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SEEDS FOR SUCCESS

The Value of Seed Treatments for Ontario Growers.

REPORT JULY 2014

Seeds for Success: The Value of Seed Treatments for Ontario Growers
By Michael Grant, James Knowles, and Vijay Gill

Preface

Neonicotinoid insecticides are widely used by farmers around the world to protect crops from insect pests. In this report, we explore the economic consequences that a hypothetical restriction on neonicotinoids in Ontario would have on Ontario corn and soybean farmers. Such a restriction would likely reduce crop yields, increase farmers' costs, or both, causing farms to exit the market or reduce acreage. We estimated that this would decrease farmers' revenues by $630 million annually, and reduce Ontario's GDP by nearly $440 million. Policy-makers considering changes to neonicotinoid regulations should fully examine all of the costs and benefits of such a policy, and clarify the potential costs to the farming community in Ontario.

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EXECUTIVE SUMMARY

Seeds for Success: The Value of Seed Treatments for Ontario Growers

At a Glance

- This report details the estimated effects of a hypothetical Ontario-wide restriction on neonicotinoid insecticides on Ontario corn and soybean farmers.
- We estimated that such a restriction would cause farms to exit the market or reduce acreage, costing Ontario farmers more than $630 million annually in lost revenue and reducing Ontario's GDP by nearly $440 million.
- For any significant change in regulations, it is incumbent upon governments to consider the effects on individual farming businesses, as well as any potential benefits.

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In order to be successful in international markets, Canadian food producers need to compete on a level playing field. A lack of regulatory harmony between jurisdictions can hamper trade, since producers with fewer restrictions on their operations can offer lower prices to customers, all else being equal. This is as true for farmers as it is for other businesses.

This report examines the potential consequences for Ontario farmers if a restriction were placed on the use of neonicotinoid insecticides on Ontario corn and soybeans, due to a concern that such insecticides could be related to a reduction in bee numbers. Neonicotinoids are a class of insecticide that is widely used among grain farmers to control a variety of insect pests, some of which cannot be treated with other registered insecticides.

This report is designed to help policy-makers at the federal and provincial levels conduct a thorough cost-benefit analysis of a restriction on neonicotinoid seed treatments. We focus on corn and soybean farms, which collectively accounted for more than 85 per cent of the value of Ontario grains and oilseeds harvested in 2012.[1] To the extent that the impacts of potential restrictions are negative, policy-makers should be able to estimate how the purported benefits of restrictions would ameliorate or offset these impacts and, in the process, make Ontario better off than before the regulatory intervention.

In order to frame the issue, this report looks at neonicotinoid regulation and use in Canada and Ontario. Regulated at both the federal and provincial levels, insecticides are particularly susceptible to falling out of regulatory harmony with other provinces and countries. While Health Canada has recently set new requirements for the use of seed-flow lubricant when planting seeds treated with neonicotinoids, no restriction on their use has been implemented in Canada or the United States.

1 Ontario Ministry of Agriculture and Food, “Estimated Area, Yield, Production, and Farm Value of Specified Field Crops.”

As a result, if a restriction were imposed in a specific province it could cause economic harm to farmers there, since these farmers compete with jurisdictions where neonicotinoids are not restricted.

Field studies show that the use of neonicotinoid insecticides can increase corn and soybean yields considerably. Alternative insecticides have also been shown to be effective against a number of insect pests. However, since neonicotinoids are used to control some insects for which there is no registered alternative insecticide, a restriction on their use would likely reduce crop yields. These yield impacts would likely vary widely between farms, since differences in local insect populations and climate conditions make some farms more susceptible to yield loss than others. In addition to the yield reduction, since neonicotinoid seed treatments are widely used, farmers are unlikely to realize a substantial reduction in seed costs due to the economics of scale involved in seed production. At the opposite end of the spectrum, they would likely have to purchase and use more costly alternative insecticides.

The financial position of farms varies widely across Canada, even for those producing grain and oilseed. As a result, some farms would be more capable than others of dealing with the decreased yields and increased costs resulting from an Ontario-wide restriction. But regardless of current profitability, Ontario corn and soybean farms would, on average, experience higher per tonne production costs from such a policy, while competitors from other jurisdictions would not. And while Ontario produces a large percentage of Canada's corn and soybeans, Ontario's output is dwarfed by farmers in the United States. This means that Ontario farmers would have little power to increase their prices to offset increased unit costs. Consequently, some farms will exit the market or scale back production on marginally profitable land, reducing profits across the industry.

Using national and provincial level farm financial data from 2008–12, as well as estimated input costs for corn and soybean production, we modelled the impact of a hypothetical Ontario-wide restriction on neonicotinoids for Ontario corn and soybean farms at the enterprise level. This was carried out for several scenarios with different yield loss and cost increase assumptions. After estimating changes in revenues and costs for individual farms, we modelled a reduction in total acres harvested across the province and the resulting change to total revenues and profits. Subsequently, we assessed the broader impact these changes would have on Ontario's GDP by estimating the supply chain impacts.

We found that a restriction on neonicotinoids in Ontario could reduce the revenues from corn and soybean production by more than $630 million per year. In addition, we estimated more than $100 million in lost profits to farmers and a direct reduction in GDP of almost $250 million. Including spillover effects, the total reduction in GDP could be nearly $440 million.

These estimates are subject to the uncertainty associated with the impacts of neonicotinoid use on individual farm yields, highlighting the policy risk inherent in restricting their use. While the benefits of such a policy need to be evaluated as well, the costs to Ontario farmers and the broader Ontario economy are almost certain to be significant. Simply put, neonicotinoids would not be so widely used if they were not cost effective, so their absence would likely have significant impacts on farm operations and the broader economy.

RÉSUMÉ

Les graines du succès : L'intérêt du traitement des semences pour les agriculteurs de l'Ontario

Aperçu

- Ce rapport détaille l'effet que pourrait avoir une hypothétique restriction à l'utilisation des insecticides néonicotinoïdes, à l'échelle de l'Ontario, sur les producteurs de maïs et de soja de la province.
- Selon nos calculs, une telle restriction entraînerait la disparition de certaines exploitations et en pousserait d'autres à réduire leur surface cultivée, avec à la clé un manque à gagner de plus de 630 M$ par an pour les agriculteurs ontariens et une réduction du PIB de l'Ontario de près de 440 M$.
- Dès lors qu'ils envisagent de modifier sensiblement la réglementation, les gouvernements doivent tenir compte des effets que ces modifications auront sur les entreprises agricoles, ainsi que de leurs retombées potentielles.

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Pour réussir sur les marchés internationaux, les producteurs canadiens de produits alimentaires doivent y affronter la concurrence sur un pied d'égalité. Un manque d'harmonie réglementaire entre les pays peut fausser les échanges, car toutes choses étant égales par ailleurs, les producteurs dont les activités sont soumises à moins de restrictions peuvent proposer aux clients des prix inférieurs. Cela vaut autant pour les agriculteurs que pour les autres entreprises.

Ce rapport examine les conséquences potentielles pour les agriculteurs ontariens s'ils se voient imposer une restriction à l'utilisation d'insecticides néonicotinoïdes sur le maïs et le soja parce qu'on craint que ces produits soient pour quelque chose dans la réduction du nombre d'abeilles. Les néonicotinoïdes sont une famille d'insecticides largement utilisés par les producteurs de céréales pour lutter contre une variété d'insectes nuisibles, dont certains ne peuvent être combattus avec d'autres insecticides.

Ce rapport vise à aider les décideurs aux niveaux fédéral et provincial à effectuer une analyse approfondie des coûts et des avantages d'une restriction au traitement des semences aux néonicotinoïdes. Nous nous concentrons sur les producteurs de maïs et de soja, qui représentaient collectivement plus de 85 % de la valeur des céréales et des oléagineux récoltés en Ontario en 2012[1]. Si des restrictions potentielles ont des effets négatifs, les décideurs devraient pouvoir évaluer en quoi leurs avantages éventuels amélioreraient ou compenseraient ces effets et feraient donc que l'Ontario serait en meilleure position qu'avant l'intervention réglementaire.

1 Ministère de l'Agriculture et de l'Alimentation de l'Ontario, « Superficie, rendement, production et valeur à la ferme estimatifs de certaines grandes cultures ». [www.omafra.gov.on.ca/french/stats/crops/estimate_new.htm]

Afin de bien cerner la question, ce rapport se penche sur la réglementation des néonicotinoïdes et sur leur utilisation au Canada et en Ontario. Le risque de disparités entre les règlements d'une province et d'un pays à l'autre est particulièrement grand pour les insecticides, qui font l'objet d'une réglementation fédérale et provinciale. Santé Canada a établi dernièrement une nouvelle série d'exigences qui visent l'utilisation de lubrifiants facilitant l'écoulement au cours de la plantation des semences aux néonicotinoïdes, mais aucune restriction à l'utilisation de ces derniers n'a été imposée au Canada ou aux États-Unis. Résultat, si une province ajoutait un autre règlement, cela pourrait nuire à ses agriculteurs sur le plan économique, car ils sont en concurrence avec des producteurs d'endroits où les néonicotinoïdes ne sont visés par aucune restriction.

Les études sur le terrain montrent qu'en utilisant des insecticides néonicotinoïdes, on peut obtenir de bien meilleurs rendements de maïs et de soja. D'autres insecticides se révèlent également efficaces contre plusieurs insectes nuisibles. Toutefois, comme les néonicotinoïdes sont utilisés pour lutter contre certains insectes pour lesquels il n'existe aucun autre insecticide homologué, en restreindre l'emploi réduira probablement les rendements des cultures. Il est probable aussi que cet impact sur les rendements variera considérablement d'une exploitation à l'autre, étant donné que des différences de populations locales d'insectes et de conditions climatiques exposent davantage certaines exploitations à des baisses de rendement que d'autres. En plus de la baisse de rendement, comme le traitement des semences aux néonicotinoïdes est très répandu, il est peu probable que les producteurs fassent une économie de coût substantielle en semences en raison des économies d'échelle intervenant dans la production de semences. À l'opposé, ils devront probablement acheter et utiliser d'autres insecticides plus coûteux.

La situation financière des exploitations agricoles varie considérablement à l'échelle du Canada, même pour celles qui produisent des céréales et des oléagineux. En conséquence, certaines exploitations seront plus en mesure que d'autres de composer avec la baisse des rendements et la hausse des coûts entraînés par une restriction provinciale. Mais indépendamment de la rentabilité actuelle, si une telle politique est appliquée, les producteurs de maïs et de soja ontariens se verront, en moyenne, confrontés à des coûts de production par tonne plus élevés, ce qui ne sera pas le cas de leurs concurrents d'autres provinces ou pays. De plus, l'Ontario produit un pourcentage important du maïs et du soja canadiens, mais sa production est éclipsée par celle de nos voisins américains. Autrement dit, les agriculteurs ontariens n'auront guère de possibilité d'augmenter leurs prix pour compenser la hausse des coûts unitaires. En conséquence, certaines exploitations disparaîtront ou réduiront la production sur les terres peu rentables, ce qui réduira aussi les bénéfices dans toute l'industrie.

Nous avons modélisé, à partir de données financières agricoles nationales et provinciales allant de 2008 à 2012, ainsi que d'une évaluation du coût des intrants pour la production de maïs et de soja, l'impact d'une hypothétique restriction ontarienne de l'utilisation des néonicotinoïdes sur les producteurs de maïs et de soja ontariens au niveau de l'entreprise. Cette modélisation porte sur plusieurs scénarios avec différentes hypothèses de baisse de rendement et d'augmentation des coûts. Après avoir évalué l'évolution des revenus et des coûts pour les exploitations, nous avons modélisé une réduction de la superficie totale cultivée dans la province et l'évolution des revenus et bénéfices qui en découlerait. Ensuite, nous avons évalué l'impact plus général que ces changements auraient sur le PIB de l'Ontario en calculant les répercussions sur les chaînes d'approvisionnement.

