



RURAL ONTARIO
INSTITUTE

Vision, Voice and Leadership



ECOLOGICAL FOOTPRINT AND BIOCAPACITY FOR RURAL ONTARIO

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Introduction

Ecological Footprint and Biocapacity are sustainability metrics that measure the human impact on Earth's ecosystems. Ecological Footprint measures the amount of resources we consume. Biocapacity measures the capacity of ecosystems to regenerate the resources that we use. In other words, Ecological Footprint measures the demand on natural resources while Biocapacity measures the supply of ecosystem services. Overconsumption occurs when the Ecological Footprint of an area exceeds Biocapacity. Consumption is sustainable when Biocapacity exceeds Ecological Footprint. Together, Ecological Footprint and Biocapacity present a holistic snapshot of the impact of human activity on the environment.

Unfortunately, these metrics are telling us that we are consuming the Earth's resources at an unsustainable rate. Current rates of consumption require almost [2 planets](#) worth of resources. We need to reduce our Ecological Footprint by making more sustainable choices. Coordinated action is needed from national and provincial governments to improve Canada's sustainability. Action is also needed at the local and regional level, however, there is currently very limited data regarding Ecological Footprint and Biocapacity at the community level.

Ecological Footprint and Biocapacity Accounts can be scaled to different levels. From 2003 until 2019, the [Global Footprint Network](#) produced Ecological Footprint and Biocapacity Accounts at the national and global levels. In 2019, the production was transferred to the Ecological Footprint Initiative at York University. In 2021, the [Ecological Footprint Initiative](#) produced accounts for Ontario by downscaling Canada's accounts (see [Ontario's Ecological Footprint Report](#)).

Starting in the fall of 2022, ROI began working with York University's Ecological Footprint Initiative to downscale Ontario's accounts to the municipal level. This partnership is part of the [International Ecological Footprint Learning Lab](#), a multi-year global partnership funded by the Social Sciences and Humanities Research Council. This project is the first attempt at creating comprehensive Ecological Footprint and Biocapacity accounts at the community level for all municipalities in Ontario. This report provides a summary of the results for rural and urban communities in Ontario.

In summer of 2024, we completed the calculations for Ecological Footprint and Biocapacity accounts for all communities where data were available. The results of this project are presented as indicators on ROI's Community Wellbeing Dashboard. A detailed methodology report is also available ([see Dworatzek et al. 2024](#)).

Ecological Footprint

The Ecological Footprint of Consumption ("Ecological Footprint") measures the amount of land needed to supply the ecosystem goods and services we consume. Our consumption of goods

and services also produces waste, such as carbon emissions. Ecosystems also play an important role in absorbing the carbon emissions produced from consumption.

Ecological Footprint has 6 components: cropland, grazing land, forest products, fishing grounds, built up land, and carbon. Cropland refers to the area required to grow crops. Grazing land refers to the area required to feed livestock. Forest products is the area of forests needed to support consumption of forest products. Fishing grounds is the area of marine and inland waters needed for fish consumption. Built up land reflects the area covered by human-made infrastructure. Carbon is the amount of forest area that would be required to absorb carbon emissions.

Not all of the goods and services produced in Ontario are consumed in Ontario. Ontario's Ecological Footprint reflects the consumption of Canada's domestic production and imports, but excludes the consumption of Canada's exports.

Biocapacity

Biocapacity measures the capacity of an ecosystem to support an ecological footprint. Biocapacity has 6 components: cropland, grazing land, fishing grounds to support food production; forests to support forest products and absorb carbon; wetlands to absorb carbon; and built-up land for infrastructure and shelter. In addition to providing the goods we consume, ecosystems also provide critical services like wildlife habitat, air and water filtration, and carbon storage. Forests provide two important types of ecosystem services for people: forest products, and carbon absorption.

The productive capacity of Ontario's lands is influenced by climate and geography. The Hudson Bay Lowlands ecozone in the northern part of the province is the least biologically productive ecozone because of the cold and dry climate. Accounting for 23% of Ontario's land area, most of this ecozone is covered by wetlands, with few settlement areas. The Ontario Shield is the largest ecozone and covers 64% of the province. This ecozone is dominated by boreal forest ecosystems that are frequently disturbed by forest fires or harvesting. The most productive ecozone in Ontario is the Mixedwood Plains in the south. Covering 13% of lands, Mixedwood Plains is the most urbanized and intensively managed landscape in Ontario. Most of Ontario's built-up lands and croplands are located in this ecozone. Overall, forests cover 52% of Ontario's land area.

