

Learning Journey: Principles of Regenerative Agriculture

Regenerative agriculture focuses on restoring the soil and managing water wisely. The main focus is to rebuild the soil that has been destroyed over the course of many years and to work together with the ecosystem rather than against it. There are six main principles that help to define regenerative agriculture as a system of practices, which you will learn about in this learning journey!

Context

The Context Principle acknowledges that each farm has its own unique and distinct circumstances and characteristics. Context includes production and financial goals and objectives, historical production factors, ecological parameters (both current and historical), community dynamics (family, neighbors, friends, vendors, lenders, etc.), and philosophical beliefs. It stresses the importance of tailoring decisions and practices to fit these specific conditions and goals. This principle highlights that regenerative organic agriculture isn't a black-and white approach; it involves navigating the grey areas and adapting to the complexities of each unique situation. There is no single right way, just the way that is right for you. Farmers must consider both place based and person-based factors to support the health of their farm.

Why Context Is Important

Understanding the Principle of Context in regenerative organic agriculture is crucial because it acknowledges the interconnectedness of various factors within an agricultural system. For example, crop(s) selection affects soil health, which in turn impacts farm productivity. By considering their specific circumstances, producers can make well-informed decisions that align with their individual goals and ensure that every aspect of their operations work together effectively, fostering a thriving and resilient agricultural system.

Questions for Farmers to Determine Their Context:

Soil Health and Management:

- What are the key indicators of soil health I want/need to monitor, and how can I improve and maintain soil health to benefit both current crops and future generations?

Biodiversity and Ecosystem:

- How can I enhance biodiversity on my farm to create a balanced and resilient ecosystem, and what long-term strategies can I implement to support and preserve it?"

Climate Resilience and Adaptation:

- Which soil management practices will help my farm withstand changing weather conditions, and how can I adapt my farming practices to build and ensure resilience against future climate changes?

Farming Practices and Techniques:

- Which regenerative practices can provide immediate benefits while sustainably enhancing my farm's productivity over time?

Grazing and Livestock Management:

- How can I design a grazing plan that maximizes pasture recovery and soil fertility while maintaining land health and productivity in the future?

Crop Rotation and Diversification:

- What crop rotation practices can improve soil fertility and reduce pest issues while diversifying my crops to enhance the farm's resilience and sustainability?

Economic Goals:

- What are my financial goals to ensure my farm is profitable?

Community Dynamics and Support:

- How can I engage my community and build partnerships to promote regenerative organic farming?
- What capacity does my farm team have to implement new practices and support farm operations?

Personal Priorities:

- What decisions do I need to make to balance farming with maintaining a healthy family life?
- What should I consider given my current stage of life?

Example:

Farmer A: I use rotational grazing to improve pasture health, tailored to my livestock and land management style.

Farmer B: I don't have livestock, so I support soil health by spreading manure and compost, and I practice crop rotation to manage pests and improve soil structure, fitting my crop needs and available resources.

Minimizing Disturbance

Picture This:

Spring is in the air. Gardens are being tilled, fields are being worked, all in preparation of seeding.

These are memories that many of us share. It's simply the way it has always been done. In this discussion, we will focus on the principle of minimizing disturbance, what it is, and what we can do to advance this idea in practice.

What Is the Principle of Minimizing Disturbance?

The principle of minimizing disturbance refers to the act of reducing physical, biological and chemical disturbance of the land and maintaining as much biology in the soil as possible.

"20% and 40% of organic soil carbon is lost within 2 years of cultivation." - Richard Eckard

What Are The Benefits of Minimizing Disturbance?

