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Regenerative Agriculture in Potato Production Systems

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SCHOLAR PROFILE

I am a Senior Agronomist at Quattro Farms in Bow Island, Alberta. I work to ensure that we are sustainably producing quality crops. Quattro produces a wide range of crops such as cereals, seed canola, peas, beans, hemp, grass seed, sugar beet, potatoes, mint and dill. I enjoy my job because every day is different, from scouting fields and helping at harvest to carrying out research trials. I come from a family with a strong agricultural background. My parents were the first generation off the farm, but both continued working in the agriculture industry. My father worked in livestock nutrition, and my mother worked in potato science. My path to agriculture was not intentional and happened almost by accident. Throughout my undergraduate degree, I worked as a summer student for a soil scientist in New Brunswick. This is what sparked my research interest. As a continuation of that work, I completed a master's degree researching greenhouse gas emissions from potato production. Upon completing my education, I worked for McCain Foods, managing their research farm in New Brunswick. This is where my passion for all things potato-related began. I moved to Alberta from here to serve as the McCain Coaldale plant agronomist. This opportunity allowed me to learn from some of the most progressive potato growers in North America. I thoroughly enjoyed working with these growers and when the opportunity arose to work with one of them in a permanent role I took it. My job at Quattro has allowed me to be my authentic self and focus my efforts on projects and work that I find fulfilling. Supporting others to learn and develop in the industry is a passion of mine and I contribute to various school programs, sharing my knowledge and experience. I currently serve as chair of the research committee for the Potato Growers of Alberta. I have always been on a quest for continuous learning, and I hope that it never ceases.

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A final thanks to all the fantastic people I met on this journey, the fellow Nuffield scholars I can now call friends, and the producers who opened their farms and homes to me so graciously. And a special shout out to the esteemed members of the NFT (you know who you are) who kept me grounded throughout this process.

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In addition to my primary sponsors, the following organizations also stepped up and helped.

Klearchem Service Inc.

EXECUTIVE SUMMARY

This report provides a thorough overview for industry professionals and stakeholders within the Canadian agriculture sector, emphasising the growing emphasis on regenerative agriculture practices. This movement, increasingly adopted in potato production, is led by major corporations such as McCain Foods who recognize the environmental sustainability required by modern agricultural methods.

The report explores the essential role that growers play in meeting ambitious climate goals through regenerative agriculture, which not only meet but can potentially exceed these targets. This approach is significant for its multiple benefits: mitigating climate change, improving soil health and creating sustainable farming businesses. This report incorporates insights from my experience as a Nuffield Scholar, where I delved into the principles and applications of regenerative agriculture across multiple growing regions around the globe. This experience underscored the necessity of moving from isolated, technique-focused farming to a more holistic, systems-based approach in regenerative agriculture whilst highlighting the barriers to adopting these practices. Key challenges include the initial cost of transitioning to regenerative methods, education and training for growers and agronomists on new practices, the lack of immediate financial returns, and the need for supportive policies and incentives from governments and more significant industry players. This report also investigates the barriers to widespread adoption. There is often resistance to change, rooted in traditional farming practices and scepticism about new methods. The report argues for a shift towards more sustainable and holistic practices that consider the entire ecosystem, suggesting that for the Canadian potato industry to thrive and stay competitive globally and sustainably, an all-hands-on-deck approach is necessary. In conclusion, while advocating for integrating regenerative agriculture into Canadian potato production and agriculture overall, the report stresses the importance of addressing the barriers to adoption. It calls for a collective effort to promote practices that enhance the sector's productivity and profitability, which, in turn, significantly benefit agricultural sustainability across the world.

DISCLAIMER

This report has been prepared in good faith but is not intended to be a scientific study or an academic paper. It is a collection of my current thoughts and findings on discussions, research and visits undertaken during my Nuffield Farming Scholarship.

It illustrates my thought process and my quest for improvements to my knowledge base. It is not a manual with step-by-step instructions to implement procedures.

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Introduction

Regenerative agriculture focuses on enhancing soil health, increasing microbial diversity, improving soil structure, utilizing perennial crops, and minimizing tillage, among other practices. Although potato production may not be the first crop that comes to mind when considering regenerative agriculture, it is essential to explore practices that offset the tillage passes required for growing potatoes. In Alberta, approximately 60,000 acres of land are dedicated to potato cultivation, with 73% of the produce destined for the French fry market (Duhatschek, P., 2024). The potato industry in Alberta is in the middle of a boom thanks to french fry plant expansions in the region and the province recently outpaced Prince Edward Island as the leading potato producing province (Glacier Media, 2024). One of the major players in the region, McCain Foods, has announced that 100% of their acres will be grown using regenerative agriculture practices by 2030 (Blair, J., 2024). Similarly, other major food processing companies like PepsiCo, Walmart, General Mills, and Nestle have set similar goals (Jessen, J., 2024; Grady, B. 2024; Cover Crop Strategies, 2023). The methods for achieving these goals in potato production are yet to be determined. As someone at the producer level, I strongly need to understand how these practices can be integrated into our individualised operations. Determining the metrics for success and maintaining crop yields while implementing new ideas will require significant effort. Apart from McCain Foods' goals, Canada has announced ambitious climate targets, and I believe that growers are pivotal in meeting and potentially exceeding these goals (Government of Canada, 2023). The ability of regenerative agriculture practices to sequester additional carbon compared to conventional practices presents a clear path forward for Canadian growers (Villat & Nicholas, 2024).

This scholarship aimed to help me connect with like-minded individuals and expand my network in regenerative agriculture. By interacting with growers from other regions and learning about their mindsets, I gained valuable insights into the motivators to change and barriers to adoption. This will help me effect change when it comes to our own operation. This scholarship was a pivotal opportunity for me to deepen my engagement with the regenerative agriculture community. By connecting with like-minded individuals who share a passion for sustainable practices, I could expand my network significantly. Engaging with fellow growers from diverse regions allowed me to explore a variety of perspectives and methodologies in regenerative agriculture.

Through these interactions, I gained invaluable insights into what drives others to adopt new practices and the obstacles they face in implementing change. I learned about the different approaches taken by growers in various climates and conditions and how these factors influence their decision-making processes. Understanding these motivators and barriers has

equipped me with the knowledge needed to effectively bring about change within my own operation.

The discussions we had during workshops and informal gatherings opened my eyes to innovative solutions and practices that I had not previously considered. I realized that while our circumstances may differ, the underlying challenges and aspirations in regenerative agriculture often resonate across borders. This collective knowledge will empower me to drive meaningful transformation in our operations, ultimately contributing to more sustainable outcomes for our land and community.

My involvement in the Canadian potato industry allows me to share my experiences and learnings from the Nuffield Scholarship, contributing to meaningful change across the industry. There is a growing demand for expertise in regenerative agriculture to assist with planning and implementation, and I aspire to become a resource for fellow growers. My passion for sustainable farming and agriculture for future generations drives me to help Canadian producers lead the way to a resilient and sustainable future.

Initially, my Nuffield journey focused on the practical implementation of regenerative agriculture practices in potato production systems. I wanted to know what cover crop species work; I wanted to know how to reduce tillage, and I wanted to know what specific practices people were doing and finding success. However, after my initial travels and engagement with industry experts, I realized that these were not the right questions for me to focus my report on and I wanted to research beyond this specific area. I cannot write a paper on what cover crops to seed or what time to seed them; I cannot write a report on specific tillage implements to use because regenerative agriculture is a holistic, systems-based approach. What works for one producer will not necessarily work for the next. Each farm is unique, and many factors, such as the environment, soil type, and crop rotation, play a role in what will and will not work. To understand how regenerative agriculture will be integrated into an operation, you need to understand the individual goals of that farm. For example, at Quattro Farms our primary goal is to minimize the risk of wind erosion, so for us, implementing cover crops is the first step. This realization made me recognize that the pertinent questions I wanted to answer focused on understanding the barriers to adopting these beneficial practices among growers despite acknowledging their advantages.