Most of the goods and services we consume pass through the global supply chain. Resources that we consume are often produced and traded using resources from other places. This means that individuals in a community are not exclusively consuming resources from the community that they live in. However, it is still helpful to understand the amount of resources that a community's ecosystems can produce.

Units

Different parts of the world have different rates of ecosystem production, which can make comparisons difficult. To address this issue, Ecological Footprint and Biocapacity are measured in global hectares, which is a standard unit that enables comparisons at different scales, different times, and for different locations across the world. A global hectare is the global average amount of biological regeneration for human use in a given year. Conversion factors enable us to convert hectares in Ontario to the global equivalent.

We present results for community Ecological Footprint and Biocapacity accounts on a per capita basis, to ensure the comparability of results between communities and different levels of geography. The Ecological Footprint or Biocapacity for the average Ontarian will be different from a community's per capita values, depending on where people live and their lifestyle. This allows for consistent comparisons that broaden our understanding of consumption patterns.

See [Ontario's Ecological Footprint and Biocapacity Report](#) for details.

Accounts for Rural Ontario

There are too many communities in Ontario to display all of the results in a report. Community accounts can be viewed on ROI's [Community Wellbeing Dashboard](#). The dashboard also presents accounts for groups of communities within specified categories or regions. The dashboard automatically calculates Ecological Footprint and Biocapacity accounts for different levels of geography selected by the user.

In this report, we present results for rural communities. We compare and contrast rural results with results for urban areas, First Nations communities, and Ontario.

Community

Census subdivisions, municipalities, and areas treated as municipal for statistical purposes, including unorganized territories, and Indigenous communities.

Community type

Categories of communities as First Nations, Rural, or Urban.

First Nations communities

Communities designated as First Nations reserves or settlements.

Rural communities

Non-Indigenous communities located outside of Census Metropolitan Areas.

Urban communities

Non-Indigenous communities that are part of a Census Metropolitan Area.

Table 1. Summary of results with contextual information for First Nations, rural, and urban communities.

Community type	Number of communities	2021 Population	Land area (sq km)	Median individual income	Biocapacity (Gha/capita)	Ecological Footprint (Gha/capita)	Biocapacity balance (Gha/capita)
First Nations	147	54,808	6,746	\$27,300	13.4	4.7	8.6
Rural	329	2,430,261	852,225	\$36,400	31.7	6.3	25.2
Urban	101	11,738,873	33,441	\$40,000	0.8	6.4	-5.6
Ontario	577	14,223,942	892,412	\$36,400	6.1	6.3	-0.3

Rural communities have a much higher Biocapacity than all other community types (Table 1). This is mostly because of the vast land area covered by rural communities. Rural areas in Ontario are less developed and have more natural land cover - mostly forests. In contrast, urban areas are smaller and more developed, so they have very low Biocapacity.

Ecological Footprint is influenced by many factors including population, population change, population density, dwelling types and sizes, income, and commuting patterns (see Appendix I). First Nations communities have the lowest Ecological Footprint of all community types. Rural and urban communities have a similar Ecological Footprint, which is interesting given their different population sizes and economic contexts.

It is possible that the influence of large population sizes in urban areas is offset by smaller dwellings, higher population density, and better access to public transit. Conversely, the lower population size of rural areas may be offset by larger dwelling sizes, lower population density, and limited access to public transit.

