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# A Framework for Policy Innovation and Reform for Environmental Conflicts in Ontario Agriculture

Paper prepared for CAPI

by

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## Abstract[1]

Agricultural production practices in developed country agricultures are coming under increased scrutiny with respect to the effects of those production practices on various aspects of environmental protection. This scrutiny has contributed to an increasingly complex and sometimes controversial set of actions, by governments, aimed at reducing environmental problems associated with contemporary agriculture. The purpose of this essay is to outline a framework for agricultural-environmental policy that integrates recent contributions to the economic theory of policy with evidence-based policy making. The primary focus of this effort is on conflicts associated with agricultural production in Ontario. I use the framework to identify important examples of misdiagnosis of the causes of environmental problems related to agricultural production and also to identify problems that have arisen from the misapplication of some standard economic policy measures. I discuss some important challenges to the reform of agricultural-environmental policy within the Canadian context.

[1] This paper was commissioned by CAPI for the "Optimizing Land Use for Sustainable Growth" dialogue that was held in Guelph, Ontario, on April 24, 2019. The dialogue Agenda can be found here: https://capi-icpa.ca/events/capi-dialogues/optimizing-land-use-for-sustainable-growth-capi-guelph-dialogue-april-24-2019/ Glenn Fox's paper is based on the presentation he made at the dialogue, found here: https://capi-icpa.ca/explore/resources/the-role-of-ation-for-policy-instruments-in-adressing-environmental-externalities-in-agriculture/

## Introduction

I joined the faculty in what was then called the Department of Agricultural Economics and Business at the University of Guelph in November 1985. One of my first research projects involved the economics of soil erosion. The Sparrow (1984) Report had been published the previous year.[2] The main finding of that report was that soil erosion was then costing Canadian farmers $1billion per year in farm income.[3] The Sparrow Report argued that Canadian agriculture faced an erosion crisis and that the future of the sector hung in the balance. As an illustration of the principle that, from an academic point of view, there is no such thing as a bad crisis: the bigger the crisis the bigger the research grants, I got a grant to fund some graduate students to do research on the economics of soil erosion in Ontario. We failed to find evidence[4] that soil erosion posed an immediate threat to agricultural productivity in Ontario. We did, however, find that soil erosion from cropland in Ontario was costly. But the costs were not accruing on the farm. Displaced sediment from erosion was imposing significant costs[5] downstream from the farm, in the form of increased water treatment costs, damage to fish habitat, and increased costs for municipal infrastructure maintenance. It occurred to me at the time that I was curious as to why the people downstream who bore these costs did not seem to have any recourse against the farmers whose actions resulted in these costs.

A few years later, I was part of a delegation of University of Guelph faculty visiting agricultural universities and research institutes in Germany and the Netherlands. Our hosts for the German portion of the visit organized a one-day tour of the Black Forest. During the day, we stopped for refreshments at a medium-sized town. This was an old walled settlement, on a river. The river had been diverted around the town to serve, I assume, for defensive purposes in a bygone era. After we parked the van, we walked across a footbridge over the river to get to the town. I happened to look down at the river when we were about half-way across the foot bridge. I was transfixed by what I saw, to the point that everyone else in our group continued on to the town and I was left standing by myself, looking down into the river. Once our German hosts

[2] The Senate Committee on Agriculture, Fisheries and Forestry Report on "*Soil at Risk: Canada's Eroding Future".*
[3] According to Statistics Canada, net farm income was about $2.8 billion in 1985.
[4] We were not alone among agricultural economists in failing to find the effect that the Sparrow report claimed. The American Agricultural Economics Association (1986), Crosson and Stout (1983), Crosson (1982) and others reached similar conclusions.
[5] See Fox and Dickson (1990) as well as Fox *et al* (1995).

realized that they had lost one of their guests, they retraced their steps to find me, on the bridge, looking at the water. Really, I was looking at something in that water: large brown trout swimming lazily below. I have been looking at rivers in Canada since I was about 4 years old. Our German hosts could not understand why I was so fascinated by these large, abundant fish. I explained that I had never seen anything like this in Canada, a statement that surprised them. I went on to say that if this situation were to arise in Canada, the riverbanks would be lined with anglers and that, in short order, the fish would be gone. They found this confusing. They explained (and to clarify, they were not from this town nor were any of them anglers) that the fish that I was watching were owned by someone. They didn't know who the owners of these particular fish were. They might be owned by a club, a family, a municipality or even an individual. And anyone who wished to fish for these trout would first have to obtain permission from their owner. I was astonished by this statement. How is it that this fugitive resource, these wild animals, could be owned by someone? But the contrast with the situation that I had observed in Ontario was clear. The brown trout in Ontario, ironically, descendants of brown trout transplanted from Germany, lived much different, arguably worse lives than their distant relatives. I remember being curious about this as well. Why is it that brown trout seem to be treated so much better in Germany than in Ontario?

These two early-career experiences turned out to be foundational to my teaching and research that I have conducted at Guelph. What role do institutions, particularly property institutions, play in the genesis of environmental conflicts? Agricultural production practices in the developed economies are being increasingly examined for their environmental effects. The purpose of this essay is to outline an economic framework to help us understand the nature and the origins of environmental problems associated with developed-country agriculture.

