

Data Note

Canadian agriculture technology adoption

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Abstract

Objectives Statistics Canada administers the Agricultural Census every 5 years, and this paper presents unsuppressed data from the 2016 and 2021 Census. The data set encompasses detailed information on farm types, sizes, technology choices, and a demographic profile of farm operators from the 2021 Census. Data on farm characteristics and operator demographics is crucial for understanding innovation in agriculture and formulating evidence-based policies.

Data description The data sets cover the two most recent agriculture censuses of 2016 and 2021, presenting data on the number of farmers by region, farm type, size, and the adoption of technologies. Additionally, a third data set lists the number of farm operators by age and sex. The census questionnaire inquires about using different technologies, varying the types across the two census periods. Notably, there is no data suppression in these data sets, and they cover all 10 provinces in Canada, excluding the three territories. Farm types are categorized based on the North American Industry Classification System (NAICS), and farm size is measured in acres.

Abbreviations

G7	Group of Seven
GIS	Geographic Information System
GPS	Global Positioning System
NAICS	North American Industry Classification System
NDVI	Normalized Difference Vegetation Index
USDA	United States Department of Agriculture

1 Objective

As a Group of Seven (G7) member and major agriculture and food exporter, Canada's food and agriculture system faces a three-pronged challenge: feeding a growing global population, sustaining productivity growth, and addressing environmental concerns. In response, various government levels are implementing policies to encourage the adoption of agricultural technology, particularly those aimed at assessing and mitigating the environmental impact of agriculture and enhancing production. The foundation for effective policy lies in evidence-based analysis, for which the Canadian Census, conducted every five years by Statistics Canada, serves as a critical information source.

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This paper presents data from the 2016 [1] and 2021 [2] Canadian Agriculture Census conducted by Statistics Canada. The data set is unsuppressed, containing the entire census and all variables. It shows the number of farms by geography, type, size, and technology for the two census years. There is also demographic information from the 2021 Census on the number of farms by age and sex of farm operator.

The agriculture census is administered to farmers, with a response rate of over 80 percent [2]. Statistics Canada [2] describes the definitions of a farm operation, the questionnaire design, their approach to encouraging farmers to complete the questionnaire, and providing access to the questionnaires [3].

The data set [4] was obtained from Statistics Canada in April 2023 and has not appeared in published papers. It contains information broadly analogous to data sets on digital agriculture adoption in the United States, see McFadden et al. [5] (Table 1).

Data file 1, representing the 2021 Census, is structured into 16 columns and spans 1,056 rows. The first two columns are designated as geographic identifiers, including the national level, Canada, and its ten provinces.

The data set includes two columns categorizing farm types based on the NAICS classification. It encompasses 12 distinct farm types, with “All Farms” being one of the categories. The 2021 Census shows that among the prevalent farm types in Canada, oilseed and grain farming (NAICS 1111) and beef cattle ranching and farming, including feedlots (NAICS 11211), stand out. Oilseed and grain farming constitute over one-third (34%) of all farms, while more than one-fifth (21%) are dedicated to beef cattle ranching and farming, including feedlots. These two categories account for 83% of the total farm area.

The data set includes two columns dedicated to the total farm area, classified into eight categories and measured in acres. These categories range from “all farms” to those spanning “3520.00 acres and over.” A separate column enumerates the total number of farms, providing a precise count of farming entities.

The final nine columns detail the technologies utilized on farms, with the first column providing a tally of the total number of farms that use technology. This section corresponds with the 2021 Census of Agriculture’s inquiry about technology usage, which asked farmers to report technologies used on their operations during 2020, including those employed by third parties working on their farms. The technologies listed are as follows:

- Automated guidance steering systems (auto-steer) on farm equipment;
- Geographic Information System (GIS) mapping, e.g., soil quality mapping, yield mapping, Normalized Difference Vegetation Index (NDVI) mapping;
- Variable-rate input application (including variable-rate seeders, sprayers and fertilizer applications);
- Drones;
- Soil sample test;
- Slow-release fertilizer;
- Fully robotic milkers, i.e., no manual intervention required;
- Robotic greenhouse equipment.

File 2, representing the 2016 Census data, includes information categorized by geography (11 regions), farm type (12 industries), and farm size (8 size categories). These variables—geography, farm type and farm size—maintain consistent definitions with those in the 2021 census.

The 2016 Agriculture Census inquired about technology use on farms, asking: “In 2015, which of the following TECHNOLOGIES were used on this operation? Include work done by others on this operation.” The technologies listed are as follows:

- Computers/laptops for farm management
- Smartphones/tablets for farm management
- Automated steering (auto-steer)
- Global Positioning System (GPS) technology
- GIS mapping (e.g., soil mapping)
- Greenhouse automation
- Robotic milking
- Automated environmental controls for animal housing
- Automated animal feeding
- Other technology (open-ended)

Table 1 Overview of data files/data sets

Label	Name of data file/data set	File types (file extension)	Data repository and identifier (DOI or accession number)
Data file 1	Technologies by farm type and farm area, Canada and the provinces, 2021	M.S. Excel (.xlsx)	https://doi.org/https://doi.org/10.5683/SP3/2OCJIO 2023-09-10_CanAgTech_FarmTypeArea2021_v.1.1.tab
Data file 2	Technologies by farm type and farm area, Canada and the provinces, 2016	M.S. Excel (.xlsx)	https://doi.org/https://doi.org/10.5683/SP3/2OCJIO 2023-09-10_CanAgTech_FarmTypeArea2016_v.1.1.tab
Data file 3	Farm operators by age and sex, Canada and the provinces, 2021	M.S. Excel (.xlsx)	https://doi.org/https://doi.org/10.5683/SP3/2OCJIO 2023-09-10_CanAgTech_FarmOpAgeSex2021_v.1.1.tab

- None of the above

File 3 from the 2021 Census encompasses demographic data of farm operators categorized by geography (11 regions, including the 10 provinces and the nation), age (4 categories: all operators under 35 years, 35 to 54 years, and 55 years and over), and sex (3 categories: all operators, male, and female). This demographic data presents an opportunity to examine correlations and trends in technology adoption behaviours across various demographic groups.

2 Limitations

The Canadian Census solicits information on agricultural technologies, but the technologies included in the survey questionnaires differ between the 2016 and 2021 census periods. Currently, there is no publicly accessible Canadian data set for tracking the effects of technology adoption on environmental, financial, and economic indicators. This data is not directly comparable to similar adoption studies, such as the United States Department of Agriculture (USDA) study on digital agriculture adoption [5].

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Data availability The data described in this Data Note can be freely and openly accessed on Borealis under <https://doi.org/10.5683/SP3/2OCJIO>. Please see Table 1 and References [4] for details and links to the data.

Code availability Not applicable.

Declarations

Consent for publication Link: <https://www.statcan.gc.ca/en/reference/licence>.

Competing interests The authors report no competing interests.

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