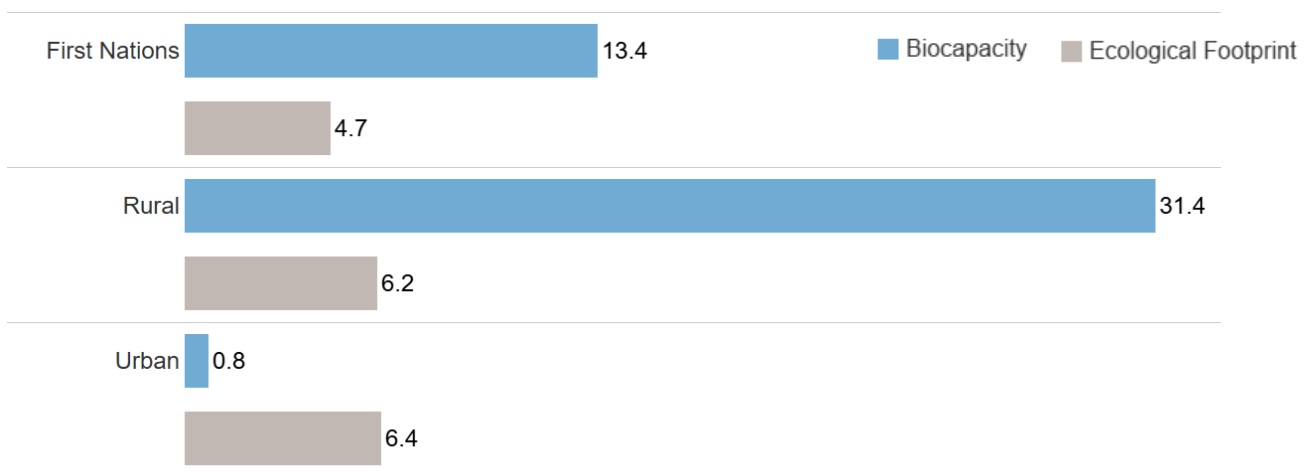


Figure 1. Biocapacity and Ecological Footprint accounts for First Nations, rural, and urban communities (global hectares per capita).

Biocapacity balance is the difference between Biocapacity and Ecological Footprint. First Nations and rural communities have a positive Biocapacity balance because of their high Biocapacity (Table 1). Urban areas have a negative balance because of their low levels of Biocapacity. Overall, Ontario has a slightly negative Biocapacity balance. Strategies for improving sustainability include increasing natural land cover in highly developed areas, improving access to public transit, and reducing greenhouse gas emissions. See Figure 2 for a map of Biocapacity balance.

