Farmers' ecological motivations: implications for forestation in South Nation River watershed and Ontario's mixedwood plains ecozone

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Acknowledgement and dedication

I dedicate this major paper to all of the Indigenous nations who lived for millennia and still dwell on the land now known as southern Ontario.

The area where I live is known as Tkaranto, the meeting place, on land subject to the Dish With One Spoon Wampum Belt Covenant, a treaty established between the Anishinaabe, the Mississaugas of the New Credit, and the Haudenosaunee, through which they share and protect this territory and all the living things within it.

In what is now known as the South Nation River watershed, I pay respect to the Algonquin people, who are the traditional guardians of this land. I acknowledge their longstanding relationship with this territory, which remains unceded. I acknowledge their traditional knowledge keepers, both young and old, and honour their courageous leaders: past, present, and future. The Nation watershed is named after a small Algonquin nation that dwelt there, on both sides of the Ottawa River: along the Petite-Nation River in Quebec, and along the South Nation River in Ontario (Larose 1947, 103).

The British brought their rule and ways of life to Upper and Lower Canada after the Treaty of Paris with France in 1763. Soon afterwards, according to David T. Moorman: "Colonial officials in both London and Quebec abandoned their plans for the expansion of the French colony and the preservation of an extensive western Native reservation in favour of a British-style settlement, complete with a balanced constitution, common law, and free and soccage land tenure." (Moorman 1997, 5).

In 1783, Loyalists from the American Revolutionary War began pouring into Upper Canada from adjacent states. Lands designated to Indigenous peoples were ceded by the crown to settlers (Moorman 1997, 10; Bacher 2014, 3-8). Settlers received 200 acres of land and minimal supplies, as long as they cleared a proportion every year until 50% was cleared of trees and planted to crops (Moorman 1997, 21).

There is a long and tragic history of Indigenous contact with colonial powers. Chief George Johnston later died from a gunshot wound inflicted in 1873 while fighting loggers on Mohawk lands (Bacher 2012, 36). First Nations today comprise but a tiny proportion of the lands that the British Crown rightfully designated as theirs in 1763.

Remaining First Nation areas include the most forested areas of southern Ontario today, standing in stark contrast to colonially settled areas. One wonders how history would have unfolded had the extensive western Native reservation been established across Upper Canada. May we learn what Chief Johnston and others have taught and continue to teach us about the land, the trees, and their care.

Abstract

This paper investigates deforestation in southern Ontario's mixedwood plains ecozone. Farmers own much of the land in the mixedwood plains, thus forestation is examined through the lens of farmers' ecological motivations.

Two research methods are employed: an integrative literature review, and key informant interviews of farmers in the South Nation River watershed.

Firstly, farmers' ecological motivations on forestation in the EU, USA, Canada and Australia are examined via an integrative literature review of peer reviewed research. Various themes and issues are explored, which differ by region, policy, economic regime, and biophysical conditions.

Secondly, the South Nation River watershed in eastern Ontario is examined closely since it experiences accelerated deforestation in the early 21st century. Results of key informant interviews of farmers in the South Nation River watershed are presented and compared to literature review results, which are quite different.

Are tree-cutting by-laws effective at preventing deforestation? Experiences from other southern Ontario municipalities are compared to key informants' comments. Only one literature review article examined the role of regulations.

A main driver of deforestation in southern Ontario is urbanization. The literature review contains few references to urbanization. Adjacent eastern North American regions are examined and compared to southern Ontario's mixedwood plains.

Motivational crowding out is a concern in several literature review articles. The effects of motivational crowding out on farmers' intrinsic motivations are discussed when extrinsic conservation motivators are introduced. Motivational crowding out has consequences; programme design may minimize these.

Keywords: reforestation, deforestation, forestation, South Nation River watershed, farmers' motivations, mixedwood plains ecozone

Foreword

When I applied to the Masters in Environmental Studies (MES) programme at York University, I strove to find out what could be done about deforestation in the mixedwood plains ecozone of southern Ontario. I personally experienced southern Ontario's forest cover increasing to 25%, and I contemplate what further deforestation will mean to future generations.

This major paper is a key component of my MES plan of study. It includes an integrative literature review of farmers' motivations for forestation in OECD nations, and the results of qualitative, open-ended interviews with farm leaders in the South Nation River watershed, where deforestation is occurring.

Both address component two of my plan of study, which is to develop insights into farmers' motivations to ecologically conserve and/or restore their forested lands, and to gain an understanding of the political, economic, and ecological constraints and possibilities that farmers face when seeking to conserve and restore these lands.

My plan of study further explores whether payments for ecosystem services are effective in protecting forests and increasing forestation in agricultural zones. I found the answer to this question to be complex, with many qualifiers. In Canada, few payments exist. In the EU and the US, they consist primarily of government subsidies, often with competing goals and interests. Some of these complexities are discussed in this major paper.

I got a passion for reforestation when I was young. I reforested eroding clay slopes resulting from Highway 401 construction. In the creek valley where cows used to roam, I planted white pine intermingled with black walnut, replanting several times to achieve a stand. I was inspired by the history of the Ganaraska Forest and the formation of conservation authorities (Richardson 1944; Martin 2014). Low cost bare-root tree seedlings from the Orono Provincial Tree Nursery also helped. There is no erosion today, and surviving trees are fifty feet high.

My experiences as a horticulturist taught me that solutions to complex problems are often not technical, but socio-economic. These are the domains of the social sciences, which include political ecology, ecological economics, psychology, neoliberal economics, and more. They usually lie with people – their values, attitudes, motivations, and hesitance. Humans exert an enormous amount of control over nature. This is the core of my investigation.

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List of abbreviations

AES   Agri-Environment Scheme
AFCC   Agricultural Forest Cover Committee
ALUS   Alternative Land Use Services
BMP   best management practice
BPN   basic psychological needs
CAP   Common Agricultural Policy
CAPI   Canadian Agri-Food Policy Institute
CBD   Convention on Biological Diversity
CE   conservation easement
CLTIP   Conservation Land Tax Incentive Program
CRP   Conservation Reserve Program
ECCC   Environment and Climate Change Canada
EFP   Canada-Ontario Environmental Farm Plan
EGS   ecological goods and services
EOMF   Eastern Ontario Model Forest
EU   European Union
FAO   Food and Agricultural Organization
FCC   Farm Credit Corporation
GFO   General Farm Organization
GGH   Greater Golden Horseshoe
GHG   greenhouse gas [emissions]
IPCC   Intergovernmental Panel on Climate Change
MFTIP   Managed Forest Tax Incentive Program
NOAA   National Oceanic and Atmospheric Administration
NCED   National Conservation Easement Database
OECD   Organization for Economic Cooperation and Development
OMAFRA   Ontario Ministry of Agriculture, Food and Rural Affairs
OMECP   Ontario Ministry of the Environment, Conservation and Parks
OMNR   Ontario Ministry of Natural Resources
OMNRF   Ontario Ministry of Natural Resources and Forestry
OSCIA   Ontario Soil and Crop Improvement Association
PES   Payments for Ecosystem Services
PEI   Prince Edward Island
SDT   self-determination theory
SNC   South Nation Conservation Authority
UCFO   Union des Cultivateurs-Franco-Ontariens
UK   United Kingdom
UNFCCC   United Nations Framework Convention on Climate Change
US/USA   United States of America
USDA   United States Department of Agriculture

Glossary of terms

Additionality: If an activity or result would not have occurred without a specified policy intervention (Gillenwater 2012, 3-5), the activity or result is "additional" to a measurable baseline. This includes the consequences of the activity elsewhere (see leakage).

Afforestation is the conversion to forest of land that was historically not forest. The UNFCCC, in 2001, adopted this definition: *"conversion to forest of land without forest in the last 50 years"* (Puustjärvi et al. 2002). UNFCCC projects in Ontario employ this definition.

Deforestation is the conversion of forest to another land use, or the long-term reduction of tree canopy cover to below 10%.

Ecological goods and services are the benefits that humans obtain from ecosystems.

Extrinsic motivation is behaviour and action driven by external rewards, such as monetary or social acceptance, to achieve a *"separable outcome"* (Ryan and Deci 2000).

Forestation is the state of being covered with trees.

Intrinsic motivation, or internal motivation, occurs when a behaviour or action is motivated from within oneself, without any extrinsic or external satisfactions or rewards. These could arise from the basic psychological needs of competence, autonomy and relatedness (Deci and Ryan 2008), or other intrinsic motivation.

Leakage occurs when ecosystem benefits at one location result in ecosystem degradation at another location. Leakage needs to be subtracted from any additionality.

Mixedwood plains ecozone is an ecozone in southern Ontario and southern Quebec that, in Ontario, encompasses two-thirds of southern Ontario and Manitoulin Island (Map 1).

Motivational crowding out is the undermining of intrinsic motivations for performing a behaviour when extrinsic incentives are provided to perform that same behaviour.

Net deforestation equals the rate of afforestation and reforestation less the rate of deforestation.

Reforestation includes natural regeneration and/or human replanting of forests in locations that were once forested. This major paper employs "reforestation" in the mixedwood plains.

Southern Ontario is that portion of the province south of the districts of Muskoka and Haliburton, and Algonquin Park. The mixedwood plains ecozone in Ontario is almost geographically equivalent to southern Ontario.

The South Nation River watershed is a large watershed located in the mixedwood plains ecozone in eastern Ontario between Brockville, Cornwall, and Ottawa (Map 2). The South Nation Conservation Authority's jurisdiction is slightly larger than the actual watershed.

INTRODUCTION

This paper investigates deforestation occurring in the 21st century in southern Ontario's mixedwood plains (Map 1) and how it can be reversed.

My research focuses on agriculture's impact on this deforestation. Farmers play a decisive role in the ecology of Ontario's mixedwood plains ecozone. Farmers rent or own approximately 60% of the land. They thus have agency over their ecosystems and have a huge impact on how these ecosystems are shaped (Bowley 2015, 23; Dunkin 2008, 47-56). Private land comprises 85% of the remaining forest land of Ontario's mixedwood plains ecozone. 81% of active farms and 92% of non-active farms include significant forest areas on their property, averaging 27% and 74% of their total land area respectively (Neave and Wolthausen 2004). My research questions include:

1. What hinders and motivates farmers to preserve and/or plant forests?
2. What, if any, are the differences between farmers' positions on forestation in southern Ontario's South Nation River watershed and farmers in other jurisdictions?
3. What does the situation in southern Ontario's South Nation River watershed add to the wider scholarly and policy literature?
4. What lessons do the scholarly and policy literature hold for southern Ontario's mixedwood plains ecozone?

The first chapter provides a historical background to forestation in the mixedwood plains ecozone of southern Ontario and in the South Nation river watershed, where key informant interviews with farmer leaders took place.

The second chapter summarises a literature review of farmers' motivations towards forestation in OECD nations, and attempts to integrate the findings.
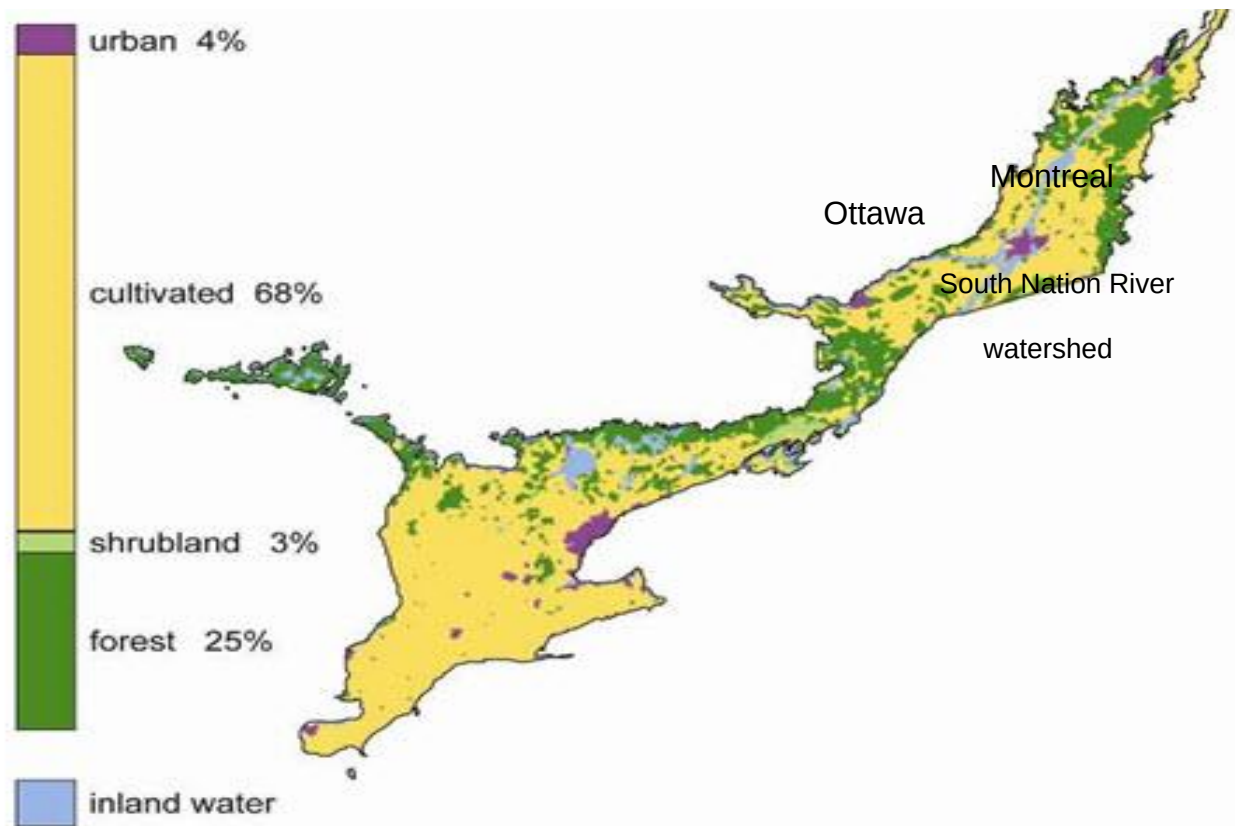
Map 1 − Canada's mixedwood plains ecozone Source: ESTR Secretariat. 2016. Mixedwood Plains Ecozone+ evidence for key finding summary. Canadian biodiversity: ecosystem status and trends 2010, Evidence for Key Findings Summary Report No. 7. Ottawa (ON): Canadian Councils of Resource Ministers. x + 145 p. [accessed 2021 Oct 1]. https://biodivcanada.chm-cbd.net/ecosystem-status-trends-2010/mixedwood-plains-summary p. 4, fig 3. Scale = 1:6,000,000.

Large-scale deforestation is occurring in the 21st century in the South Nation River watershed in eastern Ontario. In chapter three, I summarize the results of my engagement with seven farm leaders in the area, expressing their views on forestation, stewardship, and ecological values.

Chapter four is a general discussion of themes arising out of the integrative literature review and results of key informant interviews in the South Nation River watershed. Deforestation in adjacent regions is compared to deforestation in southern Ontario's mixedwood plains ecozone. The effects of motivational crowding on payments for ecological services are examined. In conclusion, the implications of my findings on proposed policy are discussed.

