most useful instruction that I (the mentor) can offer are my mistakes. Now with our third apprentice, this is truer than ever.

❖

Patience is the key to joy. Staying with Rumi here, as this is another of his quotes. Patience is also one of the six paramitas, or six perfections, of the bodhisattvas, whose vow is to save all beings from suffering. The effort to take care is endless, so why be in a rush? When working with people, young or old, or with cows, constraining the process by your self-imposed timeline invites resistance and reduces the opportunity for a mutually-supportive response. Let's return to the early bull anecdote. When I, on foot, and the bull joined up with the open cows, the cows startled and kept wanting to run around me — a common tactic of a herd animal when not trusting of the situation. A forced response was impossible. I simply kept walking calmly, parallel to the cows, eventually allowing them to circle and become curious and reassess the danger. Eventually, I could position myself to apply steady pressure in the direction we all needed to go. If a cow raised their head, I backed off rather than applied pressure. If we needed all day, we would take all day. In time, the cows turned and walked on. Go slow to go fast.

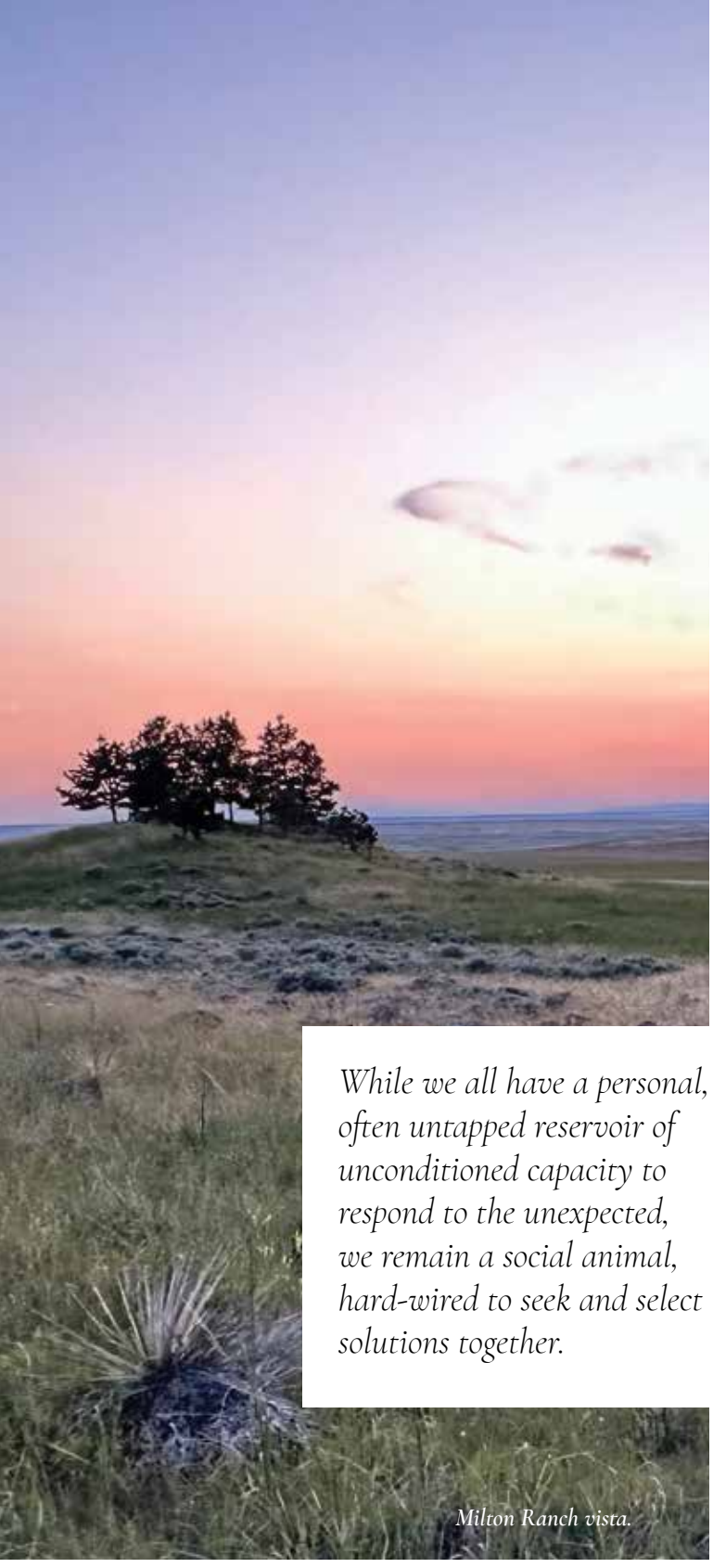
❖

Don't throw fuel on the fire. This team practice on the Milton Ranch is well-honed and deeply appreciated. Nothing creates a more useful "ability to recover from or adjust easily to misfortune or change" than explicitly avoiding harboring ill will on the cause. Today we find just the opposite via social media and polarized politics. Placing blame and increasing one's anger occur far too often; by so doing we weaken and waste our opportunity to adapt and grow.

❖

Enhancing feedback. Our objective is to leverage and advance our shared experience, our collective wisdom, to improve our understanding and adaptive response to whatever unmet need is at hand. Designing circles of people with different perspectives and unique conditioning will magnify our angles of reflection, our curiosity, and allow space for surprising solutions.

❖



While we all have a personal, often untapped reservoir of unconditioned capacity to respond to the unexpected, we remain a social animal, hard-wired to seek and select solutions together.

Milton Ranch vista.

Yo Yo Ma, when asked what skills are most necessary for the 21st century, replied without hesitation: flexibility, collaboration, adaptation, and imagination. While we all have a personal, often untapped reservoir of unconditioned capacity to respond to the unexpected, we remain a social animal, hard-wired to seek and select solutions together.

❖

I believe Paul Hawken conveys the heart of the matter. Collaboration and imagination, strategically applied, can often overcome a lack of resources:

When asked if I am pessimistic or optimistic about the future, my answer is always the same: if you look at the science about what is happening on earth and aren't pessimistic, you don't understand data. But if you meet the people who are working to restore this earth and the lives of the poor, and you aren't optimistic, you haven't got a pulse. What I see everywhere are ordinary people willing to confront despair, power, and incalculable odds in order to restore some semblance of grace, justice, and beauty to this world.

❖

Succession. It does not matter how successful we may be in achieving enduring and responsive capacity within ourselves, our families, our businesses, our organizations, even our governments; if we shirk our responsibility to skillfully address succession, and fail to prepare and inspire those who follow us with passion and enthusiasm, then we will tragically succumb to a small and constricted view of the passage of time. The past, present, and future are irrevocably threaded together. We are all impermanent players completely interdependent and co-arising together. There is no separation between us, and when our actions manifest this expression of true nature, our relationship to suffering will forever transform.

❖

I will give the last word to our first New Agrarian Program apprentice, Natalie Berkman, as she best articulates (and with much more brevity than I) how we can actualize the fundamental point:

When I think about resiliency in ranching, I think about a team's ability to withstand wrecks or unforeseen challenges. My oxbow team had a good long debrief last Sunday night after our intense branding week and the biggest takeaway was that everything worked so well because of our foundation of love and respect for each other. We all stepped up and went that extra mile because we all care about each other so much. I think it might be hard to go that extra mile without that level of respect for each other. When I think about the Milton team, it's the relationship between you [Bill], Dana, Ryan, and the apprentice that gets you through all the nonsense that comes up in ranching. I don't think you can do this work without love for your coworkers. At least not for long, or not effectively.

❖

If none of the above resonates, and you still hope this series of meditations might offer just one tangible, failsafe, inexpensive, daily practice to nurture your personal capacity to respond: take a nap. Rest. It works for grass, and it works for us.

TO *REGENERATE*, LOOK TO THE ECOSYSTEMS THAT ORIGINALLY *GENERATED*

Tim Crews

Author Tim Crews in a soil pit at The Land Institute's Prairie Festival. Photo by Allison Miller.

That agricultural ecosystems need re-generating implies that they have experienced some degree of de-generation. This narrative — especially with respect to soils, the foundation of terrestrial productivity — was central to the establishment of The Land Institute, a non-profit organization that has been striving to make grain agriculture regenerative since Wes and Dana Jackson first filed the papers to incorporate in 1976. It is a mission I share, which is why I moved to Salina, Kansas, over a decade ago, contributing my research to help transform agriculture from being an ecological liability to an asset. The title of Chapter 1 of Wes Jackson's early ground-~~breaking~~ healing book "New Roots for Agriculture" was "The Earth in Review: The Rise, Role, and Fall of Soil." Toward the end of it he wrote:

> *A profound truth has escaped us. Soil is a placenta or matrix, a living organism which is larger than the life it supports, a tough elastic membrane which has given rise to many life forms and has watched the thousands of species from their first experiments at survival, many of them through millennia-long roaring successes and even domination before their decline and demise. But it is itself now dying. It is a death that is utterly senseless, and portends our own. In nature the wounded placenta heals through plant succession: enterprising species cover wounds quickly... The human agricultural enterprise and all of civilization has depended upon fighting that succession.*

When Jackson referred to fighting succession, he was talking about the plow. Left alone, a field of bare ground in central Kansas will gradually, over years, become a diverse prairie or woodland — that is succession. But to grow annual grains, we must knock back succession every year, arresting the ecosystem in a very early stage of development to give the seedlings of our annual crops a chance to grow and set seed. Corn and wheat and beans would never thrive if we were to plant them directly into the dense, already-established, deep-rooted perennial vegetation of the prairie.

On Friday mornings at The Land Institute, groups of visitors gather at the Wauhob Prairie overlook in the middle of the campus — about 3.5 acres of never-plowed grassland that covers both gentle and steep slopes, which descend to the floodplain along the Smoky Hill River. The Wauhob serves as an ecological and spiritual compass for the work that takes place in the fields and labs that surround it. As with almost all of nature's ecosystems, the vegetation of the Wauhob prairie is made up of diverse perennial vegetation. Relying solely on sunlight, precipitation, weathering minerals, and nitrogen fixers to supply inputs, the prairie builds soil fertility, accumulates soil carbon, and becomes remarkably productive. We may never have an agriculture that is quite as elegant as the prairie, especially because we export nutrients in food that are difficult to cycle back when the consumers live far away. But with these natural systems as models and standards, the path to regeneration becomes very clear. If the soils we farm only generate under diverse perennial vegetation, it follows that to regenerate the soil quality that was present before the first plow cut into the placenta, it will be essential for agriculture itself to allow succession to proceed. All of the major ecosystems of the world are comprised of perennial polycultures — why not agriculture?

All of the major ecosystems of the world are comprised of perennial polycultures — why not agriculture?

When "New Roots for Agriculture" was first published in 1980, the discipline of soil science, at least in the U.S., was still more concerned with chemistry and physics than biology. There were renegades, like the British agronomist Sir Albert Howard, who, fascinated with compost systems in India and mycorrhizal fungi, wrote "Soil and Health" and other fascinating books. But in the last four decades, a number of things have converged to position soil biology on equal footing with chemistry and physics: (1) the organic agriculture movement continued to gain steam and draw attention, (2) global soil degradation became a central concern of international agencies like the Food and Agriculture Organization of the UN, (3) awareness grew of environmental problems, like fertilizer-induced algae blooms and greenhouse gas emissions originating from croplands, and finally, (4) the development of molecular techniques helped take inventory of the diversity and abundance of the soil microbial community. These — and no doubt other threads of history — motivated and facilitated an explosive awakening around the complexity of the belowground universe that is now seen as integral in supporting all life aboveground. Some colleagues and I have begun to refer to the totality of the mineral-gas-water-organism interaction as the "soil ecosphere." Plants convert solar energy into carbon compounds that feed soil organisms, which influence plant growth and soil structure. These ecospheric interactions all happen in the context of unique, relatively static, broader interactions taking place between the *parent material* (the particular rock or sediment from which a soil is formed), the *time* since the parent material was exposed or deposited, the *topographic* position where the soil is being formed, and the *climate* of the place.

Succession and the soil ecosphere. Photo by Tim Crews.

One can easily get lost in the soil ecosphere. Many, if not most, who wander into it do. After all, scoop up a handful of soil and you can easily be holding 100 billion organisms. And those organisms are diverse! There are up to 10 million species of bacteria in soils and 6 million fungi. One gram of soil (about the size of a pencil eraser) can contain 60 miles of fungal root-like filaments called hyphae. Our recently expanded capacity to measure the diversity and abundance of soil life has, not surprisingly, caught the attention of agricultural companies that are interested in monetizing ecological intensification. Can the soil microbiome be engineered? Or even

nudged to produce predictable microbial services, like nitrogen fixation or disease suppression, improved drought tolerance or efficient phosphorus uptake? Companies like Indigo Ag, BASF, and many others have invested considerable sums to develop products that deliver biofertilizers and biopesticides. The global market value of agricultural microbes is predicted to reach around $12 billion by 2027. And yet, when trialed in farmers' fields, the efficacy of microbial inoculants and other microbial manipulations have thus far proven to be inconsistent. For one, microbiologists in a lab might succeed in identifying a single high-functioning bacterium that suppresses a crop disease, but when that organism is introduced to a soil microbial community consisting of billions of individual organisms representing millions of species surrounding each plant's root system, the chosen bacterium often has a hard time competing with the locals. Alternatively, some soils, based on their pH or texture, might make an ideal habitat for the lab-cultured microbe, while other soils might prove inhospitable.

