HOLLAND MARSHTechnical
novationInnovation
Roadmap

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Table of Contents

1. PURPOSE & GOALS	4
2. PROJECT OVERVIEW & METHODOLOGY	5
2.1 LITERATURE REVIEW	5
2.2 INDUSTRY OUTREACH	5
2.3 DISTRIBUTION AND PROMOTION OF RESOURCES DEVELOPED TO SECTOR	5
3. LITERATURE REVIEW	6
3.1 THE HOLLAND MARSH - BACKGROUND	6
3.1.1 Economic Significance 3.1.2 Challenges and Pressures	7 8
3.2 HUMAN RESOURCES	10
3.3 COSTS OF THE NEW NORMAL	13
3.4 IMPROVEMENT AND INNOVATION OPPORTUNITIES	14
3.4.1 Health and Safety	14
3.4.2 In Field Technologies	16
3.4.4 Addressing Consumer Needs	
3.5 FOUNDATIONS FOR TECHNOLOGY	
3.5.1 Infrastructure	19
3.5.2 Strageic Planning	
3.5.3 Education/Skilled Labour	
4. INDUSTRY OUTREACH	22
4.1 SURVEY OVERVIEW	23
4.1.1 Overview of Businesses in the Holland Marsh	23
4.1.2 Human Resources - Staffing	24
4.2 PRIORITIES	
4.2.1 Impact of Covid on Business	26
4.2.2 Being Pandemic Ready	27 פכ
4.2.4 Possible Labour Reductions	

4.3

3 BUSINESS IMPROVEMENTS THROUGH INNOVATION & BARRIERS TO INVESTMENT	
4.3.1 Financial Barriers	
4.3.2 Infrastructural Supports	
4 PROCUREMENT & PLANNING FOR INVESTMENT	
4.4.1 Size of Farm & Short Seasons	35
4.4.2 Age of Farm Owner	36
4.4.3 Culture	36
5 DIGITAL INNOVATIONS TO ADDRESS CHANGING MARKET CONDITIONS	
CONCLUSIONS & RECOMMENDATIONS	
FERENCES	40
PPENDIX A: SUPPLEMENTARY ONLINE SURVEY FIGURES	

4.4

4.4.1 Size of Farm & Short Seasons
4.4.2 Age of Farm Owner
4.4.3 Culture

4.5

5.0

REI

AP

LIST OF TABLES

Table 1: Crops Grown in the Holland Marsh
Table 2: Monthly average retail prices for Carrots an
Table 3: Key Markets
Table 4: Staffing Requirements, by Farm Size
Table 5: Average Agreement to Staffing Challenges,
Table 6: Key Technological Improvements
Table 7: Expected Labour Reductions with Introduction
Table 8: Survey Results: Identified Barriers to Investr
Table 9: Access to Infrastructure, by Farm Size

LIST OF FIGURES

Figure 1: Map of the Five Townships that Define the
Figure 2: Challenges in Retaining Workers
Figure 3: Infection Control Pyramid
Figure 4: Word Cloud Describing Greatest Pandemi
Figure 5: Over the past year, how has COVID impac
Figure 6: Relative Importance of Areas, to be pande
Figure 7: On my farm/business, investments throug
would reduce the need for labour in the foll

	7
nd Onions, Accounting for Inflation	9
-	23
	24
, by Farm Size	24
-	29
tion of New Technology, by Farm Size	30
ment and Areas of Business Improvement	32
· · · · · · · · · · · · · · · · · · ·	

e Holland Marsh	6
	11
	14
ic Challenges	25
cted your business?	
emic ready and stay competitive	27
gh technology and innovation	
lowing areas	



PURPOSE GOALS

In 2018, the Labour Market Forecast found that the shortage of labour cost Canada's agri-food sector \$2.9 billion in lost sales. The COVID-19 pandemic has amplified these existing labour challenges within the agri-food sector due to the labor-intensive nature of many farms and food processors. The Holland Marsh which typically supplies 56% of Canada's requirement for carrots alone, forecasted a drop in production by 50% due to pandemic related issues, among which is insufficient labour.

There is a pressing need to make innovative changes to the way agri-food businesses operate to reduce the risk of illness transmission such as COVID-19. There is opportunity to reduce risk factors present in these agri-food operations, reduce the impact to human health and safety while also influencing labour productivity to respond to the chronic ongoing labour issues.

The purpose of this project is to identify technological improvements not yet widely adopted by the sector and the Holland Marsh specifically, which would allow industry to be equipped to manage the effects of a pandemic, have co-benefits to help address ongoing labour challenges, and support the continuation of a safe, high-quality and nutritious supply of food.

Research goals were to:

- Establish priorities for applicable Innovative Technologies that businesses could consider implementing to achieve the objectives of being pandemic ready, competitive, and feature labour co-benefits.
- Identify ways to aid businesses to conduct an operational assessment of available technologies.
- Identify best practices related to business planning, procurement and implementation of technologies to be adopted and implemented.

2. PROJECT OVERVIEW & METHODOLOGY

The research comprises three activities, a literature review, industry outreach and finally communication of the findings to industry stakeholders. The following provides an outline of each of the activities.

2.1 LITERATURE REVIEW

To provide direction and ensure relevance to the Holland Marsh, the research team began the project by interviewing five industry stakeholders. These industry experts provided advice about challenges and opportunities related to production in the Holland Marsh, the current use of technology in their sector, labour capacity, and how their businesses have responded to COVID-19. They also provided insights into how their businesses might become better prepared for any future pandemics, and be more competitive in the future through the adoption of technological innovations.

The research team used this information to provide direction on what areas to include in the literature review. Data from academic journals, media reports and industry articles were reviewed to provide insights. A note of caution: Academic research related to COVID-19 and its impact on the agricultural industry is understandably limited.

The literature review summarizes:

- The role and composition of the Holland Marsh, and its importance to local food security, and the economy of Ontario,
- The importance of strategic planning and infrastructure on decisions relating to technological investments,
- Review of Human Resources for the sector in general and pertaining to COVID-19; to demonstrate the current state and how technology might best support the sector in the future,
- Opportunities and challenges relating to COVID-19 and technological innovation regarding Health and Safety, Automated Equipment both in field and in the packing and operations of the farm,

• Consumer trends impacted by COVID and how businesses in the Holland Marsh may adapt using technology to remain competitive.

2.2 INDUSTRY OUTREACH

The research team utilized the findings from the Literature Review to inform and guide discussions with additional industry stakeholders. An initial focus group with six industry participants was conducted digitally. Their insights, with the literature review provided the basis for the telephone questionnaire template and online survey.

An online survey link was emailed to all members of the Holland Marsh Grower Association (HMGA) to participate and provide feedback. It was the intention that would allow the research team to identify any trends and/or priorities that relate the group as a whole, as well as by business type and/ or size. A 25% response rate was planned for (15 respondents). Thirty-seven percent (22 members) participated.

Two additional focus groups were initially planned to further enhance the primary data collection process, but due to scheduling difficulties, personal phone calls were made instead. The research team interviewed 17 additional value chain stakeholders. In total 22 individuals provided insights through this direct outreach.

All primary research is presented in aggregate format to protect individual business confidentiality. The conclusion and recommendations are included in this section.

2.3 DISTRIBUTION AND PROMOTION OF RESOURCES DEVELOPED TO SECTOR

This report and key findings will be communicated publicly on the HMGA website, industry newsletter and social media posts in 2021.



3.LITERATURE REVIEW

3.1 THE HOLLAND MARSH - BACKGROUND

The area of the Marsh extends beyond the land viewed from the 400 Highway, covering the five townships of Innisfill, Georgina, Bradford West Gwillimbury, East Gwillimbury and King.

The shaded area on the map below identifies the muck cropland that is almost entirely dedicated to vegetable field crops¹. About 60% is agricultural production and 40% is wetlands².

Figure 1: Map of the Five Townships that Define the Holland Marsh



Source: Ontario Ministry of Agriculture, Food and Rural Affairs

The Holland Marsh is an important contributor to the local economy and provides a reliable, high quality food supply to the people of Ontario. Referred to as, "Ontario's Soup and Salad Bowl" by the Holland Marsh Growers Association, there are 125 farms over 7,000 acres of prime agricultural land producing over 60 different crops³.

Though best known for field crops such as carrots, onions, potatoes, beets and cabbage, greenhouse agriculture is also important to the agricultural system of Holland Marsh. Greenhouse production further extends the growing season by providing seedlings for early field transplanting, and vegetable production though an extended season. Through the storage of root vegetables and greenhouse production, the crops grown in the Holland Marsh enable a supply of fresh produce for two-thirds of each year.

Domestic demand for carrots in 2017 was approximately 288,393 metric tonnes⁴ and the amount of carrots produced in the Holland Marsh that year was approximately 158,300 tonnes, representing over 56% of Canada's required supply. The region is an essential supplier to the Canadian food system.

3.1.1 Economic Significance

The 2016 agricultural census reported that agricultural production on the Holland Marsh had a value of \$306.5 MM, of which an estimated \$105 million is attributed to horticultural crops. While the Holland Marsh is especially well suited to the production of root crops (carrots, onions, potatoes, parsnips, beets), there has been expansion in crops for growing domestic ethnic markets such as Chinese vegetables and greenhouse production of cucumbers and floral products. Despite the increased diversity in crops carrots and onions remain the two most significant crops grown in the region accounting for \$29.8 million and \$20.9⁵ million respectively. In addition to this, the greenhouse sector is worth an estimated \$32 million⁶ of the farmgate value and as mentioned above enables the extension of the growing season from the region. Value adding activities such as storing, packing and processing of the products produced in the region is worth an additional \$80 million.