CHAPTER 1 − 20ᵀᴴ CENTURY REFORESTATION FOLLOWED BY 21ˢᵀ CENTURY DEFORESTATION

20th century reforestation and 21st century deforestation in southern Ontario's mixedwood plains

Land clearing and settlement, and their ecological consequences, are well documented (Butt et al. 2005; Bacher 2011, 2012; Bowley 2015, 24; Dunkin 2008). Concern over deforestation was already raised in the 19th century, which led to the passage of the *Act to Encourage the Planting of Trees Along Highways* (1871) and the *Ontario Tree Planting Act* (1873) (Zavitz 1939). These laws did not interfere with private land tenure established under British rule. The province subsidized the planting of shade trees, at $0.25 per tree, along the road allowances that settlers had been required to clear. 75,000 trees were thus planted by 1896 in an effort to reduce wind erosion (Dunkin 2008, 51-53).

Farmers were prime motivators in the reforestation of southern Ontario in the early 20th century. By 1906, bankers were upset that southern Ontario's natural capital, its trees, were gone. Many farms were ruined by soil erosion, and sandy soils had turned into deserts. Bankers and farmers together convinced the government of the day to plant trees (Nelles 2005, 187-192; Bowley 2015).

In 1937, London, Ontario experienced a major flood. As a result, Conservation Authorities were established in 1946 (Chant 2017), employing returning servicemen in reforestation (Bacher 2011; Zavitz 1961). In 1954, Hurricane Hazel swept through Ontario, leaving 81 dead and $1.3 billion in damage in 2020 dollars (MacLeod 2020). Following this, the *Conservation Authorities Act* was strengthened to acquire and regulate lands.

In the 20th century, southern Ontario's forest cover thus increased from 5% to about 25% (Riley 2013, Fig. 15). For example, forest cover today ranges from 5% in Essex County

to 35% in Grey, Simcoe, and Northumberland Counties (MacDonald et al. 2018, Table 2). The issues of wind and water erosion, droughts, flooding, loss of timber wood products, and general economic losses caused by deforestation began to be addressed. However, the ecological and economic quality of that secondary forest growth is less than that of the original forests (Keddy and Drummond 1996; Rideau Valley Conservation Authority 1999; Flinn and Marks 2007). Many years are required for biological diversity and forest quality to increase.

By the late 20th century, reforestation reverted back to deforestation. The direct causes of this deforestation include agriculture and urban growth (Environmental Commissioner of Ontario 2018, 55). Other causes include loss of government support for reforestation (Private Land Reforestation Alliance 1996; Los 2010) and strong world agricultural commodity prices. Southern Ontario's mixedwood plains ecozone is now deforesting at a rate of 700-1200 hectares a year, after reforesting from approximately 10% to 25% forest cover in the 20th century. From 2000-2005, we lost 3324 hectares (33.24 km.^{2}) and from 2006-2011, we lost 3786 hectares (37.86 km.^{2}).

A history of reforestation and deforestation in the South Nation River watershed
The South Nation River watershed (Map 2) was settled by United Empire Loyalists and Scottish immigrants (Larose 1946, 106). The formerly forested area was soon cleared. By the mid-20th century, forest cover stood at 28.5%, of which productive forest lands were only 7.2% (Larose 1946, 108). Larose carefully documents the damage that this deforestation caused up to 1946, including wind and water erosion, clay slides, shoreline erosion, and deterioration of bogs and wetlands from burning and ditch construction (109). In 1947, the South Nation Conservation Authority (SNC) was established (SNC 2016) and the region began to be reforested (Piltz 2018, 28-29; SNC 2014).
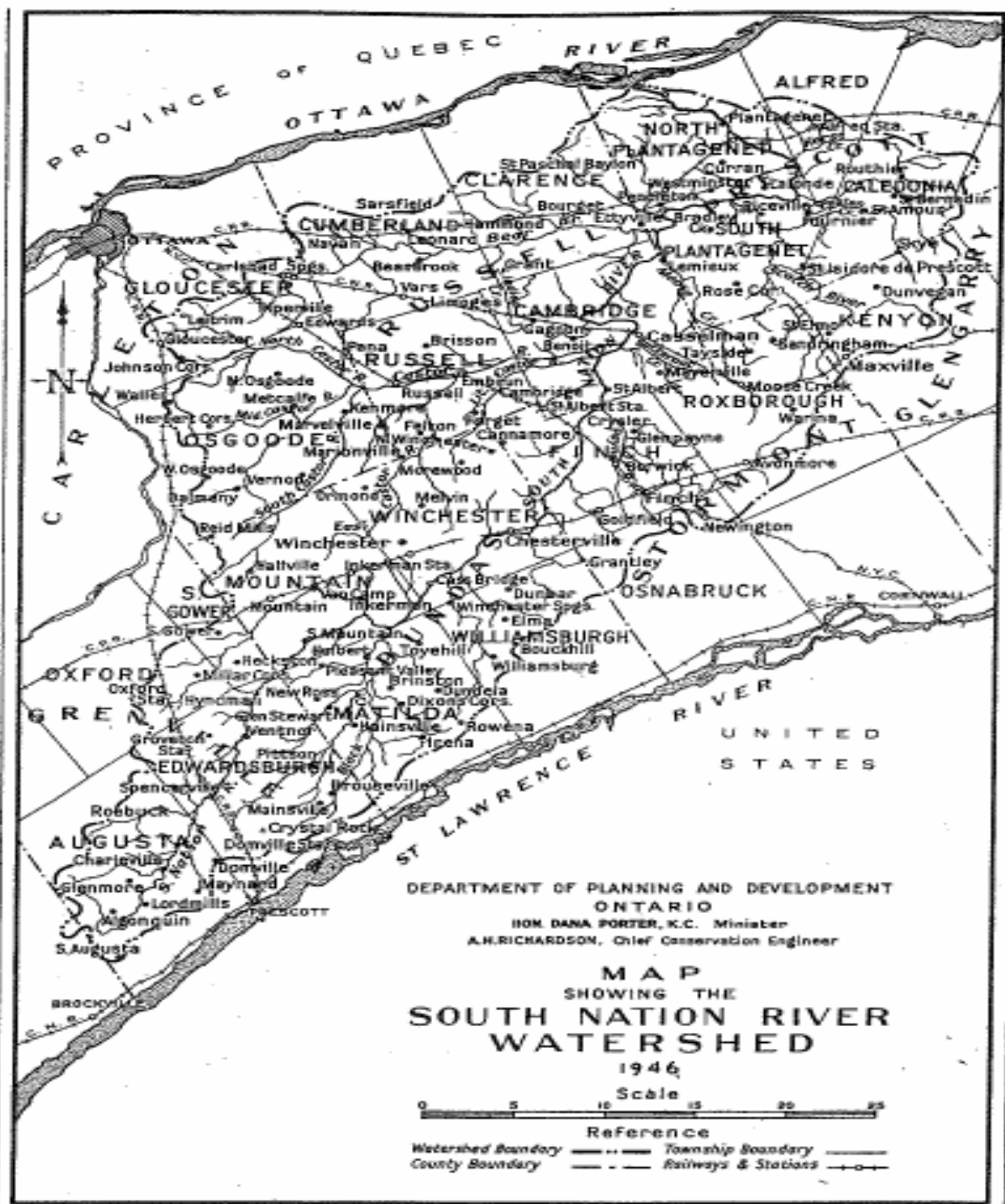
Map 2 − South Nation River watershed 1946 Source: Larose F. 1946. The South Nation and Its Environs. In: Conservation in Eastern Ontario. Toronto (ON): King's Printer. 132 p., p. 106.

In the 21st century, this has been reversed to net deforestation. The South Nation watershed has deforested for several decades (Mesman 2016; Noteboom 2020). Forests continue to be removed in 2021 (Carroll 2021; Van Dusen 2021). Our society ignores ecological values and considers 'highest and best use' as an effective land use policy (Appraisal Institute 2020). Several factors around the turn of the 21st century contributed to changing the relative economic value of standing forests versus cleared land:

1. A devastating ice storm in 1998 caused major tree damage in woodlots across eastern Ontario, southern Quebec, and New England (Hopkin et al. 2003).
2. Emerald ash borer is killing mature ash trees. Ash are a predominant species in the region, found in fence rows, wet and riparian areas (Streit et al. 2012).
3. Demand for pulpwood, including pulp from hybrid poplar plantations, ended with Domtar's Cornwall mill closure in 2006 (Barkley and Lawn 2005, 50).
4. Farm commodity price rises are increasing the demand for farmland (El-Khoury et al. 2014, 509; FCC 2021b). Federal subsidies (Cheadle 2016; Natural Resources Canada 2018) and provincial policies requiring 10% biofuel in gasoline and diesel (OMECP 2020) contribute to this demand. Over one third of Ontario corn was manufactured into ethanol in 2020 (Montgomery 2020).
5. Urban growth continues, both locally and primarily in the Greater Golden Horseshoe (GGH). Many hectares of valuable class 1-3 farmlands are being permanently removed from agriculture (Cocklin et al. 1983; Troughton 1983; Tomalty 2015; Caldwell and Epp 2017; Environmental Commissioner of Ontario 2019, 128-175).

Between 2002 and 2008 the watershed deforested by 510.9 hectares per year. This accelerated to 890 hectares annually from 2008 to 2014 (Mesman 2016). This rate is greater than the net deforestation rate for all of southern Ontario from 2006 to 2011, 757.2 hectares annually (Environmental Commissioner of Ontario 2018, 55).

How deforestation became a recent issue in the South Nation River watershed

The State of the Nation report (SNC 2014) and the preliminary Forest Cover and Trends Analysis (2014) drew attention to the increasing deforestation in the region. When a second report (Mesman 2016) was released, the SNC decided to establish the Agricultural Forest Cover Committee (AFCC). The AFCC met for several months in 2017 and issued a preliminary report in June (SNC 2017; Tessier-Burns 2017c) and a final report in 2018 (SNC 2018).

As forests were clearcut within the region in the early 21st century, both individuals and organizations have drawn media attention to this deforestation (Brunette 2017; Carroll 2021; Tessier-Burns 2017a, 2017b, 2017c; Sproule 2017; Sproule 2018; Sproule 2019; Van Dusen 2021). No action has resulted, except in the municipality of Alfred-Plantagenet, which is considering a tree-cutting by-law (Babin 2021; Masson R. 2021).

Why deforestation matters, and how farmers can contribute to forestation

Ecosystem benefits of forestation

Forests and wetlands provide the greatest ecosystem benefits per unit of area to society (Wilson 2008a, 31-32; Wilson 2008b; Dupras et al. 2016; L'Ecuyer-Sauvageau et al. 2021). Forests provide multiple ecological benefits, including (but not limited to):

1. ecosystem goods, including lumber, pulpwood, firewood, fencing materials, maple syrup, and Christmas trees,
2. ecosystem services, including flood protection,
3. wind and water erosion reduction,
4. habitat for wildlife, including native endangered species,
5. recreational opportunities,
6. mitigation of nitrogen, phosphorus, manure, and pesticide runoff,
7. climate regulation,
8. positive psychological effects for both humans and non-human species, and
9. carbon sequestration.

Some of these benefits were not obvious or of concern during 20th century reforestation efforts. Those that were previously of concern − flood protection, reduction of wind and water erosion, and the mitigation of agricultural runoff − are of greater concern in the 21st century because climate-change can accentuate harm (El-Khoury et al. 2014; El-Khoury et al. 2015; Feltmate and Moudrak 2016).

The ecological costs of not addressing deforestation are large. Preservation and ecological restoration of farm remnant woodlots, wetlands, and riparian areas on southern Ontario farms can benefit the planet and human health and wellbeing, including the farmers dwelling on that land (McGauley et al. 2004; Newton et al. 2021).

Scientists recognize the importance of private lands in conservation efforts (McCune et al. 2017; Olive and McCune 2017). Preserving the last farm woodlots can contribute to preserving endangered species and their habitat. Most of our watersheds have less than the 30% forest cover recommended for healthy ecosystem function (Environment Canada 2013).The mixedwood plains region of Canada is one of the most densely populated and least protected areas of Canada (Kraus and Hebb 2020). Less than 1%, just over 66,000 hectares, of this region is protected (OMNR 2011) and one third of Canada's species at risk (144 species), are located in this area (ECCC 2015).

Greenhouse gas mitigation – an important 21st century reason for forestation
Canada's Paris Accord commitments call for significant reductions in greenhouse gases (GHG), of which forest management plays an important role (Magnus et al. 2021). One hectare of mature trees can absorb 6.4 tonnes of CO_2 per year (CCFM 2018). Increasing forest cover in southern Ontario's mixedwood plains by 10% (849,780 ha) could sequester 5.43 million tonnes of CO_2 per year several decades hence, when that forest begins to mature.

The Intergovernmental Panel on Climate Change (IPCC), in its Fifth Assessment Report, recommends that:

The most cost-effective [GHG] mitigation options in forestry are afforestation, sustainable forest management and reducing deforestation, with large differences in their relative importance across regions... About a third of mitigation potential in forestry can be achieved at a cost <20US$/tCO2-eq emission. [Working Group III Summary for Policy Makers 4.2.4]. (IPCC 2014, 102).

Human impacts on forests and agriculture are responsible for a quarter of anthropogenic climate change (Kupfer and Karimanzira 1990, 77; IPCC 2019, 11). Since 1850, one-third of net CO_2 emissions into the atmosphere have originated from forest clearing (Rhemtulla et al. 2009). Carbon sequestration is an important reason for increasing and correctly managing forest cover (Waring et al. 2020). How we manage our forests and agriculture will impact how climate-change proceeds or is mitigated.

Besides sequestration, carbon conservation and carbon substitution are equally important (FAO 2001). Carbon conservation means keeping sequestered carbon in the soil, wetlands, and forests. Carbon substitution involves employing lower emission carbon-based products (e.g. wood, fibre) in lieu of those with higher emissions (e.g. concrete, brick, steel).

In general, the carbon sequestration potential of wetlands is greater than forests, which is greater than native prairies, which is greater than cultivated soils (Table 1). All of the above require correct management to maximize sequestration potential (Bird and Boysen 2007; Henschel and Gray 2007; Rhemtulla et al. 2009; Bellassen and Lussaert 2014; Kane 2015; Griscom et al. 2017; Voicu et al. 2017; Smukler 2019; Wilson and Green Analytics 2019; Weber 2020).

In 2007, a new tree planting project was announced to plant 50 million seedlings on private lands in southern Ontario by 2020. This project plans to sequester 6.6 million tonnes of CO^2 by 2050 (Parker et al. 2009). Formerly a provincial program, it is now federally financed and executed by Forests Ontario (Forests Ontario 2021; Syed 2019a, 2019b).

Table 1 − Estimates of carbon sequestration potential in temperate zones

ecotype	tonnes/hectare/year	source:
wetland	47.34	Stan KD 2019, 15
temperate forest	0.7 – 7.5	FAO 2001
mature forest	6.4	CCFM 2018
urban forest	2.8	Nowak et al. 2013
forest	1.4	Wilson and Green Analytics 2019
native prairie	0.74 – 4.2	Tallgrass Ontario 2020
cultivated soil	0.56 – 1.15	Zomer et al. 2017, Table 1

Bird and Boysen (2007) did the initial research for this. They found that 309,878 ha. could be planted by 2025 if planting costs were paid. Uptake would be 415,432 hectares, if an additional $25 per hectare was provided every year. If $125 was provided every year, marginal returns would decrease, since only 451,221 hectares would go into plantation. The mixedwood plains would encompass 92.5% of these seedlings (Bird and Boysen 2, Table 1).