As regenerative practices require more of farmers, it becomes imperative that the rest of us do our part to help those farmers to succeed; we need to support them as neighbors, as consumers, and through policy initiatives.

Just over a decade ago, I was involved in a study that illustrates this point remarkably well, which was led by agroecologist Jerry Glover. A Kansan by birth, Glover used to enjoy driving around the region on back roads, observing the state of crops, rivers, songbirds, and rural life in general. From time to time, he stumbled upon never-plowed bottomland prairie remnants that were used for hay production. These patches of grasslands are remarkably rare, as nearly all high-quality bottomland soils have been plowed and put into annual crops. Being a gregarious and inquisitive guy, Glover struck up conversations with the farmers who hayed these meadows to learn something about why their particular parcel was spared from the plow, and maybe some details about their productivity and management. He was surprised to learn that many of the meadows had been hayed for more than 75 years without any manures or synthetic fertilizers applied to replace exported nutrients. Yet the farmers had not noticed any declines in the productivity of their fields. This made Glover super curious about how the health of the soils under

Photo left: Soil Ecology research staff sampling a Kernza®-alfalfa intercrop. Photo by Tim Crews.
Photo Right: Author monitoring the Kernza®-alfalfa intercrop. Photo by Claire Wineman.

Maybe we don't have to engineer and monetize microbes to achieve the ecosystem functions associated with a healthy soil food web. Maybe the limiting factor is not the microbes themselves, but rather the availability of quality microbial habitat (that is, good places for microbes to live). There is increasing evidence that naturally-occurring soil ecospheres developed under the influence of grassland, forest, or savannah perennial polycultures exhibit many features that we strive to achieve in agriculture — not least of which is the holy grail of improved soil organic matter contents.

the native perennial hay meadows compared with land that had been converted to wheat and other grains. Motivated as such, he assembled a group of researchers who were in one way or another affiliated with the work of The Land Institute to compare soil characteristics and other aspects of grasslands and adjacent wheat croplands at sites across five counties in central Kansas. Here are two important lessons from their findings:

1) The average total organic carbon in the soils of the never-plowed prairie remnants was 81 tons/acre, while the annually-tilled

cropland averaged 62 tons/acre. Part of this difference was likely due to tillage breaking up soil aggregates and exposing protected soil organic carbon to microbial consumption, and partly due to the perennial grassland vegetation allocating 6.7 times greater carbon in roots than annual wheat plants.

2) Each year, an average of 62 pounds of nitrogen as fertilizer is applied to each acre of wheat, and 42 pounds of nitrogen is removed in the harvest. No nitrogen fertilizer is added to the hay meadow, but nearly the exact same amount of nitrogen is removed in hay (43 pounds/acre/year). After 75+ years of production, the soils of the grassland contained an average of 6.7 tons of nitrogen per acre while the annual wheat croplands had an average of 5.2 tons of nitrogen. Thus, even though the grassland soils were unfertilized, they contained more than a ton/acre greater nitrogen than the fertilized cropland soils. If one assumes that the wheat fields had the same soil organic nitrogen stocks before they were first plowed as adjacent prairies, then an additional average input of 44 pounds of nitrogen/acre/year was made available to the wheat crop from the net decomposition of organic matter. What this tells us is that over the 75+ years of wheat farming, the 34-60 percent of the available nitrogen in the cropland soils was *not* taken up by the crop and instead was presumably lost to the atmosphere or leached into freshwater ecosystems.

An ecosystem arrested in early succession. Photo by Tim Crews.

These coarse comparisons, summing multiple decades of change, paint a broad-strokes picture of the contrasting ecological efficiencies of both grassland perennial polycultures (in which the soil is largely undisturbed) and monocropped annual grains (that experience soil disturbance on an annual basis). In 2010, in an effort to glimpse what is "under the hood" of these contrasting efficiencies, researchers Tiana Dupont and her Ph.D. advisor, Howard Ferris, from the University of California, Davis, focused on a particular group of soil organisms that are considered by some to be the soil animal equivalent of canaries in coal mines — I am talking about nematodes.

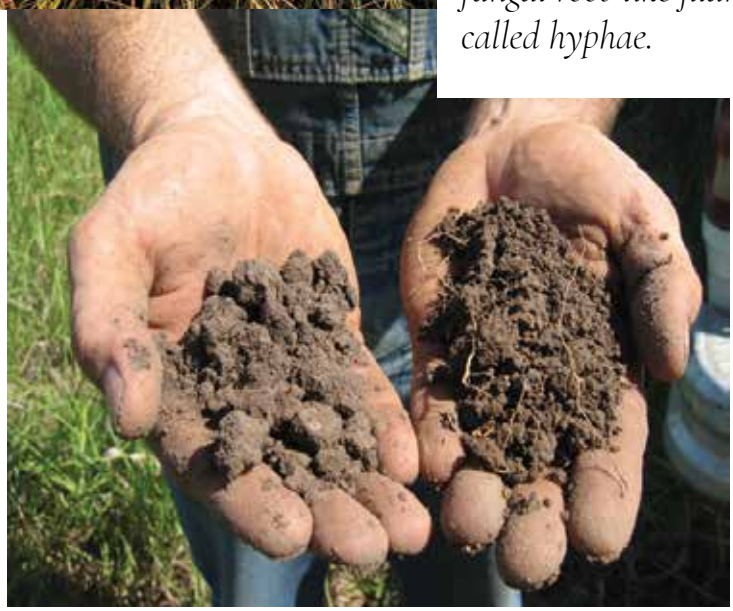
There are several reasons why nematodes are proving to be such good indicators of soil health. First, like bacteria and fungi, they are ubiquitous. Nematodes are by far the most abundant member of the animal kingdom. For every human alive on earth there are some 60 billion nematodes living pretty much everywhere — in soils, on our skin, on plants, on our pets. While incredibly abundant, there are far fewer species of soil nematodes than there are bacteria or fungi — only about 27,000 identified species. Another attribute that makes nematodes such great indicators is that they vary tremendously in the roles they play and how they affect the organismal community around them. Soil nematodes have been categorized into a handful of functional guilds to help understand important relationships between species and soil ecosphere activities. There are guilds of nematodes that feed on, and thus, harm plants, and others that help plants with activities such as consuming algae and fungi and releasing nitrogen. Then there are guilds of nematodes that specifically feed on bacteria, or feed on fungi; those that are omnivores or predators can help regulate the populations of other nematode groups like the plant feeders.

In Kansas, Dupont and Ferris surveyed the nematode community in the topsoils of the wheat fields and hay meadows, and what they found was revealing. The wheat soils were colonized with more bacteria and plant feeding (parasitic) nematodes, whereas the grassland communities were made up of more fungal feeding, plant-associated, omnivorous and predatory nematodes. Nitrogen-rich and carbon-poor agricultural soils tend to be dominated by bacteria relative to fungi, as bacterial bodies have carbon to nitrogen ratios of around 5 to 1, compared to fungal tissues of around 10 to 1. It is not surprising, therefore, to see more nematodes that eat bacteria in the cropland soils. The more pronounced presence of plant associates, as well as the omnivore and predatory nematodes that reside higher in the food web, reflect a more balanced nematode community structure. Plant eating nematodes are certainly present in the grassland; they are simply better held in check than in the disturbed cropland soil — similar to how predators like wolves keep (plant eating) deer populations in check. Why are the nematode communities different between these ecosystems? We do not know with certainty, but the undisturbed grassland soils are "fed" lots of diverse roots every year and contain a wide range of different habitats: aggregates, horizons with different textures, pores left

open by decomposed roots, and intact mycorrhizal hyphae. In contrast, these soil features are homogenized by repeated tillage in croplands, whose soils are fed far fewer roots, and typically of one species.

Photo top: Wauhob Prairie. Photo by Tim Crews.

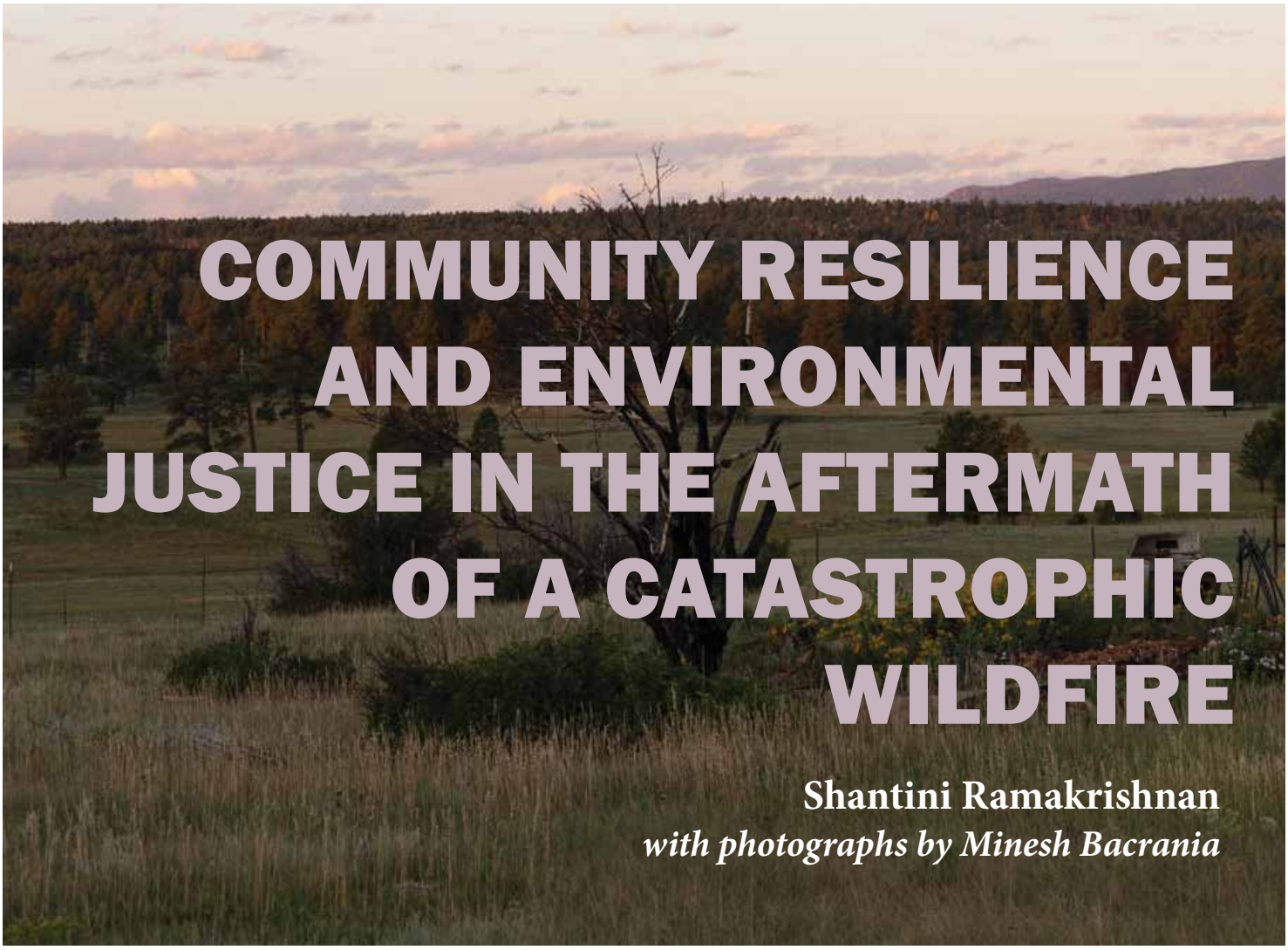
Photo right: topsoil from an annual wheat field (left) and from an adjacent prairie meadow (right). Photo by Jerry Glover.



Nematodes, nitrogen, and carbon — a few examples of soil health differences between prairie and cropland. Examples like these help us appreciate what might be regenerated by a regenerative agriculture, as well as what needs to happen for regeneration to take place. Incorporating two key features of the prairie into the cropland — perenniality and diversity — allows countless biological and physical interactions to proceed in the soil ecosphere.