Table 1: Crops Grown in the Holland Marsh

Сгор	In Millions of Dollars	Acres
Carrots	\$29.8	4,203
Onions	\$20.9	3,348
Chinese Cabbage	\$8.9	1,510
Other Vegetables	\$8.3	1,049
Celery	\$3.3	250
Beets	\$1.8	485
Greenhouse Vegetables & Floriculture	\$32.0	49
TOTAL	\$105.1	10,894

Source: Take it Up, 2019

The Holland Marsh produces 158,300 tons of carrots annually. That's more than 56% of Canada's requirement for carrots.

Farms and the businesses they anchor in the value chain both upstream and downstream are major employers in Ontario. Ontario's agriculture and agri-food manufacturing GDP contribution ranked highest in Canada, at \$15.3 billion (2015). The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) reported that the sector's economic contributions, reporting provincial agri-food GDP contributions at \$47.7 billion. This number, a true representation of field to fork, includes primary agriculture production, food processing, retail and food service. OMAFRA's agri-food employment reports that 873,064 jobs are directly linked to agriculture and food⁷.

More specifically, in the Holland Marsh, total agricultural employment, including seasonal as well as full-time work was 2,831 positions in 2016, up 7% from 2011⁸.

One of the strengths of the Holland Marsh is that there is a network of local businesses to enable agriculture, such as dedicated companies to build and maintain specialized farm machinery for planting, spraying, and harvesting.

Unemployment for the local area was 6%, less than the average of 7.4% in Ontario. Seasonal workers continue to be an important part of the agricultural workforce in the Holland Marsh, with many coming from Mexico and the Caribbean through the Seasonal Agricultural Worker Program (SAWP). As in other parts of Canada, these teams are well integrated into the farms they work on, with many returning to the same farms for periods as long as twenty-five years.

According to data provided by the Foreign Agricultural Resource Management Service, over 1,450 seasonal agricultural workers were assigned to 112 employers in York Region and the County of Simcoe in 2016⁶.

3.1.2 Challenges and Pressures

As with many sectors in agriculture the farms on the Holland Marsh have experienced consolidation into fewer, larger farms. The total number of farms declined by 5% from 2011 to 2016 while the acres of farmland in production has remained stable, indicating that the scale of farming is increasing¹⁰. "A few of the challenges facing local growers of root vegetables are common to many farmers in Ontario: labour issues, dollar exchange rates, agricultural input costs rise more than retail prices, adhering to more and more standards imposed on them regarding food safety certification, water use and waste, and observe crop protection regimens against pests and blights"11. Added to this the Holland Marsh has the pressures of urbanization.

Being located North of Toronto, the urban population of the five local municipalities that make up the Holland Marsh continues to grow, increasing 12% from 2011 to 164,235 in 2016. A few of the larger towns have grown even more significantly. For example, the population of Bradford in East Gwillimbury grew by almost 26% between the 2011-2016 Census calculations, and King grew by 23%¹². The proximity to major markets is a benefit, though ongoing urbanization creates challenges for agriculture include increasing land costs, contrasting urban vs rural priorities for government resource allocation and planning, and access to transportation. Roads shared by growers with slow moving farm equipment and suburban residents can be antagonistic. Traffic congestion can create delays for farmers needing prompt access between fields and facilities.

Preserving the rich farmland of the Marsh for high value crop production while allowing the local communities to grow will be an ongoing challenge. Costs of doing business have increased exponentially in the last decade, which Holland Marsh growers report is not consistently reflected in the prices they are paid¹³. A snapshot of the average retail prices for carrots and onions from 2010 to 2020 reflect this ongoing pricing pressure. Worth noting is that although the retail prices for carrots and onions has increased, at varying amounts, retail price increases are not necessarily passed along to growers. This is related not only to the comparative negotiating position of suppliers and Canadian retail buyers who dominate market share, but also to the fact that as commodities, the selling price is largely determined by international competition. The primary growing region with which the Holland Marsh competes is California, which benefits from economies of scale¹⁴, year-round growing and often times lower input costs^{15 16 17 18} (i.e. labour). Mexico provides counter seasonal produce. When government policies impose costs or restrictions on businesses in Ontario that are not applied to international suppliers, the competitive position of the Holland Marsh vegetable production value chain is adversely impacted¹⁹.

Table 2: Monthly average retail prices for Carrots and Onions, Accounting for Inflation

	Avg. 2010	Avg. 2010 Ajusted for Inflation	Avg. 2020	Avg. Retail Price Increase 2010-2020
Carrots	\$1.57	\$1.81	\$2.30	21%
Onions	\$1.88	\$2.20	\$2.29	4%
Agricultural, machinery & equipment	\$100	\$118.86	\$147	32%

Source: Statistics Canada²⁰, Bank of Canada²¹, Statistics Canada²²

Closures in the foodservice industry during the COVID-19 pandemic are also expected to have a long-term negative impact on the viability of local farms, especially those growing vegetables in the Marsh like potatoes, onions and jumbo carrots. These commodities typically sell large volumes to restaurants and food processors servicing foodservice. Avia Eek, from Eek Farms²³ provided context. "In a year like 2020 with the pandemic, it wasn't just Canada being impacted by this virus, it was all of our trading partners. So labour was an issue worldwide, not just here in Canada...We don't have the labour force we would normally have. We're going to switch crops or we're not going to plant some acreage. So not all of the acreages got planted in the traditional ways that they would have been planted. Yields were down...Then, we had a heat wave. We didn't have our labour to help us with irrigating. Irrigating is a big deal. You could do it alone, but it's very labour intensive. So, you've got all these things coming against you...We lost the processing sector. On our farm, we grow carrots and onions for the processing market. We lost money because that processing market was no longer available. Once you got your seed, it's not like you can say, 'Oh, well, we've got the jumbos but we're not going to plant them.' We planted them. We took a loss. That's the way the business goes. To put it all into context, not the same crops being grown and we can't count on our international partners. So, yeah, the cost has gone up."

paid a little less.²⁴"

Professor Mike Von Massow, commented further, "We're seeing kind of the irony of consumers having to pay a bit more while producers were getting



The pandemic is likely to intensify the farm consolidation trend. According to Richards and Rickard (2020), the near-complete loss of an entire distribution channel [foodservice] is expected to invalidate long standing retail-supplier contracts. "When end-markets disappear, contracts in the retail fresh produce market are subject to a wide range of force majeure clauses that render them unenforceable in the event of an "act of God," which, we suspect, includes pandemic spread." This would undoubtedly have a negative impact on profits and the ability of farms to plan for large investments related to technology and automated machinery. Sylvain Charlebois, senior director of the agri-food analytics lab at Dalhousie University commented that Canada could lose 15% of its farms by the end of 2020. He later clarified that was a conservative estimate. Past-President of the Ontario Federation of Agriculture, Keith Currie agreed²⁵.

To remain competitive and protect this unique and productive region, investment, improvement, and adaptation are required. There are risks that need to be managed to ensure the longevity of the significant food supply that is produced in the region.

3.2 HUMAN RESOURCES

Human Resource challenges have long been evident in the agricultural sector and the COVID-19 pandemic has highlighted this key vulnerably even more. The Temporary Foreign Worker (TFW) Program was created in 1973 and is integral to the productivity of the fruit and vegetable industry. In 2017, before the COVID-19 pandemic, the Canadian field fruit and vegetable industry employed 24,000 people, or roughly 7% of the total agricultural workforce; with 10,320 (43%) working in Ontario²⁶.

Figure 2: Challenges in Retaining Workers



Source: CAHRC, 2019

The nature of agricultural field work is labour intensive and highly seasonal. These are two factors contributing to the industry's heavy reliance on foreign workers, who account for 43% of the field fruit and vegetable industry's workforce. Together, general farm workers and harvesting labourers account for 31% of the industry's current employment. These are the roles that are expected to be the most challenging to fill in the future²⁷. Despite the influx of foreign work, the industry was unable to fill 1,500 jobs in 2017, this situation was only exacerbated in 2020 as was reported by Jody Mott, Holland Marsh Growers Association Executive Director, that in May 2020 the Holland Marsh was short 300 workers²⁸. The Marsh typically supplies 56% of Canada's fresh carrot requirement, and an early report from 2020 suggested this supply was forecasted to drop by 50%²⁹

Estimates of lost sales of \$403 million, production delays, delayed expansion, overtime costs, and the human factor of excessive stress for owners and management³⁰ were all being reported as significant consequences result from ongoing shortages prior to the pandemic hitting the world in 2020.

These reports indicated that it is expected that by 2029, the domestic workforce will continue to shrink mainly through retirements, and the number of workers required to service the industry will rise to 27,500 workers; creating a shortfall of 14,500 more jobs than the domestic workforce can fill³¹. The labour issues relate to much of agriculture in Canada but Ontario is expected to be most seriously affected because Ontario accounts for the largest percentage of Canada's field fruit and vegetable workforce. Insufficient access to labour is a weakness in the food supply chain and are a key consideration to be resilient to any future pandemic or labour disruption.

In addition to a shortfall of workers, the agriculture industry consistently reports challenges finding workers with the right skills and experience³². Almost a quarter of employers surveyed reported a lack of qualified workers in their area (23%) and a lack of experience in the sector (24%). Hence temporary foreign workers often return to the same farms year after year with knowledge and experience specific to those operations.

Politically, there were calls for a mechanism to be created to enable Canadians who were unemployed due to COVID to be notified of farming jobs in their region, including those normally filled by temporary foreign workers. "Canadians should have first crack at every single job before it goes to a temporary foreign worker in these extraordinary times," said Conservative finance critic Pierre Poilievre³³.

While some may have hoped that local Canadians would fill these positions, the reality is that locals did not alleviate the shortfall. The TFW program was established in 1973 because Canadians are not interested, nor able to do the work for the price paid. Unemployed Canadians also are less interested in this type of short-term seasonal work. The lack of experienced workers returning could not be replicated by new workers coming in for one season. Furthermore, there is insufficient management on farms to train and supervise a high ratio of new employees. Experienced teams who return year after year do not require this type of training and supervision, and are far more efficient³⁴.