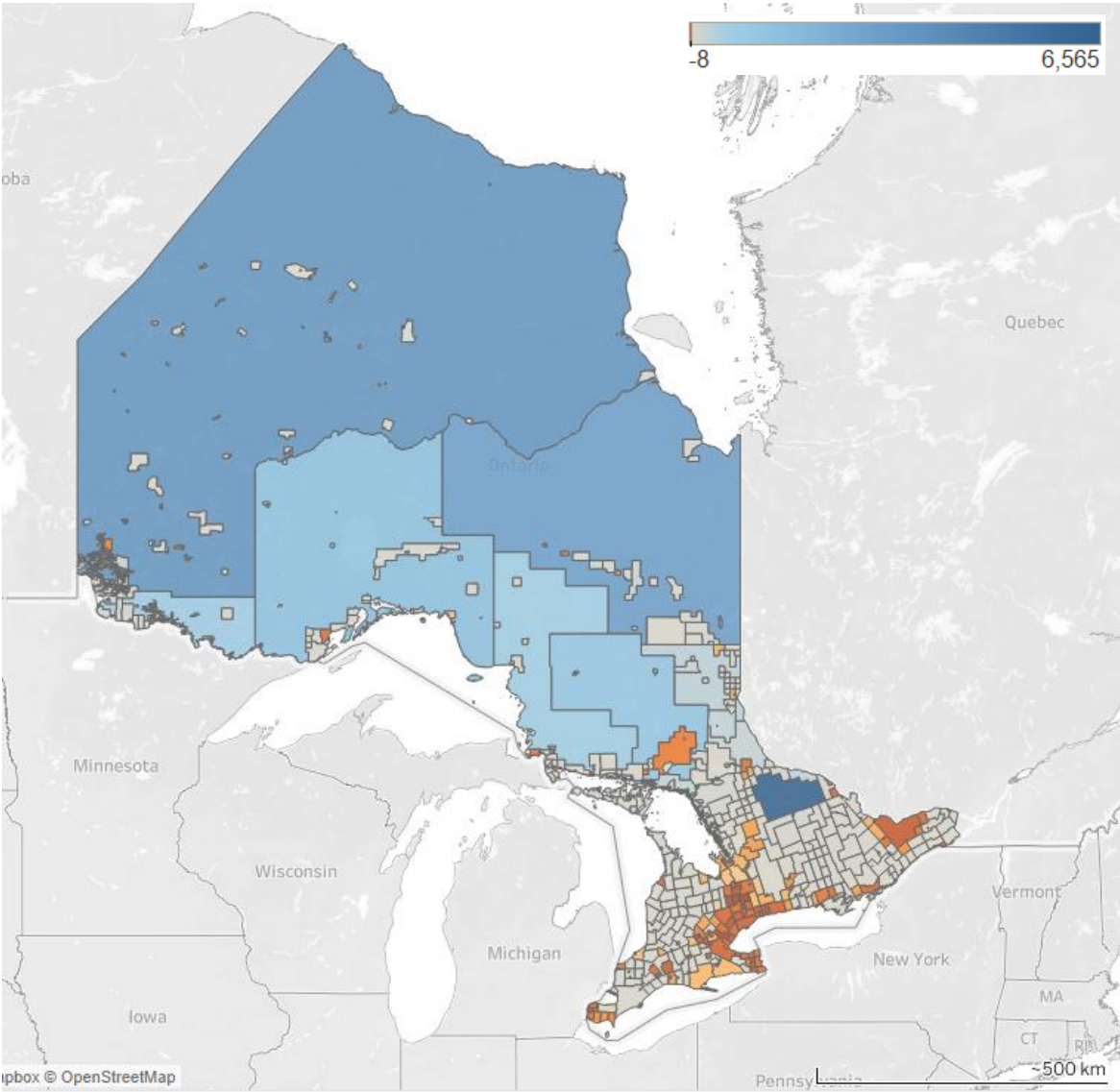


Figure 2. Map of biocapacity balance for communities in Ontario (global hectares per capita). Communities shown with an orange colour have a negative biocapacity balance (i.e., overconsumption). Communities shown with a blue colour have a positive biocapacity balance.

Components of Biocapacity and Ecological Footprint

Biocapacity and Ecological Footprint accounts are made up of components that reflect different land uses (Table 2). Rural areas have most of Ontario’s natural land cover and accordingly, most of Ontario’s productive ecosystems.

Table 2. Components of Biocapacity and Ecological Footprint

Fishing grounds	Area of marine and inland waters available and needed for human consumption of fish, invertebrates, aquatic mammals, and aquatic plants
Built-up land	Area of land available for, and occupied by, human-built infrastructure, including housing and other buildings, roads and paved areas, and urban greenspace.
Cropland	Area of land available and needed to grow crops consumed by humans as food or fibres, and for crops fed to animals and fish that are consumed by humans.
Grazing land	Area of land available and needed to feed livestock consumed by humans, beyond the feed supplied by the cropland component
Forest products	Area of land available and needed for forest harvests to derive pulp and timber products.
Wetlands	Area of wetlands that can absorb carbon. This component only applies to Biocapacity.
Carbon	Area of forests needed to sequester anthropogenic carbon emissions (beyond emissions sequestered by the oceans) from combustion of fuels and electricity generation, plus carbon emissions embodied in traded electricity and globally traded goods inclusive of their global transport emissions. This component only applies to Ecological Footprint.

Components of Biocapacity

Forests account for about half of the Biocapacity in rural and First Nations communities but represent only 11% of urban Biocapacity (Figure 3). Fishing grounds make up more Biocapacity for First Nations communities than both rural and urban communities. Wetlands account for 16% of rural Biocapacity, but only 7% of First Nations Biocapacity and 1% of urban Biocapacity. Not surprisingly, built up land represents 36% of urban Biocapacity, which is much higher than the 7% of First Nations Biocapacity and 9% of rural Biocapacity. Grazing land contributes more of the urban Biocapacity than for rural and First Nations communities.

Surprisingly, cropland makes up only 13% of rural Biocapacity. Rural areas do have a lot of cropland, however, their contribution to overall Biocapacity is smaller than both forests and wetlands. The cropland component comprises 47% of Biocapacity in urban communities, which is unexpected. Urban communities have less forests, so croplands make up more of their ecosystems. Another reason for this interesting result could be how we classified communities as rural or urban. Communities with agricultural lands that are located within the Greenbelt were classified as urban if they are part of a census metropolitan area. See the ROI website for more information about [community classification](#).

The Importance of Protecting Agricultural Land

This report shows that croplands are a critical component of urban Biocapacity. About half of Ontario’s farmlands are protected by provincial policy. The other half is at risk from human pressures for residential development and resource extraction. Existing protections are not guaranteed as policies change over time. Protecting cropland from urban sprawl and development is critical for maintaining Ontario’s food security, providing wildlife habitat, and supporting jobs in the food and agriculture sector.