Today, an increasing number of growers are learning about regenerative agricultural practices that can help save and improve soil, as well as urban and rural communities. In most cases, these individuals are taking on more work, expense, and worry as they come to care more deeply about the repercussions of various farming practices. Consider the decision to employ cover crops. Whereas before a grower might leave the soil without living roots for months between crops, now they spend significant sums on legume and grass seed, and extra time and fuel to plant and terminate that additional crop. As regenerative practices require more of farmers, it becomes imperative that the rest of us do our part to help those farmers to succeed; we need to support them as neighbors, as consumers, and through policy initiatives. It is their virtue that compels them to do more — to go the extra mile to improve soil health and social well-being. But when it comes to regenerative practices, virtue alone is not sufficient. Virtue might skip a generation or individuals with knowledge and experience might confront an unexpected tragedy and be forced to leave their land. Moreover, for whatever reason, there are many farmers who simply cannot or will not engage in regenerative practices. It is widely known that the adoption of cover crops continues to lag far behind the expectations of groups like the National Resources Conservation Service, which promotes soil health principles. The fact of the matter is, the consequences of relying primarily on virtue has consequences. Anyone who monitors Iowa State's Daily Erosion Project website knows how, when soil is exposed, an intense rainstorm can easily erode a hundred years of soil formation within an hour. It happens many times per year. Management can provide valuable tools in our dance to nurture nature, but even more fundamental to healing the placenta is learning from ecosystems that originally created the soils that we farm.

One gram of soil (about the size of a pencil eraser) can contain 60 miles of fungal root-like filaments called hyphae.



COMMUNITY RESILIENCE AND ENVIRONMENTAL JUSTICE IN THE AFTERMATH OF A CATASTROPHIC WILDFIRE

Shantini Ramakrishnan
with photographs by Minesh Bacrania

Catastrophic wildfires are not rare in the West. California, like New Mexico, has had its share; the town of Paradise remains the poster child for what happens when the wildland-urban interface goes south. When the McBride fire near Ruidoso, New Mexico, flared into existence in 2022, burning dozens of homes, I remember feeling empathetic and recalling some time I once spent in the Lincoln National Forest. Then the Cook's fire in Ocate, New Mexico, lit up, and I thought about the people and places I knew in that area and hoped for containment. But last spring, the Hermit's Peak/Calf Canyon fire (HPCC) hit home for me in ways that no other fire has approached. This was the first fire where my own friends lost their homes. I observed entire village populations evacuate, saw ash falling from the sky, and watched from my front porch the dancing flames that glowed night after night.

Post-fire restoration is typically centered on ecological restoration and activities like flood mitigation and soil stabilization. It asks the question: "how do we fix what a fire burned up?" Often, we ignore community restoration, or the recovery of the people impacted by the fire. Community dispossession after a fire, relegated to an inventory of material losses, does not begin to quantify the complex changes for those whose lives are shaped by shed hunting, annual deer harvests, collecting and drying mountain oregano, wood cutting, and trout fishing, all things that are greatly impacted by wildfires. Nor can such an inventory meaningfully account for the gathering of people in a place for generations, the memories of loved ones still present or long gone, the identities steeped in an adobe home, next to a garden, watered by an acequia, adjacent to a thick wooded forest. A place and its people, so integrally connected, are alarmingly disassociated after a fire. With the trees gone, once-familiar places become oddly disorienting; sightlines grow long and natural landmarks disappear. Community restoration after a fire — when land-based livelihoods are upended for an indeterminate period — is about reimagining and reconstructing new lives, new identities, and unknown futures. These lives are scattered across burn severities, in a matrix of public and private lands, that range from the single digits to hundreds of thousands of acres.

I could not wrap my head around the magnitude, severity, and scale of the HPCC fire. My first up-close look was in Las Dispensas, when a friend opened up her burned property for a walkabout to see, touch, feel, smell, and spend time amid that destruction. During that walkabout, with my friend (who has a professional background in forest monitoring), and a mutual fire ecologist friend, we tried to process what we witnessed: the bare mineral soil, devoid of any vegetation, the stark skeleton trees charred black, and

bits of blackened bark and scorched pine needles that fell to the ground with each gust of wind. We talked about hydrophobicity (the repellency of water after a fire that is most prevalent in the first year in high severity burn sites), how to reestablish organic matter so that vegetation could regrow on a substrate more conducive than mineral rock, how many trees would live or die, how many dead trees would fall in the coming years, what might be beneficial uses for so many standing dead trees, and how this community might begin to make a comeback. The questions were plentiful as we tapped into each other's professional and personal experiences to imagine a new reality after this fire.

I was soon afforded further opportunities to examine other parts of the burn scar, and meet the people who lived in and belonged to this place that had burned. My own professional work is centered on capacity-building and growing natural-resource leadership among local youth populations, work that was derailed after the

Shantini and Tazzie.

fire. My forest-specialist colleague had dozens of monitoring plots that burned, which now needed to be revisited — not part of her annual monitoring plan. She needed more staffing resources, and I had time on my hands, so I volunteered to assist. I am not a forester and when I walk among trees, my eyes are drawn to the wildflowers at my feet, not the grandeur of the overstory. I consider my colleague's state-wide monitoring program to be the heart of the New Mexico Forest & Watershed Restoration Institute (NMFWRI), where we work. This was my chance to learn and contribute at a time of need. I joined her seasonal crew and learned the monitoring protocols, including tree identification of both living and dead trees, and the measuring of fuel loads in plots estimated by the occurrence of 1-, 10-, 100-, 1,000-hour fuels. I talked to others around the state who had more experience with wildfires to investigate what's needed after a fire, and availed myself of online resources. I wanted to understand the many emergency programs that were hastily launched after the wildfire, with often conflicting and confusing details, in order to share that knowledge with the community. I explored the viability of employing erosion-control techniques, which I had previously used for drought mitigation, and how those could be adapted in a post-fire landscape. I asked my friend in Las Dispensas if we could pilot contour felling techniques, and invited more friends and colleagues to an informal workshop. Later, I attended a town hall, which provided some very personal narratives and first-hand accounts, and a glimpse of the long road to recovery ahead.

✦

At 341,000-acres, HPCC is currently New Mexico's largest wildfire on record. While HPCC started on federal land, almost 60 percent of the final burn scar endures on private working lands; restoration on the latter can be especially challenging. The funds for public land rehabilitation are not transferable to private lands, and private land restoration programs primarily function through a reimbursable process, requiring landowners to pay costs upfront and only later apply for compensation. Under ordinary circumstances, this process favors landowners with means, who can utilize these programs to their benefit, while excluding landowners with fewer financial resources from participating. In our current extraordinary circumstances, many landowners of variable financial means have been left behind from restoration efforts because the extensive losses incurred from HPCC have exceeded their ability to front costs outside of immediate needs for food and shelter. The HPCC Fire Assistance Act and low-interest Small Business Administration (SBA) loans have only just begun to provide those with fewer means with the ability to think about rebuilding. Landowners impacted by HPCC can apply for a low-interest loan to start building a new home while their claim is under review; restitution under the act includes repaying SBA loans.

Ranching and farming are a way of life for HPCC burn scar communities, providing food sovereignty and security, especially when combined with hunting and fishing. Food prices have increased significantly in recent years; in response, many families have been able to fill their freezers and fridges with a bounty from the land. That security is now under threat for the long-term. Since the HPCC fire, agricultural infrastructure has been destroyed. Stock ponds have turned into sediment basins, and the acequia systems have been completely inundated with ash and debris, severing the lifeblood of once-fertile croplands. The first few years following a severe fire are always brutal because post-fire flooding can cause additional losses equal to or greater than the fire itself. As always, those with resources may be able to wait out this period, but others may be forced to consider giving up their way of life. Those who cannot wait three to five years for post-fire flooding to diminish may invest the little they have into new infrastructure that may get wiped out again, sinking them further into debt and despair.

The immensity of daily life struggles can lead to an exacerbation in the downward population trends in rural communities, spurring an out-migration that further diminishes economic and social viability. Addressing and providing some relief to that sense of immensity (and the accompanying feelings of hopelessness) is where a great deal of post-fire restoration work nests. Effective long-term, post-fire recovery combines ecological and community restoration, and is only possible with vested community members willing to engage and participate throughout the process. This requires retaining the connection to the charred landscape, re-engaging in the recovery process of these changed working lands, and managing scales of recovery.

The immensity of daily life struggles can lead to an exacerbation in the downward population trends in rural communities, spurring an out-migration that further diminishes economic and social viability.

About 185,000 acres burned with moderate to high severity during the HPCC fire; the remaining 156,000 acres burned at low severity, speckled with pockets of unburned forest. Anyone who has cultivated a productive one-acre garden can appreciate the enormity of the task of rehabilitating such vast landscapes. It is an entirely human trait to focus on and worry about the worst, hardest-hit, and ugliest problems. But these are often the most challenging problems to treat, those which require the most expensive solutions, and prove the most likely to fail. In the dynamic years immediately following a major burn, when the landscape is subject to change (due to flash flood, soil instability, or the prospect for new growth) there are often sites that cannot be addressed immediately. Conversely, the sites that were lightly or moderately burned often offer the easiest prospect of recovery. My experience leads me to advocate for working on smaller scales that can be influenced at readily-visible and imaginable levels: land that you can bring into focus, and on which you can make meaningful contributions more quickly. Incremental, multi-year, modestly-sized projects can be stitched together for real, albeit moderate, gains, providing affirming progress. Document and celebrate those successes and let it inspire stronger commitment toward additional work in the marathon of recovery. There are practical reasons for the little-by-little approach; the one-year anniversary of HPCC is a four-month-long commemoration because it took that many months to contain this fire. Small changes to the land, in a fundamentally altered landscape, can revive memories of what once was. Instigating modest change allows room for your heart to catch up to what you might know intellectually, but have not yet come to accept emotionally.

✦

Since July 2022, as a program manager at NMFWRI and in partnership with Luna Community College, I have been involved in hosting the Querencia in Action landowner workshop series. The workshops' most basic function is to provide a convening occasion for landowners. Set in burned private sites, each workshop has a theme to guide conversations and co-learning opportunities about, among other things, hillslope stabilization, reseeding dozer lines, post-fire plant communities, and creating survivable space. Instructors share their experiences encountering wildfires and facilitate further conversations with the group. The various workshops normalize living and working in a burned landscape and emphasize that recovery is a multi-year effort. We return to the scales of time and space repeatedly.

Larger scale land recovery initiatives are generally led by state and federal entities, even though forests, rivers, and meadows do not recognize jurisdictional boundaries. Upstream efforts impact downstream communities. Grass reseeding on public lands affects grazing allotments. Compromised roads and bridges interrupt access and disrupt recovery efforts. The HPCC fire demonstrated how conventional communications and siloed actions can be incredibly ineffective and sometimes detrimental. Federal/state/nonprofit/landowner initiatives are inter-connected, but when it comes to practical action, we sorely lack the operational capacity to think holistically. While inter-entity and inclusive community outreach are still works in progress, strong alliances built in the last year have been sustained primarily through individual efforts.

It is sometimes difficult to talk about *resiliency* among rural communities and communities of color because the word itself suggests one's ability to persist despite a barrage of adversity. The COVID-19 pandemic hit northern New Mexico hard. Many residents were considered essential workers and continued to work, even those with underlying conditions. Most families did not emerge from the pandemic shutdown intact. This region's median household income fails to provide a living wage, and annual cost-of-living increases are not represented in average incomes. When HPCC ravaged the landscape — followed by wave-after-wave of post-fire floods from the monsoons — many community members became land poor as well as cash poor. When billowing clouds of smoke filled the air in May 2023 during the Las Tusas fire, there was the damning realization that fires can still occur within a burn scar just one year later. When one encourages hope in this climate of adversity, is it simply an exercise in perversity? Resiliency, adaptability, plasticity, and persistence are often packaged under that mantle of "toughness and grit," but it also extracts unseen tolls in communities, a tax on mental health that can manifest physically and emotionally in a distant and assumed-to-be-unrelated future. When advocating for resiliency, one must also think through robust support systems and multi-faceted solutions.

In the last year, through workshops, community meetings, and fairs, I engaged with landowners who generously shared their coping mechanisms for how they "keep on keeping on." I have been privileged to bear witness to these paraphrased examples of resilience:

Joy where there is no place for it… *fetid goosefoot everywhere among the matchstick trees, they're beautiful!*

Humility in loss… *I lost my home, yes, but at least my shop didn't burn, so I'm fortunate.*

Processing loss over time… *so many new plants have come up, I am watching to see how my land has changed and continues to grow after the fire and through each flood.*

(continued on page 41)

Where the fire came over the ridge.