Scotlynn, one of the province's largest asparagus growers based in Norfolk, offered local residents an inflated hourly rate of \$25 per hour to pick asparagus in prearranged groups of five for the 2020 season. Scotlynn president and CEO Scott Biddle commented, "But on the first day of this makeshift harvest, it quickly became clear the plan wasn't going to work. Not being trained on the machines used by migrant workers, the new farmhands walked the fields and tried harvesting by hand. We got in by 7 a.m. but by 9 a.m. we called it off." Compounding the problem, some of the fields had gone too long without being worked and could not be saved. Biddle said the fields would be mowed over, essentially cancelling their harvest for the 2020 season. To Bernie Solymar, Executive Director of the Ontario Asparagus Farmers, the short-lived experiment illustrated how specialized the farm labour performed by migrant workers are essential to food production in Canada.³⁵"

The Marsh is comprised of a relatively small but diverse collection of growers, packers and shippers, each with their own needs. Small operators tend to be more labour intensive than larger firms with fewer economies of scale to invest in automations and labour reducing equipment. Being more reliant on labour, these companies are vulnerable to human resource disruptions. From an overall supply chain resiliency perspective, however, disruptions on larger firms will have a greater impact as they supply a larger market share³⁶. This was evident with the three-day closure of Ontario greenhouse grower, Nature Fresh Farms in 2020^{37 38 39 40}. Employing approximately 600 staff, they had 199 positive COVID-19 test results in the spring of 2020. Though the majority were asymptomatic, there were unfortunately workers who died from the virus. As a result, roughly 400 Nature Fresh workers were required by local health authorities to quarantine. 165 acres of crops were negatively affected and 50 acres could not be salvaged. The financial cost of the shutdown was estimated to be \$15 million with 7.8 million pounds of food wasted.

The challenge to secure sufficient staff on farms was intensified and the pandemic revealed, "where our food system is vulnerable, and one of those areas is labour," says Evan Fraser, director of the Arrell Food Institute at the University of Guelph⁴¹.

Some growers were unable to secure sufficient workers in time for their season, others were not able to accommodate new rules cost effectively. Physical distancing extended to all areas of work, reducing the quantity and efficiencies of growing and packing processes⁴². Fewer offshore farm workers resulted in fewer acres of all fruit and vegetables being planted. Farmers who participated in the season reported committing to reduced capacities of 50-66%.⁴³



3.3 COSTS OF THE NEW NORMAL

Although labour shortage was a significant consequence of the pandemic, the costs to adhere to new and ongoing changes in law and process, disruptions to transportation networks, and threats to supply networks across borders all added to the challenges the industry are facing due to the pandemic.

To meet the requirements outlined in new COVID-19 regulations, growers needed to quickly adapt for physical distancing and extra cleaning in all areas of their business. Examples include extra PPE and cleaning supplies, extra staff for cleaning, installing dividers between staff areas, running slower lines with fewer workers, changes to housing regulations, and getting groceries for workers to maintain distancing^{44 45}. Bunkhouses original intended for 50 were suddenly only permitted to house three. Farm equipment needed to be retrofitted to keep workers safe and well⁴⁶.

The federal government provided \$50 million (\$1500 per foreign worker) to help farmers cover the costs of complying with a mandatory two-week quarantine upon their arrival in Canada⁴⁷ but the added costs and layers of red tape created currently unmeasured loss over the course of the year.

Negotiating the multiple layers of bureaucracy and remaining up-to-date with changing government regulations placed unnecessary pressure on many growers (and other stakeholders through the chain) throughout the pandemic.

When the federal government closed the Canadian border on March 21, 2020 to non-essential travel as part of it's plan to combat COVID-19, the ban initially included seasonal agricultural workers; later providing exemptions⁴⁸. Increased administration at the home countries of workers⁴⁹, as well as changing and cumbersome administration in Canada, compounded with a lack of flights, created confusion, frustration and delays in 2020^{50 51}. Once in Canada, workers reported feeling like they were, "in prison⁵²" during the season, particularly during strict 14-day quarantines, which further delaying work during the important spring season.

With delays and shortages of their regular temporary foreign workers, local growers were more likely to hire from Ontario temporary employment agencies to fill gaps, even if they did not have previous farming experience and were less efficient than trained crews. Issues arose with local, temporary staff being allowed to travel to work from various municipalities. Companies based in the Marsh, with staff living in three different municipalities suddenly had to report to three different offices to get permission for staff to come to work. Travel was forbidden by the Toronto health department, while others like York and Simcoe allowed staff to come to work⁵³. Operating with this burden of administration, and municipal threats of closures for what was deemed essential work by the provincial government, created anxiety and excessive red tape for companies already struggling to keep the food supply chain moving. It is suggested by Hobbs (2020), that extending the "key workers" designation to workers involved in all aspects of food supply chains can help mitigate disruptions due to movement and travel restrictions.

In addition to these obvious costs, extra labour in terms of hours was required to manage the increased operational requirements. Due to the rapid onset of the pandemic, it was likely that existing staff worked overtime to ensure that Ontario's food supply was maintained. The cost of stress and exhaustion on these workers would be difficult to calculate.

3.4 IMPROVEMENT AND INNOVATION OPPORTUNITIES

3.4.1 Health and Safety

All businesses across Ontario have been directed to increase their cleaning and sanitation of their workplace for the health and safety of their employees. Specific guidelines for agricultural operations have been provided by the provincial government. Some key components of these guidelines are:

- 1. Personal hygiene (washing hands)
- 2. Masking (preventing expectorant emission)
- 3. Cleaning high touch surfaces
- 4. Workspace Ventilation
- 5. Monitoring staff health

The infection control pyramid presented in Figure 5 illustrates the controls needed to combat a pathogen such as the virus that causes COVID-19. With PPE being standard across workplaces and industries these days, this section focuses on tools that can be used to engage the two tiers of the pyramid that can be more effective in managing the pathogen; engineering controls (sanitation and ventilation) and administrative controls (health monitoring).

Figure 3: Infection Control Pyramid



Source : Morawska et al. 2020

3.4.1.1 Sanitation and Ventilation

Studies have shown that when viruses are exposed to ultraviolet (UV) light, particularly UV-C (a specific short wavelength of UV light), they are inactivated and can not reproduce. Although there has been limited study on this for the virus that causes COVID-19 (SARS-CoV-2) it has been effective on other coronaviruses and therefore it is highly likely to be effective on SARS-CoV-2. However, UV light can have detrimental health effects for people when exposed and thus the World Health Organisations issued warnings about using UV-C in sanitation indicating it should not be used on hands/skin⁵⁴.

However, robots with UV lights attached are being used in warehouses, factories, and offices to sterilize the space when staff are not present and therefore not exposed to the damaging light⁵⁵. A company from Tavistock, Ontario are fitting UV lights into offices and facilities to be turned on when people are not present to provide sanitation⁵⁶. For example, these can be placed in bathrooms and sensors used to ensure the UV lights are not turned on when



occupied. This may be an option for vegetable packing facilities, office spaces etc. as it reduces the cleaning staff required and reduces their potential exposure to the virus while cleaning. It should be noted however that several studies have indicated that the inactivation of viruses and bacteria from UV exposure decreases with increased humidity⁵⁷ therefore the environment in which it is being used should be considered.

The scientific community is still split regarding the extent to which SARS-CoV-2 is spread through small-particulate aerosol transmission⁵⁸ (through the air) however as Morawska et al. (2020) suggest there has been reports of transmission via this route all be it limited times. Therefore, reducing the number of routes that the virus can be transmitted improves the health of employees and keeps the business operating. Air quality is thus a factor in the battle against COVID-19.

As described in Morawska et al. (2020) ventilation is "the process of providing outdoor air to a space or building by natural or mechanical means" and plays a significant role in removing exhaled virus-laden air from the indoor space and by doing so reduces the concentration and dose occupants may inhale. Increasing the air changes per hour (ACH) and filtration of recirculated air are two means by which the concentration of potentially virus-laden air can be reduced.

Increasing the ventilation of a space depends on the current ventilation system in place. If there is no mechanical system such as a heating, ventilating and air conditioning (HVAC) system, then opening windows and doors to increase the airflow/air exchange with the outside is an option. Where HVAC is used these systems can be modified to increase the ACH but it can't be increased without the consideration of other requirements such as temperature and humidity control, air flow distribution and direction therefore it is recommended that an HVAC engineer be engaged to make any required modifications. The recirculation of air should be avoided as this can circulate or redistribute droplets containing the virus throughout the facility. In situations where this is not possible it is recommended that outdoor air input be maximized and that filters (that capture small enough particles) or UV disinfection of the recirculated air be implemented. Portable air scrubbers/filtration systems that have HEPA filters are also being used within indoor spaces to reduce level of contaminants.

Improvements in ventilation and filtration systems on farms with indoor workspaces will not only help reduce exposure to COVID-19 they will improve overall air quality and improve the working environment including reducing other workplace hazards such as dust inhalation.

3.4.1.2 Health Monitoring

Organisations around the world have implemented health screening measures and contact tracing to reduce the spread of SARS-CoV-2. These can include self-assessment of health by employees/customers answering prescribed screening questions to taking the temperature upon entrance to a facility in addition to management of work logs which are generally common practice. Taking the temperature can put the employee/management conducting the screening at risk of infection so automated touchless temperature screening kiosks have been developed for use in these situations.

The implementation of an online self monitoring program could be the most effective tool in conjunction with monitoring of health on-site may prevent sick employees from coming to work and spreading illness. It should be noted that these measures aren't full proof and don't prevent asymptomatic individuals from attending the workplace, and it is acknowledged that infected individuals could spread the virus while they are asymptomatic although it is believed they are less infectious than symptomatic people⁵⁹.

