Seeds of Sustainability: An Analysis of Small-Scale Commercial Seed Producers in Ontario

By

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ABSTRACT

Food and agriculture are an important part of Ontario's economic and social identity. Seeds are some of the most basic and important inputs of these systems, both in Ontario and globally. Despite this, there is a noticeable lack of research on seeds within Ontario that does not focus solely on their economic importance. Thus, this study aims to fill a gap in current food systems research by identifying the demographic characteristics of small-scale commercial seed producers in Ontario, their values and motivations, and areas of future concern and opportunity. Through (1) an anonymous electronic survey and (2) content analysis of the websites of 23 small-scale commercial seed producers, this study found that these producers are largely guided by relational values, or values that they hold due to their responsibilities to, and relationships with, other people and the environment. Specifically, these producers are largely motivated by a desire to promote sustainable agriculture, which they action through the production of seeds that are organic, non-genetically modified, and open-pollinated. Furthermore, this study revealed that while current challenges to seed production vary significantly, these producers overwhelmingly anticipate that environmental challenges, such as periods of drought and warming summers, will become the greatest challenge to their production within the next ten years. These findings highlight the need for further research into the unique role, values, and challenges held and experienced by small-scale commercial seed producers in Ontario; the lack of pre-existing literature on this topic makes it difficult to contextualize and understand how the experiences of small-scale commercial seed producers in Ontario differ from their larger counterparts.

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CHAPTER 1: INTRODUCTION

1.1 Situating myself

Within research, positionality, or the worldview of the researcher and the position they adopt in respect to their research project and its social and political context, influences every phase of the research process (Coghlan & Brydon-Miller, 2014; Holmes, 2020). As Holmes (2020) notes, the positionality of a researcher affects both how the research is conducted, its outcomes, and its results. In an effort to be as transparent as possible about the relationship between my positionality and the following research, I would like to reflect on my own positionality.

I come from a background in conventional agriculture – my mother is a sheep farmer and my father is a dairy farmer. For the past two summers, I have worked as a seed intern for a small-scale organic commercial seed producer in Southeastern Ontario. Additionally, I have also volunteered for and cultivated relationships with individuals at the National Farmers Union (NFU) and the Ecological Farmers Association of Ontario (EFAO). In the summer of 2022, with the support of my mentors at Kitchen Table Seed House, I also attended the Student Organic Seed Symposium, a gathering of students, researchers, farmers, and seed industry professionals working in the organic seed sector, in Morgantown, West Virginia. As Coghlan & Brydon-Miller (2014) note, an important aspect of positionality is the researcher's relationship to the community engaged in the inquiry. The experiences outlined above allowed me to approach this research on small-scale commercial seed producers in Ontario as an insider working in collaboration with other insiders (Coghlan & Brydon-Miller, 2014). Importantly, however, I must acknowledge the limitations of my experience and familiarity with the seed sector in Ontario. Though my experience working as an intern at a seed operation was hugely informative, I still have much to learn and do not claim to understand the breadth and depth of the experiences of seed producers across Canada.

1.2 Why seeds?

The importance of seeds cannot be overstated – in a world in which the global population is expected to reach nine billion by 2050 and total global food demand may increase by more than 35%, seeds are the foundation of food production (Dijk et al., 2021; Helicke, 2015). The origins of agriculture began when humans began collecting, selecting, and planting seeds, making seeds the most basic and important input of agriculture and inextricably linking food security and seed security (Alliance for Food Sovereignty in Africa [AFSA], 2018; Hampton et al., 2016; Maity & Pramanik, 2013). From a biophysical perspective, seeds are important carriers of valuable genetic information that allow humans to adapt and respond to biophysical challenges (Breen, 2015; Helicke, 2015). Importantly, however, seeds are also an important part of humanity's cultural heritage – documentation exists of seed-saving practices dating back 13,000 years, meaning that the plant genetic material we know and utilize today were shaped by social, cultural, and environmental practices around the world (Montúfar & Ayala, 2019). Seeds, therefore, represent thousands of years of careful selection and adaptation whose histories and futures are inextricably intertwined with those of humans (Philips, 2013; Puglisi, 2021).

1.3 The importance of seeds within Ontario

Food and agriculture are an important part of Ontario's identity. Ontario holds the largest concentration of farms and farm operators (25.5%) in Canada and in 2021 had more than 11.8 million acres in agricultural production (Chen, 2022). Seeds are the starting point of any agricultural system, including Ontario's, and the crop genetic resources they contain allow humans to adapt to current and future environmental challenges (Breen, 2015; Brooks et al., 2022; Helicke, 2015). The seeds saved and produced by seed producers, also referred to as "seed growers," in what is now called Ontario have a long history – one that extends far

before the colonization of Turtle Island in the 17th century (Butzer, 2002). Long before European settlers first arrived in Canada in the 1500s, Indigenous groups such as the Anishinaabe and Haudenosaunee saved, protected, cherished, and traded seeds (Brant, 2020; Post, 2016). The Kanienkehá:ka, or Mohawk, creation story illustrates the importance of seeds within their culture (Kontinonhstats, 2017). According to the creation story, when Atsi'tsaká:ion, or Sky Woman, fell through the hole in the skyworld she brought with her seeds from the roots of and around the Tree of Life (Kontinonhstats, 2017). When Atsi'tsaká:ion landed on a turtle's back, she informed the animal kin around her that she needed land, or soil, around her in order to survive and help other nourishments, such as the seeds in her pockets, to grow (Kontinonhstats, 2017). One by one the animals dove down into the water to get dirt for her, until finally Anó:tien, or the muskrat, succeeded in bringing a few grains of dirt to Atsi'tsaká:ion (Kontinonhstats, 2017). Atsi'tsaká:ion placed the seeds into the dirt and danced and sang, causing the turtle's shell to grow and creating land and plant life everywhere (Kontinonhstats, 2017). It is from the seeds of the Tree of Life, therefore, that the land we now call North America, and was originally known as Turtle Island, emerged (Kontinonhstats, 2017).

Despite the ongoing and historical importance of seeds within Canada, there is a noticeable lack of research on seeds within Ontario that does not focus solely on their economic importance (Mussell & Rajcan, 2013). As Brooks et al. (2022) note, the seeming disregard of the importance of seeds beyond their economic role may in part be a result of the domination of the global seed market by only a handful of commercial companies. In 2011, for example, the ETC Group reported that the ten largest commercial seed companies in the world controlled 73% of the global formalized seed market. In recent decades, however, organizations like the Bauta Family Initiative for Canadian Seed Security, SeedChange, and the Ecological Farmers Association of Ontario have emphasized the need for further research

on existing seed systems within both Ontario and more broadly in Canada (Bauta Family Initiative for Canadian Seed Security [Bauta], 2020b). Within Ontario, there exists a particular lack of information on the network of small-scale commercial seed producers. While these producers, who are also referred to as "seed growers," represent only a small portion of the larger commercial seed market in Ontario, they often offer seeds that are specifically adapted to regional growing conditions and cannot be found elsewhere (SeedChange, 2020; Vásquez, 2017). As Levert (2014) notes, the lack of information on small-scale commercial seed producers in Canada, as well as the lack of local analyses to identify possible areas of growth, are viewed as major obstacles to growth for small-scale commercial seed producers.

1.4 The importance of small-scale seed producers within a globalized seed sector

In Canada, the seed industry is highly regulated by governmental agencies, making farmers dependent on seeds sourced from formal sources (i.e., commercial seed companies) (Seed Synergy Collaboration Project, 2018). The formal seed sector in Canada is largely composed of larger scale, often international, seed companies that source their seed internationally (Bauta, 2012). As previously noted, only a handful of commercial seed companies control the majority of the global seed market – the United Nations note that only four agrochemical companies control 60% of the global seed market and 75% of the global pesticides market (Fakhri, 2022). The concentration of power and market monopoly by commercial companies within the seed sector, as well as the broader global industrial food system, can make farmers dependent on a complex and vulnerable network of international suppliers for their seeds, which are the primary, and arguably most important, input of their agricultural production (Bauta, 2020b; Dey & Hughes, 2021). The vulnerability of this globalized system was illustrated by the COVID pandemic, in which both farmers and

consumers alike experienced significant supply chain disruptions (Clapp, 2022; Fakhri, 2022). Moreover, this high concentration of corporate power within both the seed sector and the wider agricultural system allows a relatively small group to control access to seeds and, as Fakhri (2022) notes, to shape markets and innovations to prioritize shareholder profit maximization rather than the public good.

Although small-scale commercial seed producers represent only a small portion of the formalized seed sector in Canada, reports conducted in British Columbia, Nova Scotia, and Newfoundland in recent years identified and emphasized the importance of small-scale commercial seed producers in these areas and offered recommendations to support the growth of localized seed systems (FarmFolk CityFolk, 2021; Jamieson, Hughes, & Knezevik, 2016; Worden-Rogers et al., 2019). The importance of small-scale seed producers include their ability to link both formal and informal seed systems and to represent the needs of smallholder farmers while still conforming to the requirements of the formalized seed sector (Neate & Guei, 2010). Compared to their larger counterparts, small-scale commercial seed producers also tend to offer more diverse seed offerings specifically adapted to local conditions that meet the specific demands of local growers (Dey & Hughes, 2021; Gerber, 2022; Worden-Rogers et al., 2019).

1.5 Definition of small-scale commercial seed producers

Within the context of this study, **small-scale commercial seed producers** refers to seed producers within Ontario who sell seeds commercially, part of which they have grown themselves *in Ontario*. These producers must offer and grow more than one plant variety, rather than specializing in a single crop. Producers who solely distribute seed from other sources, rather than growing their own seed crop for commercial sale, were excluded from the study population. Producers who grow their own crops, but do so outside of Ontario, were

also excluded. The study population therefore included producers who are based within Ontario and produce seed specifically for Ontario's climate.

1.6 Research Questions:

1. Who are the small-scale commercial seed producers in Ontario and where are they located?
2. What are the values and motivations of small-scale commercial seed producers in Ontario?
3. What are the areas of concern, opportunity, and growth for small-scale commercial seed producers across Ontario?

This study aims to bridge a gap in current food systems research within Ontario by identifying the small-scale commercial seed producers who currently operate within Ontario. Specifically, by examining the particular goals, values, and motivations that small-scale commercial seed producers in Ontario share, this study hopes to identify areas of opportunity, potential growth, and concern for small-scale seed producers within Ontario's larger seed system.

CHAPTER 2: LITERATURE REVIEW

This literature review first explores the differences between formal and informal seed systems in an attempt to situate small-scale commercial seed producers within this context. In addition to providing a broad overview of Canada's current seed system, I will briefly summarize what is known about the demographics of commercial seed producers in Canada and the major identifiable differences between small and large scale commercial seed producers. In order to situate the role and dominant characteristics of small-scale commercial seed producers, I will also introduce the concept of locally adapted seeds and the importance of plant genetic diversity within our food and agriculture systems. Finally, I will distinguish between hybrid, open-pollinated, and heirloom seed varieties and explain their importance.

2.1 Conceptual framework: Values and motivations

The study of values and motivations within research is a broad area. As a result, this brief overview of values and motivations aims only to provide enough context and overview to understand the analysis of values and motivations of small-scale commercial seed producers in Ontario included in the results and discussion section. As Levontin & Barid (2019) note, values are "broad motivations that can serve as the basis for goals" (p. 1). Thus, values and motivations are inextricably connected and inform and shape the actions that individuals take (Levontin & Barid, 2019).Within this study, the two terms are often used in tandem to analyze and explain the defining goals these small-scale commercial seed producers share.

Studies examining the values and motivations of participants within environmental or agricultural studies typically assess three different types of values: i) intrinsic values, or those that believe in the value of things in and of themselves (e.g. seeds have value in themselves,

independent on human values); ii) instrumental values or those that endow value based on its utility to us (e.g. seeds have value for us because they produce food for humans to eat); and iii) relational value or values that people hold as a result of their responsibilities to, and relationships with, other people and the environment (e.g. seeds have value because they can improve food insecurity within my community) (Isbell et al., 2021; Mattijssen et al., 2020; Tobin, 2022). Given the complex and evolving nature of humans' relationships with the environment, researchers in the past have argued that instrumental and intrinsic values are too narrow to adequately describe and encompass humans' relationship with nature (Chan, 2018). This led to the emergence of relational values within recent environmental and agricultural research, therefore, as a lens through which to understand the ethical principles that may cultivate environmental stewardship (Schulz & Martin-Ortega, 2018). Importantly, however, while relational values can fill the gap left by the antagonism between intrinsic and instrumental values, all three values fulfill distinct functions that can aid in our understanding of the distinct values that underlie small-scale commercial seed producers motivations to produce seed (Ching See et al., 2020).

An examination of previous studies of small-scale seed producers and savers offer some insight into the types of values and motivations that guide the actions of these individuals. Recent studies conducted by Tobin (2022) and Baxley et al. (2020) found that the values and motivations of small-scale seed producers in Vermont tended to be either relational or instrumental. This is supported by further studies conducted by Jones and Tobin (2018) who argued that instrumental and relational values are more prevalent within agriculture than intrinsic values. In a survey of small-scale seed producers in Vermont, Baxley et al. (2020) asked respondents to rate the importance of a set of given values in motivating their seed producing activities on a scale from 1 (not important at all) to 5 (very important). They found that most producers were motivated by instrumental values rather

than relational values; examples of these instrumental values included the desire to produce food for their own home consumption (average rating of 4.78) or to produce seeds for their farm or garden (average rating of 4.69) (Baxley et al., 2020). The results of these studies offer some insight into the types of guiding values and motivations that small-scale seed producers and savers hold. Importantly, however, it must be noted that the contexts of these studies (Vermont) are distinct from the context (Ontario) of this study. Not only are Vermont and Ontario located within separate countries, but the biophysical, legal, and sociocultural backgrounds of each of these settings are unique. Thus, the values noted as of import by small-scale seed producers and savers in Vermont must not be indiscriminately applied to small-scale commercial seed producers in Ontario.

2.1 Formal vs. informal seed systems

Seed systems refer to the network of production, saving, exchanging, and selling of seeds within a specific place (SeedChange, 2020; Wattnem, 2014). These systems are commonly divided into two categories: "formal" seed systems that are heavily regulated and composed of public institutions and private industries that rely on modern scientific plant breeding, and "informal" systems (commonly referred to as "farmers' seed systems") that are largely unregulated and depend on the knowledge and experience of farmers (Vásquez, 2017; Wattnem, 2014). The seeds produced within the formal seed system belong to a narrow genetic base composed of a few cultivated species that are highly regulated by legislation (Vásquez, 2017; Wattnem, 2014). In contrast, the seeds within the informal seed system tend to be highly localized, bred, and selected by communities to meet their particular climatic conditions, food preferences, and cultural needs (SeedChange, 2020; Vásquez, 2017). As noted by the FAO's Commission on Genetic Resources for Food and Agriculture (2011), the relative importance of these two systems within a society depends on the state of

development of its agricultural system and crops. Within the Global South, for example, depending on the crop, informal seed systems contribute 80 to 90% of farmers' seed requirements (Mooney, 2017; SeedChange, 2020). Conversely, in countries with highly regulated and developed agricultural systems like Canada, the vast majority of seeds comes from the formal seed system (Seed Synergy Collaboration Project, 2018).

