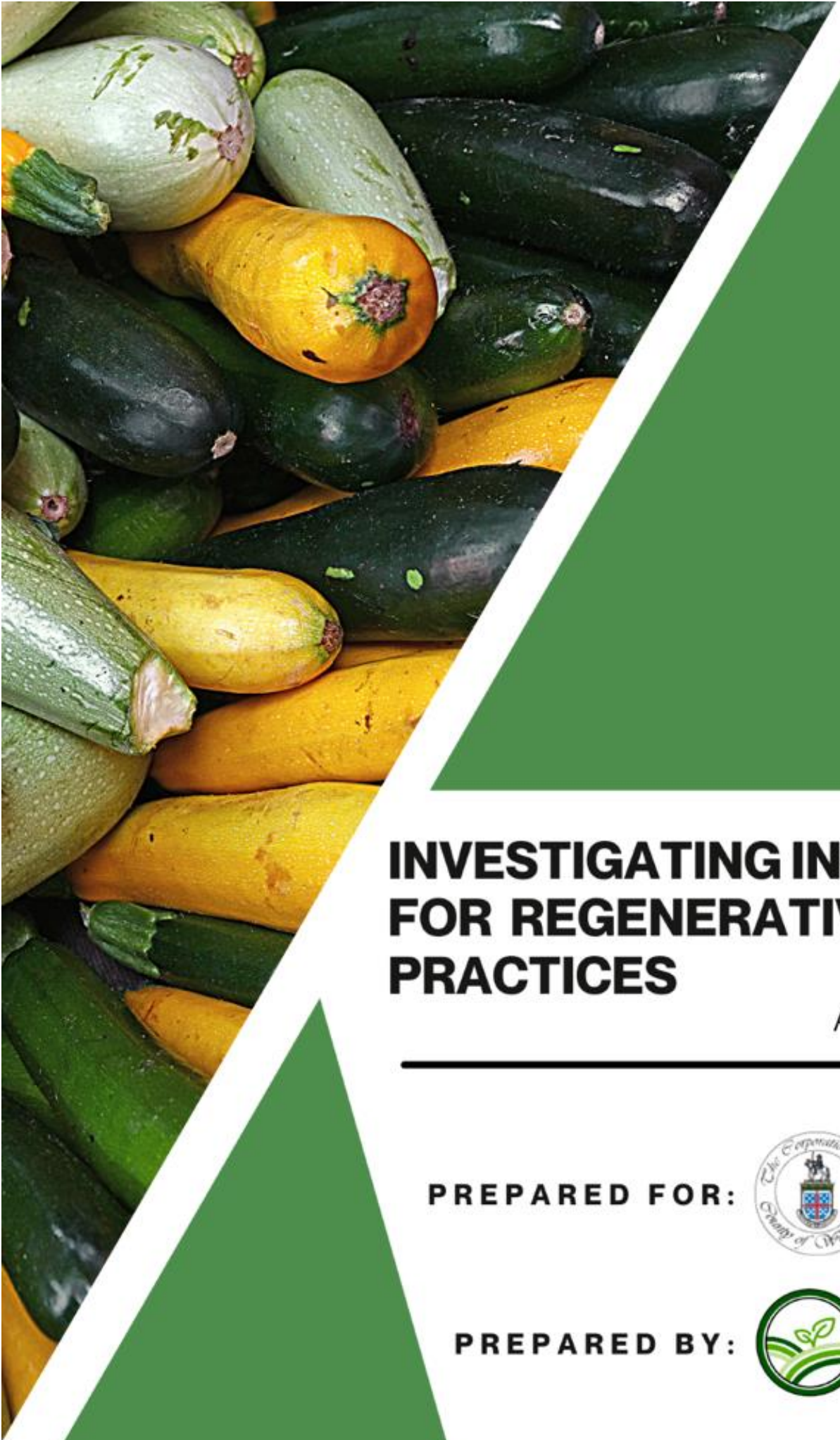

INVESTIGATING INCENTIVES FOR REGENERATIVE FARMING PRACTICES

April 22 nd, 2021

PREPARED FOR: WELLINGTON COUNTY

PREPARED BY: FUTURE OF FARMING CONSULTING

DISCLAIMER

This report is an academic exercise conducted by graduate students in the *Masters of Environment and Sustainability* (MES) program in the *Centre for Environment and Sustainability* (CES) at Western University, London, Ontario, Canada. The named consulting company that produced this report is a fictional entity created for the purpose of this exercise. For information on this program, please visit www.uwo.ca/mes/.

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- Ontario Soil Network

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Executive Summary

This consulting project was designed to investigate regenerative farming practices in the County of Wellington, Ontario. In this context, we defined **regenerative agriculture** as a **dynamic concept** that focusses on the **long-term renewal** of organic carbon, nutrient content, and microbial biodiversity in the soil, while also nourishing the ties between the land, its natural heritage, and the community. The objective of this report is to build a knowledge bank of regenerative farming practices and provide Wellington County with a better understanding of how agricultural businesses can be supported as they improve the sustainability of their farm. The findings showcase success stories of regenerative farming obtained through interviews with local farmers, challenges and barriers that farmers encounter, grant application experiences, and suggestions on how the County can best support farmers.

The County of Wellington has taken steps to support the local agricultural sector by partnering with the City of Guelph to create Our Food Future, a project that aims to create a **circular food economy** for the region. The project presents a golden opportunity for the County to work with farmers to develop a circular economy that benefits farmers, protects the environment, and helps inform the County's Climate Change Mitigation Plan. The incentivization of regenerative farming practices **improves the resilience and productivity of farms**, which generates cascading environmental and economic benefits for the County of Wellington.

This report analyzes incentives of regenerative farming through a literature review and primary data obtained through an online survey and interviews with local farmers, agricultural organizations, and grant agencies. Findings demonstrate that regenerative farming is widely practiced within the County of Wellington. During interviews, farmers identified various benefits of regenerative farming practices, most notably **increased soil health** and **marketability** of their products. Despite reaping the multiple benefits of regenerative farming, farmers also expressed challenges when seeking support to transition towards a sustainable system. A majority of farmers identified accessibility to grants and limited awareness of available local supports as key challenges. Farmers also reported municipal barriers, including lack of infrastructure, lack of informational resources, and poor urbanization and land-use planning. While the majority of respondents expressed a high interest in regenerative farming practices, findings demonstrate that existing municipal barriers warrant the County's attention.

Recommendations for the County to support regenerative farming include:

1. Adjusting zoning laws.
2. Attracting investments in internet accessibility.
3. Implementing a farmer's market gift card program.
4. Implementing tax incentives for farmer conservation efforts.
5. Developing a living document of resources for local farmers.

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1. Introduction

The introduction section of this report will provide a project description, establish context with characteristics of Wellington County, and describe the project objectives, scope, and methodology.

1.1 Project Description

As part of the Smart Cities Challenge, the City of Guelph and Wellington County have partnered to create Our Food Future, a project that aims to create a circular food economy for the region. This project supports Our Food Future and the County's Climate Change Mitigation Plan by assessing how regenerative farming has been, and can continue to be, practiced in the County of Wellington, and its role in contributing to ecosystem and soil health, and watershed protection. Regenerative farming is a dynamic concept that focusses on the long-term renewal of organic carbon, nutrient content, and microbial biodiversity in the soil, while also nourishing the ties between the land, its natural heritage, and the community. Understanding regenerative farming and its role in the County is key to supporting agricultural businesses and building a sustainable local food system.

1.2 Characteristics of Wellington County

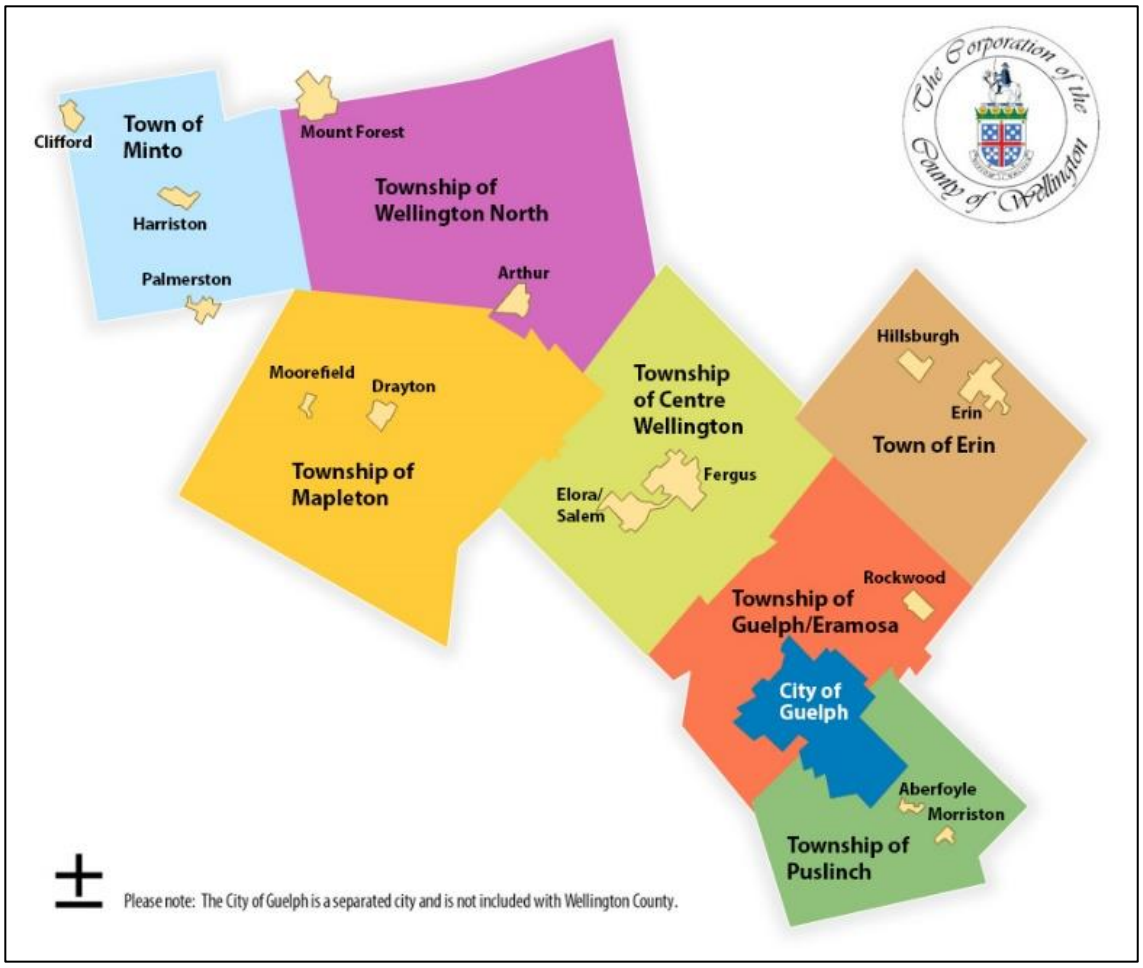

Figure 1. Map of County of Wellington district boundaries.

With more than 2,000 businesses in the crop and animal production sector, the County of Wellington is home to over 8,000 people working in this industry, which has accounted for over $150 million in gross income annually since 2016. This sector is present in every town and municipality across Wellington County and plays a major role in the lives of its residents.

In the 10-year strategic action plan put forth by the County in 2020, a “Future Focused. People Invested.” approach is taken. To achieve the goals set out by this plan, understanding the intersection of environmental and economic sustainability is key.

Our Food Future is a partnership project of the County of Wellington and the City of Guelph. The project sets out to achieve three main goals within five years in the 50:50:50 Plan (Figure 2).

Figure 2. The three main goals of Our Food Future as part of the 50:50:50 Plan set out by the County of Wellington and the City of Guelph.

Unprecedented economic shifts brought on by the onset of the COVID-19 pandemic have shifted the priorities of municipal, provincial, and federal governments. Financial security is at the forefront of people's minds, while environmental concerns may fall to the wayside. However, through Canada's Smart Cities Challenge there is a golden opportunity to work with the farmers in the County of Wellington to build a circular food economy which will benefit them economically, protect the environment, and help to meet the target goals set out by the County of Wellington.

1.3 Objectives of this report

1. **Identify Regenerative Farming Definitions, Practices, and Approaches**
   - Produce a literature review that will compare information on regenerative farming in local areas and regions with growing zones similar to those exhibited in the County. The literature review will inform interviews with farmers, organizational experts, and grant representatives, and contribute to the project write-up.

2. **Discover Local Farmers in the County of Wellington**
   - Connect with local farmers to identify mentors, recognize regenerative farming success stories, inform future directions, and identify barriers and challenges.
   - Determine whether there are municipal barriers that should be addressed, what incentives should be publicized or advocated for, and how agricultural businesses can best be supported as they adopt change.

3. **Identify Local Agricultural Organizations and Grant Agencies**
   - Connect with local organizational leaders and grant agencies and identify how they can support farmers hoping to improve on-farm sustainability.

4. **Produce a Publicly Available Electronic Report**
   - Produce a publicly available electronic report for the Smart Cities Office which will provide a literature review and collection of findings which will aid in determining how regenerative farming may be adopted by Wellington farmers.

5. **Create a Directory of Local Practitioners, Organizational Experts, and Grant Opportunities**
   - Build a directory of local practitioners, organizational experts and grant opportunities in Wellington County. The directory will include contact information and act as a resource for both farmers and the County to support engagement and sharing of knowledge in the future.

6. **Develop an Infographic to Share Key Findings with Members of the Public and the County of Wellington**
   - Produce an informational infographic to visually represent the findings outlined in this report and to contribute towards possible advertisement and educational material that the County of Wellington can utilize to promote local regenerative farming practices.

1.4 Scope

The parameters of the project will fall under the following restrictions:

- The academic literature review on regenerative farming will explore local practices in Wellington County, Ontario and non-local regions in southwestern Ontario with similar climate, agricultural soils, and farming techniques.
- An online survey will be distributed to local farmers in Wellington County to discover those interested in being interviewed, to gauge local opinions on regenerative farming, and to collect data on farming experiences. Contact information for local farmers will be obtained from the County of Wellington's Business Directory.
- Farmer interviews will be conducted with 25 local practitioners within the County, inclusive of both farmers with and without regenerative farming experience.
- Organization interviews will be conducted with 12 individuals who focus on regenerative farming pedagogies and practices. Contact information for 6 individuals will be provided by the County of Wellington, and the remaining contact information was obtained organically through recommendations and research.
- Grant organization interviews will be conducted with 2 organizations, whose contact information will be obtained through an online survey.
- The geographic scope of recommendations will be limited to the County of Wellington (see Figure 1 for a map of the County and its district boundaries).

1.5 Methodology

To investigate regenerative farming practices in Wellington County, three components were used:

i) Literature review
ii) Discovery of farmers
iii) Interviews with farmers and organizational leaders

A **literature review** was conducted to identify regenerative farming definitions, practices and approaches (Objective 1). As part of the literature review, local practitioners and organizational experts were interviewed to develop a local definition of regenerative farming. Regenerative practices implemented in the County of Wellington as well as other regions in southern Ontario with similar agricultural soils and landscapes were identified and analyzed. Information regarding the advantages and challenges associated with regenerative farming, climate change risk to agriculture, and the impacts of agriculture on soil health were obtained by analyzing articles in academic journals. Information regarding the characteristics of the County of Wellington's agricultural sector was obtained from municipal documents, such as the County's Economic Profile. The literature review served as a starting point, providing context for survey and interview questions.

A large portion of the project's findings were contingent on the **discovery of local farmers** in the County of Wellington (Objective 2). The contact information for 190 local farmers was obtained from the County of Wellington's Business Directory, available online. A Qualtrics survey (Appendix F) was created and distributed by e-mail to County of Wellington farmers to establish a baseline connection with local farmers. The survey questions sought to obtain general demographic information and farmers' insights on their farming practices and experiences. Survey participants were informed that their responses would help the County of Wellington identify any municipal barriers that should be addressed and how agricultural businesses can best be supported by the County. Lastly, participants were asked if they would like to be contacted for a follow-up phone or video interview to expand on their survey responses and/or if they would like to be added to the County Directory. The survey received 45 responses from Wellington County farmers (Appendix G).

Due to COVID-19 restrictions, all **interviews** were conducted remotely by telephone or video-call. At the beginning of each interview, interviewees were asked by the interviewer if they were comfortable with being recorded and included in the final report. For all interviewees, consent was obtained to record responses for notetaking purposes. Interviews with agricultural and grant management organizations were generally conducted with two team members present, with one member dedicated to notetaking

and the other conducting the interview. Alternatively, interviews with local farmers were generally conducted with one team member present, who would record the interview if consent was obtained, to maximize team resources.