Nous avons conclu qu’une restriction à l’utilisation des néonicotinoïdes en Ontario pourrait entraîner une réduction des revenus tirés de la production de maïs et de soja de plus de 630 M$ par an. De plus, selon nos calculs, le manque à gagner dépasserait les 100 M$ pour les agriculteurs et le PIB serait directement réduit de près de 250 M$. Si l’on inclut les effets indirects, la réduction totale du PIB approcherait les 440 M$.

Ces estimations présentent un degré d’incertitude associé aux effets de l’utilisation de néonicotinoïdes sur le rendement individuel des exploitations, ce qui souligne le risque stratégique inhérent à la restriction de leur emploi. Les avantages d’une telle politique doivent également être évalués, mais il est presque certain que les coûts pour les agriculteurs ontariens et pour l’économie ontarienne en général seront importants. Pour parler simplement, on n’utiliserait pas autant les néonicotinoïdes s’ils n’étaient pas rentables. Il est donc probable que leur absence sera lourde de conséquences pour les exploitations agricoles et pour l’économie en général.

CHAPTER 1

Introduction

Chapter Summary

- Research for the Centre for Food in Canada reveals that a lack of regulatory harmonization can impose an undue burden on Canadian farmers.
- For any significant change in regulations, it is incumbent upon governments to consider the effects on individual farming businesses and the farming economy.
- This report contributes to an understanding of these effects, focusing on the regulation of neonicotinoid seed treatments.

The Conference Board of Canada recently completed a three-year program of research and consultations under the auspices of its Centre for Food in Canada (CFIC). This program has culminated in a Canadian Food Strategy. A key theme of the strategy—released at the 3rd Canadian Food Summit on March 19, 2014—is regulatory streamlining to position Canadian food companies to compete in international markets.

The recommendations on regulatory streamlining are based on the findings of comprehensive research into Canada's food system carried out by the Conference Board. Two reports are especially pertinent in the context of this report.

The first report, *Seeds for Success: Enhancing Canada's Farming Enterprises*, considered the financial viability and managerial success factors of Canada's farms. That report analyses farm-level financial performance, and notes considerable variability in the profitability of Canadian farms. More than half of Canada's farms achieve either very high profit margins (more than 20 per cent) or very low profit margins (less than 10 per cent) in any given year. Interestingly, this profitability is not tightly linked to farm size. Smaller revenue farms have occupied a greater percentage of the top profitability quartile than have larger ones. At the same time, smaller farms are most likely to occupy the bottom profitability quartile.[1]

The second report, *All Together Now: Regulation and Food Industry Performance*, suggests that food industry regulations are important for consumer trust.[2] However, it also argues that, to the extent possible, Canadian and provincial regulatory regimes should be harmonized

1 Stuckey and Butler, *Seeds for Success*, Chapter 3.

2 Grant, Butler, and Stuckey, *All Together Now*.

with those of competing jurisdictions. When regulations in Canada are more onerous than in competing jurisdictions, producers here are disadvantaged. This results in reduced profitability of Canadian businesses in relation to international peers, all else being equal. This is especially true in industries such as farming that are comprised of many producers and consumers. In these competitive markets, producers have little market power and, therefore, little ability to pass along regulatory costs to the consumer.

Other regulatory research by The Conference Board of Canada reaches similar conclusions.[3] Our findings show that, to the extent possible, governments should ensure that the regulatory process is evidence-based. Treasury Board of Canada guidelines, for example, require federal departments and agencies "to show that the recommended option maximizes the net economic, environmental, and social benefits to Canadians, business, and government over time more than any other type of regulatory or non-regulatory action."[4] This sensible approach to regulation is likely to ensure that regulatory costs are weighed properly against expected benefits of altered regulation.

We note, however, that publicly released cost-benefit analyses rarely accompany new regulatory interventions. In our view, this is a major weakness in Canadian regulatory policy and practice. As such, it is incumbent upon independent research analysts in academia and the broader policy research community to fill this gap.

To this end, the Grain Farmers of Ontario (GFO) approached The Conference Board of Canada to conduct an independent economic analysis of a hypothetical restriction on neonicotinoid seed treatments. Neonicotinoids are a class of synthetic insecticide commonly used by crop farmers around the world. However, several jurisdictions, including Canada, have recently tightened regulations on their use. This has

3 Doern, *Red Tape, Red Flags*; Burt, Grant, and Butler, *Exploring the Iceberg*.

4 Government of Canada, *Cabinet Directive on Streamlining Regulation*.

been driven by a concern that current neonicotinoid use is toxic to bees and could be related to a reduction in bee numbers observed in many jurisdictions, including parts of Europe and the United States.[5, 6]

The European Union has implemented the most restrictive regulations on neonicotinoid insecticides. In May 2013, following reports from the European Food Safety Authority about the effects of these insecticides on honey bees,[7, 8, 9] the European Commission adopted a proposal that imposes restrictions on the use of three widely used neonicotinoids: imidacloprid, thiamethoxam, and clothianidin.[10] This occurred after the voting member states of the European Parliament failed to agree on whether or not to adopt such a proposal. For two years, starting December 1, 2013, the use of these insecticides will be extremely limited. Following this two-year period, the restrictions on their use will be re-evaluated, with the intent of incorporating new evidence into the decision-making process.

Meanwhile, Health Canada issued a consultation on a Notice of Intent for neonicotinoid pesticides in September 2013.[11] For the 2014 growing season, corn and soybean farmers using seeds treated with neonicotinoids must use only a newly developed seed flow lubricant designed to reduce dust production during planting and minimize the airborne spread of these chemicals.[12] Notably, the United States Environmental Protection Agency (EPA) has not implemented any new requirements for neonicotinoid use—it is, however, in the process

5 vanEngelsdorp and Meixner, "A Historical Review of Managed Honey Bee Populations," S81–S83.

6 van der Zee and others, "Managed Honey Bee Colony Losses."

7 European Food Safety Authority (EFSA), "Conclusion on Peer Review of Risk Assessment for Clothianidin."

8 EFSA, "Conclusion on Peer Review of Risk Assessment for Imidacloprid."

9 EFSA, "Conclusion on Peer Review of Risk Assessment for Thiamethoxam."

10 EUR-Lex, "Commission Implementing Regulation (EU) No. 485/2013."

11 Health Canada, *Action to Protect Bees From Exposure to Neonicotinoid Pesticides*.

12 Health Canada, *Pollinator Protection and Responsible Use of Insecticide Treated Seed*, 1.

of conducting a re-evaluation of these pesticides in conjunction with Health Canada's Pest Management Regulatory Agency (PMRA) and the California Department of Pesticide Regulation.[13, 14]

Any alternative regulations developed for Ontario or Canada could result in Canadian regulatory treatment becoming disconnected from U.S. regulatory approaches. For some types of policy, a lack of regulatory harmonization could be justified since Canadian conditions may diverge from those in the United States. However, the Ontario grain growing community is rightly concerned that their industry could be put at a competitive disadvantage compared with U.S. growers if neonicotinoid regulations were altered. Grain growers in the U.S. compete more directly with Ontario grain producers than those in Europe because of their geographic proximity. If Canada or Ontario imposes greater costs on its grain growers than the U.S. as a result of a change in regulations, Canadian and Ontario policy-makers owe it to the Ontario farming community to explain the cost and benefits of regulatory action.

This report is designed to help policy-makers at the federal and provincial levels conduct a thorough cost-benefit analysis of a hypothetical restriction on neonicotinoid seed treatments. Our report is not a cost-benefit analysis per se, since it focuses on the potential commercial impacts on Ontario's grain farms and does not consider the potential benefits or environmental impacts of such a restriction, which are beyond the scope of this analysis. Specifically, we focus on potential impacts to corn and soybean farms, which collectively accounted for more than 85 per cent of the value of Ontario grains and oilseeds harvested in 2012.[15] To the extent that the impacts of a restriction are negative, policy-makers should explain how the purported benefits of a restriction would ameliorate or offset these impacts and, in the process, make Ontario better off than before the regulatory intervention.

13 U.S. Environmental Protection Agency, *Colony Collapse Disorder.*

14 Health Canada, *Re-evaluation Update for Neonicotinoid Insecticides*.

15 Ontario Ministry of Agriculture and Food, "Estimated Area, Yield, Production, and Farm Value."

Method

We used several methods in our analysis, including a thorough review of the relevant literature. This literature review largely focused on the impact of neonicotinoids on farming operations, particularly in terms of their yields and costs of production. The literature review informs the quantitative analysis of our report.

Using farm-level financial data, we modelled a range of Ontario farming operations that differed in size and financial viability (as gauged by profits). We established a base (control) case analysis that did not include any regulatory restrictions on the use of neonicotinoids. We then modelled a variety of scenarios (model shocks) based on different assumptions of the impacts on yield and costs of production.

This scenario-based approach is necessary, since the potential yield and cost impacts are variable. Because of this variability, new regulatory interventions create a regulatory risk to individual farms. The risk facing an individual farm depends on the farm's pre-regulatory crop yield and commercial viability. A range of estimates allows us to understand the nature and extent of this risk.

In order to gauge the macro impacts, we extended the farm-level analysis across the population of grain farms. We initially aggregated the farm data and determined first-round impacts at the farm level. We then conducted a supply chain analysis to show how these effects filter through the economy and create second-round impacts. Supply chain effects create a multiplier effect on the surrounding economy that is dependent on the nature of the supply chain.

Organization of the Report

Chapter 2 reviews the current neonicotinoids science that forms the basis for regulatory interventions. Chapter 3 discusses the characteristics of the Ontario grain sector. These two chapters feed into Chapter 4, in which we develop models to estimate the effects of neonicotinoid regulation on Ontario grain farms and the Ontario economy. We conclude the report in Chapter 5 by detailing the implications for neonicotinoid regulatory policy.

CHAPTER 2

Controlling Pests and Striking a Regulatory Balance

Chapter Summary

- Farmers need to control insect pests to maintain viable enterprises. Neonicotinoid insecticides have become a common option used by grain farmers.
- Without neonicotinoids, farmers would have to rely primarily on other options such as foliar or granular insecticides that are not effective for certain pests.
- In this chapter, we discuss the purpose of insecticides and summarize the findings of field tests carried out to measure their effectiveness. The literature agrees that they have been effective in increasing crop yields, although the degree to which they do so is highly variable.
- The variability of increases to crop yields complicates the assessment of a restriction on seed treatments, but also highlights the risk that individual farmers would face with such a restriction.

This chapter familiarizes readers with neonicotinoid seed treatments and explains why and how they are regulated. Understanding the regulation of these insecticides is important when considering a policy shift in order to understand the nature of regulatory risk, the impact of regulations on farmers, and the potential channels of regulatory action.

Why Do Farmers Use Pesticides and What Are Neonicotinoids?

Farmers use pesticides to control crop pests such as weeds, insects, and fungi, which in turn increases crop yields and the viability of their enterprises. Since pesticide use has become more widespread, they have contributed to increased production and availability of agri-food products in general and, ultimately, lower prices of food products for consumers.[1]

If farmers do not control insect pests they may experience substantive yield losses. For example, soybean aphids can cause yield losses of up to 50 per cent in soybeans if untreated.[2] Simply put, farmers need to use some method to control pests if they are to maintain viable farms. Insecticides are widely used for this purpose.

Neonicotinoids are a novel class of synthetic insecticide commonly used by farmers throughout North America. Since the early 1990s, several different neonicotinoids have been developed for farm use, including imidacloprid, clothianidin and thiamethoxam. These insecticides are used

1 Cooper and Dobson, "The Benefits of Pesticides to Mankind and the Environment," 1340–41.

2 Ragsdale and others, "Economic Threshold for Soybean Aphid," 1258.

to control a variety of pests that feed on plants by acting on their central nervous system. Notable pests they are used to control include corn rootworm, cutworms, aphids, and wireworms.