Many benefits are achieved by applying this principle, including:

- Compaction of soil is reduced
- Infiltration of air and water into soil is increased
- Crusting from heavy rain is reduced
- The creation of a "sponge-like" soil is increased
- Carbon loss from soil is reduced (important for microbes as that's their food and shelter!)
- Sequestration of carbon is increased

The Problem and Solution to Soil Disturbance

Not all soil disturbances are man-made. Wind erosion is a natural process that can have a huge effect on soil, particularly when all of your topsoil is bare and prone to be blown away. Thankfully, our grandfathers had a solution for this. That solution is to incorporate hedgerows, wind breaks, and alley cropping. Not only can this alleviate soil erosion, it can also increase biodiversity and life in the soil and area.

In Conclusion

While this can seem like an impossible task, the important thing to remember with regenerative agriculture is that it is a process. Nothing happens overnight, there's no magic switch to flip. It is an ongoing process to better soil and better yields.

Armouring the Soil

Many of us have childhood memories of pulling weeds out of the garden. Every weed had to be pulled until all that was left was the growing vegetables and the bare soil. If there was anything growing other than what was being harvested, you would be considered a bad or messy gardener. But what if weeding does more harm than good? In this discussion, we will go over what armouring the soil is, what its benefits are and how it can be done.

What Does “Armouring the Soil” Mean?

Armouring the soil is the act of keeping the surface of the soil covered. This is typically done through the use of cover crops or litter (crop residue or mulch).

What Are the Advantages?

- Soil temperature is regulated and soil biology and roots are protected.
- Weeds are suppressed and soil biology is fed as plant material breaks down.
- More moisture is retained.
- Wind and water erosion is reduced or eliminated.
- Splash up effect is prevented during heavy rains.

How Can Soil Coverage Be Achieved?

There are two primary ways that we can keep the soil covered:

- Planting cover crops
 - Intercropping can be used with a cash crop through subsequent seeding of the cover crop (ensuring cash crop is ahead in the growing cycle).
- Utilizing litter (plant material)
 - Litter/mulch can be used by spreading it out between plants, ensuring that the soil is covered.

We can also plant fall crops to keep the soil covered and keep living roots in the soil.

Diversity

What Is Soil?

There are five key ingredients that make up soil:

- Minerals (clay, silt, and sand)
- Gas (nitrogen, oxygen, hydrogen, carbon dioxide, etc.)
- Water
- Organic material (dead or decaying carbon matter)
- Living organisms

What Living Organisms Exist In the Soil?

Here is a list of microbes you can find in soil, that include but are not limited to:

- Fungi: A lot of fungal species grow in the soil and form complex and intricate networks in and around plant roots to cycle nutrients, decompose carbon matter, and direct water flow.
- Bacteria: Bacteria take on the role of the decomposer in the early stages of breaking down decayed material. They take unusable forms of things like nitrogen gas and phosphorus, and they convert it into a form that is then usable by plants.

- **Protozoa:** Protozoa are similar to bacteria in that they are both single-celled organisms, but protozoa are actually more similar to plant and animal cells. In the soil, they feed on bacteria and maintain their population sizes so that bacteria are constantly processing materials into usable metabolites.
- **Nematodes:** Nematodes are microscopic worms that behave as predatory grazers in the soil. They consume smaller organisms, spread fungal spores and bacteria through the soil, and release ammonia that becomes available for use by plants.
- **Insects and Other Arthropods:** Insects and other arthropods can contribute greatly to soil health in moderate numbers. They cycle nutrients, ward off harmful pests, and facilitate the spread of fungal spores and pollen.

What Is Biodiversity?

Biodiversity, short for "biological diversity," is the variety of life in all its forms, from genes to species to ecosystems. Biodiversity takes shape in various environments, like remote deserts and bustling rain forests. It contributes to the natural biomes of Earth. If you look close enough, you will see it in your own farm.

Why Bother with Biodiversity?