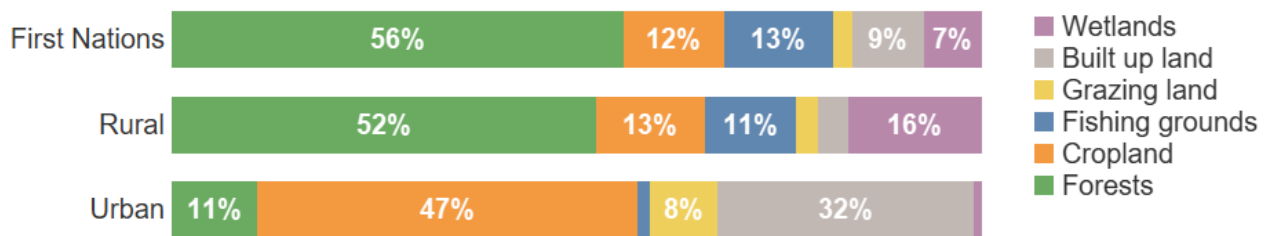


Figure 3. Proportion of Biocapacity by component.

Components of Ecological Footprint

The carbon component makes up the largest proportion of the Ecological Footprint for all community types (Figure 4 & Appendix II). This is similar to other Ecological Footprint accounts at the provincial, national, and global levels where the carbon component is typically the largest. The proportion of Ecological Footprint components are roughly the same across all community types. This is also similar to the proportion of the Ecological Footprint components for Ontario. While the proportional components are almost the same across community types, their total Ecological Footprint per capita may vary (Table 1).

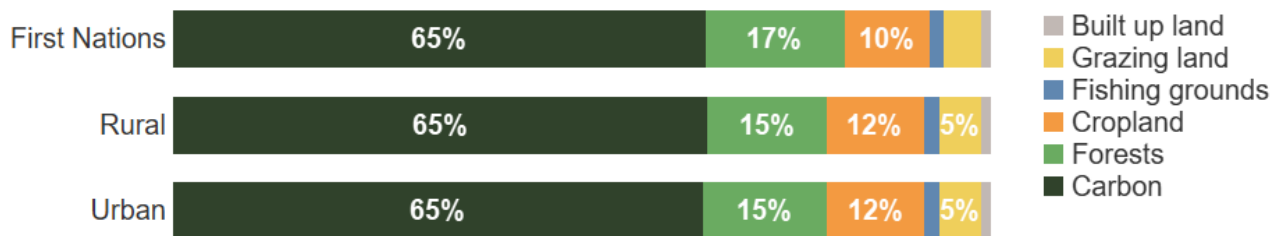


Figure 4. Proportion of Ecological Footprint by component.

Categories of Ecological Footprint

Ecological Footprint represents consumption by households and by government, along with resources consumed in the process of creating fixed capital. Household consumption includes clothing, furniture, healthcare, and education, along with repairs and maintenance for housing,

and energy used for heating and cooking. Fixed capital is the creation of durable infrastructure such as residential and commercial and industrial buildings, infrastructure for transportation and communications, and military equipment. Government consumption reflects resources consumed by government purchases of goods and services.

Household consumption is lowest in First Nations communities, however fixed capital consumption is higher than the other community types (Figure 5 & Appendix II). Rural and urban communities have similar patterns of household, fixed capital and government consumption.

Household consumption can further be broken down into subcategories of food, goods, housing, personal transport and services (Table 3). Interestingly, personal transportation makes up the largest proportion of household consumption for rural and urban communities and Ontario. First Nations communities have a larger proportion of consumption for food, compared to the other community types. This is offset by a smaller proportion of personal transportation for First Nations communities compared to rural and urban communities. The personal transportation subcategory is impacted by various scaling factors and ratios, including data on the duration of commuting and the commuting mode such as a personal vehicle or public transit (Dworatzek, P., et al., 2024). Proportions of the other household subcategories are similar across community types.



Figure 5. Proportion of Ecological Footprint by category of consumption.

Table 3. Proportion of household consumption subcategories.

Community types	Food	Goods	Housing	Personal transport	Services
First Nations	28%	12%	15%	22%	22%
Rural	21%	12%	16%	28%	22%
Urban	21%	13%	14%	30%	22%
Ontario	21%	13%	14%	29%	22%

Discussion

Community-level Ecological Footprint and Biocapacity accounts were derived by downscaling Ontario’s accounts. Downscaling was completed by creating scaling factors and ratios based on Statistics Canada 2021 census data, and other relevant Statistics Canada research and data

(Table 4). For more information on the scaling factors and ratios and how they were used, see Dworatzek et al. 2024.