I want to note that carbon sequestration and greenhouse gas mitigation are closely aligned with regenerative agriculture but will not be discussed in this paper.

This report will seek to define regenerative agriculture, explore the reasons behind its recent popularity, examine the motivators for change among producers already adopting it, and identify the barriers to widespread adoption.

Travel Summary

Throughout my Nuffield Scholarship, I had the opportunity to travel to the following locations and visit the following people:

- Vancouver, British Colombia, Canada: Contemporary Scholars Conference
- New Zealand (Various locations): Nuffield Triennial Conference, McCain Timaru, McCain Twyford, Landwise Research Farm, multiple potato producers (Loveitt Farms, Nick Taylor, Simon White)
- Florenceville, New Brunswick, Canada: Shaun Paget, McCain Florenceville, McCain Farm of the Future
- Cuba (Various locations): Visited with orange and sugarcane producers
- Rome, Italy: Attended the FAO World Food Forum
- Australia (Various locations): Multiple producers from livestock to potato production. McCain Tasmania, McCain Ballarat, Moonrocks, Hill Potatoes

Introduction to Regenerative agriculture

Background on regenerative agriculture

In the 1980s, the term “regenerative agriculture” was coined by Robert Rodale, and it was used to describe farming practices that sustain and improve the health of the soil, environment, and communities. He believed that regenerative agriculture went beyond organic farming by emphasizing the restoration of ecosystems, soil fertility, and biodiversity. His vision encompassed holistic management practices such as crop rotation, cover cropping, minimal tillage, composting, and agroforestry. All these practices aim to enhance soil organic matter, water retention, carbon sequestration, and overall system resilience (Alexanderson, M. et al., 2023).

The conversation surrounding regenerative agriculture has exploded in papers and news media since 2015. There is a lack of consensus on any exact definition. The definition of regenerative agriculture is so vague that any producer can claim to participate in these practices (Kempf, J., 2023). Only 22 of 229 research papers reviewed by Frontiers in Sustainable Food Systems provided concrete definitions of the term (Newton, P. et al., 2020). It should be noted that regenerative agriculture is a contentious term, implying that conventional farming is degenerative and that current land managers are not doing the right things. Perhaps the industry has talked about this narrative the wrong way. Based on personal observations and conversations, this is categorically not the case. Many regenerative agriculture practices are

practices many “conventional farmers” already do, just rebranded. Therefore, the purpose of this paper is to attempt to better define what regenerative agriculture means.

A quick online search can yield a multitude of definitions, all slightly different. Below are a few examples.

“Regenerative Agriculture describes farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle (Miller, A., 2024).”

“Regenerative agriculture focuses on improving the health of soil, which has been degraded by the use of heavy machinery, fertilizers, and pesticides in intensive farming (Masterson, V.,2024).”

“McCain defines Regenerative agriculture as an ecosystem-based approach to farming that aims to improve farm resilience, crop yield, and quality by improving soil health and water quality, optimizing water use, enhancing biodiversity, and reducing the impact of synthetic input (McCain, 2024).”

There is a lack of consensus on any single definition, but the common themes are improvements to soil health, human health, and the broader environment. Figure 1 depicts the most common, primary pillars of regenerative agriculture.

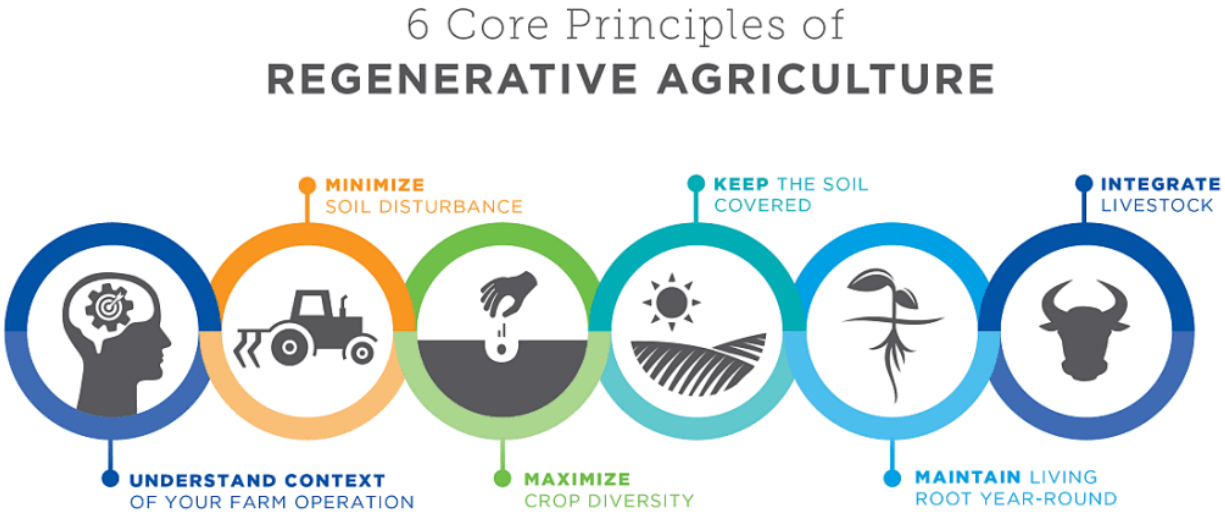

Figure 1. Six core principles of regenerative agriculture (Source: Wood, D.,2024)

Importance of regenerative agriculture in potato production

Regenerative agriculture has been touted to hold great significance in potato production, offering various benefits that address environmental and agricultural challenges. Potatoes are a

staple crop globally and are the world's third most important crop, following rice and wheat (Sustainability Magazine, 2024). Their production has traditionally relied on intensive practices that can degrade soil health, reduce biodiversity, and contribute to environmental degradation. Over the past ten years, yields worldwide have stagnated or declined (Food and Agriculture Organization, 2000). Can adopting regenerative agriculture practices in potato production allow farmers to mitigate these challenges while also improving the resilience and productivity of their farms?

Potatoes can be a tricky crop for soil health. They require intensive tillage to prepare, plant, and harvest the crop. This intensive tillage can increase the risk of soil erosion. Potatoes are heavy nutrient users and require significant amounts of fertilizer to be applied. Without proper nutrient management, the soil can quickly deplete essential nutrients. If crop rotation is not managed correctly, disease pressure can build up and increase the reliance on chemical controls. Improper irrigation practices can lead to waterlogging and compaction, which can degrade soil structure and fertility. Given the above-mentioned points, there are opportunities where regenerative practices could play a critical role in improving soil health in potato production.

Regardless of the source, one commonality across all definitions of regenerative agriculture is the focus on soil health. What is soil health? Moreover, how do we define it? Soil health encompasses a broad range of elements that must be examined individually to gain a comprehensive understanding. We can agree and understand that soil health is something positive to work towards, making it crucial to identify specific, measurable indicators that can be tracked and assessed over time (Giller et al., 2021). Potatoes have specific soil needs and are vulnerable to erosion, compaction, and nutrient depletion. Regenerative practices, such as diverse crop rotations, cover cropping, and minimal tillage, contribute to building and maintaining soil health, essential for sustained potato cultivation. By nurturing a healthy soil ecosystem, regenerative agriculture can enhance the soil's fertility, structure, and biological activity, providing an optimal environment for potato growth while potentially reducing the need for synthetic inputs. It is also important to note, however, that agronomic practices that benefit soil health often adversely affect other soil functions, such as increased nitrate leaching, primary production, or increased greenhouse gas emissions (Giller, K., et al., 2021). There are usually multiple trade-offs.

