# THE MANITOBA FOOD SUPPLY UNDER A PANDEMIC STUDY
# RESEARCH METHODS AND RESULTS

Brian Wirth, Dave Wolters, and Stephen Wright
University of Manitoba Transport Institute

## Introduction & History

Some researchers suggest that a global pandemic is not a matter of "IF" but rather a matter of "WHEN". As a part of preparing for a potential pandemic, (such as from H5N1 Bird Influenza), the University of Manitoba Transport Institute (UMTI) has been developing a plan for the continuation and distribution of the Manitoban food supply.

### Scenario

The current pandemic scenario projects several "waves", each lasting roughly 8 weeks. During these periods, approximately 30% of the workforce will be affected either directly or indirectly and will be absent from work. Those that are affected directly are cases where individuals contract the virus and become ill. Indirect cases may involve individuals who are unable to work because they are either busy caring for infected persons, or refuse to leave their residence out of fear of becoming ill.

### Project Goals and Guidelines

During the planning and development of the project, 4 key goals were outlined.

- Determining nutritional needs of the provincial population.
- Determining provincial food production capacity.
- Identifying nutritional surpluses and deficits, critical ingredients, and vulnerabilities.

- Planning and mapping of provincial nutritional supply chain under a variety of scenarios.

In addition, project members were provided 2 guidelines to follow while researching and developing pandemic strategies.

- The project will focus exclusively on post "farm gate". Essentially, the supply chain will begin with the arrival of raw materials to initial production facilities (e.g. wheat to a flour mill, live animals to an abattoir).
- Planning will focus on market based solutions and maintaining the operation of private businesses. (i.e. production would remain a "pull" operation rather than a "push" operation, retailers would continue to sell groceries, etc.).

## Methodology

### Survey Creation

It was determined that the most efficient way to collect data about the Manitoba food supply chain was to create a survey for companies to complete. Several surveys were developed for key food supply industries. These industries were food processors, abattoirs, wholesaler/distributors, retailers, and logistics firms. The data gathered by each of the five surveys is listed below.

**Processor**:

- Type(s) and amounts of each food item they produce.
- To whom and where these food products are shipped.
- The critical ingredients used for production, including the sourcing of these items.
- The size and type(s) of storage facilities and/or company equipment, (i.e. trucks and trailers), owned or leased.
- The number of employees and business hours.

**Abattoir**:

- Type(s) and amounts of each type of animal slaughtered.

- To whom and where the meat products are shipped.
- The sourcing of the respective animals.
- The size and type(s) of storage facilities and/or company equipment (i.e. trucks and trailers), owned or leased.
- The number of employees and business hours.

**Wholesaler/Distributor:**

- The size and type of storage facilities.
- The sourcing and distribution of goods.
- The available equipment (owned or leased) for the movement of the food products.
- The number of employees and business hours.

**Retailer:**

- The size and type(s) of storage and display areas.
- The number of customers served.
- The available equipment (owned or leased).
- The number of employees and hours of business.

**Logistics:**

- The number of each equipment type that is owned/operated (trucks, trailers, cube vans, etc.).
- The size and type of storage facilities (including trailer yards).
- The number of drivers, and more importantly, the number located in Manitoba.
- The size of fuel depot(s), if operated by the company itself.

Additionally, data was collected from other industries including water and ice companies, industrial caterers, and charity/foodbank/hospital.

## Population Breakdown

The next task was to determine the members of the population for each industry category. To create the population several different sources were used. Among the sources were:

- Manitoba Food Processors Association (MFPA)
- Manitoba Agriculture, Food and Rural Initiatives (MAFRI)

1. Manitoba Food Products Directory Database
2. U-Pick Guide, Vegetables, Market Gardens, and Roadside Stands
3. Other industry lists

- Yellow Pages
- DNB's "Selectory" Business Database
- Manitoba Business Information Service

After forming a general list which combined companies from the various sources, the list was evaluated and companies were either categorized or eliminated if it was deemed they did not pertain to the study. Among the eliminated companies were distillers or breweries, coffee roasters, and small meat shops or delis. Alcohol and coffee processors were removed as these products provide little nutritional value. Small meat shops were removed because they were considered to be a double count as meat that had been slaughtered at an abattoir was sent to these shops for further processing.