Farmer interviews were conducted with 25 farmers who responded to the survey and expressed an interest in answering follow-up questions. Farmer interviews were thorough, lasting approximately one hour each. Interview questions were uniquely catered to the survey responses; however, each farmer was asked the following set of questions:

- “Are there regenerative techniques that you have implemented without support from funding or organizations?”
- “What challenges or barriers are you facing to improve your agricultural practices?”
- “Do you believe that there is enough support available for farmers, whether financial, mentorships, or coaching?”
- “What kind of support would be most beneficial to you, and how can that support be made accessible to you?”
- “Do you know of any other farmers that would be interested in speaking with us?”

Organization interviews were conducted with 12 experts on the topic of regenerative farming pedagogies and practices, as well as 2 representatives from grant organizations (Objective 3). These interviews were thorough, lasting approximately 1 hour each.
In general, industry experts were asked the following questions:

- “How do you define regenerative farming?”
- “Can you describe the environmental benefits of regenerative practices?”
- “What are the greatest barriers/challenges that farmers encounter when transitioning to regenerative practices?”

Grant organizations were asked questions that would facilitate farmers’ grant application experiences. Specifically, interviewees were asked the following questions:

- “Could you describe the target audience for your grant?”
- “Are there common mistakes that disqualify grant applications?”
- “Where do you advertise your grants? What platforms do you use?”
- “Can you provide tips for farmers hoping to receive future funding?”

Findings from both farmer and organization interviews were analyzed to produce this publicly available electronic report (Objective 4). In addition, an infographic and resource directories were created as educational resources for both farmers and members of the public, for stronger engagement and sharing of knowledge (Objective 5 and Objective 6).

2. Literature Review

This section of the report explores regenerative farming definitions, practices and approaches relevant to Wellington County. Using academic journals and municipal documents, this literature review addresses the following topics: defining regenerative farming, soil health, impacts of agriculture, climate change, regenerative farming benefits, social and economic co-benefits, challenges of regenerative farming, and examples of local regenerative practices.

2.1 What is Regenerative Farming

Regenerative farming encompasses a wide range of techniques that aim to decrease external inputs and increase on-site recycling within the farm (Pearson, 2007). From conversations with farmers and organizations (Figure 3), our team developed a working definition of what regenerative farming means within the County of Wellington:

> A farming philosophy which aims to not only protect, but also to improve the health of the soil and surrounding ecosystem. Regenerative farming is a dynamic concept that focusses on the long-term renewal of organic carbon, nutrient content, and microbial biodiversity in the soil, while also nourishing the ties between the land, its natural heritage, and the community.

This working definition will serve as the explanation of the term regenerative farming for the report's remainder.

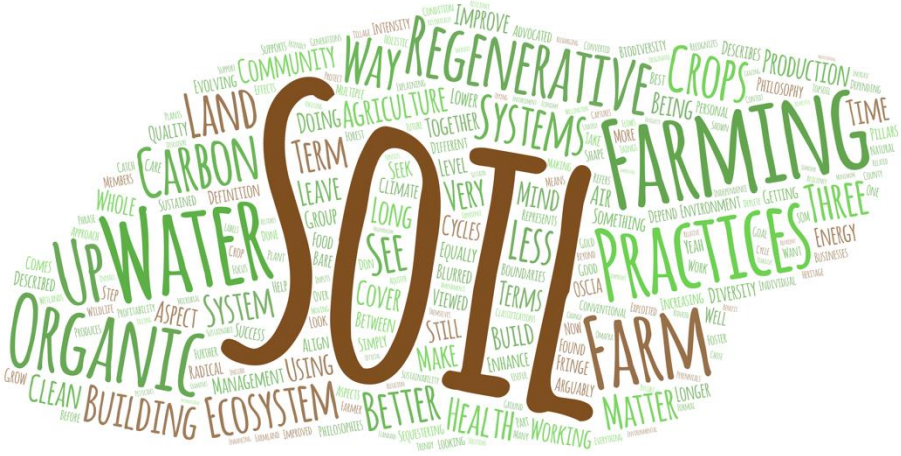

Figure 3. "What is regenerative farming?" word cloud. This word cloud illustrates responses from local farmers and organizations when asked “What is regenerative farming?”. The size of the font corelates with the number of times the word was used by respondents (i.e., the larger the word, the more frequently it was used).

2.2 Soil Health Characteristics

Soil health is at the centre of regenerative farming and is controlled by a balance of biological and physical components, inputs, and farming practices. Soil is a complex and sensitive system composed of inorganic and organic components, water, and air. The inorganic or mineral components of soil form about 45% of the soil's volume and vary largely based on the geological history of the area. The three major types of soil particles, in order of decreasing size are: sand, silt, and clay. Because of their larger surface-area to volume ratio, smaller particles are better at retaining water and nutrients (Brady & Weil, 2014). However, the ideal soil type for agriculture is loam, which contains roughly equal portions of sand, silt, and clay as it can effectively retain water without becoming waterlogged (Jaja, 2016). Figure 4 represents the spectrum of soil texture types. Organic matter forms 2-6% of soil by volume and is composed of both dead and living organisms (Brady & Weil, 2014). Generally, greater amounts of soil organic matter (SOM) contribute to healthier and more productive soil since SOM is the main reservoir of carbon and plant nutrients, such as nitrogen and potassium. The remaining 50% of the soil's volume consists of pores, or spaces between soil particles. These spaces are filled with air and water, ideally in equal proportion as water is essential for plant growth, while air in soil is necessary for the respiration of both plant roots and soil microorganisms (Brady & Weil, 2014).

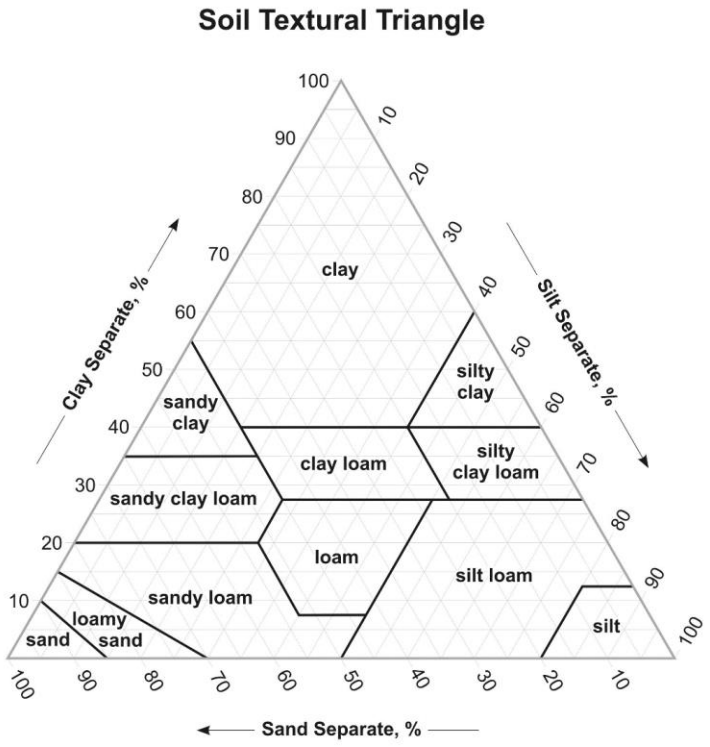

Figure 4. The soil texture pyramid. The pyramid represents the spectrum of soil types based on their clay, silt, and sand content (USDA, n.d.).

2.3 Agriculture and the Environment

Before the benefits of regenerative farming can be appreciated, it is necessary to understand the impacts that conventional agricultural operations have on soil health and the environment. Conventional agriculture refers to the practices that have been largely adopted by industrial farms wherein yields are maximized at the cost of greater environmental impacts through intensive tilling and chemical inputs (LaCanne & Lundgren, 2018). In order to produce an adequate amount of food to feed the world's growing population, agricultural operations have grown to use large amounts of water, especially for irrigation. The repeated working of land with conventional tilling methods may also lead to soil degradation, erosion, and compaction. Finally, farm operations produce pollution in the form of pesticide, animal waste, and nitrogen pollution, and greenhouse gas (GHG) emissions (Skinner et al., 1997). The magnitude of these impacts can be decreased through sustainable farming and modern impact monitoring methods.

With respect to water usage, the agricultural industry is the largest global user of freshwater supply. For example, in 2017, the World Bank reported that 71% of the world's freshwater supply was used for agriculture, with Canada's agricultural sector accounting for 7% of this global freshwater usage (World Bank, 2019a). While 7% may seem low, this number amounts to 2.65 billion cubic liters of freshwater used for agricultural purposes in Canada (World Bank, 2019b). About 85% of this water is used for irrigation, while about 10% is used for watering livestock (Kulshreshtha & Grant, 2007).

Conventional farming practices, such as frequent tilling, can lead to soil degradation and erosion. In the process of soil erosion, repeated working of the soil and removal of groundcover exposes soils to rain and wind, which remove organic components, and clay and silt from the soil. The removal of these components reduces soil's ability to retain water and nutrients, and the process of erosion results in dry, inhospitable soil (Skinner et al., 1997). Organic matter in soil is also constantly broken down by microbes and taken up by crops or released as CO_2 through the respiration of soil microbes (Brady & Weil, 2010). Without replenishment through the decomposition of plant matter, the organic portion of soil dwindles and subsequently reduces the quality of the soil (Brady & Weil, 2010). Soil compaction is another form of degradation in which soil is compacted by the weight of farm machinery. Through compaction, the pore space of soil is reduced, increasing its density and reducing its permeability to water. As a result, compacted fields have poor drainage and water retention, and often cannot be penetrated by crop roots, ultimately leading to lower yields (Batey, 2009).

Chemical pollution, in the form of pesticide use, is often toxic to both people and wildlife. Pesticides may kill wildlife directly or accumulate in predators that consume poisoned prey, weakening or eventually killing them (Willis & McDowell, 1982). Additionally, pesticides can run off into surface water or leach into groundwater, contaminating waterways and drinking water supplies (Sultana et al., 2018).

Another major source of pollution from agriculture is livestock. Ruminants produce large quantities of methane, a potent GHG, through their digestive process (Moss et al., 2000). Animal waste, both in pasture and in the form of manure, also produces a multitude of undesirable environmental effects. For example, the organic materials in run-off animal excrement consume oxygen in waterways, making them less hospitable to aquatic life. Animal waste is also a source of ammonia and nitrogen oxides, which contribute to the generation of acid rain and ozone depletion (Skinner et al., 1997).

Agriculture is a major source of nitrogen pollution, which encompasses a variety of compounds that negatively affect human and environmental health. Nitrogen compounds are generally produced from manure and fertilizer and can enter the environment as runoff from agriculture fields or from leaking manure storage structures. As with pesticides, fertilizers can run off into waterways and infiltrate aquifers, potentially contaminating drinking water. Nitrogen compounds in surface water accelerate eutrophication, where algal blooms decrease the oxygen content of water and kill oxygen-dependent aquatic organisms. Microbes convert excessive nitrogen compounds in soil into nitrogen oxides (NO_x) which contribute to ozone depletion and the creation of acid rain. The rate at which soil microbes generate NO_x depends on several factors, including the degree to which the soil is disturbed by tilling, the amount nitrogen fertilizers applied to soil, manure application methods, and the amount of plant cover on farmland (Kurvits & Marta, 1998). Finally, bioavailable nitrogen that escapes into the local ecosystem upsets natural competition between plants and decreases plant biodiversity, as nitrogen is disproportionately utilized by grasses (Skinner et al., 1997).

Despite the potential negative effects of some farming practices, agriculture is critical for feeding the growing human population and supplying various industry needs. The first step in minimizing these impacts is measuring and understanding them. To measure the impact of farming, means-based or effect-based indicators have been developed. Means-based indicators focus on the practices of farmers themselves and are thus easier to measure, focusing on indicators such as the amount of fertilizer a farmer uses per square meter, or the amount of water used for irrigation. In contrast, effect-based indicators are based on the actual impact on the environment, such as nitrate measured in the runoff from a field (Van der Werf & Petit, 2002). Effect-based indicators are difficult to measure as they require specialized sampling and analytical equipment, and are thus less accessible to smaller, independent farms.

Several frameworks have been developed globally to measure the overall sustainability of a farm. Some are based on specific indicators, while others involve a life-cycle assessment of a particular agricultural product (Van der Werf & Petit, 2002). One example is the Ecopoints program that was used in Austria, where farms were given scores based on the sustainability of their practices. Farms with higher sustainability scores were given monetary incentives (Van der Werf & Petit, 2002). While many tools for measuring the environmental impact of farms, including software-driven ones, have been developed in Canada, none are ubiquitous.

2.4 How the Agriculture Sector is Affected by Climate Change

Agriculture is contingent on environmental factors, making food production and supply stability sensitive to temperature and precipitation fluctuations (Government of Ontario, 2019; Anderson & Gough, 2021). In Ontario, the average temperature is expected to rise by as much as 3 to 8ºC over the next century (Gough et al., 2016). Warmer temperatures will result in longer growing seasons and more frequent severe weather events, such as droughts and heat waves. In addition, rising temperatures will exacerbate water scarcity and the loss of arable land (Anderson & Gough, 2021).

Given that the County of Wellington houses the most farms in southwestern Ontario, the region's agricultural sector is particularly vulnerable to Canada's changing climate (EDAC, 2015). Climate affects crop productivity, animal production, virility of pests and diseases, pollinator health, as well as water quality and availability (Campbell et al., 2014). While lengths of growing seasons are expected to increase, the positive effect of the lengthened growing season will be offset by increased water, heat, and moisture stress during the season (Pearson et al., 2008). In addition, the increase in spring runoff has been identified as a key challenge for Ontario, potentially increasing field nutrient losses and surface water pollution (Campbell et al., 2014). Farmers may experience difficulties completing spring seeding due to changes in soil quality, given that plant growth is dependent on soil health and nutrient availability. However, researchers found that the increase in water stress will have the greatest impact on grain yield, as their development is sensitive to short-term stress (Pearson et al., 2008). Livestock production will also be affected by climate variability, in particular increased heat stress, changes in quantity and quality of feeds, increased livestock diseases and competition for natural resources (Rojas-Downing et al., 2017). Needless to say, both crop and livestock production will be impacted by the region's changing climate.

2.5 Environmental Benefits of Regenerative Farming

Overall, regenerative farming can be utilized as a means of improving the resilience, integrity, and function of farms to maximize farm productivity and profitability (LaCanne & Lundgren, 2018). Regenerative farming systems provide farms with numerous environmental advantages, including improved ecosystem services, increased biodiversity, greater watershed health, and enhanced land productivity (LaCanne & Lundgren, 2018; Rhodes, 2017).

Regenerative farming methods improve soil health by reducing the need for synthetic chemical inputs, drawing carbon from the atmosphere, and improving soil properties related to microbial biodiversity, moisture retention, fertility, and soil structure (LaCanne & Lundgren, 2018; Rhodes, 2017; Gosnell et al., 2020). Additionally, regenerative farming serves as a means of increasing the quantity of soil organic carbon in existing soils, allowing it to act as a carbon sink and therefore mitigate current global trends of atmospheric carbon accumulation (Burns, 2020). For example, tree-based intercropping can reduce GHG emissions by improving soil health, decreasing reliance on pesticides and fertilizers, and enhancing carbon sequestration (Anderson & Gough, 2021).

With respect to watershed health, regenerative farming can be utilized as a technique to increase water retention and aquifer recharge, thus reducing incidences of both flooding and drought, and decreasing runoff and subsequent erosion (Rhodes, 2017). For example, diversification of crop varieties through companion planting and cover crop practices have been shown to increase the drought and heat wave tolerance of agricultural land, improve livestock production, and enhance resilience against climate change-related diseases and pest outbreaks (Rojas-Downing et al., 2017).

In addition to the environmental benefits, incorporating regenerative farming practices provides farmers with the opportunity to increase crop yields and reduce energy consumption, use of farm equipment, and cost (LaCanne & Lundgren, 2018; Kenne & Kloot, 2019).

2.6 Social and Economic Co-Benefits of Regenerative Farming

Social Benefits

Regenerative farming aims to strengthen the ties between the land, its cultural and natural heritage, and the community – a concept embodied by the "farm-to-table" approach (Pearson, 2007). Creating a more tight-knit community will lead to increased value in interactions between local farmers and residents. Residents may purchase local food directly from farmers which will allow them to connect socially with their food growers and create a greater sense of community (Pearson, 2007). In addition, regenerative farming practices stem from what has always been known and demonstrated in Indigenous foodways, and allow for the preservation – or restoration – of traditional knowledge (Singh & Singh, 2017). Indigenous-led farming is intergenerational and sustainable; its practice not only reduces GHG emissions and increases carbon sequestration, but also allows for collaboration and learning between Indigenous and non-Indigenous farmers (Arcand et al., 2020).