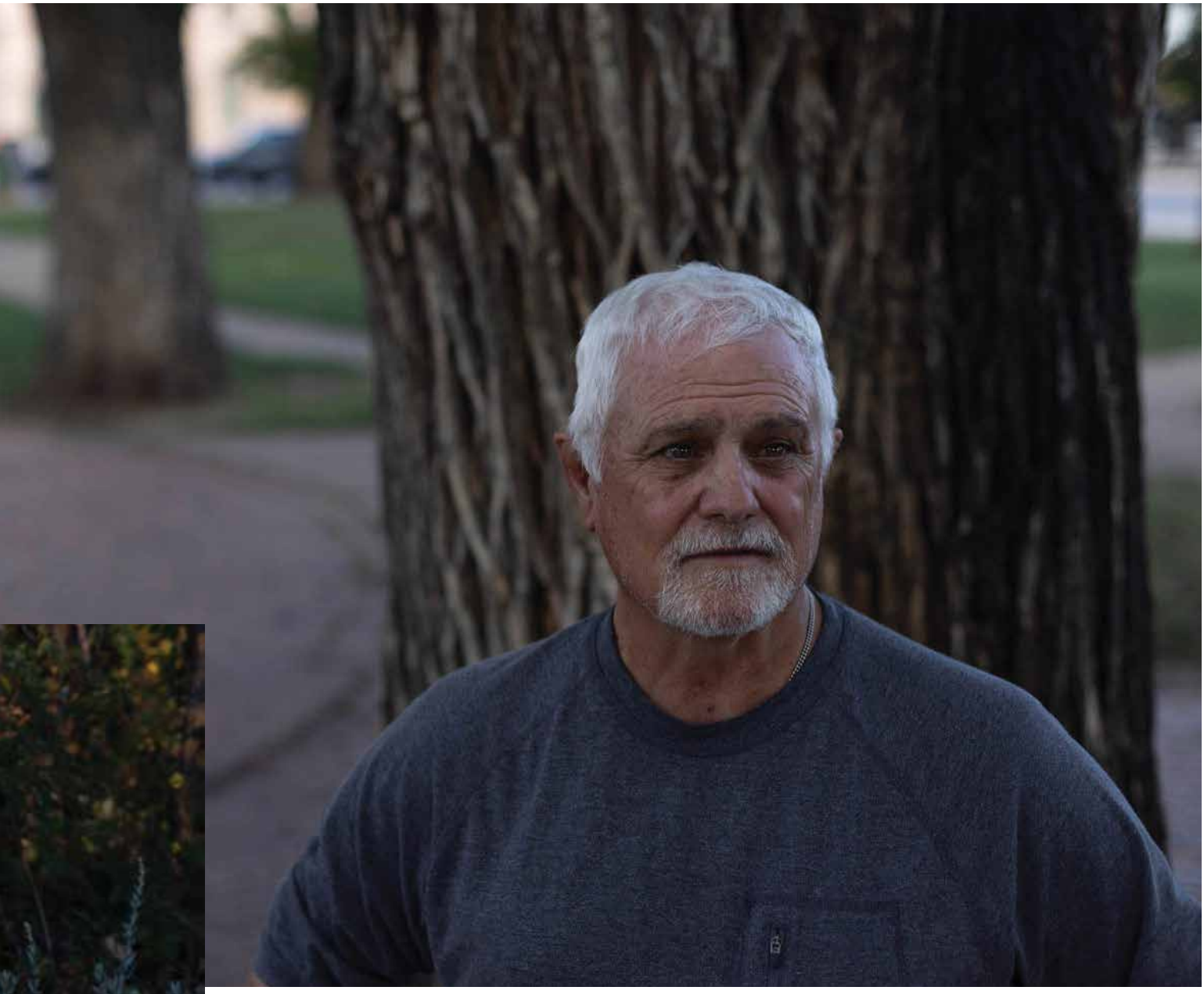
We're still in a disaster. But everybody is still going. Everyday I hear how angry everyone is. This is such a large thing that happened, we haven't moved past the 'disaster' phase. There hasn't been a recovery period between the fire and now. But everyone is still going. If our community wasn't resilient, it wouldn't be here anymore. We're not going to give up.

Sarah Obermeyer
Montezuma, New Mexico

Sarah at home.

A year later we're just barely beginning the recovery process for a disaster of this magnitude. But we need to think about how to make this landscape habitable for the long term. It can't be an acute approach, it has to be an incremental, systemic change.

Hank Blackwell
Fire Specialist



Hank on his land.

Ernesto on his land.

Our family's been in the valley here for something like 300 years. Our community has always relied on self-sufficiency, and a lot of these ideas still carry through today.

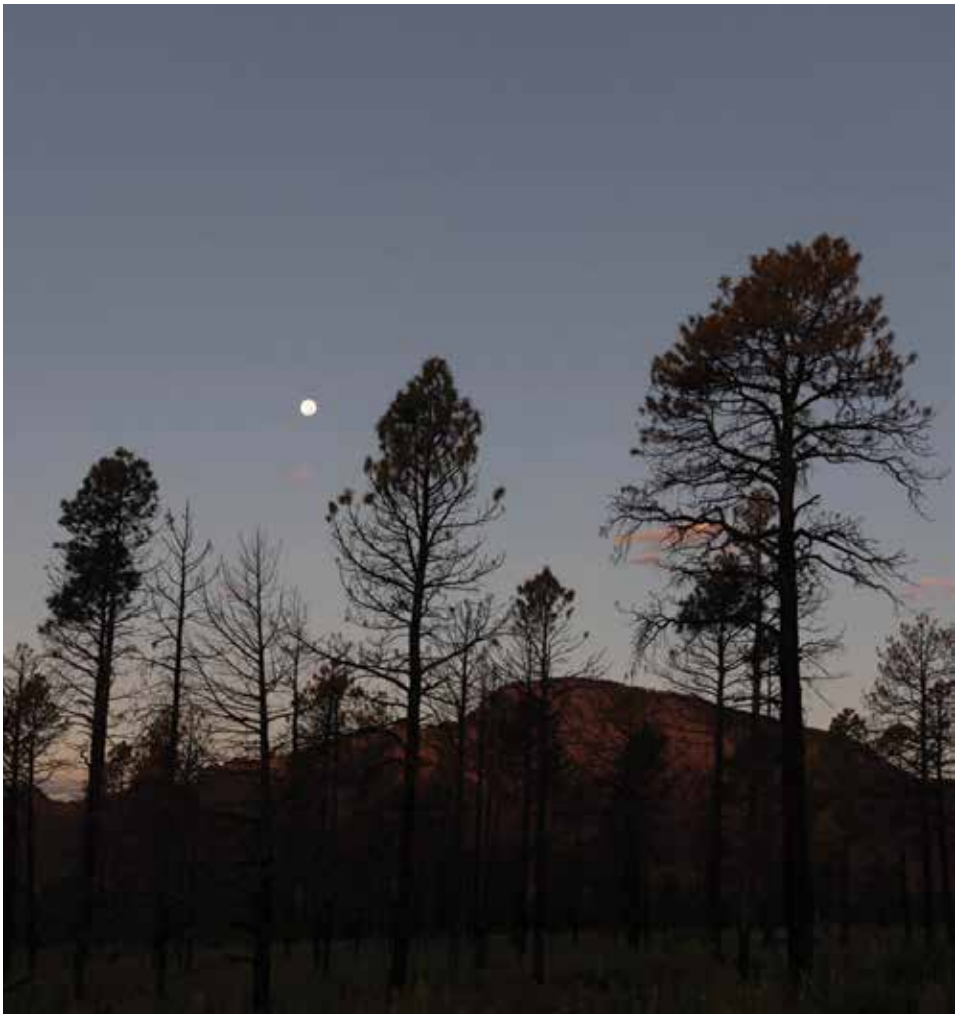
Ernesto Hurtado
Holman, New Mexico

Ernesto describing the aerial mulching operation.

The process of loss and grieving and remembering and longing for what was, and the transition to being able to imagine something else, that's resilience.

It may not be the forest people remember, but that doesn't mean it's gone forever. It's on its own trajectory, and that trajectory takes time.

Shantini Ramakrishnan
Las Dispensas, New Mexico



(continued from page 33)

Courage to stay and daring to rebuild… *It's like losing a loved one and not being able to bury the body. What's left of our home of 30+ years has been labeled a 'hazard' so dangerous that debris removal cannot touch it and yet, not hazardous enough to make any progress one year later. We are moving ahead with meeting a contractor to try to imagine building a new home.*

✦

Another friend recently reminded me that we all move forward when we help each other. Neighbors helping neighbors is the way of life in rural New Mexico. Individual and collective action both have roles in recovery. Climate-induced catastrophes now extend beyond the scales of our models. We need to expand our thinking about what's possible and plausible, to accommodate the widening reach of scale and severity. If we live off the land, if we live within the wildland-urban interface, if we live in fire-evolved ecosystems, and if we have ties to natural areas, we need to employ all our tools — even the scary ones, like prescribed fire — frequently and with creativity.

I recently moved into a home on the HPCC burn scar. My priorities include reducing fuel loads within the 100-yard zone around my home for survivable space. But my scale of influence extends beyond those 100 yards, to the green forests I am fortunate enough to have surrounding me. To protect that green in the next fire, I need larger, healthier trees that can only thrive with reduced competition and densities. This means only retaining about a quarter of the fire-adapted ponderosa pine trees on my property. It means recognizing ladder fuels — when a juniper tree is growing next to a ponderosa — that provide fire with a vertical combustible climb toward the crown, and choosing to keep just one of those trees, instead of both. It means cutting a little more each year, for a series of incremental new normals. If I wish to create a forested environment that will persist when another fire moves through, I must consider a prescribed burn as protection against a catastrophic wildfire. Fire — necessary but scary as heck — is my best tool to protect the forests. Although I may not see the full recovery of these forests in my lifetime, I can influence the trajectory of recovery while I am still here.

Last September, I gained a new sense of hope when I visited Santa Clara Canyon, to the southwest of Española. I did not know this canyon before the Los Conchas fire (2011), Cerro Grande fire (2000), and the Oso Complex fire (1998). I only knew that each fire began outside of tribal lands but burned 80 percent of Santa Clara Pueblo's forests. The creek was running clear, the hillslopes vegetated and stable — some bare of trees, others full of tall growth. The tribe hosted a tour, describing and showcasing years of intense and committed recovery efforts. They also spoke about introducing native trout, and the recreational opportunities they were building for local community members. They discussed the complexities of reconciling plans for roads, fisheries, and stocked and unstocked ponds with the ongoing challenges of cleaning out post-fire debris nets, rehabilitating alluvial fans to stabilize side canyons, and ongoing installations of in-stream rock structures and log-mats for erosion control. Despite the evidence of past fires, the canyon was beautiful, alive, and thriving.

Given time, recovery is indeed possible. All efforts — small and large — can contribute to the timeline of recovery, either hastening or slowing it down. We must be cognizant of this, respectful of the limits of scale, and intentional in choosing collaborators with whom we can work to rejuvenate burnt lands. The knowledge I gained that day in September, backed by the many experiences from the past year, has begun to sink in: my soul realigning to believe what I already knew to be true.

HOW TO HONOR THE WHOLE PROCESS:

AN INTERVIEW WITH

ELENA MILLER-TER KUILE

Photo credit: Christi Bode

Elena Miller-ter Kuile is a sixth-generation farmer working on the original lands of her Hispano ancestors. Her farm, Cactus Hill Farm, still uses some of the oldest water rights in Colorado, established in 1867. Elena raises sheep for grass-fed meat as well as value-added wool products, such as yarn and other products for fiber artists. Her farm also produces organic grains and hay.

Elena served as the vice-chair of the San Luis Valley Local Foods Coalition and currently serves on Rural Women-Led Business Fund at the First Southwest Bank of Colorado. She recently worked for Adams State University supporting students from a migrant agricultural background to achieve their education. She has also been involved in many water rights battles for her community over the years. She was recently nominated to the Colorado Agriculture Commission.

This interview was adapted from an episode of "Regeneration Rising," a podcast created by Quivira Coalition for beginning or interested agrarians, about the trials, tribulations, and joys of a life in regenerative agriculture. Read on for Elena's thoughts about fast-fashion and livestock, the balance between a quality product and animal livelihood, and the need for a counternarrative to popular depictions of farming.

"How Does What You Wear Represent What You Stand For?"

We are in an era of throw-away fashion: bell bottoms aren't cool anymore so throw them away, start over again. But if you look at that from an ecological standpoint, that is a horrible idea. Historically, people owned fewer pieces of clothing. That said, they were high quality pieces. I met a woman and she said something beautiful. She said, "How does what you wear represent what you stand for?"

If you look at historical clothing, it wasn't merely clothing — it had a cultural reference. It was art, it was wearable art. And women wore clothing that represented their culture, that represented a story they could tell. If you look at a lot of Indigenous clothing, it's beautiful, amazing, and deeply connected to the traditions of how clothing is made. That is the story they tell.

So I love that idea of connecting more deeply to what you wear, as well as to what you eat.

