# Estimating Food Capacity in Nova Scotia

by

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## III Abstract

Given the real possibility of food shortages in Nova Scotia and their potential implications to consumers, it is important we gain a more complete understanding of food capacity in Nova Scotia. This study sought to identify key nodes and supply chains and estimate the food capacity within key nodes. Through directed interviews this study described some of the strengths and vulnerabilities within the Nova Scotian food system. Approximately 90% of the one billion meals consumed in NS were consumed in households, 9.6% of the meals were consumed in restaurants, 0.33% of these meals were consumed in universities, and 0.28% of these meals were consumed in hospitals which highlights the relative importance of nodes to the average Nova Scotian. Sit-down restaurants held seven days of food capacity, and fast-food restaurants held 14 days of food capacity, where a diverse range in capacity would be expected. Universities held ten days of food capacity. Hospitals held 21 days of food capacity in rural communities and 14 days of food capacity in urban communities. Sysco held seven days of food capacity. Grocery stores hold two days of food capacity. Though Sysco and universities had contingency plans, no other nodes did. Hospitals intentionally stockpiled food in preparation of food shortage events, but no other node did so. Though most supply chains held unexpectedly high food capacity, grocery stores were identified as a vulnerability to NS food security. It would be important for NS decision makers to consider how to make this node better prepared for food shortage events.

**Key Words: Nova Scotia, Food Capacity, Food Security, Food System, Food Shortage**

## IV Acknowledgements

**V Glossary**

The terms defined below are integral to discussions pertaining to food security, critical infrastructure, food shortage and other topics within this study. For the purposes of this study the following definitions are used.

- Chokepoints - A form of critical infrastructure where transportation becomes limited to one route. Chokepoints are particularly important when considering vulnerability in transportation into a certain region (Nova Scotia Health and Wellness, 2015).

- Food Shortage Event – An event that affects food transport, production, or storage to the point that food becomes scarce for a period of time.

- Food Security - The "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2003).

- "Food sovereignty  - The right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Agarwal, 2014). It refers to the mobilization of peasant movements to increase access to food by marginalized groups (Clapp, 2014). Food sovereignty emphasizes agro ecological principals and explores alternatives for current food systems and trade (Clapp, 2014).

- Food system – the structure and organization that allows food to be consumed. This consists of a diverse set of local and global supply chains connecting food from producers and manufacturers to consumers (Weir, 2014).

- Just-in-time Delivery – Refers to supply chain management that minimizes additional stored product. This allows a reduction in inefficiencies, but in the case of food systems results in a higher likelihood of limited food access following food shortage events. Due to the nature of just-in-time delivery, shortage events are more costly to producers than the supplier and therefore suppliers make less of an effort to avoid shortage events (Zimmer, 2002).

- Local food system – A food system where the production, distribution, and storage of food is geographically local to consumers (Agarwal, 2014). This reduces the distance travelled by food before consumption and makes community food systems more self-reliant (Agarwal, 2014).

- Nodes - The points between the production and consumption of food, where food resides.

- Resilience (i.e. resilience of food systems) – The ability for a food system to respond quickly and completely to changes (Folke 2006). In the case of a food shortage event, a resilient food system would be able to adjust as necessary, find alternatives to providing food for the population during the shortage, and allow food access to return to normal as soon as possible.

- Shelf Life – The amount of time a product can be stored before its expiry (Garden-Robinson, 2012).

**1.0 Introduction**

**1.1 The Nova Scotian Context**

Globalization has resulted in the interconnection of communities locally, nationally, and globally (Weir, 2014). In the context of food, it has reduced the vulnerability of nations to famine, it has made fresh produce available in winter, and has allowed for the sharing of products produced all over the world but it has come with a cost (Grada, 2007). The interconnectedness of communities and food systems has become fundamental to a food secure society (Weir, 2014). With a global population of approximately seven billion people and many communities in inherently food insecure parts of the world, today's global food system is necessary to provide food to the global population (Weir, 2014). That being said, with communities becoming increasingly dependent on one another for the production, processing, storage, and distribution of food, vulnerability to food shortage events is no longer just an issue of production, but of access and supply chain resiliency (Weir, 2014).

With food insecurity rates consistently higher than the national average, Nova Scotia (NS) has a unique set of strengths and vulnerabilities with regards to food access (Williams, et al. 2012). 923,598 people live in NS and it is important that nutritious meals be provided to Nova Scotian residents despite the prevalent food insecurity (Statistics Canada, 2017). In NS, food security is influenced by the province's agricultural capacity, its proximity to the ocean, and its geography (Nova Scotia Health and Wellness, 2015). As a peninsula with more than 3000 lakes and surrounded by the Atlantic Ocean, the province has a robust seafood industry which accounts for a large proportion of Nova Scotia's food exports (Beck, 2015). However with shallow, rocky soils, agricultural land is minimal in Nova Scotia (Beck, 2015). Although areas like the Annapolis Valley boast productive soils, Nova Scotia is home to only 3,905 farms, 1.68% of Canada's total, and is mostly comprised of cattle, fruit, and dairy producers (Nova

Scotia Department of Agriculture, 2014; Nova Scotia Health and Wellness, 2015). NS does not produce enough food to feed its residents and therefore relies heavily on imported food products (Nova Scotia Health and Wellness, 2015).

As a coastal province NS has a close relationship to its fisheries and has a robust port (Beck, 2015). Though this may intuitively suggest a diet centered on seafood and greater access to imported food by boat, due to the centralized structure of the global food system very little seafood caught in NS is consumed in NS and very little food is imported into NS by boat (Beck, 2015). This means that the majority of food consumed in NS arrives by train or road via the Isthmus of Chignecto (Nova Scotia Health and Wellness, 2015). This is one of two chokepoints in the province along with the Canso Causeway, both of which pose a unique threat to NS food security (NS Department of Health and Wellness, 2011). The Isthmus of Chignecto links the Nova Scotian peninsula to mainland Canada and allows the transport of food in and out of the province along the Trans-Canada Highway and Cobequid pass (NS Department of Health and Wellness, 2011). Severe weather emergencies such as hurricanes and snowstorms, dangerous goods emergencies such as explosions, forest fire emergencies, flood emergencies, sudden impact emergencies such as train accidents, health emergencies such as epidemics, and agricultural emergencies such as mad cow disease all have the potential to threaten the NS food system (NS Department of Health and Wellness, 2011). It would therefore be ideal to understand if and where capacity exists in NS to help stakeholders respond to possible food shortage events (NS Department of Health and Wellness, 2011).

With many components of the NS food system being profit driven businesses working with just-in-time models, food security and capacity are not necessarily prioritized (Smith, et al. 2015; Zimmer, 2002). Though government funded institutions may intentionally stockpile

food or create contingency plans for possible food shortage events, it is unclear how NS would respond to events compromising transportation through the Cobequid pass for example (NS Department of Health and Wellness, 2011). Anecdotal accounts like those of the resilience of communities following Hurricane Juan, a tropical hurricane with winds up to 170km/hour in 2003, would suggest that much of the food system resilience would lie in households (Fulmore & Russell, 2005). That being said, this places much of the responsibility on the individual, who for various reasons may not be able to prepare sufficiently (Williams, et al. 2012). Based on conversations with various knowledge holders including NS Chief Medical Officer Dr. Robert Strang and Director for NS Department of Health and Wellness Mr. Russell Stuart it became clear that little was formally known regarding food capacity within the NS food system, and the structure and flow of the NS food system.

## 1.2 Research question and hypothesis

Several years ago the Cobequid pass closed down temporarily revealing a concerning food insecurity challenge for institutions across Nova Scotia. This event raised important questions for Nova Scotians; where and how much food capacity exists in the NS food system? Considering governments manage certain nodes such as hospitals, it is predicted that these nodes might be better prepared for food shortage events and therefore have greater food capacity. Considering most nodes within the NS food system utilize just-in-time procurement strategies, it would be expected that nodes including large scale distributers, grocery chains, universities, and restaurants would run out of food quite quickly (Zimmer, 2002). Conversely, based on anecdotal experience like the resourcefulness of households during Hurricane Juan, households may hold many days of food capacity (Fulmore & Russell, 2005). Though this capacity would be subject to socio-economic conditions, such as age and income it is expected that households would hold

the greatest capacity (Williams, et al. 2012). Though large distributers such as logistics companies and grocery chains would have vast quantities of food at hand, due to the number of individuals they serve it is expected that the days of food capacity would be few, but would vary significantly between food types (Zimmer, 2002).

## 1.3 Research purpose and significance

This study investigated the nodes and supply chains significant to NS food access and estimated the food capacity and flow within these supply chains. By first visualizing important food supply chains, and estimating the food capacity at nodes along these food chains both within and outside of NS, stakeholders in the province can better prepare for food shortage events, relevant policies and procedures can be informed, and issues of food security in the province can be highlighted. This study was planned to be accomplished through a basic survey of households and directed interviews with knowledge holders, only the latter of which was ultimately possible. Given the possible outcomes of this research, this study may provide meaningful insight into the strengths and weaknesses of Nova Scotia's food system and could allow groups to better prepare for food shortages. This may influence provincial legislation, inform contingency plans, improve response from supply chains, and allow households to address issues of food security at home.

