GROWING THE PRAIRIE REGENERATIVE REVOLUTION

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As Dr. David Montgomery stated in his 2017 book with a similar title, a Growing Revolution is occurring across the Canadian Prairies. This agricultural revolution is an increase in regenerative agriculture but what does this mean? Regenerative agriculture is frequently combined with soil health and soil carbon sequestration, and on a fundamental level this is a component of regenerative agriculture. However, what regenerative agriculture really means is an innovative, integrated, and dynamic systems approach to agriculture which utilizes primarily biologically based management practices and tools to regenerate soils.

On some level, because regenerative agriculture is focused on soils and biological practices and tools, regenerative agriculture and organic agriculture are synonymous, making regenerative organic agriculture redundant. At its core, organic agriculture is founded in biologically-based solutions to fertility, pest, and disease issues, and healthy soil making regenerative agriculture – organic agriculture. The innovative, integrated, and dynamic system also is similar to the organic approach which utilizes innovative biological fertility and pest management tools that are integrated across seasons and years and respond dynamically to changing markets and conditions.

Although soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans, this is rather vague and is not really dedicated to the soil but rather to functions for organisms outside of the soil. Soil is organic matter (i.e. carbon, hydrogen and oxygen) bound to the mineral component (i.e. sand, silt and clay). To have the organic component (i.e. to have soil), you need living organisms. The origin of soil came from the complex interactions between the precursors to plants, namely a photosynthetic bacterium, and animals, namely a fungus. By looking at soil origination, the keys to soil regeneration are identified.

All life is supported by managing carbon flows which are the primary building blocks for the physical structure as well as the biological activities for almost every living organism on Earth. To facilitate carbon flow, the guiding principles developed to assist in identifying the practices and tools have been modified to illustrate which principles, practices and tools decrease carbon loss and/or increase carbon accrual and transformative flow through living organisms. The United States Department of Agriculture uses five principles: 1. Keep it Green & Growing, 2. Energize with Diversity, 3. Reduce Tillage, 4. Keep the Soil Covered, and 5. Manage Livestock. When focusing on carbon loss, input and transformation, we concentrate on six principles (five of them similar to USDA): 1. Maximize Photosynthetic Time, 2. Enhance with Biodiversity, 3. Reduced or No Inputs, 4. Integrating Livestock, 5. Reduced or No Soil Disturbance, and 6. Protect Soil Surface (Figure 1).

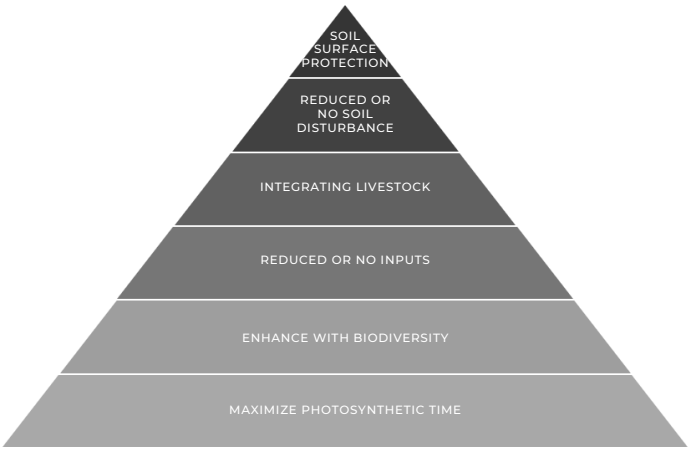

Figure 1. This pyramid diagram illustrates the interlinked Regenerative Organic Agriculture principles for economic and environmental wealth. By using a pyramid to illustrate this, the integrated between the layers is emphasized because in a pyramid one layer is not more important than another but they are interlinked to enhance structural stability and 2. Like pyramids, regenerative agricultural systems have the ability to stand for thousands of years.

As stated previously, regenerating soil is about increasing organic matter by managing carbon flows. Carbon enters the soil either directly or indirectly by photosynthesis. By maximizing photosynthetic time, harvesting sunlight and fixing carbon not just during the growing season but also before and/or after crop growth or year long in pastures and range. Several regenerative cropping tools exist such as green manure, poly, relay, companion, and cover

cropping as well as mixing annuals and perennials either in the same year or within a multi-year rotation. In addition to maximizing photosynthetic time, these tools enhance biodiversity to add fertility and assist in pest and disease management. Throughout most of the Canadian Prairies, the goal needs to be to have at least 230 days of sunlight harvesting.