Tressa Weidenaar of Tsinbikee created the "Silversmith Hat" pattern with my wool. Tressa honors her Navajo cultural heritage in her work. Fiber art traditions have a long history in the Southwest. The Indigenous communities have such a depth of knowledge about dyeing and fiber and plants. I have so much to learn from — and

so much respect for — these traditions. I love the design that Tressa created because it is a wonderful way to honor her community and these long traditions. We have a lot of healing to do as a nation and I don't know how we will. I really love this pattern and knowing Tressa.

I am lucky that so many of the people I sell wool to will share their creations on my social media, or even find me at shows. Nothing makes my day more than knowing a customer had a good experience with a fleece or another product. I work so hard to give my sheep a good life and create quality wool. Ranchers don't often get feedback and it's so wonderful to hear positive experiences.

As far as the fiber goes, one challenge is to keep sheep clean.

Sheep are naughty and they're like: *Oh, let's take a hay bath*. And you're like: *No, you have to keep the hay out of your wool!* So I think, from the production side, there's definitely that question of how to maintain quality?

I want to make sure I produce high-quality wool, but I don't have to change my management completely. I think sheep should be able to move around — paddock grazing or mob grazing. It's really important for sheep to live that kind of life. So I have to figure out how to keep the balance of high-quality wool with my style of management, of allowing them to move around.

I don't know how to shear. I pay someone to come and shear for me. There are people who actually want to buy raw fleeces. So a lot of my product just goes straight to the customer after shearing. I put it in a bag, I grade it, and then I sell it online and people will buy the whole bag. And I think that's amazing because they're basically taking these (hopefully) high-quality fleeces and turning them into their own product.

So that's my main goal: to get as many of those fleeces off the sheep in the highest condition possible, so that I can sell them that way. Because to me, it's the easiest if it's just one bag of wool. But it definitely has to be high quality.

"Forgiveness of Ourselves Is Really Important"

If you watch a movie and there's a farm, you only see the most beautiful part of the farm. They don't have junk lying around. There's no dead cow in the ditch. Everything's beautiful. The sheep and the animals are so friendly and they love the people and they didn't just butt the owner in the back and knock them down, you know?

We have this romanticized version of agriculture that — and I'm saying this as a person who grew up on a farm — can set you up a little bit for failure, because you're like, okay, so if everything's so wonderful, then how did this happen?

You go to the grocery store and everything's beautiful. Everything's all wrapped in plastic and the meat section displays these gorgeous chops that are all wonderfully shaved. The truth is, agriculture is tough. Anything that you're doing with livestock, you're going to lose some, there's going to be the worst tragedy you can ever imagine.

And that is not something that we're talking about.

When we talk about farming, we're talking about these beautiful pastoral visions. We're talking about happy little sheep. We're not talking about the one that stuck its head in the gate and broke its neck, or the one that couldn't have its babies and got sick.

So I think having forgiveness of ourselves is really important; knowing that even if you try your best, you're going to lose some, you're going to fail some. Especially dealing with agriculture — I don't care if it's livestock or client production — you'll have a hailstorm, you'll have a disease, you'll have these horrible things that happen.

But that doesn't mean you're a failure, it just means that's the business that you're in. People don't want to hear those stories. They don't want to hear that something bad happened to this animal, and then they ate it.

They don't want to hear that side because I think they want to have a vision of this beautiful, pastoral, happy animal thing. But those stories are really important for producers to hear because we need to hear them to understand failure and forgiveness. They're also important for consumers, in terms of understanding a real relationship with their food — instead of this beautiful sunshine-and-rainbows vision.

"We Need More Place-Based Solutions"

If you eat food or wear clothes, then you need farmers and ranchers, which basically means everyone is connected to the land through varying degrees of separation. How our food is grown and how our animals are treated should be everyone's problem. What I see that has happened is the demonizing of ranchers and farmers for problems that are more systemic. The livestock industry has been trashed a lot by animal rights groups and environmental movements. This makes me sad, as farmers and ranchers are on the front line of our environmental crisis, and many care deeply about regeneration and have a deep commitment and connection to the land.

I think a lot about solutions that would help our world. There's this concept of an 'ecosystem cuisine,' which goes beyond something like vegetarianism or veganism and really examines a place-based diet that uses resources responsibly from a region. The reality of the Southwest is that it's arid. Meaning, we are best suited to raise livestock. We don't have a lot of water, and the high altitudes and cold winters make it hard to raise a lot of crops. Instead of making black-and-white statements about what is best for everyone, we should look at ecosystem solutions; this could help us create agricultural solutions that are catered specifically to each area. It takes an informed consumer to drive these sorts of real, place-based solutions. Consumers shape the marketplace that farmers and ranchers both depend on and serve. We need more place-based solutions that are grounded in the culture, economy, and ecosystem of various regions. This can never happen without informed, involved consumers.

REGENERATIVE FINANCE

What If Lenders Had to Consider Soil a Depreciating Asset?

Lauren Manning

Image by DAPA Image, Canva Pro

Whether or not you roll your eyes when you hear the term "regenerative agriculture," the concept has become household fodder. It can be hard to pin down, defined frequently by what it is not instead of what it is. I come at the subject from a variety of angles: an adjunct professor of agricultural law, eight years in agrifood tech venture capital, nearly two years in financial activism, and perhaps most importantly, as someone who tried to earn income raising and direct marketing grassfed meats.

My various intersections with this space result in frequent conversations about the fate of our food system, and how it impacts everything from the future of our planet to the ongoing rural-urban divide. What usually does not come up, however, is the role that money plays in helping or hindering our transition away from extractive agriculture. Unless, of course, the other person is a producer who has dipped a toe into the regenerative waters and attempted to transition their operation away from conventional commodity markets (bolstered by federal farm safety net programs, cookbook agronomics, and plug-and-play supply chains) toward the wild, wild west of growing, processing, marketing, retailing, and by some miracle, making a profit from unconventional food production.

After nearly a decade of thinking about the relationship between money and agriculture, my observations and ideas have little to do with dollars and cents anymore. Money is inherently uncomplicated. It is simply a numerical system for defining the value of things. It is our relationship to money and how it flows through bank accounts, bail outs, middlemen, paycheck withholdings, government programs, and so many other transactions that mucks things up.

Our current federal farm safety net programs are a prime example. What farmers and ranchers grow and how they grow it is dictated largely by the financial safety net our government policymakers have offered them, favoring commodity crops like

soy and corn (with much of the latter ending up in fuel tanks rather than on dinner tables). Even with the existing safety net, farming is a brutal exercise in economic survival for most producers. As a result, 96 percent of farm households receive off-farm income, and those earnings provide 82 percent of total income for all family farms.

The opportunity to neutralize risk — particularly the economic kind — is appealing to most producers. While the federal farm safety net programs may appear to be a carrot, they act more like a stick. If you're a farmer who has bravely stepped off the commodity treadmill to embrace new types of production or new market opportunities and forfeited your access to government programs like crop insurance and subsidy payments, you are one severe weather event or supply-chain crisis away from losing your livelihood — and perhaps your fifth-generation family ranch. Sadly, the realities of today's food production business have left our producers carrying a disproportionate share of the economic risk associated with actually transitioning to regenerative practices.

Banal as the phrase may be, there is no such thing as a free lunch. True cost accounting analyses have demonstrated how the system that provides us with cheap, widely-available food has externalized the total cost elsewhere: to our lakes, streams, grasslands, forests, and bodies. If we truly want to make the shift toward regenerative agriculture, we must also accept that there is no such thing as a free transition. The good news is that there is no shortage of capital available that could foot the bill. Once again, discussions about money are rarely ever just about money. The bad news is that unless we can effect a massive culture shift in the way that capital providers engage with agriculture, regenerative agriculture will be limited by the ability of producers to bootstrap, consumers' already shrinking food budgets, and philanthropic life support. For better or worse, I suspect that our ability to change the culture of capital from a short-sighted, extractive mindset to a patient, flexible, and non-extractive paradigm will ultimately be what makes or breaks this movement.

Fortunately, a growing chorus of stakeholders are championing new approaches to growing food that prioritize non-economic outcomes, like environmental regeneration and a move toward non-extractive agriculture where the returns to the lender or investor do not exceed the wealth created by the farmer.

To understand our current culture of capital, it helps to go back to the 1980s farm financial crisis, spurred on in no small part by Secretary of Agriculture Earl Butz, who encouraged farmers to "plant fence row to fence row," "get big or get out," and capitalize on foreign trade markets. To increase their production capacity, producers took on significant debt to acquire more land, machinery, and inputs. Between 1970 and 1980, farm sector debt soared from roughly $300 billion to $500 billion. What happened next is well-known: interest rates skyrocketed, the Federal Reserve shifted policies to tamp down inflation, President Jimmy Carter enacted a grain embargo on Russia in response to its invasion of Afghanistan, overproduction sent prices on a downward spiral, and tens of thousands of farms went under. As farms disappeared, rural communities faded with them.

The federal farm policies of the "get big or get out" era did tremendous damage to producers. But they also caused harmful ripple effects elsewhere in our food system. The major grain companies saw an opportunity to take advantage of the enormous grain supply by launching new markets around high-fructose corn syrup and ethanol — markets that subsequently distorted the eating habits of millions of Americans and diverted vast amounts of farmland to the production of fuel for automobiles. Meanwhile, the cattle industry capitalized on the abundance of cheap animal feed, encouraging Americans to eat even more meat.

The ag biotech industry also capitalized on the "fence row to fence row" mentality. Monsanto introduced Roundup Ready soybeans in 1989 and Roundup Ready corn in 1998 — genetically modified varieties designed to survive the heavy use of chemical pesticides. The long-term impact of the food policies launched in the 1970s and 1980s is still with us today. Most of our current agricultural finance policies still favor high yields and maximum efficiency with little regard for the impact that aggressive production strategies and a prevalence of commodity-based monocultures has on the environment, human health, social equity, and — as the COVID-19 pandemic demonstrated — food security.

Here's just one example: the USDA Natural Resources Conservation Service estimates that Iowa alone has lost 6.8 inches of topsoil since 1850, which harms agriculture yields to the tune of 10 fewer bushels of corn per acre. Meanwhile, the Iowa Daily Erosion Project estimates that soil loss is costing Iowa corn growers as much as 29 bushels per acre on highly erodible land. Overall, the price tag for Iowa's ongoing soil loss has cost producers in the state an estimated $1 billion in revenue. Current government policy has not only ignored this sleeping giant of a problem, it's condoned it. The USDA maintains a metric called T, which refers to the amount of soil loss that is tolerable on a farm. Producers have largely offset yield reductions due to soil loss and poor soil health by applying more nitrogen fertilizer and choosing different biotechnology-derived seed varieties — short-term fixes that do not solve the long-term underlying problem.

The yield-hungry policies set into place during the Butz era have led to ecological decline, low incomes for producers, less nutritious food, and a vulnerable food supply chain. This policy environment has bred a culture of private capital with a similarly myopic hunger for profits and growth regardless of the cost. Fortunately, a growing chorus of stakeholders are championing new approaches to growing food that prioritize non-economic outcomes, like environmental regeneration and a move toward non-extractive agriculture where the returns to the lender or investor do not exceed the wealth created by the farmer. But without adequate financial support and a favorable policy environment, these movements have little

hope of scaling across the 911 million acres of farmland in the U.S. Changing federal policy is a herculean task made thorny by lobbyists with substantial corporate-backed war chests. And until policy changes, private capital has little incentive to change its posture from yield-focused capital providers to capital partners who could shoulder the risk of transitioning to a more regenerative agriculture alongside producers.

Financing a Revolution

Venture capital and private equity may help commercialize technologies that produce food with fewer inputs or develop a new class of bio-based inputs to replace existing agrichemicals. However, these pools of capital typically lack the patience and flexibility that producers need when transitioning to regenerative agriculture, which values healthy soil, biodiversity, water quality, safe working conditions, nutritional quality, and food security rather than the biggest financial returns possible. Transitions come with high upfront capital costs and risks associated with changing what is grown, how it is grown, and where it is sold. In essence, many producers transitioning to regenerative agriculture are forced to architect their own independent supply chains while becoming marketing, branding, and distribution managers. This can result in longer timelines to profitability and slow growth.

Debt capital is the predominant source of financing for food producers. The Farm Credit Administration is an independent financial regulatory agency that oversees the Farm Credit System (FCS), a nationwide network of lending institutions that serve farmers, ranchers, agricultural cooperatives, and other eligible borrowers. It also oversees the Federal Agricultural Mortgage Corporation or Farmer Mac, which provides a secondary market for agricultural real estate mortgage loans, rural housing loans, and rural cooperative loans.

Although the agency's policies have recently become more sophisticated, especially when compared to non-savvy lenders, its underwriting practices are still largely steeped in the ethos of the Earl Butz era. Loan applications are evaluated solely based on whether a producer will yield enough profit to repay the loan over the required period. Soil is not viewed as a depreciating asset, and non-economic outcomes like water quality, reduced nutrient runoff, and wildlife are not reflected on the balance sheet.