## 1.4 Delimitations and limitations of study

The food capacity of certain nodes and supply chains in NS was investigated during the winter months of January to March of 2017. Household and restaurant capacity were expected to have the most variable results due to the diversity within these nodes. The results were subject to the estimation of the survey responder and therefore susceptible to error. Large scale food

distributers, grocery chains, university, hospital and restaurant capacity were based on information provided from knowledge holders and therefore limited to their experience and access to relevant data. Furthermore, based on the study's access to information, the data from these sources may not be random, but based on which knowledge holders were willing to be interviewed. The time of year in which the survey took place and data collected could also affect the results. Season has been shown to affect food capacity and although the season in which data is collected will affect the fresh categories of food and their quantity, it will not significantly affect the total quantity of food available at any given time (Hillbruner & Egan, 2008; Stevenson, et al. 2015).

## 2.0 Literature Review

### 2.1 Historical Importance of Self Reliant Food systems

Food and famine play a defining role in the world we live in today (Grada, 2007). Famines and food shortages have affected humanity's ability to populate regions for generations; they have destroyed empires and caused mass migration (Grada, 2007; D'Souza & Jolliffe, 2012). Famines in Europe from the late Seventeenth-century to the mid eighteenth-century influenced the colonization of the Americas, and each colony's ability to store food defined its success (Grada, 2007; Nau, 1978). Although famine may be less common today it still defines global aid and development strategies and follows political turmoil and natural disaster (Grada, 2007; D'Souza & Jolliffe, 2012). Modern food production allows society to feed our ever-growing population and without it, the twenty-first century world would fall apart.

Lord Cameron of Dillington famously said that "[we] are nine meals away from anarchy". This was true during World War II, during the global food crisis of the 1970's, and is perhaps most notably true, in a current sense, in regards to unrest in the Middle East and Sudan (Winders, 2015). Saudi Arabia responded, in part, to the food crisis of the 1970's by creating a more self-sufficient food system (Winders, 2015). In Saudi Arabia's case this meant increasing production of food within the country. Self-sufficient food systems, however, are not just those that produce their own food, but those that have the infrastructure to store and transport that food as well (Winders, 2015; Ohberg, 2012). In Greenland, Norse settlements failed partially due to the lack of cooperative infrastructure in their food system (Dugmore, Keller, & McGovern, 2007). This meant that although they had access to vast marine resources, it was difficult to sustainably expand their settlements (Dugmore, Keller, & McGovern, 2007). Ultimately, food access is one of the most important indicators of the strength of a nation or community and

although the globalized market allows the sharing of products from around the world, a self-reliant food system will always be an important component of a successful community, region, and nation (Nau, 1978).

In a current sense, the Sudanese conflict is perhaps the best, if tragic depiction of the influence of food on national and regional security (Paul, et al., 2014). The decades old conflict began, in part, due to the disproportionate rise in food cost caused by currency inflation and food access (Paul, et al., 2014). In turn, this conflict then made communities throughout Sudan more food insecure (Paul, et al., 2014). This has led to high rates of child malnutrition and has become a global health emergency (Paul, et al., 2014). Not only does this conflict and famine affect the Sudanese people, it affects the entire global community (Brown, 2009). When an entire country's food production and export are compromised, not only does this affect the nations relying on this food, it affects all of the connected local food systems required to compensate for this reduction in global food production (Brown, 2009). With the food risks associated with conflict and the ever rising threat of climate change, it is not unlikely that famine could become more common through the twenty-first century (Brown, 2009). It is therefore important to recognize that for inherently food insecure regions like NS, a threat to Sudanese food security is a potential threat to NS food security (Brown, 2009). Though the disproportionate rise in food costs in Sudan was partially due to the globalized food market, it must be recognized that the same global food market is now what allows the provision of food aid across Sudan (Paul, et al., 2014). Ultimately, food system practices must prioritize the resilience of food systems to compensate for the local vulnerabilities caused by a globalized food system (Foley et al. 2011)

## 2.2 Localized Food Systems

The current food system relies upon industrial production and global distribution of food (Weir, 2014; Foley et al. 2011). This allows the global food system to feed the seven plus billion people on earth, but also gives rise to a variety of socio-political, economic, and environmental impacts (Hendrickson & Heffernan, 2002; Ohberg, 2012; Foley et al. 2011). Supplementary, localized food systems have been identified as a means to reduce emissions associated with food transport, take pressure off tropical regions to increase production to meet increasing demand, and make the global and local food systems more resilient to food shortage events (Hendrickson & Heffernan, 2002; Ohberg, 2012; Smith, et al. 2015; Foley et al. 2011). As issues of food security and food sovereignty have moved into greater prominence, it has become clear that by understanding and improving local food systems, food systems can become more responsive, cohesive, diverse, and smaller in scale (Agarwal, 2014; Smith, et al. 2015).

It must be recognized that through a globalized food system, communities have diversified procurement strategies that allow new ways of responding to food security (Godfray, et al. 2010). Communities which are inherently food insecure can only be sustained through global food systems (Godfray, et al. 2010; Brown, 2009). Though the globalized food system is necessary, supporting local food systems empowers communities to better respond to food shortage events (Ohberg, 2012). Food system transitions are typically grassroots driven where priorities have changed from national self-sufficiency to local self-sufficiency which allows communities to better adapt and adjust food systems to meet changing needs (Agarwal, 2014; Ohberg, 2012). International market pressures are reduced through the localization of food systems, and in turn the local capacity and ecosystem health can be re-established (Agarwal, 2014). Patel (2009) emphasizes the importance of local food systems, but fears that with a loss

of connection between people and the production and supply of their food, communities no longer have the capacity to determine their own self-reliance. In 1997 17% of all money spent on food in NS was spent on Nova Scotian products and in 2008 this number decreased to 13% (Scott, Macleod, 2010). It is clear that not only is NS not self-reliant, but it is quickly becoming less self-reliant (Scott, 2007). By understanding the province's capacity between production and consumption, a more complete concept of the local food system can be created.

Although producing more food locally could contribute to food security and the sovereignty movement, food must also be stored and supplied locally for the benefits to be realized. Ohberg (2012) identified insufficient infrastructure as one of the main barriers to the local food movement in Ontario. This lack of infrastructure was due to a shortage of resources and processing capacity, where different infrastructural inadequacies may be present in NS (Ohberg, 2012). The distribution of food requires cold storage, warehouse space, refrigerated trucks, and good transit routes (Ohberg, 2012). A lack of any of these important infrastructural components can decrease the capacity of a community to process, store, or transport their food which influences how much is worth producing (Ohberg, 2012). Regardless of Nova Scotia's capacity, or lack of capacity, to produce more food, if they do not have the capacity to store, process, or transport that food, many of the benefits of local production are lost. Furthermore, depending on the environmental sustainability of these facilities, the environmental advantages of localized food systems are lost (Ohberg, 2012). For example, although many apples are produced in NS, and are labelled as such, they are not necessarily processed and stored in NS (Scotian Gold, 2016). Scotian Gold, an NS apple producer, only stores 50% of their Nova Scotian apples in the province which means many of their apples may be transported out of province for processing and back into the province before the local population can eat them

(Scotian Gold, 2016). Before we can effectively localize our food system we must ensure the infrastructure exists.

**2.3 Supply Chains, Food Shortages, and Resilience**

A typical food supply chain begins at a point of production, is transported to a processor or manufacturer, then to a retailer or distributor, and finally to a point of consumption (Murray, 2001). Good supply chain management consists of synchronizing market predictions with production, procurement, and distribution of food, but the uncertainty of these predictions can be problematic (Vollmann *et al.* 2004). Predicting consumption and farm yields determined by market forces can cause excessive and insufficient production of certain products and complicate food systems (Murray, 2001). Ultimately, the goal of any food system is to provide quality food to consumers (Taylor, Fearns, 2006). This means that for a local food system to be successful the infrastructure must exist to allow quality processing and storage of food.

Though any community or region is susceptible to the possibility of food shortages, given the unique conditions in NS, a more self-reliant food system could allow NS to better respond to food shortages. With an isolating geography, damage to critical infrastructure could cause a significant food shortage (Nova Scotia Health and Wellness, 2015). Furthermore, with most food providers working with a just-in-time delivery system, capacity is rarely maintained as it is seen as a waste of money and food (Zimmer, 2002). In the event of a failure in critical infrastructure, it is the resilience and capacity of a community's supply chain that determines the extent of the food shortage (Smith, et al. 2015). The resilience of a supply chain is determined by its scale, diversity, responsiveness, and cohesion (Smith, et al. 2015). Although both short and long supply chains exhibit certain characteristics that affect their ability to address food shortages, Smith, et al. (2015) go on to explain that locally sourced food chains are typically more

resilient by nature. Smith et al. (2015) argue that the most important elements of resilience in the context of a food system are scale, which refers to the distance food has to travel between production and consumption, diversity, which allows solutions to be addressed with a variety of actors, skills, and ideas, responsiveness, which refers to the speed at which a system can adapt to adverse conditions, and cohesion, which refers to the connectivity of parts within the food system (Smith, et al. 2015). During the 2011 floods in Queensland Australia, it was noted that had the government better understood the supply chain they could have more effectively coordinated their efforts and made food more accessible to communities in need (Smith, et al. 2015). By better understanding the food supply chain and its capacity in NS, the government can better prepare for food shortage events.

**2.4 Shelf Life**

In addition to understanding how much food exists within the Nova Scotian food system, it is important to understand how long that food can last in the appropriate storage once purchased.