Upon placing companies into individual categories, companies were further grouped by size (small, medium, large). It was assumed that the bulk of provincial food production is done by a handful of larger firms. Therefore, it was determined that large companies would be targeted for in-person interviews while surveys would be mailed to small and medium firms. In addition, firms producing unique commodities were also selected for in-person interviews regardless of size (eg. dry milk, canola oil).

**Table 1: Number of Firms in Population, by size**

| Number of Firms in Population | | | | | |
|---|---|---|---|---|---|
| | Processor | Abattoir | Wholesaler | Retailer | Logistics |
| Small | 199 | 25 | 14 | 335 | 157 |
| Medium | 29 | 3 | 6 | 120 | 61 |
| Large | 21 | 4 | 12 | 64 | 31 |
| **Provincial Total** | **249** | **32** | **32** | **519** | **249** |

## Data Collection & Weighting

Information gathered from both the in-person interviews and mail-out surveys were coded and stored in a database. Based on the survey type (processor, logistics, etc.), data was separated into the appropriate industry file.

Although a 100% response rate was not expected, the limited response rate (by many important firms) was surprising.

The goal of this study was to project the types and amounts of different food items in Manitoba, as well as the provincial storage and transportation capacities. In order to accomplish this, different weighting techniques were used to fill "holes" in the dataset. "Holes" being those companies that had not been surveyed (either by choice by the study team or refusal on their part) but were listed as part of an industry relevant to this study. The following are some the weighting techniques used to complete the datasets in absence of information for the different industry types.

**Processing/Abattoir Firms (Food/Nutrition Projections):** This was the most crucial area for data weighting due to the importance of estimating the nutritional surpluses/deficits in the province.

After surveyed results were tabulated, the food processing firms were classified based on the type of food produced, the size of the firm (number of employees), and their location in Manitoba based on regional health authority (RHA). Referring back to the total population list of food processors, any company without information

would be filled in using the data from surveyed firms who had all three of the same characteristics as that "empty" firm. For example, two medium-sized milk producers in the Central RHA were not surveyed either in-person or by mail-out. However, three other medium-sized milk producers in this region had been interviewed. The estimation of production numbers for these two firms would be filled by the weights of the three surveyed firms. Table 2 illustrates this process.

**Table 2: Example of Weighting Process**

| RHA | Type | Size | Total Firms | Surveyed Firms | Weight |
|---|---|---|---|---|---|
| Central | Milk | Medium | 5 | 3 | 1.67 |

The weight was calculated by dividing the total firms by the surveyed firms. The weight of 1.67 multiplied by the total production of the three surveyed firms gives an estimate of the total production of the five firms. Case in point, if the survey results showed that the three interviewed firms produced a combined total of 450,000 litres of milk annually, then an estimate for all of the firms would be 450,00 x 1.67 = 751,500 litres of milk. This number would then represent the milk production of medium sized milk producers in the central region.

Although this technique worked well in some situations, it also posed distinct issues in others. For example, cases occurred where "holes" in the data could not be filled by weighting simply because a specific RHA would not have any firms to form the basis for the weights. In these cases other strategies, such comparing similar firms across different RHAs or consulting industry group websites, had to be utilized. Considering the population of Manitoba is concentrated primarily in the southern regions, the northern areas had scarce information available for the study.

**Logistics Firms:** Surveys and interviews with logistics firms focused on equipment and driver availability. This provided an overview regarding the average number of transportation units and drivers to be

found in the province on any given day. In addition, each industry survey included a section on company-owned transportation equipment. UMTI also received a summary of Manitoba registered cube-vans, (semi) tractors, and 53' trailers from Manitoba Public Insurance (MPI), though this data did not include a summary of reefer and non-reefer units. Based on the data provided by both logistics and other industries, the distribution and availability of these equipment types was determined and applied to the registration summary.