As Louwaars (2002) notes, this distinction between "formal" and "informal" seed systems is relatively recent, as seed only became the focus of increased regulation and agricultural policy work during the Green Revolution in the 1960s. It was at this time that seed became recognized by modern industrial agriculture not as a source of common cultural heritage and a freely shared resource, but rather as a commercial product to be regulated, commodified, and exploited (Breen, 2015; Louwaars, 2002; Wattnem, 2014). Though informal and formal seed systems are often distinguished from each other, it is important to note that the two can overlap (Wattnem, 2014). The benefits of small-scale seed producers therefore include this ability to link both formal and informal seed systems and to represent the needs of smallholder farmers while still conforming to the requirements of the formalized seed sector (Neate & Guei, 2010).

2.2 Canada's seed system

Given that there is a lack of seed system research specific to Ontario, the following information provides an overview of the larger-scale context of the seed system in Canada. Canada's seed system is largely dominated by the formal seed sector (Canadian Seed Institute, 2017). Seed producers in Canada represent only one role within the larger formalized seed system in Canada. Other key actors within the formalized seed system in Canada include plant breeders, seed conditioners, seed distributors and retailers, and farmers

(Government of Canada, 2019). Given that seed producers are considered to represent only one aspect of the larger seed system in Canada, little research focuses exclusively on the importance and needs of these producers (Levert, 2014). Instead, seed producers are often considered in tandem with the other key actors identified above (plant breeders, seed conditioners, etc.). Pre-existing literature and research on Canadian and Ontario-specific seed systems tends to focus heavily on their economic importance and role within Canada's larger agricultural system and economy (Government of Canada, 2019; JRG Consulting Group & SJT Solutions, 2018). This makes it difficult to identify the extent to which the demographics of Canada's commercial seed producers vary, in terms of scale, values, motivations, as well as needs.

2.2.1 Small vs. large-scale commercial seed producers

What little research exists on commercial seed producers in Canada suggests that the demographics of commercial seed producers vary widely. A profile of the Canadian Seed Sector in 2019, for example, found that the average size of seed producing farms, including monoculture seed operations, was 381 acres (Government of Canada, 2019). This is in stark contrast to the findings from a study of small-scale seed producers in British Columbia that found that the vast majority (72%) produce seed on less than an acre of land (Goodall, 2014). The capacities and offerings of commercial seed producers in Canada also vary widely (Glasgow et al., 2016; Levert, 2014; Phillips, 2008). Large-scale commercial seed producers tend to focus on the production of high-value hybrid crops, such as corn or soybeans, that meet the needs of high-demanding customers, such as industrial farmers (Neate & Guei, 2010). These producers tend to avoid open-pollinated crop varieties, which may be saved and

reused by farmers and growers (Neate & Guei, 2010).[1] Conversely, the intense resources and inputs required to produce hybrid varieties means few small-scale commercial seed producers offer them (Neate & Guei, 2010; Steiner, 2008). Instead, most small-scale commercial seed producers offer varieties that are open-pollinated, or varieties produced through natural pollination (e.g. wind or animal pollinators) that require less labour and resources to produce (CABI, 2014; Steiner, 2008).

In 2011, the average size of census farms in Canada was 778 acres (Statistics Canada, 2011). Given that the majority of small-scale commercial seed producers produce seeds on less than an acre of land, as noted by FarmFolk CityFolk's 2014 BC-based seed producer survey (Goodall, 2014), they are often limited in the quantity of seed they can offer and unable to provide the bulk quantities of seeds required by average farmers (Goodall, 2014; Levert, 2014). This restricts the customer base of small-scale commercial seed farmers to home and market gardeners (Glasgow et al., 2016; Levert, 2014; Phillips, 2008). Given that regional and small-scale producers cater to a smaller customer base than larger-scale, often international producers, they have the unique capacity to respond to the particular needs of local growers (Worden-Rogers et al., 2019). Regional and small-scale seed producers therefore often offer seeds that are specially adapted to local growing conditions and reflect the needs of local growers, thereby strengthening the adaptive capacity of the seed and agricultural systems in which they are situated (Dey & Hughes, 2021; Gerber, 2022; Worden-Rogers et al., 2019).

In recent years, organizations like FarmFolk CityFolk and the Bauta Family Initiative on Canadian Seed Security, as well as researchers from the University of Vermont, have conducted regional studies of seed producers and/or savers in their area (Bauta Family

[1] It should be noted that this distinction between hybrid and open-pollinated seed varieties will be further discussed in later sections of this literature review.

Initiative on Canadian Seed Security, 2012; Baxley et al., 2020; FarmFolk CityFolk, 2014). While these studies provide some context for future studies of seed producers and/or savers (such as this one), caution must be applied when attempting to extrapolate the results of these studies outwards given the diverse contexts of these studies. While these studies may represent their local demographic (i.e., seed producers in British Columbia or Vermont), the conclusions of these studies must not be universally applied to the context of this study given the differences in population, geography, and more that exist between them. In British Columbia, for example, 62% of the total geographic area of the province experiences a growing season that is 140 days or longer (Agriculture and Agri-Food Canada, 2018a). Conversely, in Ontario the average growing season is much shorter – almost 72% of the total geographic area of the province has a growing season that is 140 days or less (Agriculture and Agri-Food Canada, 2018b). Production of seeds in these areas is therefore region-specific, conforming to the unique conditions of these areas – hence all the more reason data specific to Ontario seed producers should exist.

2.3 Locally adapted seeds

As previously noted, small-scale commercial seed producers often offer seed varieties that are specifically adapted to local growing conditions (Dey & Hughes, 2021; Gerber, 2022; Worden-Rogers et al., 2019). Locally adapted seeds are those seeds that are adapted to their local or regional environmental conditions through the process of natural selection (Bucharova, 2017; Jones, 2013; Vander Mijnsbrugge et al., 2010). Compared to seeds produced in and sourced from international sources, locally adapted seeds perform similarly or even better under environmentally stressful conditions (Borron, 2006; Ficiciyan et al., 2021). As Ficiciyan et al. (2018) note, modern varieties are often preferred by farmers over landraces, or plant species that lack formal crop improvement, due to their high crop yields.

Importantly, however, unlike their modern counterparts, traditional locally-adapted landraces often show high resilience under non-optimal and environmentally stressful conditions, such as drought, and produce a consistent and stable crop yield (Ficicyan et al., 2018). The increasing monopolization of these larger multinational seed companies within the seed industry has led to a decrease in the availability of locally adapted seeds and an increase in widely or generally adapted seeds, or those seeds bred to “display ecological fitness across a variety of environments" (Jones 2013a, p. 2; Worden-Rogers, 2015). In 2011, for example, ETC Group reported that the ten largest global seed companies control 73% of the global formalized seed market. This makes local communities with environmentally unique conditions largely unable to benefit from the commercial seed market due to the absence of seeds able to flourish in diverse conditions (Mahoney, 2019). This is often the case in Atlantic Canada, for example, where the unique climatic conditions make it difficult to find seeds specifically adapted to the region (d’Entremont, 2022; Jamieson et al., 2016).

The use of widely adapted seeds can lead to the introduction of genes ill-adapted to local conditions, a weakened ability to adapt to future environmental changes, and the possibility of inbreeding and domestication within the gene pool as a result of artificial selection (Jones, 2013b). As the effects of climate change become clearer, however, discussion of the importance and suitability of locally adapted seeds to changing climatic conditions continues (Vitt et al., 2022; Jones, 2013b). While some note that locally adapted seeds are more tolerant to changing weather conditions (Borron, 2006; Mweninguwe, 2018; Worden-Rogers, 2019), others, more recently, have argued that the ability for seeds to adapt to changing climatic conditions may become outpaced by the rapid effects of climate change (Vitt et al., 2013; Jones, 2013b). Widespread consensus exists, however, that greater diversification of crop genetic resources, or seeds, is needed in the face of climate change (Otieno et al., 2022; Kahane et al., 2013).

2.4 Plant genetic diversity

The basis of human's food and agricultural systems is plant genetic diversity, allowing these systems to cope with changes that are both environmental and socio-economic in nature (Food and Agriculture Organization of the United Nations [FAO], 2021). Genetic erosion refers to the decline of plant genetic diversity through the "loss of individual genes and of combinations of genes" (FAO, 2021). In our modern, globalized food and agricultural systems, the replacement of locally adapted varieties by modern varieties and the introduction of commercial, genetically uniform varieties into traditional farming systems are the main drivers of genetic erosion (FAO, 2021). Of the more than 6,000 globally available plant species cultivated for food, only nine represent 66% of total global crop production[2] (FAO, 2019). Since the 1900s, ~75% of plant genetic diversity has been lost as farmers worldwide have shifted away from traditional, locally adapted crop varieties in favour of genetically uniform and high-yielding varieties (FAO, 2004). This decrease in plant genetic diversity coincides with the industrialization of agriculture and increased focus on high yielding crop varieties and genetic uniformity and stability over diversification and locally adapted plant varieties (Chable et al., 2020; Kahane et al., 2013; ETC Group, 2011). Increased corporate concentration and monopolization within the commercial seed sector means that only a handful of commercial seed companies supply the majority of commercial seeds available to farmers (ETC Group, 2011; Alliance for Food Sovereignty in Africa [AFSA], 2018). Prioritization of seeds that are genetically uniform and more profitable has led to increased rates of genetic uniformity within our current agricultural system (FAO, 1997). Today, only a small fraction of Canada's original crop genetic diversity is available to farmers (FAO, 1997). For example, approximately 86% of the original 7,098 apple varieties documented as

[2] Sugar cane, maize, rice, wheat, potatoes, soybeans, oil-palm fruit, sugar beet and cassava.

being in use between 1804 and 1904 have been lost (FAO, 1997). Similarly, 81% of tomato varieties, 91% of field maize, 94% of peas, and 95% of cabbage can no longer be found in either commercial agriculture or any national genebanks (FAO, 1997).

Over-reliance on genetically uniform crops lessens the ability of food and agricultural systems to adapt to the changing climatic conditions associated with climate change and can lead to widespread crop loss, and resultantly, large scale food insecurity (Ficiciyan et al., 2021; FAO, 1997). As Ficiciyn et al. (2021) note, the opportunities for farmers to adapt to their local climatic and environmental conditions relies, in part, on the supply of genetic diversity available to them in the form of diverse varieties of crops. Greater rates of agrobiodiversity allow for increased opportunities to identify and utilize particular varieties or characteristics of varieties that can withstand changing and/or extreme climatic conditions (Otieno et al., 2022; Kahane et al., 2013).

2.5 Types of seeds: Hybrid, open-pollinated and heirloom varieties

2.5.1 Hybrid seed varieties

Hybrid plant varieties are produced by pollinating the line of one genetically uniform parent with the pollen from another genetically uniform parent, with the most complex hybrid varieties involving the crossing of up to four parents (CABI, 2014; Curry, 2022). The creation of hybrid varieties involves identifying the particular traits desired within two or more specific parental varieties, resulting in an offspring, or F1 hybrid, with those particular traits (CABI, 2014; Goulet et al., 2016). Hybrid varieties are typically more genetically uniform or "stable" than non-hybrid varieties, making the quality of their crops more predictable (CABI, 2014; Goulet et al., 2016). The production of hybrid seed is a labour-intensive activity that requires a carefully controlled environment that often eliminates the

ability to grow other crops in close proximity (CABI, 2014). As a result, hybrid seed production is largely restricted to large-scale, often multinational, seed producers who target the needs of medium and large-scale industrial farmers (CABI, 2014; Neate & Guei, 2010). Importantly, hybrid seeds cannot reliably be saved for use the next growing season – the genetic characteristics of hybrid seeds do not extend past the first (F1) generation, meaning that the saved seed from hybrid varieties do not contain the same characteristics as the original hybrid seed (CABI, 2014). This makes hybrid seeds particularly attractive to large-scale commercial seed producers as it requires the repurchase of hybrid varieties each season (CABI, 2014; Neate & Guei, 2010).

2.5.2 Open-pollinated seed varieties

Unlike hybrid varieties, open-pollinated varieties are most often a result of natural pollination practices, such as the wind, insects, or birds (CABI, 2014). Given that there are no restrictions on the exchange of pollen between individuals of the same variety, open-pollinated plants tend to be more genetically diverse than hybrid varieties (SeedSavers Exchange, 2012; Ashworth, 2002; Stone et al., 2019; Ficiciyan et al., 2021). The unrestricted crossing of these varieties can result in increased rates of variation among plant populations and allow plants to slowly adapt to local growing and climatic conditions (SeedSavers Exchange, 2012). When pollen is shared only between other plants of the same variety, the seeds from open-pollinated varieties will produce plants that are “true-to-type” or like their parents (CABI, 2014; Ashworth, 2002). This makes open-pollinated varieties especially important to seed savers and farmers and gardeners who either do not want to or do not have the ability to repurchase seeds every year (Ashworth, 2002; CABI, 2002). Prior to the introduction of modern plant breeding techniques in the mid 1900’s, all seed was considered open-pollinated (Stone et al., 2019).

2.5.3 Heirloom seed varieties

Importantly, it should be noted that while all heirloom varieties must be open-pollinated, not all open-pollinated varieties are heirloom (SeedSavers Exchange, 2012). While the definition of heirloom varies, heirloom varieties are typically understood as "traditional or older cultivars that are open-pollinated, passed down from gardener to gardener or handed down in families" and are not often used outside of small-scale agricultural operations (Dwivedi et al., 2019, p.1). Heirloom cultivars often vary and are often considered genetically unstable compared to hybrid or other non-heirloom open-pollinated varieties (Dwivedi et al., 2019). As a result, modern agricultural systems that greatly value genetic uniformity often favour hybrid or more stable open-pollinated varieties over heirloom varieties (Dwivedi et al., 2019). Heirloom cultivars are often highly unique and specific to their locale and are frequently the focus of seed saving efforts that aim to preserve traditional varieties (Dwivedi et al., 2019; d'Entremont, 2022). As the use of hybrid cultivars over heirloom, open-pollinated varieties increased in the 20th century, many heirloom or traditional cultivators disappeared, leading to a decline in overall crop genetic diversity (Dwivedi et al., 2019).

CHAPTER 3: METHODS

3.1 Research design

3.1.1 Main objective

The research design is based on the three main research objectives: 1) to identify the small-scale commercial seed producers in Ontario and their demographic characteristics; 2) to explore the motivations and values of small-scale commercial seed producers in Ontario; and 3) to identify areas of opportunity, concern, and growth for seed producers across Ontario.

3.1.2 Study population & recruitment

This study targeted small-scale commercial seed producers, defined as seed producers within Ontario who sell seeds commercially, part of which they have grown themselves in Ontario. These producers offer and grow more than one plant variety, rather than specializing in a single crop. Producers who solely distribute seed from other sources, rather than growing their own seed crop for commercial sale, were excluded from the study population. Producers who grow their own crops, but do so outside of Ontario, were also excluded. This limited the study population to producers who are based within Ontario and produce seed specifically for that climate. Through a detailed search of publicly accessible databases of Ontario seed producers (Seeds of Diversity Canada, n.d.; Canadian Organic Growers, n.d.; SeedChange, 2020; Young Agrarians, 2020), 23 small-scale commercial seed producers meeting these criteria were identified.