Economic Benefits

Certain regenerative farming practices rely strongly on human labour, which creates new employment opportunities for local community members (Pearson, 2007). Additionally, a fundamental principle of regenerative agriculture is to sink and store water through sustainable irrigation operations. The storage of water in the soil allows crops to be watered in the summer months and increases their resiliency, meaning that crop yields will be less affected by drought and farmers can generate an income despite extreme weather events. Similarly, regenerative farming practices maintain and improve soil health, ensuring that cropland remains viable and productive in the future, and will provide farmers with long-term economic benefits. In contrast, conventional farming methods continuously wear down soil quality over time, which may lead to yield losses and reduced productivity in the future (LaCanne, 2018).

Another economic benefit of regenerative farming practices is a reduction in operational costs (Anderson & Gough, 2021). Studies show that farmers who seek to improve their soil health benefit from reduced fertilizer and pesticide costs, as well as reduced irrigation costs (Anderson & Gough, 2021). Farmers who choose to have on-farm generation of energy, either from wind or fermentation of biosolids, will benefit from reduced energy costs and create renewable clean energy (Pearson, 2007). Moreover, future market values may reflect the value of climate friendly products and farmers may benefit from new niche markets to increase their net profits (Pearson, 2007).

2.7 Challenges of Regenerative Farming

Despite the numerous benefits of regenerative farming, it is important to consider the associated challenges and drawbacks. For example, although regenerative farming is more efficient, it sometimes relies more strongly on human labour and often requires the acquisition of new knowledge and skills (Pearson, 2007). Additionally, regenerative farming is occasionally associated with lower yields, but this challenge is offset by cost savings resulting from reduced chemical inputs and enhanced resilience to climate change (Pearson, 2007).

The greatest obstacle amongst farmers is often the perceived cost of transitioning into regenerative farming practices (Renton et al., 2020). Contrary to this belief, LaCanne et al. (2018) reported that U.S. farmers who incorporated regenerative farming techniques, such as winter cover crops, lengthened crop rotations, and diversified field margins, successfully improved farm resilience and significantly reduced pest abundance. As a result of the drastically reduced seed and fertilizer costs and increased revenue generated from crops, the farms employing regenerative farming experienced a profit nearly twice that of conventional farms (LaCanne, 2018). Ultimately, by promoting soil biology, organic matter, and biodiversity, regenerative farming requires fewer costly inputs such as insecticides and fertilizers to manage pest populations (LaCanne, 2018).

2.8 Local Regenerative Practices

The twelve regenerative farming practices relevant to southern Ontario and Wellington County include cover crops, green manure, no-till farming, crop rotation, companion planting, tree-based intercropping, silvopasture, 4R nutrient management, rotational grazing, detention ponds, windbreaks, and buffer strips. Each of these practices have been defined and placed in a local context below.

Cover Crops

Cover crops describe the regenerative farming technique of planting crops with the goal of protecting the soil. Cover crops are employed to protect soil against erosion, enhance soil fertility, suppress weeds, increase crop yields, recycle soil nutrients, prevent nutrient leaching, and improve the farm's water quality (Blanco-Caqui & Lal, 2010). Yang et al. (2019) examined the use of cover crops in southwestern Ontario in the hopes of increasing crop yields and enhancing soil fertility during the 3-year transition period from conventional farming to organic farming. Yang et al. (2019) examined interactions between organic corn, soybeans, and wheat with the cover crops of hairy vetch (*Vicia villosa*), crimson clover (*Trifolium incarnatum*), and red clover (*Trifolium pratense*). They discovered that organic corn planted with hairy vetch (Figure 4) or red clover cover crops produced yields of 13.1 Mg/ha in nutrient-depleted soils. These yields were similar to that of conventional agriculture (13.8 Mg/ha). Therefore, Yang et al. (2019) concluded that organic corn and hairy vetch or red clover was the most successful cover crop mixture for farmers in southwestern Ontario that are transitioning from conventional agriculture to organic farming (Yang et al., 2019).

Figure 5. Well established hairy vetch (*Vicia villosa*). Hairy vetch is an excellent cover crop for southwestern Ontario farms due to its high tolerance to cold weather.

Green Manure

A cover crop left to decompose naturally is known as green manure. Green manure amends soil by stimulating soil microbial growth and activity for the next crop, thereby increasing soil fertility and quality (Tejada et. al, 2008). The most common types of green manure are leguminous for their increased nitrogen complexes (Tejada et. al, 2008). The slow release of nitrogen from decomposing plants in leguminous green manure provides a continuous source of nutrients for growing crops, while non-leguminous green manure only increases the organic matter in soil (Tejada et. al, 2008; Cherr, 2006). Green manure has economic and environmental benefits, reducing soil erosion and nutrient or pesticide loss, while also suppressing weeds and specific crop pests (Conklin et. al, 2002). In southern Ontario, this regenerative strategy is commonly used in organic farming.

No-till Farming

Tillage is a process that aims to increase a seedbed's tilth by loosening and mixing the soil. However, recent publications have noted that excessive tillage has led to soil erodibility, destruction of natural soil architecture, reduction in essential microorganisms, and degradation in soil tilth (Blanco-Canqui & Lal, 2010). This has encouraged the development of low-till and no-till farming, which refers to a system where seeds are planted with little to no primary or secondary tillage, leaving the soil undisturbed until planting (Blanco-Canqui & Lal, 2010).

A 2-year no-till case study was conducted in Dunnville, Ontario, on maize and soybean crops to determine this regenerative practice's viability within southwestern Ontario (Islam et al., 2015). Islam et al. (2015) concluded that the no-till farm developed plants with more robust root architectures, higher plant biomass, and larger populations, producing yields 75% higher than nearby farms employing conventional farm practices.

Scientists at the Ontario Crops Research Centre in Ridgetown, Ontario, have undertaken a 25-year study that has combined different tillage and crop rotation levels. In this study, soil organic carbon, total nitrogen and a soil health assessment score were delegated using the Cornell Soil Health Assessment (CSHA) score (Van Erd et al., 2014). The results of this study demonstrated that, on average, soils that did not employ tillage saw higher nitrogen levels, higher carbon storage, and had higher soil health scores (Van Erd et al., 2014).

Crop Rotation

In the 25-year study performed by the Ontario Crops Research Centre in Ridgetown, Ontario, researchers also studied crop rotations. Crop-rotations were performed using soybean-winter wheat, soybean-winter wheat-corn, continuous soybean, and soybean-corn (Van Erd et al., 2014). Soybeans were selected as part of all crop rotation studies as they are commonly grown in southwestern Ontario and economically viable globally. This study concluded that when winter wheat was included in the crop rotation, all three metrics (nitrogen, carbon storage and soil health score) were most ideal for growing conditions (Van Erd et al., 2014). The inclusion of winter wheat also has positive co-benefits in supporting species at risk such as the Eastern Meadowlark, by providing nesting material (Van Erd et al., 2014). In addition, retention of soil carbon has added economic and environmental co-benefits of reducing spring fertilizer requirements.

Companion Planting

Companion planting is a practice that focuses on the co-beneficial relations that exist between plants. This regenerative practice consists of four primary techniques: physical, biological, botanical, and nutritional companions. Physical companions pair plants that provide an immediate practical use; for example, when planted as companion crops, sunflowers (*Helianthus*) provide cucumbers (*Cucumis sativus*) with a trellis upon which the crop can be supported (Holzman, 2018). Biological companions are insect-focused; practitioners plant plants together that attract beneficial organisms and repel harmful pests. For example, borage (*Borago officinalis*) (Figure 5) attracts braconid wasps (*Braconidae)* who parasitize tomato hornworms (*Manduca quinquemaculata*) (Holzman, 2018). Botanical companion planting evaluates plant chemical extracts; for example, mint extract oils repel carrot worms (Holzman, 2018). Nutritional companions provide other crops with nutritional requirements to facilitate and enhance growth; for example, legumes absorb nitrogen from the atmosphere and store it in their roots and slowly release nitrogen into the soil as the roots break off (Holzman, 2018).

Vernon et al. (2015) evaluated biological companion planting potatoes (*Solanum tuberosum*) and wheat (*Triticum)* seeds treated with fipronil or thiamethoxam in Rodney, Ontario, over five years. Companion planting resulted in an 81.2% decrease in potato blemishes compared to conventionally treated potatoes. The study also concluded that adopting this method within southern Ontario would allow practitioners to use only 3.4 g of active pesticide ingredients per hectare (AI/ha) relative to 3250 g AI/ha for 100/kg of seeds (Vernon et al., 2015).

Figure 6. Close up of borage (*Borago officinalis*). Borage is a commonly used plant in biological companion planting.

Tree based intercropping

Tree based intercropping (TBI) is a system of growing trees and crops together which incorporates tree planting between rows of crops. TBI is an agroforestry technique which focuses on the principle of tree-crop complementarities, which minimizes competition while maximizing co-benefits. Farmers implementing TBI must consider the light and nutrient requirements of individual trees prior to planting trees. TBI in the northern latitudes of Southern Ontario is less diverse than when this practice is implemented in warmer climates. However, this technique still benefits carbon sequestration, biodiversity, and water quality in northern climates (Thevathasan & Gordon, 2004).

Through research performed by the Guelph Agroforestry Research Station, TBI was implemented, and growth, yield, and soil health were assessed between trees on corn and soybean fields (Thevathasan & Gordon, 2004). The results of this study demonstrated that while total yields did not differ, there was significant improvement of bird and insect diversity and soil organic carbon content in areas exhibiting agroforestry (Thevathasan & Gordon, 2004). During this study researchers noted two distinct zones when using TBI: the competitive zone and the complementary zone (Figure 6). The competitive zone is an area where crops and trees compete for resources such as light and water. Furthermore, the complementary zone is the ideal distance away from trees for planting crops to maximize co-benefits (nitrogen availability, soil organic carbon, earthworm activity) and minimize competition between the trees and crops. The researchers also stated that tree-based intercropping could lead to a reduction in nitrous

oxide emissions from agricultural fields by 0.7 kg ha^{-1} yr^{-1} and was specifically suitable for agriculture in southern Ontario (Thevathasan & Gordon, 2004).

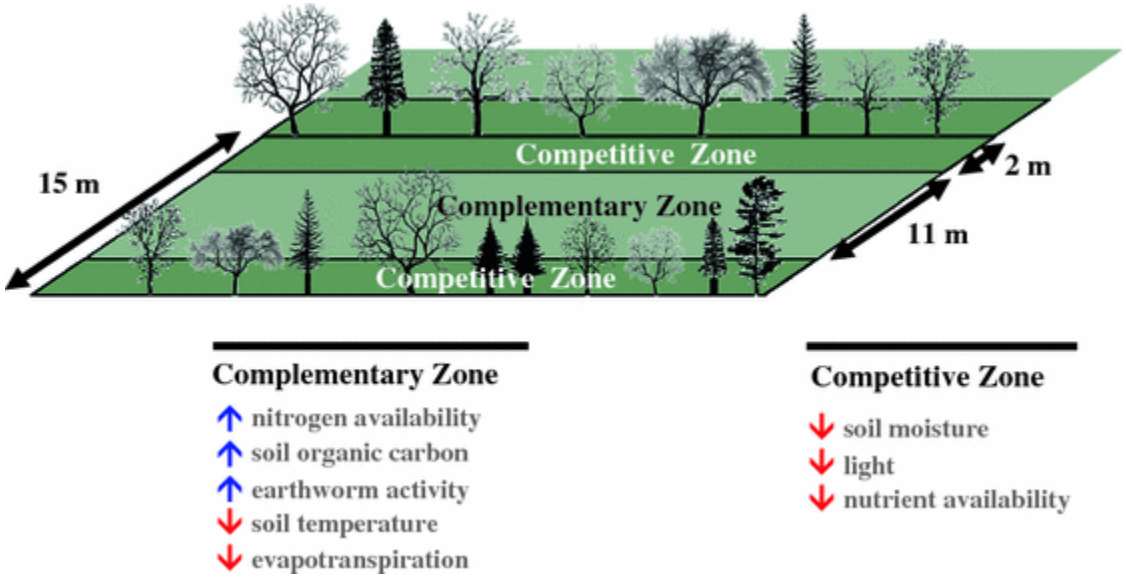

Figure 7. Diagram which identifies the two distinct zones when implementing tree-based intercropping (TBI) and characteristics of each. Retrieved from Thevathasan & Gordon, 2004.

Silvopasture

Silvopasture, a branch of agroforestry, is a whole system approach integrating trees, forage, and livestock to maximize yield output (Gabriel, 2018). This approach offers numerous environmental and economic benefits. Ecological benefits include soil enrichment, efficient nutrient cycling, carbon storage, enhanced water quality and shelter, shade, and food for livestock (Jose et al., 2017). Economic benefits of silvopasture include expansion and diversification of income sources, increased resiliency to extreme weather events, and the potential to increase yields (Jose et al., 2017). Economic benefits may take several years to come to fruition; however, silvopasture will produce healthier animals and soils, greater yields, and more significant carbon sequestration when compared to conventional agriculture (Gabriel, 2018). Despite these benefits, silvopasture is a complex regenerative technique. It requires a farmer to understand grassland ecology, forestry, and animal husbandry to reap these benefits (Gabriel, 2018). While silvopasture techniques vary from farm to farm, incorporating rotational grazing is essential to minimize damage to surrounding forages.

An accomplished practitioner of silvopasture, Greg Judy, spoke with the Ecological Farmers Association of Ontario (EFAO) in London, 2019 to share his experiences of adopting Silvopasture with other farmers (Slater, 2019). Judy, a famer of pigs, sheep, and cows, noted that his keys to success are gradual breeding, buying animals smaller in stature, a managed rotational grazing system, and incorporating an abundance of drought-tolerant and cool-weather plants to increase farms' resiliency (Slater, 2019). In line with Judy's first recommendation of gradual breeding or buying smaller livestock, Judy aims to acquire cows weighing 900 to 1,100 pounds and mature bulls weighing around 1,200 pounds. The inability of pigs to sweat prompted Judy's decision to keep pigs on pasture that had been previously converted from forest or bush, due its increased shading. Judy ensures that his sheep only graze on fully regrown pastures by moving the animals at least once every seven days. Judy has noticed that this technique has decreased the need to deworm his sheep (Slater, 2019). Overall, Judy recommended that farmers should learn to dislike bare soil as it cannot capture solar energy (Slater, 2019).

4R Nutrient Management

4R nutrient management focuses on responsible fertilizer management practices, acknowledging that fertilizer currently supports the growth of 40-60% of global crop production (Johnston & Bruulsema, 2014). The 4R's refer to "right source, right rate, right time and rate place" (Johnston & Bruulsema, 2014). This ideology focuses on the: 1) source of nutrients, 2) rate of application, 3) timing of application, and 4) location of application. In 4R nutrient management, the key to developing a methodology which balances crop needs and environmental protection is developed through research and implementation by farmers (Johnston & Bruulsema, 2014). This methodology is based on the triple bottom line approach which attempts to connect environmental, economic, and social goals. To develop best management practices for each area, performance indicators and metrics must be measured. Examples of these indicators include, but are not limited, to soil fertility, food production, nutrition levels, greenhouse gas emissions, and eutrophication levels (Johnston & Bruulsema, 2014). When employing 4R nutrient management, soil testing serves as a key method to identify when fields are being over or under fertilized. This practice can help to increase yield and decrease environmental impacts, while optimizing fertilizer expenditures (Johnston & Bruulsema, 2014).

Rotational Grazing

Rotational grazing is a regenerative practice utilized on any land, including lands that are no longer, or never were, suitable for crops. Rotational grazing takes advantage of plant growing patterns by allowing livestock to graze only when the crop has replenished (Figure 8; Mackie et al., 2017). In general, a plant can take anywhere from 25 to 365 days, depending on the farm's location and season, to replenish its energy.

Extending the grazing season is financially feasible as it reduces feed and hydro energy costs. Wand (2000) evaluated winter grazing in Liskeard, Ontario, from October 10th to December 18th, with 175 grazing cattle and 20 control cattle housed indoors. The study discovered that hay-fed indoor cattle gained 68 kg, whereas grazing cattle only gained 30.5 kg during the same period. However, snow cover did not affect cattle feed consumption, demonstrating that outdoor grazing can continue in Ontario during moderate snow cover. While reproductive activity is not affected by winter grazing, Wand (2000) observed that negative temperatures with a wind speed of 40km/h negatively affected the cattle's digestibility, especially in young or lactating cattle. Therefore, Wand (2000) recommends placing a wind shelter in each grazing zone to protect the venerable livestock.

Díaz de Otálora et al. (2021) conducted a six-year study examining the soil benefits of regenerative grazing on a flock of 135 Latxa breed dairy ewes. The researchers divided a 4.5-ha pasture into two sections: regenerative rotational grazing and conventional rotational grazing. On the regenerative plot, the sheep were fed on an area for one to two days, with a one-day rest period. Alternatively, on the conventional plot, the sheep grazed for six to ten days with a fifteen-day rest period. From this study, Díaz de Otálora et al. (2021) discovered that the regenerative grazing method increased springtime grass production by 30% and increased carbon storage in topsoil by 3.6% compared to the conventional plot. Conversely, there were no significant differences in water flow, nutrient cycling, or biodiversity between regenerative and conventional grazing pastures (Díaz de Otálora et al., 2021).