The adoption of regenerative agriculture in potato production can also benefit farmers economically in the long-term. By promoting soil fertility, biodiversity, and ecosystem resilience, regenerative practices can contribute to increased yields, reduced input costs, and enhanced long-term farm viability (Khangura, R., et al. 2023). Regenerative agriculture aligns with consumer demand for sustainably produced food, expanding market opportunities and providing a competitive advantage for potato farmers who embrace these practices. As it stands today, french fry potato producers are not financially rewarded for this adoption of these practices, but that may change in the future. There may be more opportunity for direct-to-consumer producers to charge a premium for regeneratively produced potatoes.

Understanding Regenerative Agriculture

Principles of regenerative agriculture

Regenerative agriculture is a holistic approach to farming and food systems that prioritizes restoring and enhancing the entire ecosystem (O'Donoghue et al., 2022). This method is grounded in principles designed to improve soil health, increase biodiversity, enhance water cycles, and strengthen the resilience and vitality of agricultural landscapes. Central to regenerative agriculture is the idea of not just sustaining but actively enriching the earth's resources. Practices such as no-till farming, organic crop rotations, cover cropping, and integrated pest management work harmoniously to rebuild organic soil matter, sequester carbon, and create more robust, self-sustaining ecosystems. By mimicking natural processes, regenerative agriculture aims to produce nutritious food, mitigate climate change, and foster a deeper connection between people and the planet (Giller, K., et al., 2021).

Minimize soil disturbance

Tillage predisposes the soil to erosion by covering plant residues and exposing the soil surface. Optimal soil aggregation enhances water infiltration rates, provides critical pore space for air and water storage, and supports diverse soil organism habitats. Tillage-induced aggregate disruption enhances surface runoff, augments soil erosion, and reduces water holding capacity. Additionally, tillage introduces excessive oxygen into the soil ecosystem, leading to the accelerated oxidation and subsequent release of carbon from soil organic matter. The deleterious effects of tillage on soil biota may be likened to the impacts of a combination of natural disasters (Frøslev et al., 2022). Minimizing soil disturbance is indispensable for fostering soil health in the long term, despite the occasional necessity of tillage interventions. Plants cover the soil and aid in its recovery. Agricultural systems regularly subject soil to disturbances from various sources, including biological factors, such as overgrazing, synthetic applications, and tillage (Lemaire, G. et al., 2018). Soil disturbance can damage soil biology by altering its environment, breaking down soil aggregates, destroying natural transportation methods, and physically harming soil organisms (Nichols, K., 2022). These disturbances often leave the soil bare for extended periods, exacerbated by repeated herbicide applications that further disrupt soil biology and hinder natural recovery processes, specifically plant regrowth. Minimizing soil disturbance is vital for preserving soil health. Tillage can lead to compaction, disrupt soil aggregation, and interfere with nutrient cycling and microbial activity (Bronick & Lal, 2005). Frequent tillage limits the time available for biological recovery, with pest species typically being the first to re-establish, while beneficial organisms that control these pests take longer to return (Tamborini et al., 2016). Mycorrhizal fungi are especially susceptible to damage from tillage (Kabir et al., 1997), and they play a critical role in maintaining soil structure and health. These communities are vital for soil and plant health through their roles in mineral and water exchange, chemical signalling, and aggregate formation (Sadu et al., 2019).

It is difficult to minimize tillage in potato production systems as they require well aerated loose soil for tuber development and good water infiltration. The harvesting process is also quite

disruptive to the soil structure. Reducing tillage in potatoes is a paradigm shift. This will take some time before growers are comfortable and understand how it will work in their soils. It takes many years for a grower to get confident enough to make this change, not to mention the financial commitment to implement this change, hence the very small percentage of growers doing this (Bruins, 2022). A larger number of growers are implementing cover crops in potato rotations, which can be a good start towards minimal tillage. At Quattro Farms we have seeded cover crops in the fall to avoid wind erosion in place of a fall tillage operation with some success to date.

A Manitoba farmer, Chad Berry, successfully experimented with direct seeding and minimal tillage in one of his potato fields, achieving yields statistically on par with his conventionally planted fields. Using a SPUDNIK 8080 planter with hill shapers, Berry planted 70 acres with minimal tillage while the remaining field was conventionally planted for comparison. Despite a slight yield reduction in the minimally tilled side, attributed to dry spring conditions, the trial produced a high-quality crop. Soil compaction, moisture levels, hill dimensions, and crop performance were monitored throughout the season. The results revealed no significant differences in crop quality, size profile, or disease incidence between the two methods. Berry also observed reduced soil erosion, lower fuel costs, and fewer field passes, prompting plans to expand the trial. The study demonstrates potential for direct potato planting into crop stubble, with ongoing research aiming to provide actionable insights for other growers (Robinson, A., 2021).

Living roots

Living plants are indispensable in developing soil ecosystems, serving as inhabitants and dynamic contributors, and funneling essential energy into the system. On average, crops allocate 30% of their captured carbon directly to the soil, feeding the foundational food chain layers—the fungi and bacteria. This process is pivotal for fostering organic matter formation, augmenting plant nutrition, and preserving soil structure, thereby establishing a mutually beneficial loop. Plants supply carbon-based molecules, which are a 'food' source for the soil microorganisms, promoting their sustained growth and their beneficial effects on soil health. The absence of this carbon input during fallow periods triggers a starvation mode wherein soil biology consumes stored organic matter, subsequently depleting these crucial reserves (Tamborini et al., 2016). Without organic matter, microbial life dwindles, leaving the soil barren and compacted, necessitating cultivation to restore a viable growing environment (Handelsman & Cohen, 2021).

Modern agricultural practices that include monocultures and some periods of bare soil disrupt carbon supply and limit microbial diversity— potentially degrading soil quality whereas natural ecosystems support a diversity of species coexisting at various life stages. This biodiversity ensures a perennial carbon supply across seasons, a principle starkly diverging from the contemporary farming rotations that provoke soil ecosystem deterioration and perpetual cultivation dependency.

To counter this, the emphasis on continual plant growth year-round becomes paramount. Through photosynthesis, plants convert sunlight, CO_2, and water into carbohydrates, some of which are secreted as root exudates. These secretions offer a critical carbon source for soil microbes, cementing a reciprocal exchange where soil organisms, in return, supply plants with essential nutrients which are otherwise inaccessible. Mycorrhizal fungi are particularly noteworthy, establishing symbiotic relationships with terrestrial plants to improve their water and nutrient uptake, while plants reciprocate with carbohydrates produced during photosynthesis (Watkinson, 2011). Besides, these fungi may also fortify the host plant's resistance against specific pathogens (Harrier & Watson, 2004). This interdependence illustrates the broader soil food web, which is critical to soil nutrient cycling and, by extension, plant growth and reproduction (Inderjit & Weston, 2003). Maintaining living roots in the soil throughout the growing season ensures the survival of essential organisms, thus preserving the soil's nutrient cycling capacity. Living plants create habitats for numerous aboveground organisms, integral to completing the food web and facilitating nutrient recycling into the soil.

Perry Produce in Alberta recognizes the significant soil disturbance caused by conventional potato farming, as planting and harvesting involve deep soil disruption. To address this, they implement strategies to reduce tillage, enhance organic matter, and improve nutrient cycling. Multi-species cover cropping plays a central role in their approach, with pre-planting cover crops such as sorghum Sudanese grass, millet, and oilseed radish reducing nematodes and aiding nutrient cycling by freeing up potassium and phosphorus. Post-harvest, they use cold-tolerant winter cover crops like fava beans, oats, Austrian winter peas, and cereals to create soil armor and minimize erosion.

In terms of what cover crops work well in potato production is, again, a very complex question to answer. In Alberta, the majority of growers are keeping it simple and are using a cereal crop such as barley, wheat or oats before or after their potato crops. Some of the more advanced regenerative growers are using multispecies blends that may include winter wheat, tillage radish, buckwheat, Austrian winter peas and vetch. On the East Coast of Canada there is ongoing work looking at mustard cover crops as biofumigants to minimize disease pressure. Quattro Farms is a certified seed grower, so our primary goal is to produce clean, disease-free seed. Because of this, we are limited as to what cover crop species we can use and where they can fit into our rotation without risking our seed crop. There is also a risk in creating green bridges, or continuous living crop, that hosts diseases. This is a potential risk for non-potato crops. This highlights farm and regional level differences in terms of what will work in specific situations.

