



Original Research Article

Food system resilience tested: The impact of COVID-19 on a major node in North America's produce supply chains

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Abstract

At the beginning of the COVID-19 Pandemic, many warned that the resilience of the global, industrial food system would be tested. We conducted regular interviews in 2020 with key actors at the Ontario Food Terminal, North America's third largest produce wholesale market, to better understand urban food system resilience in the first year of the Pandemic. How major wholesale marketplaces, such as the Ontario Food Terminal, fare during emergencies is key to understanding urban food system resilience, as these institutions connect farms to cities. Widescale interruptions to the supply of fresh produce did not take place at the Terminal despite challenges. We present data from the frontlines,

documenting the challenges participants faced and their adaptive capacity. We find that food system resilience was rooted in pre-existing relationships, the adaptability of actors in produce supply chains, and worker stress and effort. We caution that, even though the system displayed resiliency, this does not mean that it is inherently resilient. We highlight vulnerabilities in the status quo and raise a red flag around the future ability of the system to withstand shocks. We conclude that, because the system resilience we document depends on people, the well-being of humans in the system is key to resilience of the food system itself.

Keywords: Resilience; supply chains; food system; markets; COVID-19; produce

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Résumé

Au début de la pandémie de COVID-19, de nombreuses voix ont annoncé que la résilience du système alimentaire industriel mondial serait mise à l'épreuve. En 2020, nous avons mené des entretiens réguliers avec des acteurs clés de l'Ontario Food Terminal, le troisième plus grand marché de gros de fruits et légumes d'Amérique du Nord, en vue de mieux comprendre la résilience du système alimentaire urbain au cours de cette première année de pandémie. Observer la façon dont les grands marchés de gros, tels que l'Ontario Food Terminal, s'en tirent pendant les urgences est une clé pour comprendre la résilience du système alimentaire urbain, car ces institutions relient les exploitations agricoles aux villes. Malgré les difficultés, aucune interruption à grande échelle de l'approvisionnement en produits frais n'a affecté le Terminal. Nous présentons des données provenant des

premières lignes, qui documentent les défis auxquels les acteurs ont été confrontés et la capacité d'adaptation dont ils ont fait preuve. Nous constatons que la résilience du système alimentaire était ancrée dans les relations préexistantes, dans la capacité d'adaptation des acteurs des chaînes d'approvisionnement ainsi que dans la pression et les efforts assumés par les travailleurs. Nous faisons une mise en garde : même si le système a démontré de la résilience, cela ne signifie pas qu'il est intrinsèquement résilient. Nous mettons en évidence les vulnérabilités liées au statu quo et tirons la sonnette d'alarme quant à la capacité future du système à résister aux chocs. Nous concluons que le bien-être des individus qui font partie de ce système que nous décrivons est essentiel dans la mesure où sa résilience dépend d'eux.

Introduction

The Ontario Food Terminal sits at the edge of the Gardiner Expressway, a busy highway that links downtown Toronto to its western suburbs and beyond. As the road curves around the shore of Lake Ontario, the Terminal comes into view. Farmers and regional dealers travel here to sell produce, and wholesalers buy fruits and vegetables from Canadian farms and import internationally. The Terminal operates on the just-in-time model and is part of the global, industrial food system, in which cross-border trade has doubled since the 1980s (Marchand et al., 2016; Qualman, 2017). Trucks carrying produce from points of origin across Ontario, Canada, and the United States, as well as from ports, railyards, and airports, arrive six nights per week to be

unloaded before dawn and sold. Buyers come in the early morning hours to “walk the market” before making deals. The actors at the Terminal form a supply-chain network connecting the regional foodshed and Ontario farmers with local and regional buyers, global producers, and international importers.

The Terminal is part of the complex global food system that scholars have long warned is brittle and at risk of failure during stochastic events (Seekell et al., 2017) such as extreme weather, power failures (Medical Officer of Health, 2018; Puma et al., 2015)—and pandemics. Early in the COVID-19 Pandemic, debate about the resilience of the system unfolded within food systems studies and agricultural economics. The concern

among many food systems researchers was that the Pandemic would test the resilience of the globalized, industrial food system that supplies much of the food to major North American cities such as Toronto. Supply chain actors, such as one study participant who trades in fresh produce, worried too. He recalled his fears: “we went from buying fresh and then we realized, ‘Oh my god, if this goes a week further are we going to frozen? Are we going to frozen vegetables?’” Conversely, the view of the food system as brittle was contested by some in agricultural economics who posited that the shock of COVID-19, while significant, would not lead to major structural changes; they held that the system would display resilience during the Pandemic (Ker & Cardwell, 2020; OECD, 2020). The gulf between these two perspectives underlines a larger gap in understanding the nature of resilience and vulnerability in the global food system. This is a complex network that increasingly connects local foodsheds to international commodity chains (D’Odorico et al., 2014). It faces the rising possibility of disturbances as a result of both the complexity of the globalized world and climate change—as was witnessed in western Canada in November 2021, when flooding and mudslides destroyed farms and killed livestock, berry plants, and other food system infrastructure (Newman & Fraser, 2021). Local and regional food systems are often understood to be loci for transformative food system change away from industrialized, global supply chains, including during the Pandemic (Jones et al., 2022). However, large-scale wholesale marketplaces channel food from farms locally and globally to cities around the world, including Azadpur Mandi in Delhi, Paris’ Rungis market, Hunt’s Point in New York, and the Ontario Food Terminal in Toronto. How such institutions fare during emergencies is pertinent to understanding urban food system resilience. Furthermore, the complex wholesale supply chains of the Ontario Food Terminal stand in contrast to