All 23 small-scale commercial seed producers previously identified through publicly accessible databases of Ontario seed producers were invited by the researcher to participate in an online survey via email using contact information publicly listed online. The preliminary

recruitment email included an overview of the project, what participation in the project entailed, how the results would be used, and a direct link to the survey, which began with an informed consent page. Both the initial recruitment email and the informed consent survey outlined the purpose of the study, the definition of small-scale commercial seed producers individuals must meet in order to participate, and what participation entailed. This offered participants multiple opportunities to familiarize themselves with the demands of participation. Participants were offered no incentives, monetary or otherwise, to participate in the study.

Importantly, it must be noted that a representative sample of the individuals who met the criteria of "small scale commercial seed producers" was not chosen – instead, **all** individuals (23 in total) who met these criteria were contacted and invited to participate. This follows the guidance offered by Morris (2022), who argues that if a population size is smaller than 300, it is prudent to survey the entire population.

3.2 Research ethics

Given that the study was anonymous, signed or audio-recorded consent was inappropriate as it invalidated the anonymity of participants. Instead, the consent form (see Appendix B) was included as the landing page of the survey, thereby requiring participants to acknowledge and read over the entirety of the consent form before continuing to the survey questions. The consent form included detailed information about the purpose of the study, requirements of participation, the types of questions asked, and details on the safe and secure storage of their responses upon completion of the survey. Participants indicated their consent to participation in the study by clicking the 'Continue to Survey' link at the bottom of the consent form. Participants were notified that they could leave the survey at any time by

simply closing the browser window they were using to complete the survey. Additionally, each question included the option to answer "Prefer not to answer," allowing participants to skip or decline to answer questions at their discretion. Importantly, however, participants were informed that they could not withdraw their participation **after** completion of the survey, as the absence of any directly identifying information made it impossible for the researcher to remove their information.

All study data was anonymized, meaning no direct identifiers such as specific age, location, or name of participants and their seed-operation were collected. All questions included the option to select "prefer not to answer," and any potentially identifying information such as age of participants and location allowed participants to select from a range of possible answers that were general and non-specific. For example, participants were asked to identify which age range category their age fell into (18-24, 25-34, etc.).

The research was given approval to proceed from Dalhousie's research ethics board on January 23 2023 with REB #2023-6514 (see Appendix C).

3.3 Instrumentation & materials

Using an online survey as the research instrument (see Appendix A), participants responded to questions concerning their basic demographic information (such as age range, gender, and scale of their seed-operation), their values and motivations surrounding seed-producing, and current and anticipated challenges to their seed-crop production. The survey design draws from, and in some cases parallels, similar studies conducted by FarmFolk CityFolk (2014) of seed producers in British Columbia and Baxley et al.'s (2020) survey of Vermont seed producers and savers. The survey included both quantitative and qualitative questions, including Likert scale and open-ended questions. Survey questions and responses

were logged through Dalhousie University's Opinio secure survey software. Data logged into the Opinio server were then directly exported into Microsoft Excel for data analysis. Qualitative responses to the survey were analyzed using nVivo, a qualitative data analysis software that aids researchers to organize, sort, and thematize qualitative data (Ozkan, 2004).

3.3 Content Analysis

Content analysis is a well-known data analysis method used to organize data into groups of categories that identify particular chosen characteristics (Kleinheksel et al., 2020; Stemler, 2001). Although originally conceived of as a strictly quantitative method, its use has since expanded to include qualitative data analysis as well, enabling researchers to provide richer descriptions of the social realities created by the identified themes and/or categories unique to a particular setting (Kleinheksel et al., 2020; Zhou et al., 2009). Content analysis allows researchers to analyze large volumes of data in an organized manner that is less laborious than other research methods (Stemler, 2001). Content analysis can be used for many purposes, including the focuses and priorities of individuals, groups, institutions, or societal attention (Stemler, 2001; Weber, 1990). As a result, it can allow researchers to make inferences that may then be supported or verified by other data collection methods (Stemler, 2001).

Due to a lower than expected response rate (23% or 6 total responses), a content analysis of the websites of small-scale commercial seed producers was conducted to supplement the survey responses received by participants in relation to the second research objective: "*what are the values and motivations of small-scale commercial seed producers in Ontario?"* 22 of the 23 previously identified small-scale commercial seed producers possessed publicly accessible websites that advertised their products, enabling the researcher

to use this data to perform their content analysis. Importantly, the content analysis was restricted solely to the websites of small-scale commercial seed producers, rather than both their websites and social media. This decision was made due to the fact that while most small-scale commercial seed producers possess websites, not all of them have active social media profiles. Furthermore, extending the content analysis to social media profiles as well as websites was beyond the confines of this thesis, as limited timelines restricted the researchers' ability to thoroughly analyze both sources. The content analysis was conducted specifically to supplement the responses received from participants in regard to the second research objective.

Coding is the process of assigning tags, names, or labels pieces of the data, allowing the researcher to organize the data into themes and identify patterns within the data (Punch 1998). Using nVivo, themes from the list of seed characteristics and motivations in questions 24 and 25 of the online survey were used as *apriori* codes, or codes established prior to analysis, when analyzing the websites (Stemler, 2001). Conversely, themes that emerged during analysis were listed as *posteriori*, or themes that emerge after completion of research based on review and observations of the data and results (O'Leary 2011).

3.5 Data analysis

A combination of descriptive statistical analysis and coding analysis was used to analyze participant responses. Prior to analysis, the researcher manually reviewed the data and removed responses from respondents who either failed the screening questions, and therefore did not meet the criteria for participation, or who only partially completed the survey.

Quantitative data from the survey was exported from Opinio to Microsoft Excel where the researcher conducted **descriptive statistical analysis**. Simple statistics such as frequency distribution tables, percentages, and calculations of mean, median, and mode were completed by the researcher for questions relating to demographic indicators, the values and concerns held by participants, and current and anticipated challenges to production. When contextually relevant, the researcher also chose to refer to the results from the content analysis in order to support the conclusions identified through the survey results.

When more than five responses to open-text questions were received (Q13, 16, 19, 25, 27, 29, 31), the researcher completed **coding analysis** using nVivo software. In cases of five or fewer responses to open-text questions, responses were instead synthesized and common themes described. Prior to analysis, the researcher removed any potentially identifying information (such as geographic location of the respondent) from responses to open-ended questions, ensuring that the anonymity of respondents was preserved.

3.6 Integration of survey results and content analysis

To integrate the results of the content analysis (described below) with the survey responses from questions 24 and 25, the researcher converted the survey responses, ratings of a pregiven set of seed characteristics and motivations on a scale of 1 (not important at all) to 5 (very important), to positive or negative value responses. Responses that rated a seed characteristic or motivation either a 1 (not important at all), 2 (not very important), or 3 (neither important nor unimportant) were deemed a negative value response, or an indication that this was **not** a characteristic or motivation that producers prioritized. Conversely, seed characteristics or motivations that were rated a 4 (important) or 5 (very important) were deemed a positive value response, or a characteristic or motivation that producers valued or

prioritized in their work. This conversion of survey rating responses into positive or negative values responses allowed for better integration of content analysis and survey results.

CHAPTER 4: RESULTS

23 producers that met the criteria outlined in section 3.1.2 were identified as potential survey participants. Of these 23 producers, only 6 opted to participate in the survey, resulting in a response rate of 26%. Of these six responses, one survey was invalidated due to incompletion. This chapter aims to answer the three research objectives introduced in section 1.6 by dividing the chapter into three corresponding sections: 4.1 personal demographics; 4.2 values and motivations; and 4.3 areas of concern, opportunity, and growth. While all three sections present the results from the survey using descriptive statistical analysis, section 4.2 alone combines the survey results with the results of a content analysis of seed producers websites. As a result of the survey sample size, when contextually relevant the researcher chose to cross-reference the websites of small-scale commercial seed producers when synthesizing survey data in order to substantiate the survey results.

4.1 Personal Demographics

The geographic locations of respondents were categorized according to the location of their seed producing operation within the six public health regions of Ontario. The majority of respondents' seed-producing operations (60%) were located within the Eastern portion of the province, with 40% of respondents located in the Eastern zone and 20% in the Central Eastern zone. Additionally, 40% of respondents were located within the Central Western zone of the province. Of the 23 small-scale commercial seed producers originally identified, analysis of their websites revealed that only 2 producers (~1% of total) lived outside of these zones. Crucially, no responses were garnered from small-scale commercial seed producers operating in the North Western, North Eastern, Toronto, or South Western zones. All respondents identified as female (cisgender or transgender), representing a significant lack of gender diversity within this study.

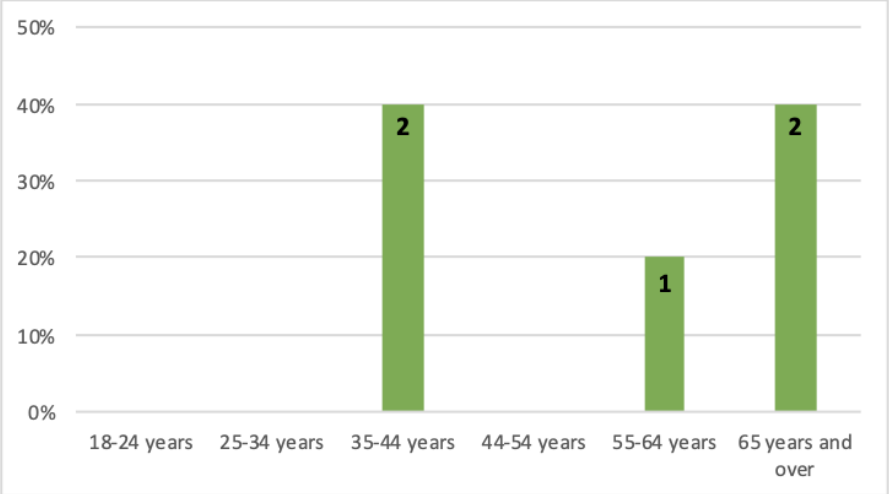

Figure 1: Age ranges of respondents, *n=5*.

As illustrated in Figure 1, all respondents were over the age of 35, with two of five respondents (40%) between the ages of 35 and 44, one respondent between the ages of 55 and 64 and two respondents (40%) 65 years of age or older.

4.1.1 Personal Education and Experiences

80% of respondents reported an agricultural background of some kind, including but not to limited to growing up on a farm or having family members that were farmers. Two survey questions asked respondents to report their levels of training and education. Question four of the survey asked respondents to report their highest level of formal education, while question six asked respondents to note the education, training, or experiences they have in the specific areas of seed growing, breeding, and saving. Responses indicate that the educational backgrounds of respondents are diverse – while one respondent (20% of total) completed secondary education (high school) as their highest level of education, all other respondents possessed either an undergraduate degree (40%) or a graduate university degree (40%).

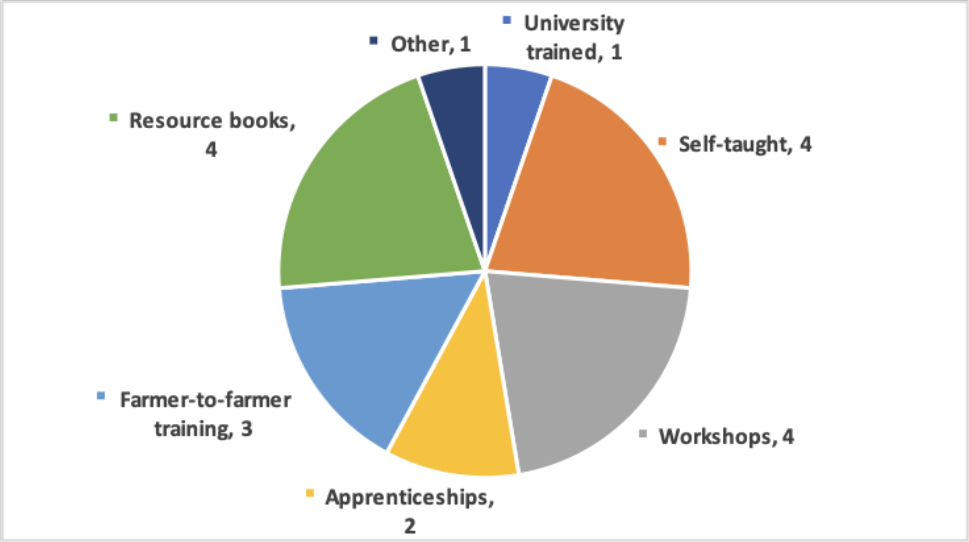

Figure 2: Seed-specific educational backgrounds and experiences of respondents, *n=5*. *Note:* Participants were asked to select all responses that apply.

The educational backgrounds and training experiences of respondents in relation to their roles as seed producers are varied, as illustrated in Figure 2. Respondents were asked to identify all education, training, and experience they had in the areas of seed growing, breeding, and saving. The majority of respondents were self-taught (80%) or derived their understanding from resource books (80%), with only one respondent possessing formal university training (20% of total responses). Many respondents (80%) cited workshops and farmer-to-farmer training (60%) as a source of their training.

At the time of the survey, all respondents reported more than six years' experience saving seeds. Most respondents (60%) had more than 16 years of experience saving seeds, with all other respondents reporting either 6-10 years' (20%) experience saving seeds or 11-15 years' experience (20%). Participants were also asked to disclose the length of time they had produced seed for **commercial sale**, distinct from their experience saving seed. All respondents reported producing seeds for commercial sale for a minimum of six years. The majority of respondents reported producing seed for commercial sale for either 6-10 years

(40%) or 16+ years (40%). Only 20% of respondents reported producing seed for commercial sale for 11 to 15 years. These results indicate that all study participants are both seed savers and seed producers who have more than six years of experience saving seed and producing seed for commercial sale.

4.1.2 Farm and Operation Demographics

Although participation in this research study was open to all small-scale commercial seed producers in Ontario regardless of farming practice type (e.g. conventional, organic, or other), all study participants identified their farming practices as either certified organic (60%) or organic without official certification (40%). This is significant and narrowed the focus of this study, unintentionally, to small-scale **organic** commercial seed producers in Ontario. Furthermore, 60% of respondents noted that they produced their seeds on less than 1.9 acres of land, with 40% of producers with less than an acre of land total in seed production. Only 40% of producers, or two of the five respondents, produced their seeds on more than five acres of land.