Keep the soil covered

Covered soil is nature's default state, where litter layers and growing plants provide protection. This natural coverage plays a crucial role in maintaining a favourable environment for soil biology (Coyne, M., 2016). Exposed soil, on the other hand, is vulnerable to adverse effects from wind, sunlight, and rainfall. Wind can carry away small particles, including valuable soil components, organic matter, and nutrients, while also contributing to the evaporation of

crucial soil moisture. Direct sunlight further depletes water reserves by heating the soil, making conditions unfavourable for soil biology and plant life. Similarly, cold events can lead to soil cooling or freezing, which disrupts the stability needed for soil organisms. Coverage helps buffer these extremes, maintaining stable temperatures that are more conducive to soil health (NRCS, 2024).

Water, while essential to the soil ecosystem, can also cause damage to bare soil. Uncovered soil exposed to water experiences high pressure from impacts, leading to soil particle displacement, disturbance, compaction, and erosion. Despite the critical importance of soil coverage, its value is not always widely recognized. This lack of coverage exacerbates erosion, soil degradation, and the struggle against weeds. Interestingly, weeds or 'undesirable' plants can naturally cover and protect the soil, acting as nature's quick fix.

Maintaining soil cover with living plants and crop residue effectively controls wind and water erosion. The residue is a barrier against raindrop impact, which can otherwise break up soil aggregates and dislodge surface particles. This protection helps prevent soil compaction, surface sealing, and poor water infiltration, reducing pathogens' transfer from soil to plants. Moreover, soil cover helps retain moisture during dry periods and moderates temperature fluctuations. Because plants and soil organisms are more sensitive to soil temperature than air temperature, stable soil temperatures reduce stress on both (Brady & Weil, 2008).

Maintaining residue does come with challenges. It can act as a reservoir for pathogens and keeps soils cooler and wetter, potentially delaying springtime field operations. In regions with typically excellent, wet spring soils, practices such as strip-till or other minimum tillage methods may be necessary to address these concerns. Strip tillage is a conservation tillage method that involves tilling narrow strips where crops are planting while leaving areas between the strips undisturbed. This method creates small, tilled zones for planting while the rest of the field remains covered with crop residue.

Most, if not all, of the farms I visited during the course of my travels understood the value of keeping the soil covered when feasible. It is not always simple to implement. There are regional challenges around inclement weather post harvest, or lack of accessibility to irrigation water late in the season to get a cover crop to germinate. For example, Eastern Canada gets a lot of rain in the fall which can, at times, makes fields inaccessible and in Alberta when there are water restrictions, there may not be access to irrigation water after mid-September. At Quattro we do our best to keep any and all crop residue on the field post harvest as a barrier to wind erosion and to help in maintaining our soil organic matter.

Biodiversity

At the heart of thriving ecosystems lies the power of diversity. Imagine a farm, not just as fields of a single crop but as a mixture of plants, microbes, insects, and everything in between. This diversity's strength lies in the variety of plants, the intricate root networks, and the bustling soil

life. Diversity is nature's ultimate insurance policy, ensuring resilience, adaptability, and resistance in adversity (Clapperton, 2014).

Why is this so critical? Take the impact of extreme weather, for instance. Monocultures - vast expanses of a single crop - are notoriously vulnerable during droughts or floods. Pallin (2018) states that diverse ecosystems have impressive endurance to these events. Why the difference? A diverse spread of plants continuously feeds the soil with a cocktail of exudates, enticing microbial life that, in turn, keeps the soil fit and fertile. Researchers like Jacoby et al. (2017) suggest that each plant's unique contributions foster a soil community rich in nutrients and life.

Enriching the soil does not stop at plant diversity; it extends to the animals these plants support. A mix of plants that flower and fruit at different times ensures the land is full of life throughout the year. This strategy, supported by research from Gaudin et al. (2015) in Canada, enhances yield stability and fortifies the land against the weather. Integrating strategies like crop rotation or planting various species together, as advocated by McDaniel et al. (2014), elevates soil health by boosting crucial indicators like soil carbon, nitrogen, and microbial biomass. These practices breathe life into the soil, fostering a diverse and healthy ecosystem above and below ground.

At its core, maximizing diversity in agricultural practices is not just beneficial; it is necessary. Whether by diversifying crop rotations, engaging in intercropping, or optimizing soil microbial interactions, the desired outcome is clear - a healthier, more resilient ecosystem. As Clapperton suggested in 2014, managing these interactions is not just possible; it is a pathway to unlocking the full potential of our soil and ensuring the sustainability of our agricultural systems, promoting the thriving diversity of soil life. The type of plant species present influences soil microorganisms, and these interactions can be managed. Some plants favour bacteria, while others favour fungi (Clapperton, 2014). A mix of plant species can foster a broader diversity in soil biota than the sum of the individual species might suggest. Species mixes can be designed to maximize soil biota potential and target specific nutrients that are present but not available (Clapperton, 2014).

A farm visit in Australia highlighted how increasing biodiversity can have positive effects on the crop in production. They had used pollinator strips around their fields to attract beneficial insects. Because of the diversity of insects present, this producer felt that it negated his need to use insecticides as the natural predators for the common pests were present in the pollinator habitat. Perry Produce in Alberta has also worked on using pollinator mixes in and around their potato fields. This increase in diversity of insects has stopped the Colorado Potato Beetles from reaching economic threshold and required chemical intervention.

Livestock

The symbiotic relationship among plants, animals and the environment, signifies a complex interdependence that fosters ecosystem health and productivity (Correia & Lopes, 2023). This

interrelation has unveiled animals' instrumental role in enhancing and restoring soil quality. Recent recognitions appraise animals as pivotal agents in soil recuperation, attributing their significance to nutrient dissemination, organic matter contribution through manure, and the distribution of microbial communities from their gastrointestinal tracts to the soil, thereby aiding in the re-establishment of soil homeostasis (Nichols, K., 2022).

The practical contribution of livestock to soil management is predicated on meticulous management strategies. Improper management approaches precipitate rapid soil degradation. Optimal management techniques ought to mimic the movement patterns of Indigenous animal populations, which involve large herds migrating across landscapes under the influence of predation, thereby leaving substantial vegetative matter in their trail. This process promotes plant regrowth, enhances carbon sequestration, and improves soil nutrient profiles. Employing strategies that incorporate high stocking densities coupled with frequent relocations of livestock has emerged as a paramount approach to preventing soil degradation. When executed proficiently, such practices can significantly accelerate soil restoration, thus enhancing agricultural productivity and economic returns from cash crops (Aljoe, H., n.d.).

While integrating livestock into on-farm soil restoration practices poses a methodological challenge, its adoption is gradually gaining traction. The concept, initially derived from South American agricultural innovations, has subsequently been adopted by a limited number of North American farmers (Thompson, 2018).

Integrating livestock into potato rotations in North America can be challenging. Speaking in terms of my experience in Alberta and in New Brunswick with potato producers, is less common for them to have livestock. Our fields that are used for potato production almost exclusively have no perimeter fencing present. The idea of fencing fields and striking a deal with the neighbour to graze cattle on your irrigated fields with centre pivots can be an overwhelming amount of work.

This is in stark contrast to producers in New Zealand and Australia. The majority of producers I met with already have livestock integrated into their systems and have had livestock for some time now. This did not happen under the guise of regenerative agriculture, but traditionally this is how they have farmed. The majority, if not all fields I visited there had pre-existing fencing to accommodate grazing. In New Zealand the one producer I met with was harvesting potatoes and was planning on going in the next day to seed grass for pasture for his sheep.