the major supermarket chains that comprise almost seventy-four-percent of the Canadian market (United States Agricultural Service). These chains—Loblaws, Sobeys, Metro, Walmart, and Costco— have their own buyers, suppliers, and warehouses. They do not source at the Terminal unless they have “shorts” they need to fill. Wholesalers and dealers at the Terminal are mid-sized businesses. Farm suppliers can range in size from family farms in Ontario to multinational corporations such as Dole plc. For researchers working towards more sustainable food systems, what happened when this part of the food system was tested in a crisis is pertinent to understanding what works and what does not. Insights can inform the building of more resilient and sustainable ways of feeding society.

Thus, we followed key actors who operated out of the Ontario Food Terminal during the first year of the COVID-19 Pandemic. Telephone interviews with participants were conducted, generating qualitative data from the frontlines and contributing to scholarly debates about resilience and vulnerability in the food system (Eriksen, 2008; Pingali et al., 2005; Schipanski et al., 2016; Tendall et al., 2015). We found that, while concerns about interruptions to the supply of fresh produce voiced early in the Pandemic did not come to fruition, problems did emerge. Here, we document the challenges study participants faced, as well as their sources of adaptive capacity.

We begin by outlining the research thus far, exploring the various impacts of COVID-19 on the food system. We situate our work in the context of resilience theory as applied to the global food system. Next, we outline our research methods and context. We argue that the resiliency displayed at the Ontario Food Terminal emerged from adaptability, pre-existing relationships, and personal efforts, including the stress and hard work of workers. In the discussion, we highlight the role of the institution in supporting resiliency. This article

contributes to the literature on food systems resilience through our findings that, firstly, the regional system displayed interconnected vulnerabilities with the global food system, as the two systems at the Terminal are interdependent; the regional system was not spared from uncertainty during a global pandemic that closed national borders and reduced transportation. Secondly, an important contribution to the food system resilience

literature is our finding that, because the system's capacity to shift and adapt depends fundamentally on people, it is vulnerable to personal stress and burnout. Food system resilience must therefore consider the humans in food system supply chains.

Resilience and vulnerability of the global food system during COVID-19

At the beginning of the Pandemic, food researchers published articles contemplating the risks and possibilities presented by COVID-19. For example, Clapp and Moseley (2020) identified vulnerabilities created by past food policies that left food systems vulnerable during the crisis, while others warned of shortages in staples like wheat, rice, and corn (Fraser, 2020). Some scholars voiced hope that the Pandemic would lead to something better (Altieri & Nicholls, 2020; Clapp & Moseley, 2020; Friedmann, 2020), arguing that disruption would allow for radical shifts (Blay-Palmer et al 2020). Importantly, many academics pointed out that, while food supply chains largely functioned during the Pandemic, a massive food insecurity crisis was provoked when people lost their jobs, and food banks reported a record-high demand for their services (Men & Tarasuk, 2021).

Since then, some scholars have contended that the food system in fact coped well and that North American supply chains proved remarkably resilient. Deaton and Deaton (2021) observe that, despite the rise in food insecurity, the Canadian food system weathered early pandemic-related disruptions in term of supply. In these positive accounts, authors parse out household food access from the supply chains that link farms to retail outlets. This view of the food system as existing

apart from the issue of food insecurity allows for a positive evaluation. In contrast, scholars who considered food supply chains within the context of COVID-19 food insecurity crises found failures (see for example Cox & Beynon-MacKinnon, 2020). These disparate analyses speak to larger ideological debates within the academy between those who believe in the benefits the industrial food system provides to humanity (ample food for sale, economic activity) and those who critique its failures (environment impact, social injustice, continued hunger).

Regardless of whether one concludes that the food system fared well or failed, the fact is that during the first year of the Pandemic in Canada there was no catastrophic collapse in produce supply chains. Deep-seated flaws in the food system have become more visible, and yet the industrial system continued to bring fresh fruits and vegetables from farm to retail. Hence, reflecting on the functioning of the food system during the Pandemic offers an opportunity to explore concepts around food system resilience in the context of an actual shock to the food system. Broadly speaking, resilience theory finds its antecedents in both the engineering and ecology literatures. In engineering, resilience is conceived of as the size of perturbation that is needed before a system stops providing basic

functions, such as the size of earthquake a building is designed to withstand. In the ecological literature, resilience has been more often defined in terms of the time it takes for a system to recover and return to a pre-existing equilibrium, such as how quickly a stream would return to its typical flow after a major rainfall (for a review of these literatures, see Fraser et al., 2009). These two definitions of resilience have been modified by scholars working within the social ecological systems literature to include the ability of a system comprising both humans and nonhumans to learn and positively adapt (Adger, 2000).