Neonicotinoids have several key advantages over many other insecticides. First, they are systemic, and therefore can be applied directly to seeds as a seed treatment. As a seed treatment, the insecticide protects young plants against key early season pests. This protection is reduced as the plant grows; however, protection lasts long enough for the plants to become established. Second, neonicotinoids reduce potential exposure to non-target organisms since a smaller amount needs to be applied than if using alternative foliar insecticide sprays or granular insecticides.[3] Third, neonicotinoids exhibit low toxicity in mammals.[4]

There are additional benefits to neonicotinoids. Many farmers use conservation tillage practices, which reduces erosion caused by tilling. However, the reduced environmental impact from erosion comes at a cost: some insect populations may increase when tillage is reduced (e.g., black cutworms and seedcorn maggots).[5] The use of neonicotinoid seed treatments plays a role in enabling farmers to retain yields while decreasing tillage, and therefore erosion. Moreover, the use of neonicotinoids reduces the use of alternative insecticides, many of which have higher toxicity in non-target species including aquatic organisms, birds, and mammals.[6]

3 Ontario Ministry of Agriculture and Food, *Neonicotinoids and Field Crop Production in Ontario*.

4 Tomizawa, “Neonicotinoids and Derivatives,” 177.

5 McGuire, *The Effects of Reducing Tillage on Pest Management*, 3.

6 See Table 3, below.

The Rationale for Increased Neonicotinoid Regulation

Bees are important pollinators of crops worldwide. In recent years, there has been a considerable decline in managed honey bee populations in many parts of the world.[7, 8] Scientists agree this is likely due to a combination of multiple stressors, including the parasitic *Varroa* mite and the viruses it spreads to honey bees; other honey bee pests and pathogens; nutrition; migratory beekeeping practices; and pesticides.[9, 10, 11] There is no conclusive evidence yet to verify which of these stressors is primarily responsible for the decline in bee populations. Pesticides, specifically neonicotinoids, have been under considerable scrutiny as a possible cause of general declines in honey bee and bee pollinator populations. In addition, there is concern that bee pollinator populations specifically associated with agro-ecosystems are being negatively affected.

Regulatory agencies in Canada and the United States are currently re-evaluating neonicotinoid use. Health Canada now requires growers to use a newly developed seed flow lubricant during the planting of treated seed to minimize the likelihood that pollinators may be exposed to insecticide-containing dust.[12] This is an intermediate step while Health Canada's Pest Management Regulatory Agency determines whether regulatory action is required, in collaboration with the U.S. EPA and California's Department of Pesticide Regulation.[13] For the time being, the Government of Ontario is awaiting the PMRA's ruling. However, the province may choose to regulate on its own if it deems the federal

7 vanEngelsdorp and Meixner, "A Historical Review of Managed Honey Bee Populations," S81–S83.

8 van der Zee and others, "Managed Honey Bee Colony Losses."

9 Di Prisco and others, "Neonicotinoid Clothianidin Adversely Affects Insect Immunity," 18466.

10 Blacquière and others, "Neonicotinoids in Bees," 974.

11 vanEngelsdorp and Meixner, " A Historical Review of Managed Honey Bee Populations."

12 Health Canada, *New 2014 Requirement When Using Treated Corn/Soybean Seed*.

13 Health Canada, *Re-evaluation Update for Neonicotinoid Insecticides*, 1.

approach insufficient. To that end, the Government of Ontario has already established the Ontario Bee Health Working Group to devise and implement strategies to reduce the exposure of bees to neonicotinoid insecticides.[14]

How Are Neonicotinoids Regulated in Canada?

In Canada, the regulatory system for pesticides is multi-jurisdictional. The federal government, acting through Health Canada's PMRA, is responsible for the registration of pesticides according to extensive pre-market testing and registration requirements. Provinces and territories are responsible for the training and certification of pesticide vendors and applicators and for issuing permits for certain pesticide uses.

Before pesticides can be sold or used in Canada, they must be registered with the federal government. Under the *Constitution Act*, provinces and territories can pass laws to regulate the sale, use, storage, transportation, and disposal of pesticides.

The PMRA's evaluation is extensive, with a human health assessment involving evaluations of toxicology, occupational exposure, and food residue exposure. An environmental assessment is also carried out to explore the chemistry of the pesticide and its fate in the environment. The evaluation determines the minimum amounts of a pesticide required for effectiveness and specifies safe usage levels.

Although neonicotinoids are registered for use federally, the Government of Ontario could choose to restrict the use of seed-applied neonicotinoids. Ontario has acted in such an independent manner in the past. Since 2009, Ontario has restricted the outdoor use of many cosmetic pesticides,[15] even though these pesticides are registered with the PMRA. This indicates that provinces may be willing to deviate from federal policy in this area.

14 Ontario Ministry of Agriculture and Food, *Ontario Bee Health Working Group Report*.

15 Ontario Ministry of the Environment, O*ntario's Cosmetic Pesticides Ban*.

Due to the overlapping jurisdiction of pesticide use regulation, some consideration should be given to which level of government is best able to regulate each aspect of pesticide use. The federal government, through the PMRA, has an established capacity to assess the science behind pesticide use. Since provincial governments may not have the same capacity, it is unclear whether the implementation of independent regulations results in an improvement of the decision-making processes or simply added regulatory redundancy and costs.

Neonicotinoids and Crop Yields

The primary purpose of neonicotinoids and other insecticides is to prevent insect attacks on plants, which helps to increase crop yields. Killing herbivorous insects reduces crop damage so farmers can harvest more product per area of land planted. For example, imidacloprid seed treatments were found to reduce black cutworm damage in corn.[16] Beyond their insecticidal properties, they appear to provide a "stress shield" that protects plants from sub-optimal growing conditions.[17] This improves the commercial viability of farms and ensures that the food system requires less land to produce the same amount of crop, or is able to grow more crops on a given amount of land.[18] For a world concerned with food security, insecticides make an important contribution.

Although neonicotinoids are widely recognized to increase crop yields, the incremental impact of their use is difficult to generalize. Table 1 summarizes the impacts of neonicotinoid seed treatments on the yields of corn and soybean (the largest cash crops in Ontario), as measured during field trials in different locations and under various conditions. In general, the effects on yield varied highly both within and between studies. For example, a study of the effects of two different neonicotinoid treatments on soybean farms in Nebraska found no change in yield

16 Schaafsma, Paul, and Phibbas, *Control of Black Cutworm in Corn With Seed Treatments*.

17 Ford and others, "Neonicotinoid Insecticides Induce Salicylate-Associated Plant Defense Responses," 17527.

18 Oerke, "Crop Losses to Pests," 33.

during the first year, but a 13 per cent yield loss in untreated crops during the second year.[19] The loss was attributed to a larger population of soybean aphids.

Table 1

Corn and Soybean Yield Reductions Observed and/or Estimated to Accompany a Loss of Neonicotinoid Insecticides in the Absence of Alternative Treatments

Source	Crop	Yield loss (per cent)	Statistical significance?
Maloney, 2003	Soybean	12–15	Yes†
Schaafsma and others, 2005	Soybean	0–14	No‡
Schaafsma and others, 2006	Soybean	0–28	Unreported
Smith and others, 2008	Soybean	19–42	Yes*
Magalhaes and others, 2009	Soybean	0–13	Yes*
Ohnesorg and others, 2009	Soybean	0–10	Yes*
Seagraves and Lundgren, 2012	Soybean	0–3	No
Maloney, 2003	Corn	6–16	Yes†
Schaafsma and others, 2003	Corn	0–12	No
Schaafsma and others, 2003a	Corn	0–34	Yes*‡
Rice and Oleson, 2004	Corn	0–11	Yes*
Schaafsma and others, 2004	Corn	0–10	No
Schaafsma and others, 2005	Corn	0–23	Yes*‡
Schaafsma and others, 2005a	Corn	5–9	Unreported
Jordan and others, 2012	Corn	0–6	Yes*
Noleppa and Hahn, 2013	Corn	1.4–10	Not applicable ¶
Dupont Pioneer, 2013	Corn	3.3 §	Unreported
Bayer CropScience, 2013	Corn	3.3 §	Unreported

† Statistical significance was stated by the authors, but results of statistical tests were not presented.
* Statistical significance of yields was observed for some experimental treatments, but not for all.
‡ Statistical significance of yield reduction was not tested for all individual experimental treatments.
¶ Statistical tests were not applicable because data come from surveys, rather than observations from field trials.
§ Calculated by dividing the reported change in bushels/acre by Ontario's 2012 average yield/acre.
Sources: The Conference Board of Canada; sources listed above.

19 Calculated from Magalhaes, Hunt, and Siegfried, "Efficacy of Neonicotinoid Seed Treatments," 191.

These contradictory study results highlight the difficulty of estimating typical yield losses or gains based on whether or not insecticides were used. Clearly the effectiveness of neonicotinoids depends on a variety of factors that likely include the size and type of local insect populations, weather, climate, and other factors. Thus, the efficacy of these and other pesticides may vary considerably between farms within a region depending on local conditions.

Alternatives to Neonicotinoids

Currently, the *Field Crop Protection Guide* published by the Ontario Ministry of Agriculture and Food (OMAF) lists only one insecticide seed treatment that excludes neonicotinoid pesticides. Thus, if there were a restriction of seed-applied neonicotinoids in Ontario, farmers would have to rely primarily on foliar insecticides (sprayed onto the leaves of plants during growth), soil-applied insecticides, or transgenic seeds in order to manage the insects previously managed with neonicotinoid seed treatments. Table 2 shows a list of corn and soybean insect pests that are currently managed using neonicotinoids in Ontario.

Table 2
Soybean and Corn Insect Pests Currently Treated with Neonicotinoids in Ontario

Soybean insect pests	Corn insect pests
Seedcorn maggot	Corn rootworm
Soybean aphid	Wireworm
Bean leaf beetle	Seedcorn maggot
Japanese beetle	Black cutworm
	European chafer
	Corn flea beetle

Source: Ontario Ministry of Agriculture and Food.

While a variety of alternative pesticides have been approved for use in Ontario for both corn and soybeans, few are registered to treat the same insect pests as neonicotinoid seed treatments. Table 3 compares a list of the available neonicotinoid seed treatments and their current alternatives, listing the pros and cons of each option.

Table 3
Pros and Cons of Soybean and Corn Insecticides

Soybean insecticides	Pros	Cons
Neonicotinoid seed coating: thiamethoxam	Low toxicity in vertebrates; treats seedcorn maggot and Japanese beetle	High persistence in environment; toxic and possible non-acute effects on bees; does not treat spider mites, potato leafhopper, western bean cutworm, or tarnished plant bug
Foliar spray: λ-cyhalothrin	Low toxicity in vertebrates; low persistence in environment; treats western bean cutworm and tarnished plant bug	Toxic to bees; does not treat seedcorn maggot or Japanese beetle
Foliar spray: dimethoate	Low persistence in environment; treats spider mites and potato leafhopper	Moderate toxicity in birds, mammals, and fish; high toxicity in bees; does not treat seedcorn maggot or Japanese beetle
Seed treatment: diazinone and captan	Includes a fungicide (captan); low persistence in soil	Highly toxic to aquatic organisms, birds, and bees; high persistence in water; only treats seedcorn maggot

Corn insecticides	Pros	Cons
Neonicotinoid seed coatings: thiamethoxam, imidacloprid, clothianidin	Low toxicity in vertebrates; treats widest variety of pests	High persistence in environment; toxic and possible non-acute effects on bees
Foliar granules: tefluthrin	Low toxicity in bees; low toxicity in terrestrial vertebrates	High toxicity in aquatic organisms; high persistence in environment; does not treat European chafer or corn flea beetle
Foliar spray: chlorpyrifos	Low toxicity in vertebrates; low persistence in environment	Toxic to bees; only treats corn rootworm
Seed treatment: diazinone and captan	Includes a fungicide (captan); low persistence in soil	Highly toxic to aquatic organisms, birds, and bees; high persistence in water; only treats seedcorn maggot

Sources: Ontario Ministry of Agriculture and Food; Interprovincial Cooperative Ltd.; Amvac Chemical Corp.; Syngenta Canada Inc.; U.S. Environmental Protection Agency; The Conference Board of Canada.