4.1.3 Seed Specific Demographics and Characteristics

As illustrated in Figure 3, respondents were asked to identify which seed crops they had produced for commercial sale within the last ten years. One producer declined to answer the question. Results indicate that 21 crops were grown for commercial seed sale by all respondents that opted to answer the question (4 total respondents) at least once in the past ten years, as illustrated in red in Figure 3. These crops include peppers (hot and sweet), tomatoes, kale, and more. Other commonly grown crops, grown by 75% of respondents and highlighted in blue in Figure 3, include swiss chard, okra, arugula, and radish. Only half of

respondents reported growing radishes, pumpkins, parsnips, leeks, carrots, cabbage, broccoli and asian greens for commercial seed sale within the past ten years, illustrated in green in Figure 3. Only a quarter of participants (1 of 4 total respondents) reported growing spinach, potatoes (true seed), collards, or celery for commercial seed sale in the previous decade, as indicated by the yellow bars in Figure 3.

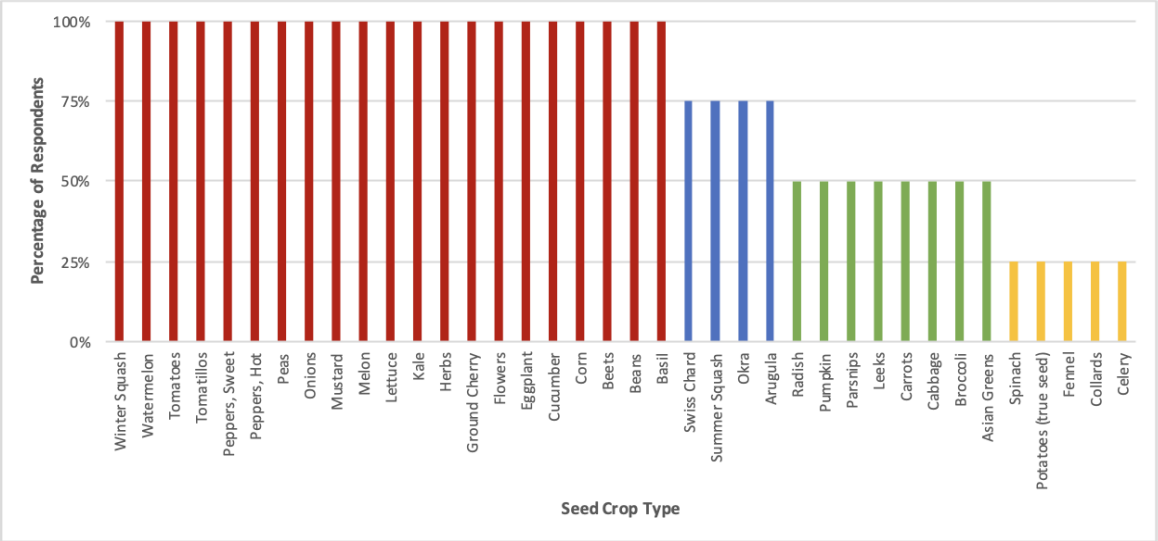

Figure 3: Seed crops respondents have produced for commercial seed sale within the last 10 years, illustrated by percentage of total respondents (*n=4*).

Respondents were also asked to estimate the approximate number of varieties of each seed crop they had grown in the past ten years, illustrated in Figure 4. Importantly, it should be noted that this figure illustrates the **maximum** number of varieties reported by participants. Seed varieties were broken down into four categories: roots & tubers, "other", leafy greens, and vegetables. Survey responses show that the individual crops with the largest number of varieties grown by small-scale commercial seed producers are tomatoes, flowers, and herbs, each with at least 100 different varieties grown. The category with the fewest number of varieties grown per crop were roots and tubers, with as few as only one variety of celery and as many as six different varieties of onions.

Figure 4: A) Maximum number of seed varieties of **roots and tubers** reported by participants; **B)** Maximum numbers of seed varieties of **"other"** varieties reported by participants; **C)** Maximum number of seed varieties of **leafy greens** reported by participants; **D)** Maximum number of seed varieties of **vegetables** reported by participants.

When asked to assess how rigorous they are with their crop selection processes, 60% of respondents noted that on a scale of 1 (not rigorous) to 5 (very rigorous), they were (4) rigorous. An additional 40% of respondents indicated that they were (5) very rigorous with their crop selection processes. 50% of respondents noted that lack of time prevented them from being more rigorous with their crop selection, while the remaining respondents declined to note any additional barriers that prevented them from practicing specific selection on their seed crops.

Open-Pollinated Seeds

Almost all (80%) respondents reported that 76-100% of their seed offerings each year were open-pollinated seeds. One respondent (20%) declined to answer the question. 60% of respondents noted that it was very important to them to offer open-pollinated seeds, while 40% noted that it was either important (20%) or neither important nor unimportant (20%) to offer open-pollinated seeds.

When asked to identify any barriers that prevented them from offering any or more open-pollinated seeds, respondents noted that a lack of time and help was a significant barrier. One respondent noted that the recent decision by some organic seed suppliers to offer primarily hybrid seeds limited their ability to offer and produce open-pollinated seeds. Another respondent noted that they currently faced no significant barriers to their production of open-pollinated seeds, stating that all their seeds were open-pollinated in order that their customers could grow out and learn to save their own seeds.

Heirloom Seeds

The proportion of heirloom seed varieties that participants reported within their total seed offerings varied significantly. 40% of respondents reported that 26-75% of their seed offerings were heirloom seed varieties. A further 40% of respondents noted that heirloom seed varieties made up more than 76% of their seed offerings. One respondent declined to disclose the proportion of heirloom seed varieties included within their seed offerings and the importance of offering these varieties to their customers. Compared to open-pollinated seed varieties, respondents rated the importance of including heirloom seed varieties within their offerings as less important. 40% of respondents noted that it was neither important nor important to offer heirloom seed varieties for sale. Conversely, 20% of respondents rated the importance of including heirloom seed varieties within their seed offerings as not important at all. A further 20% of respondents noted that it was very important to them to offer heirloom seed varieties to their customers.

When asked to identify any barriers that prevented them from offering any or more heirloom seeds to their customers, a lack of time and help was again identified by respondents. 75% of respondents noted that the definition of heirloom seed varies and

resultantly, what some defined as heirloom seed varieties were defined differently by others. One respondent noted that larger seed companies, from whom they source some of their seed varieties, commonly neglect older heirloom varieties in favour of newer varieties, making access to these heirloom varieties increasingly difficult. Another participant noted that they prefer to offer "open-pollinated seeds that may become heirlooms of the future" and argued that because the definition of heirloom seed varieties varies so much, increased focus should be placed on open-pollinated rather than heirloom seed varieties.

Hybrid Seeds

Importantly, 80% of respondents noted that they do not offer **any** hybrid seed varieties for sale, with one respondent (20% of total) declining to answer the question. Moreover, when asked to rate the importance of including hybrid seed varieties within their total seed offerings, 60% of respondents noted that it was **not important at all** and 20% of respondents noted that it was neither important nor unimportant. Again, one respondent declined to answer the question.

When asked to identify barriers that prevent them from offering any or more hybrid seeds, all participants noted less interest in offering hybrid seed varieties compared to open-pollinated or heirloom varieties. One participant noted that while large seed companies typically offer hybrid seeds, their focus and preference lay on open-pollinated varieties that produce plants that true-to-type, or genetically similar to their parents. Another participant noted that while cost was a major barrier to the production of hybrid seed varieties, they felt no desire to offer any hybrid seed varieties and instead preferred to focus on open-pollinated seed varieties specifically adapted to their region.

4.2 Content Analysis: Values & Motivations

The results of the content analysis of the content analysis were organized into two separate categories: 1) the seed characteristics respondents prioritize in own their seed sourcing and production; and 2) the values and motivations that influenced respondents' decision to begin producing seeds. These sections were further subdivided into the *apriori* and *posteriori* themes that emerged as the websites were analysed. A total of 22 websites were analysed.

Seed Characteristics

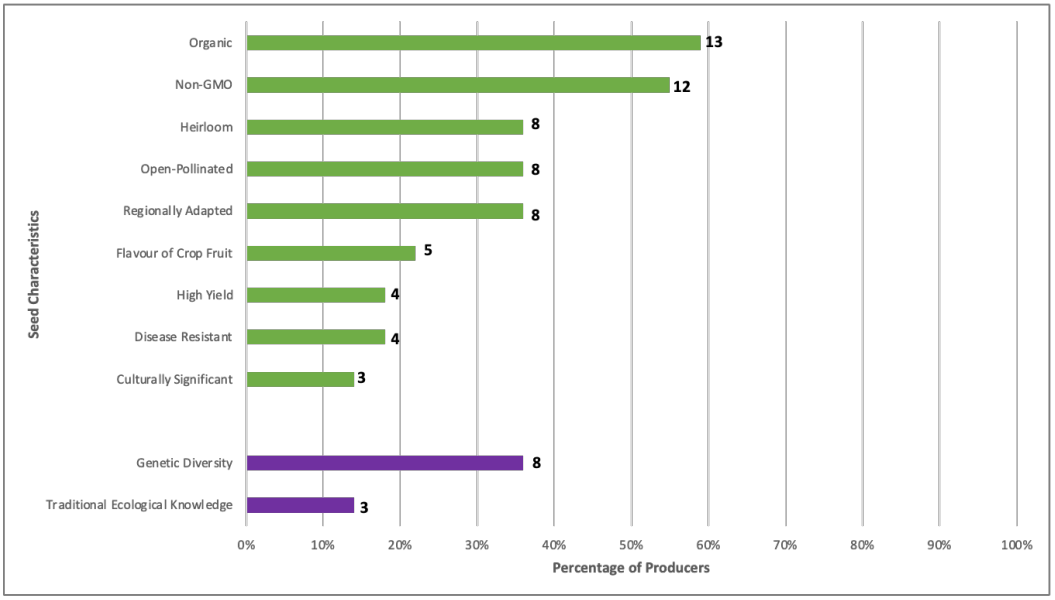

Figure 5: Seed characteristics valued by small-scale commercial seed producers, identified during a content analysis and organized according to *apriori* (green) and *posteriori* (purple) themes. (*n=22).*

Twelve a*piori* seed characteristics were identified prior to content analysis, nine of which are illustrated in green in Figure 5. Three apriori characteristics that received no results from the content analysis were therefore excluded from Figure 5. This included frost resistance, drought resistance, and ease of growability. A further two *posteriori* seed characteristics, traditional ecological diversity and genetic diversity, represented in purple in Figure 5, were identified once coding began. The top seed characteristics most identified by small-scale commercial seed producers included organic seeds

(59%) and non-genetically modified organisms (55%) (GMOs). The characteristics least identified by small-scale commercial seed producers were the integration of traditional ecological knowledge (14%) and seeds of cultural significance (14%).

Motivations to Begin Producing Seed

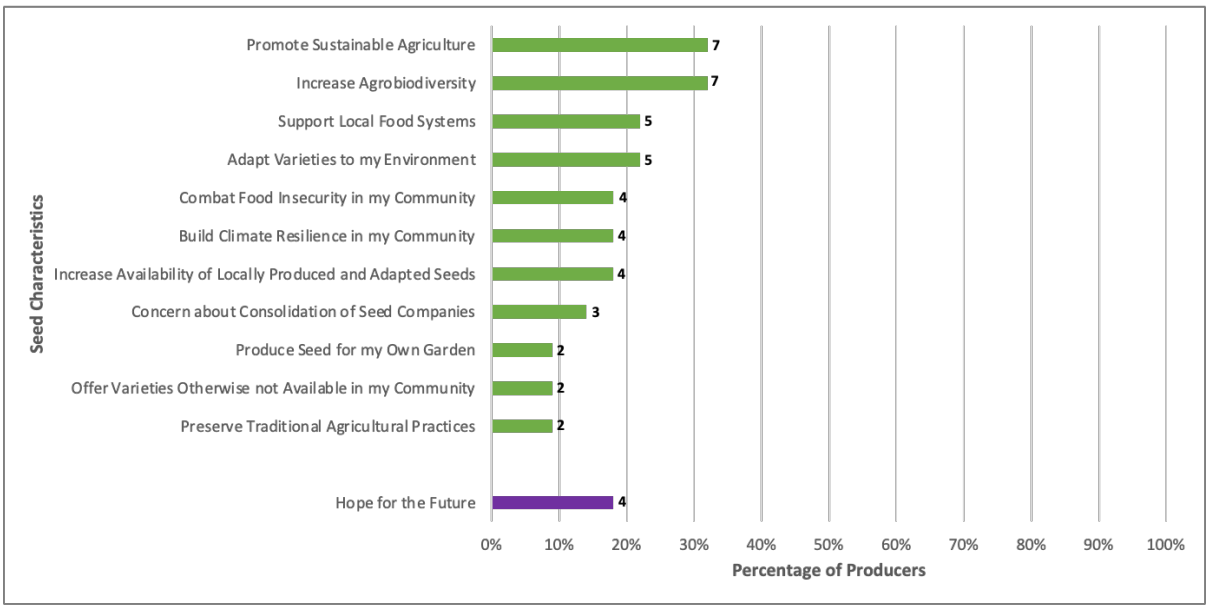

Figure 6: Guiding motivations of small-scale commercial seed producers to produce seed, identified through a content analysis and organized according to *apriori* (green) and *posteriori* (purple) themes. (*n=22*).

Fifteen *apriori* motivations were identified prior to content analysis, eleven of which are presented in green in Figure 6. Four *apriori* motivations that received no results from the content analysis were excluded from Figure 6 - these included the motivation to produce seed as a source of leisure or hobby, to make money, meet market demand, or meet people. One additional *aposteriori* motivation, hope for the future, was identified once coding began, illustrated in purple in Figure 6. The most identified motivations for producing seed cited by small-scale commercial seed producers on their websites were the wish to increase agrobiodiversity (32%) and to promote sustainable agriculture (32%). Conversely, the motivations least frequently cited by producers as a motivation to

produce seed was the wish to produce seed solely for their own garden (9%) and the desire to preserve traditional agricultural practises (9%).