As the top loan provider to some of the largest pork conglomerates in the United States, FCS perpetuates the kinds of harmful practices that characterize the entire food system. For example, in addition to the climate impacts of high-density confinement livestock operations — such as water contamination and nutrient runoff — pork production is responsible for using 27 percent of all medically-important antibiotics sold in the U.S., perpetuating antimicrobial resistance and reducing the efficacy of antibiotics for both humans and animals.

Producers can also access loans through the USDA Farm Service Agency (FSA), which provides direct and guaranteed farmland loans and operating loans to producers who cannot obtain commercial credit from a bank. Known as "the bank of last resort," FSA's loan guarantees provide conventional agricultural lenders with up to a 95 percent guarantee of the principal loan amount.

Producers wanting to transition to regenerative agriculture face many of the same challenges they experience at FCS when attempting to access capital through FSA, including a lack of understanding about regenerative practices and a tendency to prefer conventional practices due to their familiarity. FSA loan officers have to want to learn more about alternative markets in order to understand a producer's proposed business plan. They also need to recognize that short-term changes in farm management practices can have long-term impacts on soil health and the land's overall productivity, and that these realities should be reflected in the agency's lending policies. As it stands, a producer largely has the burden of proving to FSA that the alternative practices or markets she wishes to adopt will provide sufficient cash flow.

Imagine how agriculture finance might be different if lenders redesigned their policies to support the values inherent in regenerative agriculture. Recall the massive levels of soil damage condoned by the current policies of government agencies as well as private lenders. Then consider how an underwriter's opinion of a potential loan deal might change if soil were counted as a depreciating asset on the balance sheet. How might an underwriter's opinion of a potential loan deal change if they knew that conventional farming methodologies were stripping soil away at a rate that would make that land unprofitable in 15 years, regardless of all the agronomic bandaids and government payments available? The result might be that a loan applicant planning to apply regenerative farming principles would suddenly be more attractive than a conventional farmer — precisely the opposite of current lending practice.

How might an underwriter's opinion of a potential loan deal change if they knew that conventional farming methodologies were stripping soil away at a rate that would make that land unprofitable in 15 years, regardless of all the agronomic bandaids and government payments available?

Changing the Culture of Capital

Fortunately, some members of the financial community are already forging a new economic path for farmers and ranchers. Their innovations are providing examples of how a different approach to agricultural finance is possible — one that shares risk more equitably and makes it possible for farmers to produce food in sustainable, healthy ways while earning a fair share of the profits. Philanthropy, in particular, has a unique opportunity to reveal a different path, along with any members of the private capital space who are willing to buck against conventional culture and demand

something different from their peers.

There's a strong connection between how farms are financed and the kinds of agricultural practices farmers are able to employ. At a very high level, the solution to this financial conundrum is convincing all capital providers — heads of government agencies, private investors and lenders, philanthropists, and consumers as taxpayers — to start viewing themselves as capital partners. It also lies in creating a financial safety net akin to the one conventional food producers currently access that is better tailored to more regenerative forms of food and fiber production.

One way to jump-start this change is by leveraging the power of philanthropic capital. This category of finance encompasses donated money that is deployed in a variety of forms including grants, recoverable grants, and program-related investments.

A grant is essentially a gift, while a recoverable grant is a grant that can be returned to the donor if the recipient achieves their objectives. A program-related investment (PRI) is an investment made using the foundation's capital that is reserved for philanthropic purposes, like mitigating climate change or addressing social injustice. These investments are made with below market-rate return expectations.

Current philanthropic strategies largely involve deploying capital to intermediaries — other nonprofit entities and charities that carry out the actual day-to-day work that the philanthropists want to see done. For example, a foundation geared toward addressing climate change may provide financial support to a number of programs working in areas such as energy, clean water, or food and agriculture.

PRIs offer a promising opportunity for philanthropic organizations to create a safety net for producers wanting to transition to regenerative agriculture or expand their existing regenerative operations. Unlike grants, which are one-time allocations of capital, PRIs can generate returns that maintain the fund indefinitely. Foundations can also set their own expectations around returns, timing, and the non-financial outcomes they hope to produce. This allows them to offer producers patient, flexible, and non-extractive capital.

A host of philanthropic entities are rallying to this cause already. Mad Agriculture is an organization working to launch patient, flexible, and non-extractive capital sources for producers. Inspired by the Mad Farmer poems of Wendell Berry, it offers radically different financing terms for producers wanting to transition to organic production, including transition loans, down-payment assistance, and succession or farm transfer loans, as well as classic capital forms like operating loans, mortgages, equipment loans, and infrastructure loans. Perhaps most important, Mad Ag acts as a partner in the process, advising on business design, market development, diversification opportunities, and more.

Mad Ag is also tackling one of the biggest challenges facing our transition to a more regenerative agriculture: architecting a new supply chain. Their Mad Markets platform aims to connect farmers to mission-aligned buyers while promoting adoption of regenerative agriculture in the broader marketplace.

Mad Ag is not alone in its endeavors. The Steward Foundation provides flexible loans to "human-scale" farms, ranches, fisheries, and food producers engaging in regenerative agriculture. It does this by providing qualified lenders with the opportunity to purchase loan participations. Dirt Capital Partners invests in farmland in partnership with regenerative producers throughout the Northeast to assist with relocation, expansion, restructuring, and engaging with land trusts to keep agricultural land out of development. Iroquois Valley Farmland REIT is an organic farmland finance company that helps producers secure long-term land access and working capital through leases, mortgages, and operating lines of credit.

There's a strong connection between how farms are financed and the kinds of agricultural practices farmers are able to employ.

Important work is also being done to bring greater social equity to agriculture, which has a history of financial discrimination against non-white producers. Potlikker Capital is a farm-community-governed charitable and integrated capital fund created to holistically serve Black, Indigenous, and people of color (BIPOC) producers. This involves providing capital to stabilize and grow existing businesses, access to higher-value markets, access to cooperative ownership opportunities across the food-value chain, educational opportunities, and assistance with adopting regenerative agriculture. Similarly, Akiptan, a Native-focused community development financial institution, is working to transform Native agriculture and food economies by delivering creative capital, leading paradigm changes, and enhancing producer prosperity.

There are more examples of lenders and investors working to build a new financial ecosystem for agriculture. It takes courage to tackle this work. Pioneers in this field face criticism, mockery, and even shunning from their peers if they fail (and sometimes even when they succeed). But their work is critical to solving not just the economic crisis that producers face but also the climate crisis and the human health crisis that our entire species face.

The changes we need to create a more regenerative agricultural system — financially and in other ways — may seem daunting. But they don't have to happen overnight; and they shouldn't. Long-term, sustainable change is the goal, and such change is driven just as much by ordinary citizens as it is by philanthropists, policy-makers, investors, and farmers.

LATE NIGHT THOUGHTS FROM THE WIND

By Joshua McKenna
with painting by Rachael Leitnaker

Every night, through the screen of my open window, I listen to the wind rustle the leaves of the cottonwood trees in the pitch black sky. Occasionally the rustling dies, and the other sounds of the dark take its place. Crickets chirp, an owl hoots, and the coyotes cry to the moon. It's a moment of relaxation that helps lull me to sleep after a long day of hard work, but it's also a time when the somber feeling of the unknown can settle in. Darkness has always been closely linked to the unknown — and by extension, fear — in our subconscious. I wonder how the cattle are faring in the night, if the calves have paired up with their mothers, if my unending list of things to do has reached an acceptable stopping point as it swirls through my head. If I'm not careful, this swirl can overtake my mind. The unknown, the incomprehensible, the uncontrollable, all can lead to fear and stress. What's important to remember, though, is that night — and darkness, too — is a natural occurrence, one that plays an important role in our lives, despite the unease it can bring.

Much like the aforementioned fall of night, many of the various forms of nature can cause us to become stressed or anxious, especially for those who work within agriculture. Too often throughout my years in this industry, I've heard: "Sure could use some rain..." Stress is a cross we bear, as our livelihoods depend upon the whims of the seasons. Climate has a very direct and immediate impact on our everyday lives, going so far as to make or break some businesses. Most of us take precautions against the worst that nature can throw at us, such as installing water storage tanks, building reservoirs for drought, or mowing grass and digging fire breaks in case of that stray lightning bolt. But no matter how much or how well we prepare, inevitably something will happen that proves Mother Nature has the final say.

For myself, and for many out here in eastern Colorado, it was the suddenness of a very wet spring — after years of less-than-average rainfall — that reminded us that we aren't in complete control of the world around us. On the Brett Gray Ranch, every day, week after week, dark clouds would move in, creeping across the landscape, accompanied by streaks of white hot lightning as the air began to move, becoming wind that tore at my clothes and made me squint my eyes. The low rumble of thunder could be felt in my bones and was quickly followed by rain that drove down to the earth with the speed of many bullets, soaking anything left outside in moments. The result was that many of our roads got washed out, and entire fields became flooded and muddy. Insects swarmed up in response and quickly attached themselves to our calves, biting and sapping them of energy. Our yearling herd wasn't spared in the onslaught of new, unexpected problems. Foot-rot became an ongoing battle, as many of the younger cattle began to partake in their newfound love of lounging in large, muddy pools of standing water. This is but one example of the unpredictability of climate and how it can easily affect our lives for the worse. It is perhaps the reason why past generations leaned so heavily on man-made, artificial solutions to solve certain natural challenges, and provide food producers a small edge on which to carve out a living.

Despite the hardships and difficulties that arise as a byproduct of climate, I can't help but find myself in awe of it every day. The unknowability and unpredictability, while dangerous and stressful, are also what make climate so exhilarating. Like night, the oncoming storm brings darkness, worry, and anxiety. But also like night, the sensations of adrenaline and adventure are very present. When I am out on the prairie in the early morning and watch the clouds roll by against the backdrop of a perfectly blue sky — so absolutely massive and breathtaking in their form — I can't help but feel as though I am a meaningful part

of this incredibly interwoven and detailed landscape. It is a feeling that I believe the majority of farmers and ranchers can relate to.

Climate, and by extension nature itself, is a wonderfully complex thing. The dictionary definition of climate is "the weather conditions prevailing in an area in general or over a long period," but I would argue that in order to discuss climate, you need to broaden your vision to encompass more than just weather. In chaos theory, a branch of mathematics that focuses on finding patterns of randomness in chaotic and complex systems, there is a principle known as "The Butterfly Effect." The core of this principle is that

everything is affected by everything else — the distant wingbeat of a butterfly in Chile applies a minuscule but meaningful pressure to the tree that falls in a gale outside Albuquerque — and it is through this lens that I find it most appropriate to appreciate weather, climate, and nature.

Consider, for instance, the hydrologic cycle. This cycle directly affects weather, and is itself directly affected by soil health, which is directly affected by the animals grazing the foliage grown from said soil. Farmers and ranchers make their contribution to this cycle by determining how they graze their animals or plant their crops. The example could continue, going in any direction to further illustrate the depth of interconnection which is nature. The point is that climate encompasses more than merely the clouds above our fields and herds. It impacts us and we impact it. It is both vitalizing and volatile, sturdy and fragile, and I believe it's our responsibility — as people so closely tied to the Earth — to aid and protect it. Now, with advances in technology and a better understanding and comprehension of the intricacies of our world, ranchers and farmers are better equipped than ever to grow and develop new techniques that continue to give more to nature than we take.

We may never be able to fully comprehend our climate, or the other unknowns of our natural world, and thus, always have a healthy dose of fear and anxiety in regard to them. But it is my belief and hope that as we move forward with regenerative agricultural practices, educating and teaching those around us, we will arrive at the day when society understands the importance of our natural environment and the incredible role that agriculture has to play in preserving it for the generations to come. Thoughts like these run through my head and bring peace of mind, enough for me to close my eyes and fall asleep. The sun will dawn on a new day, ripe with possibilities. And whatever the day holds, we face it with determination, joy, and bravery, confident in the knowledge that we all have a role to play in the beautifully convoluted system that is climate.

NUTRITIONAL MIGRATIONS: The Importance of Purpose in

Melanie Kirby

with photos courtesy of Melanie Kirby

"Nature vs. Nurture"

The sun is setting, the truck is loaded and humming, and the straps are tightened… A migration is about to commence, one resting on the combination of symbiosis and consilience, between livestock and steward, bringing together diverse disciplines to further progress. Food for one leads to food for the many, fortifying individual organismal health and fabricating the woven tapestry of a superorganism's overall networking capacity. The nectar nomads and pollen pilgrims are following the bloom…

There is a reason that beekeeping falls under the category of animal husbandry: the steward soon becomes married to the well-being of these buzzing, individual, and collective lives, each of which interacts with nature to pollinate and substantiate forage, cultivars, wild zones, and various pastures. From my perspective, as an entomologist and beekeeper for almost 30 years, it is apparent that more attention needs to be given to nutrition for this livestock. As the old adage states, "You are what you eat." Bees are the midwives of our food. Therefore, we must be cognizant of their interactions and the interconnectedness of their role in our multiple ecosystems — the agro-ecosystem, the api-sphere, and the biosphere — for their sake as well as our own.