Table 4: Data sources used to create Ecological Footprint scaling factors and ratios

Data Tables from Statistics Canada	Statistics Canada Source and Year
Income statistics for detailed income sources and taxes	Census 2021
Commuting duration by main mode of commuting time and arriving at work	Census 2021
Population and dwelling counts	Census 2021 and 2016
Structural type of dwelling and household size	Census 2021
Average household size	Canadian Housing and Statistics Program 2019
Average household energy use	Households and the Environment 2011
Seasonally adjust annual rates of gross fixed capital formation	Gross fixed capital formation 2024

Table 5. Comparing results from different methods

Community type/geography	Ecological Footprint (Gha/capita)
First Nations	4.7
Rural	6.3
Urban	6.4
Ontario (Dworatzek et al. 2024)	6.3
Ontario (Miller et al. 2021)	7.0

There are slight differences in the values for Ontario’s Ecological Footprint based on different methods (Table 5). The derivation of Ontario’s value from 577 municipalities results in an Ecological Footprint of 6.3 global hectares per capita, whereas Ontario’s value from the 2021 report was 7.0. This difference was expected partly because the 2024 method used primarily 2021 Census data whereas the 2021 method used earlier data sources. Additionally, each municipality’s Ecological Footprint was derived from scaling factors and ratios that were often based on averages. So, it makes sense that the results from these different methods are slightly different.

Summary and Next Steps

Sustainable development is not only a national or provincial responsibility. Municipalities and regions are also responsible for land use planning decisions, public transportation, emergency management, and waste management, and more issues that have an impact on the local environment. The impacts of climate change will be felt at the local level across Ontario. It can be difficult for communities to develop plans for sustainable development and climate action because of a lack of readily available information, especially for rural communities.

ROI's Community Wellbeing Dashboard presents indicators for Ecological Footprint and Biocapacity that provide insight into a community's consumption and how this relates to the environment. The results presented in the dashboard and in this report will help rural communities understand their ecological impact and facilitate plans for sustainable development and climate action.

We plan to update Ecological Footprint and Biocapacity accounts for communities regularly, whenever Ontario's accounts are updated and/or new Census data is released by Statistics Canada.

If you are interested in using Ecological Footprint and Biocapacity data to support decision making for your community, but are finding it difficult to apply or understand – we can help!

For more information and assistance, please contact the [Rural Ontario Institute](#) and/or the [Ecological Footprint Initiative](#).

References and resources

Dworatzek, P., Letang, D. Miller, E. Mandel, Y. (2024). [Methodological Handbook for Deriving Ecological Footprint and Biocapacity Accounts for Ontario Communities. Report. Prepared for the Rural Ontario Institute.](#)

Global Footprint Network

https://data.footprintnetwork.org/#/??_ga=2.242075393.2008521042.1686154008-1540145852.1647013906

Miller, E., Robinson, R., McMaster, M.-L., Holloway, E., and Kapoor, A. (2021). Ontario's Ecological Footprint and Biocapacity: Measures and trends from 2005 to 2015. Report submitted to the Ontario Ministry of Natural Resources and Forestry.

https://footprint.info.yorku.ca/files/2021/11/OntarioEFBreport_20211119.pdf?x61824

Rural Ontario Institute. [Community Wellbeing Dashboard](#). Published September 2024.

Appendix 1 – Factors influencing Ecological Footprint

Table A-1.1 Proportion of commuters by commuting mode.

Community type	Car, truck or van	Public transit	Walked	Other method	Bicycle
First Nations	83%	1%	14%	2%	0%
Rural	92%	1%	5%	2%	1%
Urban	82%	10%	5%	2%	1%

Table A-1.2 Proportion of commuters by commute duration.

Community type	Less than 15 minutes	15 to 29 minutes	30 to 44 minutes	45 to 59 minutes	60 minutes and over
First Nations	71%	14%	8%	2%	5%
Rural	41%	28%	16%	7%	9%
Urban	25%	35%	22%	9%	9%

Table A-1.3 Proportion of dwellings by dwelling size.