4.3 Current and Future Challenges to Production of Seed Material

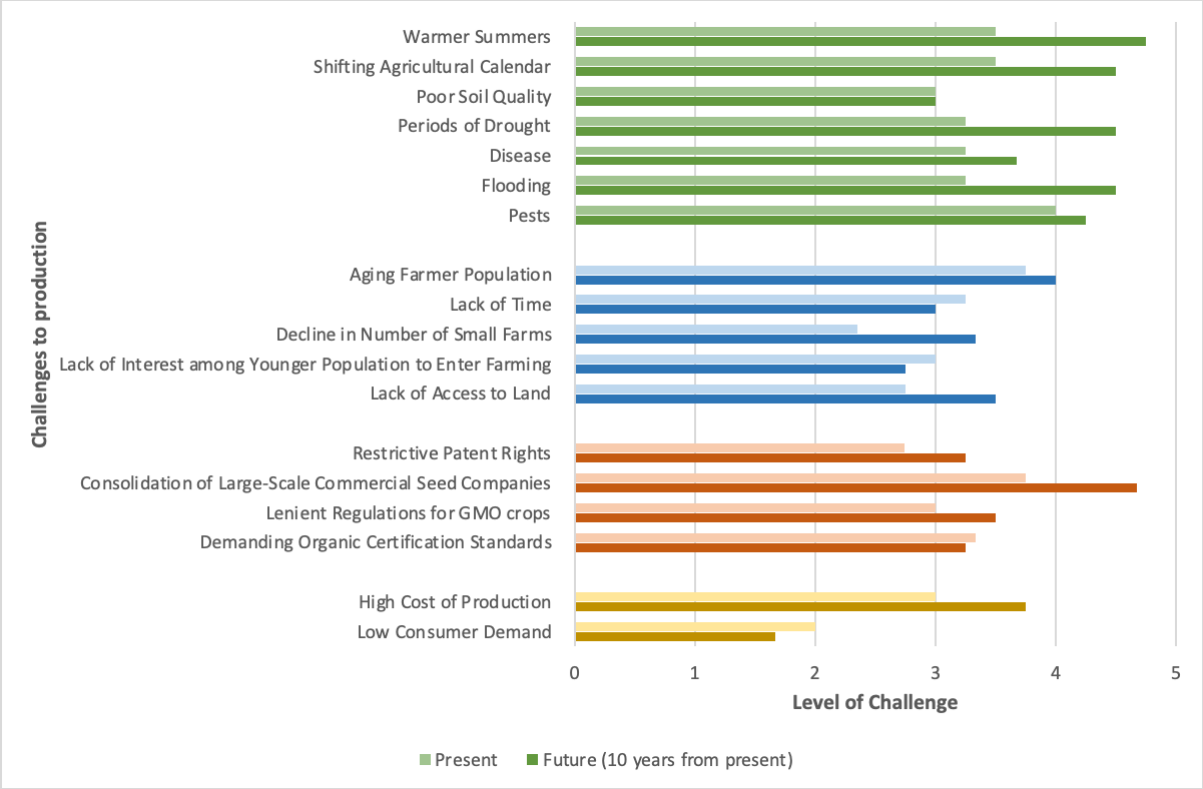

Figure 7: Mean responses to current and future challenges to production of seed crops. Mean responses to **current** challenges to production of seed crops represented in orange, mean responses to future challenges (10 years from present) represented in blue. Mean calculated on a scale where 1=Not a challenge at all, 2=Not challenging, 3=Neither challenging nor unchallenging, 4=Challenging, and 5=Very challenging. *Note:* Environmental concerns illustrated in green, social concerns illustrated in blue, legal concerns illustrated in red, and economic concerns illustrated in yellow.

In order to gain insight into the challenges small-scale commercials currently face and those that they anticipate facing in the future, respondents were asked to rate the level of their concern of a predetermined list of eighteen challenges on a scale from 1 (not a challenge) to 5 (very challenging). Participants rated their **current** level of concern for these challenges as well their anticipated level of concern for these same challenges in ten years' time, in 2033. The highest concern identified by participants as a **current** challenge to their seed production was pests, with a mean rating of 4 or "challenging." Conversely, when asked to anticipate **future** challenges to seed production in ten

years, respondents identified warmer summers (mean = 4.75) as the most pressing issue. Other climatic concerns, such as periods of drought (mean = 4.5), shifting agricultural calendars (mean = 4.5), and flooding (mean = 4.5) were also identified as significant causes of concern. Low consumer demand was identified as the least concerning or challenging issue for both current (mean = 2) and future (mean = 1.67) seed production. The average difference between present and current rating of challenges was .5, indicating that producers anticipated increasing challenges to seed production in the future. The concerns that producers perceive will intensify/worsen over time (as shown by the largest difference in rating between current and anticipated challenges to production) were warming summers and periods of drought, each with a 1.25 increase in anticipated challenge between the present and future.

CHAPTER 5: DISCUSSION

The objectives of this study and content analysis were threefold: 1) to identify the small-scale commercial seed producers in Ontario and their demographic characteristics; 2) to explore the motivations and values of small-scale commercial seed producers in Ontario; and 3) to identify areas of concern, opportunity, and growth for small-scale commercial seed producers across Ontario. Following the analysis of survey results and the content analysis presented in Chapter Four, this chapter situates these findings within the wider literature on seed producers and discusses the insights this research might offer for organizations and municipal and provincial governments aiming to support these producers. Finally, this chapter identifies potential limitations of this study and concludes with recommendations for future research.

5.1 Key findings

5.1.1 Female-identifying seed producers outnumber male-identifying seed producers

Although the survey was open to all small-scale commercial seed producers in Ontario, regardless of gender, all respondents identified as female (cisgender or transgender). Importantly, it must be recognized that only five responses total were received. Thus, when appropriate, contextual reference was made to the demographic information accessible on the websites of the 22 previously identified small-scale commercial seed producers. Analysis of these websites revealed that almost 70% of the operations associated with these producers were either women-led (41%) or led by a partnership (e.g., husband and wife) that included at least one woman (27%). The gender identity of the rest of these producers was either unable to be determined (23%) due to a lack of identifying information on their websites or was identified as male-led (1%). These results show that the gender identities of these small-scale commercial seed producers are predominantly female but fail to explain why solely females opted to participate in the survey. A possible explanation for this could be the increased

likelihood of women over men to complete surveys, as noted by Smith (2008). The results of Bauta Family Initiative's on Canadian Seed Security 2020 Farmer Survey also found that the majority of seed growers surveyed identified as female (65.3%) (Bauta Family Initiative on Canadian Seed Security, 2020a). The overrepresentation of female to male seed producers is particularly interesting when juxtaposed with the wider gender demographics of Ontario's farmers, into which these small-scale commercial seed producers fall. Only 29.5% of total farm operators surveyed within the 2023 Agricultural Census identified as female (Statistics Canada, 2023). The gender identities noted by survey respondents thus differ substantially from the gender demographics of Canada's larger agricultural population. Attempting to contextualize the gender demographics of small-scale commercial seed producers of Ontario within the larger gender demographics of seed producers nationally, or even within other Canadian provinces, is difficult – little literature exists on the gender demographics or the role of women in seed systems in developed countries or agricultural systems. While some literature examines the gender roles of seed systems in developing countries, comparatively, no existing literature was identified that explicitly analyses the gender demographics within seed systems similar to Canada's. As a result, it is difficult to identify the underlying causes for the overrepresentation of female rather than male small-scale commercial seed producers.

5.1.3 Aging seed producers outnumber youth in the industry

The ages reported by respondents reflects the general aging trend experienced by the agricultural sector in both Ontario and the wider country. All survey respondents were over the age of 35, while a further 40% of respondents were 65 years of age or older. In 2021, Canada's Agricultural Census noted that the average age of Canadian farm operators was 56 years, while the proportion of farm operators 55 years of age and older was a staggering 60.5% (Statistics Canada, 2022). In Ontario, the Agricultural Census revealed that the

average age of farm operators, or those responsible for the "management decisions in operating an agricultural operation," (Statistics Canada, 2019) was even higher than the national average: 56.7 years, a 2.5% increase from the average age reported in the 2016 Agricultural Census (Statistics Canada, 2022). As producers who run their own businesses and sell seeds commercially, small-scale commercial seed producers fall under the definition of farm operators noted by Statistics Canada. Thus, the age ranges reported by survey participants indicate that the aging population reported within the larger agricultural sector is also being experienced in the seed industry.

When asked to rate their **current** level of concern for the aging farmer population, survey respondents reported an average rating of 3.75 out of 5. Thus, respondents indicated that while they were concerned about the aging farmer population, it was not presently a pressing concern. When asked to rate their level of concern for the aging farmer population in ten years' time, however, respondents reported an average rating of 4, indicating that they predicted that the increasing age of farmers would become a more pressing issue in the future. The implications of this aging farmer population within the seed sector are varied. As noted by Antons (2010) and Sievers-Glotzbach et al. (2020), the development and maintenance of seed varieties by farmers is in many ways dependent on the preservation and intergenerational transmission of traditional ecological knowledge. As emphasised in a 2010 report to the Standing Committee on Agriculture and Agri-Food, the aging farmer population and decline of youth entering the farming industry poses a risk to the transmission of knowledge. This transmission of farming knowledge is crucial to the maintenance and preservation of the traditional skills associated with seed production. Moreover, given that the proportion of seed producers over the age of 55 (60% of respondents) and presumably nearing retirement exceeds the proportion of producers 44 years of age and under (40%), it is anticipated that the total number of small-scale commercial seed producers in Ontario will

steadily decrease in coming years. This mirrors similar predictions made by Statistics Canada, in which it is noted that the increasing age of average farm operators in Canada and the decreasing number of total farm operations indicate that this trend will continue in the future (Statistics Canada, 2015). The decrease in total number of these producers could limit the total diversity of seeds available to farmers in Ontario, given the recent literature that shows that the offerings of small-scale commercial seed producers tend to be more diverse and regionally adapted to local growing conditions than their larger counterparts.

5.1.4 Sustainable agriculture as organic production methods that produce non-genetically modified and open-pollinated seeds

The content analysis of the websites of the 22 small-scale commercial seed producers identified the desire to promote sustainable agriculture as one of the most commonly cited motivations for seed production. 32% of the previously identified 22 small-scale commercial seed producers noted that sustainable agriculture was a guiding motivation for their seed production. Importantly, however, sustainable agriculture is an ambiguous term whose definition often differs per producer or even per governmental authority. Whereas, for example, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) defines sustainable agriculture by three principles – economic profitability, environmental stewardship, and social responsibility – the United States Department of Agriculture (USDA) labels sustainable agriculture as "farming in such a way to protect the environment, aid and expand natural resources and to make the best use of nonrenewable resources" (Beets, 2015; USDA, 2023). Thus, the question must be asked, "*what does sustainable agriculture mean for these small-scale commercial seed producers?"* The survey results and results of the content analysis revealed that for these small-scale commercial seed producers, sustainable

agriculture is the production of **organic, non-genetically modified (GM),** and **open-pollinated** seeds.

Organic seeds

Organic seed was the seed characteristic most cited as of importance by small-scale commercial seed producers on their websites – 13 of the 22 (59%) websites analyzed identified organic seed as an important value. The language used by these producers to describe their organic seed offerings indicate that the values assigned to organic seed production were not simply instrumental (e.g. offering organic seeds for financial gain) but instead largely relational and guided by their feelings of responsibility to, and relationships with, other people and the environment (Isbell et al., 2021). As one producer noted on their website:

> We have stayed true and committed to our own beliefs, to a natural comprehensive **organic** enterprise. We believe that the foundation of agriculture, no matter which branch, is founded upon **sustainable** and holistic management practices that produce healthy soils, plants, food and environments for ALL species in our global community (Canadian Organic Seed Company, 2023a) (emphasis added).

The relational values associated with organic seed offerings are also affirmed by Steiner (2008) and the Bauta Family Initiative on Canadian Seed Security (2012). As Steiner (2008) notes, organic seed production is not simply about the *absence* of synthetic chemicals but is also about the production of seeds within a larger communal context that values sustainable, local farming practices in which producer and consumer are intimately connected. Likewise, Bauta (2012) asserts that the principles underlying organic seed production include commitment to and respect for the environment, social equity, and well-being for future generations. The excerpt above illustrates the multidimensional nature of organic growing practices – as the producer notes, the sustainable and holistic management practices that

underlie organic production methods necessarily result in benefits for **all** species, human or otherwise (Canadian Organic Seed Company, 2023a). This association of organic production methods with sustainability directly supports the notion that for many of these small-scale commercial seed producers, sustainable agriculture includes organic growing methods. This is further illustrated by the results of the survey conducted by the researcher; although the study was open to all small-scale commercial seed producers in Ontario, regardless of farming practice type (e.g., conventional, certified organic, or other) all respondents ($n=5$) identified their farming practices as either certified organic or organic. Importantly, it must be noted that while certified organic and non-certified organic production practices are distinct from one another, for the purposes of simplifying the distinction between organic (certified and non-certified) and conventional growing practices within this section, the two are often referenced here in tandem.

As defined by the Organic Federation of Canada (2023), organic agriculture "sustains the health of soil, plants, and livestock by prescribing minimized tillage, crop rotation, diversification of biodiversity and animal welfare." **Certified** organic refers to organic food and agricultural products, in this case seeds, whose conformity to the Canadian Organic Standards legislated by the government are verified by a certification body (FarmFolk CityFolk, 2014). This certification allows producers to advertise their products as organic (FarmFolk CityFolk, 2014). As noted by the Bauta Family Initiative on Canadian Seed Security (2014), however, the economic costs associated with obtaining this organic certification have led some producers to abandon official certification and instead direct market their seeds to customers who "trust in the ecological integrity of their production methods." Thus, while the growing methods utilized by both organically certified and organic seed producers may be similar, or in some cases identical, barriers to the certification of

official organic growing standards mean that some producers are either unable to, or opt not to, become organically certified.

Review of the websites of the 22 previously identified small-scale commercial seed producers in Ontario revealed that 73% (16 total) identified their operations as either certified organic or non-certified organic, 18% (4) did not note whether their operations were organic or conventional, and 1% (2) noted that they offered both organic and conventional seeds. The disproportionate representation of organic farming practices compared to conventional farming practices within small-scale commercial seed production is supported by additional studies of small-scale seed savers and producers in Vermont (Baxley et al., 2020). In a study of seed savers and producers in Vermont, researchers at the University of Vermont found that 88% of respondents identified their farming practices as either non-certified organic (81%) or certified organic (7%) (Baxley et al., 2020). Some studies propose that the high proportion of organic small-scale commercial seed producers compared to conventional could be due to the gap for organic seeds in the seed market left by large-scale commercial seed producers, who typically focus on conventional seed production and offerings (Levert, 2014). Whereas large-scale commercial seed producers typically serve a large customer base comprised primarily of industrial farmers who utilize conventional farming practices, small-scale commercial seed producers tend to focus primarily on the needs of home and market gardeners who utilize both conventional and organic seeds (Glasgow et al., 2016; Levert, 2014; Phillips, 2008). As noted by Levert's (2014) report on the market for organic and ecological seeds in Canada, many large-scale commercial seed producers are uninterested in producing organic seed for commercial distribution due to the lower demand for organic seeds compared to conventional seeds and the strenuous regulations associated with producing and selling organic seeds. This therefore leaves a gap in the seed market for small-scale commercial seed producers to fill.

Non-Genetically Modified (GM) Seeds

55% of the websites of small-scale commercial seed producers analysed explicitly referenced the importance of non-genetically modified organisms (GMOs) and their commitment to offering non-genetically modified (GM) seeds. The production practices associated with GMOs and non-GM seeds are importantly distinct: whereas non-GM seeds are cultivated through pollination, GM seeds are instead specifically manufactured in a laboratory through the use of modern biotechnology techniques (SeedSavers Exchange, 2023). The relationship between certified organic production methods and non-genetically modified seeds is explicit; the Canadian Organic Standards prohibits the use of genetically modified (GM) seeds (Standards Council of Canada [SCC] & Canadian General Standards Board [CGSB], 2020). Thus, with some limited exceptions, producers that are certified organic are prohibited from utilizing GM seeds. Moreover, given the limited financial resources of most small-scale commercial seed producers, the ability to even offer GM seeds is largely unavailable to them, given the high costs associated with the production of these seeds (Brookes, 2022). As noted by the Bauta Family Initiative on Canadian Seed Security (2014), GM seeds are most profitable to seed companies that cater to large-scale, capital-intensive, and low-diversity agricultural operations. Critically, however, Canada's current seed policies do not allow for the sale of GM seeds for non-commercial use – instead, the sale of GM seeds is restricted to commercial users like industrial farmers who sign technology use agreements (TUAs) that agree not to save, replant, or sell the seed to others (Bauta Family Initiative on Canadian Seed Security, 2014; Smyth, 2014). Given that the customer bases of small-scale commercial seed producers are largely restricted to home and market gardeners, therefore, they are largely unable to provide GM seeds to their customers in the first place.