**Table 1** *The approximate shelf life of various foods grouped by food type and ordered from shortest to longest shelf life. Retrieved from (Garden-Robinson, 2012; USDA, 2015).*

| Food Type | Shelf Life |
|---|---|
| Poultry | 1-2 days |
| Fish | 1-2 days. |
| beef, pork, and lamb | 3-7 days. |
| Eggs | 5 weeks. |
| Milk | 5 days. |
| Yogurt | 1 week. |
| Cheese | 1 month. |
| Butter | 1 year. |
| Mushrooms | 1-2 days. |
| Asparagus | 2 to 3 days. |
| Berries | 2 to 3 days. |
| Leafy greens | 3 – 5 days. |
| Melons | 5 days. |
| Carrots | 2 weeks. |
| Citrus fruits | 2 weeks. |
| Apples | 1 month. |
| Frozen Vegetables | 8 months. |
| Frozen Meat | 4-12 months. |
| Canned Foods | 1 year. |
| Bread | 2-3 weeks. |
| Frozen Bread | 2-3 months. |

Although shelf life is specific to individual products and storage conditions, through understanding the duration that food groups typically last one can better understand the limits of food capacity.

## 2.5 Summary

By recognizing the historical context of food shortages and the importance of resilient food systems one can begin to understand the need to strike balance between local and global food systems (Smith, et al. 2015). Though food shortage events are always possible, regions and communities can actively prepare and facilitate better responses (Smith, et al. 2015). Food shelf life does affect food access but ultimately it is the infrastructure and resilience of food systems that determine communities' access to food (Garden-Robinson, 2012; USDA, 2015; Ohberg, 2012). NS has consistently had a higher rate of food insecurity and as such it must take all efforts to address this concern (Williams, et al, 2012). That being said, before efforts can or should be made to adapt the NS food system, efforts must first be made to understand the current state of the local food system.

**3.0 Methods**

To begin understanding the NS food system, several steps were taken to contextualize the research. Through a literature review and informal conversations, the research questions were framed and significant nodes and supply chains were identified. Through further directed interviews more nodes and supply chains were identified and food capacity was estimated. A survey was prepared to understand household food capacity, but was not implemented due to an untimely ethics approval.

**3.1 Literature Review**

A literature review was performed to allow the framing of the research questions and to better understand the context of the NS food system. Before research could begin, conversations with Chief Medical Officer Dr. Robert Strang and director of NS Department of Health and Wellness Mr. Russell Stuart informed the direction of the study. These two knowledge holders informed the process, provided context for the research questions, and introduced the researcher to the first set of knowledge holders. Following this, a series of online database searches were performed using various combinations of the following terms: food, food systems, globalized, localized, resiliency, supply chain, food security, food shortage, Nova Scotia, Canada, infrastructure, and shelf life. Through these searches this research sought to understand:

- The assets of the NS food system and risks to the NS food system with regards to food capacity and response to food shortage events. These topics were explored in regards to their influence on NS food security with additional consideration for the influence of the globalized food system on food capacity and food shortage response. Of particular importance, the import of food in NS was researched.

- The global context in which food systems exist. This increased understanding of the role, advantages, and disadvantages of global food systems. Specifically this search examined the influence of a globalized food system on the food security of regions or provinces similar to NS and the role of food in peace and the sustainability of communities.

- The advantages and disadvantages of a localized food system. Environmental impacts were researched as was the resiliency of localized food systems. This framed the importance of infrastructure to food security and examined limitations of a localized food system.

- The structure and characteristics of supply chains and the resiliency of supply chains. This identified characteristics of a resilient food system, how supply chains were able to respond and adapt to food shortage events, and the role of just-in-time delivery and profit driven food systems.

- The shelf life of food items and its influence on food capacity was examined. This contextualized the study by providing limits to food capacity.

While reading the articles associated with these topics, detailed notes were taken and synthesized. After a basic organization for this paper was formulated, topics were grouped based on relevance and synthesized to best provide context for this research.

### 3.2 Quantifying Consumption

In an attempt to understand where NS residents consume their meals, data were procured which allowed the characterization of meals consumed in various nodes within the NS food system.

### 3.2.1 Meals in NS

The population of NS was identified (Statistics Canada, 2017). Based on the assumption that only NS residents are eating three meals a day for 365 days of the year, the total number of meals consumed in NS was estimated (NS population x 3 x 365).

### 3.2.2 Meals in Restaurants

The number of meals consumed in restaurants each week by NS residents was estimated using data from The Canadian Restaurant and Foodservices Association (2010). By multiplying the number of meals consumed in restaurants each week by 52, corresponding to the number of weeks in the year, and the population of NS, the total number of meals consumed in NS was estimated. By dividing that number by the total number of meals consumed in NS and multiplying that number by 100%, the percent of meals consumed in restaurants was estimated.

### 3.2.3 Meals in Universities

Through a conversation with Derrick Hines, Director of Food Services at Dalhousie University, and Angela Emmerson, Registered Dietician for Dalhousie Food Services, the number of meal plans holders at Dalhousie was provided. Through analysing data from the Canadian Association for University Teachers (2015) the number of full time students at Dalhousie and the number of full time students in all universities in the province were identified. Having made the assumption that the ratio of students with meals plans at Dalhousie University to full time students at Dalhousie University would be the same for all full time students in NS, the number of students on meal plans in NS was estimated (students on meal plans ÷ full time students at Dalhousie University x number of full time students in NS). Based on the assumption that meal plan holders ate three meals a day every day that residence dining halls were open, the total number of meals consumed in university dining halls was estimated. By dividing that

number by the total number of meals consumed in NS and then multiplying by 100%, the percent of meals consumed by meal plan holders in university dining halls was estimated. This number does not include the faculty and staff who consume meals in university dining halls, nor does it include students who purchase meals on campus. These meals would be considered as meals consumed in restaurants.

**3.2.4 Meals in Hospitals**

Through analysing data from the Canadian Management Information System (MIS) database (2014) the number of in-patient days in NS was determined. Based on the assumption that each in-patient would eat three meals a day, the total number of meals eaten in hospitals by in patients was determined. By dividing that total by the total number of meals consumed in NS and then multiplying by 100%, the percent of meals consumed by in patients was determined.

**3.2.5 Meals in Households**

The number of meals consumed in homes was estimated by calculation (total meals consumed in NS – meals consumed in restaurants – meals consumed in universities – meals consumed in hospitals). This number would include meals consumed in nursing homes and prisons as these were not separately determined and are expected to make up such a small proportion of the meals consumed in NS that this number is a fair estimation.

**3.3 Directed Interviews**

As a means of exploring the food system in NS, a series of interviews were conducted with knowledge holders. Through informal discussions with Chief Medical Officer for NS Dr. Robert Strang, a Director of the NS Department of Health and Wellness Mr. Russell Stuart, and Director of the Dalhousie School for Resource and Environmental Studies Peter Tyedmers, the research

questions were framed and a context to the research was established. Through these

conversations, a generalized list of questions and topics were created to guide interviews. The

full interview template can be found in Appendix A, and included the topics:

- The interviewee's role and their node's role in supplying food to Nova Scotians.

- How food is procured, delivered, stored, and supplied in general and specific to food types.

- Where the food each node provides comes from geographically.

- How long food lasts before depletion.

- Whether additional storage capacity exists.

- Their node's connection to other nodes in the NS food system.

- How many people consume food in their node each day.

Each interview ended with the assurance that in the case of further inquiry a follow-up

interview or phone call could take place. These interviews applied problem-centered interview

style described by Witzel (2000). This consisted of developing well informed research questions,

allowing the interviewer to respond and adapt to information shared within the interview, and

developing trust with those interviewed (Witzel, 2000). Preliminary interviews identified several

important nodes to understand. These were Sysco Canada Ltd., grocery stores, universities,

restaurants, hospitals, and households. After these nodes were identified, meetings were sought

with one or more knowledge holders with access to information regarding one or more of the

identified nodes. Food capacity at each node was estimated based on data or the experience of a

knowledge holder where questions were phrased to best utilize the knowledge provided. In

situations where this was not possible, days until the node could no longer provide its

consumers/clients with a balanced diet based on the Canada Food Guide determined food

capacity. Knowledge holders provided expert insight on the NS food system as a whole and on individual nodes within the food system.

Dr. Robert Strang, Mr. Russell Stuart, and Prof. Peter Tyedmers facilitated connection to approximately ten knowledge holders and snowball sampling methodology was implemented beyond these ten, to allow access to appropriate knowledge holders (Gyarmathy, 2014). These knowledge holders were identified as having authority of or responsibility for the food services within the identified nodes. Those interviewed were limited by time and their interest in contributing to this research project. Of the ten knowledge holders contacted, a third of them were interviewed, a third did not respond, and a third facilitated connections to other knowledge holders. This process ultimately resulted in a network of 25 knowledge holders that were contacted, 14 of whom were interviewed. Based on the questions and themes, identified knowledge holders were asked to set aside approximately one hour for an in person, or telephone interview. Interviews were held at the knowledge holder's place of work or at a location of their choosing.

The food capacity of Nova Scotia's food system was established through a two-step analysis: first the important supply chains and their relevant nodes in the food system were identified, where the flow of food terminated in one or more points of consumption; second, food capacity within each identified node was estimated based on data procured from directed interviews. The result is an estimate of food system capacity in NS based on days of food capacity and defined by the amount of days to food depletion.

