Concerns Regarding Policies for Agricultural Land Management and Farmland Retirement for California.

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Policies can be created that may reflect what is thought to be the best science at the time, almost ensuring unintended consequences that can be seriously detrimental to the underlying objectives or the rationale of the original policy when created. Intentionally developing more system wide ecologically sound provisions to accommodate emerging science and evolving societal and ecosystem needs will serve not only the moment but the future generations of all species, communities, and the health of the planet.

An emerging scientific evolution regarding soil and ecological health is appropriately evolving to a holistic (whole-system view) and regenerative perspective that focuses on improving the carbon cycle and life systems. This can overcome the limits of reductionist science that evaluates only restricted variables in an attempt to answer a specific question. This approach fails to factor in broader challenges thereby leaving a significant risk of negative effects on other critical components of ecosystems. The problem with a reductionist paradigm is that natural systems only work in wholes, not in partitioned, singularly extracted simplified inquiry. It is like looking at "excessive" rainfall or flooding events as a question solely focused on the amount of rainfall without considering the soil's water infiltration rates. If soil has been disturbed or compacted, it has a compromised percolation rate of perhaps ¼ inch of water per hour (many soils are in this current condition) vs a biologically healthy soil that can percolate up to 14 inches or more of water per hour. This dramatic difference begs for a more holistic perspective. In other words, is the flooding event the amount of rainfall, or a combination of rainfall with the capacity of the soil's infiltration rate to capture that water and prevent flooding?

Any land management decision that may hold a holistic long-term affect remains context specific; meaning soil types, available moisture, evapotranspiration rates, potential for aquifer recharge, all must be included in the planning to improve the water availability within the whole region. Soil health, soil carbon accrual, and biodiversity can be regenerated rapidly to enhance water capture with conscious holistic and regenerative-management approaches as has been shown in research and on farms.

To avoid the disastrous unintended consequence of desertification or ecological degradation, a well-designed policy toward regenerative approaches can improve water and carbon cycles reinvigorating biodiversity and ecosystem health.

1. **The idea to "retire" land from growing plants to bare fallow with the assumption of water savings creates huge potential for unintended consequences.**

A total fallow as defined by leaving the land untouched or perhaps worse, tilled, will often have a cascading effect on soil carbon storage, biodiversity loss, decline in water infiltration

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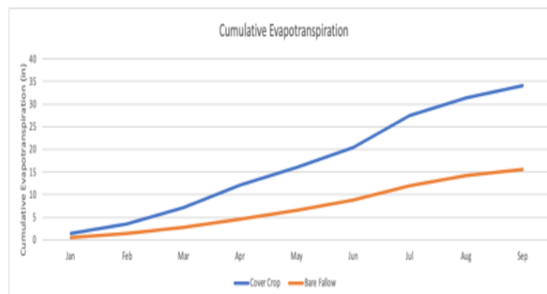
rates, erosion, decreased air quality, and increased heat radiating back into the atmosphere. If the rationale was to save water, then fallow could severely damage the existing potential for stream restoration, aquifer recharge, biodiversity enhancement, carbon capture, etc. Considering the inclusion of intentional regenerative practices including strategies of minimal to no-tillage combined with multispecies cover crops perhaps only grown with rainfall has been shown to have a significant positive effect on the ecosystem as previously mentioned. "Since the 1970's a shift away from fallows in Canada has resulted in an increase in precipitation and a decrease in summer temperatures."[1]

2. **Water capture for cropping, ground water recharge, and flood prevention:**

So much rainwater is lost due to poor soil stewardship from runoff and evaporation, especially on bare soil. Enhancing the water infiltration rates leads to more robust water capture and plant life; thus photosynthesis which leads to higher soil carbon capture, biodiversity, better overall soil health, flood mitigation, depth of soil aggregation, and in certain contexts higher aquifer recharge. Soil that can rapidly infiltrate those large amounts of rainfall usually combine diverse and abundant soil biology supported by a diversity of plant species, soil cover, and greatly reduced soil disturbance. Fallowed or bare ground that is tilled or chemically treated to control weeds, continues to lose moisture as demonstrated in a recent study conducted in Blythe CA where fallowed farmland (bare soil) continued to lose water despite the fact that it had not been irrigated.[2]