In terms of whether markets are resilient, Pingali et al. (2005) observe that markets are “known to be resilient and recover quickly” (p. S18) and invoke an ecological interpretation that sees resilience as the capacity to “bounce back” (Maneyna et al., 2011). The idea that resilience is about bouncing back to a certain state has been challenged by those who argue that a better measure would look at the capacity to “bounce forward” and create something new—what Jones et al. (2022) characterise in terms of food systems as “transformative resilience capacity” (p. 210). The pre-

pandemic “vulnerability” of food systems has been identified in the global industrial food system as arising from the high number of food system actors that are interconnected (Ericksen, 2008; Fraser et al., 2005). In a food systems context, diversity can mean the number of places where food comes from or the range in types of different actors with different capacities to respond to changing circumstances (Hodbod & Eakin, 2015). So, diversity in a food system on one hand can increase resilience because, for example, if one source is knocked out, food can come from elsewhere (Seekell et al., 2017). On the other hand, diversity also means risk from an increased likelihood of a shock having a cascading effect (Folke et al., 2010; Tendall et al., 2015). It is precisely the complexity of the interdependent system that Puma et al. (2015) flag as a vulnerability, speculating that international trade in food offers both some protection against localized shocks but also exposure to cascading events. Meerow et al. (2019) stress that resilience is not only about systems, but that people too need to be considered—especially from a social justice perspective.

Methods

Working with Research Ethics Board approval (2020-147), we conducted regular telephone interviews throughout the first year of the Pandemic with eight key actors at the Terminal, as well as interviews with supplementary key informants. Recruitment involved cold-calling or emailing potential participants with whom we either had no connection or to whom we had been previously introduced. Of the twelve people approached, three declined, saying their workload was too high; one participant stopped communicating with our study after reportedly contracting COVID-19 in

the fall of 2020, and another did not respond to messages in 2021. Participants were selected to represent a diversity of roles at the Terminal. Telephone and Zoom interviews were recorded, transcribed, and coded. Document analysis of the grey literature also contributed to data generation. Thematic analysis of interview data identified several themes; the three themes applied in analysis for this paper were discussed in interviews by all participants and overshadowed other topics in their frequent mention. Also, together, the three themes explored in this article offered an

explanation for why supply chains did not falter.¹ Here, participant identities, as well as identifying information about their businesses, have been disguised to satisfy research ethics protocol and to shield participants from unknown effects of revealing details about their business operations to competitors in what they describe to be a highly competitive field. The authors report that there are no competing interests to declare.

Research context

The Terminal reports that two billion pounds of food pass through the facility annually. Not all produce consumed in Toronto comes through the Terminal, as other produce supply routes include the proprietary supply chains of major supermarket brands and food service suppliers. It is often repeated in food systems circles in the city, including during interviews, that the Terminal allows for small and mid-sized businesses to participate in the urban food system. It provides a wholesale marketplace where any business, regardless of size, can pay \$275 for a two-year pass to source wholesale produce. We opted to study the Terminal because of its important role in the Toronto food supply, but also because of what the institution represents in the evolution of the city's food system. The Terminal was created by the provincial government in 1954 as an act of food system modernization (Elton, 2010). A wholesale market downtown, the St. Lawrence Market, was previously the hub for buyers and sellers of all scales; live cattle were sold alongside fresh produce merely a few kilometers from City Hall (Dickau et al., 2021). In the 1950s, wholesale operations were shifted to the suburbs, 'cleansing' the downtown of this agricultural

scene. The new Terminal was envisioned as a modern marketplace (Elton, 2010).

Much has remained constant at the Terminal since then. It remains a public institution. The buildings have the same appearance as in early photos (Figure A). Some of the same companies that purchased the original leases from the province still sell from the building (although some companies have expanded and also run produce warehouses off-site). The Terminal is owned and overseen by the Ontario Food Terminal Board, which operates at arm's length from the provincial government; the Lieutenant Governor in Council appoints board members. It is the Terminal board that oversees the day-to-day operations, and during the Pandemic it was the board that led the response to public health directives. In 2019, when it was leaked that the provincial government was considering overhauling the Terminal, including speculation that they planned to sell it to a private owner, there was furor in the independent grocery sector and among Ontario farmers (Brown, 2019). They lobbied the government, saying that many of their businesses would collapse if the Terminal closed. The government did not make the rumoured changes. This outcry demonstrated that the Terminal not only plays a key role in the city but is valued by those who use it. The Pandemic offers further testimony of this.