The ongoing monitoring of employee health may provide more HR data from which the business can better plan staffing needs and requirements to maintain operations even outside of pandemic situations. The implementation of HR monitoring processes and recording are likely to help individual businesses and the industry manage their human resources more efficiently.

3.4.2 In Field Technologies

Technology and automation have long provided a reduction in overall labour needs and increased efficiency of production. Tractors and various machines have provided the means to speed up the processes of producing a crop. Precision agriculture, GPS guidance systems and data collection have grown in many sectors of agriculture to improve production efficiencies. Many technological tools have also allowed for reduction in the labour requirements. Field vegetable producers still have significant labour requirements and further mechanisation, and perhaps even robotics can assist in reducing the reliance on manual labourers.

A recent report documented that "growers and packer-shippers in the Holland Marsh work in continuous improvement mode, always looking for better ways of achieving outcomes that are economically and environmentally desirable^{60"}. Examples of innovation occurring in the Marsh that supports the security of local food supply, as well as improving efficiencies and overall profitability includes:

- Automation technology to improve efficiencies and effectiveness in repetitive manual tasks like sorting and packing.
- One example is advanced optical sorting equipment for packing round produce. These are used in the Ontario tender fruit and apple sectors, as well as with potato packers situated in areas outside of the Holland Marsh.
- Automated planters for starting seedlings,
- Precise application of crop protection materials to specific parts of a plant or field where it is needed using advanced technologies to identify hot spots,
- Advanced controlled atmosphere storage systems to improve product quality, extend storage keeping, and reduce energy consumption,
- · Intensive efforts to reduce water use required for post-harvest functions through deployment of technologies.

Early discussions with sector stakeholders identified that the greatest areas for labour reductions through technology and innovation were in planting, weeding, harvesting, storage, sorting/grading, packing.

COVID-19 and on-going labour shortages, as discussed above, have highlighted the need to look toward technology to help alleviate reliance on labour. With increased technology and automation there is the opportunity to reduce the overall number of labourers however there is a shift in the type of labour required. There is a reduction in low skilled labour but a need for higher skilled labour and support services to ensure that the equipment is used,

serviced, and maintained appropriately. Robots provide the opportunity for tasks to be done 24 hours a day and can provide more consistency in production tasks. However, affordability by smaller farms and the possibility of changing production systems to accommodate these new technologies are potential barriers or considerations⁶¹.

Producers on the Holland Marsh have expressed that processes that require significant labour requirements are in planting, weeding, harvesting out in the field.

Machines that reduce labour and increase efficiency are available; for example at a field day in 2018 a transplanting machine⁶² was being demonstrated and one prouder indicated that "something like that could alleviate 85% of labour costs (associated with planting)".63

Controlling weeds in all crops, but especially carrots, is critical for increased yields and product quality. Carrots are a poor competitor and without weed control yields can be reduced by 90%. Manual weeding by crews of labourers is increasingly expensive and difficult with labour shortages. Mechanised weeding machines have been on the market for many years however they are increasing in the sophistication and enabling mechanical weeding later in the season. With the use of cameras and computer programming tools enable differentiation between the crop plant and weeds, targeting the tool appropriately. Some examples found are listed below.

- OliverAgro, an Italian company that make the RotoStark and the Colibri weeding machines among other implements
- Steketee a Dutch specialises weeding machines/tools.
- To further reduce labour requirements, some companies are developing fully autonomous weeding robots, for example.
- Ecorobitix, from Switzerland, with the Avo weeding robot
- Nexus potato weeder from Nova Scotia

In Europe the company Farming Revolution that used to be Deepfield Robotics, a division of Bosch, are providing weeding robots as a service.

Herbicides use has increasing been restricted due to, herbicide resistance, health and safety concerns and consumer demands. Blue River Technologies (purchased by John Deere in 2017) developed the See and Spray equipment that uses sensors (computer vision) and machine learning to target the weeds in a crop with herbicide while avoiding the crop. It is reported to use 90% of herbicide traditionally used in weed spraying.

Harvesting of hardier crops such as carrots, onions, potatoes, parsnips and beets has been successfully automated but automation of softer more delicate crops such as cauliflower, broccoli, and lettuce are more challenging to harvest. In the early 2000s the harvesting of baby lettuce, spring mix and spinach was introduced with the use of a machine with a band saw that cut across am 80 inch densely populated bed.





Naio Technologies, from France. The only North American distributor of which is in St-Liquori, Quebec

Adjustments to production practises was required to enable the efficient use of this machine including ensuring the planters planted at optimal spacing to allow for sufficient density of plant growth.⁶⁵ In order to mechanise harvesting of some of these more delicate crops there is likely to be a need to change practises and also invest in cultivar development. The Crunch Brothers in California have mechanised the harvesting of broccoli however it required the development of a cultivar that grew the crow higher up the stem to allow for the harvester to do its job. Similarly, harvesters for strawberries require varieties with smaller leaves to allow machines to see the berries below⁶⁶.

Again, robotics is being used to mechanise harvesting for more delicate/challenging crops such as iceberg lettuce. Engineers at Cambridge University have developed the "Vegbot" which harvests iceberg lettuce . This robot has been built and tested in the field but is not at a commercially viable stage as it is still not as fast as a human.

3.4.3 Grading & Packing

Once product has been harvested, the grading and packing of the product for market is another key area of labour usage. There is opportunity to reduce labour requirements here as well. The use of sensors and scanners on the packing line that can detect weight, colour, volume, diameter, density, and quality can replace the human judgement of product^{68,69}. The use of sensors/scanners can increase consistency of sorting therefore improving quality and efficiency of the sorting process and has been in the industry since the late 1980s. However, the challenge for small and midsize operations, such as those on the Holland Marsh, are that these technologies are expensive to install and operate, require higher skilled labour that can configure and operate the machines. In addition, many of these machines require a high level of stable internet connectivity. Often the machines are designed for a specific crop/ product and require technical adjustments to calibrate. Research in the US has proposed a cost-effective solution to this, a smart camera that has learning capability.68

Foreign object detection is also an extremely important process of the packing line as it has been reported that vegetable products account for 20% of foreign material contamination events across all food types. Commonly used techniques for detecting foreign materials are metal detectors, X-ray inspection and colour imaging although there have been reported limitations on these techniques at detecting commonly found foreign materials in fresh cut vegetables. Scientists from South Korea have developed a new technology that uses a multispectral fluorescence imager to detect foreign material in fresh cut vegetables. It the testing it had greater than 95% accuracy except with tiny dark foreign materials that it could not detect⁶⁷. Closer to home, a case study on EarthFresh Foods in 2017 found that a 29% increase in potato pack-out produces a 74% increase in grower margin. The pack-out efficiencies were made possible with automated optical grading and sorting equipment. The study concluded that differentiating between the grades (or determining what is only suitable for animal feed or waste) is not something that manual laborers can do reliably or quickly enough⁷⁰.

Packing requires significant labour, depending on the product and the level of package requirements. Packaging, boxing, and palletizing products are all points of potential labour usage. The reduction of labour requirements at these points in production requires the implementation of robotics. Cost and technical support may prohibit robotics from being a current viable solution to labour issues on the Holland Marsh but as was reported recently, "the COVID-19 pandemic is a crisis that robots were built to address."71

There are several companies (many from Europe) that design and implement robotic/mechanical grading/sorting and packing systems that can also package, box, and palletize the products. Some of the challenges of engaging some of these companies on the Holland Marsh are related to cost, scale, and technical support. Some of the companies with sorting and/or packing systems are:

- Greefa⁷²,
- Aweta,
- Unisorting
- <u>Visar Sorting</u>
- RSIP Vison
- FANUC America

3.4.4 Addressing Consumer Needs

Two areas were highlighted by the research regarding consumers and how to be better prepared for future crisis. The first is to consider how companies, and agri-food stakeholders can better communicate with consumers to provide reassurance and prevent panic buying⁷³. While there have not been serious food shortages through the pandemic, consumers created shortages by stocking up on key items; with fresh staples such as potatoes, carrots and onions being in high demand early on⁷⁴. Steps to mitigate consumer panic through improved communications using digital platforms should be addressed. While many growers in the Holland Marsh have websites and social media accounts, many others are lacking in marketing expertise and do not have resources to dedicate to ongoing consumer marketing programs. The return on investment is insufficient for those who do not sell direct to consumers but there could be some benefit to group communications through the HMGA outlets on behalf of its members.

The second long-term consideration relevant to this paper is the changing market and rapid rise of online grocery shopping. Prior to the pandemic, the Canadian grocery sector had been slower than its counterparts in Europe and the United States to offer online grocery delivery services. With stay-home orders and vulnerable citizens looking for safe shopping options, many consumers started online grocery shopping for the first time. "Prior to the spread of COVID-19, only 1.5% of groceries were sold online in Canada, a number that had grown to over 9.0% by the third week of March and grocery chains were reporting surges in online orders of up to 300%⁷⁵". Now that the barrier to set up accounts has been eliminated; it is uncertain how many will continue to shop online but it is expected that the pandemic certainly accelerated the pace of adoption^{76.}

This shift in purchasing behaviour is an opportunity for growers and packers who are interested in developing a digital market presence. There are opportunities to develop improved product and brand presence with retail partners, and there are more opportunities to sell direct to consumers online. Online sales could be a significant opportunity for smaller producers who already sell direct via farmers markets⁷⁷. In terms of technological investments, this would include but is not limited to improved websites for communication and ordering, Search Engine Optimization (SEO), and software for online financial transactions. This is likely an important time for the marketers of both fresh and processed fruit and vegetable firms to maintain, attract, and expand their consumer base⁷⁸.

Increased consumer demand for local food has also been registered as one outcome from the pandemic and this trend is expected to continue. Growers and packers from the Holland Marsh may review how technology can help them not only improve efficiencies at the farm level but also how to pivot their business to meet this demand for local produce. Growers who have already carved out niche opportunities could serve as example to others. A few case studies available online are79:

- utilized to continue growing this business.