Cumulative ET over Time by TRT



Contrasting soils that were allowed to lay idle with multispecies cover crops benefited from a significantly lower soil temperature, higher overall soil moisture content, more stable soil aggregates (reduced erodibility), and a flourishing soil microbiome that resulted in a higher soil carbon content (CO_2 drawdown). The regenerative soils took on sponge like characteristics not only from increased carbon but also the enhanced microbiological populations that are crucial in "the formation of biogenic amorphous silica (bASi) in improving soil texture and water holding capacity. BASi can form silica gels with a water content at saturations higher than 700%, dramatically increasing plant's resistance to drought."[1] These soils held more water and allowed more water to percolate into the lower soil profile (recharge). Any management strategy where water conservation, water use efficiency, and ground water recharge is the goal, should consider soil health management as a foundational component.

3. **Soil health for biodiversity and soil fertility enhancement in planning for possible future needs to feed future populations:**

The amount of biodiversity below the ground is usually reflected by the amount above the ground and vice versa. Plant species diversity in cover crops or perennial plantings has been shown to increase diversity of the soil's microbiome which increases nutrient cycling, drought resistance, and soil carbon accrual. This diverse and complex plant mixtures (diversity) consistently foster microbiological balance among species, thus increasing nutrient cycling, soil aggregation, soil organic matter, CO_2 drawdown, and insect and bird diversity and abundances.

This immediate effect of increased plant diversity alone mitigates extinction challenges such as the loss of pollinator species. Diverse species can have a positive effect on biodiversity much larger than solely monocultured cropping. As insect populations continue to decline globally, this should be understood as a threat to food production. "Without insects," the legendary biologist E.O. Wilson wrote nearly 40 years ago, "I doubt that the human species could last more than a few months." First, "most of the fishes, amphibians, birds and mammals would crash to extinction." Next would go the flowering plants and forests. "The earth would rot," he continued, and the remaining vertebrates would disappear. "Within a few decades the world would return to the state of a billion years ago, composed primarily of bacteria, algae and a few other very simple multicellular plants."[3]

4. **Soil armor/covering:**

As mentioned above in point 2. keeping soil covered is critical to ecosystem health; ". . . the combined effect of both living and dead mulch greatly enhances soil carbon sequestration and soil and environmental cooling all of which are major ecosystem services provided by soil cover."[4] Policy aligning solely with the idea of total fallow could add to the climate crisis partly through warming the atmosphere further as well as continued degrading the soil's ability to capture CO_2 and water. Unprotected bare soil significantly increases in temperature and radiates that heat back into the atmosphere confounding the planet warming issue. In measuring desert soils Buxton found the surface levels heated to 160 degrees F during the afternoon hours.[5] At a field day in Blythe, CA bare fallow farm soils showed temperatures at 120 degrees F during a day with ambient air temperatures of 100 degrees F. If a million acres of farmland in the Central Valley were "retired" into a bare fallow condition, what unintended ambient air heating consequence would this cause? This human induced desertification of the landscape, while increasing the heating factor would also create a much-degraded condition from pre-settlement times when plant life and animal life were present in abundance.

Additional consequences of soil heating are the increased potential for soil water evaporation, up to a 34% increase.

At times, solar panels/solar farms are suggested as alternative use for these currently farmed lands. Wherein, that may provide some renewable energy production advantages, to design and build these systems without design features to properly graze livestock below the panels or at least to enable farm equipment to pass under the structures in order to terminate winter rain fed cover crops with roller-crimpers, mowing, or shredding to provide carbon based plant material to both feed the soil microbiome and to armor (mulch) the soil, we completely lose the opportunity to capture CO_2 and build the diverse and health of the regions ecosystems. India has alternatively placed solar panels over the top of water canals reducing the rate of evaporation from the open canals and making use of the thousands of acres this represents. Within our state of California there are miles of canal opportunity for solar panel installation. A recent article in the LA Times stated that "shading the 4,000 miles of water canals in the state of California could save as much as 63 billion gallons of water annually by reducing evaporation, which is enough to irrigate 50,000 acres of farmland or provide water to the homes of more than 2 million people".[6]