It is important to note that there are no alternative insecticides registered to treat the entire gamut of insects that are currently treated using neonicotinoids, for either corn or soybeans. For corn, both the European chafer and the corn flea beetle would be untreatable if neonicotinoid seed treatments were restricted. The corn flea beetle, in particular, has the potential to affect all corn grown in the province.[20] Additionally, soybean farms throughout Ontario could face a potential problem without a way to properly manage the Japanese beetle.[21]

However, two alternative treatments for soybeans that can treat soybean aphids and bean leaf beetles, which are currently managed with neonicotinoids, also address other pests that neonicotinoids cannot. λ-cyhalothrin is used to prevent western bean cutworm and tarnished plant bug infestations, and dimethoate can be used to deter spider mites and potato leafhoppers. Soybean farmers who switch to one of these alternative pesticides would experience a trade-off. They would lose treatment for the Japanese beetle and the seedcorn maggot, but gain protection against two other insects. If they were already using one or both of these pesticides to treat these other insects, they would not experience increased insecticide costs.

Of course, there are non-pesticidal management practices for controlling insect pests, which are commonly used in the production of organic crops. For example, biological controls can be used. This involves introducing predators of the problematic insects to reduce their population. Mechanical controls could also be used, including insect traps, physically removing insects from plants, or using extra tillage to inhibit insect growth.[22, 23] Crop rotation or increased crop rotation may also help since insects that prey on one crop may not prey on a subsequently planted alternative crop, reducing the need to manage

20 Ontario Ministry of Agriculture and Food, *Neonicotinoids and Field Crop Production in Ontario*.

21 Ontario Ministry of Agriculture and Food, “Insects and Pests of Field Crops.”

22 See, for example, McGuire, *The Effects of Reducing Tillage on Pest Management*, 3.

23 Alberta Ministry of Agriculture and Rural Development, *Physical Control of Pests*.

those pests. Crop rotation also helps to minimize harm from other types of crop pests such as weeds or disease-causing agents and can improve soil quality.[24] It should be noted that many Ontario farmers already rotate crops between growing seasons.

However, like insecticides, these types of alternatives have repercussions. Biological control can have unintended effects on local ecosystems, and additional tilling requires extra labour. Increased crop rotation, if possible, may require extra capital expenditure to plant, harvest, etc. multiple types of crop.

Regardless of how Ontario farmers choose to manage insect pests, an ongoing strategy is necessary to maintain yields and remain economically viable. As such, any regulatory action that restricts neonicotinoid seed coatings needs to be made within the context of alternative insect treatments. Since the farmers considered in this report currently use insecticides to manage insects, we presume that alternative insecticides would be the predominant technique used if neonicotinoids became unavailable for use.

Moreover, other factors come into play. As an Ontario farmer noted, for example, neonicotinoid use is also related to beneficial management practices (BMPs) designed to reduce soil erosion. One such practice involves planting ground cover, but the plants used for ground cover are ideal hosts for a variety of insect pests,[25] which would then need to be managed. The upshot is, environmental management is complex and "depends on a complicated array of factors that relate to local land attributes and the everyday activities and practices of farmers." [26]

24 Epp, "20 Years of Crop Rotation."

25 Interview with Michael Grant, February 5, 2014.

26 For a discussion of beneficial management practices, see Stuckey, Charman, and Le Vallée, *Reducing the Risk*.

Efficacy of Alternative Insecticide Treatments

As with neonicotinoids, the effectiveness of alternative pesticides depends substantially on the conditions under which they are applied, in addition to when they are applied and how much is applied. Table 4 summarizes the results of several studies that have explored the efficacy of two insecticides that we consider to be primary alternatives for neonicotinoids (based on the pests that they are registered to treat) and for which pricing information is readily available: tefluthrin for corn and λ-cyhalothrin for soybeans.

Table 4

Estimates of Increases to Soybean and Corn Yields Through the Use of λ-Cyhalothrin and Tefluthrin, Respectively

Source	Alternative insecticide	Yield increase (per cent)	Statistical significance?
Quesnel and others, 2004	λ-Cyhalothrin	0–39	Yes†*
Myers and others, 2005	λ-Cyhalothrin	0–10	Yes*
Schaafsma and others, 2005	λ-Cyhalothrin	0–9	No‡
Ohnesorg and others, 2009	λ-Cyhalothrin	0–12	Yes*
Henry and others, 2011	λ-Cyhalothrin	5	Yes
Rueber and Oleson, 2002	Tefluthrin	0–11	Yes*
Maloney, 2003	Tefluthrin	7–17	Yes†
Rice and Oleson, 2004	Tefluthrin	0–13	Yes*
Schaafsma and others, 2005a	Tefluthrin	10–29	No‡
Studebaker, 2005–2007	Tefluthrin	0–15	No‡

Sources: as listed above; The Conference Board of Canada.
† Statistical significance was stated by the authors, but results of statistical tests were not presented.
* Statistical significance of yields was observed for some experimental treatments, but not for all.
‡ Statistical significance of yield increase was not tested for all individual experimental treatments.

The findings of these studies indicate that yield increases can be attributed to λ-cyhalothrin and tefluthrin. As with neonicotinoids, however, the effects seem to differ strongly within and between studies. In some cases yields increased dramatically, though typical increases were 10 per cent or less. Given these variable results, farmers would need to evaluate their fields before applying alternative insecticides to determine whether they are likely to benefit from their use.

Importantly, several studies directly compared the efficacy of tefluthrin with neonicotinoid seed treatments for corn. An Iowa study, for example, found that tefluthrin and two types of neonicotinoid seed coating were associated with comparable yield increases, both in terms of the likelihood of a yield increase and the average yield increase.[27] The researchers noted, however, that the plots with tefluthrin produced results that were more consistent. Three other corn studies, in Arkansas,[28] Wisconsin,[29] and Iowa,[30] also found comparable yields from tefluthrin and several varieties of neonicotinoid seed treatment.

Comparisons have also been made between λ-cyhalothrin and neonicotinoid seed treatments for soybeans, including an Ontario study that did not find a significant difference in yields.[31] A similar study in Iowa, comparing the efficacy of various insecticides for preventing soybean aphid damage, found that λ-cyhalothrin performed better than the neonicotinoids tested.[32] Another study in Iowa also found that λ-cyhalothrin generated better yields than neonicotinoids in some treatments, but comparable yields in others.[33]

In general, direct comparisons of neonicotinoids with alternative insecticides have not found the former to be substantially more or less effective. This suggests that in some circumstances, farmers switching from neonicotinoid seed treatments to tefluthrin or λ-cyhalothrin may not experience any yield loss.

27 Rice and Oleson, *Two-Year Summary of Corn Rootworm Insecticides*.

28 Studebaker, *Increasing Profitability of Corn and Grain Sorghum*.

29 Maloney, *Insecticide Seed Treatments for Corn and Soybeans*, 5–9.

30 Rice and Oleson, *Two-Year Summary of Corn Rootworm Insecticides*.

31 Schaafsma and others, *Control of Soybean Aphids With Seed Treatment and Foliar Insecticide Applications*, 3–7.

32 Hodgson and VanNostrand, *2011 Report of Insecticide Evaluation*, 16.

33 Ohnesorg, Johnson, and O’Neal, “Impact of Reduced-Risk Insecticides on Soybean Aphid,” 1821.

It is important to note, however, that these comparative studies do not cover the entire range of insects that neonicotinoids can manage. There are currently no registered alternate insecticide treatments for certain pests, such as the corn flea beetle or the Japanese beetle, which affects soybeans. If direct comparison field trials included such insects, it is likely that neonicotinoid seed treatments would prove more effective than alternatives.

Observations indicate that these otherwise untreatable pests can harm grain crops. For example, a study of corn grown in Ontario in 2003 found typical yield losses of around 10 per cent in untreated crops affected by corn flea beetles.[34] A subsequent experiment the following year found no significant differences in yield, but did find seeds treated with neonicotinoids showed increased sprouting.

Another study of the effects of the European chafer on corn in 2000 did not observe significant yield loss in untreated plants, but did observe increased plant damage.[35] A 2004 study found improved sprouting resulting from the use of neonicotinoids, but yields were not measured.[36]

For soybeans, the key insect pest for which there is no alternative treatment is the Japanese beetle. A study in Iowa found that neonicotinoid-treated seeds did not have better yields than untreated controls in the face of relatively low Japanese beetle density. The authors concluded, however, that increased damage from these beetles would warrant the use of insecticides for treatment.[37] The *Agronomy Guide for Field Crops*, published by OMAF, also notes that yield loss can result from defoliation by this pest.[38]

34 Schaafsma and others, *Control of Corn Flea Beetle in Corn With Seed Treatments*, 4.

35 Schaafsma and others, *European Chafer Control in Corn With Seed Treatments*, 1.

36 Schaafsma and others, *European Chafer Control With Seed Treatments*, 1.

37 Hodgson and VanNostrand, *2011 Report of Insecticide Evaluation*, 27.

38 Ontario Ministry of Agriculture and Food, “Insects and Pests of Field Crops.”

Although there are effective alternative insecticides registered for some insect pests, it is clear that damage may be caused by insects for which there is currently no registered alternative. As such, it is likely that many corn and soybean farmers in Ontario would experience a yield loss if they no longer had access to neonicotinoid seed treatments.

Conclusion

This chapter has reviewed the science of pest control, focusing specifically on neonicotinoids and alternative treatments. The literature confirms that pest control plays an important role in increasing yields, thereby improving the economic viability of farms. Since farmers are being encouraged to adopt beneficial management practices such as growing ground cover and reducing tillage to limit soil erosion, pest control may become even more pressing. Continued insect pest management is essential; the issue is how farmers will do it.

All pest treatments have potential environmental impacts. One of the key roles of a science-based federal regulatory process is to thoroughly evaluate pest management products and ensure they will not pose unacceptable risk to human health or the environment. The inherent uncertainty associated with field test results, which are typically variable, complicates the challenge of weighing costs and benefits.

There is a cost associated with this uncertainty, because pest treatments act, to some extent, as insurance for farmers. Any given farm may or may not be exposed to a range of pests in a growing season. However, the decision to use certain pest controls must often be made ahead of time, since there are no "rescue treatments" for certain pests. With fewer insecticide options available, there is greater risk that crops will be exposed to plant-eating insects, which comes with a cost whether or not insect pests affect a crop.

CHAPTER 3

Ontario's Grain Economy

Chapter Summary

- Corn and soybean production are important contributors to Ontario's economy. In 2012, farm cash receipts in Ontario from corn and soybeans were $3.5 billion.
- Farm income is not evenly distributed. Some farms are in a strong financial position, while others break even or operate at a loss.
- Depending on their financial performance, farms will likely either reduce their production or exit the industry in response to higher production costs, lower crop yields, or a combination of both.

Potential regulatory restrictions on neonicotinoid seed treatments would affect different farms in different ways, depending on their operational and financial circumstances. One factor is the physical characteristics of the farm. Neonicotinoids benefit farmers by controlling insects that attack their crops. Since farms differ in land quality and exposure to insect pests, so does their dependence on neonicotinoids and alternative pest treatments.

Yet farms also differ in their business characteristics. Farms that are only marginally profitable may have to exit the industry if regulation results in lower revenue or additional costs. Farms that are more prosperous may be in a better position to absorb the lower revenue or higher costs that may result from regulatory actions, but they are likely to change their management decisions in such case. Understanding how farms in different financial positions respond to new regulations enables us to estimate the economic impact of these regulations.

In terms of the overall impact on the Ontario economy, the macroeconomic effects simply flow from individual farm-level decisions, which affect other parts of Ontario's food supply chain. These supply chain effects spill over into the overall Ontario economy and, in turn, affect the Canadian economy.

Notably, a regulatory restriction on neonicotinoid seed treatments would also affect seed production companies by changing what they could legally sell to Ontario farmers. To understand how this part of the supply chain affects individual farms, it is also important to understand how seed production companies are organized.