Having diverse species growing in the fields and soil is crucial to a successful farm because ecosystems with greater diversity:

- **Have better defenses against diseases and pests:** Living organisms in the soil are key factors in plant defenses against pests and diseases. Having multiple species in the soil that can perform the same job (e.g., converting nitrogen into a plant available form) helps guard against the loss of one or two species to environmental factors or disease. Having these beneficial microbes "set up shop" around a plant's roots also means there's no room for undesirable (bad microbes) to get established and cause disease in the plant!
- **Provide more nutrients to the soil:** Different plants require unique metabolites. By growing a multitude of species above ground, we're able to support a multitude of species below ground. Each species contributes something different to the (eco)system, ensuring that it continues to function even when faced with disease or environmental pressures. A diversity of species is necessary in healthy soil as none can operate alone.
- **Build resilience against natural disasters and disruptions:** As the climate continues to change, farms are facing drought, floods, and storms that threaten food production. Having biodiversity in the soil allows the plants to build strong defenses against these issues by incorporating more microbes that store water, aerate the soil, provide fundamental minerals that can fortify cell walls, etc. This is why biodiversity builds resilience in an ecosystem.

What Can You Do to Increase Biodiversity In Your Farm?

- Include species from different functional group into your crop mix: Add forbs (flowering plants), grasses, and legumes to farmland
- Increase and/or extend crop rotations: Plant beneficial crops together and rotate crops between seasons for longer or shorter durations
- Be intentional with the sequence of your rotation: For example, one year of peas → next year of oats → next year of sunflowers
- Keep crop residue on the soil: Helps to prevent erosion, top soil degradation, and more
- Seed directly into the previous year's litter: Prevents erosion, top soil degradation, and minimizes disturbance
- Reduce tillage: Repetitive tillage disrupts the soil microbiome (especially the fungi) and breaks down soil structure, reducing the soil's ability to support the plants growing in it
- Use organic fertilisers
- Plant cover crop: A diverse cover crop provides a diverse buffet of exudates to soil microbes. They also protect crops and microbes from the elements and keep the soil moist and cool.

Conclusion

The principles of regenerative organic agriculture provide the framework for how to repair and restore soil health, and the principle of diversity focuses greatly on promoting biodiversity above and below ground.

Keeping a Living Root in the Soil

Keeping a living root in the ground as long as possible has numerous benefits for soil and plant health. It maintains soil structure, supports a living, photosynthesizing plant above ground, and cycles carbon into the soil. Roots and microbes (fungi, bacteria, nematodes, etc.) have a symbiotic relationship, where roots feed about 50% of sugars to microbes, and microbes provide essential nutrients to plants. This process, where plants transfer carbon to soil through roots, helps build soil carbon.

What Are the Basic Structures of a Plant?

Plants are hugely unique, and many species have wildly diverse characteristics that contribute to the biodiversity of an ecosystem. However, many plant species share three common characteristics: leaves, stems, and roots. The leaves capture solar energy and absorb carbon dioxide from the atmosphere to activate photosynthesis and produce sugar. The stem takes part in transpiration by conducting water and nutrients through the vasculature toward the leaves. Sugars travel down the vasculature to enter the roots. The roots uptake and exude metabolites that are necessary for photosynthesis and cellular respiration.

Getting to the Root of It All

Roots help to build carbon in the soil. Carbon (sourced from CO₂) is used to build sugar in the leaves, and some of it (about 50%) is transported through the stem and exuded through the roots. The microbes in the soil use the exuded sugars for their own metabolism and accumulate nutrients to exchange with the roots. The longer a plant root stays in the ground, the more microbes can benefit, grow, and expand to find more nutrients from the soil.

What Are Root Exudates?

Root exudates are organic compounds that can be simple sugars, organic acids, or amino acids. Roots send out these signals (exudates) to the soil, microbes respond to these signals, and in exchange for sugar, the microbes bring whatever nutrient was “requested” by the plant.