Figures of supply chains including key nodes within the food system were made. Important nodes including Sysco, grocery stores, restaurants, hospitals, universities, and households were included as were the estimated number of meals consumed at the end of each supply chain.

Using the knowledge regarding supply chains and the estimated days of food capacity determined through directed interviews, this information was compiled into a series of supply chains, where each node was depicted as a circle and sized relative to its food capacity. Furthermore, the approximate point at which food entered the province was also indicated on these figures. Finally, to provide context of the supply chain, the estimated number of meals consumed at the consumption point of each supply chain was included.

**3.4 Survey**

As shown in Section 3.2.5, household food capacity is the most important node within the NS food system to understand. It is in households that approximately 90% of meals are consumed in NS. Without understanding this node issues of food security and food shortage response cannot be understood. Considering the nature of household food capacity, research ethics approval was necessary before the data could be procured. A survey was identified as the most effective means of procuring information given the time constraints of the project. In an attempt to understand the food capacity that exists within NS households, a survey which can be found in Appendix B, was created for distribution throughout NS. The questions were created in collaboration with Prof. Peter Tyedmers and in consideration for the pre-existing works of Professor Patty Williams of Mount St. Vincent University. Within the survey, there were three main areas of investigation. First, household information was to be investigated, allowing the researcher to analyse how the number of people served within a household and the geographic location of the household influenced food capacity. Second, information on how much food capacity existed within the households for various food types and whether households intentionally stockpiled food was to be sought. Third, demographic data were to be collected that

allowed us to contextualise food capacity and understand what socio-economic factors influence access to food and food capacity.

The survey first posed questions regarding the eligibility of participants to exclude non-Nova Scotian residents and those not responsible for their own food procurement. Next, basic and anonymous location and household questions were posed to understand who was responding to the survey and to understand who the respondent was responsible for the procuring food for. Next, a question was posed to seek the approximate food capacity within the household. This was followed by an option to complete a long or short-form version of the survey. If the participant opted to continue with the long form survey they were asked a series of questions about the estimated days to depletion for fresh produce, eggs, milk, meat, grains, frozen food, preserved foods, and other. These estimates were made per individual, where multiple persons may have responded from the same residence. The long form survey option also posed questions regarding intentional stockpiles kept in preparation for food shortage events. If the participant opted to continue with the short form survey they were moved directly to questions regarding the intentional stockpiling of food. Finally demographic questions were asked to better understand how socio-economic factors may affect household food capacity. Demographic questions were in both the long and short-form version of the survey.

The online survey was created on Opinio and was planned for distribution through email and Facebook. Professional and personal networks were going to be used to distribute the survey. Every attempt would have been made to ensure no personal bias was introduced through personal connection to participants. This survey detailed the survey's intentions and the methods by which analysis would be done. The survey was designed to be anonymous and did not ask for any identifiable data. Data were only to be accessed by the lead researcher and supervisor and

would have been destroyed one year after reporting the results of the survey. As participants may have felt uncomfortable participating in the survey if they were self-conscious about their eating habits, income, age, or employment status, the opportunity to opt out at any time was explicit. An informed consent form was provided before participation in the survey where consent was warranted by the completion of the survey which typically took less than 10 minutes. The survey was to be completed at the convenience of the participant and did not incur any expenses, remuneration was not necessary for the study. Quantitative data were to be retrieved from these household surveys. No names, opinions, or quotes were to be reported nor was any demographic data consisting of less than 10 participants. Unfortunately, the survey was not approved in a timely manner by Dalhousie's Research Ethics Board and therefore was never distributed or executed.

**3.5 Defining Scope**

The scope of the project was limited by the researcher's access to information. The capacity of the system is the product of all exemplar nodes identified through conversations with knowledge holders, but data is limited to the knowledge held by those interviewed. Furthermore, based on the scope of the project not all nodes within the NS food system could be assessed. Most notably, households were not assessed due to a late research ethics approval. Other nodes not considered include producers and manufacturers of food, prisons, nursing homes, small scale markets, and small scale food providers like corner stores and gas stations.

**4.0 Results**

**4.1 Where Food is Consumed**

      To understand the role of nodes within the food system, it is important we understand how people interact with these nodes. The purpose of a food system is to provide food to people, therefore this research first sought to understand how people procure and consume food. Considering all of the supply chains identified as important in NS result in consumption, various databases were consulted to estimate how many meals are consumed in each nodes. Though this was not possible for grocery stores and companies like Sysco, restaurants, universities, hospitals, and households were all analysed to estimate how many meals were consumed there in relation to the total number of meals consumed in NS.

      The total number of meals consumed in NS each year was calculated to be approximately 1,000,000,000. The population was taken from statistics Canada (2017), the population was then multiplied by the number of meals eaten each day, which was assumed to be three, and finally multiplied by the number of days in the year, 365. The total number of meals eaten in restaurants each year in NS was calculated to be 96,000,000 which is 9.60% of the meals consumed in NS. The Canadian Restaurant and Food service Association (2010) determined that the average Nova Scotian resident ate at restaurants twice a week on average. By multiplying the two meals consumed in restaurants each week by the 52 weeks in a year and finally by the population of NS, the number of meals consumed in restaurants each year was calculated. The total number of meals consumed by meal card holders in NS universities was calculated to be 3,300,000 which is 0.33% of the meals consumed in NS. The number of students with meals plans at Dalhousie University was divided by the number of full time students at Dalhousie University to determine the ratio of meal plan holders to full time students. Both of these numbers were taken from the

Canadian Association for University Teachers (2015). This ratio was multiplied by the number

of full time students in NS and was multiplied by the three meals offered each day in meal hall

(Canadian Association for University Teachers, 2015). This value was then multiplied again by

the number of days residence meal halls serve food. The total number of meals consumed in

hospitals by in-patients in NS was calculated to be 2,800,000 which is 0.28% of the meals

consumed in NS. The number of in-patient days per year in NS was determined by the Canadian

MIS Database (2014) and multiplied by the three meals served each day in hospital cafeterias.

The total number of meals in households was calculated to be 900,000,000 which are 90% of the

meals consumed in NS. This was estimated by subtracting the number of meals consumed in

restaurants, universities, and hospitals from the total number of meals consumed in NS. The

estimated proportional consumption of the nodes discussed can be seen in Figure 1.
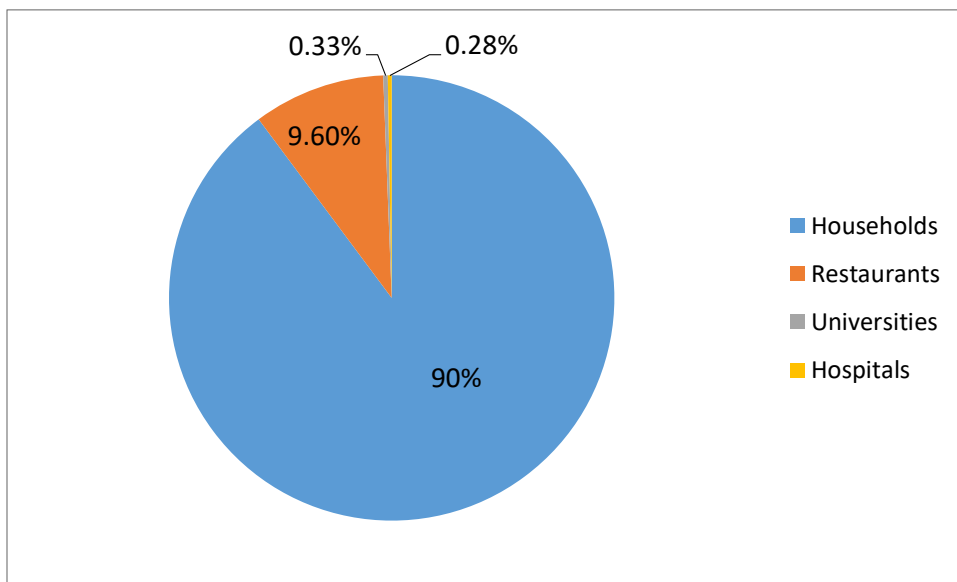


*Figure 1 The proportional consumption of meals in Nova Scotia annually.*

## 4.2 Interview and Survey

After establishing the important nodes within the NS food system, it was determined that directed interviews and a household survey would be the best methods to investigate these nodes. Through expert interviews this research successfully collected knowledge regarding Sysco, grocery stores, universities, restaurants, and hospitals. By contacting 25 individuals, eight one-on-one interviews and two group interviews took place with 14 individuals between the months of January and March 2017 (Table 2). Those who were contacted but did not participate in interviews were either able to connect the researcher to a knowledge holder who could better answer these questions or did not respond altogether. Though information was sought regarding household capacity ethics approval was not granted before March 21, 2017 and therefore the survey was not implemented.

Through the research process, certain nodes within the NS food system were identified but not assessed. These components and nodes include producers and manufacturers of food, prisons, nursing homes, households, small scale markets, and small scale food providers like corner stores and gas stations.