Context of the farm

Exploring the integration of regenerative agriculture into one's farming operations is of extreme importance. Every farm is distinguished by its unique characteristics, such as climate, soil composition, topography, biodiversity, and specific production objectives. Applying regenerative agriculture principles necessitates an approach that accounts for these distinct attributes to ensure optimal outcomes.

The process of incorporating regenerative agriculture into a farm operation requires a thorough understanding of the farm's unique environmental and ecological context. This involves an in-depth evaluation of the available natural resources, such as water reserves, soil quality, and local biodiversity, and devising strategies to optimize and safeguard these resources. For instance, in areas susceptible to drought, prioritizing regenerative practices such as water conservation techniques, mulching, and cultivating drought-tolerant crops is essential. Similarly, an analysis of soil conditions can inform the selection of suitable cover crops and organic amendments to foster soil health and increase productivity (Moyer et al. 2020).

Acknowledging the economic and social facets of the farm operation is crucial. The goal of regenerative agriculture extends beyond improving ecological outcomes; it also aims to bolster farming communities' financial resilience and social well-being. Consideration must be given to the market demand for products produced through regenerative methods, the cost and accessibility of necessary inputs, labour requirements, and the potential to enhance local food systems and community ties. Farmers must assess the feasibility of regenerative practices, ensuring they are economically viable and socially beneficial, thereby facilitating a sustainable transition for the farm and the broader community.

As mentioned previously, in addition to producing potatoes for processing, Quattro Farms is a certified seed production operation. The seed production side of our business creates a layer of complication in regards to cover crop species selection. There are standards we need to abide by to certify the seed we produce. For example, to produce a wheat seed crop there can be no history of cereals present on that piece of land for two years previous. Quattro also farms in an area that relies on irrigation to produce crops. Our limited access to irrigation water late in the season presents challenges in terms of establishing cover crops. We are a very diversified operation, which means that harvest is spread over a long time period and our staff remains busy. Being able to dedicate staff to seed cover crops or engaging in other regenerative agriculture practices is one of our main challenges to widespread adoption.

Implementing regenerative agriculture is recognized as an iterative process that necessitates ongoing learning and adaptation. Farmers are encouraged to continuously monitor and assess the effects of their regenerative practices, adjusting their approaches based on the outcomes observed. Being able to measure and document the outcomes of changing practices is of utmost importance. What is measured, documented and benchmarked will depend on what the producer is aiming to achieve with the implementation of a new practice. This adaptive management strategy enables farmers to refine their practices more effectively, aligning them with their specific conditions and goals, resulting in more sustainable results.

Why the sudden popularity of regenerative agriculture?

The consumer push for food products grown regeneratively is continuously gaining significant momentum in recent years, driven by a growing awareness of environmental issues and the impacts of agriculture on the planet. Regenerative agriculture refers to farming and grazing practices that, among other benefits, restore degraded soil, improve biodiversity, and increase carbon capture. This approach not only helps in combating climate change but also supports more resilient and healthy food systems.

Consumers are increasingly seeking food products that are not just organic or non-GMO but also grown in ways that actively improve the environment. This shift is driven by a deeper understanding of how food choices impact the environment, from soil health to water use and biodiversity. As a result, there is a growing demand for transparency in food sourcing, with more consumers wanting to know where their food comes from and how it is grown. This has led to more food processors and retailers sourcing regenerative agriculture ingredients and highlighting these efforts in product labelling and marketing (International Food International Council, 2023).

The movement towards regenerative agriculture is driven by more than the niche environmentally conscious consumer group. The increasing demand has become part of the broader discussion on addressing global challenges such as climate change, food security, and ecological degradation. Forward-thinking companies are responding to consumer demand by investing in regenerative practices, supporting farmers in the transition, and creating products that contribute to a more sustainable and regenerative food system. This consumer push is a powerful driver for change, encouraging more sustainable agricultural practices and contributing to a healthier planet.

Multinational food companies' climate change commitments are under scrutiny by governments, shareholders, investors, and the public. These companies are under pressure to reduce their emissions in their production and supply chains, adopt resilient agriculture practices in their supply chains, and respond to their consumers about their climate change commitments. Investing in regenerative agriculture can help to relieve these outside pressures. For example, if General Mills partners with grain farmers to adopt regenerative agriculture, it strengthens its supply chain, as healthier soil is more resilient to climate extremes, and gives them a competitive advantage. These companies know consumers are willing to pay a premium to purchase products that align with their values (Marks, 2024).

Food companies that embrace regenerative agriculture gain a competitive advantage by differentiating their products in the marketplace. Consumers are increasingly concerned about the environmental and social impacts of the food they purchase, and companies that adopt regenerative practices can appeal to this growing demand for sustainably and ethically produced food (Casey, C. 2023). Investing in regenerative agriculture can help food companies

build resilience against climate-related disruptions and reduce their dependence on synthetic inputs.

Marketing strategies can facilitate partnerships between food companies and farmers practicing regenerative agriculture. By showcasing these partnerships in their marketing campaigns, companies can build credibility and trust with consumers, reinforcing the value proposition of supporting regenerative agricultural practices. A good example of this marketing is the segment of Spud Smart's website entitled "Regen Ag Voices" which features McCains grower partners who are implementing regenerative practices in their process potato production (https://spudsmart.com/category/viewpoints/regen-ag-voices/).

Despite the consumer demand for such products, marketing products in a sustainable manner does not come without risks. Regenerative agriculture must be presented in clear terms, not marketing jargon. Improved marketplace clarity would ensure that consumers and producers have a common understanding. This would also lessen the risk of regenerative agriculture becoming a buzzword. This attractive, easily exploited ambiguity can partially explain the regenerative ag momentum showcased in all forms of media. The lack of definition can create a risk of misleading claims that confuse the consumer or water down the term so much that it loses any valuable meaning. There is a spectrum of farming practices that ranges from good to bad to regenerative and everything in between. If you are not a good environmental steward and are implementing practices that cause organic matter loss and soil erosion, for example, and then you implement a few regenerative practices, are you a practitioner of regenerative agriculture, or are you just moving in the right direction (Sincock, A., 2023)?

As a reaction this greenwashing legislation has been gaining momentum globally as governments respond to the misuse of environmental claims by companies (Dorileo & Galbiatti, 2024). In the European Union, regulations like the Green Claims Directive are being introduced to curb misleading claims, requiring businesses to substantiate eco-labels with verifiable data (Traina, D. 2023). Similarly, in the United States, the Federal Trade Commission enforces guidelines under the "Green Guides," which aim to clarify environmental marketing claims and hold companies accountable for false advertising (Kim et. al., 2023). Australia, through its Australian Competition and Consumer Commission, has intensified scrutiny of businesses using misleading "green" terminology. Meanwhile, countries like Canada and New Zealand are emphasizing transparency in sustainability claims through consumer protection laws (King, 2024). Globally, these legislative efforts reflect a shift toward enforcing corporate accountability, ensuring that claims of environmental responsibility align with tangible, measurable actions rather than marketing tactics. This push not only protects consumers but also incentivizes genuine corporate responsibility in sustainability efforts.

The risks of regenerative agriculture just becoming a label on food products have been highlighted to me through various producer interviews. One poignant example was at a farm visit in Australia. I asked the producer I was visiting with if they felt any pressure from the supermarket chain to whom they were supplying fresh potatoes to implement regenerative agriculture practices. The producer laughed and stated that two weeks before my visit, a man in

a suit representing the supermarket showed up at their farm and asked them questions about their farming practices. The producer indicated they had not recently changed practices and considered themselves conventional farmers. Once the supermarket representative had completed his interview, he handed over new bags for the potatoes to be packed for sale at the store. These bags had large lettering on the front that stated “Regeneratively Grown” (Figure 2).