There is much debate over the safety and sustainability of genetically modified organisms. Some argue that the introduction of GM seeds into the global market and subsequent patenting of their genetic material enabled the privatization and commodification

of genetic resources that were once part of humanity's common heritage and freely accessible to all beings (Kloppenburg, 2014). Conversely, others posit that the rising food demands associated with the increasing global human population require the implementation of new technologies, like genetically modified organisms, to ensure food security (Fernandes et al., 2022; Taheri, 2017). Given that 55% of small-scale commercial seed producers noted their commitment to non-GM seeds and the content analysis noted that 73% of producers identified their seed operations as either certified or non-certified organic (and thus unable to utilize or produce GM seeds), it can be concluded that these small-scale commercial producers believe that the benefits of GM seeds do not outweigh the potential consequences. This hypothesis is further substantiated by the results of the content analysis, in which many producers not only emphasized their non-GM seed offerings but also cited their opposition to and concern for GM seeds. This is illustrated most explicitly through the commitment of a number of small-scale commercial seed producers (27%) to the Safe Seed Pledge. Created in 1999, the Safe Seed Pledge is a declaration by seed companies and producers that they do not knowingly buy, sell, or trade genetically modified organisms (High Mowing Organic Seeds, 2023). The Safe Seed Pledge not only expresses a rejection of genetically modified organisms but also affirms the importance of sustainable farming practices:

> Agriculture and seeds provide the basis upon which our lives depend. We must protect this foundation as a safe and genetically stable source for future generations. For the benefit of all farmers, gardeners, and consumers who want an alternative, we pledge that we do not knowingly buy or sell genetically engineered seeds or plants. […]. Further, we wish to support agricultural progress that leads to healthier soils, genetically diverse agricultural ecosystems and ultimately healthy people and communities (High Mowing Organic Seeds, 2023)

The framing of non-GM seeds as connected to farming practices that support healthy soil, genetic diversity, and healthy populations indicates that for these small-scale commercial seed producers, the decision not to use GM seeds is inherently connected to their conception of sustainable agricultural practices. The Bauta Family Initiative on Canadian Seed Security also identifies this relationship between non-GM seeds and agricultural sustainability: as they note, the risks of GM crops and seeds to organic and conventional producers alike are not only economic but also threaten the "ecological integrity of their farming communities" (Bauta Family Initiative on Canadian Seed Security, 2012, p. 9). Thus, the value posited by small-scale commercial seed producers to non-GM seeds is inherently connected to their conception of sustainable agriculture, as evidenced both through the results of the content analysis and secondary sources.

Open-Pollinated (OP) Seeds

The content analysis revealed that 36% (12 producers total) of small-scale commercial seed producers noted the importance of offering open-pollinated seeds on their websites. Explanations of the significance of offering open-pollinated varieties varied – while the websites of some of the small-scale commercial producers analysed simply noted the availability of open-pollinated varieties, others emphasized the importance of making these varieties available for the future sustainability of food systems:

> Just as the seed is the plant's way to preserve itself (through time or winter) until the conditions for life are perfect again, preserving the open-pollinated seed is the gardener's way of feeding the future (Soggy Creek Seed Company, 2023).

Seeds are typically either open-pollinated or hybrid varieties, the distinction between which was already articulated in section 2.5.1 and 2.5.2 (SeedSavers Exchange, 2012). Due to the lack of restriction on the pollination between plants, open-pollinated seed varieties tend to be

more genetically diverse than their hybrid counterparts (Ashworth, 2002; Stone et al., 2019; Ficiciyan et al., 2021). Unlike hybrid seed varieties, open-pollinated seeds can be saved and depended on to produce true-to-type plants in the following years, making them particularly attractive to low-income farmers that cannot afford to repurchase hybrid seeds each year (CABI, 2014; Freshley & Delgado-Serrano, 2020). The unrestricted crossing of these varieties and the ability to save their seeds makes open-pollinated seed varieties more likely to be locally adapted, a seed characteristic identified as important by 36% of the small-scale commercial seed producers surveyed in the content analysis (SeedSavers Exchange, 2012). Furthermore, open-pollinated seed varieties require fewer inputs, such as pesticides or fertilizers, than hybrid varieties, making them more ecologically sustainable to their environments and reducing the need for costly inputs (Freshley & Delgado-Serrano, 2020). Thus, the benefits of open-pollinated seeds varieties are vast and range from increased genetic diversity and economic accessibility to a decrease in synthetic or other inputs.

The importance posited to open-pollinated seed varieties by small-scale seed producers and savers was also noted in a study conducted by researchers at the University of Vermont (Baxley et al., 2020). In their study, ~45% of participants noted that offering open-pollinated seed varieties was “very important,” while a further 65% of participants noted that most (32%) or all (33%) of their seed offerings were open-pollinated (Baxley et al., 2020). Importantly, it should be noted that while many small-scale commercial producers cite the sustainability benefits of open-pollinated seed varieties as a motivator for offering these varieties, the lack of accessible alternatives make open-pollinated seeds the only practical option for many of these producers. Compared to open-pollinated seed varieties, the production of hybrid seeds is labour-intensive and costly (Foundation for Food & Agriculture Research [FFAR], 2021). The production of hybrid maize seeds, for example, requires 33% more land and the use of specialized equipment (FFAR, 2021). This makes hybrid seed

production largely inaccessible to small-scale commercial seed producers, leaving open-pollinated seed varieties as the only viable alternative (Foundation for Food & Agriculture Research, 2021; Neate & Guei, 2010). Survey results from small-scale commercial seed producers support these findings – all survey respondents (n=4) reported that they offer **no** hybrid seeds. When asked to share why they did not offer any hybrid seed varieties to their customers, participants cited a preference for open-pollinated varieties that produce locally adapted true to type seeds and noted cost as a barrier to hybrid seed production:

> Currently [it] is mostly the cost of producing hybrids on-farm that is a barrier. Though we don't have a strong desire to move into the hybrid market as [we] are more focused on adapting open-pollinated varieties to better perform (Survey Respondent #1).

While, therefore, characteristics associated with sustainable agriculture, such as reduced crop inputs, economic accessibility, and increased genetic diversity, were cited as motivations for offering open-pollinated seed varieties, it must be noted that a lack of practical alternatives offers these producers little choice. This does not mean that open-pollinated seeds do not represent a critical component of sustainable agriculture for these producers, but it cannot be ignored that for most of these producers, seed production of anything other than open-pollinated seed varieties is impossible due to financial constraints.

5.1.4.4 Bringing it all together

Based on the content analysis and survey results reviewed above, combined with additional information from secondary sources, it can be concluded that for these small-scale commercial seed producers, sustainable agriculture is the production of seeds that are **organic, non-genetically modified**, and **open-pollinated.** While it would be fruitful to consider how small-scale commercial seed producers' conceptions of sustainable agriculture

compares and/or contrasts to that of larger-scale commercial seed producers, no such studies were identified that make this distinction. This therefore represents an opportunity for further research and review.

As previously noted, many varying conception and definitions of sustainable agriculture exist. As Velten et al. (2015) note, sustainable agriculture is necessarily context-dependent and must be adapted to fit the needs of each unique circumstance. Thus, any attempt to identify and apply a precise and absolute definition of sustainable agriculture universally is impossible (Velton et al., 2015). The results from this survey and content analysis, in which it is suggested that sustainable agriculture is the production of organic, non-genetically modified, and open-pollinated seeds, can only be applied to this context: that of small-scale commercial seed producers in Ontario.

5.1.5 Agrobiodiversity as a key motivator & genetic diversity as a key seed characteristic

The desire to increase agrobiodiversity was cited as one of the most shared motivations for seed production in the content analysis. 32% of the 22 websites of small-scale commercial seed producers analysed cited the importance of preserving and sustaining agrobiodiversity as a key value and motivator within their seed production practices. Relatedly, the content analysis also identified genetic diversity as one of the seed characteristics of most importance to small-scale commercial seed producers, with 36% of producers citing the importance of genetic diversity on their websites. Related in part to plant genetic diversity, the Food and Agriculture Organization of the United Nations (FAO) defines agrobiodiversity as the "variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries" (FAO, 2004). Agrobiodiversity is the result of the

interaction between genetic resources, the environment, and the management systems and practices used by culturally diverse populations (FAO, 2004). As noted by the FAO (2004), it is the human activity of agriculture that shapes and conserves agrobiodiversity. Thus, the biodiversity present within these agricultural systems reflects the local knowledges and cultures of the people involved in these systems. Research shows that the benefits of increased agrobiodiversity are vast and can lead to increases in natural soil fertility and health, reduced pressure on ecosystems and endangered species, and diversified agricultural products and streams of income (FAO, 2004).

On their websites, some producers lament the agrobiodiversity already lost and note the need to preserve and foster remaining agrobiodiversity. As one producer states on their website:

> In the last century, we have lost 90% of our vegetable varieties – a tragic loss of diversity and a threat to our food security. It is important to stop this trend and, as growers and consumers, look for alternatives (Tree and Twig, 2023).

Many producers also emphasize the importance of increased agrobiodiversity, particularly in the face of climate change and increased concerns about the vulnerability of global food and agricultural systems:

> We are committed to preserving genetic biodiversity and our goal is to save from extinction as many rare plant varieties as we can, in an aim to serve our lofty goal of saving the world one seed at a time (Cottage Gardener, 2018).

> The genetic variation in all life forms allow us to adapt and withstand disease, droughts, and pests. […]. As our climate changes, and pests and diseases become immune, the need for genetic diversity is crucial to our human survival (Heritage Seed & Produce, 2006b).

These quotes illustrate the importance and urgency posited to maintaining existing agrobiodiversity. As noted by these producers, the consequences of failing to maintain existing agrobiodiversity include threats to food security, limited ability for humans to adapt to changing climates, and loss of what one producer describes as "humanity's genetic heritage" (Hawthorn Farm, 2023). Previous studies of small-scale seed savers and producers also affirm the importance attributed to agrobiodiversity: a study at the University of Vermont found that ~50% of participants rated the motivation to "contribute to biodiversity" as very important (Baxley et al., 2020). Thus, the importance of agrobiodiversity to small-scale commercial seed producers identified by the content analysis is consistent with Baxley et al.'s (2020) findings.

The emphasis placed on agrobiodiversity by these small-scale commercial seed producers is unsurprising when contextualized within pre-existing literature and research on small-scale seed producers and their ability to link formal and informal seed systems. As previously noted, the importance of small-scale commercial seed producers includes their ability to link formal and informal seed systems by conforming to the requirements of the formalized seed sector while simultaneously meeting the needs of smallholder farmers (Neate & Guei, 2010). While the formal commercial seed system is largely composed of large, multinational agrochemical companies that emphasize uniform seed material that can be grown across a variety of environments, small-scale commercial seed producers have the unique ability to facilitate and preserve access to diverse seed offerings suited to their particular environments (ETC Group, 2011; Jones, 2013a; Pautasso et al., 2013).

5.1.6 Adaptation of varieties to local contexts as key motivator and valued seed characteristic

The desire to adapt varieties to local environments was the third most cited motivation for seed production noted by small-scale commercial seed producers in Ontario. 22% of the 22 websites analysed note the importance of locally adapted seeds and a further 36% of websites identify locally adapted seeds as a seed characteristic prioritized in their seed production. The language used to describe the significance of locally adapted seeds includes reference to the resiliency and sustainability of food systems and the need for adaptable varieties able to withstand the unique growing conditions across Canada:

> Working closely with our counterparts in a robust network of Canadian seed growers to promote access to high quality regionally adapted seeds is another endeavour we value. We are passionate about seed and believe that **access to high quality seed grown for Canadians in Canada** to the best of our abilities helps to **build a more secure resilient food system** in our local communities and nationally (Hawthorn Farm, 2023) (emphasis added).

> Bear Root Gardens believes that seeds are one of the most important elements in creating a **sustainable** food system. They pride themselves on offering their neighbours and friends a range of locally adapted seeds that thrive in Northern conditions. Locally adapted seeds are important for producing and sustaining strong yields year after year and are often more resistant to pests and diseases (Bear Root Gardens, 2023) (emphasis added).

The value attributed to locally adapted seeds by small-scale commercial seed producers was also affirmed by a similar study of small-scale seed savers and producers conducted by Baxley et al. (2020); participants rated local adaptability as one of the most valued seeds

characteristics in their production practices, with ~70% of participants rating local adaptability of seeds as either very important (~50%) or important (~20%). Participants in the same study also identified the desire to adopt varieties to their local environments as a key motivator for their seed production, with ~80% noting that this was either "very important" (~45%) or "important" (~35%) to their seed production practices.

The websites of small-scale commercial seed producers analysed above focus primarily on the environmental benefits of locally adapted seeds, ranging from increased pest and disease resistance to drought tolerance and increased ability to withstand changing environmental conditions associated with climate change (Bear Root Gardens, 2023; Canadian Organic Seed Company 2023b). Importantly, however, the value attributed to locally adapted seeds by these small-scale commercial seed producers must be understood within the context of the seed market in which they operate. As previously noted, the current Canadian seed market is dominated by regional resellers who source their seeds from international producers and seed companies who ship their seeds to Canada (Bauta Family Initiative on Canadian Seed Security, 2020b). Given that these resellers rely on seeds sourced and produced internationally, few seeds are specifically bred for the diverse environmental conditions within Canada (Chable et al., 2020; Kahane et al., 2013). Instead, large-scale seed companies prioritize seeds developed in other countries that can grow in a wide range of conditions that can then be marketed to the greatest number of customers across a range of growing zones (Worden-Rogers, 2015). Thus, it is largely small-scale commercial seed producers, who typically cater to a smaller and more localized customer base, who offer seed varieties adapted to the locales in which they are based. As a result, given the unique opportunity for small-scale commercial seed producers to offer seeds specifically adapted to local environments, it makes sense that this is a valued motivation and seed characteristic shared among these producers. In addition, as the Bauta Family Initiative on Canadian Seed

Security (2012) notes, the value posited to the demand for and production of locally adapted seeds is also inherently connected to other values already discussed in this thesis, such as that of increased agrobiodiversity and non-genetically modified seeds.

5.1.6 Heirloom as a valued seed characteristic

36% of small-scale commercial seed producers noted the importance of offering heirloom seed varieties on their websites. Heirloom seed varieties are closely related to, but importantly distinct from, open-pollinated seed varieties, another characteristic identified as of value by small-scale commercial seed producers. While all heirloom varieties are necessarily also open-pollinated, not all open-pollinated varieties are heirloom (SeedSavers Exchange, 2012). The significance posited to heirloom seed varieties by small-scale commercial seed producers noted in the content analysis was also reflected by Baxley et al. (2020), who found that ~65% of participants rated the significance of heirloom seed varieties as either important (~35%) or very important (~30%).