*Table 1 Interviewed expert knowledge holders and areas of expertise.*

| Name | Node of Expertise | Job Description |
|------|-------------------|----------------|
| Dr. Robert Strang | NS Health Care System | Chief Medical Officer for NS |
| Mr. Russell Stuart | Emergency Response | Director of the Department of Health and Wellness |
| Ms. Karla O'Neil | University Food Capacity | Sous Chef for Howe Hall Dining Hall at Dalhousie University |
| Ms. Angela Emmerson | University Food Capacity | The Registered Dietician for Dalhousie food services |
| Mr. Derrick Hines | University Food Capacity | Director of food services at Dalhousie |
| Ms. Taylor Nicholson | Hospital Food Capacity | Production Coordinator and Order Clerk for the IWK |
| Mr. Jean Paul Rochon | Hospital Food Capacity | Director of supply chain operations of the NS Health Authority |
| Ms. Brenda Macdonald | Hospital Food Capacity | Senior Director of Nutrition for the NS Health Authority |
| Ms. Sara Scarfe | Sysco Food Capacity | Account Executive for the health care branch of Sysco |
| Mr. Peter Chapman | Grocery store Food Capacity | Executive Director at GPS business solutions, former chief of procurement of deli, seafood, and prepared foods for Loblaws |
| Ms. Chantal Leblan-Poulin | Restaurant Food Capacity | Shift Manager at the Quinpool road McDonald's |
| Ms. Jessica Babin | Restaurant Food Capacity | Dining Room Manager for the Keg, Halifax |
| Dr. Sara Kirk | Nova Scotia Food Security | Professor in Health Promotions at Dalhousie University |
| Dr. Satya Ramem | Nova Scotia Food Security | Community Engagement, Research and Policy Specialist at Dalhousie University. |

## 4.3 Interview Results

### 4.3.1 Restaurants

Restaurants were considered a significant node within the food system as they are an

obvious point of consumption for many residents. This observation was verified based on the

calculation in Section 4.1 where 9.6% of meals in NS are consumed in restaurants. It was also

recognized that the food capacity of restaurants would have a wide range where for example fast-food restaurants would likely hold a different capacity to sit-down restaurants. Through an interview with Ms. Chantal Leblan-Poulin, Shift Manager at the Quinpool road McDonald's, flow and food capacity was estimated for fast-food restaurants. Flow and food capacity was estimated for sit-down restaurants based on a conversation with Ms. Jessica Babin, the Dining Room Manager for the Keg, Halifax. As shown in Figure 2, food is first produced or manufactured, it is then distributed by external distributers like Sysco or through centralized distributers working with a specific restaurant, and finally food is delivered to the restaurant location. McDonald's locations have a centralized distribution centre in Dieppe New Brunswick managed by The Martin Brower Company while other fast-food restaurants like Tim Hortons locations receive food from the quick serve Sysco warehouse in Moncton.  Restaurants would have procurement strategies specific to the food they serve, their location, and the contracts they establish.

Fast-food restaurant chains like McDonald's hold a maximum of 21 days of food capacity, where most items would be depleted after 14 days. Food capacity also changes based on season, the time of the week, and McDonald's promotions. In the case of fast-food restaurants like McDonald's, days to depletion was not determined based on the number of days for which a balanced diet could be provided because typical meals at McDonald's are not part of a balanced diet. Instead it was based on the days to depletion of popular items. Chantal Leblan-Poulin believes the Quinpool McDonald's location is indicative of other fast-food restaurants, but does have more than typical storage capacity. The Keg, a sit-down restaurant holds approximately 7 days of food capacity after which point they cannot serve meals to their customers.
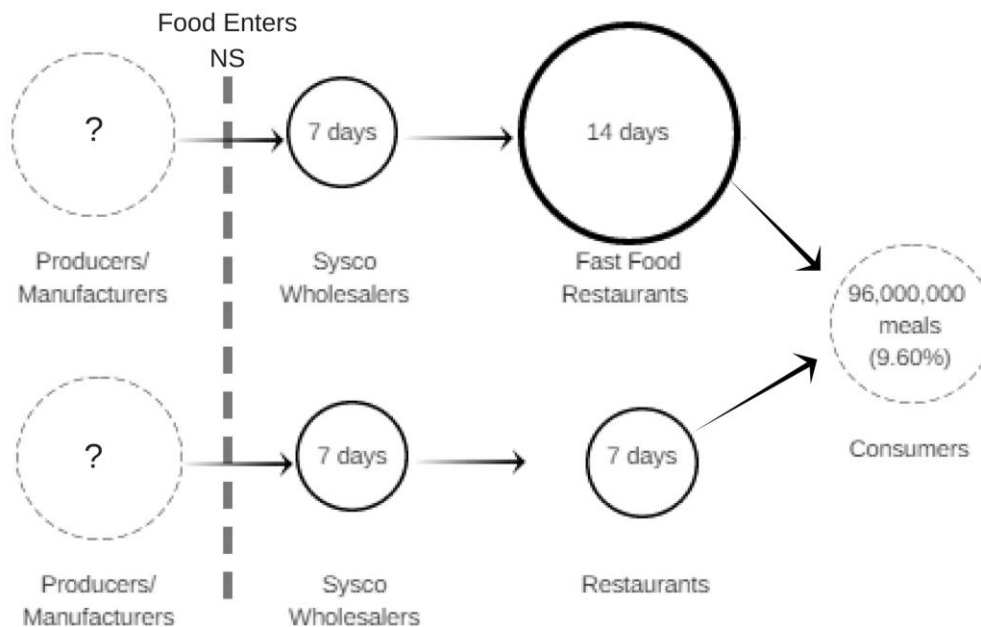
*Figure 2 NS supply chain with days of capacity for nodes involved between production and manufacture to consumption in fast-food and sit-down restaurants.*

### 4.3.2 Universities

Although universities do not feed a large proportion of the people in NS, they were recognized as characteristic of nodes that operate with food service operators like Aramark. Furthermore, as Patty Williams et al (2012) note, many students are in positions of food insecurity and therefore special attention should be given to related nodes. Through interviews with Ms. Karla O'Neil the Sous Chef for Howe Hall Dining Hall at Dalhousie University, Mr. Derrick Hines Director of Food Services at Dalhousie, and Ms. Angela Emmerson the Registered Dietician for Dalhousie Food Services, the basic supply chain, flow, and food capacity was estimated for Universities. Dalhousie University food provision is coordinated by Aramark. As shown in Figure 3, food is first produced or manufactured by organizations like Farmers Dairy or Canada Bread, it is then distributed by those same organizations directly to the university or delivered to the Halifax or Moncton Sysco warehouse where it is then taken to university

campuses around the province. University dining halls provide only 3,300,000 meals each year in NS which is 0.33% of the meals in Nova Scotia (Figure 3). Dining halls are only one means by which Universities provide food to students, faculty, and visitors, but other means such as cafés and restaurants are considered in the restaurants section of this research (4.3.1). In the 2015/2016 academic year Dalhousie spent a total of $4.3 million on food services.

In a food shortage event, a university dining hall's food capacity is determined by frequency of delivery, additional food stockpiles, and the practices of individual sous chefs responsible for procurement, as some sous chefs choose to be more or less prepared. Aramark works with a just-in-time policy where dining halls try to keep most items limited to the capacity necessary to provide food between deliveries. Food is delivered every day to residences with low storage capacity, five times a week to residences with large populations, and three times a week to residences with moderate capacity and population. Most dining halls intentionally hold extra capacity in the form of frozen and dried goods.

Popular items like burgers would run out in two days. Fresh produce would be served for a week before depletion, but additional frozen fruits and vegetables could be provided for an additional three days. Liquid dairy would deplete in a week, eggs would run out in three or four days. Fresh produce would limit a university's ability to provide balanced meals; their food capacity would be 10 days (Figure 3). Though these numbers are indicative of the food services in academic institutions, they clearly have a wide range. The kitchens, with the exception of the University Pub and the Students' Union Building, are all operated under Aramark management. This means that if a particular item is running low or depleted, and delivery of that item is impossible, kitchens can share food. This would mean that regardless of preparedness, storage capacity, and consumption at each individual hall, they would all serve food for the same period

of time. Furthermore, if one dining hall were no longer able to serve food, students would simply go to a different dining hall. Though other variables including number of kitchens, number of dining halls, number of students, geographic location, and food provider may affect food service, Karla O'Neil suggests that Howe Hall would be an approximate representation for University dining halls and food services across the province.

Aramark have specific contingency plans in response to food shortage events. Not only do they intentionally stockpile additional food for these instances, they also have created provision contracts with Sysco to ensure the continued supply of food in the case of food shortage events.



*Figure 3 NS supply chain with days of capacity for nodes involved between production and manufacture to consumption in Universities.*

### 4.3.3 Hospitals

Hospitals were identified as important nodes within the NS food system by Dr. Robert Strang. Considering they serve many of the most vulnerable people in our society it is important that we can ensure food provision in this node. Through interviews with Mr. Jean Paul Rochon, Director of Supply Chain Operations of the NS Health Authority, Ms. Brenda Macdonald, Senior Director of Nutrition for the NS Health Authority, and Ms. Taylor Nicholson, the Production

Coordinator and Order Clerk for the IWK, the basic supply chain, flow, and food capacity was estimated for hospitals. As shown in Figure 4, food is first produced or manufactured by organizations like Farmers Dairy or Canada Bread, it is then distributed by those same organizations directly to the hospital or delivered to the Halifax or Moncton centralized warehouse where it is then taken to any of the 41 hospitals throughout the province. Hospitals provide only 2,800,000 meals each year in NS which is 0.28% of the meals in Nova Scotia (Figure 4). In-patient meals are only one food service hospitals provide, where other means of services such as cafeterias that feed staff and visitors or their meals on wheels program are considered in the restaurants and household sections of this research respectively.