This chapter explores all these factors in relation to the economy of Ontario's grain sector.

Corn and Soybean Farming in Ontario

According to the Census of Agriculture, Ontario's cropland totalled approximately 3.6 million hectares in 2011,[1] with the harvested area of grain corn and soybeans accounting for more than 50 per cent of this.

Table 5 details corn and soybean production between 2000 and 2012, when Ontario accounted for about 65 per cent of Canada's corn production and 75 per cent of its soybean production, on average. Chart 1 illustrates harvested hectares and growth. Notably, yields have risen steadily, particularly for corn.

Table 5

Grain Corn and Soybean Production in Canada and Ontario, 2000–12

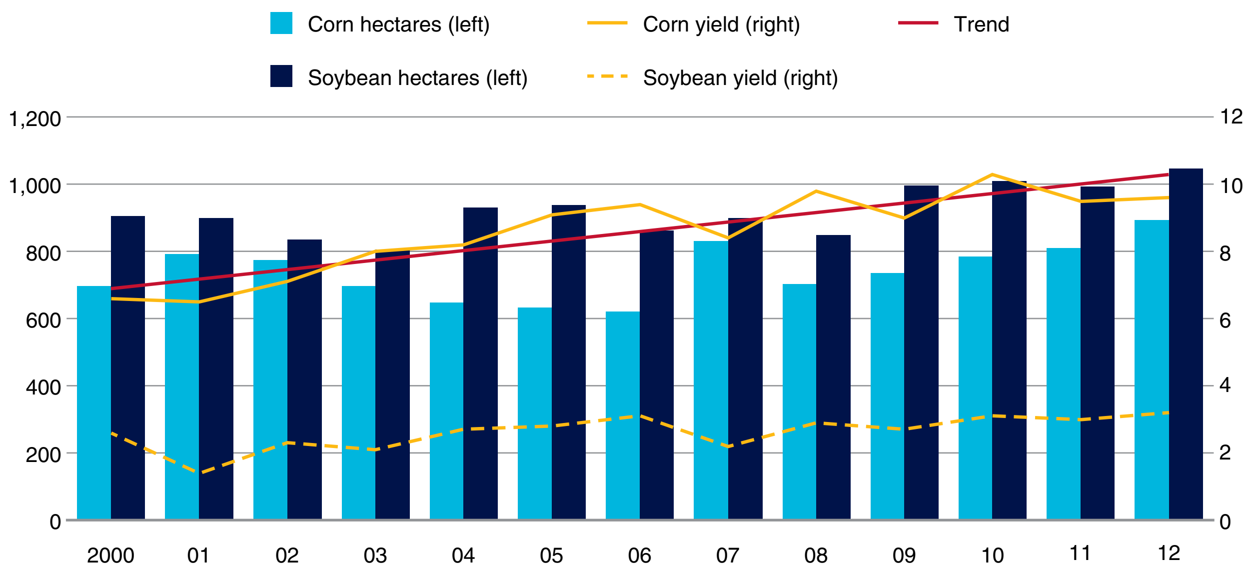
(tonnes, 000s)

	Grain corn			Soybeans		
	Canada	Ontario	Ontario share (per cent)	Canada	Ontario	Ontario share (per cent)
2000	6,954	4,610	66	2,703	2,313	86
01	8,389	5,131	61	1,635	1,279	78
02	8,999	5,487	61	2,336	1,905	82
03	9,587	5,563	58	2,273	1,728	76
04	8,837	5,334	60	3,044	2,477	81
05	9,332	5,766	62	3,156	2,586	82
06	8,990	5,868	65	3,466	2,667	77
07	11,649	6,985	60	2,686	2,000	74
08	10,643	6,909	65	3,336	2,477	74
09	9,796	6,604	67	3,582	2,694	75
10	12,043	8,078	67	4,445	3,130	70
11	11,359	7,722	68	4,298	3,021	70
12	13,060	8,598	66	5,086	3,402	67
Average			**64**			**76**

Sources: Statistics Canada; The Conference Board of Canada.

1 Statistics Canada, "2011 Census of Agriculture, Farm and Farm Operator Data."

Chart 1
Grain Corn and Soybean Harvested in Ontario, 2000–12
(hectares, 000s; yield per hectare, tonnes)



Sources: The Conference Board of Canada; Statistics Canada.

In 2012, the total value of corn and soybeans sold in Ontario was $3.5 billion—more than half of the $6.7 billion of provincial crop sales.[2] Collectively, corn and soybean farming contributed an estimated $2.4 billion in gross domestic product (GDP) to Ontario's economy in 2011,[3] after considering the spillover (supply chain) effects.

Ontario's Contribution to North American Corn and Soybean Supply

Although Ontario produces most of Canada's soybeans and corn, it is a drop in the bucket compared with total North American production. In 2011, for example, Ontario harvested 8.6 million tonnes of grain corn and

2 Statistics Canada, "Table 002-0001: Farm Cash Receipts."

3 Calculated based on MNP LLP estimates of total GDP for corn, soybeans, and wheat. Corn and soybean shares were estimates based on their shares of gross output.

3.4 million tonnes of soybeans. The United States, on the other hand, harvested more than 280 million tonnes of grain corn[4] and more than 80 million tonnes of soybeans.[5] Mexico also produces large volumes of corn: approximately 20 million tonnes in 2012.[6]

In North America, soybean and corn futures are typically traded on the CME Globex exchange, based in Chicago. Since this is a centralized international exchange, Ontario and other jurisdictions with a small market share have limited ability to affect the market price of these crops. As such, we expect that increased production costs for Ontario corn and soybeans would not mean Ontario farmers would receive higher prices for their crops, since they can be substituted with crops from other jurisdictions.

Organization of Farms

Each farmer's response to new regulations depends on the nature of the farming enterprise. The financial position of individual farms matters more than the size of the sector. Thus, we need to understand the organization of farms to assess how regulations might affect the sector.

First, we consider the average operating financials for Ontario's grain and oilseed farms.[7] Table 6 shows that the number of farms with revenue from grains and oilseeds has increased in recent years, most likely in response to better commodity prices. Still, the average farm is a very small business. In 2012, the average farm realized less than $250,000 in operating revenue from all sources, of which $171,000 came from grain and oilseed sales. Even though 2012 was a good year, the average

4 Calculated based on data from the United States Department of Agriculture (USDA), "National Statistics for Corn."

5 Calculated based on data from the USDA, "National Statistics for Soybeans."

6 USDA, "World Corn Production, Consumption, and Stocks."

7 Data availability requires that we use grain and oilseed farming as a proxy for corn and soybean farms. We have shown that corn and soybean farms account for the majority of grain operations. Therefore, the grain and oilseed farming statistics are a good representation of corn and soybean operations.

farm still earned slightly more than $50,000 in net operating income. By standard business definitions, Ontario grain and oilseed farms are micro-enterprises, as are typical Canadian farms in general.

It is important to note that these farms are price takers, in the sense that they are too small to influence input or output prices through their actions. If faced with new regulatory restrictions on insecticides, farmers would simply optimize their production within the constraints presented by the regulation. The marginal (or incremental) cost of output depends on the quality of the land and the exposure to pests. Farmers will produce until marginal costs equal marginal revenue—that is, until increased costs outweigh the increased revenue from additional production. As price takers, prevailing grain prices dictate marginal revenue. So farmers focus on managing marginal production and costs, over which they have control. They manage marginal production and costs by using alternative pest control strategies, determining what and how much to plant, and deciding whether they will participate in the industry.

A large portion of Ontario corn production is destined for the domestic market (more than 85 per cent of domestic production in the 2012–13 crop year).[8] As a result, if all producers were faced with an increase in production costs and/or decline in yields, it could be argued that at least some of these costs could be passed on to domestic consumers through higher prices. However, while transportation costs may act as a barrier to trade to some degree, any attempt to pass along a large portion of those costs would likely be tempered by some increase in imports from U.S. producers as well as a decrease in consumption. For example, while Ontario is now a net exporter of corn, imports accounted for more than 15 per cent of domestic demand as recently as the 2006–07 crop year.[9] As a result, our scenarios assume that farms remain price takers.

8 Calculated from data available from the Ontario Ministry of Agriculture and Food, “Supply and Disposition for Ontario Grain Corn.”

9 Calculated using data obtained from Statistics Canada, “Table 001-0042: Supply and Disposition of Corn in Canada and Selected Provinces.”

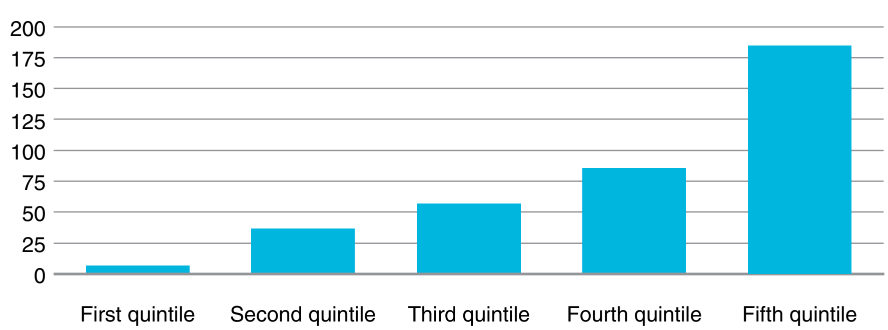
The financial statistics in Table 6 are averages and mask considerable variability in farm operations. This variability is evident in Chart 2 when we look at financial performance by income quintiles—i.e., we break the farm population into five groups, with the first quintile being the 20 per cent of farms with the lowest income, the next quintile being the 20 per cent of farms with the next highest income, and so on to the highest income farms. Due to data availability, we based this quintile analysis on Canadian grain and oilseed farms, which we use as a proxy for Ontario farms.

Table 6
Ontario Grain and Oilseed Farms Average Financials
(2012 C$)

	2008	09	10	11	12
Number of farms	15,225	15,065	16,650	17,160	18,660
Average operating revenues	166,717	172,903	174,229	202,414	216,078
Average grain and oilseed revenues	123,451	131,291	131,919	156,831	170,911
Average operating expenses	133,549	142,334	139,700	151,081	161,913
Average net operating income	33,168	30,569	34,529	51,333	54,165

Source: Statistics Canada.

Chart 2
Average Income by Income Quintiles, Grain and Oilseed Farms, Canada, 2011
(2011 $ 000s)



Source: Statistics Canada.

The distribution of income quintiles reflects the reality of Ontario's grain and oilseed farms. The first quintile likely consists mainly of hobby farms. The second and third quintiles include farming households that may be reliant on a combination of on-farm and off-farm income for viability. The highest quintiles are more likely to represent full-time, albeit small, farming enterprises.

The CFIC report *The Sky's the Limit* notes that farming activity is unevenly distributed across revenue classes. For all Canadian farms, those in the two largest revenue classes account for roughly 80 per cent of total revenue and 90 per cent of total operating profits after capital cost allowances.[10] In that report, we also noted that the probability of loss (making a negative profit) for any one farm is inversely proportional to farm revenue. In 2009, farms with less than $50,000 in revenue had a 1 in 2 chance of losing money, whereas farms with revenue over $250,000 had about a 1 in 10 chance of losing money. Nevertheless, profitability varied considerably across all farm sizes.

Seed and Pesticide Costs

A key issue is whether regulation will result in higher input costs for seeds or alternative pesticides. On the one hand, seed coatings are an additional cost of production that has to be factored into the price of seed and, therefore, less treatment might lead to lower production costs and prices. On the other hand, one must consider the economies of scale in seed production. If seed producers have to make specialized short runs to accommodate regulations (e.g., by producing seeds without neonicotinoid seed treatments), then costs and prices may increase because they have broken down their economies of scale. This would likely be the case for corn seed used by Ontario farmers, since much of it is grown and treated in the United States[11] and almost all of it is

10 Burt and others, *The Sky's the Limit*, 24.

11 James Knowles interview with Steve Denys from Pride Seeds, May 2, 2014.

currently treated with neonicotinoids.[12] Soybean seeds may not face this challenge since Ontario soybean farmers use Ontario-grown and treated seeds almost exclusively,[13] which means a restriction on all neonicotinoids would affect all relevant soybean seed producers equally.