Community type	No bedrooms	1 bedroom	2 bedrooms	3 bedrooms	4 or more
First Nations	0%	9%	28%	41%	22%
Rural	0%	8%	23%	42%	27%
Urban	1%	15%	22%	33%	29%

Table A-1.4. Proportion of households by household size.

Community type	1 person	2 persons	3 persons	4 persons	5 or more
First Nations	24%	27%	16%	13%	20%
Rural	28%	40%	14%	12%	7%
Urban	26%	31%	16%	16%	10%

Table A-1.5 Proportion of dwellings by dwelling type.

Community type	Single-detached houses	Apartments	Semi-detached houses	Movable dwellings	Other dwellings
First Nations	91%	2%	4%	2%	0%
Rural	80%	15%	4%	1%	0%
Urban	54%	39%	7%	0%	0%

Appendix 2 – Components of Biocapacity and Ecological Footprint

Table A-2.1 Components of Biocapacity (global hectares per capita).

Community types	Forests	Cropland	Grazing land	Fishing grounds	Built up land	Wetlands
First Nations	7.5	1.7	0.3	1.8	1.2	1.0
Rural	16.5	4.2	0.8	3.6	1.2	5.2
Urban	0.1	0.4	0.1	0.0	0.2	0.0
Ontario	2.9	1.0	0.2	0.6	0.4	0.9

Table A-2.2 Proportion of Biocapacity by component.

Community types	Forests	Cropland	Grazing land	Fishing grounds	Built up land	Wetlands
First Nations	56%	12%	2%	13%	9%	7%
Rural	52%	13%	3%	11%	4%	16%
Urban	11%	47%	8%	1%	32%	1%
Ontario	48%	17%	3%	10%	7%	15%

Table A-2.3. Components of Ecological Footprint (global hectares per capita).

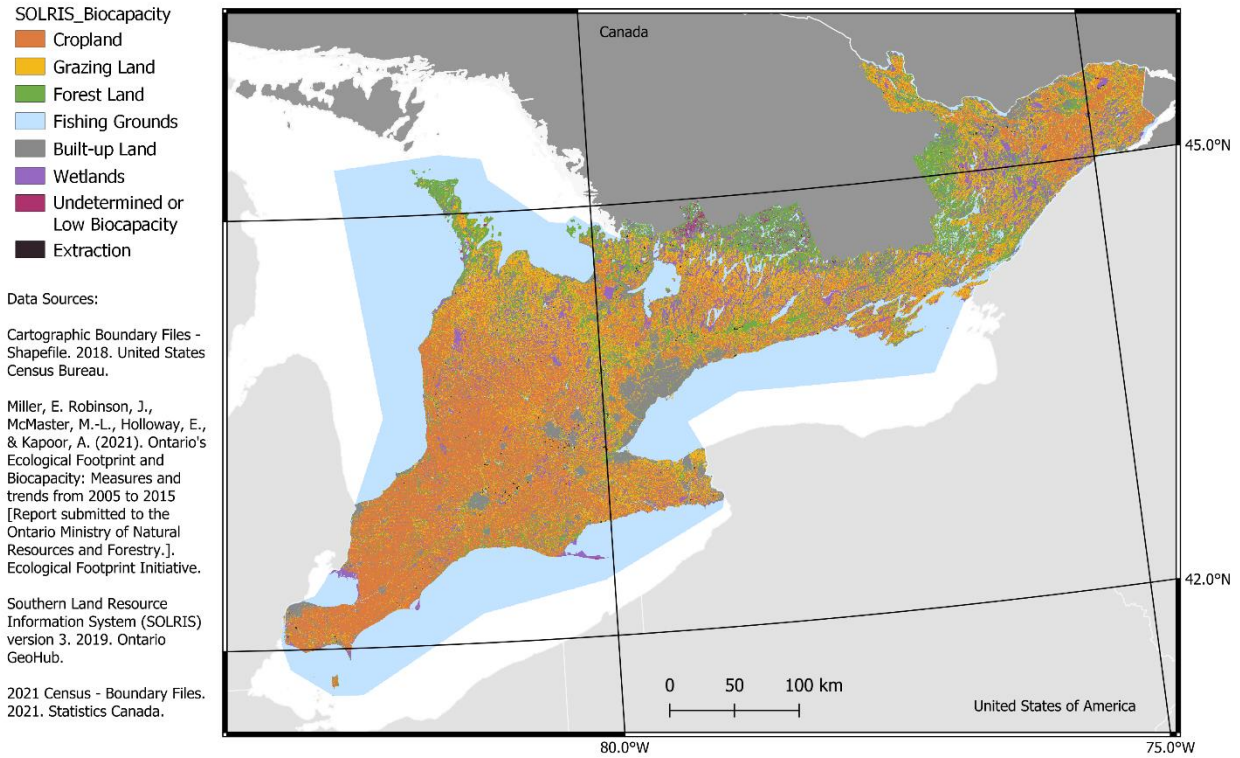
Community types	Carbon	Forests	Cropland	Grazing land	Fishing grounds	Built up land
First Nations	3.1	0.8	0.5	0.2	0.1	0.1
Rural	4.1	0.9	0.7	0.3	0.1	0.1
Urban	4.1	1.0	0.8	0.3	0.1	0.1
Ontario	4.1	1.0	0.7	0.3	0.1	0.1