Ms. Brenda Macdonald of the NS Health Authority made it clear that hospitals are expected to hold a certain quantity of additional food capacity. Rural hospitals hold 21 days of food capacity and urban hospitals hold 14 days of food capacity (Figure 4). These numbers were generated through a survey distributed by Brenda Macdonald to the 41 hospitals in NS, where 8 hospital officials responded. On an individual product basis, order clerks try to keep an additional case of each product between deliveries. Most of hospital food is frozen or preserved. Though the IWK, the Children's Hospital in Halifax, would only be able to serve their full menu for two or three days, they would be able to provide a balanced diet for two to three weeks. Hospital food capacity in NS is ultimately limited by budget.

In some cases hospitals will have centralized kitchens that provide food to other hospitals, as is the case with the Queen Elizabeth II (QEII) and Veterans Hospital in Halifax. 90% of food served in Hospitals comes from Sysco, while Farmers Dairy, Canada Bread, Health Pro, and local bakeries also provide some food directly. Though hospitals do not have a pre-existing contingency plan in response to food shortage events, they do have enough food

capacity to provide balanced meals to their patients for enough time to identify and implement

alternative food procurement strategies.



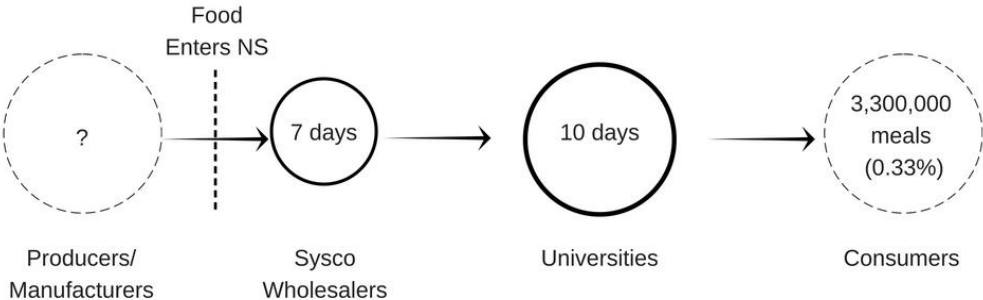*Figure 4 NS supply chain with days of capacity for nodes involved between production and manufacture to consumption in rural and urban hospitals.*
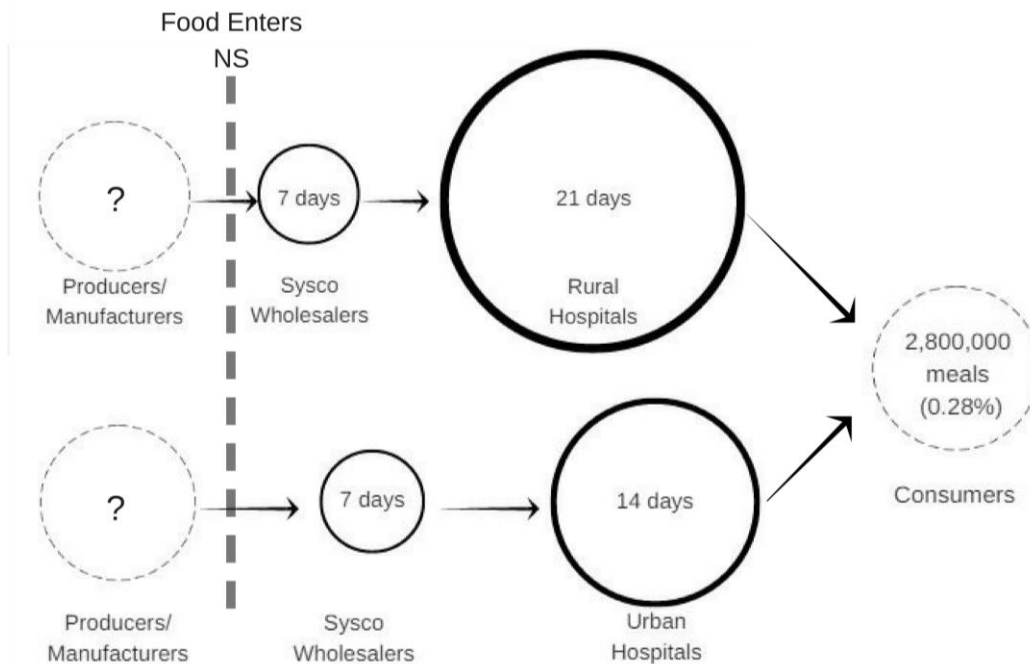
### 4.3.4 Sysco Canada Ltd.

Following conversations with several knowledge holders at other nodes within this study,

Sysco Canada became an obviously important component within the food system. As seen in

Figures 2, 3, and 4, Sysco is an integral node within the NS food system delivering food to

restaurants, hospitals, universities, as well as prisons and nursing homes. As Sysco is involved in

so many of the identified supply chains it was recognized as an important node. Information

regarding Sysco was secured through a conversation with Ms. Sara Scarfe, the Account

Executive for the Health Care branch of Sysco, who is responsible for food provision to the

various sectors of the health care system including hospitals, nursing homes, and prisons. Ms.

Scarfe was able to speak more generally regarding Sysco Canada's food logistics system in NS and across Canada.

Sysco sources their food from all over the world. Sysco import the majority of their food from North American countries, including Mexico. For food consumed in Atlantic Canada, they attempt to source preferably from Atlantic Canadian producers and manufacturers. With centralized warehouses in Halifax and Moncton, any food distributed by Sysco in NS stops first in one of these locations. Sysco has 26 trailers to deliver food throughout NS. Food would enter NS once it was delivered to the Halifax Sysco location or immediately after it was distributed from the Moncton Sysco location.

As a for-profit business working with a just-in-time model Sysco ensures fast moving and short shelf life items have very low residency time in their warehouses. In food shortage events Sysco may become unable to provide specific items immediately, but typically can find alternatives to these products depending on the nature and extent of food shortage events. If Sysco were to continue filling orders following a food shortage event using alternatives when necessary, Sysco would have seven days of food capacity. After this point Sysco would become unable to serve vegetables and produce with the exception of hardy fruits and vegetables like potatoes and oranges. Considering the range of items provided by Sysco, food capacity was determined by first establishing the products that limit the provision of a balanced diet and then determining the days to depletion of those products. Sysco could provide certain items for only a day, and provide other items for months.

Sysco Canada has national and international logistical support and a global food network that provides them with resilient infrastructure to local food shortage events. In the case of a food shortage event Sysco also has an undisclosed alternative capacity for food provision. As an ever

adapting food logistics industry participant Sysco believes that a food shortage event, though difficult, would not inhibit them from providing balanced meals to their customers.

### 4.3.5 Households

Considering an estimated 90% of meals consumed in NS are consumed in households, this node is arguably the most important node to understand. Most NS residents eat the majority of their food at homes and this node is likely where the most opportunity exists to prepare and respond to food shortage events. Without the timely Dalhousie research ethics approval of a household survey, food capacity was not estimated for households in this study. That being said, through conversations with Mr. Peter Chapman, Dr. Sarah Kirk, and Dr. Satya Ramem an idea of the importance of households in NS food capacity was established. As shown in Figure 5, food is first produced or manufactured; it is then distributed to a grocery chain's centralized warehouse, delivered to a specific grocery store location, and finally purchased by individuals who then consume the food in their household.

Households serve an estimated 900,000,000 meals in NS (90%) (Figure 5). Households rely on the food provision of grocery stores with the exception of those who grow their own food or get all of their food from local markets. Knowledge holders suggest that households would hold a large quantity of food capacity and be integral to determining where and how much food resides in the NS food system. The food capacity of each household would be determined by a variety of factors, including geographic location, rural, urban, or suburban setting household, income, employment status, and the number and age of people living in the household. As shown in Figure 5, households would have a variable capacity ranging from zero to potentially weeks of capacity. Importantly, the distribution of NS households within this range cannot be estimated at this time.
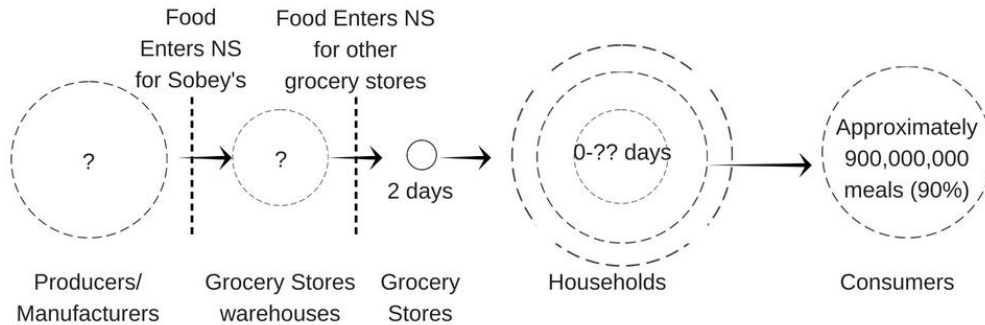
*Figure 5 NS supply chain with days of capacity for nodes involved between production and manufacture to consumption in households.*

### 4.3.6 Grocery Stores

With 90% of the meals consumed in NS being consumed in households and the majority of people in NS procuring their food from grocery stores, all grocery stores were recognized as important nodes within the NS food system (Figure 5). Mr. Peter Chapman, who created a grocery store consultancy business called GPS Business Solutions, was also the former Chief of Procurement of Deli, Seafood, and Prepared Foods for Loblaws. He was the primary contact for the information gathered regarding grocery stores. Sobey's and their associated Foodland stores and Pete's Fruitiques, Loblaws and their associated Atlantic Superstore, No Frills, Save Easy, and Convenience store locations, Walmart, and Costco are responsible for providing food to all Nova Scotians who are not sourcing their own food or directly purchasing food from farms or farmer's markets. In Atlantic Canada there are 85 Sobey's locations, 65 Foodland locations, 72 Atlantic Superstore locations, 12 No Frills locations, 55 Save Easy locations, 5 Costco location, and 23 Walmarts.