The preliminary evidence regarding the potential change in seed costs is ambiguous. For instance, the Grain Farmers of Ontario approached the Canadian Seed Trade Association to ask their members to offer a neonicotinoid-free seed choice for corn and soybean.[14] The seed producer Dupont Pioneer responded by offering neonicotinoid-free corn and soybean seeds. The soybean seed is available at a somewhat reduced price, while the corn seed is the same price, as confirmed by a representative from Pride Seeds.[15]

Notably, the Dupont Pioneer representative suggested that these seeds will not be introduced into the United States because the neonicotinoid issue is "less visible" there. This is important since U.S. producers are Ontario's closest competitors and the seed industry is organized continentally. More importantly, Ontario's corn and soybean farms compete with U.S. farms in grain commodity markets.

If new restrictions came into effect on the use of neonicotinoid seed treatments, farmers would still need to protect their plants from insects. The issue then is whether the alternative treatments increase farm costs. As the comparative field studies on seeds discussed in Chapter 2 illustrate, this will depend on how at risk individual farms are to insect pests. The most affected farms would be those that required neonicotinoids to control insect pests. These farms did not require additional treatments from other pesticides. In this case, pest treatment is effectively cost-free because the treatment is part of the seed costs, which are roughly the same with or without treatment. The incremental

12 Ontario Ministry of Agriculture and Food, *Neonicotinoids and Field Crop Production in Ontario*.

13 Interview with Steve Denys.

14 Canadian Honey Council, "Pioneer Offers Neonicotinoid-Free Corn, Soybean."

15 Interview with Steve Denys.

cost to an individual farm depends on the extent to which it already relies on approved alternative insecticides for pest treatment and whether its use of alternatives would increase if neonicotinoid use became restricted.

Conclusion

This chapter has explored the pertinent characteristics of Ontario's corn and soybean sector, noting that farms differ significantly in their capacity to manage regulatory interventions. Farms with greater revenue are likely to be more financially viable because they are less likely to have current losses. Smaller farms are much more likely to take a loss, though there is also considerable variation in the profitability of larger farms. Since all farms are relatively small enterprises, they are price takers in terms of their input costs and output prices. As such, the individual farm operators need to optimize within these price constraints.

Neonicotinoids seed treatments are effectively embedded into the seed prices, so removing the treatments will either reduce yields as pests destroy plants, increase costs through alternative pest control use, or both. Since corn and soybean prices are fixed, reduced yields effectively reduce revenue. Alternative pest control measures may prevent yield loss, but may do so at a higher cost. Either way, farmers would face lower profits or increased losses and, by implication, lower retained earnings if neonicotinoid seed treatments were restricted.

In the next chapter, we develop a model to estimate the impact of a restriction on seed-applied neonicotinoids on Ontario's corn and soybean sector.

CHAPTER 4

Economic Impact of a Restriction on Seed-Applied Neonicotinoids

Chapter Summary

- In this chapter, we model the impacts of a restriction on neonicotinoid seed treatments on Ontario corn and soybean production, based on the enterprise analysis from Chapter 3.
- Such a restriction would affect farms to varying degrees depending on their operating characteristics and exposure to pests. Our model assumes a mix of impacts, where some farms are affected only marginally and others see significant cost increases and yield reductions.
- Collectively, we estimate that total corn and soybean production could fall by $630 million. The total negative impact on Ontario's GDP, including supply chain effects, is estimated to be almost $440 million.

Restrictions on neonicotinoids would affect individual corn and soybean farms differently depending on their exposure to pests that are controlled with neonicotinoid treatments. A restriction would result in some combination of lower yields and/or higher costs. This would reduce profits (or increase losses) in the soybean and corn sectors. Individual farms would respond to these lower profits through their planting decisions and assessments of the viability of continuing grain operations, especially given that their major competitors in the United States are unlikely to face a similar restriction.

Although the basic economic effects that would result from an outright restriction are understood, from a public policy perspective we need to know the likely scale of such effects. This would provide an idea of the costs of the policy on the soybean and corn farming community. Government policy-makers would then be in a position to weigh these costs against possible benefits of the restriction. (Assessing these benefits is beyond the scope of the current study.)

In some areas of public policy, changes to regulations and taxes have predictable outcomes. For example, the introduction of the goods and services tax (GST) had a predictable impact on supply chains, government revenues, prices, and consumption because it affected the economy in a rather straightforward way, through a price and tax credit mechanism. The economic science of price demand and supply elasticities is well established. The state of the analytical science meant there were relatively few policy risks to introducing the GST in terms of its economic effects, notwithstanding the political risks.

Unfortunately, the physical and economic science related to neonicotinoid use points to a range of potential outcomes. As we have shown, the results of neonicotinoid field studies vary considerably and largely depend on location. Moreover, there is little information about the exposure of Ontario farms to neonicotinoid-treated pests. We do not know how farmers will react to a restriction on neonicotinoid seed treatments, in terms of either alternative pest control strategies or planting decisions. Moreover, we do not know how competing jurisdictions will approach neonicotinoid regulation in the future. It appears that the United States, Ontario's most important competitor, will not restrict neonicotinoids. All these factors introduce significant policy risk.

The best way to illustrate this policy risk is to generate a range of possible effects, based on our current understanding of neonicotinoid science and Ontario's corn and soybean sector. In this chapter, we develop a microeconomic (farm-level) model to estimate the effects on Ontario's soybean and corn farms. The model generates different yield/revenue and cost estimates that affect profitability. We then estimate the effect of reduced profitability (or de-capitalization) on the managerial decisions of corn and soybean farmers.

We then gather our microeconomic findings into a macroeconomic model. This enables us to generate estimates of the impact on Ontario's GDP. We develop an estimate of spillover effects from reductions in corn and soybean GDP based on our understanding of corn and soybean subsector supply chains.

It is important to note that this macroeconomic analysis is limited to the impacts resulting from a change in corn and soybean farming output. It is possible that if profits declined, land and capital would be redistributed to different farming subsectors or other industries. However, it is difficult to model land and capital redistribution a priori and the effects it would have on farm revenues and costs. As noted earlier, corn and soybeans accounted for approximately 85 per cent of the value of all Ontario grain and oilseeds harvested in 2012.[1] Given that these crops account for a high proportion of grain and oilseed farming, any transition toward other grain or oilseed farming would likely be difficult, or would at least reduce profitability. Therefore, the model assumes that any farmers who are negatively affected would be unable to recover lost profits by entering another industry.

The Model

We based the model of corn and soybean farms in Ontario on the enterprise analysis in Chapter 3. In the base case, we estimated revenue, costs, and profitability across five revenue classes of corn and soybean farms based on Statistics Canada's national data from the grain and oilseed sector. This national data provided us with a template with which to estimate relative number of farms and their sizes across revenue classes. We relate this to data on the acreage and associated revenues of Ontario corn and soybean operations,[2] anchoring total industry analysis to Ontario data. To smooth out year-to-year fluctuations in yields and financial performance, we based the scenarios on a five-year average (2008–12) of corn and soybean production in Ontario.

Combining these data sources, we generated a base case of Ontario's grain farms with two components: operations (see Table 7) and finances (see Table 8). From an operational standpoint, we assumed that each farm harvests both soybeans and corn. (See box "Crop Rotation in the Model.") These tables demonstrate the diversity of Ontario's corn and soybean sectors and the relative position of grain farms to absorb regulatory shocks such as a restriction on the use of seed-applied neonicotinoids.

1 Ontario Ministry of Agriculture and Food, "Estimated Area, Yield, Production, and Farm Value of Specified Field Crops."

2 Data used to create the model were obtained from Statistics Canada: Table 001-0010; Table 002-0002; Table 002-0035; Table 002-0044; Table 002-0047; Table 002-0053; Table 326-0021. Additional data were obtained from the Ontario Ministry of Agriculture and Food, "Historical Provincial Estimates by Crop, 1981–2013."

Table 7

Base Case, Ontario Corn and Soybean Farms: Operational Metrics by Revenue Class

(based on 2008–12 averages)

	Revenue class				
	Micro	Small	Medium	Large	Very large
Number of soybean and corn farms	4,010	2,515	3,354	2,245	2,194
Average size (hectares)	12	31	70	151	470
Soybean hectares	26,481	43,530	130,823	189,910	575,969
Corn hectares	20,930	34,404	103,397	150,096	455,220
Soybean tonnage	79,318	130,385	391,851	568,832	1,725,184
Corn tonnage	201,632	331,446	996,110	1,446,005	4,385,520
Soybean yield (tonnes/hectare)	2.995	2.995	2.995	2.995	2.995
Corn yield (tonnes/hectare)	9.634	9.634	9.634	9.634	9.634
Total number of Ontario soybean and corn farms modelled	14,318				
Total Ontario soybean and corn hectares	1,730,761				

Sources: The Conference Board of Canada; Statistics Canada.

Table 8

Base Case, Ontario Corn and Soybean Farms: Average Financial Metrics by Revenue Class

(2012 C$; based on 2008–12 averages)

	Revenue class				
	Micro	Small	Medium	Large	Very large
Number of soybean and corn farms	4,010	2,515	3,354	2,245	2,194
Revenues	16,559	43,409	97,815	212,161	658,174
Costs	14,924	35,244	77,560	166,391	499,448
Net market income from operations	1,635	8,165	20,255	45,770	158,726
Capital cost allowance (CCA)	1,872	5,361	12,430	27,997	88,557
Net market income after CCA	-237	2,804	7,824	17,773	70,169
Profit margin, adjusted for CCA (per cent)	-1.6	8.0	10.1	10.7	14.0
Soybean revenues per hectare	1,243	1,243	1,243	1,243	1,243
Corn revenues per hectare	1,600	1,600	1,600	1,600	1,600
Operating cost per hectare	1,262	1,137	1,111	1,098	1,063
Total market income (profits)	546,061,617				
Total market income, after CCA	226,212,945				

Sources: The Conference Board of Canada; Statistics Canada.

Crop Rotation in the Model

Farmers alternate crops based on several factors, including current and future crop prices. Moreover, rotating crops from one year to the next typically improves soil quality and, as a result, crop yields over time.

In Ontario, a corn-soybean rotation is common. Other rotations include corn-soybean-wheat and hay alternated with fodder crops. Research suggests that corn and soybean yields typically improve when wheat is added to the rotation.[3]

We focused our farm model on corn and soybeans, since they are the dominant cash crops in Ontario, and assumed a corn-soybean rotation that reflects the relative planted area of the two crops over a five-year period. Since the planted area of soybeans only slightly exceeds that of corn for that period, we effectively assumed that producers alternate between corn and soybeans from one year to the next.

Although we assumed no variability in yield by size of farm, we noted considerable variation in the size of the farms and their costs of production and base case profitability. The per acre costs of very large farms are about 16 per cent lower than for micro farms due to fixed and variable cost economies of scale.

Table 8 clearly shows a wide range of profitability by size of operation. In addition to this variability, we also allow for variation within each revenue class around the average profitability.

The financial statements reflect decisions that farmers make in response to a restriction on neonicotinoid seed treatments—either accepting reduced yields or pursuing alternative treatment strategies. Smaller yields reduce the revenue per acre and, therefore, gross revenue. Alternative pest treatments involve assuming higher pesticide costs.