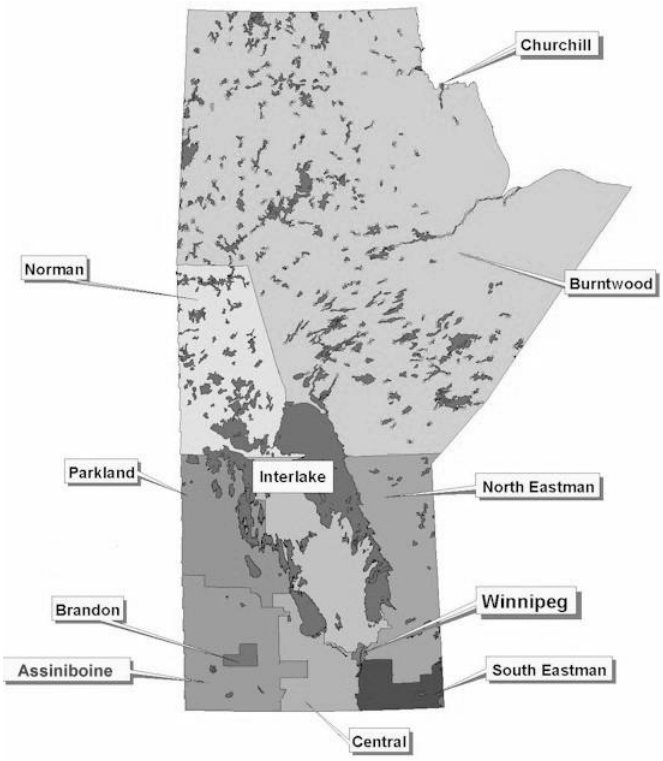
**Wholesaler/Distributor Firms:** During the interviewing and surveying of processors, firms were asked where their products were initially shipped. In cases where companies shipped their products to wholesalers in Winnipeg for further distribution, it is unknown where these products eventually end up. For the purpose of this project, it was assumed that products arriving in Winnipeg from major processors would be redistributed through the province (including in Winnipeg). To accommodate this, wholesalers and distributors were interviewed and their distribution patterns were recorded. These patterns were then used to determine the average distribution from Winnipeg throughout the RHAs and to locations outside of Manitoba.

## Preliminary Results

### Provincial Nutrition Requirements

To account for regional variations the province was separated into regions based on the current RHAs. The map below shows the RHAs in Manitoba.

**Figure 1: Map of Manitoba's Regional Heath Authorities (RHA)[1]**




As the daily nutritional requirements of humans varies from person to person (based on a variety of factors), the population was divided based on gender and further separated using a series of age cohorts. These cohorts were the same used in the Dietary Referenced Intakes published by Health Canada. However, as this data does not include infants or pregnant and nursing females, additional cohorts were created. The result was the demographic categories displayed in Table 3.

[1] Manitoba Health. "Map of Manitoba's Regional Health Authorities." (December 2007)
< http://www.gov.mb.ca/health/rha/rhamap.html>

**Table 3: Demographic Cohorts**

| Demographic Cohorts (Based on Age and Gender) | | | |
|---|---|---|---|
| Male | Female | Female (Pregnant) | Female (Nursing) |
| 0 - 6 Months | 0 - 6 Months | 0 – 18 Years | 0 – 18 Years |
| 7 - 12 Months | 7 - 12 Months | | |
| 1 - 3 Years | 1 - 3 Years | | |
| 4 - 8 Years | 4 - 8 Years | | |
| 9 - 13 Years | 9 - 13 Years | | |
| 14 - 18 Years | 14 - 18 Years | | |
| 19 - 30 Years | 19 - 30 Years | 19 - 30 Years | 19 - 30 Years |
| 31 - 50 Years | 31 - 50 Years | Over 30 Years | Over 30 Years |
| 51 - 70 Years | 51 - 70 Years | | |
| Over 70 Years | Over 70 Years | | |

The provincial population was then separated into these cohorts. Overall, the distribution of males and females is roughly even. The number of females that are either pregnant or nursing is less than 2% of the provincial population. The largest cohort is found in the 31-50 years cohort. This is understandable because this cohort contains the widest scope of ages (those ages that are younger have been split into several cohorts).

In determining the nutrition requirements of the province, the daily dietary requirements of nutrients, minerals, and vitamins were applied to each cohort. The total daily nutritional requirements for the province were calculated as shown in Table 4.