The final proposal to OMNR was to provide money to plant 25% of 309,878 ha. at 5,000 ha. per year, comprising 84,000 ha., at a budget of $79 million (Los 2010). By 2020, 16,500 hectares had been planted (Forests Ontario 2021).

This programme is premised on recipients possessing the intrinsic motivation to plant low cost trees. Two studies on this programme to date (MacDonald et al. 2018; 2020) assume that farmland is a prime location for these trees. Farmland rental rates were researched, but not whether recipients of the trees were full-time farmers, part-time farmers, or non-farmers. It is not known if any trees are planted on rented land. The percentage of rented farmland in Canada is 40% and increasing (Weersink 2018, 38). In areas of higher land rental rates, participation rates were lower (MacDonald et al. 2018, 228).

Non-farmers often have time, financial resources, land, and personal risk available to put to long term tree planting (Forests Ontario 2015). 55% of participants in the 50

million tree project are non-farmers, while farmers comprise 45% (MacDonald et al. 2020). It is not known why farmer participation rates are less than non-farmers.

Non-farmers play an ever increasing role in rural southern Ontario life (Milburn et al. 2010; Milburn 2011). They also play an important role in conservation (Moon and Cocklin 2011a, 2011b). The changing socio-economic fabric of society may affect farmers' attitudes towards conservation. This has not adequately been explored. Farmers today comprise 2% of Canada's population (Milburn 2011, 1).

How farmers can contribute to forestation

Farmers play a decisive ecological role in Ontario's mixedwood plains ecozone. Farmland comprises approximately 60% of the land (Crins et al. 2009, 48, 51), while non-farm private landowners own 30%. Public lands, including parks, conservation and protected areas, as well as highways, utility corridors and institutional lands, constitute the remainder of this ecozone.

Before settlement, the mixedwood plains were about 90% forested (Riley 2013, Fig. 15). Wetlands, remnant woodlots, and riparian areas located on the non-cultivated portion of farms can be ecologically restored to the benefit of both farmers and society (Soil Resources Group 2000; Lefebvre et al. 2011; Medland et al. 2020).

Agricultural landowners can contribute in several ways towards forest conservation. They can keep their existing woodlots and fence rows intact, and they can consider planting trees on riparian sites, slopes, and poorly drained land that is relatively unproductive as cultivated soil. Where woodlots have deteriorated from pest invasions such as the emerald ash borer, they can speed up natural succession processes by planting appropriate species to replace the damaged trees.

Well-managed woodlots may provide more farm income than competing corn/soy/hay/wheat rotations (Schwan et al. 2013). This can diversify farm operations,

and should be considered before a decision is made to clear the woodlot, install tile drainage, and plant a crop.

Ecosystem dis-services also need consideration

One issue overlooked by ecological economists is ecosystem dis-services. Existing woodlands and reforestation projects could have negative effects (ecosystem dis-services) on agriculture (Zhang et al. 2007; Lele et al. 2013; Luck 2013).

The net ecological benefits of reforestation usually outweigh negative effects, but ecosystem dis-services must be considered in the design of successful restoration and replanting projects. Some species and habitats can harbour pests, invasive species, diseases, or environmental conditions dangerous to specific agricultural crops.

Farmers must have a certain tolerance to "nuisance nature" (Goodale et al. 2015). Their relationship to wildlife is complex. They always need to consider both the ecological positives and negatives surrounding their farms. Protecting crops usually comes before the promotion of wildlife habitats, and when there are conflicts, crop protection usually wins out.

When land use is modified, owners and neighbours will be the first to know which ecosystem dis-services can come into play. Fence rows and riparian areas are beneficial, but species present could pose harm to some crops. Crop-dependent potential conflicts can arise, thus ecosystem enhancement projects must be planned and executed carefully.

CHAPTER 2 - INTEGRATIVE LITERATURE REVIEW OF FARMERS' MOTIVATIONS FOR FORESTATION IN OECD NATIONS

Methodology and rationale

What is an integrative literature review?

There is no single definition or methodology of an integrative literature review. Integrative literature reviews attempt to integrate the findings of previous researchers, and synthesize results, with new knowledge, insights or frameworks of understanding the topic (Torraco 2016, 62).

Torraco (2005; 2016) describes two occasions for integrative literature reviews: "mature topics, or new, emerging topics" (2005, 357). In this review, the field is mature. Farmers' motivations regarding conservation and ecological restoration have been researched extensively since the 1990's (see e.g. Beedell and Rehman 1999; Knowler and Bradshaw 2007; Greiner 2015). According to Torraco (2005), analyses provided by a systematic review can potentially reformulate and provide new directions or methods to examine a subject (357-364).

Meta-analyses and literature reviews are available on various aspects of agricultural ecosystem services (Lahiri 2012; Wauters and Mathijs 2014; Cetas and Yasué 2017; Pritzlaff 2018). They deal with farmers' best management practices (BMP's) (Baumgart-Getz et al. 2012; Yanni et al. 2018), conservation initiatives (Hardy 2018; Tanguay et al. 2020), and others. No meta-analyses or literature reviews were found on farm forestation in the OECD.

Purpose of this integrative literature review

The first data set for my research includes published articles on farmers' motivations to establish and/or restore forested landscapes in OECD nations. This will serve as a basis

of an investigation into deforestation in the South Nation watershed in eastern Ontario, a rural exurban, predominantly agricultural watershed. Based on the results of this integrative review, questions will be formulated to pose in open-ended interviews with farmers in the South Nation watershed in eastern Ontario.

This integrative review examines what the literature concludes about farmers' motivations − the relationships between intrinsic and extrinsic motivations, particularly by farmers towards forestation. Motivational issues are often complex. Before policies and programmes can be designed to address ongoing deforestation, it is necessary to understand which motivations predominate and how they interact.

Literature search method
The following search methods, filters, and criteria were applied:

1. Keyword search categories included:
   a   farmer identifiers,
   b   action identifiers, and
   c   result identifiers
2. Search filters applied included: advanced search, peer review, full text, after 1990.
3. Keywords used included:
   a   farmer, agriculture,
   b   motivation, intrinsic, extrinsic,
   c   silviculture, forest, forestry, reforestation, deforestation, afforestation, forestation.
4. Search engines employed were York University Library, Proquest, JSTOR, EBSCO, Web of Science, and ProQuest Dissertations & Theses Global.
5. Peer-reviewed, published primary research focusing on OECD countries was included.
6. Theses were included if significant new work was presented and not published elsewhere.

7. Grey literature was included if it is primary research and demonstrates a lack of bias.

An extensive literature search was completed in April 2021. Out of 1500 search results, 21 relevant articles were identified. The flow chart (Appendix, Figure V) describes the inclusion and exclusion methods employed.

1. 53 articles were saved on a citation manager for in-depth analysis.
2. A further 32 articles were eliminated based on the above filter criteria (Appendix, Figure V).
3. 21 articles remained in the in-depth analysis, which address the effects of farmers' motivations on farm forestation in OECD nations.
4. One thesis (Iverson 2018), on woodland creation in upland Cumbria, UK, was included since it provides significant new findings on farmer motivations towards upland woodland creation.
5. Grey literature was not identified by the search.

The theoretical framework the author(s) employed, conflicts between intrinsic and extrinsic motivators, and descriptors or modalities other than "motivation" were noted in the review. Policy and other implications of research findings were noted.

Findings of the literature review

Frequency of research over time

Figure I in the appendix displays the frequency of selected articles from 1990-2021. Research increased over time, peaking in the mid-2010-2020 decade. This was the decade that the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement was signed, the Convention on Biodiversity's Aichi Biodiversity targets were set, including forest conservation targets (CBD 2020), and the Millennium Development Goals (MDGs) targets were set for 2015.

Location of research

Most research on farmers' motivations to establish and restore forested landscapes occurs in the European Union (EU), where the Common Agriculture Policy (CAP) subsidizes ecological integrity and restoration through transnational payments. The EU in particular employs "multi-functionality" as a narrative to continue to subsidize agriculture, while focusing on non-productivity ecosystem values before farmers qualify for subsidies (Regulation (EU) No 1307/2013, Ch. 3, Art. 43-47).

Estonia, the Czech Republic, and Romania, all newer EU members, were studied before and after joining the EU. The effects of CAP payments upon both agriculture and ecosystems were researched. Romania is included even though its membership in the OECD is pending; it represents a range of EU nations, and is an eastern European nation that joined the EU in 2007.

Studies included Italy, Norway, and Flanders, and cross-nation studies that included the non-EU nations of Switzerland and Turkey (Schlueter 2008). The UK is represented here within the EU (Iverson 2018) since it has not left the EU.

The next largest group of research is from the USA, where agricultural subsidies exist, but where few payments exist for reforestation or forest preservation (USDA Farm Service Agency 2021). Municipal forest tax breaks are available in many eastern US states (Kauneckis et al. 2009; Schram et al. 2021; Starr et al. 2015).

Two studies on farm forests were sourced from both Michigan and Indiana (Farmer et al. 2011; Kauneckis et al. 2009; Ryan et al. 2003; Schram et al. 2021). Two other studies (Caputo and Butler 2017; Dayer et al. 2018) analyzed eastern US forests. An experimental study conducted on college students was included (Howard, 2020) because of his conclusions on the effects of agricultural subsidies on farmer motivations.

Canada and Australia are represented by two (Truax et al. 2015; Quartuch and Beckley 2014) and one study (Yasue et al. 2020) respectively. In the appendix, Figure II illustrates the frequency of studies in all geographical locations.

Theoretical frameworks employed by the literature

A variety of theoretical frameworks were utilized by the selected researchers.

Two European studies were based on the EU's adoption of landscape multi-functionalism (Lapka et al. 2011; Galluzzo 2015). European studies also emphasize socio-ecological systems (SES), including historical and cultural elements (Borremans et al. 2016; Hartel et al. 2016).

Two researchers used Ajzen's (1991) Theory of Planned Behaviour, and Fishbein and Ajzen's (2010) Theory of Reasoned Action in their approach (Dayer et al. 2011; Borremans et al. 2016). One study (Quartuch and Beckley 2014) was based on grounded theory, one on phenomenological data analyses (Farmer et al. 2011) and one on Deci and Ryan's (2008) self-determination theory (SDT) (Yasué et al. 2020).

Ecosystem service values were the framework for Caputo and Butler (2017) and Iversen (2018). Ecological and biological frameworks were present in Truax et al. (2015), Roellig et al. (2016) and Schram et al. (2021).

Two unique research studies include Schuetler (2008), who looked at private European forest utilization via property rights theory, and Howard (2020), who modelled the existence of payment for nothing (P4N) and the crowding-out effects of farmer payments using economic laboratory experiments with students.

A number of US studies (Hardesty et al. 1993; Ryan et al. 2003; Kauneckis and York 2009; Starr et al. 2015; Schram et al. 2021) did not mention the theoretical frameworks underpinning their research. Most of them were mixed-method surveys of farmers and

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landowners that stated their research methods, such as Dillman et al. (2009), but not the theoretical basis of the research. Their research questions were sociological, involving analysis of existing data or survey results to determine farmer motivations regarding forest and and/or riparian management practices.

Research focuses of the publications

Appendix, Figure III illustrates the frequency of key themes identified in the literature review.

Figure IV in the appendix depicts the word frequencies of key words. This format is used to report word frequency: "Key word" (total words/total number of articles containing this word).

"Forest" (3084/21) as well as its complement, "woodlands", were predominant in all 21 articles. "Farmer" (838/20) and "agriculture" (213/20) were used in 20 articles, and "rural" in 17 articles. The word "economic" (593/21) is common to all studies. Ecological terms are not as frequent: "ecosystem" is mentioned (498/16), "ecology" (97/14), "riparian" (91/11), "carbon" (8 articles), "sequestration" (6 articles), "endangered" (8 articles), and "climate change" (6 articles).

Words identifying private land: "landowner" (659/17) and "private" (384/17) were frequent. Four EU studies did not mention private land at all (Galluzzo 2015; Borremans et al. 2016; Hartel et al. 2016; Roellig et al. 2016).

"Motivation" is a word common to most studies (341/20). Descriptors of motivation may include "recreation" (204/16), "family" (184/14), "community" (168/16), "payment" (143/13), "voluntary" (132/10), "education" (110/15), "adoption" (72/11), "health" (56/11), "intrinsic" (51/9), "extrinsic" (36/8), "easement" (45/5), "multifunctional" (37/7). Word usage needs to be read in context before exact conclusions can be drawn from frequencies. For example, "education" could be employed in surveys of farmer's

education levels, or in forest management education; "health" could be human or forest health.

Four studies did not focus on intrinsic or extrinsic motivations. Farmer education (Dayer et al. 2018; Starr et al. 2015) ecosystem services (Caputo et al. 2017; Truax et al. 2015) and biological and ecological integrity (Truax et al. 2015; Starr et al. 2015), were researched.

Key themes arising from the literature review

Findings varied across study purpose, research question, methodology, legal and socio-political structure, and region. Here are some trends from the findings:

1. Motivational issues occupied over 80% of the research. This is across regions where payments and subsidies exist and where these payments do not exist. The relationships between values, perceptions, attitudes, and motivations, between intrinsic and extrinsic types of motivations, and ensuing actions (or lack of them) by farmers preoccupied the research questions. These were framed into various theoretical frameworks. The frameworks depended on the research question being examined.

2. Only one study (Quartuch and Beckley 2014) included regulations in the research question, and several others considered the role of regulations (Mitani and Lindhjem 2015; Kauneckis and York 2009; Iverson 2018). This is not to say that regulations are not important. Regulations are present in all countries, more in some regions than others. The strength and enforcement of those regulations varied, from Norway (Mitani and Lindhjem 2015) to Romania (Nichiforel 2010).

3. Economic factors play a role in all regions, whether payments, subsidies or tax reductions exist or not. Four eastern European studies suggest that while farmers' intrinsic motivations are important, EU subsidies have aided farm populations to remain on the land and thus preserve both their livelihood and the ecological integrity of those regions. These results may be applicable to regions such as those experiencing depopulation and/or farm poverty.

4. Social-ecological and political factors facing farmers are rarely examined. Exceptions include European studies of social-ecological systems (SES) (Hartel et al. 2015; Lapka et al. 2011).

5. The lands studied were private. The implications of this are:

   a   Many conservation and ecological actions, including forestation, are voluntary.

   b   The sense of private ownership affects feelings and actions towards the land by owners and by non-owners.

   c   Feelings, values, and actions vary among nation states and their socio-political, economic, and legal contexts.

   d   Conservation and forestation results vary regionally.

   e   Private ownership can include the ability to control, modify or harm these environments. Other creatures and citizens risk the effects of environmental harm created on these private landscapes. The rights of private holders and their effects were largely at play in the research.

   f   One study proposed possible changes to the concept of private property. Schlueter (2008) examined the fragmentation of European forests, reducing forest productivity. He concludes that "a kind of common property regime… built on…. forest associations... could provide an answer" (265).

The relationship between intrinsic and extrinsic motivations

Both intrinsic and extrinsic motivators are at play in human relationships with forests.

Sarah Iverson (2018) describes them as intrinsic or extrinsic values, feelings and viewpoints.