I have had many conversations with Alberta potato producers who have completed their regenerative agriculture survey with McCain Foods. They were placed in the engaged or advanced categories on the McCain framework (Appendix A) without changing any practices with the word regenerative in mind. Is this considered greenwashing or just documenting that the vast majority of producers are good environmental stewards of their land. Perhaps my view here is skewed. I live and work in Alberta where we have a very progressive grower base and growers here are very open to change.

Figure 2. Potato bag for fresh pack potatoes in Australia.

Large multinational companies often tout regenerative agriculture as a solution, emphasizing specific farming techniques that, in isolation, barely scratch the surface in boosting on-farm efficiency or on-farm resilience. Despite their vocal support for concepts like biodiversity, the stark reality is that they continue to operate in areas dedicated to monocultures, dependent on external inputs, and lacking livestock integration (Tittonell, P. et al., 2022). The enthusiasm for cover cropping is frequently mentioned, yet the common practice of terminating these crops with herbicides raises questions about its purported benefits.

The portrayal of regenerative agriculture as a hallmark of corporate sustainability by major agricultural and food corporations, financial institutions, and even governments does not advance the quest for true agricultural sustainability (Tittonell, P. et al., 2022). This approach risks backfiring, especially when it fails to deliver promised results or inadvertently contributes to greenwashing efforts, thus misleading farmers, consumers, and other stakeholders. Simplifying regenerative agriculture's definition to include any farmer who plants a cover crop

inflates adoption figures, falsely suggesting a significant stride towards sustainability. Questions linger about its impact on soil health, carbon sequestration, and biodiversity restoration without thorough assessments of relevant indicators (Tittonell, P. et al., 2022). While adopting regenerative agriculture principles is not inherently harmful and can promote sustainability, the current corporate narrative risks reducing it to mere sustainability rhetoric. The question becomes, who is benefitting from this push to implement regenerative agriculture? Corporations are using the farmers' stories and the farmers' hard work to gain or maintain market share. It is worth mentioning here that to date McCain Foods has not marketed regenerative branded fries at an increased price to consumers. Many growers have no financial or other incentive to implement regenerative agriculture; until that changes, we will struggle to see widespread adoption.

The drivers of adoption

Regenerative agriculture embodies a holistic strategy for viewing one's agricultural operations in a broader context. Throughout my travels, I was privileged to meet individuals who have adopted varied regenerative agriculture methods. Some people studied soil biology and integrated this knowledge into their operations, while others grounded their methods in their personal beliefs. Every farm had its distinct justification for shifting to regenerative agriculture, illustrating the diverse motivations behind adopting regenerative agriculture practices.

Something needs to change

One way to get started with regenerative agriculture is to realize that the current way of operating is no longer viable. Land degradation is one of those pushing points. After attending several seminars, meetings, and on-farm visits, it became clear that many producers who switched to a regenerative approach were motivated to do so because they realized something in their system needed to change to stay profitable. One producer who spoke at the Manitoba Forage and Grazing meeting spoke about how his family cattle operation was on the brink of bankruptcy if they continued down the path they were on. Out of necessity, they explored ways to save input costs, leading them to explore regenerative agriculture principles and ultimately find success.

I met with Shaun Paget, a potato producer in New Brunswick, who shared his path to regenerative agriculture which started with a desire to reduce his on-farm fuel bill. This began with reducing tillage passes where he could. From making this slight change, he noticed other benefits of minimizing soil disturbance, such as increased water infiltration and, over time, a reduced need for synthetic fertilizer.

Straight-up passion

Along my journey, I met a few producers who seemed to be exuding a passion for regenerative agriculture. There did not seem to be one event on their farm or motivating factor that spurred the change in practice, but a raw sense of passion that drove them to do the right thing.

Harold Perry of Perry Produce in Alberta is a shining example of this. He is genuinely curious and passionate about farming and growing healthy food for people while minimizing his impact on the environment. He is one of the few potato producers practicing regenerative agriculture at a large scale globally.

Moonrocks in St. George, Australia is another example. These producers are genuinely passionate about being good environmental stewards and are at the forefront of sustainable food production at a large scale. They produce onions and garlic using cover crops, minimal tillage and minimal synthetic inputs.

Market differentiation

Some growers are using regenerative agriculture as their differentiator in the marketplace, not unlike multinational food companies. In my travels, the producers doing this are often smaller scale and selling directly to consumers. One example of this is Moonacres (different than Moonrocks, mentioned above) in Roberston, Australia. They are a 140-acre farm that started as a passion project for owner Phil Lavers. He left the hustle and bustle of life as a financial trader in the big city and sought a more family-oriented way of life. That is how Moonacres was born. It is now a thriving produce operation selling its organic, regeneratively grown produce at a premium to high-end restaurants in the city or directly to consumers.

For producers in North America who are growing contracted potatoes to processors there is currently no financial incentive to make these changes in terms of contracted price or bonuses. There is some talk about this changing in the future, but there has been no concrete discussion that I am aware of.

Future thinkers

I spoke with numerous producers looking into the future and hoping to ensure sustainability for future generations. Some were implementing new practices to ensure healthy soil for future generations with regenerative agriculture in mind, while others were implementing the same practices without any consideration for the label of regenerative farming.

Adopting regenerative agriculture is increasingly seen as a pivotal decision for growers focused on safeguarding the future of farming for generations to come. This forward-thinking approach is grounded in the understanding that current conventional farming methods may deplete soil health, reduce biodiversity, and contribute to climate change, ultimately threatening the very foundation of agriculture. By implementing regenerative agriculture practices, growers are not just focusing on the yield for today. They are investing in the health of the land to ensure it remains fertile, productive, and resilient for future generations. It is a commitment to leaving the land in a better state than they found it, ensuring food security and the economic viability of farming communities for years to come.

I spoke with Chad Berry of Under the Hill Farms in Manitoba. When asked what motivated him to implement some of these new practices, he responded, “keeping our farm viable in the future and improving the farm and, at a minimum, not degrading it. It is way more engaging to try new practices and try to improve. It is easy to keep doing the same things.”

Another example is in New Zealand and Australia, where they are fortunate to have an environment where continuous cropping is the norm. They did not give much thought to the pillars of living roots or continuous cover as that is standard practice. In addition, most producers there already have livestock integrated into their systems, so they have been implementing these practices for some time now.

At Quattro Farms, we strive to be stewards of the land. When it was decided we plant cover crops, maintain crop residue in the field, and amend our soils with organic material, it was done to maintain our soil in place and increase organic matter. There was never a mention or thought of the label of a regenerative farming operation.

What are the barriers to adoption?

Producers who are actively investigating and implementing regenerative agriculture practices were excited to talk about it. They were proud of their accomplishments and wanted to share the details with me. However, it was more challenging to have a meaningful chat on the subject with producers who were not interested in going down the regenerative pathway. When I mentioned regenerative, they shut down and lost interest in talking. Below, I outline what I think are some of the barriers to adopting these practices.

Social Stigma

Social stigma is a significant reason why some people think regenerative agriculture is not suitable for them. This challenge is not unique to regenerative agriculture since the influence of family and friends within the agricultural community as a whole is especially significant. Some reluctance to implement new practices may be linked to how farming practices are learned and implemented through long-term knowledge and beliefs passed down through generations (Topp E. et al., 2024). Tradition creates a foundation for familiar agricultural practices that producers do not want to deviate from. A producer's integration into the local community, social capital, and attitude toward development and collaboration with others can affect their decisions to implement new things. Their perception of their own capacity to adapt and change is an essential determinant of their choice of farming practices (Topp E. et al., 2024).