Walmart and Costco source their food based on centralized procurement out of Ontario and Quebec. This means that the food being sold in Nova Scotian Walmart and Costco locations has previously been stored in warehouses in Ontario and Quebec before delivery. Apart from the

storage capacity of individual locations, all additional storage capacity is outside of NS. All Sobey's locations in NS store their dry preserved food in a facility in Stellarton, NS and their other products in Debert, NS. Loblaws store their fresh food in Moncton and have one fast and one slow moving storage facility in Halifax. Fast and slow moving items are referred as such based the frequency these products must be replenished in stores, where toilet paper is fast moving and kitchen appliances would be slow moving. On average, only 10% of the food served in NS grocery stores comes directly from the producer or manufacturer, the other 90% of the food served in NS grocery stores comes from the storage facilities mentioned above. Approximately 17-20% of food served in NS grocery stores is sourced from Atlantic Canada, another 65-70% of the food served in grocery stores is from North America including Mexico, and the remaining 10-15% of the food is from the rest of the world. Food enters NS once it is delivered from a centralized warehouse into a grocery store location. For Sobey's grocery stores, food enters NS when it is delivered to their centralized warehouse in Debert.

Grocery stores work with a just-in-time procurement model, limiting their food capacity in the interest of minimizing losses of perishable goods, required warehouse space, and cost. This means grocery stores typically aim to run out of food available in store just as the next shipment is delivered. With deliveries arriving four times a week for most items, three times a week for meat and deli, and one time a week for dry products and slow moving items; each item has a different duration of capacity in stores. Produce, seafood, and dairy products would run out in two days, meats and delis would become depleted after three days which would mean that a balanced diet would no longer be available after two days (Figure 5). Warehouses attached to grocery stores are typically close to full capacity. Grocery stores do not have contingency plans for food shortage events. For example, when a possible food shortage event occurred due to a

trucking dispute, grocery stores internally debated other possible means of importing food to NS. Importing food by boat was then deemed to be the most viable alternative, but upon exploration was determined to be too slow to be a legitimate contingency plan.

**5.0 Discussion**

Given NS's food insecurity and its vulnerabilities to food shortage events, it is important to increase understanding of the local food system. Though the NS food system is inextricably linked to the global food network, in the case of food shortage events caused by transportation system disruptions or reduced food imports, enhancing local food systems allows for more responsive, resilient food systems (Weir, 2014). Due to the lack of literature and the lack of cohesive knowledge regarding the NS food system, this research aimed to amalgamate knowledge of the food capacity of important nodes and supply chains within the NS food system.

Though it was not shocking to realize that one billion meals are in theory consumed in NS each year, it was a stark visualization of the sheer quantity of food required to feed people. NS represents less than one thirtieth of the Canadian population, and less than .013% of the global population (Statistics Canada, 2017). Considering NS is just a tiny portion of global food consumption and it requires one billion meals each year, it is clear that a vast quantity of food is required to feed the global population (Statistics Canada, 2017). So much so, that a localized food system would only be possible in the most fertile or least populated places in the world. A totally localized food system is simply not possible for NS. Though more local food systems do have advantages to resiliency, access, connection, and the environment it could only exist in NS as a supplement to the food imported via the global food system (Ohberg, 2012).

Recognizing the unrealistic possibility of a totally local food system, decision makers should acknowledge the value of a more responsive and resilient food system. With the unique risks to NS food security, having more food in NS would minimize risks associated with infrastructural choke points or disruptions to supply. Though increasing production and

manufacturing of food within NS would be a positive change for NS food security, if the food is not stored in NS this would not hold true (Taylor, Fearns, 2006). Consider Loblaws, Walmart, and Costco grocery stores, even when they serve food produced or manufactured in NS, those foods all currently move through centralized warehouses that are out of province. If locally grown blueberries were being produced in NS and sold in Walmart, those blueberries would have to travel from NS to a Walmart centralized warehouse in Ontario or Quebec, and then be transported back into NS. Though there are various benefits to encouraging local production, without local warehousing and storage many of the advantages to local food security and food system resilience are not realized (Smith, et al. 2015). Centralized warehouses do have their advantages; they improve efficiency, allow more effective food safety procedures, create more flexible distribution strategies, and reduce food loss during storage but these centralized warehouses reduce local food capacity (Ohberg, 2012).

Many of the estimated days to depletion and food capacities were based on the time at which a node would not be able to serve balanced meals to consumers. In most cases, and not surprisingly the limiting food item was fruit and vegetables, particularly in fresh forms. Though this would pose a food security risk to many consumers, it would not necessarily mean that food would not be available. Many more durable products would be available beyond the days of food capacity measured in this study. Universities, hospitals, restaurants, and likely households would hold additional capacity of fruits and vegetables as frozen goods. Hospitals were only able to boast 21 days and 14 days of food capacity for rural and urban hospitals because they froze so much of their food. Furthermore, given that only 29% of NS residents eat enough fruits and vegetables based on the Canada food guide, the food capacity of these items may in fact be extended (Canadian Community Health Survey, 2004).

As seen in Figures 2, 3, 4, and 5, the important supply chains that provide the majority of meals to NS residents are not so complicated. Recognizing that there would be a complex and highly diverse set of supply networks to get food from producers and manufacturers to the distributer, once the food is in the possession of distributers or retailers it is a relatively simple process to get food to consumers (Weir, 2014). It was expected that these supply chains would be far more convoluted. In regards to the resiliency of the NS food system, it means a more cohesive and responsive system is possible (Smith, et al. 2015). With few nodes between production and consumption, supply chains are connected and can work together to respond to food shortage events (Smith, et al. 2015). In contrast, the NS food system is not very diverse due to the limited road and rail access into NS (Smith, et al. 2015).  Furthermore, due to the distribution of population throughout Canada, these food systems are also large in scale (Smith, et al. 2015).

With profit driven business models, all nodes, except for households, intentionally limited food capacity to limit perishable food waste and unnecessary cost. This means that the food capacities of these nodes were not limited by the shelf life of products. Though specific items like certain specialty leafy greens may expire before their consumption, typically items were consumed before their shelf life was reached (Garden-Robinson, 2012). Though this was not examined through the study, the node that would be most affected by shelf life would be expected to be the household. Not surprisingly, it is in households that 47% food waste occurs in developed country settings like in NS, directly affect a household's ability to intentionally stockpile certain food types (Gooch and Felfel, 2014).

Though the lack of contingency plans in the studied nodes should be a concern to decision makers, the food capacity within those nodes was greater than anticipated. Hospitals

were particularly prepared for food shortage events, where Sysco and universities had such within-node, resilient networks that food capacity could be easily shared to increase resiliency. This was as expected as hospitals are managed by government whom intentionally prepare for these possible events, but Sysco was in fact more prepared than anticipated. Restaurants would need to be studied further to understand how much food capacity is in the average restaurant, but given their need to serve fresh food, capacity was limited as predicted. Grocery stores were found to be of particular concern, and they have been identified as the node least prepared or responsive to food shortage events. Thought it was expected for grocery stores to have limited capacity, the estimated two days of food capacity is less than expected. With typically only two days of food capacity on site and no contingency plans, these nodes would be unable to serve food to their consumers in the result of a serious food disruption or shortage. In a conversation with Peter Chapman, he revealed that following one particularly bad food shortage event, following a trucking industry labour disruption, grocery stores looked to import food by boat, but due to their lack of preparation it would not have been possible to implement that alternative in a timely manner.

**5.1 Methodological Discussion**

Finding relevant literature regarding this project was very difficult. Though everyone acknowledges the importance of food, it is rare such simple questions are investigated in such a limited geographic scale. As previous research related to food system capacity may exist outside publicly and academically available literature, government, or corporate documents investigating similar questions or applying similar methods were difficult to find in NS.

The directed interviews were a very effective means to get information regarding food capacity in NS and the structure and flow of food within the NS food system. That being said,

the nature of most of the data procured was based on individual, professional experience and therefore further rigorous analysis was not possible. Due to privacy concerns over contracts and food procurement it was very difficult to access any numerical data to corroborate observations secured from knowledge holders in support of this research. For the aforementioned reasons, the content of this study is subject to the estimates made by knowledge holders. Though most knowledge holders were very accommodating to the research objectives and interview format, some nodes were much more difficult to investigate due to lack of access to knowledge holders. Grocery stores and restaurants were particularly difficult to get interviews for due to the busy schedules of knowledge holders and seemingly due to the secrecy regarding food procurement strategies.

Due to the limited time frame for this research, it was not possible to investigate household food capacity. That being said, based on the complexity of household food capacity, it is unlikely that a simple survey would have been sufficient in providing a detailed understanding of this node. To understand household food capacity, it would require a series of methods in addition to online surveys, and extensive effort would be required to ensure the information was representative to the entire province and its residents.