Maï Yasué et al. (2020) employed Deci and Ryan's (2008) Self Determination Theory (SDT) and basic psychological needs (BPN) to explore the feelings of landowners as they preserved forests in Tasmania. While all intrinsic motivations are autonomous, several extrinsic motivations are autonomous as well (identification and integration, 269). Yasué et al. (2020) distinguish between autonomous and non-autonomous

motivations instead of intrinsic and extrinsic ones (269). Their investigation of how conservation motivations contribute to human well-being is unique. While they admit that few farmers filled out their survey (276) and that the survey could be biased towards those participating in conservation, they conclude that even those least enthusiastic about conservation achieved some psychological well-being benefits (276).

Payments for Ecosystem Services (PES) often aid impoverished farmers, including those in eastern Europe – Romania and the Czech republic. Agriculture and forests have lived in co-existence there for centuries. Even though PES payments are not the primary motivation for farmers to remain on the land and take care of the trees and the soil, they act as an incentive for them to do so (Lapka et al. 2011, 261; Hartel et al. 2016, 2, 9).

Motivational crowding out

One foundational paper (Howard 2020) researches motivational crowding out in relation to PES payments in agriculture. Howard demonstrates via laboratory experiments with university students that both inter-agent and intra-agent crowding out can occur under conservation incentive programmes (245). Maï Yasué et al. (2020), who take a human well-being approach to conservation, also discuss the implications for internal motivations when "*external rewards such as payments can thwart internal motivation*" 269). Motivational crowding out is discussed in more depth in chapter 4.

"Multifunctionality" and "Multifunctional agriculture"

"Multifunctional agriculture" is a term the EU adopted after the United Nations Millennium Ecosystem Assessment was adopted in 2001. The OECD uses this definition:

> Multifunctionality, or multifunctional agriculture, are terms used to indicate generally that agriculture can produce various non-commodity outputs in addition to food.

The working definition of multifunctionality used by the OECD associates multifunctionality with particular characteristics of the agricultural production process and its outputs:

(i) the existence of multiple commodity and non-commodity outputs that are jointly produced by agriculture; and that

(ii) some of the non-commodity outputs may exhibit the characteristics of externalities or public goods, such that markets for these goods function poorly or are non-existent (OECD 2013).

This narrative is used by the EU to defend agricultural subsidies to the World Trade Organization (Torres et al. 2007). Part of this narrative is that a better balance of subsidies supports agriculture, and also ecological, social, cultural and landscape goals not achievable through the market system. Through cross-compliance, agriculture's negative externalities are thus partially addressed (Appunn 2021; Friedmann 2006, 249). The non-market benefits provided by a multi-functional system thus achieve an imperfect balance between production and other values. Under CAP, a single agricultural subsidy has to capture and provide as many of those ecosystem services as possible, and also maximize agriculture's food provisioning services.

One analyst suggests agriculture is seen by the EU as a complement to the natural environment, instead of its antithesis (Lenihan 2006, 22-24). This apparent contradiction of terms has come under intense debate and scrutiny in the EU (Hart 2015; Melman 2021; Oppermann et al. 2015; Pe'er et al. 2017). Even as agriculture is intensified, the EU model seeks to maximize non-market externalities. Some have called this impossible to achieve (Holt et al. 2016).

This narrative has not achieved the same level of currency outside of the EU, where agri-environmental subsidies have entirely different histories and contexts. Subsidies and ecosystem service payments exist in Australia, the UK, USA, and other OECD nations.

Instead of "multifunctional agriculture", some researchers employ the term "post-production agriculture" (Wilson 2007, 113-118). This rural geography concept describes an ideal that is the opposite of production and is often not achievable (116). Production and post-production agriculture co-exist, and the term "multifunctional" attempts to describe this phenomenon.

Another recent term for "multifunctional agriculture" is "working landscapes" (Morse et al. 2010; Garibaldi et al. 2020). This term encompasses forestry and resource extraction as well. Garibaldi et al. (2020) maintain a minimum of 20% of working landscapes should be native habitat. Environment Canada similarly recommends a minimum of 30% forest cover for ecosystem service function (Environment Canada 2013).

Conservation easements

Three studies researched conservation easements (CEs) (Caputo et al. 2017; Farmer et al. 2011; Kauneckis and York 2009). These were all in the USA, where CEs began a century ago. In 1891, parkways in Boston designed by Frederick Law Olmstead were protected by easements (Steele 2021). In the 1930's, the federal government protected lands along the Natchez Trace and Blue Ridge Parkways via easements (Byers and Ponte 2005). CEs greatly expanded in the 1980's (Kay 2016). By 2005, 4.8 million hectares were protected by 1667 land trusts (Kauneckis and York 2009, 80) and by 2021, 13.3 million hectares were protected by land trusts and governments (NCED 2021). This comprises 1.4% of the US land area. 82.6% of forested land in the eastern United States is privately owned, yet less than 2% of private family forests are protected by easements (Kamal et al. 2015, 588).

A body of literature enthusiastically supports the use of various types of voluntary conservation easements, covenants and servitudes to support the protection of natural areas (Farmer et al. 2011; Schuster 2018; Steele 2021). They are different from PES in that they are permanent legal means of conservation.

CEs work by legally removing some property rights from private properties, giving these rights to a land trust or government, and registering this on the land title of the property (Kamal et al. 2015, 581). The owner may then experience a lower land value, but gain economic benefits, including reduced property, estate and/or succession taxes.

These conservation tools are usually supported by private US conservation foundations and agencies, some of which are also active in Canada. In Canada, most CEs occur in the prairies, where they protect endangered species and duck habitat (Federal, Provincial and Territorial Governments of Canada 2010, 54). CEs and private land trusts are rare in Europe, except in the UK. Common and private property law is different in Europe than in the UK. In Australia, CEs are common, and are called covenants (Hardy 2018).

These studies suggest that where legal, economic and other incentives supporting CE's are in place or improved, more private landowners may be convinced to voluntarily place easements on their land for both intrinsic and extrinsic motivations. Landowner views on property rights will play a role in uptake (Kauneckis and York 2009, 473).

CHAPTER 3 - INTERVIEWS WITH FARM LEADERS IN SOUTHERN ONTARIO'S SOUTH NATION RIVER WATERSHED

Methods of key informant selection, question selection, and interview procedure

Key informant interviews are particularly useful in gaining information from a small group of people with direct knowledge or experience of the study question (Tremblay 1957; Faifua 2014). They do not necessarily represent all views in the community. General conclusions should not be derived from these interviews.

Key informant interviews can aid flexibility in topic exploration, based on the knowledge or experiences of those interviewed. Ideas developed in an interview can thus be explored in depth, if respondents are willing (Tremblay 1957, 688-694).

Key informant interviews were solicited from farmer stakeholder groups known to operate and have representatives within the South Nation River watershed. The following farmer stakeholder groups were located and confirmed to be active in the area:

A. General Farm Organizations (GFOs):
1. Christian Farmers Federation of Ontario, St. Lawrence/Ottawa Valley Chapter
2. National Farmers Union, Local 362
3. Ontario Federation of Agriculture (OFA), OFA Zones 11 and 14

B. Commodity and Conservation Groups:
1. Beef Farmers of Ontario
2. Boisés Est
3. Canadian Organic Growers
4. Dairy Farmers of Ontario
5. Grain Farmers of Ontario
6. Jersey Ontario

7. Ontario Beekeepers' Association

8. Ontario Farm Fresh Association

9. Ontario Goat Producers

10. Ontario Maple Syrup Producers' Association

11. Ontario Soil and Crop Improvement Association (OSCIA)

12. Ontario Woodlot Association, Stormont, Dundas and Glengarry Chapter

13. Sheep Farmers of Ontario

14. Union des Cultivateurs-Franco-Ontariens (UCFO)

Other groups, the Eastern Ontario Model Forest, the Forest Gene Conservation Association, environmental groups, and landowner groups, do not represent farmers and were excluded.

Questions posed to key informants were guided by the key informant questions template (Appendix). They were semi-structured; further questions arose from those in the template. The interviews were 1–2 hours long and recorded on zoom; if internet connections failed they occurred by phone. All interviews were confidential and used an informed consent process approved by the Canadian Tri-Council Policy Statement.

Additional questions were posed to those with direct knowledge of the forest situation in the South Nation River watershed. Questions also arose from conservation actions, or from unique agricultural commodities. For example, woodlot owners' and maple syrup producers' experiences are different from crop farmers.

Results of interviews with key informants in the South Nation River watershed

Narrative of South Nation Conservation's AFCC committee
One member of the AFCC committee was interviewed. AFCC minutes and reports were read to find the reasons that the AFCC came up for forest clearing in the 21st century:

- landowner/property rights
- fear of new laws
- land is needed/scarce
- fewer farms
- tile draining = easy access to equipment
- population/city growth/speculation of development and planning
- solar and wind
- no incentive to keep bush (SNC 2017, 2-3).

SNC's criteria for successful forest cover begins with Environment Canada's (2013) report "How much habitat is enough?":

> Most of our watersheds have less than the 30% forest cover recommended for healthy ecosystem function, and a criteria of the SNC is a minimum of 30% tree cover (SNC 2014).

The narrative of the AFCC differs from SNC's own narrative - it begins with agricultural land capability. This is based on the Canada Land Inventory's Soil Capability for Agriculture surveys (Environment Canada 1976). According to the committee, agriculture is a significant economic and land use activity in the region and thus provides many benefits to the residents (SNC 2017).

Results of key informant interviews

Seven key informants were interviewed. Table 2 summarizes their responses. The two largest General Farm Organizations were represented by three interviewees. Commodity groups that key informants represented include dairy (2) and two former dairy operations, maple syrup (2), cash crops (2), beef cow-calf (2), sheep (1), and beekeeping (1).

Crops grown include soybeans, corn, winter wheat, barley, hay (dried and silage), cover crops, and pasture. All active farms include a mix of the above crops.

Property details of interviewees include:

- 100 acres, 88 acres workable, all tile drained, rented by the son, who is a dairy farmer on the adjoining 100 acres. 11 acres of bush, tapped as a maple syrup operation.

Table 2 − Results of key informant interviews

Question posed to key informants	Responses [a]
Total acres [b] owned and rented	Average farm size is 233.4 acres, slightly below the Ontario average of 249 acres (Statistics Canada 2016b). Farmer rents in (2), rents out (1). Average (n=7) rented acreage (in and/or out) is 31 acres.
Tile drainage	All farms are systematically tile drained, some as recently as last year, with some pasture and all woodlots not tile drained. The non-active farm includes a municipal drain through a woodlot, which drains the wetland portion of the woodlot.
Active/non-active farm	Active farm (6), non-active farm (1).
Full-time or part-time farmer	Full-time farmer (3), part-time farmer (1), semi-retired farmer, retired from another job (3).
Education completed	College or university degree (3) college diploma (3) high school grade 12 (1).
Gender	Male (5), female (2).
Estimated age of respondent	30-50 years (2), 50 years + (5).
Wooded area on farm	Average (n=7) of 25.14 acres, 10.7% of farm area.
Have you planted trees?	Yes (7), no (0).
Have you cleared land?	Yes (4), no (3).
Do you have land available to plant trees?	Tillable land available to plant trees (0). Pollinator plots (shrubs and perennials) subsidized through ALUS and OSCIA (2).
Would you plant trees on rented land?	Yes, with qualification that this land is owned by a family member (1), no (6).
Should society pay for the benefits of trees on farm property?	Yes (2), yes but... [with qualifications] (3), no (0), neutral (2).
Should society pay for the benefits of trees on private property?	Yes, but... [with qualifications] (4) No (1) Neutral (2).
Which existing programs, projects, and tax incentives are you aware of, to preserve forests or to increase them?	MFTIP (5), ALUS (4), OSCIA (3), 50 million tree project (2), Conservation Authority tree planting projects (2), Ferguson Forest Centre in Kemptville (2).Eastern Ontario Model Forest (1), Farm tax rate (1), CLTIP (1).

[a] number of respondents designated by (n).
[b] 1 acre = 0.404 ha., a common land measurement in Canada.

- 420 acres owned and rented, all clay loam, 370 acres workable, 350 acres tile drained, crops include corn, soybeans, barley, hay, 30 acres pasture, and 30 acres bush.

- 144 acres, 120 acres workable, all tile drained, 5 acres pasture, and 19 acres bush.

- 320 acres, 312 acres cultivated, tile drained, cash crops – soybeans, corn, wheat, hay and 40 beehives. 8 acres is non-cultivated, including a farmyard and a 6 acre woodlot.

- 100 acre bush, sandy loam soil, 25% wetland, municipal drain runs through a corner of wetland forest. The forest supplies firewood home heating and maple syrup.

- 200 acres, 150 cultivated and 50 non-cultivated, including pasture, riparian strips, and pond. There is no bush.

All farms include woodlots except for one. Woodlots are usually a very small proportion of the farm, and provide firewood, maple syrup, and fence posts.

No one intends to increase the proportion of forest on cultivated farmland. Four out of seven have experience with clearing land, and one's father cleared willow brush in the 1960's. One person's clearing experience was Domtar's removal of a hybrid poplar plantation on marginal land after the 1998 ice storm. Another cleared 5 acres last winter and cleaned the brush from 6 acres this spring.

All informants have experience with tree planting. Trees are planted along roadways and fence rows for windbreaks, in riparian areas, for shade and shelter in paddocks, and on marginal lands.

Interview narrative

Here is a summary of the narrative provided by key informants:

1. Southern Ontario contains some of the best farmland in all of Canada.
2. Urbanization is consuming farmland in southern Ontario, and needs to be replaced for the continued viability of southern Ontario's agricultural economy.
3. Governments and urban folk seem unsympathetic to these agricultural land losses.
4. Agricultural commodity price rises also contribute to deforestation.
5. Deforestation of prime agricultural land will continue. Land that cannot be used for agriculture, such as marginal lands and wetlands, should be preserved as forests.
6. We need to produce local, sustainable food for our population.
7. As farmers, we should do what we can for conservation.
8. If ecosystem service payments are made for forested land, it needs to be done fairly, including respect for private property rights.

Supporting this narrative, key informants stated:

"The whole thing about trees is [to] follow the money."

"I don't know how you balance those out [farming and trees]... there's definitely loss of revenue associated with having trees near land that you're trying to grow a crop, like corn or soybeans or wheat. There are yield drags associated with trees located in close proximity to crops. And that's the reason that, in addition to being hard on equipment, and maintenance, and all those things, they add to the reasons that farmers are taking trees out."

"When commodity prices go up, and land prices go up, then farmers look at alternatives to increase their land base... A lot of people will feel that clearing bush is cheap land, but you're not creating new land, you're just altering its use."

"Everybody wants their own little piece of ground to live on. But unfortunately, a lot of the prime agricultural land has gone for urban development."

"They're able to grow Toronto because they can guarantee that agricultural land remains agriculture. The balance is agricultural land coming back into production, replacing land lost to urban use."

"We can take agricultural land north of Toronto for growth but not in rural Ontario. I feel sometimes that rural Ontario is the offset programme for the growth of Greater Toronto. The province is offsetting. They're committed to urban growth and are restricting growth in rural areas."

"Unlike a lot of our urban neighbours who have jobs in the city, farmer's land is typically their pension. Farmers are known to be asset rich and cash poor, so selling it and passing it on to the next generation is what farmers rely on as they age."

