REGENERATIVE AGRICULTURE FUNDAMENTALS

Your guide to reducing inputs and restoring resources for more sustainable farming

North Central IPM Center

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The term "regenerative agriculture" has multiple working definitions. All include reducing external inputs through approaches that regenerate or restore resources consumed during crop production by tapping sunlight, carbon dioxide, biological activity, and other on-site, renewable inputs. Regenerative agriculture emerged in the mid-1980s within the spheres of agroecology, sustainable agriculture and integrated systems (Gates and Gold 2007). Among others, J.I. Rodale was an early proponent of organic and regenerative farming. He founded the Rodale Institute, where research continues on these approaches. Regenerative agriculture is experiencing renewed interest from researchers, educators, marketers and certification bodies.

Some prefer that organic be a minimum requirement for meeting the definition of regenerative agriculture, with additional requirements such as soil health improvement, animal welfare and just and equitable conditions for farmers and farm workers, delivering "organic plus" or "beyond organic." Others feel operations can accomplish the goals of regenerative agriculture without adhering to all of the requirements for certified organic production. For example, an operation may plant crops genetically modified to provide immunity to a plant virus, or use very low risk synthetic pesticides, while also implementing practices that regenerate or restore resources consumed during crop production.

"Sustainable agriculture" is legally defined in U.S. Code Title 7, Section 3103. This definition focuses on site-specific practices that meet human food and fiber needs, while enhancing environmental quality and economic viability. Regenerative agriculture has similar objectives, but explicitly aims to replace resources used during production.

PRACTICES AND DESIRED OUTCOMES

Regenerative agriculture practices aim to improve soil health, contribute to climate stabilization, optimize soil moisture and maximize benefits from biological activity. For example:

- **Reduced tillage** can enhance soil aggregation, carbon sequestration, and water infiltration and retention. In regenerative agriculture, tillage is typically reduced without over-reliance on herbicides. Employing a diverse set of approaches to reducing tillage, such as deep ripping and strip tillage into cover crop residues, and the occasional use of shallow tillage circumvents the issues inherent in a single dominant approach to reduced tillage.
- **Cover crops, crop rotations, intercropping, compost, and animal and green manures** can biologically increase soil fertility by enhancing plant root microbiomes and increasing natural nutrient cycling. Reducing reliance on synthetic fertilizers reduces contributions to climate change from fertilizer production and transportation and nitrous oxide release into the

KNOWLEDGE GAPS

To maximize the potential of regenerative agriculture, more information is needed:

1. What production systems offer optimal configurations of cover crops and green and animal manures to maintain fertility, and minimize impacts on climate and air and water quality?
2. How do the economic and environmental benefits of regenerative agriculture develop and change over time?
3. Is there an economic benefit to investing in regenerative organic certification?
4. Can systems that include the judicious use of low-risk synthetic pesticides accomplish the stated goals of regenerative agriculture?
5. If so, can these systems continue to evolve to reduce or eliminate the use of synthetic pesticides?
6. Do regenerative practices lead to greater resilience, and enhance the ability of a system to adapt to a changing climate and human needs?
7. How does permaculture serve regenerative agriculture practices while integrating annual and perennial systems together?
8. Are there differences in outcome measures between regenerative organic systems and regenerative agriculture in conventional systems?

atmosphere; prevents alteration of soil microbial communities; and accelerates decomposition of soil organic matter. Crop diversity in time and space can disrupt the life cycles of pests and diseases by alternating hosts with non-hosts.

- **Conservation of organic matter and mulching** helps soil to retain moisture, moderates soil temperatures, stabilizes soil structure, provides food sources for microorganisms, and reduces the release of carbon into the atmosphere. Crop residues slowly release various nutrients into soil as they decay over the season, increasing the efficiency of supplemental fertilizers. Mulch and crop residues can suppress weeds, reducing or eliminating the need for herbicides.
- **Well-managed grazing practices** stimulate plant growth, increase soil carbon sequestration, and improve pasture and grazing land productivity while greatly increasing soil fertility and insect and plant biodiversity (Pushnik et al. 2017). Grazing animals cycle nutrients in the form of manure without the need of equipment to spread it. Well-managed mob grazing can reduce weed pressure.

All definitions include reducing external inputs through approaches that regenerate or restore resources consumed during crop production by tapping sunlight, carbon dioxide, biological activity, and other on-site, renewable inputs.

Retrieved from http://fullbellyfarm.com/about-us/.

Full Belly Farmer owners Andrew Brait, Judith Redmond, Jenna Muller, Amon Muller, Dru Rivers and Paul Muller.

CASE STUDY: **FULL BELLY FARM**

Paul Muller, a partner at Full Belly Farm in California's Capay Valley, has been farming organically for 33 years. Full Belly Farm is designed to maximize biologically activity per acre–plants, soil microbes, insects and animals–while harvesting as much sunlight as possible. Mueller grows over 70 fruit and vegetable crops on 400 acres of land. The Full Belly team is experimenting and learning how to manage soil biology and carbon, not just for production benefits, but also for the health of the ecosystem and ultimately for the health of the planet (Muller 2018).

Cover crops: Farm goals include always having plants in bloom. Carbon accumulators that serve other forms of life including mustards and arugula are grown through bloom so that pollinators can access pollen and nectar. Diverse cover crops grow year-round in rotations providing continuous pollinator and avian forage.

Low-till: Full Belly limits tillage to where it is critical to improving production including before planting carrots and radishes. Tillage releases CO_2 and degrades soil structure. Limiting tillage leads to less erosion, better water-holding capacity and better rain infiltration, important with increasingly variable rainfall patterns. Soil organic matter, and beneficial populations of fungi and other microbiological organism are more stable with less tillage.