Figure 8. Example of a farmstead using regenerative grazing. Each grazing area is sectioned with fences.

Detention Ponds

Proper drainage on farms can lead to greater crop productivity. Without adequate drainage management, this can heighten river levels and result in floods, increase erosion, and lead to nutrient runoff (Le & Martel-Gagnon, 2011). The creation of a detention pond (Figure 9) is inexpensive as they can be completed with standard on-farm machinery and are typically no more profound than 100 m^2 (Fiener et al., 2005). While detention ponds are more efficient when paired with multiple erosion techniques, detention ponds require annual dredging when acting as the only erosion technique to produce any agricultural benefit (Fiener et al., 2005). Additionally, Le and Martel-Gagnon (2011) determined that "field conditions, volume calculation, the shape of the pond, bank stabilization, design of the water outlet, design of culvert, and estimation of sedimentation" must be evaluated to properly determine the appropriate location and size of the detention pond.

Fiener et al. (2005) monitored four detention ponds over eight years, tracking the ability to prevent downslope linear erosion, trap upslope sediment, temporarily retain runoff, reduce runoff infiltration, decrease peak runoff rate, and reduce peak concentrations of agrochemicals. Results indicated that detention ponds possessed a typical volume of 30-260 m^3 ha^{-1} and trapped 54–85% of the incoming sediment. Trapped soil lost about 5–25% of its organic carbon, phosphorus, nitrogen and clay, preventing this nutrient from travelling into the waterways. Fiener et al. (2005) discovered that detention ponds created by raising the downslope of the boarding field at the pour point further reduced erosion.

Figure 9. Example of a detention pond within a farmer's field.

Windbreaks

Windbreaks are comprised of a row of tree or shrubs lined up together to reduce the impact of high winds on farmland (Figure 10). With support from the Green Legacy Programme, windbreaks are commonly utilized in Wellington County. For example, Stephen Eastep, who farms near Elora, has four windbreaks planted about 15 years ago (Lammers, 2009). Each windbreak is a kilometre long and runs the entire length of his 200-acre farm. The windbreaks have tiny holes, up to 31% of the area, allowing for even distribution of the wind, effectively reducing windspeeds by 29-71%. This reduces wind damage to crops; Stephen Eastep experienced an increase in yields downwind from the trees by 25% for corn and 6-8% for soybean. Research performed in Ontario has also shown that high-value crops such as strawberries and tree fruits are protected by windbreaks from sandblasting and bruising. In general, the area covered by the windbreak is at least ten times the height of the trees, so a narrow strip of crop immediately adjacent to the windbreak may be adversely affected by shade or loss of moisture. Alternatively, soils in the area of a field sheltered by a windbreak warm up quicker, so crops germinate faster and corn tassels earlier (Lammers, 2009). Reduced wind speed also allows pollinating insects to pollinate crops more effectively. Further, windbreaks can reduce water erosion and provide crops with frost protection. Windbreaks also benefit livestock operations. The Canadian Pork Council reports a 20-30% reduction in energy consumed in a 600-hog farrow-to-finish barn when a row of trees shelters it. Additionally, according to Utah State University's research, windbreaks can reduce livestock odors (Lammers, 2009).

Figure 10. Example of a windbreak. Trees are closely lined up together to create a windbreak for the adjacent field.

Buffer Strips

Buffer strips are permanent vegetated areas adjacent to a watercourse, separate from the main cropping area within or around a field, with a purpose of supporting native biodiversity, improving water and air quality, providing socio-economic benefits, and increasing crop yield (Figure 11) (Haddaway, 2018). Buffer strips may also act to conserve soil, provide habitat or shading, sequester carbon, produce biomass, and enhance societal services on agricultural land (Haddaway, 2018). Buffer strips represent a best management practice of controlling and filtering nutrients, sediments, pesticides, and herbicides utilized on agricultural land or lawns (Stutter, 2018).

According to Credit Valley Conservation, although the design of the buffer ultimately depends on the land, for a flat surface, the buffer strip should be at least 5 to 10m wide on both sides of a watercourse. If there is a slope surrounding the watercourse, then the slope should act as a natural buffer. Ideally, a buffer strip should be 100m wide to accommodate wildlife functions. According to Credit Valley Conservation, while it is easiest to allow natural succession of herbs and shrubs to create buffer strips, they can also be created using grass or hay mixture spread on land adjacent to the watercourse. Tall grasses are more effective than short grasses due to their deeper root system, but native trees and shrubs may also be planted. Suitable buffer strips species near Wellington County include trees such as Balsam fir, Bur Oak, Cedar, Silver Maple, Ash, Tamarack, Basswood, Bur Oak, Yellow Birch, and White Birch, and shrubs such as Willows, Red Osier Dogwood, Elderberry, Native Highbush Cranberry, and Nannyberry. Finally, in addition to buffer width and species selection, design, placement, and protection also have a critical impact on buffer effectiveness (Mayer et al., 2005). Farmers may contact a variety of resources to assist in buffer strip development, such as Conservation Authorities, the Ministry of Natural Resources, Ontario Ministry of Agriculture and Food, and the Ontario Soil and Crop Improvement Association.

Figure 11. Example of a buffer strip utilized as a regenerative farming practice near agricultural farmland.

2.9 Conclusion of Literature Review

In summary, based on our literature and interactions with local farmers and experts, our team defined regenerative farming as:

> A farming philosophy which aims to not only protect, but also to improve the health of the soil and surrounding ecosystem. Regenerative farming is a dynamic concept that focusses on the long-term renewal of organic carbon, nutrient content, and microbial biodiversity in the soil, while also nourishing the ties between the land, its natural heritage, and the community.

Agriculture can pose a major threat to soil health and the environment with practices such as tillage, chemical inputs, nutrient and sediment run-off, and livestock waste. These practices have been shown to contaminate soils and waterbodies, degrade and erode soils, compact soils, reduce drainage and water retention, harm humans and wildlife, and increase GHG emissions. In addition, given that the County of Wellington houses the most farms in Southern Ontario, the region's agricultural sector is particularly vulnerable to Canada's changing climate through increased drought, rainfall, temperature, and wind. More specifically, climate change has led to reduced yields, increased pests and diseases, affected pollinator health, reduced water quality and availability, increased nutrient losses, enhanced spring runoff, increased surface-water pollution, impacted soil quality, and impacted livestock survival.

By employing regenerative farming techniques, farmers can improve the resilience, integrity, and function on a farm to maximize farm productivity and profitability. Specifically, regenerative farming practices allow farmers to enhance yield, increase ecosystem services, enrich soils, improve biodiversity, reduce chemical input requirements, improve watersheds, enhance land productivity, reduce energy consumption, and decrease GHG emissions. In addition to these environmental benefits, regenerative farming practices can improve social co-benefits such as increased farmer and community interactions and preservation of traditional knowledge. Regenerative farming practices also increase economic co-benefits such as new employment opportunities, increased revenue, reduced operational costs, and increased product value. Despite these benefits, possible challenges and barriers to regenerative farming include increased knowledge and skill requirements, impacts to crop yields, and perceived cost of transitioning to regenerative farming practices.

In Wellington County, farmers have commonly utilized the following regenerative farming practices: cover crops, green manure, no-till farming, crop rotations, companion planting, agroforestry, 4R nutrient management, rotational grazing, detention ponds, windbreaks, buffer strips, and manure storage. This literature review served as the basis of our research before delving into our farmer and expert findings. The interviews in their turn allowed us to create grant, farmer, and organizational directories, as well as an infographic (Appendix H) summarizing our report for public awareness and education.

3. Findings from Interviews with Farmers, Local Organizations and Grant Agencies

> *"Anybody who really understands how farming works, really finely understands that they are just a steward of the land. I made a massive, deliberate commitment to the property. Environmentally, it is in diamonds giving, it is incredible what is happening".*
>
> *– Carole Precious, Wellington County farmer*

The findings in this section of the report are based on the results of an online Qualtrics survey (Appendix F) and the subsequent interviews with survey respondents. 45 of 190 farmers responded to the survey, and 25 of those farmers were contacted for follow-up interviews via phone or video call. Survey results were encouraging, with 74% of farmers expressing an interest towards regenerative farming (Figure 12). During interviews, farmers elaborated on their own farming practices, their successes and challenges with regenerative farming methods, as well as their experiences in receiving support from organizations. Interviews revealed that Wellington County farmers successfully practice a wide range of regenerative farming methods for both crops and livestock, and that practices are uniquely implemented on each farm. Similarly, common themes arose when farmers were asked about the challenges they face. Specifically, concerns about financial and marketing support, mentorship and education, changing climate, and other issues were expressed by multiple farmers.

Experts from conservation authorities, agricultural associations, universities, ENGOs, and other organizations were also contacted based on the recommendations of farmers and Wellington County contacts. These experts provided insight into the value of regenerative farming methods, as well as information on what support they can provide to farmers.

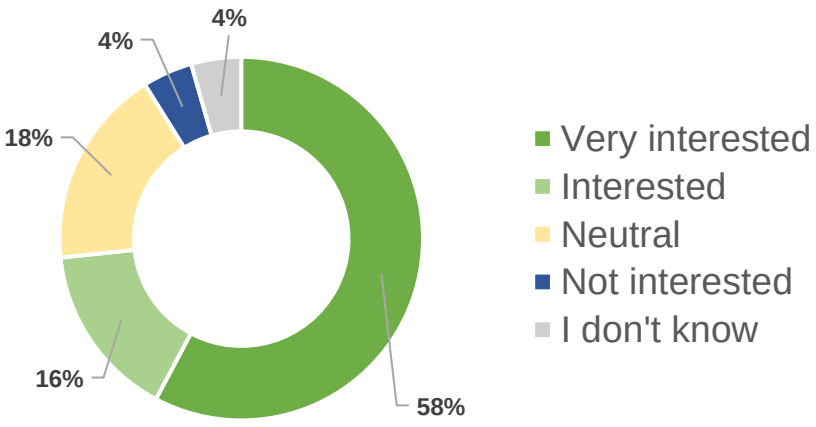

Figure 12. Personal interests of Wellington farmer respondents towards regenerative farming.

3.1 Facing Climate Change in Wellington County

Many farmers have indicated that they have felt the effects of climate change, specifically increased rainfall, wind, drought, and temperatures extremes.

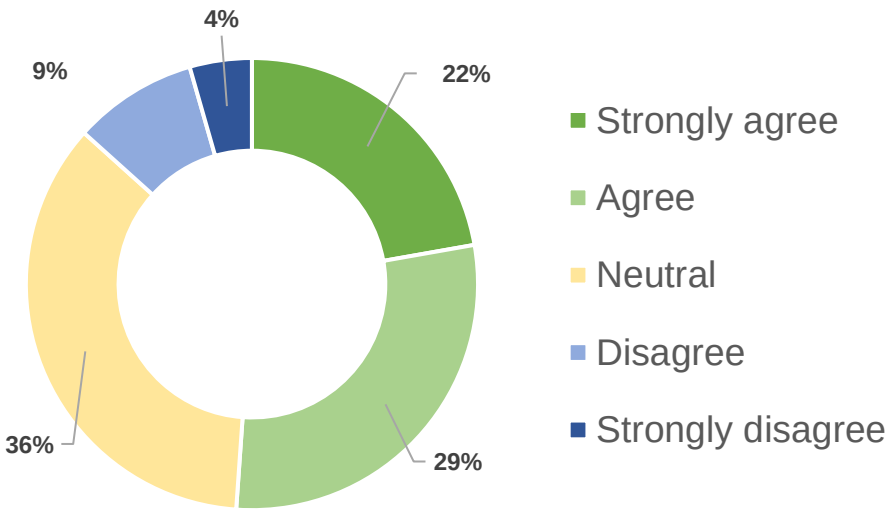

Figure 13. Wellington farmer respondents' perceptions on climate change impacts on their farming practices.

For example, 51% of Wellington County farmers surveyed stated that they agree, or strongly agree, that they have felt the impacts of a changing climate on their farming practices.

Climate change has impacted both crop and livestock farmers in a variety of ways, requiring attentive agricultural management, alternative farming practices, and increased land-use changes. This has resulted in reduced crop yields, lower quality hay and grasses, and increased agricultural costs. Crop farmers have noticed reduced crop quality, greater yield losses, altered pest cycles, greater pesticide and fungicide requirements, and earlier spring thaw. Livestock farmers have noticed lower quality and increased cost of hay and grass feed, enhanced supplementation requirements, greater difficulty keeping pastures green, and increased requirement to feed dry hay.

Overall, climate change has pushed agricultural practices in Wellington to require more labour and chemical inputs, and decreased yield and financial outputs. As a result, this has impacted the ability of farmers to invest in sustainable strategies, such as regenerative farming practices. Additionally, climate change and warmer winters can increase pest survival rates in animals which will negatively impact the industry's viability (Chiotti & Lavender, 2008). As indicated by one farmer: “Diseases that were once a curiosity, are now becoming a problem. Insects that used to not be able to

overwinter are now overwintering. We're seeing new insects and more invasive species. This is really causing a problem for a lot of farmers."

Particularly, farmers indicated they had witnessed climate change in their fields in the following ways:

Heavy Rainstorms

Rises in extreme precipitation events leading to soil erosion and nutrient loss have been, and are projected to, increase worldwide (Eekhout & Vente, 2020). Soil deterioration is typically noticeable during short, high-intensity rainfall events (Ritter, 2018). Ritter (2018) warns that agricultural lands will be the most vulnerable to erosion during the spring when soils are already saturated from snowmelt and vegetation is minimal. As one local farmer explained: "Our back fields drain so the spring is the saddest thing you've ever seen; all the topsoil is just coming down." Yet, it can be difficult or impractical to address soil erosion resulting from heavy rainfall. Anne Loeffler, a Conservation Specialist at Grand River Conservation Authority explained: "When considering erosion control structures such as water and sediment control basins, which can be used to slow down surface water flow, these often get in the way when you are using large farm equipment and may therefore be impractical."

> *"The biggest agricultural issue is the loss of nutrients along with sediment during heavy rainfall events. This commonly occurs during the non-growing season when there is no ground cover on the fields, especially when the ground is frozen."*
>
> *– Anne Loeffler, Conservation Specialist*

Heavy Winds

Wind erosion represents a small percentage of eroded lands in Ontario (Ritter, 2018b). There are three types of wind erosion that landowners experience, depending on their soil type. Landowners with finer soils are likely to experience suspension where fine soils are lifted high off the ground and travel long distances (Ritter, 2018). In this respect, one farmer indicated that: "when we first bought this property, the farmer, unbeknown to us, came in and tilled under their crop and applied Roundup® because they were leasing it. But they wrecked the farm; it became pure bare dirt and we had so much wind erosion. We had dirt all across our property, which was a real eye opener for us. It was an interesting confirmation of the damage that wind can do because all our snow in our yard and driveway was covered in dark dust all the time."

Landowners with medium-sized soils are more likely to experience saltation where soils are lifted and travel a short distance, but their travel can damage crops they run into along the way (Ritter, 2018). Finally, for landowners with larger-sized soils, if they experience wind erosion, it will be due to surface creep. Surface creep when soil

particles are too large to move, but if the wind is strong enough, it will roll the large soil particles across the land (Ritter, 2018).

Warmer Weather

Climate models suggest that over the next century, Ontario's average temperature is expected to rise by as much as 3 to 8ºC (Gough et al., 2016). Although this increase in temperature could increase Ontario's growing season, it could also increase the frequency and intensity of droughts and storms (OCCIAR, 2013). Lou Maieron, a local aquaculture farmer, explained that he has felt the effects of climate change in aquaculture: “Fish are not very easy to grow, and aquaculture, because of high density growing is a very stressful environment. Temperature fluctuations can be problematic especially in the spring, and spring comes very quickly these days. Temperature affects the ability of water to hold oxygen, so if you get an early hot spring before full tree cover is there, the fish will experience a drastic increase in water temperature, which increases the metabolic rate of the fish and decreases available oxygen. A recipe for disaster.”