"If someone puts a house on 50 acres, should they not cover 30% of their property with trees?"

"It all comes down to better planning! We have had lots of flooding that has happened along the Ottawa River in the last few years. Who were the planners that said you could build your house on flood plains?.... They want their homes, they then want to become more rural, and when they move out, they want better roads, and their schools and their shopping malls, and that all comes when the population comes."

Key informant views of stewardship

All farmers have "done away with the moldboard plow" and shifted to reduced tillage corn and soybeans within the last 15 years. Equipment costs are a problem, so some rely on custom operators with large, reduced tillage equipment for planting. Here's what informants shared about stewardship:

"I do my best to do my best. This is both a job and a career. As a farmer, I know that we're in it for the long game, or we won't have anything left for next year. As a smaller farmer, I am committed to best practices, but have to rationalize this at the end of the day to pay the bills. I don't practise all that I could. Examples include reduced tillage and no-till."

"As farmers relying on pasture, and knowing the health benefits for our livestock with that type of production system, that becomes very important to us. We also sell a lot of our meat at the farm gate to customers, so them seeing our production system and knowing the value that our consumers place on the importance of animal welfare, as well as our contribution to climate... that makes

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it that much more important to us to ensure we are good stewards and practicing good practices that align with our own thoughts [and] those of our customers."

"We need to use as a farm the percentage of the land as tillable land to feed people. More marginal land should be left as forested land. It may not be economically sensible to farm marginal land. A percentage should be left as a water sink, which also benefits the farmer's land."

"We only cut the hay once the birds have finished nesting... I haven't seen a bobolink here for 30-40 years... there are fewer and fewer hayfields, especially for birds."

"As commodity prices, like corn, soybeans and wheat, have elevated, aligned with the increased cost of land, we've seen a lot of movement away from forages and land disruption in terms of tillage practice,... simply because everybody is trying to pay the bills and capture the [crop's] value. We've also seen degradation of soils, of impacts on pollinators, and so there has been a return to some of those practices that our forefathers did in agriculture years ago, recognizing that diversified farming may not have been such a bad idea after all. As a producer, it is kind of interesting to see this shift back to what I would say my father and grandfather knew what was the right way of farming all along. It is being done with some new and innovative twists: there's new equipment around, and we're all farming much larger tracts of land. There needs to be some efficiencies built into that, but there's a lot more hay and pasture land than there was 5 or 7 years ago."

One farmer transferred 1.3 acres into pollinator plots (OSCIA 2019). Another employed Alternative Land Use Services (ALUS) Ontario East to plant riparian areas with pollinating shrubs and trees.

The Eastern Ontario Model Forest (EOMF) and the Ferguson Forest Centre in Kemptville, both former OMNRF operations, are well-known to some interviewees. The Ferguson Forest Centre is a source of low-cost trees and conservation information. EOMF certifies forests for Forest Stewardship Council® (FSC®) certification (Boakye-Danquah and Reed 2019) and the sale of voluntary carbon sequestration credits (The Working Forest 2021). Interviewees are not aware of these carbon sequestration credits.

Interviewees appreciated wildlife such as deer, fox, and birds, including owls, turkeys, and bobolinks. No crop damage was reported. Predation of livestock by coyotes and wolves is a concern, however.

Findings of key informant interviews

Lack of "multifunctional agriculture" narrative

Production agriculture is the primary narrative presented in interviews. Individually, they are all "doing what I can" to contribute to conservation.

"Multifunctional agriculture" is not recognized here, as it is in the EU, where farmers are both producers of food, and ecosystem managers (Chapman et al. 2017; Federal, Provincial and Territorial Governments of Canada 2010; LaCanne and Lundgren 2018; Lapka et al. 2011).

Lack of available land to plant trees

Even though all interviewees plant trees routinely, no one intends to increase the proportion of forest on the farm. One respondent stated: "our land base has been well established for well over 150 years". It challenges the assumption that "Significant area is available for afforestation on private farmland… across Ontario" (Bird and Boysen 2007, 4).

Since land for afforestation is unavailable on farms, would farmers be in favour of the municipality planting more roadside shade trees on public lands? Here is one response:

> "They wouldn't [be in favour] because there's a lot of maintenance. Because every time a limb comes down, that's another job that needs to be done by the farmer, to help get that out of the way. They don't want those tree limbs scratching the paint on their tractor. They don't want the trees to be taking the moisture out of the ground when we have those dry years. Trees take a lot of moisture out of the ground... It would be a very tough sell."

Should society pay for the benefits of forests on private lands?

The primary motivations for farming the land are economic and inheritance, to keep the farm in the family. This includes keeping the remaining woodlots in the family to protect them from development.

Interviewees are of mixed minds when it comes to payments for ecosystem services (PES) for forest ecosystem services on both agricultural and private landscapes. Here is a sampling of views:

> "I don't think society as a whole should pay...morally we need to be responsible [and not remove woodlots]… We do all benefit [from trees]."

> "I definitely think there is some public good in these factors, and it should not rely totally on farmers to absorb the cost, when there is that public good that is being offered through trees and the carbon sequestration that they have to offer."

> "We're losing 175 acres a day to urban development from farmland. So they're more or less pushing us to keep clearing land so we can keep producing food for them. So I think society can pay the difference if they want us to keep the trees."

> "Is breathing the air supposed to be taxed? Should we pay native animals for the benefits they create for us?"

If payments take place for forested lands, will society then treat these lands as public property? Several informants have concerns about this possibility. Farm implications include animal biosecurity, trespassing, and invasive species management.

Do tree-cutting by-laws prevent deforestation?

Within the SNC, only the municipalities of Clarence-Rockland and the City of Ottawa (former Carleton County) have tree protection by-laws. After a petition was circulated in 2021, the municipality of Alfred-Plantagenet is now considering (but has not yet passed) a tree protection by-law (Babin 2021; Masson R. 2021). Except for Kingston and Lanark, other Eastern Ontario municipalities have no tree protection by-laws (Map 3).

Tree cover losses often occur just before a by-law is passed. Key informants stated:

"My opinion is that as soon as they [tree-cutting by-laws] come up, they cause more land to get cleared, because as soon as farmers hear that they **might** [informant's emphasis] not be able to clear their land, often they are going to clear land that they might not have ever thought of clearing. I had farmers tell me that they are forced to clear land they had no intention of clearing, but if it ever gets to the point that the tree by-law comes in, that's their plan, to clear that land, just to make sure [that it's cleared]."

"A lot of farmers...they're acting [by clearing land] before that [tree-cutting by-laws] comes into play."

"...emerald ash borer, people just see that as a license to clear bush."
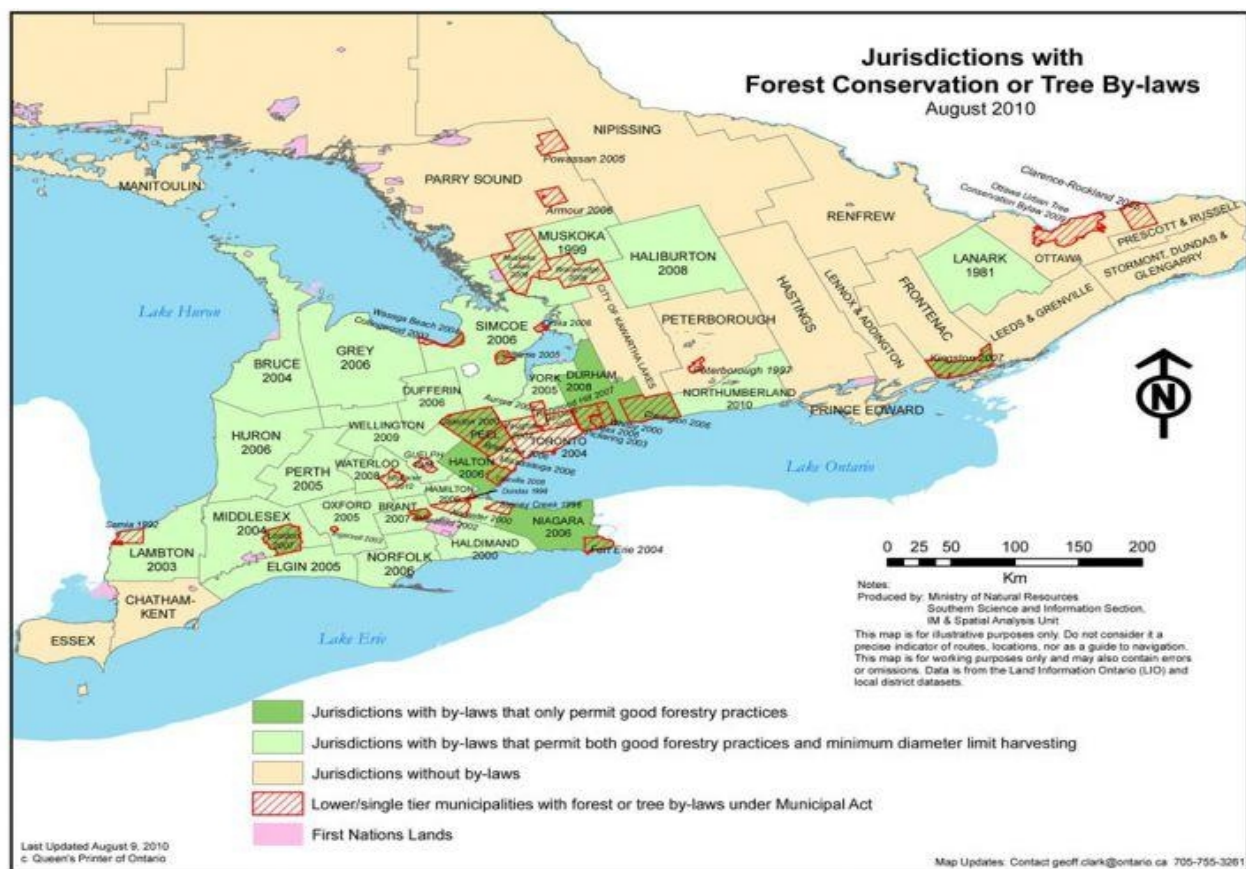
Map 3 − Jurisdictions in southern Ontario with forest conservation or tree by-laws

Source: Ontario Woodlot Association 2013 Jan 14. Tree by-law information package. 34 p., p. 5. [accessed 2021 Oct 3]. Available from: https://www.ontariowoodlot.com/images/By-law_Information_Package-Jan_2013.pdf Scale = 1:4,200,000

As key informant comments reveal, imposing a new by-law can also have counter-intuitive results. According to Bruno Frey (1997, 8-12), regulations are just as susceptible to crowding out effects as payments for ecosystem services are.

The municipality of Chatham-Kent, with a forest cover of 3.4% (Municipality of Chatham-Kent 2021), is experiencing this phenomenon. To prevent further losses, they have imposed a temporary clear cutting by-law to prevent further clearing from happening while considering a permanent by-law. Farmers oppose the by-law (Shreve 2021; Wills 2021).

In southern Ontario, approximately two-thirds of municipalities have tree-cutting by-laws (Map 3; FitzGibbon and Summers 2002; Krahn 2013). Forest cover in most of these municipalities is below the 30% threshold recommended by Environment Canada (2013). These laws have usually been in place for decades. Norfolk County was the second county after Wellington County in 1946, to pass such a by-law in 1947 (FitzGibbon and Summers 2002, 42). Norfolk County, which prides itself as being both the forest capital of Ontario and Ontario's garden, is reviewing the by-law in 2021 (Norfolk County 2021).

This is a legislative form − a 'stick' instead of a 'carrot', as Quartuch and Beckley (2014) term it. Municipalities with tree-cutting by-laws still experience some tree cover losses (MacDonald et al. 2018, 225). The reasons for these losses can include insect or disease damage, scope and strength of the by-law, exemptions to the by-law granted by the municipal council, and failure to prosecute effectively (Environmental Commissioner emphasizes...2017; Glasgow 2017).

CHAPTER 4 - GENERAL DISCUSSION

Introduction

I began this research asking: what hinders and motivates farmers to preserve and/or plant forests? What are the differences between farmers' positions on forestation in southern Ontario's South Nation River watershed and those of farmers in other jurisdictions? What does the situation in southern Ontario's South Nation River watershed add to the wider scholarly and policy literature? And, what lessons do the scholarly and policy literature hold for forestation in southern Ontario's mixedwood plains ecozone?

The context for this research question is the reversal of afforestation to deforestation in southern Ontario's mixedwood plains. Below is a summary of how this chapter discusses these questions.

Two narratives exist in the South Nation River watershed: the SNC narrative, and that of the AFCC and key informant farmers. Conditions in the South Nation River watershed have changed since the 20th century. These changes, and the differences and similarities to conditions in other jurisdictions, are outlined.

Factors affecting deforestation in southern Ontario's mixedwood plains ecozone are discussed: population growth, losses of prime agricultural land to urbanization, agricultural land capability, high commodity prices, and the resultant high agricultural land values.

This is followed by comparing Southern Ontario's mixedwood plains ecozone to adjacent eastern North American regions. Each region except one is losing forests, despite regional differences. The reversal of the "forest transition" to deforestation in each of these regions requires further explanation outside the scope of this research.

If private landowners are paid to preserve forests and plant trees on their property, the effects of motivational crowding should be ascertained. Policy makers should have a clear grasp of how internal and external motivations affect conservation actions vis-a-vis forest preservation. If monetary incentives are provided for protecting or creating forests, can payment structure and implementation methods reduce or eliminate motivational crowding?

Comparing the situation in South Nation watershed to other jurisdictions

The two narratives in the South Nation watershed
The narrative of key informants and that of the South Nation Conservation Authority conflicts. Interviewed farmers want to maximize production on Class 1, 2, and 3 agricultural soils, while SNC wants to re-establish at least 30% of the watershed in forests, wetlands, and natural habitats. Most of the land in the watershed is suitable for agriculture (El-Khoury et al. 2014).

How have conditions in southern Ontario's South Nation River watershed changed?
Conditions have changed since the 20th century:

- The agricultural land base of key informants is stable. They could preserve existing woodlots, but lack available land to reforest to trees.

- Farmers in the region are now clearing any available forested land for agriculture. Agricultural crops are more economically valuable than woodlots, including the cost of land clearing, tile drainage, stone and stump removal, machinery, crop planting and inputs (Statistics Canada 2016b).

- Present tree planting rates are not keeping up with deforestation rates (Average one million trees lost... 2016).

● 21st century climate change will affect forests, agriculture, and watersheds in various ways (Cheng et al. 2012; Statistics Canada 2014; Bush and Lemmen 2019).

How are conditions in other jurisdictions different and similar to South Nation?
Differences between the South Nation River watershed and jurisdictions in the integrative literature review include the facts that:

● There was an absence of reference to deforestation in integrative literature review articles, except one reference to tropical deforestation (Iverson 2018, 22, 45, 48).

● Most OECD jurisdictions do not face similar population and urbanization pressure. Some regions experience population decline.

● The EU, through the CAP, encourages a balance of food production and ecological service enhancement. Farmers from Estonia (Roellig et al. 2016) to Italy (Galluzzo 2015) benefit from CAP payments to preserve and increase forests. While CAP's effectiveness at ecological restoration is still under debate, the policy is clear. Each nation is responsible for implementing the policy. Forest preservation and afforestation are occurring in the EU (Eurostat 2021).