Agriculture is inherently an acquaintance society. Producers do not exist independently; their kinship and geographical relationships are complex. Their behavior is significantly affected by family, relatives, and friends (Li et al., 2023). Producers do not want to be judged by their peers for being different (Heis et al., 2023). Through interviews with some early adopters, the feeling of being judged or talked about is natural. Farming unconventionally can bring stigma and, in extreme cases, cause farmers to avoid the local coffee shop where the neighbors might be

talking about them (Alexanderson et al., 2023). The early adopters of organic production were stigmatized by their peers and often faced opposition from conventional farmers (Lähdesmäki, M. et al. 2019). This stigmatization has forced regenerative growers to create new communities to discuss shared practices and ideas, as these practices are not one-size-fits-all. Most early adopters have made their communities outside of their geographically local community, connecting with like-minded individuals on messaging platforms, for example. A concrete example of this is a WhatsApp group I am a part of called "Friend in Regen". It consists of 12 producer members who are geographically distant, but all have an interest in regenerative agriculture. On this chat group we ask questions, share ideas and ask for help.

There is a disconnect between people who self-identify as regenerative farmers and those already practicing regenerative practices but without the label. To some extent, the stigma associated with regenerative agriculture and the rebranding of existing practices, many of which have a long history, have led some producers to reject the term (Alexanderson et al., 2023).

We know that social networks play a crucial role in the diffusion and adoption of new ideas. Spillover effects have been observed, indicating the relevance of peer influence in the diffusion of regenerative agriculture practices (Wang et al., 2023). When growers hear that their neighbours succeeded, they are more interested in trying something for themselves. It takes a small amount of the fear away. Any producer I met with, regardless of country, who was practicing regenerative agriculture had stories to tell me about how their neighbours started to ask questions and make small changes once they saw success. One specific example is a grower who transitioned away from using fungicide seed treatments as a way to not disrupt the natural biology of the soil. This producer travelled to a meeting with the neighbour. As they were travelling to their destination, he shared his thoughts and success around this transition. This motivated the neighbour to trial this practice on his operation for the upcoming season.

Unfortunately, perceptions that categorize regenerative agriculture as a trend within the industry have undermined it. The proliferation of terms such as sustainable agriculture in recent conversations has further contributed to the notion that regenerative agriculture might merely represent another temporary movement. Many producers feel they are already good stewards of the land and do not want to be associated with what can and is being perceived by many as just another fad or buzzword.

Lack of information

Within the context of regenerative agriculture, information dissemination largely stems from the practical experiences of fellow farmers. This mode of information exchange stands in contrast to the conventional approach where farmers rely on various sources ranging from trusted advisors, such as agronomists, to publications and online platforms for solutions to their challenges. Most of this conventionally sought guidance is rooted in traditional academic or corporate research, which predominantly addresses mainstream agricultural practices. These traditional outlets have shown a reluctance or lack of initiative in exploring or reporting on

regenerative agriculture methodologies. Most successful regenerative agriculture farmers do not use public or commercial research but rely on farmer-to-farmer knowledge sharing.

The significance of local and regional variances in producers' decision-making processes underscores the necessity for incentives and programs specifically designed to encourage the uptake of regenerative practices. Such initiatives should be underpinned by research that is attentive to regional specifics (Sarker et al., 2019). Producers demand empirical examples of local adoption and the resultant benefits before committing to these practices. Previous research underscores a deficiency in technical support, clear protocols, and evidence-based guidelines within the sector (Food Water Wellness, 2024).

There is an identified scarcity of agriculture advisors who are not motivated by sales, alongside a similar lack of recognized leaders and mentors in regenerative agriculture. A discernible disconnect exists between the theoretical knowledge disseminated through academic institutions and the practical applications demanded in the field. This discrepancy leaves recent graduates aspiring to become Certified Crop Advisors and Professional Agrologists ill-equipped to meet the real-world demands of producers seeking advice on regenerative agriculture practices (Food Water Wellness 2024). The Canada Trusted Advisor Partnership has identified this disconnect and is launching a soil health-focused training program for agronomists commencing in 2025. This program aims to fill the gap in technical assistance for soil health management on farms (Harris, B. 2024).

Much of the current research is funded by agribusiness with the end goal of selling inputs. With the shift to regenerative agriculture, the power is being returned to the producer. With fewer inputs required, the need for this type of research may decrease. The current research is heavily biased towards conventional agriculture. There needs to be a paradigm shift if widespread adoption of regenerative practices is to be achieved (Frison, 2016). While research into regenerative agriculture is slowly gaining momentum, traditional research methodologies, characterized by a reductionist approach, often overlook the holistic benefits and synergies inherent in regenerative agriculture. Traditional research also often omits the financial outcomes; financials must be included. You cannot go green if you are in the red. Should the government shoulder some more in the financial responsibility to fund regenerative agriculture research in order to support meeting their sustainability targets?

Adopting a user-centric approach in research could yield more significant outcomes by aligning more closely with the interests and concerns of hesitant producers. There are many events and field days promoting regenerative agriculture. Many people presenting at these events have no expertise in farming but think it is okay to impose their ideas on the farmers, the ones with experience. Producers are often omitted from speaking at these events whereas academics, NGOs, or industry professionals are at the centre. This is why the most successful regenerative farmers rely on knowledge gained from self-created discussion groups, where knowledge is shared from farmer to farmer.

Barriers to change

Regenerative agriculture practices are currently not incentivized with premium pricing for commodity crops, which poses a significant barrier to their adoption. The economic benefits of these practices are not immediately apparent to many, making the financial risk of transitioning seem daunting. The additional expenses tied to covering crop seeds and labor, especially during peak seasons, exacerbate the perceived implementation challenges. This is particularly true in agricultural systems where profit margins are already razor thin, and substantial change is difficult to justify without clear financial gains. Many producers find themselves financially sustainable without adopting regenerative practices, prompting the question: if the current system is not broken, why fix it? The long-term profitability of regenerative agriculture remains unproven to many, reinforcing hesitancy towards these practices. This hesitation is even more pronounced among younger farmers, who are generally more apprehensive about accumulating significant debt. With the transition to regenerative agriculture requiring upfront investment without immediate returns, the question of who will bear these costs becomes paramount. Some examples of additional costs are cover crop seed, additional labour costs, equipment or infrastructure modifications, or costs associated with monitoring, such as soil health testing. The delay in financial returns from regenerative agriculture underscores the need for strategies that make these practices economically viable in the short term. As the Food Water Wellness 2024 Report highlights, finding a profitable way to engage in regenerative agriculture is essential for its broader adoption.

In Canada, McCain Foods and McDonald's have launched significant initiatives to promote regenerative agriculture among potato farmers. The McCain-McDonald's Future of Potato Farming Fund, a $1 million investment, supports over 130 farmers managing 76,000 acres. It focuses on enhancing soil health, reducing tillage, and improving climate resilience through education, demonstration projects, and cost-sharing grants (EconoTimes 2022). Similarly, McCain Foods, in partnership with Farm Credit Canada (FCC), offers financial incentives under a Regenerative Agriculture Framework. Farmers can earn up to $16,000 annually based on their sustainability practices, with additional benefits like free access to farm management software (McCain 2022). These programs aim to reduce financial barriers, encourage sustainable practices, and build resilience in Canadian agriculture.

Fear of failure

When implementing something new, the fear of failure can be intimidating. Deviating from what has always been done can seem insurmountable and overwhelming. As this transition to regenerative agriculture progresses, we, as an industry, need to reframe failure as a learning opportunity. There is immense power in sharing failures and embracing the lessons that come with them. This can build a sense of trust and community through sharing. This transparency can build trust and lead to collaborative problem-solving. Many of the regenerative producers I've engaged with didn't achieve their success without encountering numerous failures along the way. Yet, these setbacks are seldom discussed. Sharing these experiences holds immense value, as it normalizes challenges and helps to alleviate the fear of failure when producers experiment with new practices that don't yield immediate success.

Unattainable ambitions

So much information on regenerative agriculture is being thrown at producers from every direction that it can seem overwhelming. All the practices associated with regenerative agriculture are intertwined, and it can be hard to isolate the benefits, making direct, measurable goals problematic. Regenerative agriculture is not something you can implement overnight. It is a systems approach, and the practices will be implemented differently on every farm. When starting this journey to regenerative agriculture, producers must remember to keep it simple and measurable, keeping the changes small and incremental until they are confident in their new ways of working. It is very easy for producers to get caught up in trying too many new things at once, losing sight of their goals, and forgetting why they are making these changes in the first place.