Animal grazing: Livestock graze at Full Belly Farm, providing manure as a source of carbon, nitrogen and phosphorus. Nutrients are released from manure over a longer time horizon than commercial fertilizer, reducing external inputs and costs, and trips across the fields. Sheep also trim grass around blooming flowers so beneficial insects and pollinators aren't disturbed.

As Muller puts it, "Agriculture can come to the rescue and be part of solving the problem of how we deal with carbon in the atmosphere. How we structure that in terms of policy is very important, because the food system contributes approximately 30% of the annual greenhouse gas emissions."

The **Organic and IPM Working Group** works to increase food security and improve environmental and health outcomes by optimizing the contributions of both approaches. Our goal with this document is to inform Land Grant University scientists, extension and outreach specialists; producers, producer groups and producer-leaders; and policy makers and influencers about this important emerging emphasis within sustainable agriculture. The Organic and IPM Working Group received startup funds in 2013. Currently, our work is supported by the North Central IPM Center through the USDA National Institute of Food and Agriculture, NC IPM Center projects AG 2012-51120-20252 and AG 2014-70006-22486.

ORGANIZATIONS WORKING IN REGENERATIVE AGRICULTURE

Regeneration International
A non-profit organization with an international movement united around a common goal: to reverse global warming and end world hunger by facilitating and accelerating the global transition to regenerative agriculture and land management.

Rodale Institute
Rodale Institute is growing the organic movement through rigorous, solutions-based research, farmer training and consumer education.

Regenerative Organic Alliance
A non-profit cohort of organizations and businesses led by Rodale Institute, Patagonia, and Dr. Bronner's developing the Regenerative Organic Certification.

Terra Genesis International
An international regenerative design consultancy comprised of ecological designers, farmers, foresters, ecologists, educators, engineers, financial analysts, and branding and marketing professionals.

The Carbon Underground
The Carbon Underground was created to be an umbrella organization responsible for communicating and educating the world about the power of healthy soil to combat climate change and to facilitate the transition of enough farms and grasslands globally to restore a healthy climate.

SOURCES

Adams, A., Nilsson, J. and Almroth, C. (2016). What is Regenerative Agriculture? https://holisticmanagement.org/featured-blog-posts/what-is-regenerative-agriculture/

Gates, J. P. and Gold, M. V. (2007). Tracing the Evolution of Organic/Sustainable Agriculture. Alternative Farming Systems Information Center. *Bibliographies and Literature of Agriculture, no. 72.* https://www.nal.usda.gov/afsic/tracing-evolution-organic-sustainable-agriculture.

Gold, M. V. and Gates, J. P. (2007, May). Tracing the Evolution of Organic / Sustainable Agriculture (TESA1980). https://www.nal.usda.gov/afsic/tracing-evolution-organic-sustainable-agriculture-tesa1980.

Holling, C. S. (1973). Resilience and stability of ecological systems. Annual Review of Ecology and Systematics 4:1-23.

LaSalle, T., Daley, C., Greene, D., Carter, D., Zolezzi, A., Ingham, E. and Jonson, D. (2017). Companies, NGOs and scientists come together behind new definition for "Regenerative Agriculture." CSU Chico, Regnerative Agriculture Initiative. http://www.csuchico.edu/sustainablefuture/aginitiative/documents/RegenAgDefintionPressRelease2_23_17.pdf.

Lengnick, L. (2015). *Resilient Agriculture: Cultivating food systems for a changing climate.* Gabriola Island, BC, Canada: New Society Publishers.

Lin, B. B. (2011). Resilience in agriculture through crop diversification: adaptive management for environmental change. *BioScience,* Volume 61, Issue 3, 183-193, https://doi.org/10.1525/bio.2011.61.3.4.

Mangan, A. (2017). California is a Leader in Climate Smart Agriculture. *Bioneers.* https://medium.com/bioneers/california-is-a-leader-in-climate-smart-agriculture-9df7615edb29.

Muller, P. (2018). More Layers of Life Per Acre: Creating a Rich Farm Ecology. *Bioneers.* http://bioneers.org/more-layers-of-life-per-acre-creating-a-rich-farm-ecology-by-paul-muller-zmbz1807/.

National Sustainable Agriculture Coalition. What is sustainable agriculture? (n.d.) http://sustainableagriculture.net/about-us/what-is-sustainable-ag/

Pushnik, J., Daley, C. A., Brimlow, J., Altier, L., Liles, G., Brown, D., Hatfield, C. (2017). California State University, Chico, *The Institute for Sustainable Development.* "What is Regenerative Agriculture?" http://2igmzc48tf4q88z3o24qjfl8.wpengine.netdna-cdn.com/wp-content/uploads/2017/02/Regen-Ag-Definition-2.23.17-1.pdf

Regenerative Agriculture—The Definition of Regenerative Agriculture. (n.d.). http://www.regenerativeagriculturedefinition.com/

Regenerative Agriculture: A Definition. (n.d.). http://www.terra-genesis.com/wp-content/uploads/2017/03/Regenerative-Agriculture-Definition.pdf

Rodale Institute. (n.d.) http://rodaleinstitute.org/about-us/mission-and-history/.

SARE. (2012). Rotation Examples. https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition/Text-Version/Crop-Rotations/Rotation-Examples

United States Code, 2006 Edition, Supplement 4, Title 7—AGRICULTURE, § 3103-19. (2011).

What is Regenerative Agriculture? (2017). http://www.terra-genesis.com/wp-content/uploads/2017/03/Regenerative-Agriculture-Definition.pdf