3.5 FOUNDATIONS FOR TECHNOLOGY

3.5.1 Infrastructure

It is well understood that business improvements to support competitiveness, increased profitability and improved working conditions are often linked to investments in technology. However, the foundation required to support all technology is access to reliable infrastructure, inclusive of electricity, natural gas and widespread internet access⁸¹.

Infrastructure is critical to agricultural investments in innovation. There is no reason, nor benefit to install modern machinery and equipment without sufficient, affordable power to operate them. Automated equipment, and programs to support health and safety processes often rely on internet connectivity. Connectivity issues with wifi through fields, and even when directly connected in rural offices makes these programs redundant.

• Springh Farms, a smaller grower who has specialized in high quality leafy greens and herbs. Growers like this could invest in technology and IT training to improve direct sales opportunities to customers and consumers. Holland Acres, a family business that has diversified with Agri-Tourism. Again, online marketing could be

According to an Ontario Federation of Agriculture response paper in 2018, "A clean, reliable and affordable supply of electricity is key to creating sustainable jobs, fighting climate change and growing the economy. Energy planning does not fall within the *Infrastructure for Jobs and Prosperity Act*, and energy assets are not included in the provincial asset inventory"⁸². Though energy assets are a crucial part of the Province's infrastructure⁸³, little direct reference could be found to relate specifically to supporting the rural and agricultural needs.

Ontario farms use about 3% of Ontario's electricity or approx. 4.5 terawatt hours each year⁸⁴. Farm level power generation and increased energy efficiencies are a reality with the expectation that there will be ongoing opportunities of increased power generation with solar, bio-gas and wind power⁸⁵. These opportunities may provide added farm revenue and/or offset on farm energy expenses however, investments into infrastructure needed at various levels of government; what is available, how it can be accessed and at what cost. Companies could also investigate investments into new technology as it pertains to infrastructure.

Though it may appear that these considerations of energy and connectivity may not immediately relate to being pandemic ready or be impactful regarding labour requirements they are because without adequate infrastructure the industry will not be able to take advantage of technological advancements that are available.

3.5.2 Strategic Planning

To invest in innovative technology requires significant capital, and careful financial planning. Machinery costs rank among the largest cost items on farms with automated equipment costing hundreds of thousands, to over a million dollars⁸⁶. Data compiled from over 2,000 grain and oilseed farms in Canada suggest the following ratios should be considered to prevent becoming overleveraged. "The most profitable 25% of farmers have costs of 15-20% of their revenue for machinery and equipment. The least profitable have costs that are 30-35% of revenue ". Although detailed in data to provide the same metrics are not supplied by Statistics Canada a similar patterns can be seen from the vegetable growing sector with

more profitable farms averaging machinery expenses that are 10% or under of their total revenues and less profitable farms seeing average machinery expenses that are reaching 23% of revenues.

When considering the purchasing or implementation of new technology there are some key considerations to be aware of, and some cost-benefit analysis should be employed. The obvious one that is the foundation of this investigation is the cost, availability, skill and reliability of labour vs the cost of purchasing, operating and maintaining the machine/technology. Reliability, of labour can occasionally be a missed consideration, the COVID-19 pandemic has shown that the theoretical availability of labour might be there; however due to health and safety, a reliable supply of labour may not. To be pandemic ready may require a revised view on traditional cost-benefit calculations/ considerations. An assessment of the machines speed, efficiency, and impacts on the quality of the final product is



also a key consideration. New technology may require changing of growing methods or changing the cultivar that is being produced. Ultimately, growers would need to have a solid understanding of their market to determine if a changed product would be desirable to existing and/or new customers/consumers.

When investing in new technology and/or machinery an analysis of the return on investment (ROI) is crucial. With considerable diversity on Holland Marsh and the fact that equipment can be highly specialized to a particular crop and that the growing season in Ontario is very short, the ROI may not be feasible for smaller more diversified farms. Many of the technologies have been developed in other markets where growing seasons are longer, and scale is considerably larger. There may be opportunity for development of "home-grown" solutions however the limited economies of scale within the Holland Marsh may limit the incentive for such "home-grown" innovation.

Technological advancement does carry the risk of increasing the rate of industry consolidation. Smaller operations may not have the economies of scale to implement yet without adapting to niche markets are at risk of losing competitiveness hence resulting in farm consolidation.

Understanding that not all technologies are right for every farm is important to recognize and ensuring that the fundamentals of the production system/operation are considered before leaping into purchasing technology to solve a problem. As mentioned previously, a change in production methods/cultivars may be required to obtain the full benefit of a new machine or technology, weighing this change up with the overall farm business is essential. Having a clear purpose and understanding of what this technology is going to achieve for your business is necessary. As is ensuring that time and effort are invested in learning and fully understanding how to use the technology, documenting this learning so that employee use can be streamlined.

3.5.3 Education/Skilled Labour

With increased technology and innovation, higher skilled jobs will be required. Early discussions with producers from Holland Marsh highlighted the challenge of adopting new technologies when there is limited capacity locally to support its implementation both technically and mechanically. Without qualified labour to install, run and maintain innovative equipment, the investment in their purchase would be squandered. An added challenge is that the level of production on the Holland Marsh may not provide the economies of scale for companies to provide sustained in-person support.

To address this shortage of skilled labour, there are educational options to encourage new entrants to the industry and enhance the skillset of those already in the agricultural workforce. The University of Guelph, Fanshaw College and Conestoga College all offer various programs to support the agricultural industry in Canada. <u>Conestoga College</u> recently launched a pilot program in Jan 2021 entitled Agricultural Equipment Operation program. This hands-on course is specifically intended to train participants on how to use and maintain sophisticated agricultural machinery and equipment. Private educational firms specializing in agriculture, such as <u>Agrifood Management Excellence</u> also offer management training relating to strategic investments in innovation, machinery, and technology.





INDUSTRY OUTREACH

There were two parts of the primary research, an online survey and a series of interviews with growers and value chain stakeholders.

To support the project goals, the primary research questions focused on the following areas.

- Develop understanding of unique characteristics of the businesses currently operating in the Holland Marsh area.
- Identify key challenges and opportunities facing these businesses, specifically regarding how technology can support industry to be pandemic ready, provide co-benefits to address short term and longer-term labour challenges, and remain competitive.

The online survey link was emailed to active members of the Holland Marsh Growers Association in March 2021. The project planned for a minimum of 15 respondents but there were 22. Not every participant completed every question. Skip logic was implemented to improve flow, and participants were permitted to skip questions. Additionally, some questions total over 100% as respondents were permitted to select more than one option.

In addition to the online survey, 22 individuals participated in either a focus group or a telephone interview. All data is presented anonymously and in aggregate form.

4.1 SURVEY OVERVIEW

4.1.1 Overview of Businesses in the Holland Marsh The key market for producers on the Holland Marsh is Ontario. Based on responses it is estimated that 86% of the products would be marketed in Ontario with ~14% going to international markets. Less than 0.5% was reported as going to the rest of Canada.

Table 3: Key Markets

Products sold to:	Rank
Direct to Packer and Retail	1
Processing and Foodservice	2
Wholesale	3
Other	4

Majority of survey respondents were owner/operators of the business (17) with just three responses being provided by senior employees of the farm. Eighteen self identified as Grower - Field Crops. There were a couple of responses from Greenhouse Growers and among the 18 Field Crop Growers, there were a few Packer/Shippers and some respondents that indicated they participated in other value chain activities such as suppliers and sales. It would appear from the responses that there are two clear groups of farms based on acreage. Most responses fell in to the 300 acres or less (15 respondents) with the rest operating 900+ acres. The growers who identified as grower/packer/shippers all were growing on over 1000 acres.

Respondents were evenly split into two groups; half are under age 55 and the other half are over age 55. While majority of respondents (12) had worked at the company for 15+ years, the remainder, six 5-15 years and two less than 5 years.

Consistent with the secondary research, the majority of respondents reported that their most important crop(s) was either Carrots, Onions, or both (15). However, respondents were invited to list all of the commodities that they grow and the survey findings again support the literature in that a wide variety of crops were reported to be grown in the Marsh, including but not limited to celery, beets, parsnips, cauliflower, potatoes, leafy greens.

If we were to generalize based on the survey, the Holland Marsh consists of numerous small family owned and managed farms that grow carrots/onions. There are a few large operators that grow, pack and ship vegetables for themselves, in addition to packing & shipping services for smaller growers.

Figures illustrating these findings are presented in Appendix A.



Producers primarily sell direct to packer or to retail. The ranking of other markets is given in Table 6, processing and foodservice were equally important markets to respondents so together ranked second.



4.1.2 Human Resources - Staffing

It was identified in the secondary research that human recourses and staffing has been and continues to be a challenge for the fruit and vegetable industry. The results of the survey supported this finding and found that these issues have been exacerbated by the COVID-19 pandemic.

Seventy percent of respondents indicated that they find staffing a challenge. This is more pronounced among larger growers (100% agree), compared to smaller growers (60% agree). Unsurprisingly, larger farms have larger teams than smaller farms, who were more likely to have family members as the main year round staff (see table below).

Table 4: Staffing Requirements, by Farm Size

	Larger Growers (over 901 acres)	Smaller Growers (under 300 acres)
Avg Number Temp Foreign Staff	85	6
Avg Year Round Foreign Staff	32	3
Avg Seasonal Staff	64	4
% Family Year Round Staff	13%	76%
% Family Seasonal Staff	2%	17%

N=20

Respondents were asked to rate the challenge of finding sufficient staff (number of staff) as well as qualified staff (skills and experience), using a scale of 1-5, where 1 is not a challenge and 5 is regularly challenging. Perhaps because larger teams do not rely as heavily on family, their average response showed a stronger level of agreement that staffing is a regular challenge, across both categories.