Additionally, livestock will become increasingly affected by warmer temperatures. For example, according to Chiotti and Lavender (2008), heat stress lowers the weight gain for beef cattle, decreases milk production in dairy cattle, and reduces conception rates in poultry production. As a result of increased temperatures and drought events, one local farmer explained that: “We have had to do more vitamin supplements in recent years than we needed to initially because [the animals] are not getting as much green grass, and the quality of hay we can buy is lower. With the weather changing, getting the good grass hay has been getting increasingly difficult. About half our hay this year seems to be more yellow stock than actual edible green stuff”. Similarly, another local farmer explained: “The winters are different than when we first started 16 years ago. We aren’t getting the extreme cold for nearly as long. We have also had more years with trouble keeping the paddock green; more drought periods. Initially this never seemed to be a problem and now we have to be a lot more attentive to pasture management. We can’t water the pastures and we don’t have irrigation. There has been a number of summers that we have really had to watch out to make sure we are rotating [livestock] soon enough so that we aren’t eating it down too far because there is not enough rain to keep it revived. We have actually had to resort to feeding hay some summers. Then we have had other summers that have been so wet. Maybe it is just the normal cycle of things, but it seems like we are getting more extreme weather; the extreme heat in the summer and more overcast in the winter.”

Overall, farmers recognize that maintaining and improving farm health by practicing regenerative techniques increases land resilience to the effects of climate change. This opinion is evident as 69% of Wellington County farmers surveyed stated they agree or

strongly agree that they have changed or have considered changing their farming practices in the last five years to adjust to the changing climate.

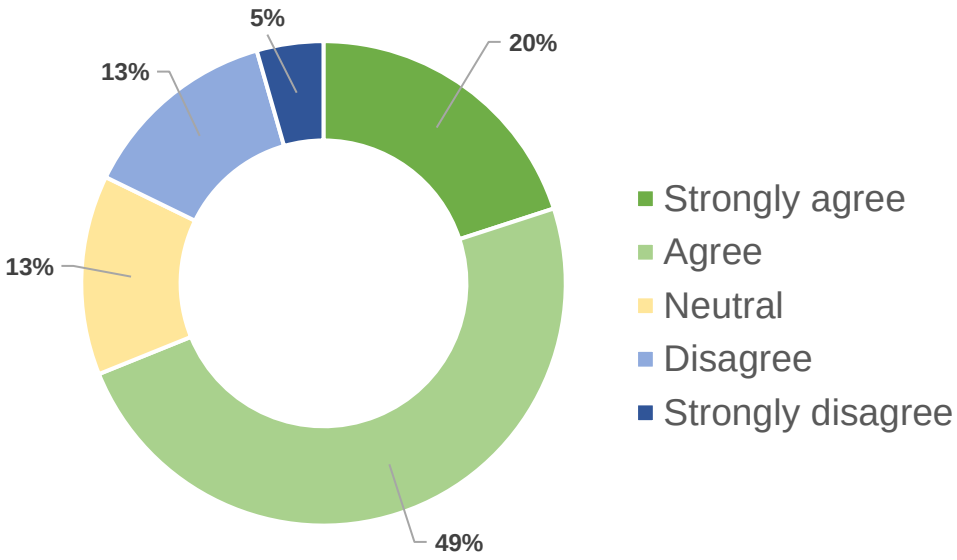

Figure 14. Wellington farmer respondents' perceptions on changing their farming practices in the last 5 years to adjust with the changing climate.

3.2 Other Challenges and Barriers that Farmers Encounter

Farmers in Wellington County have indicated a number of challenges influencing their ability to incorporate regenerative farming practices. These challenges are ongoing and relate to advertising and marketing support, availability of equipment, conventional versus organic farming, financial support, incorrect land classification, lack of informational resources, lack of infrastructure, urbanization and land-use planning, and working with other farmers.

Advertising and Marketing Support

Throughout our interviews, certain County of Wellington farmers have indicated that they do not possess the means to sufficiently advertise their products and that they struggle to obtain new customers. As one farmer mentioned: "Our biggest challenge is trying to get to people. We are hard to see, even though we are on a main highway. […] Promotion for us is very difficult." Since many farmers have indicated that consumers are primarily located in the city, increased advertising and marketing would enable farmers to increase on-farm investments. As indicated by one farmer: "what we are lacking in the most is marketing; we don't have the skills nor the network to get the information out there."

Many farmers are relying solely on farmers markets and lack the ability to connect with each other and market their farms in a centralized system. For example, one farmer explained that “the challenge for most farmers is that some only depend on farmer’s markets and don’t connect with each other. There needs to be a centralized system where people can go to find local food, or else it’s a hit and miss.” This challenge has become exacerbated during the COVID-19 pandemic because farmers have indicated that they cannot rely on tourism, store visits, retail sales, farmers markets, staff, and public activities to maintain production capacity and generate sufficient income. As a result, farmers have had to make sacrifices and experience reduced funds. As mentioned by one farmer: “The biggest barrier right now is COVID-19. Because of [COVID-19], we are experiencing a lack of income due to our heavy reliance on tourism and retail sales at farmers markets, farm stores, and craft shows.” Another farmer indicated that “COVID-19 has taken away almost all of our income sources.”

Additionally, to effectively market their products and opportunities and benefit from ongoing and future regenerative farming practices, some farmers have indicated that they lack sufficient resources to create a website, which would likely increase the number of customers and farm revenue. As mentioned by one farmer: “I would really like help to set up a website for my business, if there are any grants for that.”

Availability of Equipment

Farmers in the County of Wellington have indicated that there is insufficient local equipment availability. Farmers are finding themselves unable to purchase required specialized equipment off the shelves, and that they must either design and build the equipment themselves, pay for someone else to design and build the necessary equipment, or travel to the United States – which has become significantly more challenging in the face of COVID-19. Specifically, one farmer mentioned: “I have a bunch of broken equipment here and parts waiting for me across the U.S. border… parts which are either: (a) twice the price in Canada or (b) not available in Canada. Yet, I don’t know if I will be considered a commercial trucker and be able to cross the border or if I will have to quarantine while my animals die. Will I be able to get back to my farm?” Another farmer explained that: “you can’t go and buy a chicken tractor off the shelf, either you build it, or someone builds it for you.”

Conventional Versus Organic Farming

A number of organic farmers have indicated that they face major challenges and barriers related to animosity from conventional farmers. There seems to be a strong divide between conventional and organic farming communities. For example, one farmer mentioned: “why does one farming system get to destroy another farming system”. Another farmer mentioned that: “[conventional] farmers roll their eyes at us a lot, I would say […]. Within the farming community, I wouldn’t say that there’s a huge amount of community between the conventional farmers and people that are [farming organic]. One farmer explained that “the way the organic system is set up is that [the organic farmers] are special and unusual, and that conventional farmers are normal. And so conventional farmers can do what they want to do while [organic farmers] have to put in all of this extra work, but [the organic farmers] are the ones more likely to be impacted by things [conventional farmers] do.”

When it comes to farmer relationships, mentorships, and informational events, many farmers have indicated that there is a communication barrier between communities which hinders the sharing of knowledge and could slow advancements in the Wellington County farming community. One farmer indicated that “despite the increased pressure and cost of organic farming, many conventional farmers minimize organic practices”.

Additionally, one farmer indicated that if a neighbour over-sprays their land with pesticides, the organic farmer may have their organic certification revoked for years, without any effective legal avenues. As indicated by one farmer: “The farmer that works the field around us is not organic and if he was to go out and spray on a windy day and contaminate our crops, the onus is on us. We would lose our organic status for three years and the ability to participate in certain markets. We are doing all of the paperwork and legwork and research to follow [organic] rules but if another farmer makes a mistake and it negatively impacts us, it’s all on us. The conventional farmer might get at the most a slap on the wrist or a small fine. That to me is problematic.” Another farmer mentioned that: “we've been organic right from the start; however, we are renting land from my husband's uncle, and they are very conventional. We are this very tiny organic spot surrounded by pesticides. It doesn't feel like we can call ourselves really organic when we've got that going on all around.”

Financial Support

According to many County of Wellington farmers, they lack the appropriate financial support to purchase equipment and tools necessary to implement regenerative farming practices. That is, from the survey, 40% of farmers indicated that they disagree that there is adequate local support (financial, coaching, mentorship) for farmers. One farmer indicated that "I wouldn't say regenerative farming has provided me with economic benefits. Mostly it is just costing me money", while another farmer explained that '"the payoff [of regenerative farming] is small. It is not about being able to make money, it is about being able to breathe." Famers have indicated that the resource which is lacking the most is financial support. As one farmer explained: "[we need] less mentorship, less coaching, fewer forms, and more money. Just give us the resources that we need, not the ones we don't need. With the internet, any farmer can get the information we need. It is important for governments to provide leadership; we need a steady hand for sure, but just give us the [monetary] resources." With respect to the financial commitment associated with equipment, one farmer explained that: "Eventually, I would like to gradually take back more land from my farm and diversity it into other crop, but it all seems a little daunting. […] It is just such a big financial commitment since you have to get new machinery." Similarly, with respect to building new infrastructure, Anne Loeffler mentioned that: "a small livestock farming operation that doesn't have adequate manure storage might wish to build a good manure storage, but cannot afford to because the economic returns of beef production are so poor that it might take them [many] years of their net farm income to pay for it. That is, certain practices are not economically feasible."

Farmers have indicated that they face a challenge competing with a globalized market where they must adhere to local regulations, provide ethical wages, and are restricted to certain practices, which has increased agricultural costs and decreased revenue. Overall, this has negatively impacted farmers' businesses and created a challenge for investing into sustainable agricultural practices. As one farmer mentioned: "Farming is a tough gig in the best of times but now you have a global economy that has pushed food to be made at [extremely low] labour rates and the public may or may not be aware of it, but what they know is that they can get food at the grocery store for cheap and they look at our food and [think that it] is elitist food!". That is, there is a disconnect between what the public is paying for food and what it actually takes to produce it. As one farmer indicated: "consumers are fixated on the price and forget about values because households are also struggling". Additionally, due to increased taxes and land costs, certain farmers indicated that they have become more resistant to implementing practices on their farm that do not generate direct financial benefit, such as planting trees or building a fence around a wetland.

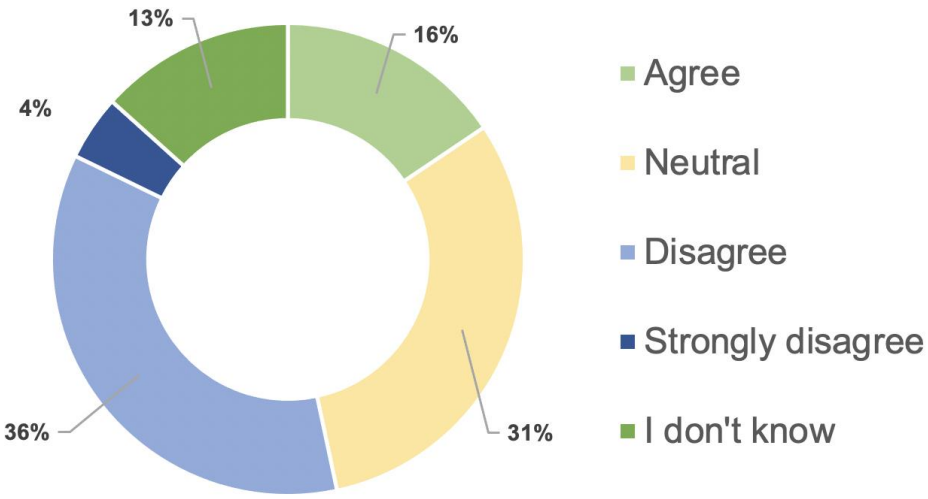

Figure 15. Wellington farmer respondents' perceptions of local support towards the agricultural sector.

Incorrect Land Classification

Throughout our interviews with County of Wellington Farmers, one farmer indicated that they have faced major challenges resulting from the incorrect classification of land before purchasing the farmland. This farmer, Carole Precious, explained that "this particular parcel of land was incorrectly classified as top-quality farmland and it is not at all. The main reason why it matters how your farm is designated is that it really enables or disables you from doing what you want to do on your property. As type A1 farmland, I am not able, at this time, without fighting – which I am going to do – to get a severance or lot agreement on my property." Despite this challenge associated with the improper land classification, this farmer explained that: "[being able to sever my land] would be amazing for my property for many reasons. But mostly because this would be a great use of the land at the front of my property that is not suitable for farmland but would be great for residence." That is, this farmer described that: "all around me, within even 3km of my farm, there are houses being built on secondary land. But the secondary land is corn fields, bean fields, all cultivated fields and a lot of those secondary bits of land are better than my farm, especially the whole bit at the front. It is a problem." As this farmland had been improperly classified before purchase of the land, this farmer has not been able to make full use of their farm, which has impacted their ability to implement regenerative farming practices.

Lack of Informational Resources

On the topic of informational resources, certain farmers have indicated that they cannot attend information sessions during work hours, which has significantly reduced their ability to access educational resources. Specifically, one farmer explained that: “[some] courses [are] only offered during the weekdays when a huge number of farms are farming part time and work full time [and] I can’t justify taking time off work”.

Some farmers indicated that they hope to implement certain regenerative farming practices or become organic, but that they feel “stuck” on how to proceed due to a lack of informational sources to guide the decision-making process. For example, one farmer mentioned: “I would really like to have help on the whole organic piece; I just find I’m circling around, not really making any headway”. One farmer explained that they would benefit from communications with other farmers and that: “if I could get together with others and learn about how and why things are working on my farm, I will be much more likely to make an appropriate management decision.”

Further, certain farmers have indicated that it is sometimes difficult to measure the benefits of implementing regenerative practices, which is a barrier influencing the way farmers are willing to adopt these practices knowing there might not be an immediate and direct benefit. One farmer explained that “it can be difficult to measure some of the benefits […]; how do we determine the yield benefits when you have windbreaks in place or use cover crops.”

Finally, numerous farmers indicated that a significant barrier to increasing regenerative farming practices on their farm is a lack of support resources to aid in the decision-making and implementation process. One farmer indicated that “there are too many [regenerative farming] options and nobody tells you what to do”, while another farmer explained that “there is so much support, so you have to figure it out on your own”. Although there are numerous ways in which farmers can improve farm sustainability, some farmers are feeling overwhelmed by the informational resources and don’t know how to proceed to implement these practices. Similarly, although many farmers acknowledge that there are abundant informational resources available to them, they have to overcome “a lot of trial and error” and facing the challenge of not knowing which resources would be beneficial to their own farm.

Lack of Infrastructure

With respect to challenges and barriers faced by County of Wellington farmers, many individuals indicated that there is a lack of infrastructure; specifically related to internet accessibility and slaughter facilities. Due to the lack of internet infrastructure, certain farmers are unable to access informational tools and events available online and must rely on printed resources to improve on-farm sustainability.

Further, certain County of Wellington farmers have indicated a lack of manufacturing, slaughter, and processing infrastructure facilities. As one farmer mentioned: “Our biggest problem right now is the lack of slaughter capacity in Ontario for beef cattle. [This means] I can’t get as good a price as I should be able to, I end up with less funds than I should have, and I can’t invest in regenerative practices”. As another farmer explained, “The small abattoirs are overwhelmed; they don’t have the capacity to be moving the pigs, cattle, sheep, and alpacas through at the rate they need to be. It is not just affecting us – it is affecting all meat animals.” When the slaughter facilities are backlogged, “it puts a lot more stress on the farmer since we cannot ship when we are supposed to. This often means keeping and feeding the cattle our crops longer, but we still get the same amount for them, or less for now overweight cattle. I think that Wellington County should push for increased slaughter capacity because there are a lot of beef farmers in Wellington County and we all face the same issues. Because we have one main slaughterhouse, they can dictate the prices since there is no competition and they can make the prices what they want and we have to take it, which is often nowhere near enough.”

In addition to a lack of capacity, Suelaine Poot of Pootcorners Alpacas explained that “I had a customer looking for federally inspected alpaca meat and no federal plant would even look at [the meat]. We were too small an order, and too specialized. I even went to one of the plants and they basically explained that it is not financially viable to make the changes to do a federally inspected alpaca run.” That is, “we are missing the mills, we are missing the manufacturers, we are missing the abattoirs, we are missing the education of the public. We have the animals and we have beautiful end products, but we aren’t doing them Canadian made as much as we should because we are lacking so much in our infrastructure.”

Urbanization and Land-use Planning

As a result of urbanization and ineffective land-use planning, certain farmers have indicated that they are experiencing challenges on their farm. For example, one farmer mentioned that “the biggest threat I have is urbanization and bad land-use planning. My trees are falling down because of the recent houses built right up to my fence-line”. Similarly, another farmer explained that: “my trees are falling down because they put a subdivision with bad stormwater management and drainable issues. Yet they won’t improve it.”

Working with Other Farmers

Certain County of Wellington farmers have indicated that there are challenges associated with renting or crop-sharing land, compared to owning land. For example, one farmer indicated that their crop-share partner is a conventional farmer that uses passed-down techniques and is generally risk-adverse, yet, all new techniques, including regenerative practices, must be approved by this partner. As indicated by the farmer “our crop-share farmer is the best mentor but [regenerative farming] is not really his thing. We are dependent on him and his equipment and his experience which is a bit of a barrier for us since we are kind of at the mercy of someone else.”