"Nature vs. nurture" is a misleading term, which fails to recognize the complex interplay between humans, bees, and our shared environments. The term sets up a faulty dualism, which keeps the realm of "nature" distinct from the realm of human care. We must forge our way past this term when it comes to our apiarian relationships, and consider the ways in which humans can nurture nature itself, promoting conditions that allow for the development of bee colonies: clean air, clean soil, and proper flora. These conditions strengthen the connections between worker bees and their queen, and alter bee gut microflora in positive ways. Caring for nature — and caring for bees and their habitats in particular — also has the capacity to promote longevity for many different species. Having a diversity of habitat promotes a diversity of pollinator species, thus encouraging biodiversity across plant and animal relatives.

Today, however, this capacity is increasingly under threat. The continued integration of modified crops, the systemic use of pesticides, poor air and water quality, extreme weather, and environmental contaminants all lead to

Place, Power, and Pollinator Stewardship

negative changes in microbial interactions between bees and their environment. For instance, when pollinators inadvertently come into contact with contaminated forage or forage that has pesticide residue, it can destroy their necessary microbiome and gut flora. Nutritional values and longevity diminish when toxic residues and multiple exposures harm food quality. Finding bees that can withstand the extremes of our changing climate — while remaining productive, healthy, pest- and disease-resistant, and gentle over time — is like finding a needle in the haystack. When found, though, such traits form a treasured gem that can be shared and distributed to other nuanced producers. Rearing bees under such disparate and dangerous natural scenarios offers something like a living laboratory in which to examine their behavior and life patterns; it is something that cannot be completely replicated by man, but only studied and cared for.

Horticulture and the Healing Arts

Food is medicine. Water is life. We are all interconnected. We learn from our landscapes where to find water, where soil teems with life, where forage abounds. Our stewardship practices are inextricably linked with our food systems. Wherever we live, work, play, reap, restore, we are beholden to this precious Earth for ensuring our survival. We are healed and can heal in return. From farms to forest lands, our landscapes can provide if we reciprocate…

Horticulture and the healing arts have long had a vital connection. Over 70 percent of modern cures have been concocted with materials derived from plants. Although plants are morphologically simple compared to animals, the simplicity of their forms is compensated for by a complex biochemistry, much of which repels pathogens and predators. This ability of plants is exploited by humans for medicines or for health-functional phytochemicals.

The so-called "magic makers" of diverse spiritual, cultural, and physical disciplines across world history have observed the plant universe, and learned that when used properly, certain flora can make us healthier. Some folks now venture to say that bees themselves are medicinal — and indeed, we are beginning to see and hear more evidence to support the belief that their products, behavior, and pollination services are therapeutic for humans. As research continues to grow around apitherapeutic capabilities — such as bees detecting diabetes and cancer, venom therapy for diseases like rheumatoid arthritis, or age-defying royal jelly cosmetics — it is only a matter of time before such healing properties are better understood and promoted for interspecies health and wellness.

Photo left: Melanie Kirby & Mark Spitzig checking bees on the High Road to Taos.
Photo right: (Wo)Man of Bicorp: oldest known cave painting of Indigenous beekeepers found in Valencia, Spain.

Given that bees often feed on medicinal forage, it is intuitive enough to surmise that, in turn, these same plants are contributing to their organismal hive health immunity and response. Such a diverse and nutritious diet gives them valuable environmental tools, nurturing their genetic story, and enabling them to overcome ailments and negative circumstances. But in order for bees to utilize their available diet to further promote such positive genetic dispositions, habitat promotion is essential. By giving bees time to develop through the various seasons, the living laboratory of our varied world poses testing scenarios in which they can learn to thrive. By observing our landscape, assessing natural flows, and

promoting healthy interactions for sustainability, stewards of all stripes — especially apiarian livestock managers like myself — are giving the bees, alongside other pollinators, the chance to develop as best they can, given their circumstances in our changing climate.

Consilience and Reconciliation

So, like seeds, are the bees. Bees are the winged angels of agriculture, who carry genetic information formed over time; as such, they are seed-information-storing machines, passing on their knowledge to the next generation. Regionally fortified by real-world, natural circumstances, these pollinators carry the stories of the ecosystem itself. They pass along the ability for life to be conceived, and interact in the most intimate of dances of biological exchange…

Developing sustainable and recurrent systems that preserve energy, respect biodiversity, and promote health and wellness for plant and animal organisms is essential. Our connection to the world around us, and the fact that this world feeds, clothes, and shelters us, is at the heart of my discussion here. For our sake, as well as that of the planet, we must ask ourselves important questions: How do we connect to ourselves — both in mind and in body? How do we connect to each other: as one person to another, as a people to society, and as a society to various cultures? Why do we connect to culture, if not to highlight the beauty and majesty of our presence, experience, and intelligence here in this world?

It is within our power and responsibility to make positive changes for the betterment of our landscapes and livestock. Caring for our places means caring for bees means caring for ourselves. My own efforts reflect the microcosm within the macrocosm: my "small drops in a big bucket" can add to the collective efforts of those around me, a connection across culture and space. The bees have led me on a most incredible journey, one I am not even half-way through, should Creator grant me another 50 years. I plan to learn from bees and their stewards until I am no more. By learning from nature, by allowing it to nurture us in return and bring forth new adaptations, we can develop a better process of understanding and consilience.

By learning from nature, by allowing it to nurture us in return, and bring forth new adaptation, we can develop a better process of understanding and consilience.

By consilience, I mean the unity of seemingly disparate knowledges: the act of bringing together multi-disciplinary efforts to create better systems of discernment and action. This term, in a sense, is another definition for holism or holistic review. I have no doubt that it will take more than new beekeepers, more than the seasoned professionals, and more than experienced researchers (alongside their respective institutions) to bring about positive change in honeybee and pollinator management. This "more" requires what I call *The Reconciliation. The Reconciliation* includes bio-diversified agro-ecosystems, populated with honeybees and native bees; it includes mindful funding initiatives, well-intentioned strategizing, and concrete steps for action that will ensure our varied landscapes will continue to sustain life — for us and for future generations. Let us work together to take positive steps to keep our pollinators healthy, productive, and resilient, today and in the future.

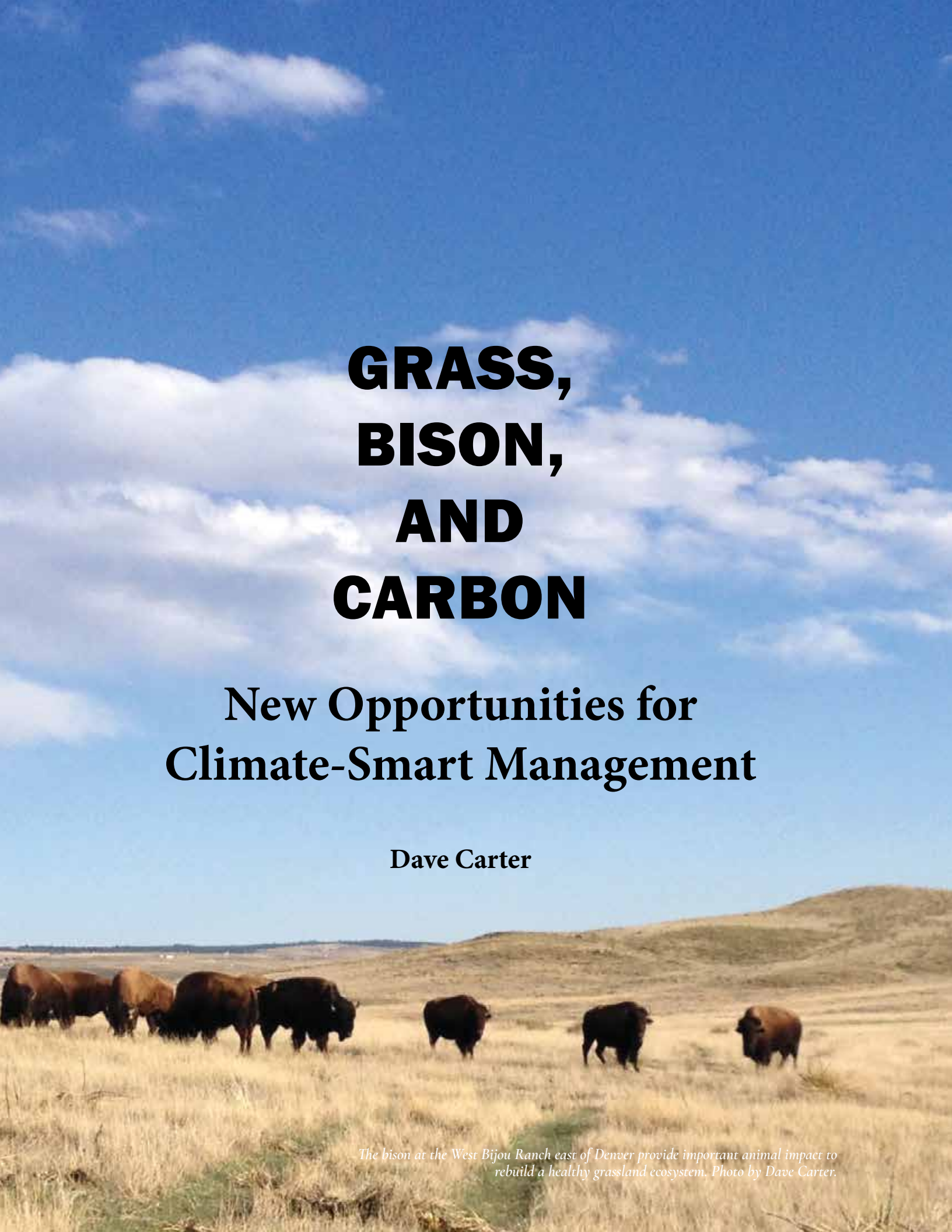
Poeh Povi: The Flower Path

It will take a community to raise bees — including you, me, the ground beneath our feet, and the air above our heads, the waterways flowing, and the fires of chemical reaction. It will take many elements, and the most important one is stewardship: the preservation of healthy landscapes, the promotion of nutritional forage and sustainable management, which rests with us as the caretakers of creation…

Such are the efforts of Poeh Povi: The Flower Path, an Indigenous matriarch collective working together to regenerate pollinator habitat in wildfire- and environmentally-contaminated landscapes in northern New Mexico. The collective includes Teresa Kualitay Quintana (Kiowa) who resides in Cochiti Pueblo; Roxanne Swentzell and Beata Tsosie-Peña of Santa Clara Pueblo; Addelina Lucero of Taos Pueblo; and me, Melanie Kirby of Tortugas Pueblo. Through a New Mexico Coalition to Enhance Working Lands Community Collaborations Fellowship seed grant, we have launched The Land of Enchantment Pollinator Preserve Initiative. Come fall of 2023, we will be collecting wildflower seeds and creating outreach materials to share with our communities. In spring of 2024, we will be holding community events for making wildflower seed balls that then can be cast in backyards and across forest lands for regenerating landscapes, thus promoting healthy pollinator nutrition. With healthy pollinators, our beloved New Mexican landscapes will have better pollination, which leads to better seed quality, and higher subsequent germination rates. This is a never-ending cycle of give and receive, one that reciprocates and that nurtures stewardship and a sense of place. Join us. Join *The Reconciliation.*

Image above: Poeh Povi logo

Photo left: Poeh Povi collective (pictured: Roxanne Swentzell, Melanie Kirby, Addelina Lucero, Beata Tsosie-Peña; not pictured: Teresa K. Quintana)



GRASS, BISON, AND CARBON

New Opportunities for Climate-Smart Management

Dave Carter

The bison at the West Bijou Ranch east of Denver provide important animal impact to rebuild a healthy grassland ecosystem. Photo by Dave Carter.

Smoke from rampant Canadian forest fires blanketed cities ranging from Denver to Boston last summer, darkening skies and creating unhealthy breathing conditions. Few stopped to consider that the smoke-filled haze was saturated with carbon dioxide, belched back into the atmosphere by the burning trees.

Forests have long been touted as the "earth's lungs," playing a critical role in filtering carbon dioxide and other greenhouse gasses from the atmosphere. These forests are indeed efficient at capturing and sequestering the carbon dioxide generated by animals and human activity across the globe.

Efficient, yes. Resilient, not so much.

Smoke pollution from forest fires is becoming increasingly common. In the past few years, fires in the Pacific Northwest, Colorado, and New Mexico have created similar blankets of CO_2-laden smoke. Fire isn't the only culprit undermining the ability of forests to effectively sequester carbon over long periods. Other aspects of climate change are diminishing the carbon-cleansing power of forests.