Table 5: Average Agreement to Staffing Challenges, by Farm Size

	Larger Growers (over 901 acres)	Smaller Growers (under 300 acres)
Challenge to find sufficient staff	4.8	3.8
Challenge to find qualified staff	4.5	4

N=13

Consistent with the secondary research in Activity One, interviews confirm that there are ongoing challenges to secure local Canadians for work on the farm. The consensus is that locals perceive farm jobs to be "beneath them", or too hard for the pay. Interviews also confirm that finding qualified candidates was an ongoing challenge. A selection of guotes are included below for context.

- Staffing is an issue. The most reliable people are new Canadians or Mexican workers.
- Unfortunately, it is almost impossible to find farm management with experience or farm workers.
- idea of dirt. They don't look at it as a great job. Perception is bad. They would rather work at McDonald's for \$14/hr.
- We have ads up almost constantly and have very little response from Canadians.

The online survey results illustrate that managing labour was the greatest challenge for growers /packers /shippers throughout the last year. The word cloud presented in figure 3 highlights the most used words in responding to the question; "Tell us about the greatest challenge(s) your business has faced related to COVID over the past year".

Figure 4: Word Cloud Describing Greatest Pandemic Challenges

businesses challenging Labour challenges Health Workers home work labour safe

N=14

Interview excerpts provide additional insights into the various ways farm businesses have provided support to temporary foreign workers throughout the pandemic and frustration they experienced.

- Keeping the workers safe from contracting the virus. That meant minimum contact with other people so it was challenging doing banking and getting groceries and supplies.
- The workers were also unable to socialize with workers from other farms the way they usually would. They needed internet access to connect with family and friends both at home and locally. We need seasonal internet access which the providers won't furnish.
- Labour challenges and the lack of organization by the countries to allow workers to travel. There was a lack of concern for the workers in getting them home safely to their families, leaving many stranded and remaining in Canada causing the employers to scramble to accommodate them with housing and work as well as work extensions, SIN and health cards.

We could pay more than where they [locals] are working and they still wouldn't be interested. They don't like the

 Unfortunately, being in a seasonal business it is very challenging to find Canadian born workers to work. We rely heavily on the FARMS program. The Mexican men we get are truly the backbone of the business.



4.2 PRIORITIES

4.2.1 Impact of Covid on Business

COVID-19 significantly impacted businesses in the Holland Marsh area by overall increasing the stress/anxiety felt by the producers and the cost of doing business. The chart below provides a summary of responses in the form of a boxplot. This allows us to visualize the reported impact of these aspects' relative significance, those that had the highest impact are on the right and lower significance to the left. The solid line in the box indicates the median response and thus 50% of responses are above/below this point.

Figure 5: Over the past year, how has COVID impacted your business?



More specifically, there was a statistically significant difference in responses to the two variables "increased cost of business" and increased "administration related to health & safety/human resources" by farm size; larger farms were more likely to indicate that COVID-19 had a very significant difference on these aspects. Additional comments suggested that challenges were exasperated by a lack of clarity dealing with a novel virus from officials. Costs to adapting housing, retrofit equipment for COVID-19 protocols along with accessing replacement parts for equipment/machinery were all aspects that directly impacted the cost of doing business.

- For example, a grower spent \$25,000 before the season started on housing
- Another invested to adapt housing but then was unable to secure workers in time for planting so the investment was effectively worthless.
- Housing is (an) issue. In Canada, the market is unaffordable so when we use resources to get farm workers here, we can't afford to house them with all of the regulations.

Border closures and potentially manufacturing delays have impacted access to replacement parts which in turn increases the cost of business as is expressed here;

• Especially with the pandemic - can't get service or parts. How can we get someone through the border as an essential worker to service our machinery. We need clarification from government on who is essential - to allow them through the border (i.e. service).

4.2.2 Being Pandemic Ready

In terms of being pandemic ready the results suggest that the three most important aspects to achieve this are "cleaning", "equipment to monitor/track staff health" and "digital support to better serve customers or sell direct to consumers". Although there was considerably variability in the response to "ability to order groceries/provide for temporary workers".

Sanitation innovations were reported in the literature review as opportunities to use technology and innovation to be pandemic ready and remain competitive. Although, cleaning was the most important aspect identified to be pandemic ready, hard crop producers (which are the majority of Holland Marsh producers) are less likely to find this "critically" important. They were also less likely to find "modifications to equipment" to be critically important. This is likely due to the fact that they are more likely to have workers outside and therefore less risk of viral transmission, i.e. responses are dominated by the smaller farmers that do not have packing and shipping facilities as was expressed by this respondent;

• We haven't done anything too significant regarding air quality as most of the work is done outdoors.

The responses as to how important the "ability to order groceries/provide for temporary workers" were guite varied. Although the median response was 4 and thus the temptation is to considered this guite important overall there were 6 responses that reported it as critically important while 5 reported it as not important with the rest somewhere in between. Two quotes from growers exemplify this spectrum.

- As a smaller farm, it was challenging to get groceries at first, but then it worked out.

There may be some opportunity to implement a simple ordering system that reduces this administrative burden.

Figure 6: Relative Importance of Areas, to be pandemic ready and stay competitive



The largest opportunities to assist in being pandemic ready revolve around providing clean work places for those that are working indoors, monitoring staff and getting product to market with limited human contact.

• We tried to do groceries for everyone but it was such an administrative burden. After the most uncertain period, the workers just preferred to go and do their own. We just reduced the frequency of grocery runs.



4.2.3 Innovatice Equipment Options in the Marsh

There is considerable awareness of innovative equipment, software etc. within the Holland Marsh producers. Seventy-six percent of respondents indicated that they are aware of innovative equipment, software, machinery or processes that would have helped to alleviate the impacts of the current pandemic or improve their ability to manage the effects of a future pandemic by addressing labour challenges and/or support the continuation of the local supply of food. In interviews, greenhouse growers reported that they have already invested in technologies that are available, while field growers were less likely to have made innovative investments into newer technologies. The comments below were made by Greenhouse growers.

- We've been a bit more aggressive to automate, we're fairly well automated in the greenhouse industry. As technology continues to advance, we hope to further reduce labour requirements in the future, but the tech isn't there yet.
- We've already invested in new equipment that cost \$350,000 and reduced labour by five.

Automated equipment, specialized cleaning equipment and software for the monitoring and administration regarding staff and staff health were the top three areas respondents see as innovation that will improve their ability to manage the effects of a pandemic, address labour challenges and/or support the local food supply chain.

However, when asked to pick one improvement that would significantly support their business the most common response was automated equipment.

The below table illustrates the key improvements/technologies that would significantly support their business and the level of impact they would have on the ability to manage the effects of a pandemic, address labour challenges and/or support the continuation of the local supply of food.

Table 6: Key Technological Improvements

Key Improvement	N	Effects of Pandemic	Co-benefits addressing labour shortage	Support food supply
Automated equipment	8	7	7	7
Specialized cleaning equipment	1	7	7	7
Digital Support / Websites / Apps to support sales & marketing	1	7	5	7
Online Grocery ordering systems/ apps (for foreign workers)	2	5	4	4

N=12. Data presented is the median response.

Interview responses supported the need for automated equipment to reduce labour and improve competitiveness, if the technology was available for the crops they grow.

- dark you can't see anymore.
- anymore. No one likes to plant and weed but everyone likes to drive tractors for harvest.
- tech for field crops.
- not seen anything like that for carrots. Carrots grow under the canopy, but the tech isn't there yet.



• More automated help for seeding would be useful because work could go past daylight. It is limiting when it is

If had auto planter, could replace eight people. We need people for planting, and then after July don't need them

• Have friends who are grain farmers, the planters they have are more tech than field crops. For seeding carrots or onions, we need to have two guys on the back and it is slow work so it would be nice to have some of that

• Weeding is labour intensive. An auto weeder would be nice. I've only seen auto weeders on the internet but I've

• There are more efficient machines for processing carrots. They would reduce labour requirements by just one person but would also provide a more consistently high quality product. These cost \$50,000 per unit.

4.2.4 Possible Labour Reductions

Although all areas of production were identified as having considerable potential to find reductions in labour requirements through investment in technology and innovation, growing season weeding is the area that investments through technology are seen to have the most impact. The chart below provides a summary of responses and places them in priority from left to right based on those responses.

Based on responses from the survey, investment in technology would potentially see a reduction in labour requirements of 33%.

Figure 7: On my farm/business, investments through technology and innovation would reduce the need for labour in the following areas.



N=17

When asked to specify how many labour reductions could be made by implementing new technology or equipment, both larger and smaller farms agreed that there were labour efficiencies that could be made, affecting both local and foreign jobs.

Table 7: Expected Labour Reductions with Introduction of New Technology, by Farm Size

Large Growers (over 901 acres)	Smaller Growers (under 300 acres)	
60% agreed local jobs could be reduced, range of 20-40 jobs per farm	20% agreed local jobs could be reduced, range of 2-5 jobs per farm	
40% agreed foreign jobs could be reduced, range of 10-20 jobs per farm	27% agreed foreign jobs could be reduced, range of 2-5 jobs per farm	

N=19



Some respondents directly referred the need for investment into technological advancements in order to minimize the need for labour. They indicating that they are actively seeking to invest in capital to reduce labour costs.

- TX, CA, OH, NY, PQ, Manitoba, all are at an advantage to ON on minimum wage. We are aggressively pursuing all possible alternatives to replace jobs with capital.
- We are pursuing labour savings through capital investment as a result of the increases in the minimum wage. We estimate that we will decrease the workforce, (all minimum wage) by 80% in the next 10 years.

Another grower interview suggested that investments in technology and more advanced equipment would entice local Canadians to apply for farm employment.