Similarly, another farmer indicated that they wanted to put in a windbreak between their farm and the neighbouring farm. However, “since the other farmer did not like trees”, they faced the challenge of planting these trees entirely on their land, “decreasing the quantity of usable land, even though both farms would benefit from this windbreak”. One farmer mentioned future goals of certifying all their land as organic. However, since a large portion of their land is rented by another farmer, that farmer will ultimately determine if they will follow organic guidelines on their portion of land. Specifically, this farmer explained that: “my preference is to have the entire farm become certified organic by requiring it in the lease agreement. However, I am not sure if my farmer tenant will see the benefit of having organic hay. I am not sure if the market for organic hay is that significant, or if it would be worth it for them to go through that process. So, it is not just me, my documentation, and meeting the organic requirements, but they would have to meet them too – and I don’t know if they would be willing.”

Finally, as Anne Loeffler from Grand River Conservation Authority indicated: “If land is being farmed by a tenant rather than the landowner, they don’t have the assurance that they will still be farming the land next year, or in five years. The tenant may not want to make a long-term sustainability investment since this will require extra cost and work. Implementing some best management practices may be more attractive to farmers who own, rather than rent, their land.”

3.3 Successful Regenerative Practices Used in Wellington County

Whether they are referred to as regenerative, climate friendly, or sustainable, farming practices that aim to improve soil and environmental health are prominent amongst the farmers of Wellington County. In fact, 67% of the farmers that responded to our survey expressed interest in regenerative farming, and nearly every single farmer that was interviewed currently practices some regenerative farming techniques. However, it should be noted that the majority of the farms we investigated were small, family-run operations, with more than 60% farming less than 100 acres.

> *"Regenerative farming is the focus of how I live my life and manage my property. Everything I have done is based on my understanding of how nature works. My whole farm is set up with that in mind; honoring the way the land is. It is a unique property but all of it is to do with regenerative in the true sense of the word."*
>
> *– Carole Precious, Wellington County farmer*

Cover Crops

The use of cover crops for maintaining soil health was common amongst the Wellington County farmers interviewed. Cover crops such alfalfa, barley, oat, peas, and vetch were all used during the non-growing season to protect soil from erosion and prevent denitrification and manure run-off. Throughout the interview process, farmers also explained the various other economic and environmental benefits of cover crops. For example, several farmers utilized their cover crops as green manure by tilling them back into the soil for nutrients. In contrast, a farmer from a large-scale organic farm explained that their cover crops were utilized as feed for their livestock—a process that not only saved them money on feed, but also reduced their overall carbon footprint by mitigating the GHG emissions associated with producing and transporting animal feed. Finally, a commodity farmer that was interviewed discovered that, due to the rising costs of hay, he could make a profit by selling his cover crops to other farmers as feed.

Nutrient Management

Several Wellington County farmers indicated that they test their soil for nutrient levels as part of their nutrient management strategy. Brett Israel of 3Gen Organics described his strategy in detail: they test their soil every three years and maintain a soil health logbook that goes back four decades. Additionally, they have their manure tested for nutrient content to ensure that adequate nutrition is available for crops and that resources are not wasted through over-fertilization.

Brett also explained a variety of techniques that 3Gen uses to minimize environmental impact and maximize soil health, embodying the principles of 4R Nutrient Management. First, in order to avoid nutrient run-off, they never applied manure to bare soil. Manure was instead applied to cover crops and around maturing corn through side dressing.

Like other organic farmers that were interviewed, Brett uses liquid and solid manure from his own livestock as a low-impact and inexpensive fertilizer. Lastly, 3Gen Organics sets the precedent for what a circular food economy can look like by using the digestate produced from organic waste at the Elmira Bio-En biogas plant as fertilizer.

Reduced Tillage

While no-till farming has steadily gained popularity, few Wellington farmers mentioned adopting the technique during our interviews. Instead, many farmers described their operations as involving minimal or reduced tillage, with the main goal of reducing soil disturbance and erosion. The farmers that were interviewed also chose to use shallow plows or lower-impact alternatives. For example, a small-scale farmer with a market garden described their use of minimal tillage using a small walk-behind tractor and following up with silage tarps. Other interviewees from larger farms reported transitioning to less destructive types of plows over time; some from moldboard to chisel plows and some from chisel to vertical plows.

Rotational Grazing

> *"Rotational grazing is something we highly recommend. Not just for preserving of the pasture itself but also for parasite and disease control because it gives a time for any parasites they have ingested to die off before they are back on to that pasture again."*
>
> *- Wellington County farmer*

Amongst the livestock farmers interviewed, rotational grazing was the most commonly adopted regenerative technique. Farmers reported that they successfully used rotational grazing on a variety of livestock, including cattle, pigs, poultry, sheep, and bison. These farmers also reported experiencing both environmental and economic benefits as an outcome of adopting rotational grazing. For example, the owners of Chicken Thika Farms save time and money by "leapfrogging" their home-made chicken tractors across their pasture, which naturally spreads out manure and allows their pasture to regenerate. Other farmers, such as Jeremy Bowman of Black Powder Bison Company, mentioned that rotational grazing is a key factor in maintaining grass and soil health, and noted that selling grass-fed bison provides their farm with a marketing advantage.

Silvopasture

Interviews with farmers also revealed that silvopasture, a form of agroforestry where trees are integrated into pasturelands, was practiced by at least four farms. One cattle farmer explained that increased tree coverage benefits his cows by providing them with shade and allowing them to graze more efficiently in the summer heat. Another farmer in Wellington County, whose pasture is interspersed with fruit and nut trees, raises poultry and pigs that benefit nutritionally from the addition of nuts and fruits into their

diet. Farmers that were interviewed were also motivated by the environmental co-benefits of having trees in their pastures, specifically an increase in biodiversity.

Windbreaks

When interviewed, many Wellington County farmers mentioned that they successfully implemented windbreaks as a means of reducing soil erosion and increasing crop yields, although they were unable to quantify the benefits. However, Rob Johnson—the manager of the Green Legacy Programme in Wellington County—explained in an interview that windbreaks are so effective at increasing yields that a farmer cultivating 200 acres could purchase a pick-up truck every year with the increased profits. It is unsurprising then that farmers in the County take great care of the natural windbreaks on their land and plant new ones with assistance from programs such as Green Legacy.

3.4 Grant Application Experiences

Discussing grant application processes with farmers unanimously brought up five central themes: accessibility constraints, complexity, eligibility issues, awareness, and increased comfort with farmer-led granting agencies—greater detail of these themes below.

> *"We sort of got discouraged, a lot of the time you would find a grant that might be useful for you and it would be prefaced by the fact that you would have to have had access to another grant in the past, or would need to be a member of another group, or you would have to do a course and the course is only offered during the weekdays, when a huge number of farms are farming part time and work full time so I can't justify taking time off work to apply for a $2,000 grant."*
>
> *– James Ferrier, Wellington County farmer*

Accessibility Constraints

The most common concern brought up by farmers was accessibility, displayed in a variety of ways including access to reliable internet, inability to attend information sessions available during working hours, and the incompatibility of online applications with older processing systems. Additionally, many grants require membership within specific organizations which smaller or new farmers may not be able to afford.

Complexity

While many farmers were pleased with their experiences with grant organizations, several farmers, raised concerns regarding the complex and time-consuming process associated with application, which occasionally outweighed the benefit of the grant. The majority of grants have multiple stages and farmers found themselves confused as to what the grants were looking for and how to complete the required paperwork.

Eligibility

The County of Wellington has the greatest diversity of agricultural industries in Ontario including, but not limited to crop, grain, dairy, cattle, poultry, aquaculture, water buffalo, and bison farms. Farms in Wellington County also range significantly in size, from under one acre to several hundred acres. Due to these variations, many farmers have expressed frustrations with their farms “not fitting in a specific box”. Largely, grants generally focus on either large- or small-scale farms, leaving “medium sized” farms ineligible for funding. Additionally, farmers which produce more unique products, such as sheep dairy, bison, water buffalo, who are interested in receiving support to incorporate regenerative practices have been restricted by eligibility requirements.

Awareness

Several farmers raised the issue of a lack of informational sources regarding grant resources. Specifically, farmers were interested in a source which could provide information regarding available grants, the qualification criteria, the application process, and how to discover grants aligned with their future directions. Farmers are looking to streamline this process so they do not miss out on funding opportunities.

Farmer Led Granting Agencies

In general, farmers indicated that the most positive outcomes of the grant application process resulted from granting agencies who involved farmers. For example, when farmers worked with organizations such as Conservation Authorities, OMAFRA, and Soil and Crop Improvement Association, they appreciated being involved in the decision-making process and being connected with farmer mentors who could assist with the application process. Similarly, when engaging with farmer-led granting agencies, farmers reported being more comfortable with the application process and were more willing to ask questions along the way.

3.5 Successful Support in Wellington County

Through survey results and interviews, Wellington County farmers shared their positive experiences with organizations and initiatives that provided them with support through grants, mentorships, and community-building opportunities. The organizations in the following section stood out to farmers as helpful and reliable. For a full list of organizations that successfully provided support to Wellington County farmers, refer to Appendix A, Appendix B, and Appendix C.

Carrot Cache

Carrot Cache is a grant that focuses on farmers who face systemic barriers, are not visible in farming, or who are often ineligible for other funding. Two farmers that we interviewed received small grants from Carrot Cache and described their experiences as “overwhelmingly positive”. One of these farmers applied for funding for a greenhouse extension and described the process as “relatively simple and straightforward”. The

other farmer appreciated that the organization ensured that they were "eligible for funding *before* spending resources on the application". Carrot Cache also engaged in two-way communication and supported the farmer by contributing ideas throughout the process.

Conservation Authorities

There are six Conservation Authorities whose jurisdictions extend into the County of Wellington, but most farmers that were interviewed were in the Credit River, Grand River, and Maitland River watersheds. Farmers that received support from their local Conservation Authority described the experience as positive and highlighted the benefit of consulting with conservation experts on how to implement a project.

> "*We have to be respectful of practical and economic considerations. At Grand River Conservation Authority, we wait for farmers to approach us. If a farmer is interested about a certain practice, we do everything possible to help them make sure they get a good design, a reputable contractor, and funding. We then follow up to understand the impact on the farm, perhaps write some fact sheets or profiles if the farmer is interested, and use this in our outreach materials."*
>
> *– Anne Loeffler, Conservation Specialist*

Additionally, County of Wellington farmers explained that Conservation Authorities facilitated the process of receiving support from a multitude of initiatives. For example, one farmer received funding to decommission an old well and build a newer one, while other farmers mentioned receiving support for implementing cover crops and windbreaks. Several farmers mentioned working with Conservation Authorities but did not specify to what end. Other farmers, such as Lee Anne Downey, worked with their local Conservation Authorities to protect or naturalize areas of their farm property. Lee Anne facilitates and helps perform fish inventories, invasive species removals, and tree plantings on her property.

Ecological Farmers Association of Ontario (EFAO)

Throughout the interview process, several famers mentioned that they are members of the EFAO. The EFAO offers farmers the opportunity to learn about, and engage in, ecological farming topics and techniques, and provides support for farmer-led research trials. In general, regenerative farmers indicated that they valued the community-building opportunities to connect with like-minded farmers with similar future directions. Additionally, one farmer described the EFAO as their least expensive farmers association membership that provides the most benefits.

Green Legacy Programme

Many of the interviewed farmers gave extremely positive feedback regarding their experiences with the Green Legacy Programme. This initiative has enhanced the naturalization of farmland with native tree species and supported the implementation of windbreaks on a variety of properties. Specifically, farmers indicated that their sugar bushes, food forests, naturalized wooded wetlands, and forests have been improved by trees from the Green Legacy Programme.

Taste Real

When asked about what support programs they have found most helpful, farmers of Wellington County often mentioned the Taste Real program. Farms that rely on the direct-to-consumer sale of a large range of products, such as Christmas trees, ciders, poultry, organic vegetables, and cattle, have benefitted from the increased marketing and exposure to potential customers in the city. One farmer also praised the Taste Real program for its success in community-building.

Other Successes

In addition to the above examples of successful support for farmers in Wellington County, farmers also mentioned that Ontario Soil and Crop Improvement Association, OMAFRA, Seeding Our Food Future, and several other small initiatives were beneficial to their regenerative farming success. Seeding Our Food Future microgrants were received by several farmers for a variety of projects, including the development of direct-to-consumer products and agrotourism programs.

3.6 Ideal County Support: Farmers' Perspectives

Through discussions with farmers in Wellington County, many suggestions arose to help address challenges and barriers pertaining to regenerative farming. Farmer-based suggestions include infrastructure improvements, education opportunities, grant awareness campaigns, marketing of local farms, tax incentives and zoning law changes.

Infrastructure Improvements

Many farmers in rural areas currently experience accessibility issues with regards to internet availability. While this has historically been an issue as public education materials become increasingly digitized, this issue has been exacerbated by the COVID-19 pandemic. As in-person events have been largely cancelled during the COVID-19 pandemic, farmers living in rural areas of the county have felt left behind. Without the availability or reliable high-speed internet, farmers have expressed difficulty accessing regenerative farming workshops, grant applications, and organizational meetings.

Education Opportunities

While the majority of farmers interviewed were interested in regenerative farming, many felt that current educational opportunities could be expanded. Due to the COVID-19 pandemic, many educational workshops have been shifted online, primarily as live lectures. However, despite the ease of accessing workshops from home, farmers indicated that many workshops were conducted during their working-hours and were not recorded. Therefore, many farmers found themselves unable to attend and access informational resources. However, if these virtual events were recorded and available for viewing after the session, they would be more accessible to a wider audience. Furthermore, as COVID-19 restrictions lift, farmers have expressed the desire for more one-on-one mentor-based education opportunities relating to regenerative agriculture.

Grant Awareness Campaigns

As previously mentioned, awareness of available grants was a notable issue for multiple farmers. The network of farmers who were interviewed suggested a variety of solutions for this issue, including an email campaign of upcoming and available grants made available by the County, an online platform which farmers could enter information about their farm and be matched to grants which they are eligible for, and an online forum listing available grants to farmers within Wellington County.

Marketing of Local Farms

COVID-19 has affected farmers in a multitude of ways, including reducing the number of consumers purchasing directly from producers and farm stores. Within Wellington County, many smaller operations who do not contribute to the commercial market have had to consider more creative solutions, such as delivering products directly to consumers or introducing COVID-19-safe activities. While interacting with farmers, there was an overwhelmingly positive response for the “Taste Real” platform; however, farmers believe that there could be increased promotion of this platform throughout the City of Guelph and Wellington County. Farmers have also expressed interest in assistance in delivery of goods into the City of Guelph.

Tax Incentives

Finally, farmers who champion regenerative techniques were hoping for tax incentives to encourage the continuity of these practices. These farmers feel as though tax incentives would encourage other farmers to adopt new regenerative practices, as the incentives would help offset initial costs during the transition period. For example, famers who have planted windbreaks, retained wetlands, or land that is being rotated as a cover crop, could pay a lower tax rate to encourage further sustainable development.

Zoning Laws Changes

Current zoning laws in Wellington County make it difficult for small scale, low impact development farmers to get involved since only one residential dwelling can be built on a parcel of farmland. Smaller and medium size farming operations see this as a major hindrance as they would be inclined to allow another family to build on housing and cooperatively work the land, however this is not allowed under current laws. With current zoning laws, farmers are faced with major capital investments which are not practical for new, smaller, and low impact farming operations.

> *"Change the zoning laws, a lot of regions allow one family, one house, one parcel…that's a problem because it makes it really challenging for groups of people to farm. What you need on a farm particularly on a low-impact, low energy farm is people. It can be really challenging to get larger groups of people on a piece of land."*
>
> *– Jennifer Osborne, Wellington County farmer*

3.7 Conclusion of Findings

Through discussions with farmers, this report explored climate change impacts, grant experiences, barriers and how farmers are looking to be supported by the County going forward. Some of the most common barriers included frustrations with complex, monotonous grant processes, lack of infrastructure, lack of up-front capital to initiate transition to new practices and the desire for increased awareness of local food systems.

Despite these barriers, the majority of farmers demonstrated a strong passion for farming best practices and, by extension, mitigating the impact agricultural processes have on the environment. In some cases, this went as far as farmers making strides to re-naturalize sections of their land into pre-agricultural conditions.
Based on these discussions, we have summarized suggestions and tangible actions for the County of Wellington which can best support our farmers as they expand regenerative farming practices and contribute towards a circular food economy.

4. Recommendations for County Action

Below is a list of five recommendations for County action based on the findings section of this report. In no particular order, the County should focus their efforts to:

1. Adjust Zoning Laws

Adjusting zoning laws to increase the number of residences on a land plot would benefit small-scale farmers. Specifically, altering zoning laws would allow more Wellington County citizens to benefit from the region's unique soils by enabling multiple farmers to work the same plot of land. Alternatively, zoning laws can be amended to enable farmers to participate in knowledge-sharing programs such as the Worldwide Opportunities in Organic Farming (WOOF) program, where farmers can share their knowledge with apprentices in exchange for on-farm help, and free room and board.