Part of the harvested sunlight provides the energy to create carbon compounds released through the roots (i.e. root exudates) which not only becomes part of the structural and biochemical components of soil biota, but also is about 58% of soil organic matter. Soil organic matter plays a number of functional roles in agroecosystems including: 1. Improves porosity for better root growth, gas exchange, water infiltration, and water holding capacity; 2. Enhances soil structure; 3. Binds both cations and anions to increase fertility; 4. Absorbs pesticides; and 5. Reduces soil erosion, soil compaction, and water and air contamination. As noted, the soil biota and organic matter are essential to building natural fertility. Biodiversity at all levels below and aboveground also provides natural pest and disease management through predators and competition. When inputs are added, particularly fertility inputs in plant-available forms, the plants reduce their exudates because the need to obtain fertility and pest management from biological processes is reduced. Over time, this reduces microbial populations to very low levels and also impacts biodiversity belowground. In the end, resiliency is lower as well because the microbes are not available to provide the redundancy of function and diversity for flexible responses to a multitude of issues.

The integration of livestock is often seen as adding grazing animals, but this includes livestock or animals at multiple trophic levels such as both macro- and microscopic insects, birds and bats as well as large grazers. Integrating large grazers provides economic value with the use of multiple cropping systems such as cover and companion crops as well as perennials which add fertility and weed management. Pest and disease management with insects, birds, and bats as well as pollinator activities are crucial to plant health which indirectly impacts plant biomass and root exudates. Damage, even minor damage, by grazing, trampling, perching, or physical contact to plant tissue may stimulate root exudation and soil biological processes to biochemically form the biomolecules such as antioxidants and polyphenolics which protect the plant from this damage as well as reinforce the plant structure and enhance regrowth.

Reducing or eliminating soil disturbance is related to no-till systems which may be difficult to integrate on a continuous basis in organic systems or in the growth of root crops. Managing soil disturbance from a carbon flow perspective means stopping the bleeding or carbon loss due to oxidation and erosion but does not directly increase carbon flow into the soil. For example, tillage causes fungal network to be broken up and the organic matter that adds the richness to the soil is now on the source instead of being buried below the surface. The hyphal fragments and organic matter are rapidly consumed by surface residue decomposers and the CO2 that came from the plant is now released back to the atmosphere making the soils a source of atmospheric CO2 rather than a sink for CO2. However, in some cases, tillage may be used to increase photosynthetic time which is key to adding carbon to the soil if it increases the use of multiple cropping systems or perennials. In hot, dry environments where there is fast decomposition of residues, inversion of soil by tillage may bury crop residues and slow their decomposition rates. Before utilizing tillage as a tool, evaluate whether a biologically based tool such as a diverse cropping system or grazing may solve the issue. If tillage is the best tool, then utilize the FIST (Frequency-Intensity-Scale-Time) acronym to determine how to implement tillage. Identify if the use of tillage going to lock you into a greater Frequency such as using a shallow weeding tool and breaking up hyphal networks multiple times throughout the season may do more damaging than using a deeper tillage once a season or once over multiple seasons. If the tillage implement is of a Scale or Intensity that disturbs a greater volume of soil than needed, use a different implement. Tillage may also be conducted at a Time that is less destructive such as when the soil is not too wet or too dry or at a time when microbes are not highly active.

The final integrated principle is to protect the soil surface from erosive forces and solar radiation which will stimulate the loss of carbon from soil. Living plant tissue is more effective at protecting the soil than crop residue which is part of maximizing photosynthetic time and enhancing biodiversity. However, like with the reducing soil disturbance itself, protecting the soil surface does not add much carbon to the soil. Crop residues are not a major source of recalcitrant organic matter but rather most of the carbon in the residues are respired in a short duration. The largest exception to this is the crop residues which are pulled belowground by the activities of earthworms.

By exploring the large array of innovative management practices and tools available to address the principles in a regenerative approach, it is easy to see their integration across and between the layers in a pyramid which provides structural stability (i.e. strength and resilience). This illustrates the concept of seeing the practices and tools as individual blocks to reinforce each other. In a paradigm shifting, regenerative organic agricultural system, the focus is not on individual components but rather on how the components fit together. This agricultural revolution is being championed by education from national organizations such as Canadian Organic Growers (COG) and provincial organizations such as Organic Alberta, SaskOrganics, and the Manitoba Organic Alliance. Consumer demand is also instigating this agricultural revolution as environmental, human and animal health are being connected to food. As a result, Canadian food manufacturers such as Riverside Natural Foods Ltd, Nature's Path and McCain Food as well as multinationals such General Mills and Danone along with grain buyers and processers such as Grain Millers and MGM Seed & Grain Ltd are responding to consumer demand by working with producers to grow regenerative organic agriculture. Regenerative organic agriculture is recognized as critical to mitigating climate change and enhancing air and water quality as well as providing a healthy diet with diverse and nutrient dense fruits and vegetables and high-quality grains and proteins needed to regenerate human health.

As the new Director of Research and Extension with COG, I am currently living and working out of the Calgary, Alberta area to facilitate an on-the-ground working relationship with farmers, provincial organizations, and companies involved in the supply chain such as those mentioned above to Grow the Prairie Regenerative Revolution. Please feel free to reach out to me at kris.nichols@cog.ca with any questions.