 It's easy to find people to drive a tractor for harvest. If work was more high tech, less grunt work, then 100% you would find younger, local people. They would operate equipment and let the equipment do the work. They are not interested in the hard labour.

4.3 BUSINESS IMPROVEMENTS THROUGH INNOVATION & BARRIERS TO INVESTMENT

The research results found that financial constraints, availability of technology and infrastructure to support it are all barriers to investment in innovation and technology. These results are presented in the table below.

Table 8: Survey Results: Identified Barriers to Investment and Areas of Business Improvement

		Count				
	Key Improvement >>>	Automated Equipment	Specialized Cleaning	Digital Support Marketing	Online Grocery ordering systems	TOTAL
Barrier	Financial	6	1	1	1	9
	Not currently available in Canada	3				3
	Unreliable internet	2				3
	Unreliable power	2				2
	Insufficient Local support	1		1	1	2

4.3.1 Financial Barriers

Although the largest barrier to investment in innovation and/or technology is financial, interview discussions identified frustrations with grant programs that are perceived as having been inequitable in the past.

• Most of the grant programs have been first come first serve... businesses should be limited as to how often they can apply, allowing others ample chance. The

co-pay options where the farm business has to pay upfront and be reimbursed is difficult for the small guys that are already tapped. So really those with money can get the extra money. Leaving the little guys no real options. There should be option where if approved, business can submit invoice to be paid directly or something where the farmer doesn't need to be out of pocket (get financing/loan).

- We need a cost share funding program from government to go directly to the business instead of big corporations. ie Hydro One, Enbridge, Rogers, Bell, etc
- Banks will support IPOs but not young farmers. Not everyone has a way in [through family]. Young people can't start out in farming. Need 50% down to buy land for farming but you can buy a house for 5% down. All of this effort to support technology won't help if there are no farmers.

4.3.2 Technology Availability

Many technologies/innovations are not available in Canada, this is reportedly because there is limited market here.

- Here in Canada, we are after Africa. We have the least service for anything imported. It takes forever to get parts. We have a motor built in Europe, and we've been waiting for three guarters of a year to get parts that should be able to get in 2 weeks.
- Europe is 10 years ahead of us.



As the Holland Marsh is a small market this represents a significant barrier for the ability to access technology and feeds into the lack of local support for that technology. Without a significant market to supply, equipment suppliers that have the cutting edge technology do not see the ROI in providing onsite service supports within this market. For example one grower reported;

when warranty is up.

Others have reported regulatory barriers that have prevented technology being implemented in the region.

Robotic weeders are not approved by Transport Canada.

One respondent did indicate that the pandemic had prevented investment due to border closure so presumably the ability to conduct this investment will return eventually, but financial situations have no doubt been impacted by the past year so timing of such an investment may be further delayed.

The cost would have been \$600,000 but would pay back over a two year period.

4.3.3 Infrastructural Supports

Insufficient infrastructural supports have also been identified as a barrier to investment in innovation and technology. Many new technologies require high-speed and/or reliable internet and although many respondents indicated they have reliable internet, the majority indicated they did not have high-speed internet which is likely to be a significant requirement as technology progresses.

Smaller growers reported more issues with access to infrastructure compared to larger farms.

Table 9: Access to Infrastructure, by Farm Size

Has Access To:	Larger Growers (over 901 acres)	Smaller Growers (under 300 acres)
Phase 3 Hydro	75%	93%
Natural Gas	0	47%
Reliable Internet	50%	60%
High Speed Internet	25%	47%

N=19

In the interviews and focus groups cost and availability of internet were identified as key issues: 100% infrastructure is a problem. We can't get certain equipment because it needs internet.

- But internet is not affordable and has low speed.
- We have High Speed internet but it's Satellite and the cost is 200% more then if we had fiber/cable.
- benefit [beyond ours], but I'm not sure if they would be willing to pay for it.

In addition to internet the availability of sufficient power can also be a limitation;

• New ventilation systems come from France. It's good while new but then there will be challenges after 3-4 years

• We were looking at robotics but the firm was unable to do it because of covid with the US border closed.

• A quote we had to get fibre optics across the canal was \$40,000. There are some businesses that would also

• We are building a new barn but do not have 3 Phase Power so we need to use smaller coolers, and more of them.



4.4 PROCUREMENT & PLANNING FOR INVESTMENT

As mentioned above finances are the most significant barrier to investment. However, the data from the online survey, focus group and interviews suggests that some farmers are unclear on the costs for the specific technologies they desire, and do not invest in the education to strategically evaluate their potential return on investment.

33% of respondents claimed to have, "no idea" of the cost of the investment they have in mind.

• You'd be pandemic ready with automated transplanters but I have no idea of the cost or accuracy with them.

In the literature review, metrics were provided to illustrate ratios for successful business investment.

More profitable farms do have debt but average machinery expenses are 10% or under of their total revenues. Less profitable farms carry average machinery expenses that reach 23% of revenues⁸⁹.

When asked how they assess when to invest in new equipment and technology, there were few who mentioned cost benefit analysis or strategic investment planning as noted in the comments below.

- [It's time to buy new,] when you have a problem.
- When the old equipment breaks and can't be repaired.
- I use my instinct to tell me what to invest in.
- We have been looking for years, knowing that our machine is getting old.

There were others that suggested they did not know the price of new equipment because every farm is different, so purchases are often custom. Others noted that the true cost of one piece of equipment isn't a true cost because of the integrated nature of their work.

what needs to be changed.

The true cost of new technology/innovation is a significant consideration that was identified in the literature review (See Strategic Planning).

In focus groups and interviews, respondents suggested they learn about new equipment and technology from a variety of sources, such as:

- Colleagues
- Trade shows (online shows were not considered useful)
- Supplier outreach
- And Social Media including YouTube, Twitter and Instagram
- Webinars were not considered particularly helpful

Through interviews and focus group discussions, it was suggested that growers in areas outside of the Marsh, including other areas of Ontario, are more willing to plan for investment in new technology and advanced equipment for their businesses. Within the scope of this project, it is impossible to determine if this is entirely accurate, nor investigate the root causes if this is so. Responses from interviews identified a number of barriers to investment among Holland Marsh growers; farm size, short seasons, age of farmer, and overall culture. These are discussed below.

4.4.1 Size of Farm & Short Seasons

75% of online survey respondents farm on less than 300 aces.

- All investments are for larger farms. It is cost prohibitive for our size, even with subsidies.
- Grants do not tend to go out fairly across the board. Bigger growers have another advantage.
- Even with 40-50% cost share, how could we afford that? [Reference was made to investment of \$200-300,000].
- The new equipment will run 12 hours a day, everyday [during the main season] but will sit in the off season.

• Looking at auto planters, the tech is proven in Europe. But it's the cost of it. When you buy an auto planter, you need to change all the prep in the greenhouse to accommodate the different trays for the new machine. When we change one thing, we need to change many things...adds costs incrementally. \$200,000 for the planter, how much more for the other connected parts? Every farm is unique so it's hard to calculate costs of



4.4.2 Age of Farm Owner

The survey found that 50% of the growers in the Marsh are over 55 years.

- Investment is not worth it for our size and stage in life. I take my hat off to younger farmers who are growing for the future.
- Technology and innovation is good for the farms that maybe have another generation behind them but some are late 50s and 60s. They are looking to cash out.
- Are they going to invest \$200-400,000 in something that they may not be around to benefit from? Will that need accelerate retirements?
- Older farmers don't see the benefit if they only have three more years. Bigger farmers will rent the land when others retire. In the Marsh in the next 10 years, 30% of the farms will disappear. The larger farms will be the ones who will be here in 20 years.

4.4.3 Culture

Very few examples were provided of farmers who have invested in new technology as industry leaders. While one large grower was named several times as being open to share learnings with colleagues, others were perceived to be closed to protect their proprietary knowledge.

No farmers want to work together. In any industry, people want to protect their own interests.

Interestingly when asked about possible co-operative, equipment sharing to overcome barriers for small growers, it was dismissed by every interviewee. The main reason why was because the local season is too short to have to, "wait your turn to plant, weed or harvest".

- With the weather, the windows are getting smaller. We all transplant on the same day.
- If you rent or share equipment, who gets it before the frost, or on the good days? Our windows are too small to share equipment. If you rent a weeder, who will get it when you really need it? No one wants to weed when it's wet, spreads disease. Sharing won't keep neighbours happy.

Many farmers referred to a local shop that builds high quality custom machinery and equipment that is built to last, preferring to purchase equipment that will last "25-30 years", and only replacing when they absolutely have to.

- GPS is the same. Can't get parts after 10 years.
- We don't like to carry debt so if we need to buy new equipment, it needs to be a no-brainer.



It was suggested by others that after 10 years, it may be more appropriate to strategically invest in new technology to support the businesses growth, rather than hesitate to buy new technology at all because it will be hard to source parts after 10 years.

• Part of the cultural hesitation is also in the risk of the unknown. Why would I spend money to buy something if I am unsure if it will work in our soil and with our crops?

With the high costs of new technology and barriers noted, it is not surprising then that majority of online survey respondents would like to see a cost-share program and financial support to reduce risk. The majority would like to see a 50% cost share but there was a range of responses from 30-50%.

4.5 DIGITAL INNOVATIONS TO ADDRESS CHANGING MARKET CONDITIONS

The literature review identified that the shift in consumer purchasing, and increased demand for local food has created opportunities for growers and packers who are interested in developing a digital market presence. There wasn't one interviewee, nor focus group participant who expressed great enthusiasm for this approach to help them be pandemic ready, reduce labour, or become more competitive.

- We set up two new websites to manage direct sales, but it was too time consuming to manage the logistics. It took double the time to process the orders.
- We are in the process of starting a website to take advance orders [for smaller customers], but our larger customers would not use this. They require more service.
- When the border closed to the States, we lost 25% of our business. That food was wasted. We usually supply 2,600 stores. We can't switch that much volume to go direct to consumers.