Environmental problems can be viewed from multiple perspectives. In this essay, I adopt a perspective advocated by Roy Cordato (2004), who characterizes environmental problems as interpersonal conflicts. This is not the traditional way that environmental economists or environmentalists have viewed environmental problems. The advantage, in this context, of Cordato's approach, is that it avoids invoking problematic or controversial standards like efficiency or morality. Environmental problems occur when two or more people disagree about how some aspect of the natural world is to be used. The challenge, in this situation, is to find a peaceful way to resolve this interpersonal conflict.

## An Economic Taxonomy of Environmental Problems Associated with Agriculture in Ontario

Environmental conflicts involving agriculture in developed countries can be differentiated using four standard categories of market failure from contemporary welfare economics. The four categories are: 1) excessive discounting, 2) externalities,[6] 3) public goods problems, and 4) common pool resources (Table 1). But market failures are not the only reasons that environmental conflicts occur. Categories of non-market or policy failure also apply, particularly problems of *derived externalities* and distributional inequities.[7] Categorization of agricultural environmental conflicts, according to these categories is necessary for effective diagnosis and remediation. Each category is associated with a specific set of corrective actions or remedies (see Table 2). Placing a specific problem in the wrong category can lead to misapplication of remedies.

**Table 1: An Economic Taxonomy of Environmental Problems Associated with Agriculture in Ontario**

| Category | Examples |
|---|---|
| Excessive Rate of Time Preference | Soil Fertility, Agricultural Land Conversion |
| Externality / Legalized Nuisance | Displaced Sediment, GHG emissions, Bacterial Contamination of Ground and Surface Water, Excess Nutrients, Noise, Odour, Flies, Drainage (off site effects), Smoke, Dust, Noise, Light |
| Public Goods | Habitat Loss, Wetland Drainage, Woodlot Clearing |
| Common Pool | Groundwater Depletion and Surface Water Diversion for irrigation |

1) Excessive Discounting

People exhibit *time preference*. At a very general level, this means that people would rather achieve their purposes sooner rather than later, *ceteris paribus*. It is possible that *time preference* is a biological imperative. An organism that does not exhibit *time preference* would

[6] For further discussion about *externalities* in agriculture, see CAPI's papers by van Kooten, found here: https://capi-icpa.ca/wp-content/uploads/2019/03/2019-02-22-CAPI-land-use-dialogue-Van-Kooten-Paper_WEB-5.pdf and here: https://capi-icpa.ca/wp-content/uploads/2016/08/A-summary-of-the-environmental-impacts-of-agriculture-in-the-Netherlands-2016.pdf.

[7] See Wolf (1979, 1980) for detailed discussion of the theory of non-market failure.

be indifferent between eating right now or later today or next week or next year. Natural selection would likely result in the disappearance of the genetic material of such an organism. The problem of *excessive discounting*, as a category of market failure, maintains that there are situations in which this general human attribute of *time preference* leads to undesirable outcomes. Typically, this involves resource allocation problems over long time periods. Even low rates of *time preference*, applied on a scale of 100 to 200 years, would result in a small weight or importance being applied to the future costs and benefits of present action. The problem of *excessive discounting* arises when people are judged, by economists, to be considering future benefits and costs with an excessively high rate of *time preference*. Another way to express this is that the present value of those future benefits or costs is too low. The literature is confused as to why people might do this. Sometimes authors invoke a risk argument. But allowance for risk is conceptually different from *time preference*. The textbook remedy for *excessive discounting* is to use what is called a *social discount rate*, which is numerically a rate lower than the rate at which people, if left to their own devices, would discount future events.

Forestry is a commonly cited example. The present value of a tree at harvest, if the tree takes 300 years to mature, is virtually nothing. So why would anyone plant (or preserve) such a tree? In the context of agricultural environmental problems, topsoil erosion and the conversion of agricultural land to non-agricultural uses are sometimes interpreted as problems of *excessive discounting*. As the standard argument goes, farmers might recognize that current production practices are reducing the future productivity of their land, but this future productivity loss is too far removed from the present to have a high enough present value to make it worthwhile to undertake soil conservation measures today. On the conversion of agricultural land to non-agricultural uses, the argument is that while there may be more highly valued uses for this land today in non-agricultural employment, in the future, higher demand for food might make it worth retaining this land in agriculture for that future situation, but *excessive discounting* makes this action unattractive.

2) Externalities

A second traditional category of agricultural environmental pathologies is *externalities.* More recently, the theory of non-market failure has added *derived externalities* or *legalized nuisances* as an alternative explanation for this class of conflict. Most environmental conflicts involving agriculture in Canada fall into this complex category. Displaced sediment from soil

erosion, often along with associated nutrients and other chemicals, which damages water quality off the farm, is an important example in this category. Greenhouse gas emissions, bacterial contamination of ground and surface water, excess nutrients and water quality, pesticide migration, noise, odour, flies, the off-farm effects of drainage, dust and even light have resulted in conflicts between farmers and their neighbours in Ontario.