Study participants

Participants were selected from the diversity of food businesses that use the Terminal. Interviews were conducted regularly throughout the twenty months of COVID-19 with a group of core participants:

¹ A secondary analysis drawing on posthumanist theory was conducted by one of the authors and led to a first paper exploring the role of nonhuman nature in keeping supply chains moving during this time (Elton, 2023).

- Luke: a vegetable farmer in Southern Ontario who cultivates more than two dozen varieties of speciality vegetables including asparagus, green onions, and leeks for retail and restaurants.
- Sandy: the head of a mid-sized family-owned supermarket chain that sells A-grade produce to a largely high-income clientele; the company also prepares and sells meals made from Terminal produce.
- Mike: the CEO of a large produce importer and wholesaler.
- Lou: one of three siblings operating a small, neighbourhood grocer selling produce and dry goods to a mixed-income community.

- Richard: a long-time wholesale buyer and employee of one of the companies that holds a 100-year lease.
- Ted: an apple dealer who sources fruit from Ontario and other parts of Canada, as well as from Chile, to sell to retailers.

Interviews with core participants were supplemented by additional interviews with other Terminal actors: restaurant owners, a wholesaler, a jobber, Ontario Food Terminal board members (past and present), employees of food assistance programs that have both purchased and acquired food at the facility, and an employee of the Terminal.

Results

The following description of the impact of COVID-19 at the Terminal provides the context for the themes that we identified in our analysis and that we detail in the following sections.

Global supply chains

In the early days of the Pandemic, many public institutions in Toronto, such as libraries and swimming pools, were shut down in mid-March of 2020. The Terminal, however, never closed. In a March 20th communiqué, the Ontario Food Terminal Board described their new infection control measures, including increased cleaning, social distancing, and contact tracing. Their goal was to protect what they described as “an essential service keeping food flowing,” stating that their “top priority is ensuring a continuous

supply of food to the public in a safe way” (Ontario Food Terminal Board, March 20, 2020). In the first year, there were COVID-19 cases at the Terminal, but sources reported that there were no super-spreader events and that the closures did not have an impact on the supply of food (in Ontario, workplace infection data were shielded from the public by the government, so this claim cannot be corroborated). During previous crises, the Terminal has rarely closed. In the August 2003 power outage that stretched across the northeastern United States and Ontario, staff remembered that they lost power for less than twenty-four hours, closed briefly, and kept produce cool with dry ice and by keeping doors shut. During the power outage of the December 2013 ice storm, they strung up temporary lights and continued to operate. And during those uncertain early weeks and months of COVID-19,

fruit and vegetable shipments continued to arrive, despite participants reporting disruptions to global produce supply chains. Mike, the wholesale CEO, described how the spread of the virus in the early days of the Pandemic affected supply chains:

Generally, we bring a lot of product from Italy. Italy was one of the first areas outside China that really had the Pandemic hit there bad. So, they shut down a lot of the product that they were sending from Italy. The pack houses were shut down. And then shortly after that it went into Spain.... We bring so much product from Spain. So it made importing products from these countries questionable. A lot of them shut down. We even bring product from India. We bring, I don't know, a hundred containers of grapes from India. They shut down fairly quickly and we stopped shipping.... There is product that comes from China as well and that became very difficult because, even if the product was available, the shipping lines weren't moving the same for containers because the factories in China were shut down.

At the same time, produce continued to arrive across the land border from the United States, Mexico, and within Ontario, but prices rose. "It's everything across the board," Mike said. "There's not as much strawberries, for example. They're selling for about forty dollars a case, mid-thirties a case, where they would generally be about eighteen to ten dollars." Richard, who works for a wholesaler, said that he saw no interruption in supply from the United States during this period, and that trucks continued to bring food to the Terminal from different regions of that country. In June 2020, the problems he identified, like

Mike observed, were in the longer-distance supply chains. He said:

Non-North American products—we're finding that either we won't be able to get them at all, due to COVID and flights being cancelled. Like our Moroccan mint. We couldn't get any of it at all. So there was a complete outage of that.... Anything that's outside of North America does pose a problem of getting it in. Either we don't get it or we have to try and source it from somewhere else.

Having a number of suppliers in different countries allowed the international wholesalers, said Mike, to pivot and buy from another country to secure the supply. While there were interruptions in the global supply chain when produce from certain areas was not available due to a rise in disease (Spain) or a reduction or elimination of air-freight (Morocco), wholesalers were able to source the majority of what they wanted from suppliers that were not facing these problems.

Regional food system

The Terminal actors who operate in the regional food system include: 1) farmers who sell their own produce in the farmers' market section, such as our vegetable-farmer participant Luke; 2) dealers who purchase from Canadian farmers and then sell produce at the Terminal, such as our apple dealer participant, Ted; 3) wholesalers, such as Mike and Richard who purchase produce internationally and locally; and 4) buyers such as supermarkets and small grocers, including grocer participants Lou and Sandy, as well as restaurants, jobbers, and other food system buyers serving a Toronto clientele, some of whom we also interviewed.