In 2019, an in-depth Washington Post series on climate change noted that "[b]eetles and drought have imperiled Montana's forests so much that they no longer clean the air of carbon dioxide. Instead, they are sending millions of tons back into the atmosphere." CNN reported in 2021 that 10 World Heritage forests are now emitting more carbon than they are removing.

Even healthy forests lack resiliency when it comes to long-term carbon sequestration. According to the World Resources Institute, more than half of the carbon captured by trees is stored above-

Bison on the Savory Institute's West Bijou Ranch are managed to help restore grassland and soil health. Photo by Dave Carter.

ground, in trunks and branches, leaves, and decaying matter.

Pioneering regenerative agriculture around the world understands that the most resilient carbon sequestration tools don't tower above us but exist under our feet.

Unlike trees, the grasses native to the North American continent sequester the majority of carbon they capture in the soil — where it is largely immune to release by fires, insects, or other impacts. That's why the University of California at Davis released a report in 2018 entitled "Grasslands More Resilient Carbon Sink than Trees."

Lead author of that report, Dr. Pawlok Dass, wrote: "Looking ahead, our model simulations show that grasslands store more carbon than forests because they are impacted less by droughts and wildfires. This doesn't even include the potential benefits of good land management to help boost soil health and increase carbon stocks in rangelands."

This is nothing new. The grasslands that historically comprised more than 30 percent of the North American landmass have quietly captured and sequestered carbon since the glaciers began their retreat at the end of the last Ice Age. According to the Climate Trust, the top meter of soil in grasslands sequesters approximately 49 tonnes of carbon dioxide equivalent per acre. Each tiny blade and leaf extending inches above ground contributes to that process by capturing the carbon and sending it into the soil via roots extending several feet below ground.

They can't do it alone.

As Allan Savory noted roughly 50 years ago, the semi-arid, highly temperature-variable ecosystems in which grasslands prevail lack the capacity for dead plant material to naturally decompose. Left untended, the dead materials will slowly choke out the living plants, leading to desertification.

These grasslands require gardeners to remove that dead material, till the soil, plant the seeds, and fertilize the plants.

The gardeners that nature provided are those methane-emitting ruminants who are today being vilified as the culprits in global warming.

As the former executive director of the National Bison Association for a nearly 21-year tenure, which ended last year, and as a bison rancher myself, I still marvel at the symbiotic relationship that evolved between these grazing animals and their grassland ecosystems over thousands of years.

Pioneering regenerative agriculture around the world understands that the most resilient carbon sequestration tools don't tower above us but exist under our feet.

In recent decades, private ranchers, stewards of the majority of bison in North America, have evolved in their understanding and appreciation of that symbiotic relationship. Beginning in the mid-1980s the National Bison Association and its predecessor organization published a handbook on bison management and handling. In 2018, while helping to compile the most recent version of what is now entitled "The Bison Producers' Handbook," I took the opportunity to go back and read the original version published in 1986. That education could have been entitled "Everything I Know About Cattle Production."

The prevailing philosophy of that time was to utilize higher fences and stronger handling equipment, but otherwise treat bison like domesticated cattle. There was a section on dehorning, a discussion on the potential of artificial insemination, and several other topics lifted from the journals of North American cattle producers.

Fortunately, bison ranchers — including the cadre of people employed by Ted Turner on the ranches he was transitioning to bison in the 1990s — began to recognize that Mother Nature perfected this animal through the ages, and that perhaps our best management approach would be to intervene as little as possible. That's the basis for most bison ranching today, and for the regenerative ranching approaches now being utilized by ranchers of other ruminant species.

Often, intervention is designed to "reintroduce" some elements of that historic bison-rangeland relationship. The practice of high-density grazing with frequent rotation mimics the historic role predators played in keeping grazing animals tightly bunched and moving frequently.

We now know that encouraging such historic interactions between grazers and their grassland ecosystems is better for those animals, and better for the soil. It's a symbiotic relationship, with each dependent on the other.

In his 2022 book, "The Ecological Buffalo," Canadian bison specialist Wes Olson observed, "As a bison grazes across the landscape, her nostrils are constantly in contact with the ground and vegetation, and those places harbor millions of microscopic organisms. With

each breath she takes, thousands of these are vacuumed up off the vegetation and into her nasal passages, where they are caught on the wet mucosal lining. Periodically, she stops grazing, lifts her head, and with a couple of flicks of her tongue, cleans out the accumulated gunk and swallows it."

Olson notes that the microbes transferred to the rumen begin the work of breaking down the coarse fiber found in the bison's diet. In other words, as the bison steadily gardens the prairie, the prairie gardens the animal's gut.

Our grazing animals play a vital role in helping grassland ecosystems capture and sequester carbon, but to date, we are doing a sub-par job of getting that message out to the public-at-large.

The $3.1 billion allocated toward climate-smart agriculture projects by the U.S. Department of Agriculture over the past year may help us tell the story. Fully one-third of the 141 projects funded through these climate-smart grants include beef, dairy, bison, and other livestock as major components.

South Dakota State University and its Center of Excellence for Bison Studies, for example, are embarking on an $80 million multi-year project to develop climate-smart beef and bison commodities. The University of Tennessee is heading up a $31 million project to quantify and monetize the carbon sequestered by grazing animals in grassland environments. And a consortium of organizations, led by the American Farmland Trust, will utilize $31 million to document the greenhouse gas benefits of various grazing systems.

The ultimate success of climate-smart grassland management will hinge upon the ability to capture the added value of the meat and other products produced through regenerative practices. The current meat processing supply chain looms as a major obstacle in our ability to connect with consumers who appreciate that added value.

That is why the Biden administration's $1 billion commitment to creating a more diverse, resilient, and equitable meat processing system is a vital link in a new, climate-smart livestock supply chain. Through this commitment, the USDA is offering an array of grant and loan programs to stimulate the resurgence of a more decentralized processing system populated with smaller processing and marketing enterprises. The USDA also established a robust network of organizations to provide technical assistance to producers and businesses accessing those grant and loan resources.

Those organizations include the Niche Meat Processor Assistance Network, the Intertribal Agriculture Council, the American Association of Meat Processors, the American Meat Science Association, the Agriculture Utilization Research Institute, and Tuskegee University. Last year, I stepped down as executive director of the National Bison Association to join the team at The Flower Hill Institute, an Indigenous-led nonprofit based in New Mexico, which has been tasked by the USDA to coordinate this technical assistance network.

Producers and processors can access this free technical assistance network here: flowerhill.institute/usda-mppta.

As of October 1, we received nearly 1,000 requests for technical assistance from places as disparate as Puerto Rico and the Northern Mariana Islands.

During our first year, we focused on connecting underserved producers with the USDA grants, loans, and other resources being offered. Moving forward, our network will assist these processors and emerging processors to develop their sourcing protocols, business operations, and marketing strategies. The USDA's bold initiative seeks to create a more resilient, diverse, and equitable meat and poultry processing supply chain.

USDA is offering an array of grant and loan programs to stimulate the resurgence of a more decentralized processing system populated with smaller processing and marketing enterprises.

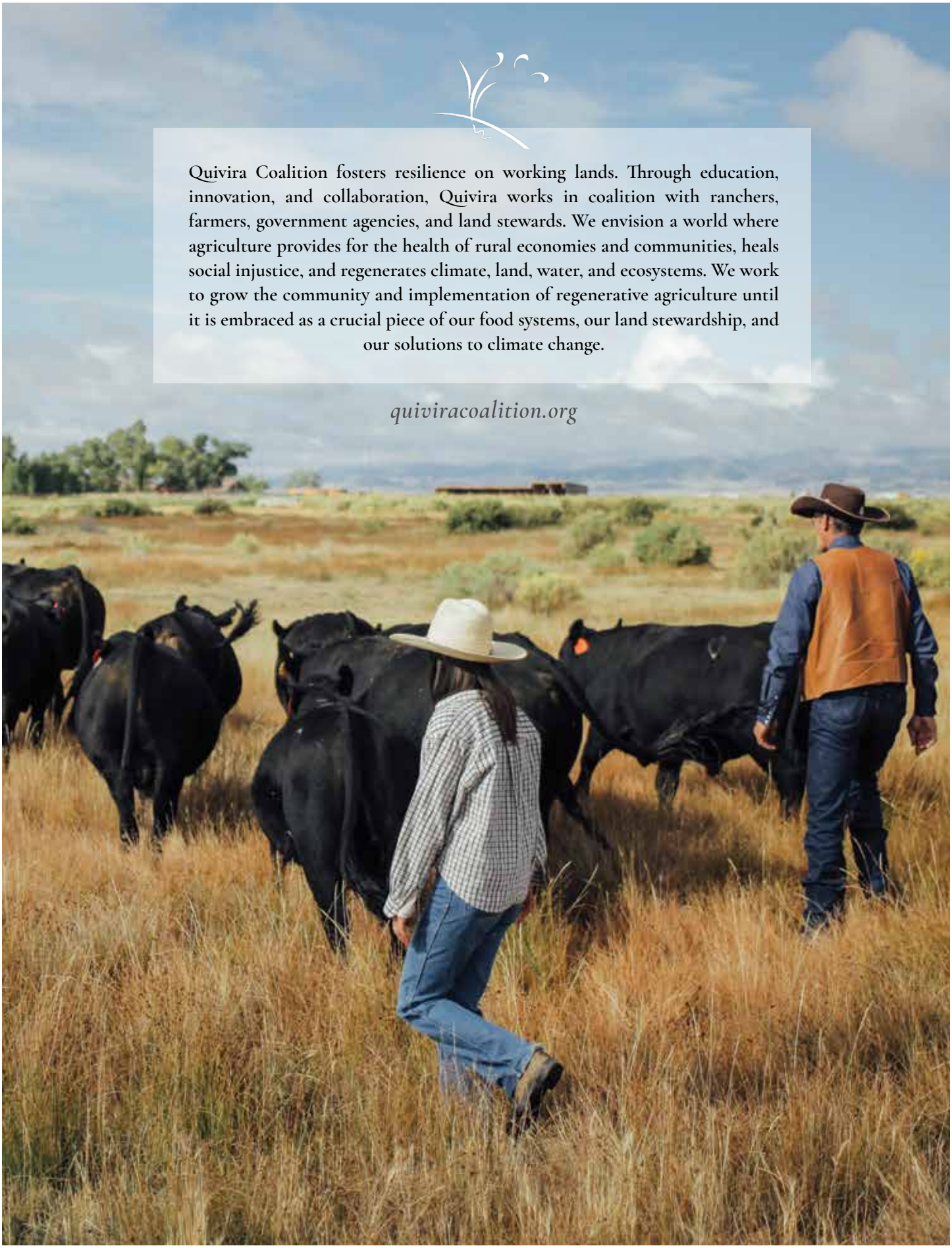
Many of those fledgling and expanding enterprises will offer new opportunities to develop market-based connections with consumers who discover that they can support climate-smart livestock production through their purchasing decision.

Much of our work is centered around helping producers, and the smaller processors, utilize "the other half of the animal." The large packers capture value for every item that comes off the animals they process. Consolidation in the rendering and hide-processing industries has left smaller processors out in the cold. Smaller plants are now paying to have hides and offal hauled to landfills, sometimes at a cost of thousands of dollars per month.

Fortunately, many pet food brands and consumer apparel companies are seeking high-quality, climate-friendly ingredients sourced from smaller enterprises. The projects and enterprises that we assist are perfectly primed to supply those ingredients.

All of these steps can help us reframe the conversation about livestock and the environment. After all, livestock today is being targeted as a major culprit in global climate change. No doubt, some prevailing practices are ecologically damaging.

But the more we dig into the historic interaction of grazers and grasslands, and the more we create new opportunities to take our climate-smart meat to the marketplace through a more resilient, diverse, and equitable processing system, the more we will be able to spread the word that our herds of bison, cattle, and other ruminants are creating carbon sinks that will never blanket New York City or Chicago with unhealthy smoke.



Quivira Coalition fosters resilience on working lands. Through education, innovation, and collaboration, Quivira works in coalition with ranchers, farmers, government agencies, and land stewards. We envision a world where agriculture provides for the health of rural economies and communities, heals social injustice, and regenerates climate, land, water, and ecosystems. We work to grow the community and implementation of regenerative agriculture until it is embraced as a crucial piece of our food systems, our land stewardship, and our solutions to climate change.

quiviracoalition.org

Find these stories of Resilience, the Down to Earth podcast, technical guides for land health, recordings of conference plenaries, information about agrarian apprenticeships, and much more at quiviracoalition.org.

Education, innovation, restoration – one acre at a time.

QUIVIRA COALITION

1413 Second Street Suite 1, Santa Fe, New Mexico | 505-820-2544 | quiviracoalition.org