**Table 2: Economic Remedies for Market and Non-Market Failure Problems**

| Category | Examples |
|---|---|
| Excessive Rate of Time Preference | Apply the Social Discount Rate |
| Externality / Legalized Nuisance | Emission Taxes, Tradeable Permits, Regulations, Legal Reform/Liability/Litigation |
| Public Goods | Finance Through General Tax Revenue, Zero Marginal Cost to Beneficiaries |
| Common Pool | Extraction Permits (Quotas), Fees, Regulation, Common Law, Voluntary Negotiation, Clarification of Property Rights |

The standard welfare economics textbook remedy for *externality* problems is to use regulations, emission pricing or tradeable permits to control the level of the *externality* (Table 2). The non-market failure explanation, however, suggests that the actual cause of the problem might be legalization of *nuisance* or of violation of riparian land-owner rights. *Nuisance* is a category of tort in common law. For present purposes, a *nuisance* is an action that places or causes to be placed something on the property of someone else leading to a reduction in the use or enjoyment of property of that person. *Legalized nuisance* arises when a court or legislature decides that an action that would otherwise be a nuisance will not be subject to the normal common law sanctions against *nuisances*. Violation of riparian land-owner rights occurs when someone diminishes the quantity or impairs the quality of water which is adjacent to the land of a riparian landowner.

Elizabeth Brubaker (2007) has argued that many, if not all, apparent *externality* problems associated with Canadian agriculture are really *legalized nuisances* or legalized interferences with riparian rights of landowners rather than *externalities*. They are, in the theory of non-market failure (Wolf, 1979, 1980) *derived externalities* rather than *externalities*. Legalization of

*nuisance*, according to her analysis, is generally implemented with so-called "right to farm" legislation. This distinction between *externalities* and *legalized nuisances* is critical to the resolution of agricultural environmental conflicts. In one case, remediation involves the introduction of measures to create incentives for farmers to internalize the external costs that their activities generate. In the other case, remediation involves dismantling legal limitations on liability.

3) Public goods problems

The third category of environmental conflicts facing the agricultural sector is *public goods problems*. Economists have a specific technical definition of a *public good*. A *public good* has two characteristics. It is *non-rival* in consumption and it is difficult or impossible to exclude people who have not contributed to the provision of a *public good* from benefiting from the existence of that good. *Non-rival* consumption means that one person can consume as much as he or she wants of a good and there is no less of that good available for others to consume. Many textbook examples purported to be *public goods*, such as lighthouses, national defence and roads, are actually not *non-rival* in consumption. But several areas of environmental conflict involving agriculture do seem to fit the *non-rival* consumption definition. Protection of wildlife habitat, including habitat of threatened species, preservation of woodlots and wetlands, all of which are sources of tension between some members of the agricultural community and the non-farm public, are *non-rival* goods in consumption. The preservation of habitat to sustain endangered species, in theory, generates benefits for the whole community. One person can enjoy (benefit from) the existence of habitat, a woodlot, a wetland, and there is no less opportunity for everyone else to enjoy this same experience.

*Public goods* give rise to what economists call *free rider* problems. *Free riding* means deriving benefits from the existence of the *public good* without contributing to its provision. If everyone tries to ride for free, however, in the limit, there will be no provision. In less extreme cases, provision is thought to be at a less than efficient level: that is where the benefit of the last unit of the *public good* is greater than the cost of provision of that last unit.

The economic remedy for *public goods* is to use general tax revenue to finance the provision of the *public good* and then to distribute that good at no charge to beneficiaries. Of course, that is not the approach that has been used in Canada with respect to the conservation of endangered species habitat, woodlots or wetlands. The typical approach relies on planning and designation.

When habitat, woodlots and wetlands are identified, they are designated as areas to be protected through land use planning. The problem with this approach is that, while it might generate benefits for the general public, the general public is *free riding*. They don't contribute to the provision of the *public good*. The rural landowner picks up the tab, in the form of reduced income or reduced land value. It is not surprising that actual policies in this area are controversial. Planning and designation turn environmental assets (to the community) into liabilities (for individual landowners). A full application of the *public good* model would use revenue from general taxation to compensate the rural landowner for the income or wealth losses attributable to the provision of habitat.

4) Common Pool Resources

A final category of environmental conflict involving agriculture in Canada is what economists call *common pool resources*. The main conflict in this category is the use of water, either ground or surface water, for irrigation. *Common pool resources* can be accessed by multiple people, but there are limits to the size of the group with such access, unlike open access resources. An example would be an aquifer located under several parcels of land. Harmful interdependence among the owners of these parcels of land can arise if each owner acts in an uncoordinated way to access and extract water from the aquifer. Uncoordinated extraction of groundwater can exceed recharge rates, resulting in increasing pumping costs in the future and even to land subsidence (sinking). Petroleum deposits can be subject to the same type of harmful interdependence problems. Unitization of the *common pool resource* is one way to eliminate this harmful interdependence. Contracting among surface rights owners or regulations are also used to reduce harmful interdependence.

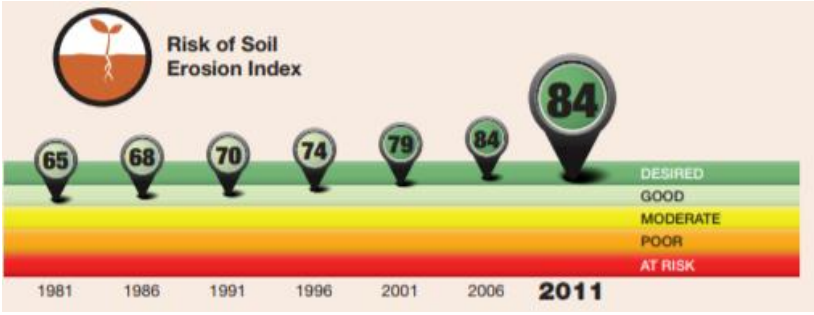
Diversion of surface water for irrigation purposes, including the construction of dams, reservoirs, and canals, also raises *common pool resource* problems. Here the tension is between upstream and downstream users as well as between extractive users and beneficiaries of in-stream flows. Like subsurface *common pool resources*, there is a limit to the number of parties that can access these water resources, so they are not open access resources. But uncoordinated action by one party can have adverse effects on other parties. Riparian and prior appropriation criteria have been applied as a means of mitigating potential conflicts, just as have regulations, contracting and water markets. The use of ground and surface water for irrigation in Ontario is currently limited. But some climate change scenarios, as well as some agronomy literature on