**5.2 Recommendations**
Considering the geographic limitations to NS food security and food system resilience, NS decision makers should instead focus on factors they can control. They could:

- Decrease the geographic scale of the food system by localizing food chains through incentivising food storage in NS (Smith, et al. 2015).

- Encourage logistical diversity in the food system by increasing the avenues for food import, such as through deliveries by boat through local ports (Smith, et al. 2015).

- Address the cohesiveness and responsiveness of the food system by requiring supply chains to work together to develop contingency plans for possible food shortage events (Smith, et al. 2015).

As suggested in the document written by the NS Department of Health and Wellness (2011) regarding medical equipment capacity these recommendations could be achieved by: "acquiring and operating as an independent, integrated system, with a [determined minimum number of] strategically located warehouses within the province which would replace most or all of the existing storage facilities" (NS Department of Health and Wellness, 2011, pg. vi). Or "expanding infrastructure by evaluating all existing facilities/agreements and design system enhancements to fulfill the objectives including, if necessary, new space development" (NS Department of Health and Wellness, 2011 pg. vi).

With 90% and 9.6% of all meals consumed in households and restaurants, respectively, it is recommended that further research be implemented to better understand food capacity in these nodes. Topics such as demographics, household food stockpiling, both incidental and deliberate, and regional, rural, urban, and suburban food access should be explored to better understand the food capacity of these two critically important nodes responsible for the vast majority of meal provision in NS (Williams, et al, 2012). Furthermore, based on Thomas & Mora's (2014) research regarding water access following water shortage events, people may underestimate their need for, and access to, water following a shortage event further supporting the need to understand these nodes. By better understanding, particularly household food capacity, and better

communicating the need for preparation of food shortage events, NS residents could better

prepare for food shortages.

Due to the scope of inquiry required to understand these nodes, it would be recommended

that an honour's or master's thesis focus specifically on household and/or restaurant capacity.

These projects would require an early application for ethics approval and various methods for

data acquisition. Furthermore, it would be integral that the researchers ensured data was acquired

from all regions, demographics, and income brackets within NS to ensure a wide range of

households are considered when estimating food capacity. Both restaurants and households

would have a wide range of food capacities dependent on the consumers procuring food, the

business's or household's strategy for procurement and stockpiling, and the capacity or incentive

to build capacity in their respective nodes.

**6.0 Conclusion**

This research set out to better inform the NS food system to increase understanding of the food capacity that exists in the province, to map important supply chains and nodes, and to determine the means to create a more resilient food system. Though current food related social movements often focus on localizing food systems, this is only possible if the infrastructure exists to allow not only local production, but local storage and distribution as well. Restaurants, universities, hospitals, large scale distributers, grocery stores, and households were identified as important nodes within the system. Directed interviews were sought with knowledge holders to better understand the roles and relationships between these nodes and how much food was held and consumed in these nodes. With an estimated one billion meals consumed in NS annually, approximately 90% of these meals were consumed in households, 9.6% of the meals were consumed in restaurants, 0.33% of these meals were consumed in universities, and 0.28% of these meals were consumed in hospitals. Sit-down restaurants held seven days of food capacity, and fast-food restaurants held 14 days of food capacity. Universities held ten days of food capacity. Hospitals held 21 days of food capacity in rural communities and 14 days of food capacity in urban communities. Sysco held seven days of food capacity. Grocery stores held two days of food capacity. Though Sysco and universities had contingency plans, no other nodes did. Hospitals intentionally stockpiled food in preparation of food shortage events, but no others did. Though most supply chains held unexpectedly high food capacity, grocery stores were identified as a vulnerability to NS food security in the event of a food shortage. It would be important that NS decision makers considered how to make this node better prepared for food shortage events. Though it was not explored, considering the vast majority of meals were consumed in households, this node likely holds the greatest opportunity to build capacity. Future research

should consider investigating restaurant and household capacity, as this would further inform

issues of food capacity in NS.

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**Appendix A Directed Interviews**

**Introductory email**

After a conversation between my thesis supervisor Peter Tydemers and Chief Medical Officer Robert Strang it became clear that little was known about the food capacity in the NS food system. I have quantified food capacity through identifying the days to depletion of food and I am looking assess this in various nodes of the NS food system. This will include, hospitals, universities, food providers, and households. I acknowledge this will not provide a complete picture of our food system it will strengthen the information we have regarding food in our province.

In our meeting on <u>date</u> I hope to discuss:

- Your and your institution's role in supplying food to Nova Scotians.

- How food is procured, delivered, stored, and supplied in general and specific to food types.

- Where the food you provide comes from geographically.

- How long food lasts before depletion.

- Additional storage capacity.

- Your institution's connection to other nodes in the NS food system.

- How many people eat in your institution each day.

**Interview Structure**

Initial questions:

- How long do I have with you today?

- Explain project.

- I am seeking knowledge from you, not opinions.

- I will only ask questions which you can answer on behalf of your organization which means I do not need ethics approval

- My research does not require anything that you would be uncomfortable providing.

Your role and your institution's role in supplying food to Nova Scotians:

- Is your strategy the same as other nodes? To what degree is this information specific to you, your department, and your node or applicable to all positions, departments, and nodes?

- Can you help me understand what your domain of food provisioning responsibility is?

How is food procured, delivered, stored, and supplied in general, and specific to food types:

- How do you order various food groups, how is it delivered, how is it stored?

- Could I look at any procurement data?

- Do you store your food on site or in satellite storage facilities?

- Can I get contact information for your food providers/storage facilities?

|  | Procurement – where does it come from? Who provides? | Storage, where is stored? | How long before you would run out | Contact people to learn more? |
|---|---|---|---|---|
|  |  |  |  |  |

| Fresh produce | | | | |
|---|---|---|---|---|
| Fresh Meat/fish | | | | |
| Cereals/grains | | | | |
| Dairy | | | | |
| Frozen | | | | |
| Canned | | | | |
| Eggs | | | | |
| other | | | | |

Where the food you provide comes from geographically:

- Where does your food come from, how much is from NS or outside?

- What percentage of your food is sourced from NS

Estimating food capacity:

- On average how many days before your food is depleted– if you don't know do you have data that would allow me to understand that?

- If a delivery does not show up with a shipment how long do you have before you run out of food?

- How often do you need to restock your food?

Additional storage capacity:

- How much more could you store if you needed to?

Your institution's connection to other nodes in the NS food system:

- Who/where do you get food from?

- What are other nodes do you rely on to procure and distribute food?

The number of people that eat in your node each day:

- How many people spend time in the facility each year, how many eat food in your facility?

- Typically what are the demographics of the people you serve?

Contingency plans:

- Do you have a plan for food shortage events?

- Do you intentionally stockpile food?

- What kinds of food do you stockpile?

**Interview conclusion**

- Can I use your name when I contact your contacts?

- Could you make an introduction to other contacts?

- Who else could you put me into contact with that may have information for me?

- Is there anything that I may be missing in my research?

If I need to clarify information you provided today or need to follow up with further questions may I contact you again?

**Appendix B Survey**

- Are you a Nova Scotia Resident?

If yes- goes to next question – no – thank you for your participation

- Do you have knowledge of and responsibility for food acquisition in your household?

If yes- goes directly into demographic questions – no – thank you for your participation

Household Questions

- How many people live in your household? -Open integers

- How many people in this household are you responsible for providing food on a regular

  basis? -Open integers

- Do you live in a rural, suburban, or urban community? (drop down list)

- What county do you live in? – (drop down list of NS counties)

Food capacity questions- determining days to depletion

Short Form

- If you began eating your food today without food shopping approximately how many

  days could you eat typical meals for your household? (open integer number of days)

- Are you are willing to complete a more detailed version of this survey? (yes or no)

If they are willing to complete the long form survey they continue onto long form survey questions

If they are not willing to complete the long form survey they would go directly to the demographic questions

Long form

- If you began eating your frozen food today, approximately how many days before your frozen food runs out. (Open integer in days)

- If you began eating your canned food today, approximately how many days before your canned food runs out? (Open integers in days)

- If you began eating your fresh meat/fish today, approximately how many days before your fresh meat/fish runs out? (Open integers in days)

- If you began eating your fresh produce today, approximately how many days before your fresh produce runs out? (Open integers in days)

- If you began eating your eggs today, approximately how many days before your eggs runs out? (Open integers in days)

- If you began eating your dairy products today, approximately how many days before your dairy products runs out? (Open integers in days)

- If you began eating your grains today, approximately how many days before your grains runs out? (Open integers in days)

- If you began eating your other food products today, approximately how many days before your other food products runs out? (Open integers in days)

- Do you maintain a stockpile of durable food in the case of a shortage event? Yes no

- Was this stockpile considered in your response to the questions in this survey? Yes no

- how many days of food capacity do you have in your stockpile? (Open integers in days)

Demographic Questions

- How many people in your household fall into the age range of? – (drop down list)

    o 0-13 – indication of # of individuals as an open integer

    o 13-18, - indication of # of individuals as an open integer

    o 18-30, indication of # of individuals as an open integer

    o 30-65, indication of # of individuals as an open integer

    o 65+ indication of # of individuals as an open integer

- Household income (drop down list)

    o <$25,000

    o $25,000-$50,000

    o $50,000-$75,000

    o $75,000<

- What is your employment status? -  (drop down list)

    o  employed full time

    o  employed part time

    o  Self-employed

    o  student

    o  retired

    o  unemployed

    o  Prefer not to say