**Table 4: Daily Provincial Nutritional Requirements**

| Daily Nutritional Requirements for the Province of Manitoba (June 1, 2006) | |
|---|---|
| **Nutrient/Mineral/Vitamin** | **Total Provincial Daily Requirement** |
| Protein | 55,000 kg |
| Carbohydrates (Carbs) | 154,000 kg |
| Fibre | 34,000 kg |
| Fat | 36,000 kg |
| Calcium | 1,250,000 g |
| Iron | 13,000 g |
| Zinc | 11,000 g |
| Sodium | 1,600,000 g |
| Potassium | 5,300,000 g |
| Vitamin A | 3,000,000,000 IU[2] |
| Vitamin C | 86,000 g |
| Vitamin B6 | 1,500 g |
| Folate | 450 g |
| Thiamin | 1,300 g |
| Riboflavin | 1,300 g |
| Niacin | 16,400,000 NE[3] |

Overall, the nutrition requirements within the province follow the population distributions of the RHA's very closely (to within one percent). Overall, the nutritional needs are influenced more by overall total population, rather than by the distribution of the various cohorts.

## Food & Nutrition, Surplus/Deficit

The amount of food produced in Manitoba is more than enough to sustain its residents if a pandemic were to occur. As a net exporting province, much of the food produced in Manitoba is destined for foreign and domestic markets. Among the products that Manitoba produces in great quantities are:

- Pork
- Potatoes
- Poultry

[2] IU = International Units
[3] NE = Niacin Equivalents

- Pulses
- Canola Oil
- Flour
- Starchy Vegetables

Pork makes up the majority of the meat produced in Manitoba at 86% of the total meat and poultry production. Poultry is the next largest at 13%. Several large companies with slaughtering facilities in Manitoba make up the bulk of this total. Crop production is also prevalent with products such as pulses, canola, oats, wheat, and potatoes produced in large amounts. The largest sector in terms of food production in Manitoba is the potato industry. With several large potato growing and cleaning operations, as well as several large potato processing firms, Manitoba is second only to Prince Edward Island in terms of potato production in Canada.

After data on food production was collected, nutrition produced by type was determined in order to calculate the available nutrition for Manitoba and for each RHA. Imports and exports of food were also taken into consideration. International imports and exports of food were obtained from the Statistics Canada 2006 Trade Database. As no data was available for domestic food trade, the nutritional component of domestic trade was calculated using the Statistics Canada publication "Food Statistics 2006." This publication lists the total available nutritional components for Canadians. Total domestic trade for nutrition was therefore equal to the total nutrition available per person subtracting production in Manitoba and net international trade.

The nutritional data from production and trade was then combined with overall food requirements to produce surplus and deficit figures for the province and individual RHA's. The following table displays the nutritional surplus and deficits in Manitoba in its current situation, with all activity such as trade and production occurring as normal, and when all trade ceases which would occur because of borders being closed.

**Table 5: Nutritional Surplus/Deficit, Current Scenario**

| **Manitoba** | **Normal Scenario** | **Normal Scenario, All Trade Ceases** |
|---|---|---|
| *Nutrient* | *Surplus/Deficit* | *Surplus/Deficit* |
| Protein | + | + |
| Carbohydrates | + | + |
| Fibre | - | + |
| Fat | + | + |
| Calcium | - | + |
| Iron | + | + |
| Zinc | + | + |
| Sodium | - | + |
| Potassium | - | + |
| Vitamin A | - | + |
| Vitamin C | + | + |
| Vitamin B6 | + | + |
| Folate | - | + |
| Thiamin | + | + |
| Riboflavin | + | + |
| Niacin | + | + |

In the normal scenario, of the sixteen nutrients listed, Manitoba has a deficit in six. Among the deficit nutrients are fibre, calcium, and Vitamin A. When different scenarios are applied, the surplus and deficit picture can drastically change.

As a net exporting province, the closing of national and provincial borders would keep all of Manitoba's exports within the province. Assuming production would remain unchanged, Manitoba would have a surplus in all nutrients listed. However, production would likely drop if the borders were closed. Additionally, production will almost assuredly drop if Manitoba is faced with a Pandemic. A significant amount of the work force may choose to stay away from work due to illness, a fear of getting sick, or to care for family members who are already sick. When faced with a 35% reduction in production capacity, Manitoba still produces enough to maintain its current nutrition level, and when trade ceases, nutrients all shift toward a surplus.