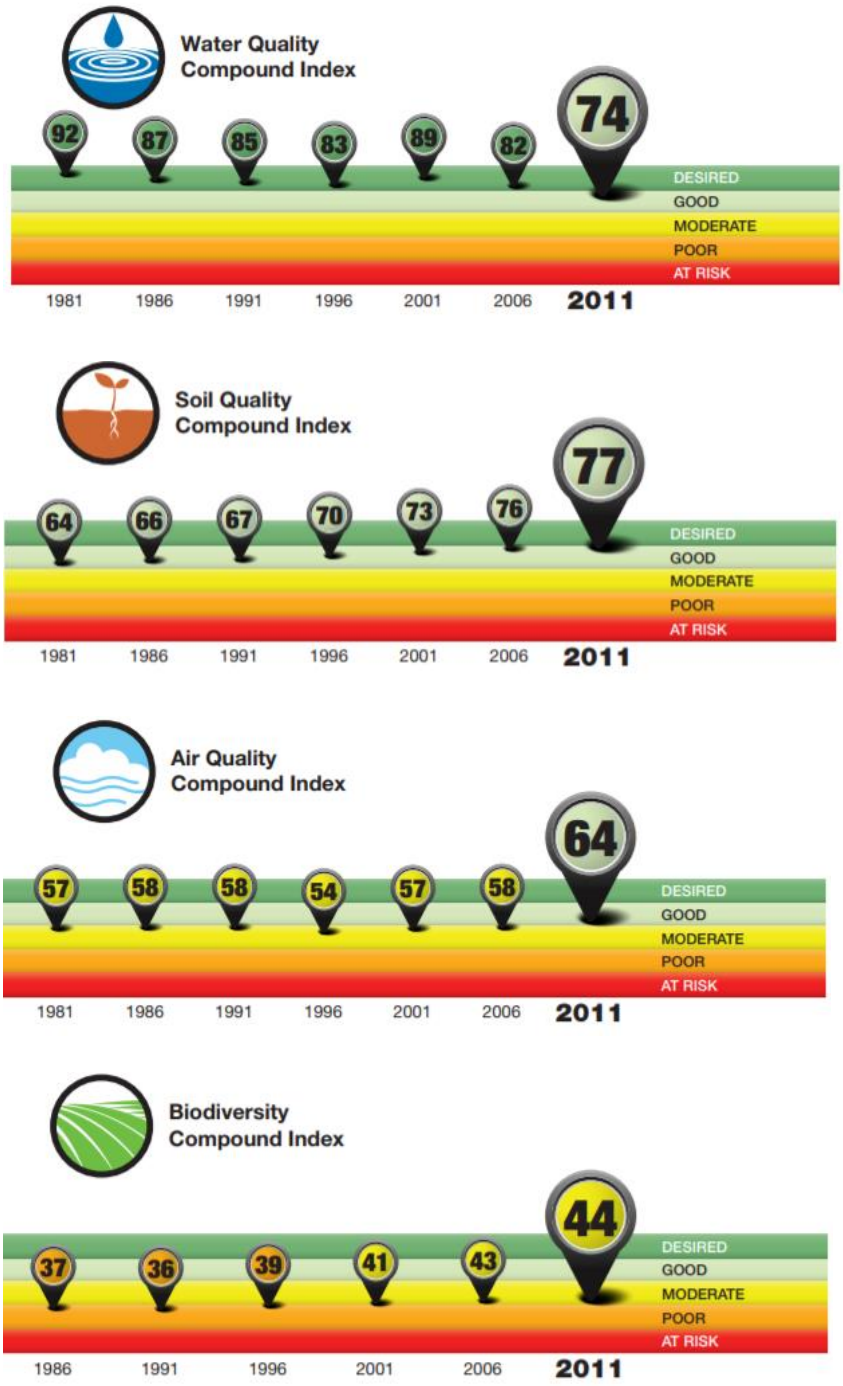
yield limitations, suggest that irrigation may be more widely applied in Ontario agriculture in the future.

**How Significant are these Problems?**

Agriculture and Agri-food Canada's agriculture and environment indicators project began in 1993 (McRae *et al.*, 2000). The project has developed a set of indices of environmental performance for the Canadian agricultural sector. These indices extend from 1981 to 2011. The fourth report of the project (Clearwater *et al.*, 2016) is the most recent summary of the results of these calculations, based on the 2011 agricultural census. The project provides an important national assessment or report card on the state of the relationship between agriculture and various indicators of environmental performance over time. Figure 1 presents selected results from the project for five categories of environmental outcomes. Index number calculations occur at 5-year intervals to coincide with the agricultural census. Index number values are interpreted on a scale from "At Risk" to "Desired." The *Risk of Soil Erosion Index* increased from a level of 65, or 'Good', in 1981, to a level of 84, or 'Desired', in 2011. In comparison, the *Biodiversity Compound Index* was at a level of 37, or 'Poor', in 1981. It increased to a value of 44 by 2011, but this is only in the 'Moderate' range. *Water quality* has been moving in the opposite direction, starting at a level of 92, or 'Desired' in 1981, and falling to 74, or 'Good', in 2011.