Their experiences were each different in the early days of the Pandemic.

The most significant changes for those who frequent the Terminal were new protocols. The public health measures implemented included restricting access, which put a sudden end to produce buyers' early morning visits. This fundamentally transformed the nature of business transactions at the Terminal because produce buyers were not able to see or touch the produce. The tactile inspection of food by buyers has been central to food sales at the Terminal, as it is in many food marketplaces. As one board member described:

The value out of the Terminal is the freshness and the quality of the product. And a lot of the buyers down there use that as their value-add to their own customers, right? This is fresh, comes directly from the farm. 'It is as fresh as it can get' is their value proposition at the Terminal.

The wholesale buyer's ability to touch and see the product is understood to provide value along the supply chain—right to the consumer. An employee of the Terminal described how the buyer's tactile experiences at the Terminal are seen to shape the consumer's experience at the grocery store. He said:

When people go to a grocery store, or whatever...you don't mind paying \$12.99 for a bag of cherries, because you know the quality is going to be there. So, this [shutting the Terminal to buyers] put our buyers at a disadvantage because they couldn't see the product, they couldn't look at the product.

Buyers had to navigate purchases through a third party. When Lou, who runs a small grocer, lost his

ability to see the produce, he had to count on the people he already knew at the Terminal. He said:

Because we've been in the business for so long, our salespeople...understand the quality that I want to carry in my store. So they are basically, during this time of COVID-19, they're pretty much my eyes, looking at the product. And they feel that during the years of doing business with us, they *know* the quality that I want. So it hasn't been that bad.

He was able to navigate the sudden change by depending on the relationships he had with his long-term suppliers. Richard, a long-time wholesale buyer and employee of one of the companies, also observed that relationships became the building blocks for transactions that previously would have been conducted in person. Personal connections offered adaptive-capacity—a topic we return to later in the paper when discussing the relationships theme.

Another change to the food supply chain flagged in May 2020 by Sandy of the independent grocery store was that, in addition to a stronger American dollar that had increased prices, freight prices had also risen. She said:

The trucks, they usually have a full load coming from Canada down to California. But with all the factories and everything being closed, their loads are empty on the way to California. So that makes it more expensive. And the second thing is that the truckers usually would drive [a truck] to one state and then someone takes that truck and then drives it to the next state. So they do more short distances, split up. Whereas now they don't feel comfortable sharing their rigs, so the drivers, they're doing the full length themselves. But then

they need more rest. So it takes longer for the trucks to get here.

These changes, she said, increased the cost of produce arriving from the United States. Still, in August 2020, Lou described easy access to the produce he sells at his greengrocery. He said: “for a small business, it has not really changed that much in terms of getting products. What I see, or what I feel, is that there is a good quantity of supply.” Despite the changes, the resilience of the supply in the face of several hurdles—rising American dollar, COVID shutdowns, changes in trucking—is notable.

Amongst participants who farm, sell, or purchase Ontario products, the most significant issue raised was the Pandemic’s impact on the functioning of the Temporary Foreign Worker Program and the Seasonal Agricultural Workers Program that have been bringing in workers from countries including Mexico and Jamaica for decades. Twenty percent of jobs in Canadian agriculture are filled through these programs (Government of Canada, 2020). Luke, who runs the speciality vegetable farm, brings in twenty-two men primarily from Mexico to work. In January of 2020, the first four employees arrived before Pandemic travel restrictions kept the next group from arriving in April. Only seven made it by that date, and the rest of the employees were delayed and then were required to quarantine for two weeks upon arrival. In June 2020, Luke described how this interrupted the farm’s plans to harvest asparagus, a labour-intensive perennial crop:

We should cut our asparagus today. But because we don’t have enough help, we let already 25% go. So that will not be harvested this year anymore. Today we mow everything. We mow everything off. Everything goes to waste because we don’t have the help to take it.

Ted, who buys apples from local farmers, also described the impact of the lack of farm labour on orchardists in May of 2020:

The problem with apples now is that the orchards are sitting ready to go. The farmworkers have not arrived. But that doesn’t stop the trees. They all came to life and all my guys say ‘don’t expect a great crop this fall because I don’t have the labour to trim and prune this year.’

There were many more problems reported in the media, specifically relating to farmers’ rights, their living conditions during the Pandemic, and their health, and these have since been explored in the scholarly literature (Vosko & Spring, 2021; Weiler & Encalada, 2022). The farmworker perspective is not reflected in our article because they do not work out of the Terminal, though the vegetables they grow do pass through the facility. The reliance in Ontario on farmworkers from other countries renders the system reliant on transnational flows of human labour. The regional system is therefore interdependent with global circulation.