2. Attract Investments in Internet Accessibility

COVID-19 has impacted information-sharing networks between farmers by shifting many educational workshops, informational events, and communication opportunities online. However, from discussions with farmers, it was established that many farmers could not access these knowledge-sharing portals due to a lack of internet infrastructure. Therefore, the County needs to continue to attract internet infrastructure to support farmers in acquiring the knowledge necessary to implement regenerative farming strategies and practices.

With respect to infrastructure investment, the County should support high-capacity fiber optic connectivity. The County should also seek to attract wireless broadband for all relevant agricultural areas in the region to support the needs of farmers. Innovation, Science, and Economic Development (ISED) has programs that are intended to support the development of high-speed Internet with its *Connect to Innovate Program*, and provinces may have additional initiatives to further support broadband infrastructure programs (Government of Canada, 2020).

A non-infrastructure option the County could consider subsidizing is low earth orbit satellites such as Starlink. Starlink is an internet service provided by Elon Musk's company Space X. This internet service prototype is planned to be available in Canada by mid to late 2021 for most addresses. The service will cost $129 a month with no data caps and an initial cost of $649 to access the equipment and hardware necessary for the device. Customers interested in the service can apply to access Starlink internet, however the company will not be accepting all applicants yet (Hurst, 2021).

3. Implement a Farmer's Market Gift Card Program

As another marketing source, Wellington County could implement gift cards to be purchased by citizens which can be used at any farmers' market booth. This initiative should be properly marketed to attract new customers to farmers' markets. For example, consumers can pre-purchase a $25 gift card with a redeemable value of $30 (a free $5). This initiative could serve the dual purpose of marketing and ensuring attendance at farmers' market events. Many farmers' markets such as Hamilton, St. Jacobs, and Kitchener use Giftly to manage their gift card purchases.

4. Implement Tax Incentives for Farmer Conservation Efforts

Farmers in Wellington County are generally interested in regenerative agriculture. To encourage continued interest, the County should continue to incentivize farmers for their conservation efforts. For example, in the United States, farm landowners can deduct expenses related to soil or water conservation, farmland erosion prevention, or endangered species from their federal taxes. Additionally, conservation expenses are limited to 25% of the farmers' gross income and are only available to landowners who farm for profit (Cooley, 2015). Environment and Climate Change Canada is looking to develop financial incentives for farmers to reduce and abate their carbon emissions through regenerative farming techniques. This is something the County should continue to follow as it provides an opportunity to support farming operations within the County (Environment and Climate Change Canada, 2021).

5. Develop a Living Resource for Farmers

Throughout our conversations with farmers within Wellington County, it was clear that practitioners are struggling to find grants and research relevant to their operations. A living document updated by the County informing the residents of available grants and research would connect farmers to resources practitioners can trust. This service would help farmers make informed decisions about adjusting their operations and improving on-farm sustainability. Beyond this, the living resource could include a section informing farmers of common "tips and tricks" of grant writing, and the County could host a bi-annual workshop explaining these suggestions in real-time.

5. Conclusion of Report

This report will support Our Food Future, a collaborative project between the County of Wellington and the City of Guelph that aims to build a local circular food economy. The report will also contribute towards the County's Climate Change Mitigation Plan. To achieve this target, this report aimed to (1) identify regenerative farming definitions, practices, and approaches, (2) discover local farmers in the County of Wellington, (3) identify local agricultural organizations and grant agencies, (4) produce a publicly available electronic report, (5) create a directory of local practitioners, organizational experts, and grant opportunities, and (6) develop an infographic to share key findings with to members of the public and the County of Wellington. These objectives were achieved through (i) a literature review, (ii) discovery of farmers, and (iii) interviews with farmers and organizational leaders.

According to the literature review, with the growing demands on agricultural food production, conventional farming has affected soil and ecosystem health. Threats to freshwater systems, soil degradation, erosion and compaction, and pollution in the form of pesticides, animal waste, nitrogen pollution, and greenhouse gases can be reduced through best management practices such as regenerative farming. Given that the County of Wellington houses the greatest number of farms of southwestern Ontario, the region is particularly vulnerable to Canada's changing climate. Climate change places the agricultural industry at risk due to increased temperatures and more frequent severe weather events which will likely affect crop productivity, animal production, pest and disease occurrence and persistence, pollinator health, soil quality, and water quality and availability.

Based on conversations with local farmers and organizational experts, our team developed a definition of regenerative farming in the context of Wellington County:

> A farming philosophy which aims to not only protect, but also to improve the health of the soil and surrounding ecosystem. Regenerative farming is a dynamic concept that focusses on the long-term renewal of organic carbon, nutrient content, and microbial biodiversity in the soil, while also nourishing the ties between the land, its natural heritage, and the community.

Regenerative farming is a practice which can be utilized to increase the resilience, integrity, and function of farms to maximize productivity and profitability. That is, regenerative farming can provide farmers with improved soil and watershed health, increased ecosystem services, increased biodiversity, enhanced land productivity, increased yields, and greater cost and energy savings. Regenerative farming can also

provide farmers with social and economic benefits which will allow farmers to benefit from their farming practices despite the impacts of climate change.
In addition to benefits, the literature review considered certain limitations to regenerative farming, notably the requirement of new knowledge and skills, possible lower yields, and the perceived cost of transitioning into regenerative farming practices. However, despite these challenges, ultimately, regenerative farming requires fewer costly inputs and provides enhanced resilience to climate change which offsets these possible challenges and barriers.

Finally, twelve regenerative farming practices that were deemed relevant to Wellington County and southern Ontario, include cover crops, green manure, no-till farming, crop rotation, companion planting, tree-based intercropping, silvopasture, 4R nutrient management, rotational grazing, detention ponds, windbreaks, and buffer strips.

Discovery of farmers was executed through a Qualtrics survey, which was distributed to 190 County of Wellington farmers and received 45 respondents (Appendix F). In addition, interviews were conducted with 25 local farmers, 12 local organizational experts, and 2 local grant agency representatives. Interviews with farmers and organizational leaders were performed to inform the “findings from interviews with farmers, local organizations, and grant agencies” section of this report, develop farmer, organizational and grant directories, produce a comprehensive data analysis, create an infographic for public distribution, and share advice for future similar projects.

Based on the survey, the majority of farmers have felt the impacts of a changing climate on their farming practices. That is, climate change has impacted both crop and livestock farmers in a variety of ways, requiring attentive agricultural management, alternate farming practices, and increased land-use changes. In particular, farmers mentioned that climate change has impacted their agricultural practices through heavy rainstorms, heavy winds, and warmer weather. In addition to climate change, other challenges and barriers that local farmers experience relate to advertising and marketing support, availability of equipment, conventional versus organic farming, financial support, incorrect land classification, lack of informational resources, lack of infrastructure, urbanization and land-use planning, and working with other farmers.

Despite these challenges, the survey indicates that approximately two thirds of farmers are interested in regenerative farming (Appendix G), and nearly all interviewed farmers demonstrated some form of regenerative farming practice. The primary regenerative farming practices in Wellington County are cover crops, nutrient management, reduced tillage, rotational grazing, silvopasture, and windbreaks.

With respect to promoting regenerative farming practices within Wellington County and supporting farmers through the grant application process, local farmers that were interviewed unanimously brought up five central themes: accessibility constraints, complexity, eligibility issues, awareness, and farming led granting agencies. The survey and interviews with local farmers also revealed some organizations they can reliably turn for support. These supports include Carrot Cache, Conservation Authorities, Ecological Farmers Association of Ontario, Green Legacy Programme, Taste Real, Ontario Soil and Crop Improvement Association, OMAFRA, and Our Food Future.

From the farmers' perspectives, the ways in which the County of Wellington could best support their farming practices and facilitate the adoption of regenerative farming relate to infrastructure improvements, education opportunities, grant awareness campaigns, marketing of local farms, tax incentives, and zoning laws changes.

Finally, based on the literature review and findings section of this report, it is recommended that the County of Wellington focus their efforts by (1) adjusting zoning laws, (2) attracting investments in internet accessibility, (3) implementing a farmer's market gift card program, (4) implementing tax incentives for farmer conservation efforts, and (5) developing a living resource for farmers.

This report may present limitations and bias because only 45 local farmers out of the 190 farmers included on the County of Wellington's Business Directory contributed towards this report. However, when contacted, some e-mails returned "Address not found" errors, some farmers indicated that they were no longer farming or that their farm was not located in Wellington County, and some listed farms did not have sufficient contact information. This indicates that the County of Wellington may not currently have 190 local farms, or that it is not possible to easily contact all farmers within the County. Alternatively, it is possible that some County of Wellington farmers are not listed on this directory, and there may be additional points of contact. Further, based on the nature of the survey, it is possible that our results demonstrated a greater proportion of farmers interested in regenerative farming than would accurately depict the County's farming community. Similarly, it is possible that the 25 farmer interviewees of the 45 survey respondents were more passionate about regenerative farming than the average survey respondent and were therefore willing to share their knowledge on the topic. As such, this report may not accurately depict all regenerative farming practices and viewpoints in Wellington County.

Despite these limitations, this report presents a collection of different paths which can inform the County's Smart Cities Office, while also contributing towards the County's Climate Change Mitigation Plan. This project defined regenerative farming, and captured what regenerative practices are being implemented locally, which practices

seem to be effective in the specific growing region, which practices are most easily adopted, and areas where incentives, subsidies, and support are needed. Additionally, this project provided a description of what is specifically being implemented in Wellington County, including who uses regenerative practices, what supports and barriers are in place, and who the local experts are. This report also developed an infographic to share key findings with members of the public and the County of Wellington. Finally, a network directory of practitioners (Appendix D) and experts (Appendix E) was created to provide information on who can continue to offer feedback and criticism as actions such as on-farm pilots emerge from these discussions, so that the County can engage and add knowledge in an iterative way in the future.

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Appendix A: Grant Directory

The following section is a resource for farmers in Wellington County to obtain more information on specific grants available to them, including the grant's main focus, the application period, the monetary value, and where to get more information.

Carrot Cache: The Carrot Cache grant is financed through proceeds from the Big Carrot grocery store in Toronto
Grant value: $500-$5000,
Focus: Carrot cache provides smaller grants up to $5,000 for small scale farmers who don't own land and are facing bottlenecks to scaling up their business, typically farmers in the first few years of growing. Carrot cache focuses on farmers who are typically not visible in farming and/or face systemic barriers.
Contact Information: Fill out information form at
https://www.carrotcache.com/general-contact
Application period: Twice a year

Friends of the Greenbelt: Friends of the Greenbelt is a charitable organization which is funded in part by the provincial government
Grant Value: Varies yearly
Focus: Mainly funds larger community-based projects which include farmers that focus on soil health, water quality, and other ecological factors. Friends of the Greenbelt is unable to fund individual farmers but can fund municipalities, commodity groups and conservation authority projects.
Contact Information: For information on grants contact **program@greenbelt.ca**
Application Period: Varies yearly, Spring and Fall minimum

Grand River Conservation Authority: Rural Water Program: The Rural Water Program is funded by the County of Wellington
Grant Value: $2,000- $25,000 based on the project, more information at https://www.grandriver.ca/en/our-watershed/Wellington.aspx
Focus: This grant is available to landowners who have an Environmental Farm Plan and helps to finance agriculture projects which improve and protect ground and surface water. Examples include cover crops, manure storage infrastructure, tree planting.
Contact information: 519-621-2761 or ruralwater@grandriver.ca
Application Period: Year-round depending on type of project may affect time of implementation

Ontario Soil and Crop Improvement Association: The Ontario Soil and Crop Improvement Association provides a grant funded by OMAFRA to support education and communication.
Focus: This grant provides educational and incentive programs on various topics related to regenerative practices, specifically focusing on best management practices related to soil health and crop quality. It provides two tiers of granting opportunities, based on scale and cost of project.
Grant value: Varies depending on scale of project
Contact Information: Andrew Graham – agraham@ontariosoilcrop.org OR 519-826-4216, For more information
https://www.ontariosoilcrop.org/association/association-membership/grants/
Application Period: Grants available on a first come first serve basis, annually

Appendix B: Additional Financial Support Directory

This section includes additional financial support options for farmers in Wellington County. While the following programs are not grants, farmers in Wellington County indicated that they were beneficial for their farming practices.

Fair Finance Fund- The Fair Finance Fund is an alternative/social finance fund that operates on trust and relationships rather than conventional lending practices. About 50% of the Fair Finance Fund's clients are farmers which many benefit from the REAL Assist Program.

The REAL Assist Program offers loan clients up to 10 free hours (or non-clients as a paid program) and provides them with assistance, support, and training. Areas of support include business development, financial management, marketing and branding, agriculture and food sector expertise, governance, and policy development.

Farmers that are denied loans by other financial institutions due to a lack of understanding about the model, size, lack of experience or no land to put up as security are often eligible for the Fair Finance Fund.

For more information
https://www.fairfinancefund.org/real-assist-program

Green Legacy Program- With the Green Legacy Program, farmers or landowners can request trees at no cost through Wellington County of Wellington's online application. These trees can be used as natural windbreaks to help prevent erosion, create wildlife habitats and other benefits.

For more information
https://www.wellington.ca/en/discover/greenlegacyprogramme.aspx

Appendix C: Current Support Options

Farmers in Wellington County have recommended the following sources as locations they trust to find support:

Credit Valley Conservation

Focus: Credit Valley Conservation (CVC) is a community-based organization that focusses on protecting, restoring, and managing natural resources within the Credit River Watershed. The CVC supports their community through conservation planning, land stewardship, environmental monitoring and inventory, environmental education, source water protection, mitigating and adapting to climate change.
Phone Number: (905) 607-1615 or 1-800-668-5557
Email: stewardship@cvc.ca
Website: https://cvc.ca

Dairy Farmers of Ontario

Focus: Dairy Farmers of Ontario is a marketing group that represents dairy farmers in Ontario. Common resources on their website that farmers regularly utilize are farming technologies, improving environmental sustainability, regulatory procedures, and animal care recommendations.
Phone Number: (905) 821-8970
Email: questions@milk.org
Website: https://new.milk.org

Grain Farmers of Ontario

Focus: Grain Farmers of Ontario is the province's largest commodity organization representing approximately 28,000 Ontarian farmers. The topics highlighted include agronomy, government relations, research, market development, and farmer wellness.
Phone Number: (519) 763-3342
Email: info@gfo.ca
Website: https://gfo.ca

Grand River Conservation Authority

Focus: Grand River Conservation Authority (GRCA) is responsible for managing water and other natural resources on behalf of 39 municipalities. Their resources are focused on supporting programs related to reducing flood damages, improving water quality, maintaining reliable water supplies, protecting natural areas and biodiversity, providing environmental education, and managing other environmentally sensitive lands.
Phone: (519) 621-2761
Email: grca@grandriver.ca
Website: https://www.grandriver.ca/en/index.aspx#

Maitland Valley Conservation Authority

Focus: Maitland Valley Conservation Authority (MVCA) is a community-based organization dedicated to improving local water, forest and soil conditions. MVCA provides effective community-based conservation services to municipalities, landowners and community organizations in a cost-efficient manner.
Phone Number: 519-335-3557
Email: maitland@mvca.on.ca
Website: http://www.mvca.on.ca/

OMAFRA

Focus: The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website holds a significant quantity of information related agricultural practices in Ontario. This resource includes background information on farming techniques, ministry initiatives, programs and funding resources, and reliable information on popular farming topics. Farmers in Wellington County have stated that they find OMAFRA's booklets on-farm best practices to be particularly beneficial.
Phone: (519) 826-3100
Email: about.omafra@ontario.ca
Website: http://www.omafra.gov.on.ca/english/

Ontario Farmer
Focus: The Ontario Farmer publishes magazines that highlight issues and opportunities that are relevant to farmers in Ontario.
Phone Number: 1-877-358-777
Email: ontariofarmer.editorial@postmedia.com
Website: www.ontariofarmer.com

Ontario Soil and Crop Improvement Association
Focus: Ontario Soil and Crop Improvement Association (OSCIA) is a not-for-profit farming organization that represents all commodity groups across the province. Wellington farmers particularly find the Environmental Farm Plan to be their most useful resource.
Phone: (519) 826-4214
Email: oscia@ontariosoilcrop.org
Website: https://www.ontariosoilcrop.org

Ontario Soil Network
Focus: The Ontario Soil Network supports farmers interested in tropics related to soil health. Farmers can learn from one of their farmer mentors or apply to be soil health mentor themselves.
Email: admin@ontariosoil.net
Website: https://ontariosoil.net

Wellington Advertiser
Focus: The Wellington Advertiser is a resource that highlights community news and local opportunities that are relevant to their readership, often spotlighting agriculture.
Phone: (519) 843-5410
Email: editor@wellingtonadvertiser.com
Website: https://www.wellingtonadvertiser.com

Appendix D: Farmer Directory

This section is a resource for farmers in Wellington County to connect with local farmers in the County. The listed farms kindly provided their contact information through a survey. The directory's purpose is to support information sharing and connectivity between farmers.