**Figure 1: Selected Results Agriculture and Agri-food Canada Environmental Indicators Project**






Source: Clearwater et al (2016)

## The Ontario Normal Farm Practices Protection Board and Farmer-Non-farmer Complaints

The *Ontario Normal Farm Practices Protection Board* was established under provincial legislation in 1998.[8] It mediates disputes between farm and non-farm neighbours in rural Ontario. The mandate of the Board is to balance the needs of the agricultural community with the health, safety and environmental concerns of rural residents of the province. The Board publishes annual tabulations of disputes under various categories. Table 3 summarizes the complaints received by the Board by fiscal year and by category from 2008 to 2017. Odour, noise, and flies have been the most frequent categories of complaints received by the Board. These are all examples of *legalized nuisances.* The mission of the Board is to determine what constitutes normal farming practices in the province of Ontario. Once established, normal farming practices establish the base line for negligence. As long as a producer is engaging in a normal farming practice, he or she would not be found negligent and hence liable for causing a nuisance. It is not insignificant that the full name of the organization is the Normal Farm Practices Protection Board.

**Table 3: Complaints Received by the Ontario Normal Farm Practices Board, 2007-2017**

| Year | Odour | Noise | Dust | Flies | Smoke | Light | Vibration | By-Law | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2016-17 | 66 | 68 | 2 | 21 | 2 | 0 | 0 | 18 | 177 |
| | 37% | 38% | 1% | 12% | 1% | 0% | 0% | 10% | 100% |
| 2015-16 | 45 | 28 | 2 | 20 | 0 | 1 | 1 | 10 | 107 |
| | 42% | 26% | 2% | 19% | 0% | 1% | 1% | 9% | 100% |
| 2014-15 | 48 | 45 | 2 | 20 | 1 | 0 | 0 | 15 | 131 |
| | 37% | 34% | 2% | 15% | 1% | 0% | 0% | 11% | 100% |
| 2013-14 | 53 | 56 | 7 | 18 | 3 | 0 | 0 | 19 | 156 |
| | 34% | 36% | 4% | 12% | 2% | 0% | 0% | 12% | 100% |
| 2012-13 | 65 | 42 | 7 | 35 | 3 | 3 | 0 | 9 | 164 |
| | 40% | 26% | 4% | 21% | 2% | 2% | 0% | 5% | 100% |
| 2011-12 | 77 | 73 | 10 | 34 | 4 | 6 | 0 | 2 | 206 |
| | 37% | 35% | 5% | 17% | 2% | 3% | 0% | 1% | 100% |
| 2010-11 | 46 | 70 | 11 | 12 | 0 | 3 | 1 | 7 | 150 |
| | 31% | 47% | 7% | 8% | 0% | 2% | 1% | 5% | 100% |
| 2009-10 | 43 | 72 | 6 | 4 | 2 | 0 | 0 | 9 | 136 |
| | 32% | 53% | 4% | 3% | 1% | 0% | 0% | 7% | 100% |
| 2008-9 | 43 | 111 | 7 | 7 | 2 | 0 | 1 | 5 | 176 |
| | 24% | 63% | 4% | 4% | 1% | 0% | 1% | 3% | 100% |
| 2007-8 | 103 | 71 | 17 | 5 | 3 | 0 | 0 | 4 | 203 |
| | 51% | 35% | 8% | 2% | 1% | 0% | 0% | 2% | 100% |

Source: Government of Ontario, Normal Farm Practices Protection Board Annual Report (Various Years)

[8]Found at this link: http://www.omafra.gov.on.ca/english/engineer/nfppb/nfppb.htm

**Water Quality in the Great Lakes**

Water quality in Lake Erie has been one of the most high-profile environmental conflicts linked to agricultural production in Ontario. Excess phosphorus has been linked to algae blooms and other problems. Dove and Chopra (2015) provide a comprehensive summary of historical basin-wide water quality measurements for the Great Lakes. They report concentrations for spring open lake concentrations for total phosphorus, soluable reactive phosphorus, nitrate and nitrite, soluable reactive silica, open lake summer chlorophyll concentrations and summer open lake Secchi depths for Lake Superior, Lake Huron, Lake Michigan, central Lake Erie[9] and Lake Ontario. Their data extend from 1970 to 2013, however there are some noteworthy gaps in the Lake Erie data series. The *Great Lakes Water Quality Agreement* sets targets for total phosphorus in the Great Lakes.[10] The target for Lake Superior and Lake Huron was 5 $\mu$gP/L. The target for Lake Michigan was set at 7 $\mu$gP/L. The target for central Lake Erie, eastern Lake Erie and Lake Ontario was 10 $\mu$gP/L and the target for western Lake Erie was 15 $\mu$gP/L. I will focus on phosphorus data, based on the authors' assessment that Great Lakes offshore waters are generally phosphorus limited, with respect to eutrophication. Dove and Chapra (2015, Figure 2) report that spring, open lake total phosphorus loadings have trended downwards from their 1970 levels. A trend line fitted to the Lake Superior data indicate that concentration was below the target already in 1970. The concentration in Lake Michigan was below the target for that lake in 1980 and has trended downward since then. The concentration in Lake Huron fell below its target in about 1990, with considerable variation around a downward trend starting in that year. The trend for Lake Ontario reached the target for that lake in about 1990. It is Lake Erie that has been the focus of water quality concerns in the Great Lakes, and this continues to be the case. Data for central Lake Erie indicate that the trend in concentrations has fallen substantially from the levels observed in the 1970s until almost reaching the 10 $\mu$gP/L target by 2013. They don't present a plot of the data for the western basin of Lake Erie, however, but acknowledge in their discussion that this portion of the lake continues to experience higher and more variable