Relationships

The first of the three themes we highlight is the effect of the Pandemic on people’s relationships at the Terminal and how the nature of these relationships supported resilience. In particular, the loss of the tactile experience of buying fresh produce due to the implementation of the new public health protocol was replaced during this period by relationships between sellers and buyers—as Lou said, the people he purchased from became his “eyes.” Further, one employee of the Terminal explained how relationships were important for the

smooth rollout of the rapidly-implemented pandemic protocols. He said:

For the most part it's been very well received by our tenants and our buyers.... They're champions when it comes to helping us enforce our policies. It's just another level of working together and making this as best as possible to handle. These are challenging times.

Some participants who spoke of relationships noted that they have always been fundamental to the functioning of the Terminal's supply chains, even before the Pandemic. Ted, the apple dealer, described how sales generally happen between actors who have a business relationship:

Most of the farmers and wholesalers know who their buyers are. So, it's not as if it's 'Oh! I need to find apples, but I don't know the name of the person I'm buying apples from,' right? Generally speaking, the buyers that come down there have their three or four contacts that they are using to buy apples from.

Sandy, who runs a mid-sized grocery chain, described how relationships enable deals. She said:

The food Terminal does offer great opportunities to bargain on products and things like that. If you have great relationships with your suppliers and they might have a good thing, you don't pay as much of a premium. You say, if I take, you know, 200 cases of it, you gotta give me a better deal. That kind of thing.

Richard also described the importance of having a variety of relationships with different supply chain actors:

We'll have more suppliers in our back pocket. We try to stay loyal with the suppliers that we usually use, but if for some reason they can't, then we know that we've created relationships with some other suppliers that we can rely on.

Implied in this statement is the importance of maintaining different kinds of relationships to ensure access to produce supply. Thus, it was these business connections, rooted in longer-term relationships, that helped facilitate the uninterrupted workings of the Terminal during the early period of the Pandemic. Relationships bolstered resilience.

Adaptability

The disruption of the Pandemic prompted all of the participants to pivot and adapt, with the alacrity of their respective shifts attesting to their resilience. Luke, the farmer, quickly adjusted in spring 2020 what he was going to plant in his fields that summer, making the decision based on what was happening in food service and retail. He also said that he considered how many foreign agricultural workers he might have on the farm that year when deciding how much of each crop to plant. Ted, the apple dealer, described how the farmers he buys from in Ontario had to decide how many apples to harvest and how many to leave on the trees based on the number of workers who might arrive in Canada. A restaurateur interviewed for the study said that he changed recipes in order to adapt. Having ordered fresh red peppers, which they were not able to use fast enough in their normal recipes, the restaurant roasted them so as not to waste the food, even though

roasted red peppers, he explained, are not part of Korean cuisine. That these food systems actors made swift decisions to change their operations was not atypical in the industry. Nimble adaptation to a changing situation is, according to Richard, something that people working in produce supply chains have long done: “that dynamic-ness—we’ve adapted to that within the industry, you know. COVID is another layer to that. But it’s just another thing that we have to handle and we just kind of move around it.”

It is important to underline that the Ontario Food Terminal supplies food not only to retailers and institutions, but also to restaurants. In April 2020 many restaurants were shuttered in Ontario, with some establishments offering a reduction in service, such as take-out and meal-kits. Patrons were unable to eat inside a restaurant due to public health rules for more than 360 days, with some media arguing that the city’s shutdown was the world’s longest (Levinson-King, 2021). This meant, according to our participants, a twenty to thirty percent reduction in demand for produce from the food services sector. Richard described the lingering impact: “there’s a lasting impression that this has left on the hospitality industry. Which of course left a lasting impression on our business as well—on how we conduct business.” Richard described how the wholesale company he works for similarly adapted by catering to retail consumers after food services mostly shut down. He said, “what we did to offset the lack of sales on the food service side, we simply beefed up our retail side and ensured we ordered what local grocers would want.” The shrinking of the sector was another cause for a pivot. Interestingly, the disappearance of food service, according to a board member of the Terminal, enabled the roll-out of public health protocol. He said that, because restaurants were not coming to the site to buy, public health protocols were easier to apply. Thus, any

ability of the system to adapt to the disturbance must be seen in the context of this sudden change. At the same time that food service shrank, system resiliency emerged from adaptability and relationships. This ability to adapt took place in the context of a stable public institution that had operated for decades, and the relationships that sellers and buyers depended on had grown and were fostered over years leading up to the Pandemic.

Stress and human toll

Stress and work wear is a third theme in the data. The culture at the Terminal was described in some interviews as being old fashioned: “it’s very much a kind of cutthroat world, it’s an old school world, it’s a zits-and-all world.” It does not appear to be the kind of place where people would talk about their emotions. Nevertheless, the stress of the job during the Pandemic became apparent. Many participants described working longer hours than they ever had before. Several people said they had to forego vacation time in the summer, even after the initial uncertainty of the first months of the Pandemic had quieted. One participant stopped returning calls after participating enthusiastically during interviews up until that point. Others chose not to participate in the first place, explaining that they could not take the time. Lou, who runs a small grocery store with his family, was often hard to get in touch with because he was in constant demand at work. When we did speak, he described new challenges, such as dealing with customers who refused to wear a mask and worrying about bringing COVID-19 home to his family. “It’s a stressful job. It’s a very stressful job,” he said. One day, when the first author telephoned Mike in August 2020, they heard a different tone in his voice and asked him about it. He said, “yeah, I guess I’m just distraught with the whole situation. I’m just COVID-

tired. You know, we've been battling this for a long time and I don't see a light at the end of the tunnel at this point." Working to keep produce flowing through supply chains left many people feeling burnt out.