5. **Photosynthesis enhancement increases our chances to mitigate weather stress:** Current farming practices leaves a lot of soil underutilized regarding photosynthesis potential. If we simply observe how much of California orchard production has bare land between rows of trees, those acres could be transformed into massive acres of atmospheric cleansing and plant captured CO_2 feeding the soil's biological life through what Dr. Christine Jones has labeled 'the liquid carbon pathway."[7] Cover crops can help turn expanses of bare soil into carbon accruing systems (organic matter creating systems) even when deciduous orchards have gone dormant as well as dramatically increase CO_2 uptake during the growing season. This approach begins to help the state meet its climate action goals in a significant manner.

6. **Conversion of retired land to grazing lands with an eye to enhance ecosystems:** In the film Common Ground[8] there is a wonderful illustration to this premise of incorporating grazing for healthy ecosystems. In collaboration with other ranchers, Mexican rancher Alejandro Carrillo is helping large expanses of the Chihuahuan desert lands transition from degraded desert lands to historical productive grasslands with grasses six feet tall. Rain patterns change, and this more diverse and robust biological symbiosis has more than tripled cattle numbers and dramatically increased biodiversity while cooling and greening the region. This adaptive multi-paddock grazing (AMP) now scientifically researched independently by Dr. Richard Teague[9], TX A&M, Dr. Jason Roundtree[10], Michigan State, and a cadre of scientists brought together by Professor Peter Byck[11], AZ State University has shown remarkable ecosystem response with proper ruminant management mimicking natural ecosystems. Thus, rather than fallow, AMP grazing can provide more total days of photosynthesis per year as well as increasing overall biodiversity. Peter Byck's team has tracked a dramatic increase in insect and bird diversity with AMP grazing as well as soil carbon accrual and water infiltration. As summarized by Dr. Jason Roundtree, "these regenerative agricultural principles suggest that modern livestock systems can be redesigned to better capitalize on animal's ecological niche as biological up cyclers and may be necessary to fully regenerate some landscapes."

A comparison of land at rest on the left and AMP grazing on the right in Sonora Mexico

Summary and Conclusions:

Under regenerative approaches, landscapes can be supported to gain soil organic matter (carbon) that increases the ecosystems services at rates faster than what is typically understood. The soil's ability to increase infiltration rates and water holding capacity can be improved year after year, at deeper and deeper levels, creating a much more life-giving future to our economies, communities, ecosystems, and atmosphere. Policies and decisions made now can positively affect soil and ecosystem health for today with even greater returns for the future.

Acknowledgments:

NoRegrets Initiative, Paicines Ranch Learning Center & Paicines Ranch
Tim LaSalle, Cofounder, Center for Regenerative Agriculture & Resilient Systems, CSU Chico
Rose Marie Burroughs, Burroughs Family Farms, Cofounder, CRARS CSU Chico
Jonathan Lundgren, Ph.D., Research | Ecdysis Foundation | Estelline, South Dakota
Cynthia A. Daley, Ph.D., Director Center for Regenerative Agriculture & Resilient Systems, CSU Chico
Nicole Masters, Agroecologist, "For the love of Soil", Integrity Soils
Kris Nichols, Ph.D., KRIS Systems Education & Consultation
Kofi Boa, Founder and Director, Centre for No-Till Agriculture, Ghana
Fadzayi E. Mashiri, Ph.D., UC Cooperative Extension ~ Mariposa & Merced
Tom Willey, Farmer Emeritus, T&D Willey Farms, Madera, Ca
https://tdwilleyfarms.com/podcast-down-on-the-farm-with-tom-willey/
Ray Archuleta, Professional Soil Scientist/Conservation Ecologist, Symore Missouri
Thomas Fenster, Ph.D., student researcher with the Ecdysis Foundation and UC Davis

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CSU Chico Center for Regenerative Agriculture: Research Studies | Annual Report

This is a White Paper written for Groundwater Sustainability Agencies, Irrigation and Water Districts, Policy Makers, DWR, other stakeholders and interested persons in the topic. December 2023