[9] Dove and Chapra (2005, p. 698) report that the data for the western basin of Lake Erie exhibit much higher variability than the central basin data that they publish in their paper.

[10] The *Great Lake Water Quality Agreement* between Canada and the United States was first signed in 1972 and has been updated. It can be found here: https://www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-countries-regions/north-america/great-lakes-water-quality-agreement.html

phosphorus levels. They make a similar comment with respect to water quality closer to the shoreline of the lake.

Dove and Chapra (2015) attribute the improvement in Great Lakes water quality to several causes – the reduction in the use of phosphorus in laundry detergents, improvements in municipal wastewater treatment in settlements surrounding the lakes and the introduction of zebra and quagga mussels in the late 1980s. They don't mention agriculture in their enumeration of sources of phosphorus that end up in the Great Lakes in general or in Lake Erie in particular. Considerable effort, however, has been made by the *Ontario Ministry of Agriculture, Food and Rural Affairs*, (OMAFRA)[11] farm organizations, and farmers to reduce phosphorus losses from farmland, generally through the adoption of what are called Best or Beneficial Management Practices (BMPs). In many cases, technical assistance or cost sharing is used to promote the adoption of BMPs by farmers. BMPs can be structural, creating physical barriers to the movement of excess water, eroded sediment and nutrients, reducing the transport of those substances to waterways. BMPs can also take the form of modified production practices, like reduced use of tillage or controlled tile drainage, which are intended also to reduce sediment and nutrient transport to water bodies.

[11] See for example Government of Ontario (2019) for more information: http://www.omafra.gov.on.ca/english/environment/bmp/phos-br.htm

**Figure 2: Great Lakes Nutrient Trends**

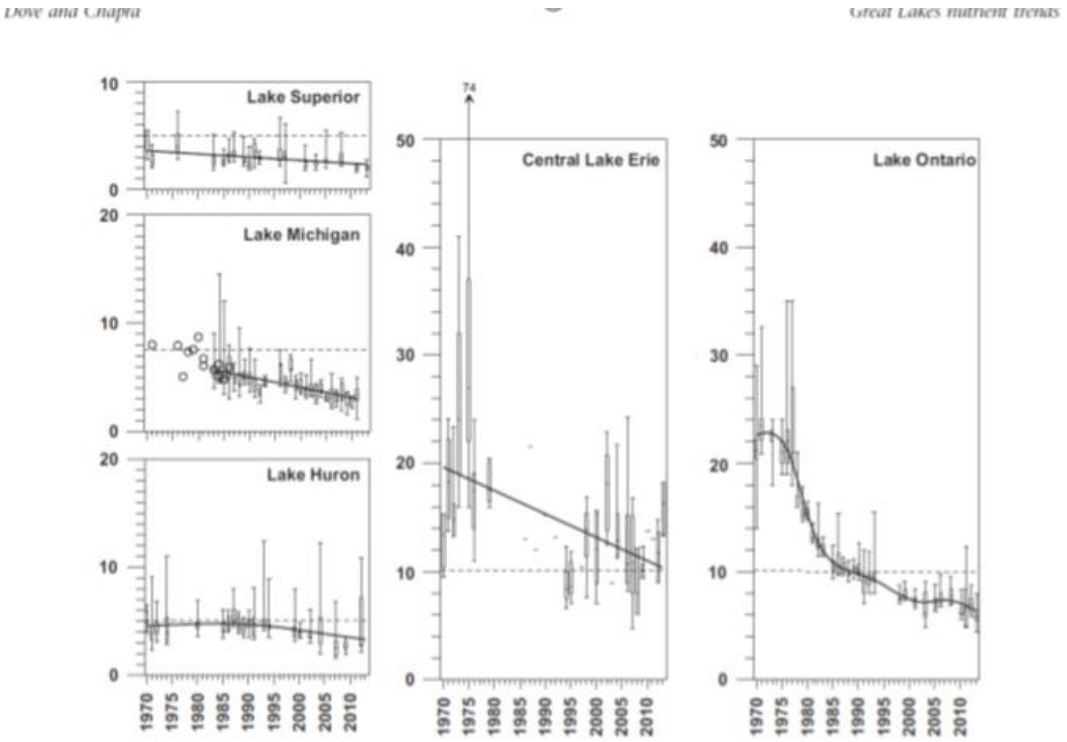
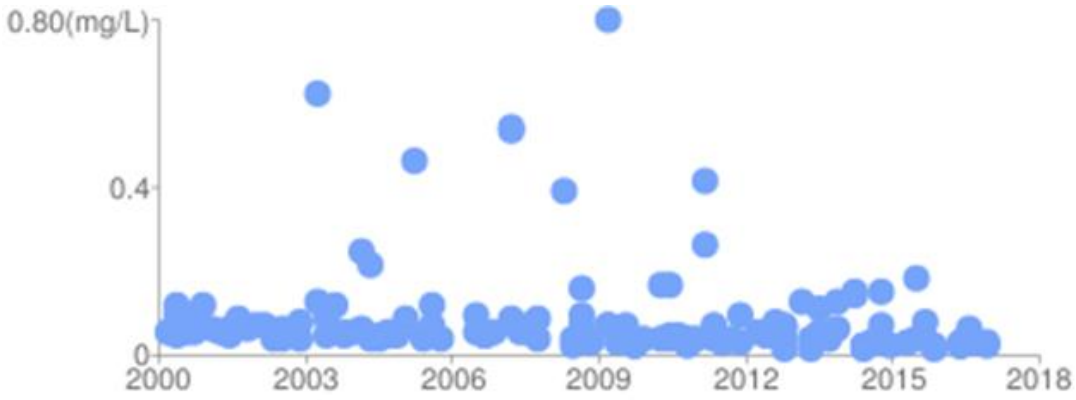