There are multiple advantages to producing exudates:

- Attract nitrogen-fixing bacteria
- Facilitate communication with other plants
- Attract microbes that help defend plant roots from invaders

Imagine a Pizza Delivery Service

Root exudates behave a lot like a pizza delivery service. For example, you call a store to order a pizza, and they begin to assemble your order. A delivery person picks up the pizza from the store and brings it to your door. You pay the delivery person and enjoy your pizza. Now take a look at the root exudates: roots send exudates into the rhizosphere, and microbes send off into the soil to gather nutrients. The microbes take up nutrients from the soil and deliver them to the root. Finally, the roots exchange their exuded sugars for nutrients. This comparison makes it easier to understand the dynamics of root communication with microbes.

Why Keep a Living Root in the Soil?

When roots develop in the soil, they create complex webs with the microbes in the soil to:

- Maintain Structure
 - Roots grow deep into the soil to access nutrients and water. As a plant seed matures and develops roots, it is establishing itself into the composition of the soil, which is integral in maintaining the soil structure. The root builds physical connections with microbes in the soil. If the living root is pulled out of the ground, the soil structure is disrupted and those connections are severed.
- Support a Living Plant Above Soil
 - The roots not only provide nutrients and water through transpiration, they also provide tensile strength to the plant. They can tether themselves into the ground to protect them from rain and wind above ground. Additionally, the leaves of the plant need crucial metabolites from the soil to photosynthesize, and they gain these from the roots shipping them up the plant body.

- **Cycle Carbon**

- Carbon is one of the most essential elements involved in photosynthesis and cellular respiration. Plants take carbon dioxide from the atmosphere and convert it to simple sugars through photosynthesis. In exchange for other metabolites, carbon in the form of sugar is exuded from the roots to be exchanged with other nutrients. About 50% of sugars produced by plants feed microbes so that they can bring necessary metabolites to the roots to be taken up by the plant.

What Are the Benefits of Keeping a Living Root in the Soil Over Winter?

- Keeps nutrients from leaching out of the soil
- Provides erosion control
- Provides grazing material for livestock
- Provides litter for weed control

Livestock Integration

Integrating livestock into farming systems is a key aspect of regenerative organic agriculture, supporting a sustainable and circular agricultural system (circular bio-economy). This integration accelerates the regenerative process by enhancing soil health and overall farm productivity. Animals' movements and activities, such as grazing and trampling, till the soil, distribute seeds, and cycle nutrients. These interactions improve soil structure, increase organic matter, promote biodiversity, and enhance nutrient availability, leading to faster and more effective ecosystem regeneration.

Here's How It Works:

1. **Feeding:** Livestock, such as cows, graze on pasture vegetation, consuming grasses and other plants.
2. **Manure Production:** As the livestock digest this vegetation, they naturally deposit manure directly onto the fields.
3. **Nutrient Recycling:** This manure is rich in organic matter and essential nutrients like nitrogen and phosphorus.
4. **Soil Fertilization:** The manure decomposes in the fields, enriching the soil with essential nutrients, increasing soil biology.
5. **Plant Growth:** The enriched soil supports the growth of various plants, improving overall farm productivity.
6. **Reduction in Chemical Fertilizers:** This natural fertilization process reduces the need for commercial chemical fertilizers.
7. **Environmental Benefits:** Healthier soil also improves water retention, protection against erosion, floods, droughts, and desertification, increased biology above and below the soil, carbon sequestration, and reduction of greenhouse gases.

Five Grazing Fundamentals:

1. **Timing:** When during a season or year grazing occurs. Ensures optimal plant growth and nutritional value.
2. **Frequency:** How often the plants are grazed. Maintains plant health and prevents overgrazing.
3. **Intensity:** How heavily the plants are grazed. Prevents weakening of plants and ensures regrowth.
4. **Duration:** How long a grazing event lasts. Avoids soil compaction and overgrazing.
5. **Rest:** Allowing plants time to recover during the growing season promotes their recovery and sustainable forage production. Grazing a pasture too early depletes vegetation before plants can replenish root reserves, potentially sacrificing future grazing opportunities. For instance, grazing one week too early in spring could lead to the loss of three weeks of grazing in the fall.