Further, people voiced their awareness of the importance of their jobs in the supply chain, which lent a gravitas to their work. One employee of the Terminal described what he perceived to be the mindset of his colleagues:

People are taking it seriously. I think *that's* something that can't go unnoticed. I think people are taking this seriously, not only to

ensure that the supply is moved through to feed the people of Ontario, of Canada. It's to ensure the employee's safety is paramount as well.

This sentiment was echoed by one wholesaler, who said: "this business doesn't stop. Pandemic or not, people have to eat." Emotions have been considered in the context of resilience (see Della Bosca et al., 2021). Fundamentally, complex systems rely on people to function. If the people themselves become too burned out to function, then this lack of human capacity may reduce resilience.

Concluding discussion

Why did the supply of produce continue to flow through the Terminal in spite of disruptions caused by the global spread of a novel coronavirus? We conclude that, in this ability to continue to function, the system displayed resiliency. This resiliency emerged from previously-existing relationships, adaptability, and personal efforts, including stress and hard work. These three factors were interdependent, with adaptability being reliant on relationships and also dependent upon the hard work of the people in produce supply chains. We also highlight the role of the public institution in providing the framework within which these factors that contributed to resiliency emerged.

Tendall et al. (2015) assign food system resiliency to four categories: 1) the capacity of the system to initially cope with a disturbance without seeing a rise in food insecurity, such as during the time period of the COVID-19 Pandemic that we focus on; 2) any "redundancy" that is built into the system that provides an element of protection against food insecurity; 3) the

speed with which the food system is able to fix any problems that lead to food insecurity; and 4) the "resourcefulness and adaptability" to build back food security. Adaptability to the disturbance of the Pandemic at the Terminal can be interpreted through this frame. The system exhibited significant resilience in, firstly, never closings its doors. Secondly, it exhibited resilience by ensuring a continuous supply of produce during a time when many people in the city, who were privileged enough to be able to stay home, were fearful of going outside as the virus' mode of transmission was unknown. Food insecurity has been documented in the city during the Pandemic, however, it was a result of lack of income and purchasing power among lower income groups as opposed to a lack of supply (Ayer, 2020). The resilience the system displayed emanated from the swift adaptations that people undertook at the Terminal. This adaptation was dependent upon relationships. The already-established, trusting relationships among food system actors meant that

sudden disruptions to the way business was conducted were overcome by relying on others. In the cut-throat world of produce sales, where look and feel have market value, the fact that the transition to proxy buying happened smoothly, with actors empowering close contacts with critical buying decisions, is testimony to the significance of these pre-existing relationships. This also underlines that this resilience was not available to those who had been excluded from these relationships.

The second element that Tendall et al. (2015) observe provides food security is redundancy. Participant accounts describe redundancy built into the complex networks of the long-distance, just-in-time food system. There was one product that was unavailable to a participant's warehouse—fresh mint from Morocco was no longer arriving at the Terminal due to the decrease in international plane travel. For the most part, however, it was apparent that the diversity of produce on the whole, as well as its supply, were not compromised, as wholesalers had a variety of suppliers to source from. Also, during the Ontario growing season, regional farmers sold food at the Terminal. Despite farmers reporting that they were able to harvest less produce than average—a problem they largely attributed to complications with bringing foreign workers into the country—the supermarket and grocer participants, as well as the international wholesalers, remarked that the market demand for local produce both rose in the growing season and was filled by Ontario farmers. At the same time, demand from food service was down, reducing the draw on the produce supply.

The third and fourth criteria of food system resiliency, as listed by Tendall et al (2015)—speed and resourcefulness—were provided in the case of the Terminal through the work of participants. The speed of adapting to a new situation, such as the Pandemic, is reliant upon the labour of those in the system to make

the necessary changes. Without ever closing its doors, the Terminal implemented its health and safety protocols. Sellers and buyers had to instantly adapt to a new way of doing business, including relying on sellers to choose for them. Resourcefulness is also a characteristic of humans. The workers we spoke to demonstrated resourcefulness in their problem-solving, such as the restaurateur who decided to roast red peppers, a way of preparing this food that was not typically associated with their Korean cuisine. Participants made swift and creative changes to their businesses—which in many cases caused stress and overwork.