Real Risks

Implementing regenerative agriculture on a potato farm presents several real risks that require careful consideration. Transitioning to practices such as cover cropping, or reduced tillage may initially lower yields as the soil adjusts to the new system, which can impact farm income during the transition period. The upfront costs of acquiring diverse seeds, equipment modifications, or possibly new irrigation systems can strain financial resources. Certain regenerative practices may lead to increased pest and disease pressures if not carefully managed, as potatoes are particularly susceptible to soil-borne pathogens. In addition, there may be quality risks to the potato crop such as increased insect damage or rot issues. Achieving optimal nutrient management with minimal synthetic inputs can be challenging, potentially resulting in deficiencies that affect crop quality and productivity. The lack of immediate economic returns and the need for specialized knowledge may discourage adoption and require substantial time and effort for proper implementation, making the process both financially and operationally risky.

A practical example of this can be observed in a field where fall cover cropping was implemented on half of the area. During a particularly wet spring in Alberta, the half of the field without a cover crop dried sufficiently and was planted within a reasonable timeframe. In contrast, the cover-cropped portion remained excessively wet, delaying planting by nearly a month. This delay likely reduced the yield potential of the potato crop.

Another notable case involves the use of buckwheat as an intercrop with potatoes. The buckwheat became overly competitive, outgrowing the potatoes and ultimately suppressing their development. This led to significant yield losses.

Additionally, there are concerns regarding increased wireworm pressure when continuous cover cropping is adopted. Wireworms can cause substantial damage to potatoes, severely affecting the quality of the harvested crop and potentially compromising marketability.

Conclusion

It is clear to me that the outcomes of regenerative agriculture practices are overwhelmingly positive from a sustainability and soil health perspective, but there is not one universally optimal approach. Each operation must determine its goals and how and what practices work for them. Producers understand their land and operation better than anyone and will have the best insights into how and where some of these practices might fit. Regenerative agriculture requires a systems approach. The soil is the system, and plants and animals are the tools that manage it. “Regenerative agriculture is not checking boxes and recipe cards. If you think it is, you are not going anywhere. That’s conventional thinking. You need to include the “whys” when implementing these practices” (Nichols, 2022). Implementing regenerative agriculture is not a destination but a continuous journey. Producers cannot get caught up in the destination and need to realize that this way of farming is static, and practices and outcomes will be in a state of continuous change.

I feel it is important not to get caught up in the labels. Through all my meetings and interviews with producers, it was clear that they are all on the same page wanting to maintain and improve their land for future generations and create a sustainable business. All growers are regenerative in some capacity. Most producers prefer to operate somewhere in the middle, without the label. If we are all working towards that common goal, it should not matter if you label yourself as a regenerative farmer as long as the industry is moving the needle in the right direction.

Other multinational food companies should take a page from McCain’s book and clearly define what regenerative agriculture means to them. This clear definition helps strengthen corporate statements around sustainability, and consumers can clearly see what they are supporting through their purchases. There needs to be intelligent, clear goals around implementing regenerative agriculture with specific and measurable outcomes.

The momentum behind regenerative agriculture is more than a passing trend—it is a pivotal response to environmental challenges and consumer demands. By embracing regenerative practices, farmers and food companies contribute to the restoration of ecosystems and the fight against climate change. They also aim to meet the growing consumer demand for sustainable and ethically produced food. This approach offers a holistic solution that addresses agriculture's ecological, economic, and social dimensions, promising a more resilient and healthy future for our planet. As such, regenerative agriculture is a critical pathway toward sustainable food systems, demanding continued innovation, collaboration, and commitment across the industry to realize its full potential.

Recommendations

- **Targeted research**. Research needs to continue and expand. Continued research should consider financial outcomes and risks.
- **New mentorship**. There is an immediate need to fill the knowledge gap within the industry. As regenerative agriculture expands, knowledgeable and trusted advisors will be critical. We need to build a new generation of mentors in the farming community. Skills development is needed to ensure the industry can take traditional agronomy to a new future incorporating regenerative practices.
- **Building baselines**. Ensure we are measuring the baseline of our soil health to determine improvement levels. We need aligned metrics from the farm level to the global level
- **Fostering collaboration**. Farmers and producers need to continue to work together, not become siloed by farming practices
- **Key incentives**. There needs to be increased financial incentives or derisking for producers trying new practices. We need to regenerate stewardship and price things to return more money to the farm, enabling producers to try to news.
- **Clear messaging**. For all these efforts to be meaningful, we must work together to eliminate or minimize greenwashing attempts by multinational companies trying to ride the coattails of producers doing the hard work on the ground.
- **First steps**. If you are a hesitant producer, just start, small and slow. Ensure you have the time and resources to try something new and evaluate its success in your operation. Find what works for you, and do not worry about what everyone else is doing.

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Appendices

Appendix A (McCain Foods, 2024)

What Defines a Regenerative Potato Grower in the Northern Hemisphere?

INDICATOR	ONBOARDING	BEGINNER	MASTER	EXPERT
Armoured soils preferably with living plants: Fields on the farm are covered by living plants with an average NDVI value >025 for all fields during the season and at least 30% of soil surface is covered by living crops or residue year round.	1 Beginner indicator of choice + Regenerative agriculture training	90 Days	180 Days	270 Days
Enhanced crop diversity: Over a 4-year period, crops of different species are grown providing a range of growth cycle (annual, bi-annual and perennial) as well as growth characteristics (plant architecture and root types).		4 Crop species are grown, including grass & legumes	6 Crop species are grown, including grass, legumes and a perennial	8 Crop species are grown, including a grass, legume, brassica and 2 perennials
Minimized soil disturbance: Intensive tillage is kept to a minimum across the rotation cycle. Tillage associated with cover crops/residue incorporation, planting and potato harvest excluded form potato tillage measurements. **Measured by* Soil Tillage Intensity Rating (STIR-USDA).		Reduce tillage by 1 event on potato crop & adopt conservation tillage in rotation crops or decrease tillage intensity across rotation by 10% *	Reduce tillage by 2 events on potato crop & adopt conservation tillage in rotation crops or decrease tillage intensity across rotation by 25% *	Reduce tillage by 3 events on potato crop & adopt conservation tillage in rotation crops or decrease tillage intensity across rotation by 50% *
Reduced toxicity of pesticides: Crop protection products are selected to reduce environmental, human and consumer impact. Growers exceeding 2500 EIQ values for potato crop cannot be considered as engaging in Regenerative Agriculture.		800 EIQ per hectare	500 EIQ per hectare	200 EIQ per hectare
Enhanced farm and ecosystem biodiversity: Small natural habitats and natural landscape elements are promoted. Small natural habitats are present within 250 m from the edge of the field, and on 70% of the field.		1% of non-cultivated land is dedicated to natural habitat	5% of non-cultivated land is dedicated to natural habitat	8% of non-cultivated land is dedicated to natural habitat
Reduced agro-chemical impact and optimize water use: Use of inputs is justified and managed to reduce risks. Decision support systems (IPM, 4R's) and technology are used to precisely apply inputs.		All inputs are applied based on DSS or expert advise from recognized crop advisor. GPS is used	Meet beginner level and 15% of crop nutrient needs to be provided from organic sources (plant/manure)	Meet beginner level and 30% of crop nutrient needs provided from organic sources (plant/manure)
Increased soil organic matter: Every 5 years, soil health is assessed for organic matter, as well as biological, physical and chemical properties.	Soil health assessment every 5 years (minimum of 1 fields for each soil type / cropping system)	OM% increase target TBD based on local expertize	% OM increase TBD Over 5 years	% OM increase TBD Over 5 years

Red indicators are required. The grower must meet 5/7 indicators to achieve the beginner level.