Local Environmental Protection and Trade:

The Cases of Hog Production in Canada and Mexico

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Executive Summary

Environmental concerns have been voiced with the expansion of trade under the NAFTA. A number of approaches have been suggested to ensure that the environment is protected under the agreement. These suggests, for the most part, fall into two broad categories: (1) mandatory regulations or (2) non-mandatory. Each of these broad categories has its own set of advantages and disadvantages to provide the necessary incentives for producers to incorporate the environment into their production decisions.

Command and control policies follow the traditional regulatory approach that defines rules that are constraints on individual behavior. These constraints usually take the form of pollution standards. However, standards are often difficult to enforce in the agricultural sector because of the non-point source nature of most agriculture pollution. As a result, many jurisdictions have chosen to define acceptable production practices that producers must adhere to.

Command and control policies have the advantage of being familiar to the agricultural sector. However, using this method to protect the environment have some disadvantages. They include such things as: information costs in setting policy, enforcement costs, penalty setting requirements and incentives for producers to decrease their pollution further.

Industry lead voluntary business environmental management (BEM) initiatives are a fairly new approach of environmental protection (Carpentier and Erwin, 2002). With this approach industry initiates a program to protect the environment on a voluntary basis. The literature cites three broad reasons for industry to adopt this approach: (1) consumer demand for green products, (2) cost savings with changes in production effort, and (3) political motivation to avoid further increased regulation. Which of these reasons provides the incentive to adopt voluntary business initiatives depends on the location of the farm, the legal/political structure of the jurisdiction and the markets where the product is sold.

One of the main advantages for the voluntary BEM initiative is that it provides the producer with flexibility in dealing with environmental problems. Some of its disadvantages include: ensuring that claims of environmental protection are real, management ability of producers to implement such a program and monitoring costs. Finally, voluntary business initiatives can be structured in several ways. The choice of structure is important both in terms of determining the costs of the program for producers and providing a means for outside parties to verify the claims that are made.

The goal of the research is to present a legal and economic treatment of the mechanisms available to provide incentives to ensure environmental protection in hog production. The research is structured using the CEC framework (CEC, 1999). The CEC framework defines the general hypotheses to be studied, the unit of analyses, the criteria for topic selection, and methods of analysis. The ultimate objective of the framework is to provide a comprehensive understanding of the production and trade in NAFTA countries. Increased hog production between NAFTA countries has also resulted in putting pressures on the local natural resource base and other environmental concerns. The OECD (2000) has stressed the need to examine this issue between trade and resulting pressures on the local natural resources. These environmental concerns include water pollution (point and non-point), soil pollution, and air pollution that can result in health problems to the broader population.

Potential measures of environmental protection include a mix of voluntary BEM initiatives and mandatory regulations (Carpentier and Erwin, 2002). The objective of the research is to determine which mechanisms best encourage less polluting methods of hog production in NAFTA countries while not creating trade barriers.

The CEC framework seeks to define the analyses to help identify the underlying factors that could be creating such trade barriers (CEC, 1999). In agreement with the CEC framework, this research is interdisciplinary and includes socioeconomic fields of research (economics, management and law) and is being conducted to include the broader institutional components. A case research study is undertaken to investigate two main hog production areas in Quebec and Mexico. A review of information available from government agencies and industry was conducted. Consultations and interviews with representatives of trade associations in both countries were held. The case dwells on the pressures for environmental regulation (local v. international) and determines whether they are linked to trade imperatives. Following the CEC framework, the cases presented report on economic factor data that captures production, management, and technology, input, and production efforts, and export-import (trade-balance), structure and composition trend data. In addition, data on regulatory environmental initiatives to manage manure and other environmental initiatives is analyzed when available.

This research contributes to the growing debate on the role of voluntary BEM initiatives and mandatory regulations for the agriculture sector as a means of protecting the environment in the North American free trade context. An analysis of the legal tools available to provide incentives to encourage the application of environmental protection is presented. Mainly, the existing general and specific environmental regulation impacting on hog production was identified and analyzed. This involves an extraction of the different approaches, methods and principles used to ensure environmental protection regarding water, soil and air pollution. With this information in hand, we describe the objectives underlying those approaches. Also, the regulatory analysis described above is contrasted against an examination of general legal principles such as non-contractual obligations. This examination provides insight on how tort regimes deal with environmental harm. In others words, a case law analysis reveals whether and, if so, the extent to which, general law considers environmental pollution arising from hog production to be a harm leading to legal consequences.

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1.0 Introduction

The early work on the development of voluntary business environmental management (BEM) initiatives identified four required areas for policy development. These are: (1) that environmental objectives would have to be clearly defined and that producers should be given the flexibility to meet these objectives, (2) the management skills of agricultural producers would have to be increased, (3) that transaction costs would have to decrease for the new production and marketing systems, and (4) new research and technical development on public goods (Batie and Erwin, 1997). The literature recognizes that greater flexibility is needed to address problems of non-point source pollution than the mandatory approach that had been applied in the past. However, there must be a relationship between the environmental regulation and the market mechanism. If this relationship does not exist, then the threat of mandatory regulation would be used to provide the incentive for producers to supply voluntary initiatives (Batie and Ervin, 1997).