Table A-2.4. Proportion of Ecological Footprint by component.

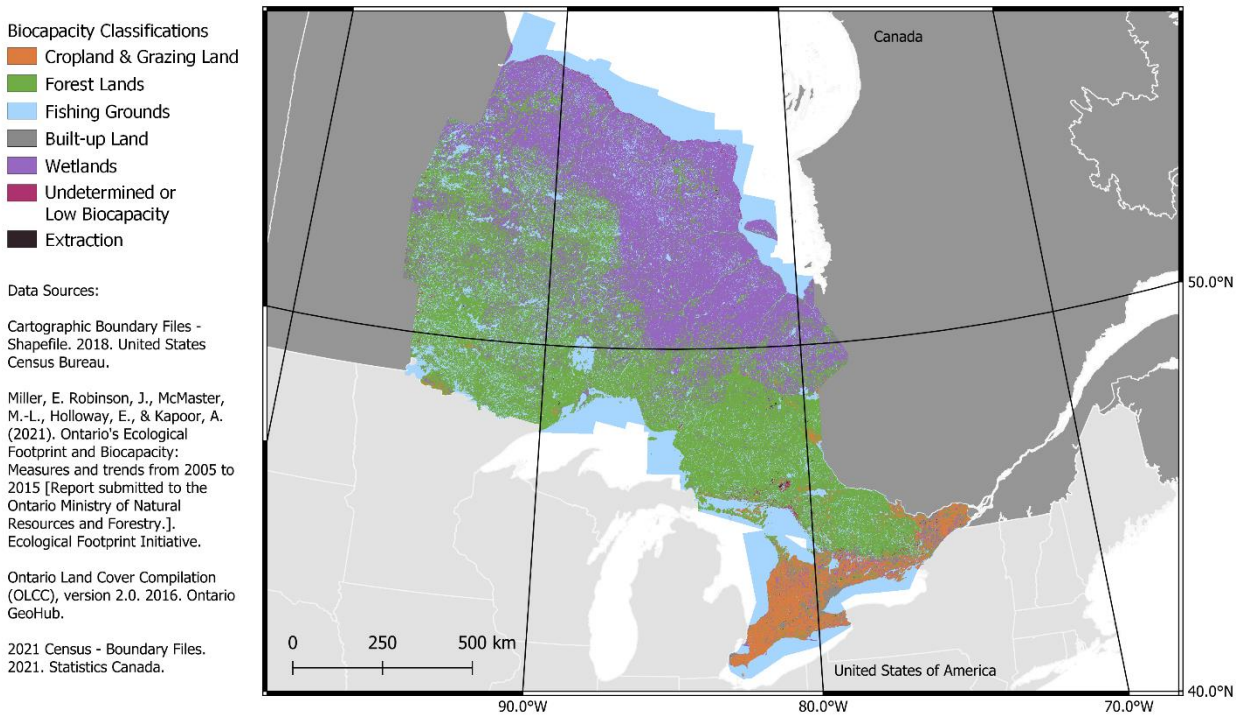
Community types	Carbon	Forests	Cropland	Grazing land	Fishing grounds	Built up land
First Nations	65%	17%	10%	5%	2%	1%
Rural	65%	15%	12%	5%	2%	1%
Urban	65%	15%	12%	5%	2%	1%
Ontario	65%	15%	12%	5%	2%	1%

Appendix 3 – Biocapacity maps

Map A-3.1. Biocapacity of Southern Ontario



Map A-3.2 Biocapacity of Ontario



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