Small-scale commercial seed producer's explanations of the importance of heirloom seed varieties contain two major themes: the cultural and historical significance of heirloom seed varieties and their ability to strengthen the future sustainability of food systems. As one producer notes, "Heirloom seeds contain the history of farming within them. Saving seeds helps protect that knowledge as well as the unique crops they produce" (UrbanTomato, 2023). Heirloom varieties are often associated with and a reflection of the cultures, families, and societies from which they originate; as Dwivedi (2019) notes, one of the defining features of heirloom varieties is that they are typically passed down from gardener to gardener or handed down generationally in families. As a result, the heirloom varieties that survive and continue to be passed down reflect the values of the gardeners who saved these

seeds and what they deemed significant enough to warrant the time and labour associated with passing them down. These values can also include taste preferences associated with particular, older cultivars that represent an important aspect of a community's heritage, as noted by Dwivedi (2019). This commitment to preserving and passing down heirloom varities is important: with the increase of availability of high-performing hybrid cultivars in the 20th century, many began to notice the disappearance of heirloom varieties as growers opted to use hybrid cultivars rather than heirlooms (Dwivedi, 2019). By making heirloom varieties more widely available, therefore, small-scale commercial seed producers aid in the preservation of heirloom varieties that may otherwise disappear.

The other overarching theme noted by small-scale commercial seed producers in their explanations of the significance of heirloom varieties, as noted on their websites, is the ability of these varieties to improve the future sustainability of food and agricultural systems. As noted by one producer, "Heirlooms are the link to the past and the key to our future" (Tree and Twig, 2023). This belief is also affirmed by other producers, including the UrbanTomato, a small-scale commercial seed producer located in Peterborough: "Heirloom seeds contain the history of farming within them. Saving seeds helps protect that knowledge as well as the unique crops they produce" (2023). The potential of heirloom seed varieties to contribute to the future sustainability of food and agricultural systems is strongly connected to the other strongly valued seed characteristics already noted in this discussion section, such as open-pollinated seed varieties and the importance attributed to genetic diversity of seeds. As previously noted, heirloom and open-pollinated varieties are closely related. Thus, many of the same benefits cited by producers when noting the significance of open-pollinated varieties were also noted in their explanations of heirloom varieties. This is illustrated in the following quote, in which one producer explicitly notes the sustainability benefits of heirloom seed varieties due to their open-pollination and the vast genetic diversity of heirloom varieties:

> Heirloom varieties have been grown for several generations. They are open-pollinated by wind and insects, allowing us to save the seed to grow for years to come, ensuring our food supply. Our ancestors have left us a rich agricultural heritage to be treasured. It is [our] mission to preserve that heritage [...] for present and future generations to come (Heritage Seed & Produce, 2006a).

The values ascribed to heirloom seed varieties by small-scale commercial seed producers are therefore unique in that they represent an amalgamation of many of the other seed characteristics already noted as of value by these producers. As John Navazio (2012) notes, the seed is a "reflection of the farming system as it is grown, cultivated, selected, and fully incorporated into that system" (p. 388). Based on the results of the content analysis, for these small-scale commercial seed producers heirloom varieties are a reflection of the values ascribed to familial and cultural heritage, transgenerational seed-saving practices, plant genetic diversity, and long-term food sustainability.

5.1.7 Present and Future Challenges

Of the 18 challenges small-scale commercial seed producers were asked to identify their level of concern for both presently and in the future, only two are specific to seed production: restrictive patent rights and the consolidation of large-scale commercial seed companies, also referred to as agri-chemical corporations. The other challenges listed, even those noted as of most concern to small-scale commercial seed producers, are currently experienced universally by all those in the agriculture sector and are not specific to seed production. These universal concerns include the environmental challenges identified as the most significant future concern by small-scale commercial seed producers, such as warmer summers, shifting agricultural calendars and periods of drought. In an attempt to remain as focused as possible on the unique experiences of small-scale commercial seed producers, this

section focuses specifically on the challenges particular to these producers: namely restrictive patent rights and the consolidation of large-scale commercial seed companies. These results suggest that Ontario's small-scale commercial seed producers are threatened not only by increasing environmental challenges, such as warming summers and periods of drought, but by legal and policy-based challenges that affect the economic viability of these producers.

Restrictive Patent Rights

"Intellectual property" refers to a set of laws, including patents, copyright, trademarks, and Plant Breeders' Rights, that aim to protect people and companies from losing control over their intellectual creations or ideas (Canadian Biotechnology Action Network [CBAN], 2023). In recent years, the application of intellectual property rights (IPR) to plant varieties and genetic traits has become increasingly common (Smyth, 2014; Stein, 2005). Although evidence of plant breeding and seed saving for hundreds, if not thousands, of years exists, the application of intellectual property laws to living organisms is a relatively new phenomenon (Jenney, 2013). Theoretically, these intellectual property protections allow companies and researchers the ability to ensure a financial return on their research and development interests (Access to Seeds, 2023). Importantly, however, this patenting also has a number of subsequent consequences. As the Organic Seed Alliance (2021) notes, patents privatize and commodify the genetic and cultural heritage of humanity – patented seeds cannot be shared, saved, or replanted by gardeners and farmers (Open Source Seed Initiative, 2023). By patenting plant varieties under intellectual property laws, large-scale agro-chemical companies can restrict access to these varieties to those who sign technology use agreements that prevent them from saving, replanting, or selling the seed to others (Jenney, 2013; Smyth, 2014; Stein, 2005). This creates consumer reliance on a handful of large-scale companies that have the power and financial resources to pursue and defend legal strategies (Jenney, 2013). Small-scale commercial seed producers, who largely operate outside of the agricultural-

industrial complex and engage in organic and ecologically sustainable growing practices are thereby left to understand and navigate complex intellectual property rights in order to source and market their seeds (Jenney, 2013).

As the Bauta Family Initiative on Canadian Seed Security (2022) importantly notes, the relatively recent increase in the application of IPRs to plant life as well as increased news coverage of enforcement of these patents (such as the *Monsanto v. Schmeiser* 1997 Supreme Court of Canada case, among others), has left many farmers and seed producers concerned about potential risks of litigation and legal action *(Monsanto Canada Inc v. Schmeiser,* 1997). These concerns are not unfounded: as reported by *Civil Eats,* small-scale seed producers in the United States are increasingly the recipients of cautionary letters from large-scale multinational commercial seed companies, like BASF, which emphasize the company patent rights and warn against the "unlicensed or unauthorized use" of their technology and/or germplasm (McCluskey & Hubbard, 2020). For many recipients, these letters feel like part of a "concerted effort on the part of BASF to intimidate farmers who breed, grow, and sell seed" (McCluskey & Hubbard, 2020). Interestingly, the results of this survey of small-scale commercial producers in Ontario indicate that while producers are not **currently** concerned about the challenge of restrictive patent rights to their production, they anticipate this becoming a greater challenge in the future. On a scale of one to five, from least (1) to most challenging (5), participants rated their level of **current** concern for restrictive patent rights a 2.74 and their level of **anticipated** concern for the same issue in 10 years a 3.25. Similarly, participants of a study of small-scale seed savers and producers in Vermont also noted an increase between the level of concern presently noted by participants (2.12) and their anticipated level of concern in ten years' time (2.76) (Baxley et al., 2020). The future anticipation of the challenges of restrictive patent rights to small scale commercial seed producers is reflected in other Canadian literature. For example, the Bauta Family Initiative

on Canadian Seed Security (2022) note that while the vast majority of plant varieties used by Canadian gardeners today are *not currently* covered by intellectual property rights (IPR) restrictions, increasingly more "public crop development institutions" and agri-crop input corporations are looking to IPR tools to recoup the costs of breeding and development in the absence of sufficient public funding. This means that small-scale commercial seed producers' access to and ability to offer particular plant varieties may become further restricted as producers are forced to navigate the complex legal mechanisms associated with IPRs in Canada. Thus, it is important that small-scale commercial seed producers and savers alike have the educational resources and information at their disposal to enable them to continue what Bauta labels as the "important work [of] stewarding the biodiversity of humanity's common seed heritage" without fear of legal prosecution (Bauta Family Initiative on Canadian Seed Security, 2022, p. 5).

Consolidation of large-scale commercial seed companies

The consolidation of large-scale commercial seed companies undeniably impacts both small-scale commercial seed producers and farmers alike. As the USDA notes, a number of universal impacts emerge from the merger of large-scale commercial seed companies and agri-input corporations, including, but not limited to, reduced competition in particularly high concentrated seed markets and decrease in the availability of crop genetic diversity (USDA, 2019). Importantly, however, small-scale commercial seed companies are uniquely threated by the continued consolidation of large-scale commercial seed companies in a number of ways. Firstly, as Howard (2009) notes, the consolidation of power associated with the mergers of these companies is "fundamentally incompatible" with traditional agricultural practices like saving and replanting seeds that are perceived by these large companies as "barriers to large-scale capital accumulation" (p. 1282). Furthermore, larger-seed companies and agri-input corporations have relatively greater access to financial and legal resources that

can enable them to utilize and apply IPRs to their advantage, restricting the access of small-scale commercial seed producers to particular plant varieties (Howard, 2009; Jenney, 2013). This monopoly on the seed market by larger seed companies allows them to guarantee stable profits on their products by "ceasing to compete on the basis of price" (Howard, 2009). What this means, essentially, is that companies of this size are able to raise prices or restrict output, with others following suit, at their leisure, given that so few alternatives to their products exist (Howard, 2009). According to Howard (2009), this kind of price-fixing occurs when a market becomes monolithic and no longer competitive, defined by the control of four firms of at least 40% of a market. In 2016, 75% of the global agro-chemical market (which includes seeds) was controlled by only six companies, thereby easily meeting the definition of a non-competitive market (Clapp et al., 2016).[3] This price-fixing is particularly detrimental to small-scale commercial seed companies who are unable to compete with the low prices offered by these large-scale seed and agro-chemical companies (Howard, 2009). This makes those with values and motivations beyond economic goals, such as small-scale commercial seed producers, particularly economically vulnerable to the shifting prices of the seed market (Howard, 2009). Moreover, the economic power and reach of large-scale companies often translates to political power, thus enabling larger firms to lobby governments for policies and legislation that supports their aims and result in an uneven playing field that favours the large (Howard, 2009). Thus, the economic viability of the operations of small-scale commercial seed producers is directly threatened by the continuing consolidation of large-scale commercial seed companies.

The consolidation of large-scale commercial seed companies was one of the concerns identified as **most challenging** both presently and in the future by small-scale commercial

[3] Known as the "Big Six," these companies are: Syngenta, Dow, DuPont, Monsanto, Bayer, and BASF (Clapp et al., 2016).

seed producers. While participants noted that the consolidation of large-scale commercial seed companies is presently a concern (3.75), they anticipated that it would become even more challenging in the future (4.67). This increase in concern for the **future** impact of the consolidation of larger-scale seed companies was also noted by small-scale seed producers and savers in Baxley et al.'s study (2020), who were also asked to rate their level of concern for the impacts of consolidation of larger-scale seed companies on their seed production both presently and in ten years' time. While participants in both studies (Baxley et al. (2020) and the results presented herein) reported increased concern for the **future** impacts of the mergers of larger-scale seed companies on their seed production, producers in Ontario reported more concern overall for the consolidation of seed companies than their American counterparts. While this is interesting, it is not entirely clear why Canadian (specifically those in Ontario) small-scale commercial seed producers perceive the threat of large-scale seed company consolidation as more harmful to their seed production than American (Vermont) small-scale seed producers and savers, especially given that these large-scale seed and agrochemical companies are multinational and operate in both these countries.

5.2 Limitations of Research

In order to provide meaningful next steps and recommendations for future research, the limitations of this study must first be noted. As noted in Section 3.3, the survey response rate was lower than expected, with only six of 23 invited participants opting to participate. Thus, the survey results noted in Chapters four and five must be taken with care.

The low response rate could be the result of several factors, including practical requirements of participation and language of survey. Recruitment and participation in the survey required reliable access to the internet through a computer or personal device. This may have unintentionally excluded participants without reliable access to the internet or a personal device from participating, particularly those in rural areas without reliable internet access or those unable to afford a personal device. In the future, designing a study with options to participate both electronically (online surveys) or through mail-in surveys may result in increased participation and greater diversity of participants. In addition, due to the researcher's capacity and resources, the survey was only made available in English. As a result, non-English speaking or reading small-scale commercial seed producers were unable to participate. Future studies may consider offering participants the ability to participate in either English or French, the two official languages of Canada, in order to enable Francophone small-scale commercial seed producers to participate.

The time constraints of the researcher and the structural constraints associated with an undergraduate thesis meant that the study was limited in its ability to engage directly with small-scale commercial seed producers. Instead of building a relationship of trust over a period of time, the thesis timeline (eight months) meant that the researcher had limited ability to cultivate relationships with producers prior to requesting their participation. Partnerships that involve stakeholders and researchers often involve an inherent imbalance of power

(Wilkins, 2018). Thus, effective engagement requires establishing and maintaining mutually respectful relationships that are built on a foundation of trust (Wilkins, 2018). Future research, therefore, may consider allotting more than eight months of time to the construction and execution of their research and establishing relationships with participants prior to participation. Importantly, however, this must be accomplished in accordance with the guidelines and approval of the Research Ethics Board. An effective example of the cultivation of mutual respect and utility between participant and researcher, in the context of agriculture, was Soubry's decision to conduct participant interviews while assisting in field work (2018). As he notes, this exchange of work for information enabled them to cultivate and maintain a sense of relational accountability and mutual respect between farmers and researchers (Soubry, 2018). Future research, therefore, may consider similar strategies to establish mutual respect and trust prior to participation. This, in turn, may also increase the rate of participation.

The content analysis focused solely on the information that was publicly accessible on the websites of small-scale commercial seed producers and chose to ignore any social media accounts associated with their operations. This decision was made for two primary reasons: the practical time constraints of the researcher and the fact that while 22 out of 23 small-scale commercial seed producers possessed websites, not all of these producers also operated active social media accounts associated with their operations. As Calcagni et al. (2019) note, however, social media platforms are important sites for the co-construction of values, particularly relational values that spring from social-ecological interactions. As a result, future content analyses of small-scale commercial seed producers could consider analysing both their websites and social media profiles in order to gain a more holistic and accurate overview of their values.