Examples of Different Ways to Integrate Livestock in Regenerative Agriculture:

Rotational Grazing:

Strategy: Move livestock between different paddock on a regular schedule, allowing each paddock to rest and regenerate, preventing overgrazing and maintaining healthy vegetation. This approach facilitates management at the paddock level, allowing for the selective skipping of paddocks requiring additional rest while intensifying grazing in those in need of it.

Example: In Alberta, a cattle rancher divides the land into several sections. Cows are moved to a new section every few days, giving the grass time to recover and grow back in the sections they left.

Cover Cropping with Grazing:

Strategy: Plant cover crops that animals can eat to improve soil health, reduce weeds, and provide forage.

Example: A farm in Saskatchewan plants clover and rye after harvesting the main crops. Sheep graze on these cover crops during the off-season, improving the soil and reducing weed growth.

Multi-Species Grazing:

Strategy: Grazing different types of animals (like cattle, sheep, and goats) on the same land.

Example: On an Ontario farm, goats and cattle are grazed together due to their complementary dietary preferences. This combination ensures that all types of vegetation are utilized effectively, as goats and cattle eat different plants. This approach allows for higher stock density (better manure distribution) and better control of woody plants, promoting overall pasture health.

Stockpiled Grazing:

Strategy: Save some forage (like hay or pasture) for animals to graze on during winter, reducing feed costs and enriching soil.

Example: In Manitoba, a beef farm practices bale grazing by placing hay bales in the pasture before winter. During the winter months, cows graze directly from these bales, reducing the need for harvested feed and naturally spreading manure to enrich the soil.

Taking What You've Learned into the Field

Although the practices you implement on your farm may differ, the principles remain universal. To simplify, this is how the six principles of regenerative (organic) agriculture would show up in your fields:

1. **Context:** Context is the most overarching of all the principles. It includes all the place-based and person-based considerations that affect us and our ability to manage our lands. Context includes taking into consideration things like average annual rainfall, length of growing season, average daily temps and number of frost free days. It also includes farm specific considerations like your access to capital/loans, available labour, access to machinery and your quality of life goals.
2. **Minimize Disturbance:** Soil disturbance can be physical, chemical or biological. Although we often categorize disturbance as a negative thing, it is one of the most powerful tools we have at our disposal. When used sparingly and intentionally, disturbance can accelerate your progress and address challenges.
3. **Armour on the Soil:** Continuous groundcover (living plants or mulch) protects the soil microbiome from the elements. Without adequate and ongoing cover, we're exposing the soil food web and hindering its capacity to work for us.
4. **Diversity:** Plants feed and heal the soil, a greater diversity of plants will support a greater diversity of microbes - this is how you build resilience, and soil.
5. **Living Roots Year-Round:** If plants are not growing, microbes aren't being fed (and may die or become less effective) and soil structure begins to fall apart.
6. **Livestock Integration:** An important tool for applying disturbance and cycling nutrients. A great way to convert waste into food for people.

Learn More With These Related Links

- [In-depth Guide to Regenerative Agriculture: Principles, Practices, and Impact](#) (Article)
- [6 Soil Health Principles for Regenerative Cattle Ranches](#) (Article)
- [Principles of Regenerative Agriculture](#) (Article)
- [6-3-4 Explained](#) (Article)

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- [The Fundamental Principles of Regenerative Agriculture and Soil Health](#) (Article)
 - [Regenerative Agriculture Explained: Healing the Earth and Nourishing Our Future](#) (Article)
 - [Barry Fisher - Regenerative Agriculture Principles](#) (Video)

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Thank you for participating in this Learning Journey on Canadian Organic Growers' Regenerative Organic Hub. We hope you were inspired and found practical information and tools that will support you on your regenerative organic journey.

We invite you to click below and use our contact form to ask us any questions you may have, or comment on your Hub experience. This form is also the place to let us know if you would like to get involved with COG, including as part of our next cohort of [Regenerative Organic Oats \(ROO\)](#) [program](#) participants.