We highlight the role of the public institution in providing the context within which speedy and resourceful adaptability emerged, based on pre-existing relationships that had developed there over years. The Terminal board and employees not only took actions that contributed to the functioning of the marketplace during the public health crisis, but the institution itself also played a role—the institution being an aggregate of the staff, the board, and all of the independent businesses including wholesalers, farmers, and the diversity of buyers that have operated at this site since 1954. This research highlights the important role of the public wholesale market.

The resiliency displayed at the Ontario Food Terminal does not, however, mean that the globalized food system is inherently resilient. As Garnett et al. (2020) observe of the perceived resilience of United Kingdom food supply chains to the disturbance of COVID-19, “this resilience has benefited from a large degree of contingent luck” (p.317) In fact, the qualities of the resiliency we document highlight serious vulnerabilities and raise a red flag around the future ability of such a complex system to withstand shock. Firstly, consider the ease with which food shipments crossed international North American land borders that

were closed to most travellers. While there was redundancy in the supply chain because food was sourced from various geographic locations, there would not have been as much flexibility in the system had the United States approached fruit and vegetable exports the same way that they did Protective Personal Equipment. Then-president Donald Trump banned 3M from exporting much-needed PPE to Canada (Walsh, 2020). It is conceivable that such an attitude could have been directed at the food supply, had there been shortages. As Puma (2015) asserts, governments protect their own food supply during crises. Secondly, the notion of a regional food system is often presented as a way of building resilience, as it protects the productive capacity of a region and provides redundancy if the global system fails. However, as we have documented, farmers in Ontario were unable to hire the standard number of farm workers internationally, due to COVID-19, and therefore reported that they were unable to harvest the typical amount of food. The issue of labour shortages on farms due to border closures and travel restrictions during the Pandemic suggests that the idea that a regional system offers redundancy is not entirely correct. If Ontario farmers depend on transnational systems, including global plane travel and the movement of people for labour, then the redundancy offered by the regional farming sector is fragile.

Further, the rapid adaptability, resourcefulness, and uninterrupted flow of produce came at a cost. Our results underscore how issues of stress and burnout should be considered along with food system resilience. The hard work of participants supported their resourcefulness and their adaptability, and enabled the system to function without the consumer having much of an idea of what was going on down the supply chain. It is questionable whether this level of effort on behalf of workers can be sustained and whether it is a

replenishable resource that can be depended upon during future unexpected disturbances. Burnout from stress and other mental health challenges of the Pandemic drive vulnerability in the system. The relationships that have been so fundamental to the functioning of the Terminal are also vulnerable to stress as they are made between humans—they exist between the same people who have been working so hard and experiencing workplace stress for many months. These relationships are vulnerable to interruptions caused by sick leave, people exiting the sector, stress-induced conflict, or any other disruptions.

This raises the question of how long workers can sustain the kind of effort they displayed. Simply because produce flowed unencumbered through the Terminal during the first twenty months of the COVID-19 Pandemic does not mean it will continue to do so during future stochastic shocks. This vulnerability is inherent to complex, border-crossing food supply chains, as opposed to being associated specifically with the Terminal or the actors themselves. In November 2021, North America's fresh produce industry released a joint statement to the governments of the United States and Canada warning that the well-publicized supply chain disruptions of 2021 were threatening not only the "long term economic viability of the North American fresh produce sector" (North America's Fresh Produce Industry, 2021), but also food security. Follow up interviews with some participants during member checking—the methodological process by which we support the rigour of our work by soliciting feedback on our results from participants—found actors at the Terminal anticipating future disruptions to their supply chains. While acknowledging that food trucked in from the United States had fed Torontonians during the Pandemic, they pointed out that the trucking industry was vulnerable to labour shortages and other logistical issues.

On the one hand, the smooth passage of fruits and vegetables through the Ontario Food Terminal in 2020-2021 is evidence of resilience in the system. How institutions such as the Ontario Food Terminal fare during stochastic events like a pandemic is key to understanding urban food system resilience and offers insight to those working toward building more sustainable and just food systems. What we document here provides insight into how resilience in public wholesale marketplaces could be improved, as our findings have resonance in other contexts where similar institutions made up of complex networks manage the flow of food. We also underline the role of the institution itself in providing a stable framework within which people were able to adapt.

Foremost, what this study draws attention to are the people who work in food systems. It highlights the relevance of their interpersonal relationships to the smooth functioning of supply chains and the

importance of paying attention to the stress and work toll they face in an emergency. While international farmworkers were not part of our study, their wellbeing in the regional food system is similarly critical (Weiler & Encalada, 2022). The issue of transnational labour in regional economies requires more research, including in the context of resilience. Other future research questions include comparing the nature and functioning of business relationships in local supply chains with global supply chains. One could also explore how the public institution compares with the vertically integrated corporate supply chains of major chain supermarkets. Certainly, the unfolding of the Pandemic at the Terminal demonstrates that increased consideration of humans in the food system is needed to support resilience. These lessons from the complex produce supply chains of the conventional system can also inform thinking about sustainable food systems futures.

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