● The USDA has competing policies and subsidies for food and biofuel production, and for farmland retirement. None of these target private forests, except for endangered species protection (USDA 2020), a small innovation fund (Isakowitz 2021) and a forest management incentive programme (USDA Farm Service Agency 2021). States are thus left to manage forest policies on private lands, including municipal tax reductions (Kauneckis et al. 2009; Schram et al. 2021; Starr et al. 2015) similar to those offered by Ontario (MFTIP and CLTIP).

● Conservation easements are used to protect forests primarily in the US and Australia. They protect a small but important portion of the remaining forests.

Similarities include the existence of large exurban non-farm populations in neighbouring US regions and Australia. Exurbanites may possess the internal motivation and financial means to conserve their land voluntarily (Duncan et al. 2014; Kauneckis et al. 2009; Schram et al. 2021; Starr et al. 2015; Yasué et al. 2020). These findings are similar for southern Ontario, where non-farm owners participated more (MacDonald et al. 2020).

Agricultural land capability, losses to urbanization, and high commodity prices
Southern Ontario contains over half of Canada's most productive and fertile agricultural soils (Environment Canada 1976, 11). These are slowly being covered over by urban development (Connell et al. 2016; Epp and Caldwell 2018). The mixedwood plains region lost 1.3 million hectares of farmland from 1971 to 2011. By ecozone, the largest increase of urban land in Canada from 1971 to 2011 occurred in the mixedwood plains, where the settled area on dependable agricultural land grew by 128,030 hectares (+27%). Over half of this growth occurred in the Greater Golden Horseshoe (Statistics Canada 2014; Environmental Commissioner of Ontario 2019, 128-175). The global COVID-19 pandemic may exacerbate these agricultural land losses (Arsenault 2021).

Agriculture is declining in area in southern Ontario, and has declined ever since the Canada Census of Agriculture began in Ontario in 1921 (Statistics Canada 2016a; Appendix Figure VII). As prime agricultural land is consumed by cities, subdivisions, highways, utility corridors, power plants, and all land usages required by population growth (Rodd 1976), agriculture has several choices: to intensify, and/or to relocate to less productive soils, and clear the most productive and economically viable of those soils.

In the South Nation River watershed, both intensification (SNC 2020) and land clearing are occurring (Mesman 2016).

The result: deforestation in the remaining prime agricultural areas

Because farmland is limited, and due to population and economic pressure, southern Ontario's farmland is increasing in value at a rate exceeding the general real estate increase (FCC 2021a, 2021b; Appendix, Figure VIII), which is also large (Burda 2013).

Ontario has no limitations on foreign investment in agricultural land. Alberta, Saskatchewan, Manitoba, Quebec, and PEI do (Heminthavong and Lavoie 2015). How foreign ownership affects land prices remains uncertain (Griffin and Maltais 2018).

Factors affecting land clearing and deforestation have become more complex since colonial settlement (Moorman 1997, 21). In 2021, farmers will receive government grants and favourable income tax treatment for land clearing and tile drainage (Beef Farmers of Ontario 2021; Van Gilst 2019). Land clearing is a normal part of farm operations except where tree protection by-laws exist.

Farmers are part of a worldwide neo-liberal economic system which affects on-farm decisions (Friedmann 2006; Pechlaner and Otero 2008). These economic factors directly affect farmer decisions whether to clear forested land, and which crops to grow.

Is the forest transition reversing in eastern North America?

The forest transition theory posits that societies cut down trees to a low point, then deforestation ceases and reforestation resumes (Mather 1992; Grainger 1995; Mather and Needle 1998). This theory describes what happened to forests in developed nations in the 20th and previous centuries (Kauppi et al. 2006). In the 21st century, this theory may no longer make sense, as many factors have changed, in both developed and developing countries (Rudel et al. 2005; Perz 2007).

All EU nations experienced a forest transition before 2021 (Meyfroidt and Lambin 2011, C-1 Fig. 1). In parts of eastern North America, where this transition also occurred, it is

reversing. Urbanization is the driving force, particularly in southern Ontario (ESTR Secretariat 2016, 9, 13) where growth policies promote urbanization and population increases. A lack of effective farmland and forest protection results in the continued loss of farms and forests (Cheng et al. 2008; Tomalty 2015; Bowman 2016; Connell et al. 2016; Environmental Commissioner of Ontario 2018).

In the 20th century, each region in eastern North America went through the typical curve of forest losses, followed by some gains, but never returning back to the original forest cover (Linehan 2010), as illustrated for southern Ontario by Riley (2013, Fig. 15).

Evidence from southern Ontario and adjacent US states of eastern North America suggests that reforestation has now ceased and we are entering into a new phase of deforestation (Jeon et al. 2014; NOAA 2015; Pastor et al. 2015; Foster et al. 2017; Albright 2018; Environmental Commissioner of Ontario 2018). In these regions of eastern North America, only one state (Michigan) still experiences net reforestation in 2021 (Pugh et al. 2017; Pugh 2018). Forest cover is expanding even in Detroit's urban fringe (Gounaridis et al. 2020). Continued urban growth in eastern North America is consuming both forests and agricultural land (proportions depending on the region), resulting in net forest losses (Ducey et al. 2018; Environmental Commissioner emphasizes...2017).

Regions can also export deforestation to other world regions, since a region's food and goods supply may not be sourced locally (Pendrill et al. 2019; Wedeux et al. 2021; Ritchie 2021). North American regions do not quantify their exported deforestation. The EU calculates how much deforestation occurs worldwide due to human consumption (Halleux 2021).

Population growth as a driver of deforestation
Population growth appears to be one of the main drivers of deforestation in southern Ontario, as it is elsewhere (Létourneau 2010; Busch and Ferretti-Gallon 2017, 11;

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Environmental Commissioner emphasizes… 2017). Population growth in southern Ontario has continued unabated since colonial settlement (Demographics… 2021). For decades, it has grown annually at 2% or more, decreasing to 1.3% from 2019-2020 (Ontario Ministry of Finance 2020).

Federal, provincial, and regional policies align with continued population growth (Immigration Refugees and Citizenship Canada 2020; City of Ottawa 2021). Projections to 2041 are to add one million people to southern Ontario every 5 years (Ontario Ministry of Finance 2020, chart 3; Ontario Ministry of Municipal Affairs and Housing 2020). On the other hand, northern Ontario has experienced population stagnation and decline for decades (Hall and Hall 2008; Hall 2009), and slight growth is projected to 2041 (Ontario Ministry of Finance 2020).

High population growth is not occurring in other regions examined in the literature. Only three literature review articles referenced urban growth and sprawl. They were from the US (Farmer et al. 2011; Ryan et al. 2003) and Quebec (Truax et al. 2020).

The EU's population is growing at 0.1% annually in 2021. Eight out of 27 nations (Bulgaria, Croatia, Greece, Hungary, Italy, Latvia, Poland, Romania) have declining populations (World Bank 2021). Even in Europe, large urbanized areas (except Warsaw) have experienced some deforestation within their urban and peri-urban zones (Hoffmann et al. 2017).

US states adjacent to southern Ontario have lower historic population growth rates, and zero (New York) to slightly positive growth (New England and Michigan) in 2021 (Gebeloff 2021; Burke 2021; Gibson 2021). All of these regions, except for Michigan, are experiencing net deforestation (Jeon et al. 2014; NOAA 2015; Pugh 2017, Pugh et al. 2017).

Motivational crowding out

Definition of motivational crowding out

In 1970, Richard Titmuss found that paying for blood donations could lead to a drop in blood donation levels (Titmuss 2019). Recent research supports this. One study found a significant motivational crowding out effect among paid female blood donors (Mellström and Johannesson 2008). When the monetary incentives were donated to charity, the motivational crowding effect disappeared (855, 857). A recent meta-analysis also confirms Titmuss' theory that monetary incentives provide no increase in blood donation rates (Niza et al. 2013).

Motivational crowding theory posits that extrinsic motivators can "undermine" (Deci, Ryan and Koestner 1999) or "crowd out" existing intrinsic motivations (Frey 1997; Frey and Jegen 2001), thus decreasing net results (Deci and Ryan 1985, 35).

Why is motivational crowding out relevant? Frey and Jegen explain: "If the crowding-out effect holds, raising monetary incentives reduces, rather than increases, supply." (2001, 3). Stated another way: net results may be reduced instead of increased by monetary incentives. This has policy implications, not just for the blood supply, but for many other situations.

How motivational crowding applies to situations other than blood donations varies. Research has investigated charitable donations (Jones et al. 1998), doctor's pay and incentives (Kao 2015), and COVID-19 vaccine uptake (Robertson et al. 2021; Schmelz and Bowles 2021) to determine what happens to intrinsic motivations when extrinsic motivations are introduced.

Does motivational crowding out matter in farmers' motivations?

The relationship between intrinsic and extrinsic motivators is complex and often hard to understand. Motivational crowding out does matter (Chan et al. 2017, 5-6). To

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implement correct reforestation and forest preservation policy, motivational crowding out situations need to be identified and corrected. Not doing so can create policy failures, including lack of additionality, poor resource usage, and/or unnecessary competition between different best management practice (BMP) outcomes (Howard 2020).

The proposal by the Ontario Environmental Commissioner to remove all land taxes from OMNRF's Managed Forest Tax Incentive Program (MFTIP) (McKay 2014) can be examined in this light (Environmental Commissioner of Ontario 2018, 84). This proposal would keep the farm tax rate for farm forests at the current value. Further research could answer uncertainties about this proposal – how much additional forest would be conserved by the change, enrolment levels by farmers and non-farmers, and whether existing motivations to conserve forests would be crowded out by the additional tax incentive.

Motivational crowding theory is relevant to farmers' motivations (Bennett et al. 2018, 603; Kits et al. 2014). Farmers across Canada are aware of PEI's (ALUS) programme which pays yearly per acre for retiring agricultural land in exchange for six specific ecological actions (Lantz et al. 2012). A House of Commons Standing Committee on Agriculture report recommended that farmers should be paid for environmental benefits they create (House of Commons 2007, recommendation 34). Anticipation of agricultural payments for EGS may crowd out voluntary intrinsic motivations to create environmental benefits. In the South Nation River watershed of eastern Ontario, farmers requested compensation to protect forests (Mesman 2016, 33). Research could ascertain whether voluntary actions that farmers would undertake have been arrested by anticipation of these ecological-goods-and-services (EGS) payments.

There is interest in establishing a payments for EGS plan for farmers in Ontario (Hager 2009). A Member of Provincial Parliament introduced a private member's ALUS bill similar to PEI's legislation (Barrett 2018). The bill passed second reading on September 27, 2018, but was not enacted.

Little Canadian research has been done on motivational crowding out with farmers. In Nova Scotia, Sherren et al. (2020) speculate whether:

> … a farmer could decide to delay doing something they had thought worthwhile on its merits because they anticipate being paid to do it in future based on programming available elsewhere (5).

Anecdotal evidence from a study of the ALUS programme in PEI (Kolinjivadi et al. 2019; Kolinjivadi et al. 2020) found a range of farmers' opinions of the new payment system for "ecosystem services".

> "So now, if 'Jo Blo' potato farmer destroys his soil down the road and now gets $200 for putting in wider buffer zones, I was sure as hell am going to get whatever money I could get from the extended buffers I had put in before ALUS came around…it was just spite."
> All three ALUS non-members felt they could be better enticed to join the programme if payments recognized efforts to regenerate soils and helped maintain fair revenues to farmers as the basis for doing agriculture, rather than simply encouraging the installation of new land-use features (2019, 328).
> "They may have retired land for payment but might be destroying land elsewhere to compensate for the loss and doing more overall damage"...
> "They are giving farmers money to bribe them not to destroy land that they should never have been farming in the first place. Who else gets money to quit doing bad things in society?''...
> "They should be paying us for any and every regulation as a form of compensation." (2019, 329).
> "While they pay us, these government programs seem to imply that we naturally destroy the land and will only act with payment to fix the damage. This is condescending and unfair. We don't need to be environmentalists to take care of our soils. We wouldn't be able to farm otherwise." (2020, 78).

Previous literature has found that material incentives crowd out intrinsic motivation after some time (Bengtsson and Engström 2014; Cardenas et al. 2000) and that there is uncertainty about how long this deterioration of intrinsic values remains (Janssen and Mendys-Kamphorst 2004; Gneezy et al. 2011). According to Deci and Ryan:

> The vast amount of variance in human motivation is… a function of the more proximal sociocultural conditions in which actors find themselves. These social conditions and processes influence not only what people do but also how they feel while acting and as a consequence of acting. Most theories of human motivation have therefore focused on the effects of social environments, including

the rewards, incentives, and relationships inherent in them, to better understand
what activates and sustains effective functioning… (2008, 14).

Some Australian research seems to disprove the concept of crowding out. Duncan et al. (2014), working in Victoria, Australia's most populous state, found that private land owners kept restoring and revegetating their land "at a moderately increased rate" after government subsidies stopped (99). Some individuals were more likely to continue revegetation after subsidies ended, while others needed the subsidy to continue. Many landowners are not farmers, but "rural amenity" or "lifestyle" (99) owners. Duncan et al. caution generalizing the results from circumstantial data to other situations. They did not determine land-owners' motivations for continuing to do what they had done while subsidies took place. Duncan et al. (2014) conclude that any crowding out effects may have been countered by several decades of strong positive narrative for landscape restoration, both within the community and by the government (100).

In New Zealand, after the 1987 government restructuring due to financial collapse, farmers continued to plant trees without government assistance (Bradshaw et al. 1998). Both positive and negative effects were recorded after funding was withdrawn. Conservation was reduced for financial reasons, but farmers still did what they could to steward their land, including tree planting for erosion control and water quality improvement (17-18).

In England, cessation of the Entry Level Stewardship Agri-Environment Scheme (AES) in 2015 provided an opportunity to test whether motivational crowding would occur. Farmers were observed in how they continued with agri-environmental practices. Darragh and Emery (2017) concluded that a very complex relationship of intrinsic and extrinsic motivations exists among farmers. They found:

> Firstly, intrinsic and economic motives cannot be seen as mutually exclusive…
> Secondly... we question whether farmers' motives for the supply of public goods
> pre-AES were ever entirely intrinsic in the first place… Many of the public goods
> supplied by farmers prior to AES engagement can also be considered as
> incidental to the business of farming…

Third, farmers' conceptualisation of what constitutes an environmental/conservation practice often differs from what a conservationist or academic would consider. We have shown that some farmers do not see AES practices and conservation practices to be synonymous and they endorse their own environmental credentials by challenging the authority and knowledge on which AES measures are based.

Fourth, the farmers in our study use environmental and conservation-oriented discourses to justify certain farming practices that others would not consider as such. This represents farmers' ability to tap-into wider societal values in a somewhat strategic manner (385).

Darragh and Emery found crowding out theory to be a useful tool to examine PES payments under neo-liberal economics, but thought the theory to be overly simplistic:

Crowding theories appear overly simplistic because they treat motives as mutually exclusive and oppositional and fail to recognise that the behaviours they seek to explore are multifariously interpreted and highly contested in practice and discourse. Whilst crowding-out theories rightly challenge processes of environmental commodification, they need to do so in a more integrated manner. For it is through the very blurring of economic and cultural motives (and the failure to recognise them as such) that neoliberal agendas and their consequences are propagated (385).