3 Epp, “20 Years of Crop Rotation.”

We simulate the model for four scenarios (which we subsequently combine into a single scenario):

1. *Best Case Scenario:* No yield loss. Farmers are already using alternate soybean pesticides, so they only have to pay for new corn pesticide (tefluthrin).
2. *No Yield Loss/Higher Pesticide Costs:* No yield loss. Farmers pay for alternative pesticides for both soybeans and corn. This assumes that farmers will use and pay for tefluthrin and λ-cyhalothrin pesticides.
3. *Medium Yield Loss/Higher Pesticide Costs:* Farmers realize an average 5 per cent yield loss because alternative treatments are not as effective as neonicotinoids. Farmers pay for tefluthrin and λ-cyhalothrin pesticides.
4. *Worst Case Scenario:* Farmers realize an average 10 per cent yield loss because alternative treatments are not as effective as neonicotinoids. Farmers pay for tefluthrin and λ-cyhalothrin pesticides.

All of the scenarios assume that 99 per cent of corn seeds and 65 per cent of soybean seeds planted in Ontario are treated with neonicotinoids.[4] Therefore, the shocks on crop production will only affect those proportions of acreage and production for each crop. (See box "Estimating Pesticide Costs" for a description of how incremental pesticide costs were calculated.)

Notably absent from the scenarios is a change in seed costs to farmers, which could occur in two ways. In the event of a neonicotinoid restriction, the cost of seeds may go down, since the seeds would no longer need insecticide treatment. Simultaneously, seed consumption could increase if farmers plant more seeds per acre in an attempt to increase yields. Our scenarios implicitly assume that changes in the price and consumption of seed are proportionately equivalent. This means that a change in seed consumption would offset any change in seed price, and vice versa. For a comparison of scenarios in which the magnitudes of seed consumption and price changes differ, see Appendix A.

4 As is reported by the Ontario Ministry of Agriculture and Food, *Neonicotinoids and Field Crop Production in Ontario*.

Estimating Pesticide Costs

As discussed, there are several available insecticide alternatives to neonicotinoid seed treatments for both corn and soybeans. Each alternative is effective against a different variety of pests and has different costs and methods of application. Since the alternative pesticide(s) used would likely vary between regions and individual farmers, estimating the cost increase resulting from a restriction of neonicotinoid use is complex.

For simplification, we have estimated the costs for two alternative insecticides: tefluthrin for corn and λ-cyhalothrin for soybeans. Of the insect pests currently treated with neonicotinoids, these alternatives are registered to treat as many as is possible with a single insecticide. In addition, province-wide pricing estimates are available for both but not for other alternative pesticides.[5]

To estimate increased costs, we used data from OMAF's *2013 Field Crop Budgets*, which details the per acre costs to farmers for inputs, labour, etc. (excluding capital costs). The costs in this document were updated with data from the October 2013 *Ontario Farm Input Monitoring Project*. We added in the costs of the alternative pesticides, based on the manufacturers' recommended dosages per acre as well as the estimated increase in labour costs for pesticide application, assuming the maximum recommended number of applications.

The new costs were then estimated as a percentage of the total per acre costs of production for several tillage practices (conventional, no-till, and minimum till) and seed types (conventional and Roundup Ready) that were reported in the *2013 Field Crop Budgets*. We averaged these values across seed and tillage types for each crop.

Average pesticide costs were then used to increase our estimates of farm costs for the appropriate scenarios, based on the data compiled from Statistics Canada—i.e., the estimated costs for each size of farm were increased by the percentage of base costs that each alternative pesticide was estimated to cost.

5 McEwan. *Ontario Farm Input Monitoring Project Survey #3*, 5.

The yield losses within each scenario were chosen to allow for a range of possible effects. Given that the efficacy of neonicotinoids appears highly variable, we chose values that we believe represent a reasonable range of potential impacts, given the yield effects reported in the literature.

Initial Impact

In Table 9, we show the initial impact on the profitability of corn and soybean farms by revenue class. Other things remaining equal, smaller yields result in lower revenues and more pesticide use increases costs. Together, these affect net market income, which reduces the profits of individual farms and the industry. At the farm level, the average impact varies from $700 for micro farms under the best-case scenario to almost $90,000 for the largest farms under the worst-case scenario.

Table 9

Ontario Corn and Soybean Farms: Average Reduction in Net Market Income by Revenue Class

(2012 C$)

	Revenue class				
	Micro	**Small**	**Medium**	**Large**	**Very large**
1. Best case	700	1,654	3,639	7,807	23,435
2. No yield loss/higher pesticide costs	1,000	2,362	5,197	11,149	33,466
3. 5 per cent yield loss/higher pesticide costs	1,680	4,145	9,215	19,864	60,500
4. Worst case	2,360	5,928	13,232	28,578	87,535

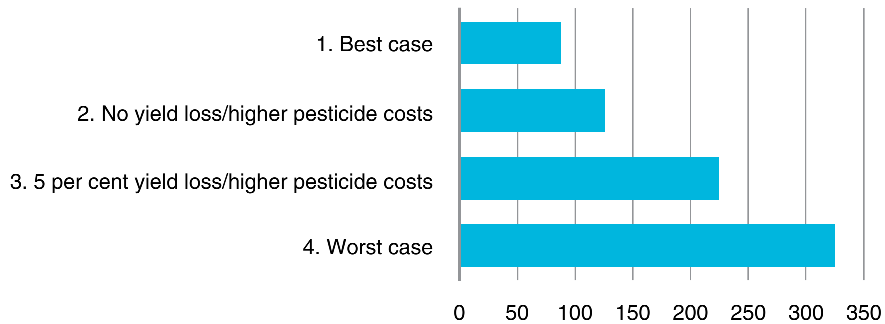
Source: The Conference Board of Canada.

Aggregating the effects for the corn and soybean sector, we estimate net income effects ranging from around $90 million to $325 million dollars, depending on the assumptions. (See Chart 3.) Since this affects the net income of the corn and soybean sector, we expect it would reduce available capital in the sector by a similar amount.

Chart 3

Reduction in Net Market Income for Ontario Corn and Soybean Industry Under Different Scenarios

(2012 $ millions)



Source: The Conference Board of Canada.

Impact as Farmers React

When faced with new regulations that effectively de-capitalize the industry, farmers will tend to react by adjusting their operations. Since a neonicotinoid restriction would affect their marginal costs, they would revisit their operations and ensure that marginal revenues are equal to their new marginal costs. While this reaction is unlikely to be immediate, we modelled it in that way to estimate the long-run impacts.

Farmers give us an idea of how they are likely to react to new regulatory costs by the way they employ capital before a new regulatory intervention. We assumed that farms were optimally employing capital prior to the regulatory intervention. As such, they will try to re-employ their reduced capital to generate the same or similar return as before the regulatory intervention.

There are several ways to calculate how this affects the industry's output. One approach is to assume that farms generate a target rate of return on their capital and adjust investment and operating decisions in response. We can calculate the return on capital prior to the regulatory intervention for each revenue class. The industry will then seek to move toward the same target rate of return. Some farms will exit the sector because they are already in a loss-making position and cannot sustain further losses. Other farms may remain in business at a lower level of profitability or scale back operations (e.g., harvested acreage) to some degree.

We noted that many farms are already in a loss-making position prior to the regulation. Typically, the smaller the farm, the more likely it is to take a loss. Such loss-making farms are likely sustaining losses through some combination of public programs (i.e., Agriculture Canada's AgriStability program) and off-farm income. Government income stabilization and crop insurance programs are designed to help farms through periodic reductions in net income from adverse price movements or significant reductions in yield due to, for example, poor weather. They do not make unprofitable farms profitable over the medium to long term. As such, our model allows for industry exits and a reduction in acreage harvested.

Farming enterprises—including all farms within revenue classes from "small" to "very large"—earn between 8 and 14 per cent (on average) on their revenue in the base case. Since this is an average return, some farms in these revenue categories may leave the industry too, although they are less likely to do so than farms in the smallest revenue class. Instead, they are more likely to reduce marginal, less fertile acreage to bring their return on capital back in line with their higher costs of doing business.

For our model, we built in a range of current profitability based on a distribution around average returns. We assumed that each farm size has a normal distribution of profitability, due to the high variation in yields and costs across Ontario farms. A wide distribution is reasonable, given that some counties with corn and soybean production had estimated yields of approximately half the provincial average in 2012.[6]

We then ran the model for each of the four scenarios. The following assumptions were made: the net increase in non-profitable farms drops out of the market in each revenue class and the least profitable

6 Ontario Ministry of Agriculture and Food, "Soybeans: Area and Production Estimates, by County" and "Grain Corn: Area and Production Estimates, by County."

farms (or acreage) exit (or are cut from) the industry. Larger farms scale back their operations by not planting on their marginal land (which has gone from marginally profitable to loss-making). Of course, the more pessimistic the scenario, the more likely farms would exit or reduce acreage.

A Small Impact on Yields or Costs Can Have a Large Impact on Production

At first glance, a 5 or 10 per cent reduction in farm yields seems small and unlikely to heavily influence production decisions. However, by considering what this means for individual farm income, it is easier to see how the impacts can potentially be large.

For example, a typical farm has operating profit margins in the range of 10 to 15 per cent. This means that a farm with total revenues of $300,000 may have profits in the range of $30,000 to $45,000. Without any pricing power—the ability to freely raise prices charged to customers—a hit to crop yield is also a direct hit on the bottom line. A negative yield impact of 10 per cent, for example, reduces profit to just $0 to $15,000, down from $30,000 to $45,000.

It is easy to see that farms faced with a potentially permanent yield impact of that size would have to adjust one way or another. Ideally, the farm operator would find ways to increase productivity and/or reduce the cost of inputs to restore the initial level of profitability, though one would assume they would have already taken advantage of such opportunities. More likely adjustments would include looking for opportunities to plant other crops, reducing marginally profitable acreage, or simply exiting the business altogether. We do not assume that there is any significant opportunity to plant alternative crops, and if there were, it is likely they would be less profitable (otherwise, we would already see a greater uptake of those crops).

If the same impact hits an entire industry, it may be able to increase prices collectively to pass some of the negative impact on to their customers. However, if their customers have access to other sources of supply that have not been hit with the impact, it is unlikely that those affected will be able to increase their prices. Since agricultural crops, including corn and soybeans, are generally traded internationally, it is unlikely that Ontario producers would be able to exert any significant pricing power if they were subject to restrictions that did not affect their competitors, particularly those in the United States.

Impact on Ontario's Economy

We have already made the point that farms will be subject to policy risk based on their financial position, exposure to pests, and current pest management techniques. While the literature shows comparable efficacy of both neonicotinoid pesticides and their alternatives in many circumstances, there is a reason why the use of neonicotinoid seed treatments is so prevalent—they are effective against a variety of pests and are inexpensive. Moreover, the fewer options that farmers have for controlling pests, the more likely their yields will be negatively affected. The more pessimistic model scenarios reflect this. As such, we assign a 25 per cent probability to each scenario across the distribution of farms. This effectively assumes that 25 per cent of the farms in Ontario will be only marginally affected. On the other hand, one quarter of the farms will face steep declines in profitability and production as a result. In aggregate, this enables us to calculate a potential macro impact on Ontario's economy based on farm exit and reduced acreage assumptions.

In Table 10, we compare our model results with the current industry. We note that industry revenue would decline by more than $630 million and profits after capital cost allowance (CCA) would drop by more than $100 million. As the size of the sector shrinks, corn production would decrease by more than 1.9 million tonnes and soybean production would fall by more than 750,000 tonnes.

Table 10
Impact on Ontario Corn and Soybean Sector
(2012 C$)

	Base case	Model with exits/ acreage reduction	Variance
Revenue	2,424,120,233	1,791,865,384	-632,254,849
Profit (adjusted for CCA)	226,212,945	124,104,753	-102,108,192
Wages	281,708,792	213,699,015	-68,009,777
Capital depreciation	319,848,673	242,631,214	-77,217,458
Corn production (t)	7,360,713	5,440,905	-1,919,808
Soy production (t)	2,895,570	2,140,353	-755,218
Contribution to GDP	827,770,410	580,434,982	-247,335,427

Note: Wages were estimated from the Statistics Canada input table for Ontario's crop and animal production industry. It was assumed that wages for the corn and soybean sector were proportionate to that sector's share of the total gross output of the crop and animal production industry. Results were generated from an unweighted average of all four modelled scenarios.
Source: The Conference Board of Canada.