Farm Name	Farmer	Focus	Contact
3 Gen Organics	Brett Israel	Organic pork, corn, and wheat	bisrael@3genorganics.ca
All Sorts Acres Farm	Jennifer Osborn	Grass-based sheep dairy, pastured eggs, chickens, apiculture, land-based art supplies	allsortsacres@gmail.com
Brae Ridge Farm & Sanctuary	Penny Burton	Alpacas, ducks, lavender, garlic, maple syrup	penny@braeridgefarm.com
Cassie Maple Products	Doug Cassie	Maple products and cover crops (corn, winter wheat, soybeans)	dougcas@kw.igs.net
Chickadee Christmas Trees	Alison McCrindle	Christmas trees	chickadeetrees@sympatico.ca
Chicken Thika Farm	Bahaar Luhar and Shaheer Abha	Poultry, produce	chickenthikafarm@gmail.com
Clovermead Farms Inc.	Bruce Whale	Dairy and feed	whalebruce@gmail.com
Coyote Hollow Farms	Steve Tedesco	Organic fruit/vegetables, chickens for eggs	coyotehollowfarms@xplornet.ca
Elliot Tree Farm	Derek Elliot	Christmas trees	info@elliotttreefarm.ca
Four Boys Flower Farm	Janette Drost	Organic, no-till flowers	flowers@fourboys.ca

Farmer Directory (cont.)

Farm Name	Farmer	Focus	Contact
Gamble Farms	Kip Gamble	Pasture cattle and microgreens	kip.gamble@hotmail.com
Green 365	Colin McVicker	Hydroponic greens	colin@gr365n.com
Heartwood Farm & Cidery	Val Steinmann	Pastured beef cattle, mixed fruit and nut orchards, maple syrup	val@heartwoodfarm.ca
Hoppy Fields Farm	Thomas Radcliffe	Organic vegetables, hay, pastured livestock (broilers, laying hens, ducks, sheep, pork, turkey)	tj@hoppyfieldsfarm.com
Huber Farm Heritage Meats	Robert Huber	Cow/calve to market, swine farrow to finish, small flock chicken, feed	robert.huber101@gmail.com
Jones Family Greens	Matt Jones	Ecologically-grown mixed vegetables	jones_matt@rogers.com
Lau-tea-da Lentils	James Ferrier	Lentils, corn, soy, wheat, hay	ontariolentils@gmail.com
Mapletwiss Farm	Amanda Twiss	Pasture pigs, turkey, cows, chickens, hay and grain (feed)	mapletwissfarm@outlook.com
Pootcorners Alpacas	Suelaine Poot	Alpacas (products and meat)	smpoot@hotmail.com
REC Farms	Richard Booy	Beef, chicken and crops	recfarms@gmail.com
Rothwell Family Farm and Apple Orchard	Terry (Terence) Rothwell	Fruit (apples)	rothwellfamilyfarm@gmail.com
Silver Creek Aquaculture Inc.	Lou Maieron	Aquaculture, aquatic crops and organic vegetables	fish@silvercreekponds.com
Stonewell Farm	LeeAnne Downey	Alfalfa/timothy blend, lavender	hello@stonewellfarm.ca

Farmer Directory (cont.)

Farm Name	Farmer	Focus	Contact
Terra Verde Homestead	Lorraine Blackwell	Pastured pork, chickens, annual vegetables, perennial fruit	info@terraverdehomestead.com
The Pfisterer Farm	Jessica Pfisterer	Pasture poultry, pork, beef, beans/wheat, hay	pfistererfarm@gmail.com
Timberline Farm	Jared James	Grass-fed beef	jared@timberlinefarm.ca
W&T Mushroom LTD	Natalie Jaroszewski	Mushrooms	natalie@wtmushroom.ca
Winterhill Farm and Garden	Nathan Smith	Cows, chickens, eggs, mixed vegetables	winterhillfarm@yahoo.com
Wrighthaven Farms LTD	Stuart Wright	Dairy and cash crops	cswright2003@yahoo.ca

Farmer Directory Locations

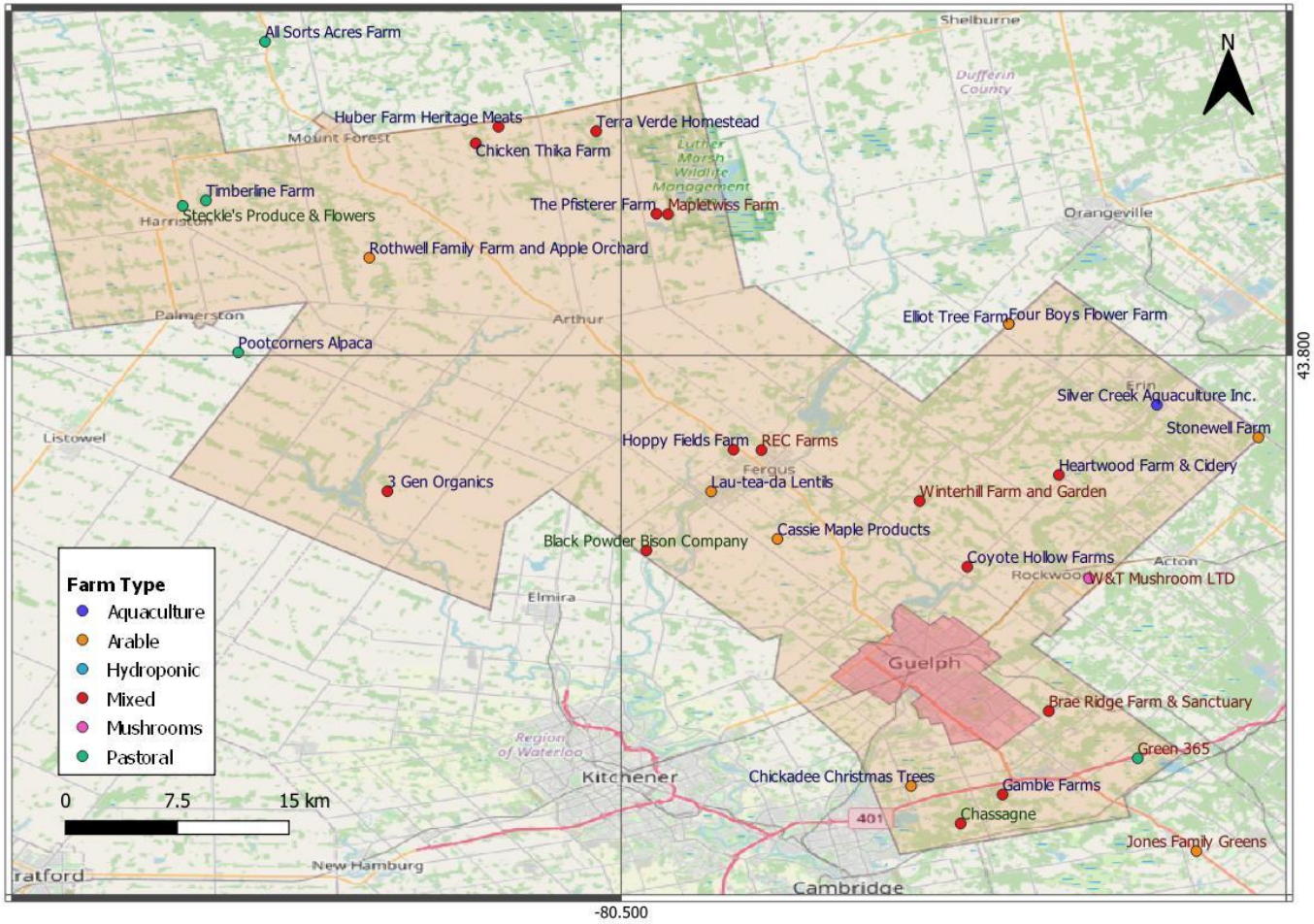

Figure 16. Map indicating the locations of Wellington County farmers included on the farmer directory and/or interviewed.

Blue labels are assigned to farms who are listed on the directory and were interviewed. Red labels are assigned to farms who are listed on the directory but were not interviewed. Green labels are assigned to farms who were interviewed but indicated they did not want to be included on the directory. Clovermead and Wrighthaven are not indicated on this map due to lack of available location information.

Appendix E: Organization Directory

The following section is a resource for farmers in Wellington County to obtain more information on agricultural organizations and grant agencies which are available to support farmers looking to adopt regenerative farming practices.

Organization	Contact Name	Position	Contact Email
Carrot Cache Fund	Kristin Wheatcroft	Grants Coordinator	kristin@carrotcache.com
Clean Field Services	Gary Van Ankum	Nutrient Management Specialist	garyva@cleanfield.biz
Credit Valley Conservation	Mark Eastman	Senior Coordinator, Agricultural Outreach	mark.eastman@cvc.ca
Fair Finance Fund	Dr. Sally Miller	Project Manager	sally@fairfinancefund.org
Grand River Conservation Authority	Louise Heyming	Supervisor of Conservation	lheyming@grandriver.ca
Greenbelt Foundation	Thomas Bowers	Senior Manager, Research and Policy	tbowers@greenbelt.ca
Green Legacy Programme	Rob Johnson	Manager	robj@wellington.ca
Innovation Guelph	Christopher Coghlan	Program Manager, Circular Food Economy Innovation Hub	christopher.coghlan@innovationguelph.ca
OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs)	Andrew Barrie	Environmental Specialist	andrew.barrie@ontario.ca

Appendix F: Qualtrics Survey

The following survey was e-mailed to 190 farmers, whose contact information was obtained from the Wellington County Business Directory. 45 responses were received.

Farming Practices in Wellington County

The purpose of this study is to gain a more comprehensive understanding of farming practices in the County of Wellington. The data collected will inform the County to determine whether there are municipal barriers that should be addressed and how agricultural businesses can be best supported.

Which municipality in the Guelph-Wellington area is your farm located in?

- Town of Centre Wellington
- Township of Wellington North
- Township of Puslinch
- Town of Erin
- Township of Guelph/Eramosa
- Township of Mapleton
- Town of Minto
- Other (please specify)

How would you describe your farming practices?

- Arable (crops) (please specify)
- Pastoral (animals) (please specify)
- Mixed (crops and animals) (please specify)
- Other (please specify)

Of the acres you worked during the last growing season (2020), how many acres do you own and how many acres do you rent?

*Please note: This question will be used to determine if farming practices vary on rented versus owned land.

Acres owned (in numbers)

Acres rented (in numbers)

How many years have you been farming the land you worked during the last growing season (2020)?

Year(s)

Do your farming practices differ on rented versus owned land (e.g., irrigation, tillage, nutrient/pest management, cropping techniques, etc.) ?

- ○ Yes (please describe)
- ○ No
- ○ Does not apply

The following are statements regarding farming in the County of Wellington. Please indicate your opinion about the following statements using the scale below.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I don't know
The County of Wellington is supportive towards the agricultural sector.	○	○	○	○	○	○
I feel that there is adequate local support (e.g., financial, coaching, mentorship) for farmers.	○	○	○	○	○	○
I have felt the impacts of the changing climate on my farming practices.	○	○	○	○	○	○
I have changed or have considered changing my farming practices in the last 5 years to adjust with the changing climate	○	○	○	○	○	○

Have you received any support (e.g., financial, coaching, mentorship, etc.) for any of the following farm/soil health improvements? Please check all applicable answers.

- ☐ I have not received support
- ☐ Agroforestry
- ☐ Companion planting
- ☐ Cover crops
- ☐ Crop rotations
- ☐ Manure storage
- ☐ Rotational grazing
- ☐ Reduced tillage
- ☐ Stormwater ponds
- ☐ Wind breaks
- ☐ Other (please specify)

If you have received support (e.g., financial, coaching, mentorship, etc.) for farm/soil health improvements, please indicate which organization(s) provided the support.

*Please note: This question will be used to determine the organizations that have historically shown support to farmers.

- ○ Organization Name(s)
- ○ I prefer not to answer
- ○ I have not received support

How would you describe your interest in the following farming practices?

	Not at all interested	Not interested	Neutral	Interested	Very interested	I don't know
Regenerative farming	○	○	○	○	○	○
Climate friendly farming	○	○	○	○	○	○

We are interested in speaking with local farmers via telephone/video calls. Would you be interested speaking with us? If yes, please enter your contact information below.

- ☐ Your Name
- ☐ Your Farm's Name
- ☐ Email
- ☐ Phone Number
- ☐ I would like to be added to the County of Wellington's directory of farmers, as a possible contact for future projects (e.g., mentorships, interviews, surveys, etc.).
- ☐ I prefer to not disclose my contact information

Appendix G: Raw Survey Data

The following section contains raw data from the survey that was e-mailed to 190 farmers, whose contact information was obtained from the Wellington County Business Directory. 45 responses were received.

Table 1. Wellington farmer respondents' perceptions of local support towards the agricultural sector.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I don't know	Total responses
The County of Wellington is supportive towards the agricultural sector.	1 (2.22%)	7 (15.56%)	11 (24.44%)	18 (40.00%)	2 (4.44%)	6 (13.33%)	45 (100%)
I feel that there is adequate local support (e.g., financial, coaching, mentorship) for farmers.	2 (4.44%)	16 (35.56%)	14 (31.11%)	7 (15.56%)	0 (0%)	6 (13.33%)	45 (100%)

Table 2. Wellington farmer respondents' perceptions of climate change impacts on farming practices.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I don't know	Total responses
I have felt the impacts of the changing climate on my farming practices.	2 (4.44%)	4 (8.89%)	16 (35.56%)	13 (28.89%)	10 (22.22%)	0 (0%)	45 (100%)
I have changed or have considered changing my farming practices in the last 5 years to adjust with the changing climate.	2 (4.44%)	6 (13.33%)	6 (13.33%)	22 (48.89%)	9 (20.00%)	0 (0%)	45 (100%)

Table 3. Personal interests of Wellington farmer respondents towards regenerative farming and climate friendly farming.

Statement	Not at all interested	Not interested	Neutral	Interested	Very interested	I don't know	Total responses
Regenerative farming	0 (0%)	2 (4.44%)	8 (17.78%)	7 (15.56%)	26 (57.78%)	2 (4.44%)	45 (100%)
Climate friendly farming	0 (0%)	2 (4.44%)	5 (11.11%)	13 (28.89%)	24 (53.33%)	1 (2.22%)	45 (100%)

Table 4. Geographic distribution of farmer respondents within Wellington County.

Town of Erin	Town of Centre Wellington	Township of Guelph/Eramosa	Township of Puslinch	Township of Mapleton	Town of Minto	Township of Wellington North	Other	Total responses
6 (13.33%)	9 (20.00%)	8 (17.78%)	6 (13.33%)	3 (6.67%)	2 (4.44%)	9 (20.00%)	2 (4.44%)	45 (100%)

Table 5. Types of farms worked by farmer respondents within Wellington County.

Arable (crops)	Pastoral (animals)	Mixed (crops and animals)	Other	Total responses
10 (22.22%)	6 (13.33%)	21 (46.67%)	8 (17.78%)	45 (100%)

Table 6. Total years that farmland was operated by survey respondents in the last growing season (2020).

Years	Number of responses (Percentage)
1 – 5	18 (40.91%)
6 – 10	6 (13.64%)
11 – 15	4 (9.09%)
16 – 20	2 (4.55%)
21 – 25	2 (4.55%)
26 – 30	3 (6.82%)
31 – 35	3 (6.82%)
36 – 40	2 (4.55%)
41 – 45	3 (6.82%)
46 – 50	0 (0%)
51 – 55	1 (2.27%)
TOTAL	44 (100%)

Table 7. Comparison of acres owned versus acres rented by farmer respondents in the last growing season (2020).

Acres owned	Acres rented	Total responses
4,658.67 (64.38%)	2,577.50 (35.62%)	44 (100%)

Table 8. Percentage of respondents that have implemented regenerative farming practices with external supports.

Regenerative farming practice	Number of responses (Percentage)
I have not received support	30 (40.00%)
Agroforestry	5 (6.67%)
Companion planting	3 (4.00%)
Cover crops	9 (12.00%)
Crop rotations	4 (5.33%)
Manure storage	1 (1.33%)
Reduced tillage	4 (5.33%)
Rotational grazing	4 (5.44%)
Stormwater ponds	0 (0.00%)
Windbreaks	5 (6.67%)
Other [1]	10 (13.33%)

[1] Other regenerative farming practices include composting manure, bale grazing, invasive species removal and greenhouse extension.