Can programme design avoid motivational out-crowding?

Bowles and Hwang (2008) discuss the complexities of designing programmes to reduce market failures of public goods, where some individuals are altruistic and others are not. They admit that "some mechanisms provide incentives that induce even the civic-minded to act as if they were selfish" (1818). Thus "the fact that crowding out makes the incentive less effective requires its greater use" (1812), and: "The presence of incentives may also reduce the value of generous or civic-minded acts as a signal of one's moral character" (1813). Good social policy recognizes these complexities, and reaches a balance where altruism is not destroyed, yet results are maximized. It is also important to consider the outcome; the outcome of not reducing altruism may differ from the outcome of maximizing another policy goal. Policy would have to be modified or adapted, depending on the nature and extent of the crowding out of altruism expected to occur.

Ramsdell et al. (2016), who researched conservation of the ground nesting mountain plover with farmers in Nebraska, found the following regarding programme design:

> Based on our results and the literature, we posit a list of potential reasons (hypotheses) for perceiving this programme as supportive:
> 1. Choice and flexibility. Farmers have many ways they can engage with the programme. As their priorities shift, they can change how actively involved they remain in the programme without sacrificing conservation outcomes.
> 2. Obligation. Once nests are hatched, farmers face no further restrictions or responsibilities, and, other than lack of payment, accidental nest loss by machinery does not carry repercussions.
> 3. Feedback. Farmers receive rapid feedback on the outcomes of their behaviour. Successfully hatched nests provide information that increases farmers' knowledge and feelings of accomplishment in helping the species.
> 4. Ease of programme entry and exit. The programme has no enrolment criteria because any farmer's field has the potential to serve as habitat for the opportunistic mountain plover. Additionally, farmers re-enrol on an annual basis, allowing them the flexibility to enter and leave the programme based on their own changing priorities.
> 5. Professional engagement. The local farmer who works for Rocky Mountain Bird Observatory (RMBO) enhances participation and engagement through social capital: bonding ties with other farmers lead to linking ties between RMBO and farmers (Woolcock 2001). This facilitates feelings of relatedness between farmers and the organization (42).

One of the three foundations of Deci and Ryan's (2008) self-determination theory (SDT) of human nature is autonomy. Autonomy should be kept in mind when designing forest conservation initiatives (Akers and Yasué 2019; Olmsted 2017, 88).

In Ontario, the Environmental Farm Plan was autonomously begun by farmers in 1993 (Cressman 1995). To date, 35,000 farm plans have been registered under the Environmental Farm Plan (OMAFRA 2020) out of 49,600 farms in Ontario (Statistics Canada 2016a). 70% of farms have thus made a plan, a very high participation rate. A smaller percentage has reached step six, a peer review of their farm plan (PRA Inc. 2011). Several of its best management practices (BMPs) include tree planting and forestation (OSCIA 2020). The EFP has a long history of social capital formation among the farm community, and has the potential to continue as a major contributor to environmental change among farmers.

Limitations of the research

Limitations of the integrative literature review of farmers' motivations for forestation

The scope of the integrative literature review is farmers' motivations for forestation in OECD nations. 21 relevant articles were located within peer-reviewed literature, out of 1500 articles searched via the criteria illustrated in Appendix, Figure V. Most farm forestation research takes place in the global south.

The literature review identified the main theoretical frameworks underlying farmer motivational research regarding forestation. No attempt was made to integrate these various frameworks.

Research on farmers' motivations towards conservation measures other than forestation can apply to farmers' motivations towards forestation, and several are cited in this work. Future integrative reviews could examine how specific theoretical frameworks are employed, as Sok et al. (2020) have done for Ajzen's (1991) Theory of Planned Behaviour (TPB). Deci and Ryan's (2008) Self Determination Theory (SDT) and basic psychological needs (BPN) models deserve further attention in this way. Instead of attempting to unite theoretical frameworks, one could examine how the research employs a framework, how helpful the framework is in describing situations, and which extensions or modifications to those frameworks are proposed. Any such review or meta-analysis could be broader than farmers' motivations towards forestation in the OECD.

Limitations of key informant interviews

The purpose of interviewing key informants is to gain information from a small group of people with direct knowledge and experience of forestation in the South Nation River watershed, and compare these results to the findings of the integrative literature review.

Seven key informants agreed to be interviewed. Those interviewed represent conservation-minded farm leaders, and do not accurately represent all farm views or farm organizations in the region. GFOs were represented by three interviewees, and seven commodity and conservation groups were represented. Two large farm groups that were not represented by informants include the Grain Farmers of Ontario and the Union des Cultivateurs-Franco-Ontariens (UCFO).

Final thoughts

Lessons for forestation in southern Ontario's mixedwood plains ecozone

The existing policy responses: the 50 million tree program, CLTIP and MFTIP to protect existing forests, and a lack of stringent regulations, will not reverse deforestation to net afforestation in southern Ontario's mixedwood plains. Public policy needs strengthening to protect our wetlands and forests, and the ecosystem services they provide.

Key informant farmers in the South Nation River watershed do what they can about forestation and other conservation measures on their land, but are constrained by economics and lack of marginal lands to return to forest. They have little manoeuvering room to aid forestation efforts.

Would monetary incentives like the EU and the US provide, be enough to prevent deforestation in southern Ontario's mixedwood plains? Results of choice experiments in the Grand and Upper Thames watersheds of Ontario show that farmers are willing to accept approximately the yearly land rental rate to preserve or restore agricultural lands to wetland, meadow and/or forest (Trenholm et al. 2017; Trenholm 2018). Residents of these watersheds are also willing to pay something towards wetland protection (Trenholm 2018, 126-164).

Land rental rates are higher in southern Ontario than in the Canadian prairies or in the US. The average per-acre CRP payments in the US are USD $82 per acre (Newton 2020) for agricultural land retirement. In the EU, CAP payments average €166 per hectare for productive land (Ruiz 2021, Table 1). A payment system incorporating ecosystem services into agricultural subsidies could be set up in conjunction with ecological cross-compliance, such as in the EU. Canadian farm subsidies vary widely and are lower than the EU or the US. It would require a major shift in Canadian agriculture policy to move towards "multi-functional" CAP style payments that include ecological cross-compliance.

The root causes of deforestation – unfettered urban growth, including exurban consumption of agricultural land, agricultural expansion, biofuel subsidies, and others – need solutions also. Low-cost trees, stringent regulations, ecosystem payments and/or tax incentives can slow deforestation, but policy must also address the root causes of deforestation, or progress will be slow.

How existing policies and proposals impact net deforestation needs evaluation
The existing *afforestation* policy of supplying low-cost trees to qualified land owners, at less than 10% of 20th century amounts (Los 2010), needs a review. Why are farmers' participation rates lower than those of non-farmers? Is land still available for afforestation in southern Ontario's mixedwood plains (Bird and Boysen 2007, Table 1)? Would afforestation increase if the proposed incentives (2007, Table 1) were paid in 2021?

There are proposals, programmes and projects *to prevent deforestation,* such as a zero municipal tax rate for managed forests (Environmental Commissioner of Ontario 2018, 66), conservation easements (Ontario Nature 2003; Atkins et al. 2004), and voluntary forest carbon sequestration offsets (OMECP 2018; The Working Forest 2021). These need to be examined carefully to see if and how the farming community would participate in these to protect forested lands on their property.

The SNC, for example, supports the development of carbon sequestration offset projects (Coleman and South Nation Conservation 2018). This has aided Bruce County's public sector forests (Nielsen et al. 2019), and could help fund SNC's public forests via the EOMF (Boakye-Danquah and Reed 2019). Would it also conserve farm woodlots?

Lastly, and importantly, the annual amount of exported deforestation from southern Ontario's consumption should be determined and published, as in the EU. Is it improving or worsening? If deforestation is prevented in southern Ontario's mixedwood plains, will this deforestation ensue elsewhere, and will the resultant ecological damage be worse than had it occurred here? Optimal ecological solutions for global forest protection can begin when each region measures and publishes its annual net global deforestation.

Appendices

Frequency of publications by year (1990-2021) re. farmer motivation of forestation on their land (EU, USA, Canada, Australia, UK)
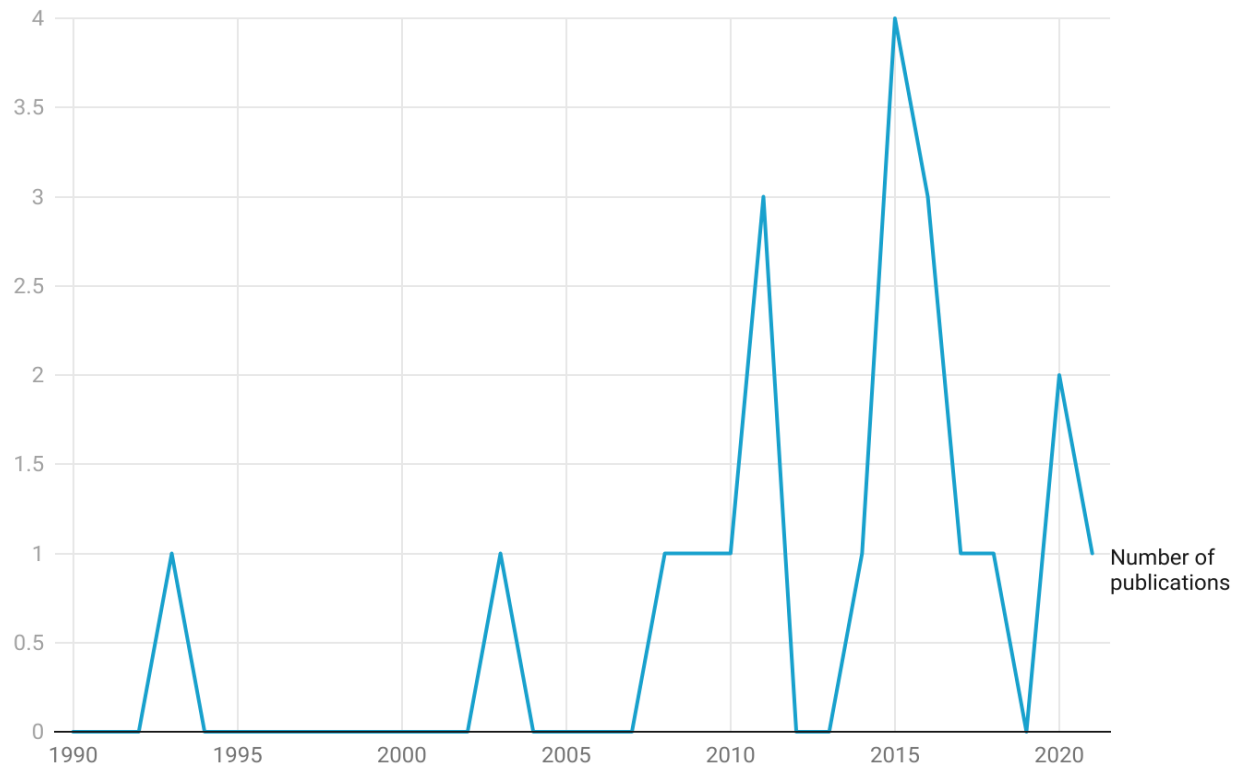
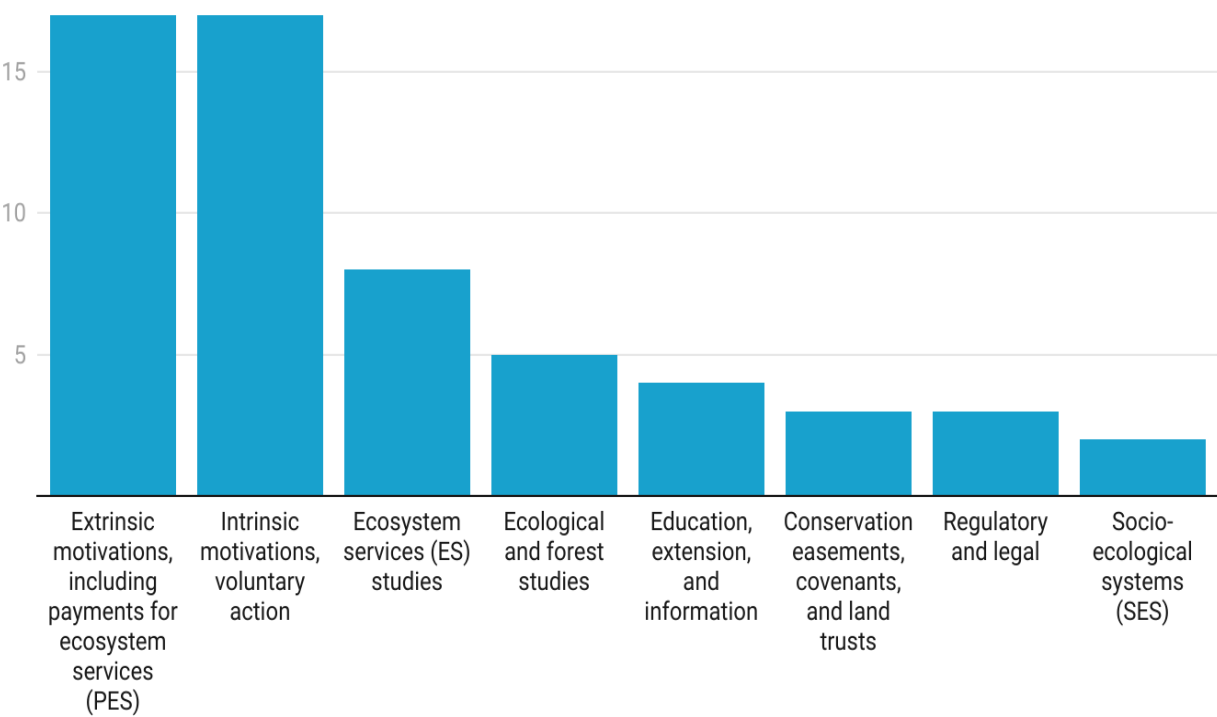Created with Datawrapper