**Fig. 1.** Trends of open lake, spring (April–May) total phosphorus (TP) concentrations ($\mu$g P/L) for the Great Lakes. The existing GLWQA TP target concentrations are shown as the horizontal dashed lines. The additional data points (circles) for Lake Michigan prior to 1983 are taken from Chapra and Dobson (1981), Scavia et al. (1986), and Lesht et al. (1991).

The *Ontario Ministry of the Environment and Climate Change* has maintained a network of water quality measurement stations through the *Provincial Stream Water Quality Monitoring Network* since 1964. The network currently includes over 400 locations. Figure 3 is an illustrative example of a result from monitoring at the Glen Morris location on the Grand River between Cambridge and Paris, Ontario. The Grand River empties into central Lake Erie near Dunnville, Ontario. For most years, the phosphorus levels at this station are at a level of .1 mg/L, which is higher than the target of 10 $\mu$g/L that has been set for central Lake Erie. But the phosphorus concentration measured in the river is highly variable. In 2010, the concentration exceeded .8 mg/L, or 800 $\mu$g/L. What can't be determined from these data is the contribution of agricultural runoff to this variation. Most municipal sanitary sewer systems in Ontario are integrated with storm sewers. During high runoff events, the combined volume of storm and sanitary sewers can exceed the capacity of the municipal wastewater treatment facility. During these events, municipalities often bypass the treatment plant. At the same time, high runoff events can also result in high erosion events in rural areas. Sediment and nutrients can be

displaced from farm fields during such events as well. To my knowledge, no one has undertaken a systematic empirical analysis of the correlations between high phosphorus loading measurements from the monitoring network and the timing of municipalities bypassing wastewater treatment facilities. The residual between the in-stream measurement and the estimated contribution from municipal wastewater could be used as an upper bound estimate of agriculture's contribution.

**Figure 3: Grand River-Glen Morris Phosphorous Levels 2000-2016**



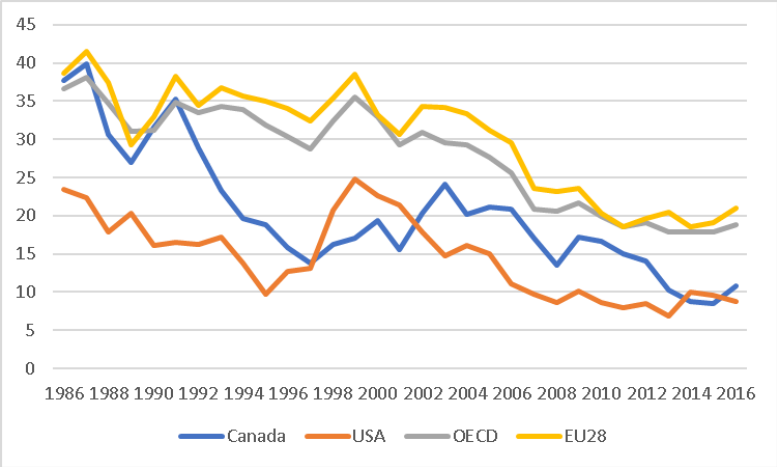

Source: Ontario Ministry of the Environment and Climate Change (2019)

**The Impact of Agricultural Subsidies on the Environment**

Rajsic *et al.* (2012) discuss the relationship between agricultural subsidies and adverse environmental effects of agricultural production. There are two dimensions to this relationship. The first is called the intensive margin effect. Here, subsidization leads to higher use of purchased inputs, like fertilizers, pesticides and even seeds, per unit of land area. More intensive use of inputs per unit of land area leads to higher risks of adverse off-site effects, most often effects on ground and surface water quality. The second dimension is called the extensive margin effect. Here, subsidization encourages farmers to expand production of the subsidized product on to land that would otherwise be used for other purposes. More extensive land use for the production of subsidized products can come at the expense of what are often less intensively-produced agricultural activities like pasture, but also at the expense of land that might otherwise be used for woodlots, wetlands and wildlife habitat. Thankfully, as Figure 4 illustrates, levels of

subsidization[12] have been falling in developed countries' agriculture sectors since 1986. At the beginning of the time period in the figure, Canadian farmers, on average, received almost 40% of their revenue from subsidies in various forms. By the end of the period covered in the figure, this had fallen to about 10%. Other developed countries have also followed a downward trend. This suggests that both the intensive and extensive margin effects are declining. But there is still more progress that can be made, environmentally, on this front.