CHAPTER 6: CONCLUSION

The lack of pre-existing research on small-scale commercial seed producers within Ontario allows this study to posit some preliminary findings about an important part of Ontario's seed and agricultural system that is little known and understood. Small-scale commercial seed producers occupy a unique role within Ontario's seed system as actors of both formal and informal seed systems: they are able to recognize and respond to the needs of small-scale farmers and gardeners while simultaneously conforming to the requirements of the larger formalized seed system. Unlike their larger counterparts, small-scale commercial seed producers in Ontario offer almost exclusively open-pollinated seeds, some of which are heirloom seed varieties produced through certified and non-certified organic production practices. These producers prioritize the production of seeds that are genetically diverse, organic, non-genetically modified, locally adapted, and open-pollinated. Crucially, the results of this study indicate that small-scale commercial seed producers are largely motivated by relational values, or values individuals hold as a result of their responsibilities to, and relationships with, the environment and other people (Tobin, 2022). The desire to promote sustainable agriculture via the production of organic, non-genetically modified, and open-pollinated seeds was identified by these producers as a primary motivation to begin seed production. Importantly, these small-scale commercial seed producers anticipate a number of future threats to their seed production, namely environmental challenges associated with changing environmental conditions, such as warming summers and periods of drought. Legal and policy-based challenges specific to seed production, such as restrictive patent rights and consolidation of large-scale commercial seed companies, was also identified as a source of significant anticipated concern.

The results of this study successfully addressed aspects of the three research objectives initially identified by the researcher: the identification of the general demographic

characteristics of small-scale commercial seed producers, their values and motivations, and their unique concerns and opportunities for future growth. Importantly, however, the low response rate and lack of prior research studies on the topic limited the ability of the researcher to make substantive conclusions and to identify actionable items to support these producers. Thus, further research is needed to fully situate the unique identity, values, motivations, and concerns of Ontario's small-scale commercial seed producers within Ontario's larger seed and agricultural systems. Specifically, studies that compare and contrast the motivations and values held by large and small-scale commercial seed producers and their present and future concerns will contextualize the results of this study and enable a more holistic understanding of Ontario's seed industry.

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APPENDIX A: Survey

INCLUSION CRITERIA:

You are required to be at least 18 years of age to complete this survey. Please confirm this below in order to continue.

- ❑ Yes, I am at least 18 years of age.

This study targets small-scale commercial seed producers, defined as seed producers within Ontario who sell seeds commercially, part of which they have grown themselves in Ontario. These producers must offer and grow more than plant variety, rather than specializing in a single crop.

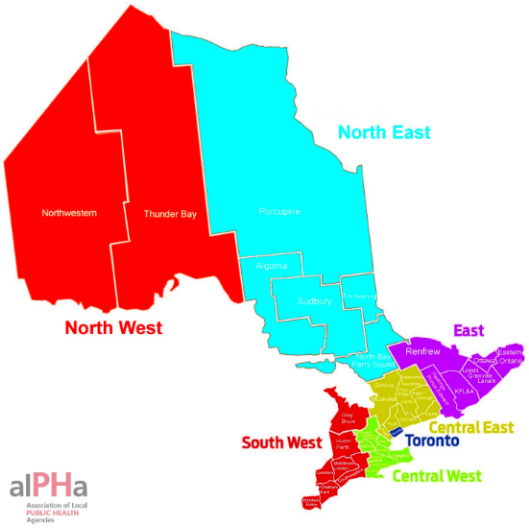
Does your seed or seed-producing operation meet this description?

- ❑ Yes
- ❑ No

SECTION A: DEMOGRAPHICS

1) **In which zone in Ontario is your farm or seed-producing operation located?**

- ❑ North West



- ❑ North East
- ❑ East
- ❑ Central East
- ❑ Toronto
- ❑ Central West
- ❑ South West
- ❑ Unsure
- ❑ Prefer not to answer

Sourced from: https://www.alphaweb.org/page/PHU

2) **What is your gender?**

- ❑ Female (cisgender or transgender)
- ❑ Male (cisgender or transgender)
- ❑ Nonbinary
- ❑ Fluid
- ❑ Prefer not to answer

3) **How old are you?**

- ❑ 18 – 24
- ❑ 25 – 34
- ❑ 35 – 44
- ❑ 44 – 54
- ❑ 55 – 64
- ❑ 65 and over
- ❑ Prefer not to answer

4) **What is your highest level of formal education?**

- ❑ Highschool
- ❑ Undergraduate University Degree (Bachelor's)
- ❑ Graduate University Degree (Master's or PhD)
- ❑ Trade/technical/vocational training
- ❑ College diploma or certificate
- ❑ Prefer not to answer

5) **Do you come from an agricultural background (ie. grew up on a family farm, hobby farm, had family members that were farmers?)**

- ❑ Yes
- ❑ No
- ❑ Prefer not to answer

6) **What type of education, training, or experience do you have in the area of seed growing, breeding, and saving? (Choose all that apply).**

- ❑ University trained
- ❑ Self-taught
- ❑ Workshops
- ❑ Apprenticeships
- ❑ Farmer-to-farmer training
- ❑ Resource Books
- ❑ Not applicable
- ❑ Prefer not to answer
- ❑ Other (please specify)

_____

7) **Which farming practice best describes your seed-operation's approach to seed production?**

- ❑ Certified Organic
- ❑ Non-certified Organic
- ❑ Conventional
- ❑ Other (please describe)

_____

- ❑ Prefer not to answer

8) **How many acres of land does your seed-operation have in seed production?**

- ❑ <1 acre
- ❑ 1 – 1.9 acres
- ❑ 2 – 2.9 acres
- ❑ 3 – 3.9 acres
- ❑ 4 – 4.9 acres
- ❑ 5-10 acres
- ❑ 10+ acres
- ❑ Prefer not to answer

9) **How long have you, as an individual, been saving seed?**

- ❑ <1 year
- ❑ 1 - 5 years
- ❑ 6-10 years
- ❑ 11-15 years
- ❑ 15+ years
- ❑ Prefer not to answer

10) **How long have you, as an individual, been producing seed for commercial sale?**

- ❑ <1 year
- ❑ 1-5 years
- ❑ 6-10 years

- ❑ 11-15 years
- ❑ 15+ years
- ❑ Prefer not to answer

11) **Of the seeds your seed-operation offers for commercial sale each year, what percentage is open-pollinated?**

- ❑ None
- ❑ 1 - 25%
- ❑ 26 - 50%
- ❑ 51 – 75%
- ❑ 76 – 100%
- ❑ Unsure
- ❑ Prefer not to answer

12) **On a scale of 1 (not important at all) to 5 (very important), how important do you feel it is for your seed-operation to offer open-pollinated seeds?**

- ❑ 1 (not important at all)
- ❑ 2 (not very important)
- ❑ 3 (neither important nor unimportant)
- ❑ 4 (important)
- ❑ 5 (very important)
- ❑ Prefer not to answer

13) **Are there particular barriers that exist that prevent you from offering any or more open-pollinated seeds?**

_____
_____
_____
_____

14) **Of the seeds you offer for commercial sale each year, what percentage is heirloom?**

- ❑ None
- ❑ 1 - 25%

- ❑ 26 - 50%
- ❑ 51 – 75%
- ❑ 76 – 100%
- ❑ Unsure
- ❑ Prefer not to answer

15) **On a scale of 1 (not important at all) to 5 (very important), how important do you feel it is for your seed-operation to offer heirloom seeds?**

- ❑ 1 (not important at all)
- ❑ 2 (not very important)
- ❑ 3 (neither important nor unimportant)
- ❑ 4 (important)
- ❑ 5 (very important)
- ❑ Prefer not to answer

16) **Are there particular barriers that exist that prevent you from offering any or more heirloom seeds?**

_____

_____

_____

_____

17) **Of the seeds you offer for commercial sale each year, what percentage is hybrid?**

- ❑ None
- ❑ 1 - 25%
- ❑ 26 - 50%
- ❑ 51 – 75%
- ❑ 76 – 100%
- ❑ Unsure
- ❑ Prefer not to answer

18) **On a scale of 1 (not important at all) to 5 (very important), how important do you feel it is for your seed-operation to offer hybrid seeds?**

- ❑ 1 (not important at all)

- ❑ 2 (not very important)
- ❑ 3 (neither important nor unimportant)
- ❑ 4 (important)
- ❑ 5 (very important)
- ❑ Prefer not to answer

19) **Are there particular barriers that exist that prevent you from offering any or more hybrid seeds?**

_____
_____
_____
_____

20) **Please identify which seed crops you have produced for commercial seed sale in the last 10 years. Please check all that apply.**

- ❑ Artichoke
- ❑ Arugula
- ❑ Asian Greens
- ❑ Basil
- ❑ Beans (Bush, Dry, Fava, Pole, Runner, Snap, Soy)
- ❑ Beets
- ❑ Broccoli
- ❑ Brussel Sprouts
- ❑ Cabbage
- ❑ Carrots
- ❑ Cauliflower
- ❑ Celery
- ❑ Collards
- ❑ Corn
- ❑ Cucumber
- ❑ Eggplant
- ❑ Fennel
- ❑ Flowers
- ❑ Ground Cherry
- ❑ Herbs (please specify which types):

  _____

_

- ❑ Kales
- ❑ Kohlrabi

- ❑ Leeks
- ❑ Lettuces
- ❑ Melons
- ❑ Mustards
- ❑ Okra
- ❑ Onions
- ❑ Parsnips
- ❑ Peas
- ❑ Peppers, Hot
- ❑ Peppers, Sweet
- ❑ Potatoes (True Seed)
- ❑ Pumpkin
- ❑ Radish
- ❑ Spinach
- ❑ Summer Squash
- ❑ Swiss Chard
- ❑ Tomatillos
- ❑ Tomatoes
- ❑ Watermelon
- ❑ Winter Squash
- ❑ Other (please specify):

  _____
- ❑ Prefer not to answer

21) **Please estimate the approximate number of varieties of each seed crop you have grown in the past 10 years.**

[open text box] Artichoke
[open text box] Arugula
[open text box] Asian Greens
[open text box] Basil
[open text box] Beans (Bush, Dry, Fava, Pole, Runner, Snap, Soy)
[open text box] Beets
[open text box] Broccoli
[open text box] Brussel Sprouts
[open text box] Cabbage
[open text box] Carrots
[open text box] Cauliflower
[open text box] Celery
[open text box] Collards
[open text box] Corn
[open text box] Cucumber
[open text box] Eggplant
[open text box] Fennel

[open text box] Flowers
[open text box] Ground Cherry
[open text box] Herbs (please specify which types):
_____
[open text box] Kales
[open text box] Kohlrabi
[open text box] Leeks
[open text box] Lettuces
[open text box] Melons
[open text box] Mustards
[open text box] Okra
[open text box] Onions
[open text box] Parsnips
[open text box] Peas
[open text box] Peppers, Hot
[open text box] Peppers, Sweet
[open text box] Potatoes (True Seed)
[open text box] Pumpkin
[open text box] Radish
[open text box] Spinach
[open text box] Summer Squash
[open text box] Swiss Chard
[open text box] Tomatillos
[open text box] Tomatoes
[open text box] Watermelon
[open text box] Winter Squash
[open text box] Other (please specify):
_____

- ❑ Prefer not to answer

22) **On a scale of 1 (not rigorous) to 5 (very rigorous), how rigorous are you with your crop selection process?**

- ❑ 1 (not rigorous)
- ❑ 2 (not very rigorous)
- ❑ 3 (somewhat rigorous)
- ❑ 4 (rigorous)
- ❑ 5 (very rigorous)
- ❑ Prefer not to answer

23) **Please select any barriers that prevent you from practicing specific selection on your seed crops. (Choose all that apply).**

- ❑ Lack of space to grow out more seed
- ❑ Lack of time
- ❑ No reason to do selection
- ❑ I am unaware of selection practices
- ❑ I am new to seed production and am still learning how to select for breeding
- ❑ I do not want to go below ideal population numbers
- ❑ Not applicable
- ❑ Prefer not to answer
- ❑ Other (please specify)

_____
_____
_____
_____

SECTION B: SEED-BASED VALUES & MOTIVATIONS

24) **On a scale of 1 to 5, from not important at all to very important, how would you rate the following seed characteristics in your own seed sourcing and production (please check box):**

Seed characteristic	1 (Not important at all)	2 (Not very important)	3 (Neither unimportant nor important)	4 (Important)	5 (Very important)
Flavour of Crop Fruit					
Regionally Adapted					
Non-GMO					
Organic					
Disease resistant					
Heirloom					
Open-Pollinated					
High yield					
Culturally significant					

Frost Resistant					
Drought Resistant					
Easy to Grow					

Are there other seed characteristics, not listed, that you prioritize in your seed sourcing and production? What are they and how would you rate them?

_____
_____
_____
_____

- ❑ Prefer not to answer

25) **On a scale of 1 to 5, from least important to most important, how important were the following factors in your decision to begin producing seed?**

Motivation	1 (Not important at all)	2 (Not very important)	3 (Neither important nor unimportant)	4 (Important)	5 (Very important)
Adapt Varieties to my environment					
Offer varieties otherwise not available in my community					
Build climate resilience in my community					
Support local food systems					
Make money					
Market demand					
Concern about consolidation of					

seed companies (overwhelming market control)					
Promote sustainable agriculture					
Increase availability of locally produced and adapted seeds in my community					
Produce seed for my own garden					
Leisure/hobby					
Preserve traditional agricultural practices					
Increase agrobiodiversity					
Meet people					
Combat food insecurity in my community					

Are there other motivations, not listed, that are important to why you produce seeds? What are they and how would you rate them?

_____

_____

_____

_____

- ❑ Prefer not to answer

SECTION C: AREAS OF CONCERN, OPPORTUNITY AND GROWTH

Potential question:

What support would most help you to grow better seeds?

26) **On a scale of 1 to 5, from least challenging to most challenging, please rate the following challenges to the <u>current</u> production of seed crops.**

Concern	1 (Not a challenge at all)	2 (Not challenging)	3 (Neither not challenging nor challenging)	4 (Challenging)	5 (Very challenging)
Pests					
Lack of time					
Disease					
Consolidation of large-scale commercial seed companies					
Aging farmer population					
Lenient regulations for GMO crops					
Decline in number of small farms					
Lack of interest among younger population to enter farming					
Periods of Drought					

Shifting agricultural calendar					
Warmer summers					
Poor soil quality					
High cost of production					
Restrictive patent rights					
Lack of access to land					
Demanding organic certification standards					
Low consumer demand					
Flooding					

Are there other concerns, that are not listed, that currently impact your seed crop production? What are they and how would you rate them?

_____

_____

_____

_____

- ❑ Prefer not to answer

27) **On a scale of 1 to 5, from least challenging to most challenging, please rate the following <u>anticipated</u> challenges to the production of seed crops in 10 years.**

Concern	1 (Not a challenge at all)	2 (Not challenging)	3 (Neither not challenging nor challenging)	4 (Challenging)	5 (Very challenging)
Pests					
Lack of time					
Disease					
Consolidation of large-scale commercial seed companies					
Aging farmer population					
Lenient regulations for GMO crops					
Decline in number of small farms					
Lack of interest among younger population to enter farming					
Periods of Drought					
Shifting agricultural calendar					
Warmer summers					
Poor soil quality					
High cost of production					
Restrictive patent rights					

Lack of access to land					
Demanding organic certification standards					
Low consumer demand					
Flooding					

Are there other concerns, that are not listed, that you anticipate impacting your seed crop production in 10 years? What are they and how would you rate them?

_____

_____

_____

_____

- ❑ Prefer not to answer