Figure I

Number of publications (1990-2021) re. farmer motivations of forestation on their land (EU, USA, Canada, Australia, UK)
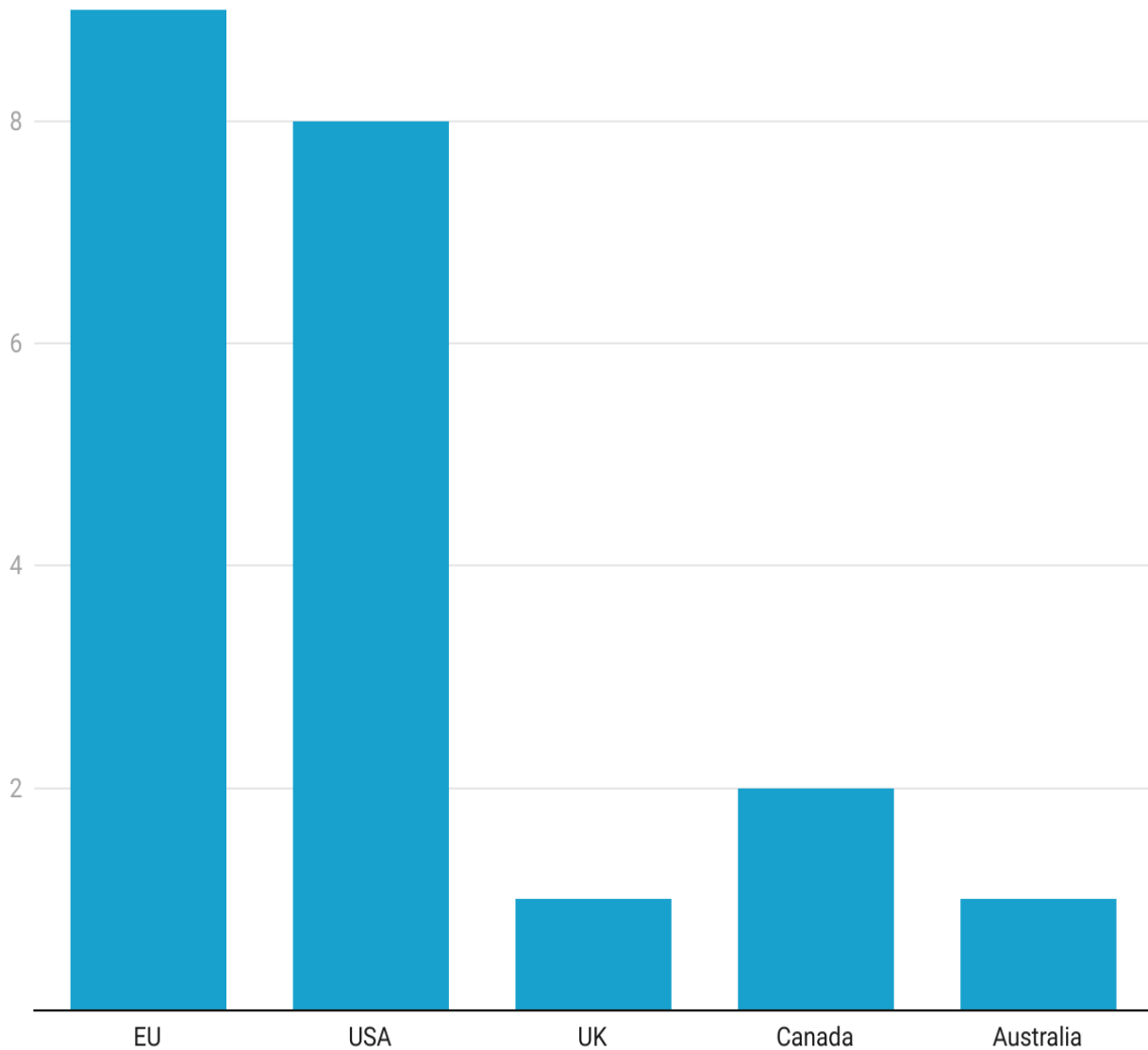
Created with Datawrapper

Figure II

Research emphasis of publications on farmer motivations to establish and/or restore forested landscapes in the OECD

Figure III.

Key word frequency in literature review articles

Column 1- total words -------------------------- Column 2 - number of articles with this word

	Column 1	Column 2
forest	3,084	21
farmer	838	20
management	773	21
conservation	766	21
landowner	659	17
economic	593	21
ecosystem	498	16
services	491	18
water	431	16
private	384	17
motivation	341	20
social	312	19
habitat	276	17
regulation	215	14
agriculture	213	20
recreation	204	16
family	184	14
biodiversity	173	16
community	168	16
payment	143	13
voluntary	132	10
education	110	15
ecology	97	14
riparian	91	11
adoption	72	11
health	56	11
intrinsic	51	9
easement	45	5
multifunctional	37	7
extrinsic	36	8

Chart: Martin Mostert • Created with Datawrapper

Figure IV

57
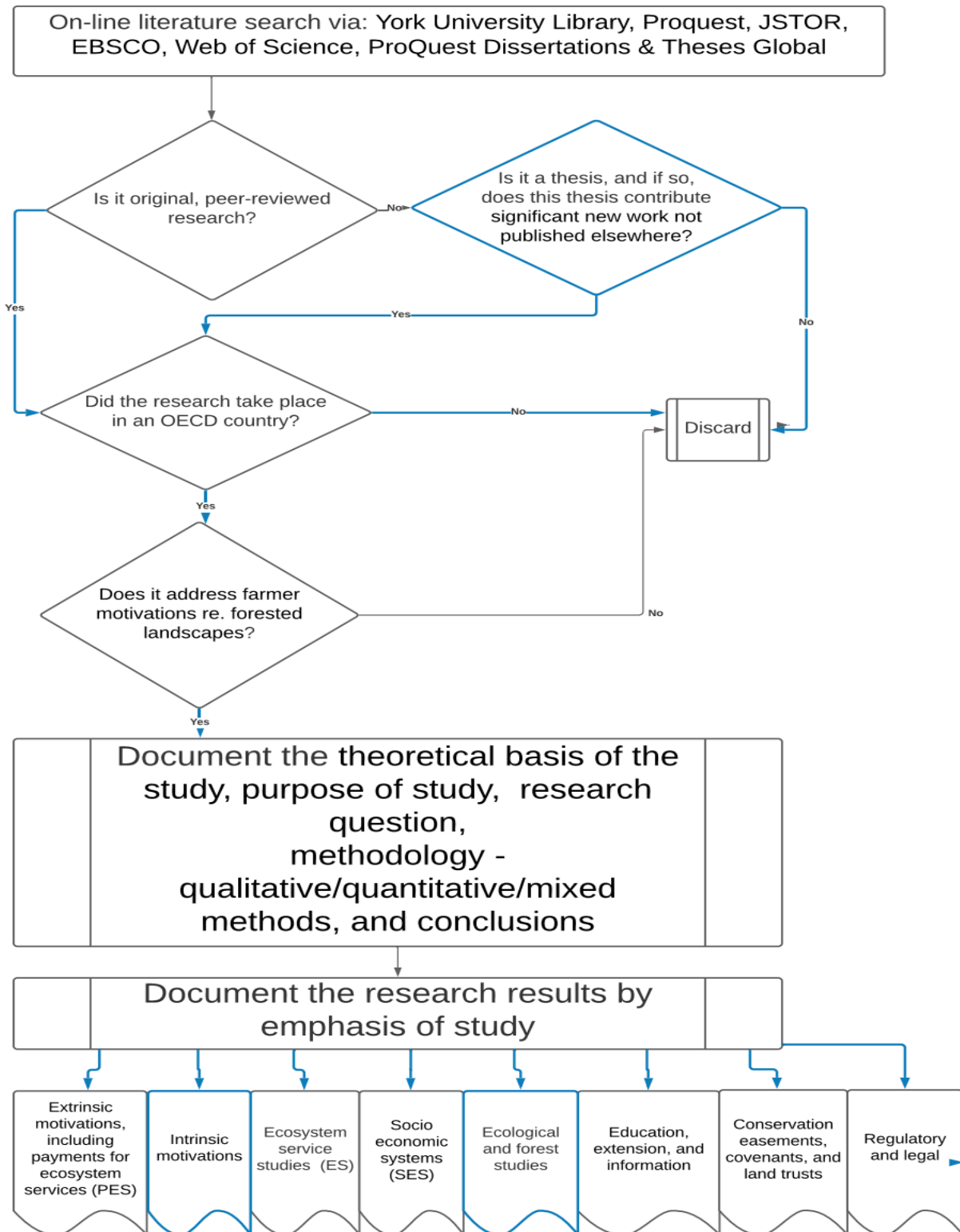
Figure V − Flow chart of on-line literature search method

Census of Agriculture - Total area of farms, Ontario 1921-2016 (ha)
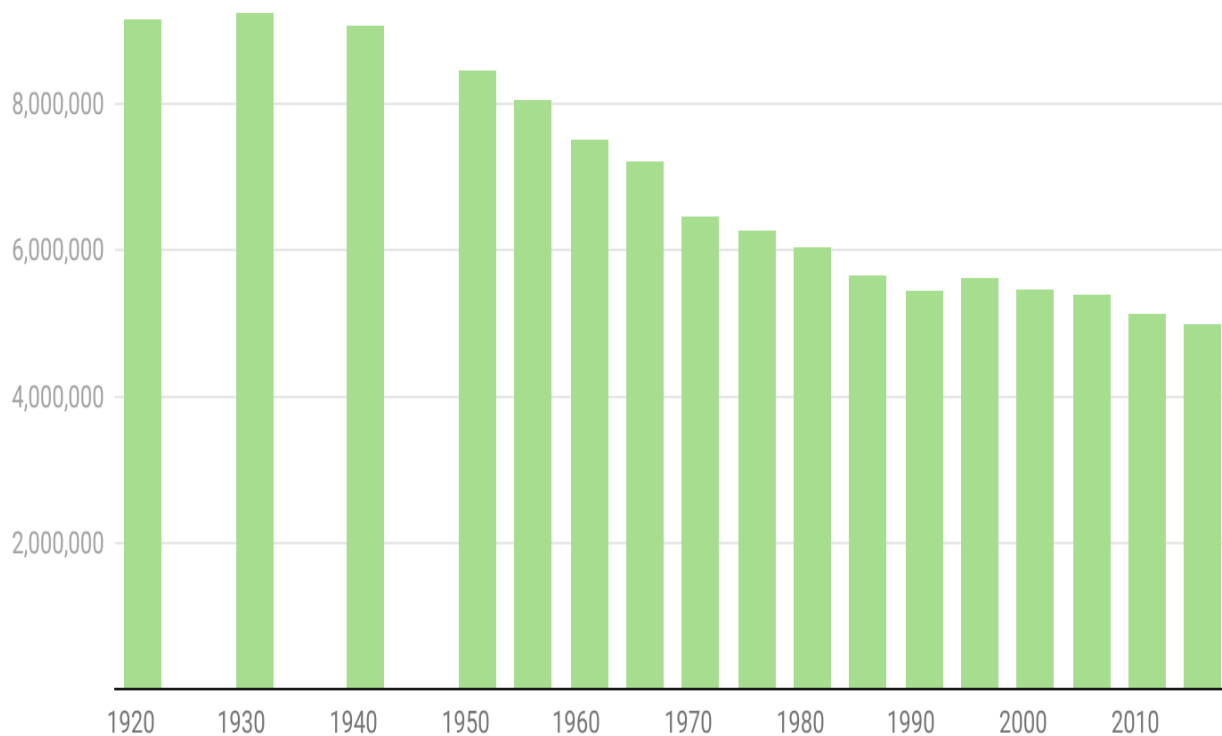
2021 data not available. For Ontario Census of Agriculture 1871-1911, see: https://dataverse.scholarsportal.info/dataset.xhtml?persistentId=hdl:10864/11150

Chart: Martin Mostert • Source: Statistics Canada • Created with Datawrapper

Figure VI
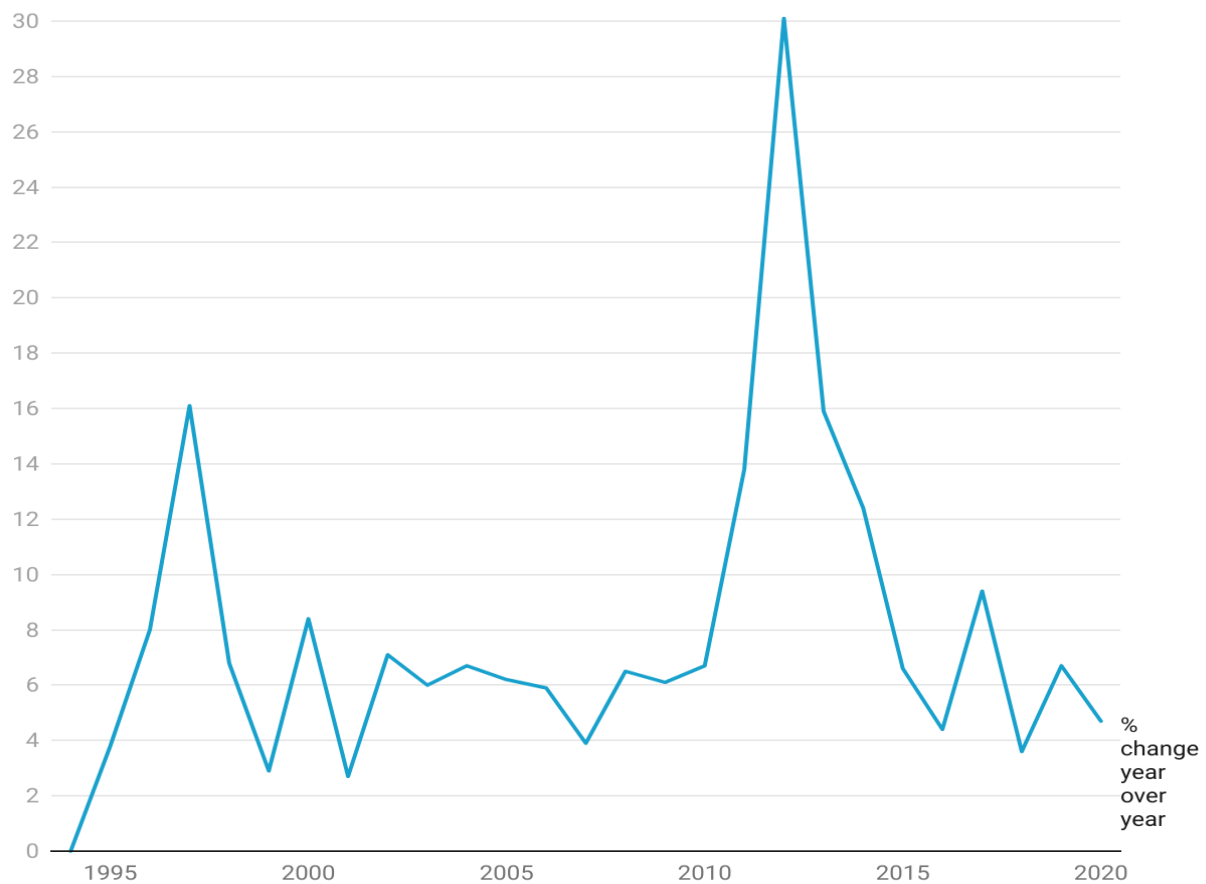
FCC- Ontario Farmland Prices % increase 1994-2020

Chart: Martin Mostert • Source: Farm Credit Corporation • Created with Datawrapper

Figure VII

Key informant questions template

The following interview questions were posed:

A. Identifying information:
    1   Crops grown, acres owned/rented, soil type, tile drainage?
    2   full/part time farmer, age, education, gender, etc.
    3   How much non cultivated, pasture, forest, and wetland is on your farm?

B. Views of nature, conservation, family legacy:
    1   Can you describe experience(s) which expanded your sense of connection to nature?
    2   Should we actively conserve nature?
    3   Describe your views of stewardship and land conservation
    4   Describe your views of land inheritance

C. Views on reforestation/deforestation, and knowledge of existing programs:
1   Have you ever planted trees? Have you cleared land before?
2   Can trees be profitable? Can they harm your operation?
3   Would you consider planting trees on rented land?
4   Should society pay for the benefits of trees on farm property?
5   Should society pay for the benefits of trees on private property?
6   Is there land available on your farm to plant trees? Estimate acreage? Would you plant, and under which conditions?
7   Which existing programs, projects, and tax incentives are you aware of, to preserve forests or to increase them? Thank you very much for your participation!

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