Even under an extreme scenario with trade occurring as normal but production reduced by 75%, Manitoba would still maintain a surplus in a majority of categories. Most notably, in this scenario, protein and carbohydrates would remain in surplus, while calcium, zinc, potassium, and Vitamin C would show a deficit.

**Table 6: Nutritional Surplus/Deficit, 75% Reduction in Production**

| **Manitoba** | **75% Reduction in Production** | **75% Reduction in Production, All Trade Ceases** |
|---|---|---|
| *Nutrient* | *Surplus/Deficit* | *Surplus/Deficit* |
| Protein | + | + |
| Carbohydrates | + | + |
| Fibre | - | + |
| Fat | + | + |
| Calcium | - | - |
| Iron | + | + |
| Zinc | - | + |
| Sodium | - | - |
| Potassium | - | + |
| Vitamin A | + | - |
| Vitamin C | - | + |
| Vitamin B6 | + | + |
| Folate | - | + |
| Thiamin | + | + |
| Riboflavin | + | + |
| Niacin | + | + |

If production was reduced by 75% and trade ceased, additional surpluses of zinc, potassium, vitamin C, and folate would occur.

This section only displays a few of the many scenarios taken into account in planning for a pandemic. With countless scenarios to consider, it may happen that the eventual situation will be different than those considered or a combination of scenarios.

### Logistics

Supplying nutrition to Manitobans is dependent on the availability of transportation equipment to distribute food throughout the province. Food production is useless if the products cannot be moved to places of need. Fortunately, Manitoba is a major transportation centre.

**Daily Logistics Needs:** In calculating the daily transportation requirements of Manitoba processors, the assumption was made that pallets would be used to package and secure loads of food. Based on the accounts of several processors and distributors, it was determined that a standard (40" x 48") pallet holds between 2000-2500 pounds (909-1136 kilograms). This information was used along with the pallet weights of some "special" products (e.g. eggs, baked goods) to calculate the total number of pallets used by Manitoban processors. Based on the assumption that pallets would not be stacked during travel, the number of pallets used by food processors was multiplied by the area occupied by each type of pallet (a bakery "tray" is much smaller than a standard pallet). This was then used to determine the number of 53" trailers and cube vans (both refrigerated and non-refrigerated) needed in each RHA to move a day's worth of total food production. Overall, Manitoba appears to have enough refrigerated and non-refrigerated transportation assets to handle the daily distribution requirements of food processors. However, this does not take into account the distribution requirements of other sectors (e.g. medical supplies), nor the continuation of regular daily operations.

## Critique & Conclusions

### Sample Distribution (Processor Survey)

When selecting firms to be interviewed in-person the primary goal was to target the large food processors. To supplement the interviews, mail-out surveys were used to fill gaps with data from the production firms in the province.

This strategy worked fairly well. Many of the key food processors in the province were willing to be interviewed, and a few more responded via the mail-out survey. However, there were still firms

who did not respond which subsequently left "holes" in the dataset. This created problems during the weighting process.

Optimally, a more specific sample distribution may have proved more efficient. For example, for the weighting process, firms were sorted by location, size, and food-type production. All firms grouped with the same three characteristics were considered fairly similar and could be used to predict each others food production where gaps existed. Sorting all of the provincial food processors into these groups before the interview process, and strategically aiming to survey one or two firms from each group may be an effective way to collect data in future studies. It would make the weighting process much smoother.

## Other Considerations

In addition to determining the food production and distribution capabilities of the province, other needs and vulnerabilities were examined. Examples include the production of water, the daily requirements of infant food and formula (neither of which are produced in Manitoba), and the continued supply of food to hospitals, health care facilities, and charities (e.g. food banks and Meals on Wheels). As well, surveys were administered to examine various human behavior factors such as the likelihood of migration during a pandemic and the sizes of personal food stocks (e.g. pantry and freezer space).

## Alternate Applications

Ultimately, the information gathered for this study is beneficial for all disaster planning and management. Not solely limited to pandemics and other health crisis, the data generated can be applied to a variety of different scenarios. In recent years, the importance of disaster planning and management has been thrust into the limelight. The public has witnessed a variety of cases where the governing agencies did not rise to the challenge at hand, sometimes ending with tragic results. Ultimately, this project and others like it can aid governments and agencies in the development of contingencies for a variety of scenarios.