**Figure 4: Trends in the Producer Subsidy Equivalents (PSE) in Selected OECD Countries, 1986-2016**




Source: Organization for Economic Cooperation and Development, Agricultural Policy Monitoring and Evaluation Report (2017)

## Evidence-based Policy and the Theory of Policy

The Governments of Canada and Ontario have endorsed a policy development process called evidence-based policy. The economic theory of policy is an important component of evidence-based policy.[13] This is particularly true for the development of environmental policy. The economic theory of policy combines the theories of market failure and non-market or policy failure. According to the economic theory of policy, documentation of a significant and persistent market failure is a necessary, but not a sufficient, condition for government action.

[12] Subsidization of agricultural production is done in diverse ways. Producer Subsidy Equivalent is a measure that has been developed by agricultural economists to convert multiple forms of agricultural subsidization into a common unit of measurement. The Producer Subsidy Equivalent (PSE) attempts to convert different types of subsidization into a cash payment. In Figure 4, this is presented as a share of total revenue.
[13] See Rajsic and Fox (2019) for a more detailed exposition of the relationship between evidenced-based policy and the economic theory of policy

Compliance with this standard requires rigour in the application of market failure categories. Casual claims of *public goods*, *excessive discounting* or *externality* problems causing specific agricultural environmental problems are not enough. Historical and institutional analysis is required to distinguish between *externalities* and *derived externalities* or *legalized nuisances*. Misdiagnosis of the market or non-market failure of an environmental problem can lead to the application of the wrong remedy.

The theory of non-market failure balances the economist's diagnostic tool kit in two ways. First, it suggests a more complete set of possible causes of environmental conflicts. Not all environmental problems associated with agriculture are the result of market failures. Some arise because of non-market failures. The second way in which the theory of non-market failure provides important analytical balance is through what Wolf (1979, 1980) calls implementation analysis. Implementation analysis is an *ex ante* examination of potential non-market failures that might arise if a specific policy action is initiated to address a documented market failure. This examination involves a comparison of the magnitude of the potential harms that these non-market failures might cause with the harms wrought by the market failure that the policy is intended to address. The outcome of implementation analysis can be that even though a market failure exists and persists, the available policy options are likely to cause more harm than good and that the best course of action might be to do nothing until better policy options are identified. This is the sufficient part of the necessary and sufficient condition.

Applying this framework to the list of environmental problems associated with agriculture in Table 1 helps with prioritization.[14] Not all of the listed problems are equally important or worthy of policy action. Based on the available evidence, it is difficult to make the case that the problems associated with *excessive time preference* are acute in Ontario.[15] The effects of agricultural production practices on water and air quality, on the other hand, seem to be more significant. The critical question here is whether those effects are caused by market failure *externalities* or if they are the result of nuisances being legalized by statute and regulation. The preponderance of evidence suggests that *legalized nuisance* is generally the cause of these problems. If this conclusion is correct, this implies that the path forward to resolve these

[14] Other important contributions to prioritization of agricultural environmental policy include Pannell (2008) and Boxall (2018).
[15] I discussed the evidence on the effects of erosion on farmland productivity earlier in this essay. For an examination of the conversion of agricultural land to non-agricultural uses, please see Fox and Wang (2016).

conflicts will involve reform of *right-to-farm* statutes and the rehabilitation of tort law. I do not underestimate the political challenge that will be involved. Brubaker (2007) and Bate (2001) describe situations where liability under tort law has been effective in protecting ground and surface water quality from agricultural emissions. But *right-to-farm* statutes exist because they have a constituency.

The public good category of problems, as reflected in the AAFC *Biodiversity Compound Index* (see Figure 1), does seem to be a persistent problem. Here, the misapplication of the economic theory of policy might be at fault. If the examples listed in this category in Table 1 generate *non-rival* community benefits, the current policy approach of rural land use planning, designation and control is inconsistent with the economic theory of policy. It should not be surprising that rural landowners in Ontario have become increasingly militant in their resistance to these policies. Planning and designation approaches turn environmental assets into liabilities for rural landowners. This makes progress on tackling this category of problems more difficult. As in the case of my proposal to eliminate *legalized nuisance*, I appreciate the political challenge associated with a proposal to more faithfully apply the *public goods* model. There is a reason that legislatures have preferred the planning and designation approach. It produces benefits for voters without any associated increase in taxation. This bargain, however, comes at the expense of unfair treatment of rural landowners. It also has resulted in a lower level of benefits as land owners have been faced with a perverse incentive to take measures to clear woodlots, drain wetlands and to eliminate habitat due to the threat of loss of income or net worth if portions of their land become subject to planning restrictions.

Finally, the *common pool* problems listed in Table 1 do not seem to be generally significant in Ontario, at least not yet. The use of ground and surface water for agricultural irrigation is limited and tends to be concentrated regionally and by commodity category. However, Xu (2017) anticipates that, under some climate change scenarios, irrigation may become more widespread in Ontario in the future, so it will be important to monitor trends in water use for irrigation. In anticipation of potential increased demand for water for agricultural irrigation purposes in the future, a proactive step would be to undertake the necessary work to clarify the nature of property rights in ground and surface water in Ontario. This step has not been justified in the past due to the low level of harmful interdependence that has existed. But that might change in the future.

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