A lack of enthusiasm does not mean that opportunities do not exist. Starting new ventures can be intimidating, but examples from Ontario demonstrate that farmers can successfully pivot their business to grow in agri-tourism and direct sales to consumers using technology for sales, marketing and logistics.



• There is no such thing as free money, but sometimes some money just helps to ensure that things get done.



5.CONCLUSIONS & RECOMMENDATIONS

The Holland Marsh is a critical component of Ontario's food system. There are 125 farms on over 7,000 acres of prime agricultural land producing over 60 different crops. As with many sectors in agriculture, the Holland Marsh area has experienced consolidation of farms. While the Holland Marsh is especially well suited to the production of root crops (carrots, onions, potatoes, parsnips, beets), there has been expansion in the variety of crops grown (i.e. Chinese vegetables) grown for the domestic ethnic market, and greenhouse production of cucumbers and floral products. Through the storage of root vegetables and greenhouse production, the crops grown in the Holland Marsh enable a supply of fresh produce through every season.

Canada's food system has historic challenges with securing sufficient, qualified staff, and these have been intensified during the 2020 pandemic. Some growers were unable to secure their workforce in time for their season, others were not able to accommodate new rules cost effectively, and as such some have been looking toward capital investments in technologies to alleviate staffing challenges.

There are three key elements required to successfully implement new technologies or innovations.

- 1. Strategic Planning
- 2. Access to Technology
- 3. Financial Capacity/Support

There are indeed opportunities to implement technology to reduce labour requirements and innovations (technology, processes etc.) that can assist in reducing human resource challenges when dealing with a pandemic. Some of these have been identified in this research and many growers have an understanding of the types of technology and innovation that currently being used. However, to successfully implement such changes growers and businesses need to better understand the true cost and maximise the benefit.

Continued education opportunities that would assist in developing the skills of producers in the area of strategic planning and cost-benefit analysis would provide a stronger foundation for impactful investment decisions and/or innovation implementation. Decisions should be based on solid foundations. A program that mentors and provides the foundational knowledge regarding strategic planning and also assists in the application process for financial supports could provide lasting beneficial impacts.

Although there was significant awareness of new technologies and innovations, the research found there was a lack of confidence regarding the relevance of it to their business. Therefore, to increase this confidence, supports are needed for research, knowledge gathering and dissemination of information from around the world. Intelligence gathering trips to other muck/vegetable growing regions, trade shows, testing, developing and/or adapting technologies through public/ private partnerships, and continuing collaboration with the resources at the Muck Research Centre would all be methods of increasing awareness and confidence in new technologies for Holland Marsh businesses. The Holland Marsh Growers Association could also facilitate educational extension opportunities for local growers, as well as coordinate test pilots of new equipment. This would assure growers that the innovations tested will work within the Marsh.

Often investments in technology and innovation are highly capital intensive, however they are other opportunities that require less of an investment and may provide significant benefits. As has been identified in this research, there are opportunities to reduce administrative burden regarding health and safety, providing essentials for workers and accessing markets and/or streamline the marketing process by using the connectivity of the internet. There is currently a lack of capacity in this area on the Marsh and thus an opportunity for improvement.

As this report was being completed <u>an announcement was released</u> indicating a plan to provide wireless high-speed internet (5G) to the Holland Marsh area. If this goes ahead and provides reliable high-speed internet at an affordable price, the infrastructure issue regarding internet will be solved but the capacity of growers to utilize this recourse will still need expansion.

Overall investment in the future of the sector as a whole is a key consideration that should not be dismissed. There is a need to promote agriculture as a valuable and viable industry to enter, support for young farmers is needed.

In addition, supporting and/or developing co-operative education/internship opportunities with colleges to encourage new entrants into the agricultural sector could be highly beneficial, especially if they are focussed on machinery innovation, development, and implementation. Promoting homegrown solutions could also address longer term issues with local support which was identified as a key barrier to investment.

The Holland Marsh has a diversity of businesses, all with varying needs. It is likely that large growers/packers/shippers are seeking investment in capital intensive automated equipment which could have the largest impact on reducing the number of employees, in addition to supporting a reliable supply of local food. They are most likely to be able to demonstrate significant ROI on these investments. However, ensuring there is capacity for smaller farms to be successful and manage crises such as the COVID-19 pandemic by increasing their capacity to access markets efficiently will help keep the variety of products currently being supplied from the Marsh sustainable.

It is therefore recommended that if a grant application process be implemented that there are broad categories which relate to labour savings, pandemic benefits, and overall business competitiveness. It would also be beneficial if this was linked with increasing the capacity of producers to plan strategically.



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Appendix A: Supplementary Online Survey Figures

Q. What is the nature of your Primary Business? Please select all that apply.



N=22

Q. What is your age?



N=22

Q. How long have you worked at the company?



N=22



Q. How many acres do you farm on within the broader Holland Marsh area? Please chose one answer.



N=20

Q. Please identify the most important vegetable grown on your farm (by \$ value). Please choose one. There is an option for "other" if you have more than one commodity of equal importance.



N=20

Q. Please identify all of the vegetables you grow.



Q. Over the past year, how has COVID impacted your business? Please reply using a scale of 1-7, where 1 is "no significant difference" and 7 is "very significant difference".



N=17

Endnotes

¹ Take it Up, 2019 ² Aurora Banner, March 2010 ³ HMGA.ca ⁴ Calculated from Statistics Canada Food Availability Data ⁵ Take it Up, 2019 ⁶ Take it Up, 2019 ⁷ Kelly-Pemberton, "Report shows agri-food economic contributions add up" ⁸ Take it Up, 2019 ⁹ Take it Up, 2019 ¹⁰ Hein, "How much bigger are farms getting?"; Statistics Canada, Census of Agriculture, "Number and Area of Census Farms, Canada and the Provinces; Larue, 2020; Richards and Rickard, 2020. ¹¹ Take it Up, 2019 ¹² Statistics Canada, 2016 Census Population Data ¹³ Interviews with Growers, Packers, Feb 3, 2021 ¹⁴ Shahbandeh, 2021 ¹⁵ Wiltz, 2016 ¹⁶ National Farm Worker Ministry, 2018 ¹⁷ Cimini, 2020 ¹⁸ Martin & Costa, 2017 ¹⁹ Take it Up, 2019 ²⁰ Statistics Canada, Consumer Price Indexes ²¹ Bank of Canada, Inflation Calculator ²² Statistics Canada, Machinery and equipment price index, by commodity, quarterly ²³ TVO, The Agenda, Jan 2021 ²⁴ TVO, The Agenda, Jan 2021 ²⁵ Collins, 2020 ²⁶ CAHRC, 2019 ²⁷ CAHRC, 2019 ²⁸ Walker, 2020 ²⁹ Collins, 2020 ³⁰ CAHRC, 2019; Larue, 2020 ³¹ CAHRC, 2019 ³² Campbell, 2020 ³³ Harris, 2020 ³⁴ Pritchard, 2020; TVO, The Agenda, Jan 2021 ³⁵ Antonacci, 2020 ³⁶ Hobbs, 2020 ³⁷ Clark, 2020 ³⁸ CBC, July 6, 2020 ³⁹ Rodriguez, 2020 ⁴⁰ CBC, July 2, 2020 ⁴¹ Pritchard, 2020 ⁴² Pritchard, 2020 ⁴³ Antonacci, 2020

⁴⁴ Walker, 2020 ⁴⁵ Gordon, April 2020 ⁴⁶ Pritchard, 2020 ⁴⁷ Harris, 2020 ⁴⁸ Pritchard, 2020 ⁴⁹ Bruineman, 2020 ⁵⁰ Campbell, 2020 ⁵¹ Sheldon, 2020 ⁵² TVO The Agenda, Jan 2021 ⁵³ Interview with Holland Marsh Growers & Packers, February 3, 2020 ⁵⁴ WHO, 2020 ⁵⁵ Bray, 2020 ⁵⁶ Spenergy Website, 2021 ⁵⁷ Morawska et al, 2020 ⁵⁸ Winnipeg Regional Healthy Authority Website, 2021 ⁵⁹ Pollok & Lancaster, 2020 ⁶⁰ Take it Up, 2019 ⁶¹ Greenaway, 2020 ⁶² Plant Tape Website, 2021 ⁶³ McIntosh, 2018 ⁶⁴ OMAFRA, Weed Management in Carrots, 2009 ⁶⁵ Smith, 2020 ⁶⁶ Greenaway, 2020 ⁶⁷ Ferrer, 2019 ⁶⁸ Lohumi, Cho & Hong, 2021 ⁶⁹ Zhonghua Guo, et al, 2020 ⁷⁰ OPMA, 2017 ⁷¹ Askew, 2021 ⁷² FreshPlaza.com, 2018 ⁷³ Hobbs, 2020 ⁷⁴ Richards and Rickard, 2020 ⁷⁵ Richards and Rickard, 2020 ⁷⁶ Hobbs, 2020 ⁷⁷ York Region, Spotlight on Reesor's, 2020 ⁷⁸ Kapsak, 2020 ⁷⁹ HMGA Website, Profile of Agriculture, Case Studies, 2019 ⁸⁰ York Region, Spotlight on Pine Farms Orchard, 2020 ⁸¹ OFA, 2019 ⁸² OFA, 2018 ⁸³ Government of Ontario, Ontario's Long-term Infrastructure Plan, 2017 ⁸⁴ OFA, 2018 ⁸⁵ OFA, 2019 ⁸⁶ Interviews with Growers, Packers, Feb 3, 2021 ⁸⁷ FeedingYourFuture.ca, 2020 ⁸⁸ Statistics Canada, Farm operating revenues and expenses ⁸⁹ Statistics Canada. Table 32-10-0136-01 Farm operating revenues and expenses, annual



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