Gross Domestic Product and Gross Output

Gross domestic product is a measure of value added. Gross output, on the other hand, measures the market value of the goods and services produced. The primary distinction between these different measures of output is that gross output is not adjusted to reflect the value of the intermediate inputs consumed by the industry. As such, an industry's gross output is, more or less, equal to its revenues. Conversely, GDP is adjusted to remove the costs of intermediate inputs in order to estimate the net value added to the economy without double counting the value of the inputs that are attributed to the GDP generated by other industries.

One way to determine an industry's GDP is to add its profits, wages, and depreciated capital. Alternatively, we can subtract the cost of intermediate inputs from the industry's gross output. For example, in the case of agricultural industries, key intermediate inputs may be seeds, fertilizer, and energy.

Comparing our base scenario with our modelled scenario, we estimated a reduction in provincial GDP of almost $250 million. (See box "Gross Domestic Product and Gross Output.") However, this is actually an underestimate of likely GDP impacts compared with an estimate that includes indirect and induced (supply chain) impacts, since corn and soybean farms consume other goods and services in the overall economy. To estimate the total GDP impacts of the scenario described above, we apply the gross output, labour income, and GDP multipliers from Statistics Canada input-output tables for the crop production industry in Ontario.[7] Table 11 summarizes these impacts.

Table 11

Economic Impact of Corn and Soybean Sector on the Ontario Economy

(2012 C$)

	Base case	Model with exits/ acreage reduction	Variance
Revenue (gross output)	4,096,763,194	3,028,252,498	-1,068,510,695
Wages	583,137,200	442,356,962	-140,780,239
Contribution to GDP	1,465,153,625	1,027,369,919	-437,783,706

Note: Includes direct, indirect, and induced impacts.
Source: The Conference Board of Canada.

The base case revenues, wages, and contributions to GDP are higher by a factor of 1.69 to 2.07 when we factor in supply chain impacts. By extension, the total impacts estimated by our exit model would be larger by similar factors. We estimated that the total negative impact on Ontario GDP would be almost $440 million when including direct, indirect, and induced impacts of the corn and soybean sector.

7 Statistics Canada, Industry Accounts Division, "Provincial Input-Output Multipliers, 2010. Ontario." Type II multipliers for gross output, labour income, and GDP for industry code BS111A00 (crop production) are 1.69, 2.07, and 1.77, respectively.

It is important to note that these supply chain impacts only consider the effects on upstream industries. They do not assume any impact on downstream industries—the buyers of corn and soybean products, including food processors and ethanol producers. Effectively, we have assumed that those buyers will be able to secure their supplies from alternate (non-domestic) sources, which is consistent with our assumption that the corn and soybean subsectors in Ontario do not have any pricing power. However, other downstream industries such as transportation and storage industries may be negatively affected, but we have not considered that impact here. Moreover, we do not consider the implications for rural communities in Ontario as a whole, for whom the agriculture sector is a key economic engine.

CHAPTER 5

Implications for Policy

Chapter Summary

- Regulatory policy related to neonicotinoid seed treatment is fraught with risk due to uncertainties in the current state of the relevant science.
- A restriction on the use of neonicotinoid treatments could significantly change the face of grain farming in Ontario.
- The large potential costs associated with a restriction on neonicotinoid use call for more research into the science of bee health and seed treatments. More research on the purported costs and benefits of any potential restriction is necessary.
- Stakeholders need to collaborate to explore a range of regulatory and non-regulatory actions that would improve bee health.

Agricultural environmental policy-making is extremely challenging, in part because the agricultural sector consists of thousands of micro and small enterprises. Many of these enterprises are thinly capitalized and often generate small margins on their employed capital. That means certain types of new regulations can easily upset their economic viability. In addition, environmental problems are highly complex, rarely lending themselves to a "magic bullet" solution.

Both of these challenges apply to neonicotinoid regulatory policy. Thousands of Ontario grain farms operate on slim margins. The science of bee population health is highly complex, as is the science of pest treatment. Results of seed treatments vary considerably from jurisdiction to jurisdiction.

The evidence demonstrates that neonicotinoids can effectively treat a variety of pests while adding little to the cost of corn and soybean seeds. Since farmers need to control pests, a neonicotinoid restriction would either reduce yields (if alternative treatments are not as efficacious) or increase pesticide costs for many farms. Both would lower net income (or profits) of the sector and, consequently, de-capitalize the sector, first through lower retained earnings and, eventually, by making grain farming less attractive as an investment.

This report illustrates that the economic impact of a restriction on neonicotinoids is likely to be significant. We estimate that the value of total corn and soybean production could fall by more than $630 million. The total negative impact on Ontario's GDP, including supply chain effects, may be almost $440 million.

These estimates are subject to limitations and influenced by several assumptions. As described earlier, the yield impacts of neonicotinoids are highly variable and depend on several uncontrollable factors.

Furthermore, our estimates are based on a scenario in which only Ontario farmers are subject to a restriction, which limits their ability to recoup some of the potential losses by charging higher prices to their customers. We also assumed that corn and soybean farmers have a limited ability to increase their income from other sources in the event that corn and soybean farming become significantly less profitable.

Both the yield and cost uncertainties are considerable. Moreover, the relationship between neonicotinoid use and the health of bees in their natural environment is also unclear. This means that there is significant policy risk to new neonicotinoid regulations, the key risk being they may impose significant additional costs with little or no corresponding benefit. However, there is also policy risk to inaction due to the important role that bees play in agroecoystems.

Given the high level of uncertainty, it is incumbent upon policy-makers to consider the policy risks inherent to new regulatory interventions. Health Canada is wise to tread carefully in this area while continuing to evaluate the effects of neonicotinoid pesticide use on bee health through the ongoing re-evaluation process.

Other potential mechanisms exist to reduce the exposure of bees to insecticides that do not require a restriction on neonicotinoids. Farmers and the bee community need to collaborate to find innovative solutions. For example, one farmer told us how beekeepers and farmers in Western Canada worked together on software that enables farmers to minimize operations near hives.[1] As another example, researchers from the University of Guelph—in conjunction with OMAF and the Ontario Soil and Crop Improvement Association—will run on-farm seed trials in Ontario in 2014, which will help create insect risk maps for Ontario corn producers.[2, 3] The maps would help individual farmers evaluate whether or not insecticide use is necessary for their farm.

1 Interview by Michael Grant, February 5, 2014.

2 Baute, “Neonicotinoid and Fungicide Only Treated Corn On-Farm Strip Trials.”

3 Smith, “Neonicotinoid Seed Treatment Efficacy Study: On-Farm Corn Trials–2014.”

This report shows that the costs of a neonicotinoid restriction would likely be significant. These costs need to be weighed against the benefits of new regulations. Given the size and extent of the costs, governments should undertake substantial research before proceeding. Federal regulatory policy is right to require that a) the net economic, environmental, and social benefits of the intervention improve the lives of citizens, and b) that the intervention does a better job than other types of regulatory or non-regulatory action. Both of these policy tests need to be applied to any policy that would restrict the use of neonicotinoid seed treatments, particularly in light of the potential costs.

APPENDIX A

Modelled Economic Impacts Resulting From Changes to Seed Costs

Tables 12–17 report the modelled impacts of a neonicotinoid restriction on grain and oilseed farms, assuming a decrease in seed costs for farmers (tables 12–14) or an increase (tables 15–17) due to the policy. Seed costs may decrease because neonicotinoid seed treatments would no longer be applied, potentially saving money. However, seed costs could increase if farmers used more seed per acre of crop planted to compensate for a reduced yield that could result from the loss of the seed treatments. In reality, it is likely that both situations would occur simultaneously and the extent to which costs decrease and seed consumption increases would alter the net effect on seed costs. The scenarios presented here are hypothetical, but demonstrate that, due to the thin profit margins of farms, a change in seed costs could potentially have a large effect on profits and the resulting GDP impacts.

Table 12

Ontario Corn and Soybean Farms: Average Reduction in Net Market Income by Revenue Class

(2012 C$; seed costs reduced by 6 per cent)

	Revenue class				
	Micro	**Small**	**Medium**	**Large**	**Very large**
1. Best case	525	1,240	2,730	5,856	17,579
2. No yield loss/higher pesticide costs	825	1,948	4,287	9,198	27,609
3. 5 per cent yield loss/higher pesticide costs	1,505	3,731	8,305	17,912	54,643
4. Worst case	2,185	5,514	12,323	26,627	81,678

Source: The Conference Board of Canada.

Table 13

Impact on Ontario Corn and Soybean Sector

(2012 C$; seed costs reduced by 6 per cent)

	Base case	**Model with exits/ acreage reduction**	**Variance**
Revenue	2,424,120,233	1,858,479,505	-565,640,728
Profit (adjusted for CCA)	226,212,945	134,762,151	-91,450,793
Wages	281,708,792	221,674,995	-60,033,797
Capital depreciation	319,848,673	251,687,043	-68,161,630
Corn production (t)	7,360,713	5,643,175	-1,717,538
Soy production (t)	2,895,570	2,219,922	-675,648
Contribution to GDP	827,770,410	608,124,189	-219,646,221

Note: Wages were estimated from the Statistics Canada input table for Ontario's crop and animal production industry. It was assumed that wages for the corn and soybean sector were proportionate to that sector's share of the total gross output of the crop and animal production industry. Results were generated from an unweighted average of all four modelled scenarios.
Source: The Conference Board of Canada.

Table 14

Economic Impact of Corn and Soybean Sector on the Ontario Economy

(2012 C$; seed costs reduced by 6 per cent)

	Base case	Model with exits/ acreage reduction	Variance
Revenue (gross output)	4,096,763,194	3,140,830,364	-955,932,830
Wages	583,137,200	458,867,240	-124,269,961
Contribution to GDP	1,465,153,625	1,076,379,815	-388,773,810

Note: Includes direct, indirect, and induced impacts.
Source: The Conference Board of Canada.

Table 15

Ontario Corn and Soybean Farms: Average Reduction in Net Market Income by Revenue Class

(2012 C$; seed costs increased by 6 per cent)

	Revenue class				
	Micro	Small	Medium	Large	Very large
1. Best case	868	2,051	4,513	9,683	29,064
2. No yield loss/higher pesticide costs	1,168	2,759	6,071	13,024	39,094
3. 5 per cent yield loss/higher pesticide costs	1,848	4,542	10,089	21,739	66,129
4. Worst case	2,528	6,325	14,106	30,453	93,163

Source: The Conference Board of Canada.

Table 16

Impact on Ontario Corn and Soybean Sector

(2012 C$; seed costs increased by 6 per cent)

	Base case	Model with exits/ acreage reduction	Variance
Revenue	2,424,120,233	1,729,478,339	-694,641,894
Profit (adjusted for CCA)	226,212,945	114,178,745	-112,034,200
Wages	281,708,792	206,247,413	-75,461,379
Capital depreciation	319,848,673	234,170,758	-85,677,915
Corn production (t)	7,360,713	5,251,470	-2,109,243
Soy production (t)	2,895,570	2,065,832	-829,738
Contribution to GDP	827,770,410	554,596,916	-273,173,493

Note: Wages were estimated from the Statistics Canada input table for Ontario's crop and animal production industry. It was assumed that wages for the corn and soybean sector were proportionate to that sector's share of the total gross output of the crop and animal production industry. Results were generated from an unweighted average of all four modelled scenarios.
Source: The Conference Board of Canada.

Table 17

Economic Impact of Corn and Soybean Sector on the Ontario Economy

(2012 C$; seed costs increased by 6 per cent)

	Base case	Model with exits/ acreage reduction	Variance
Revenue (gross output)	4,096,763,194	2,922,818,393	-1,173,944,801
Wages	583,137,200	426,932,146	-156,205,054
Contribution to GDP	1,465,153,625	981,636,542	-483,517,083

Note: Includes direct, indirect, and induced impacts.
Source: The Conference Board of Canada.

APPENDIX B
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