Other authors have concluded that greater efficiency and effectiveness can be obtained with environmental regulations that are based on voluntary initiatives because they have lower transaction costs and introduce greater flexibility than mandatory programs (Alberini and Segerson, 2002; Khanna, 2001). However, they also recognized that it was important that the regulatory agency have a strong and credible threat of mandatory regulation. The threat of mandatory regulation is needed to increase the incentive for producers to participate, to increase the bargaining power of the regulatory agency and to decrease the need for financial incentives to be supplied by the regulatory agency (Alberini and Segerson, 2002).

Voluntary BEM initiatives are considered more effective when there are a few, homogenous producers willing to cooperate (Khanna, 2001). A reliable monitoring system also provides support for the development of voluntary initiatives (Alberini and Segerson, 2002). Finally, government could promote the creation of product labels to generate market incentives for product differentiation and provide additional incentives for producers to participate in voluntary initiatives (Khanna, 2001).

The choice of mandatory or non-mandatory approach to environmental protection depends on a number of factors such as the type of pollution, its spatial dimension and industry structure. There is no blanket approach that suits all situations (Alberini and Segerson, 2002; Khanna, 2001). In many instances, a mix of approaches may be appropriate in order that the proper incentives are given to decision-making units (Carpentier and Erwin, 2002; Weersink et al., 1998).

The formation of large economic blocks of countries and increasing globalization attracts attention to the development of common institutions to make trade and economic agreements work. While global economic benefits and potentials often are publicized and emphasized in discussion, the management of the “details” on how to make these relationships between people and countries work is a tremendous challenge. Such details often are found in the local pressures and conditions to preserve various tangible and intangible aspects that may be seen as limiting the potential of global system-wide performance. Pork constitutes a major source of protein for most of the world approaching 40% of meat-based protein consumption (OECD, 2002). Pork meat production is an obvious case where the link between the environment and the use of the

resource base is clearly established. Certainly, the resource base and its management is an important factor in the future development of this sector on a world basis (Haley et al., 1998). Countries would like to strike a balance between protecting the environment locally while maintaining the competitiveness of the industry at the international level and enhancing trade (Metcalfe, 2001).

Economists, management and legal researchers are interested in understanding the connection between production, environmental management, and ultimately the impact on trade and industry success. The analytic framework elaborated under the leadership of the Commission for Environmental Cooperation (CEC) serves that purpose to define this research (CEC, 1999)[1]. The CEC framework has identified agriculture and energy as the two sectors needing the most attention for analyzing the linkages between trade and the environment. For example, the intensification hog production around the world over the past 20 years certainly impacts the use and depletion of natural resources in many part of the world (OECD, 2002). The hog sector has experienced important changes in trade during the post-NAFTA period in all three countries. This sector certainly is significant from an environmental perspective. Indeed, in many parts of Canada and United States, provincial and state jurisdictions have introduced production moratorium due to the pressured it places on the use of natural resources and the environment. In the past, sanitary issues have been perhaps one of the most important limiting factors to trade in livestock (OECD, 2002). Nowadays, environmental issues are increasingly important for trade issue in Europe and industry sources in North America anticipate this could become one of the most important causes for institutional change with respect to future world trade agreements.

Within the North American context, it is interesting to look at the cases of hog production and to compare the experience of Canada with the one of Mexico. Canada is a major hog producing and exporting country. Mexico has had a recent history of production growth and industry re-structuring, since its massive decline in the mid-1980s. Both countries have employed different means to address the local concerns with the use of economic instruments and institutions in managing public pressures about resource use and the quality of life, more generally.

The objective of this paper is twofold. First, the paper presents an overview of the literature related to the use of economic mechanisms to protect the environment. Environmental concerns have been voiced with the expansion of trade under the NAFTA. A number of approaches have been suggested to ensure that the environment is protected under the agreement. These suggests, for the most part, fall into two these broad categories: (1) mandatory or (2) non-mandatory. Each of these broad categories has its own set of advantages and disadvantages to provide the necessary incentives for producers to incorporate the environment into their production decisions. These measures are examined and discussed in the paper.

[1] The CEC (1999) analytic framework defines the scope and means of researching the linkages between trade and the environment. In regard to North American trade and environment issues it provides a comprehensive approach to the specification of hypotheses (or questions) to be researched, the scope or the appropriate unit of analyses, the time frame to consider, the criteria for identifying associated intra or intersectorial issues, methods of analyses, as well as economic factors for consideration.

Second, the cases of Mexico and Canada, and in particular, Quebec, are presented. At the time the research was completed, limited information was available for specific states in Mexico to fully develop a compelling comparison with Quebec. However, discussions with international trade representatives, and secondary literature, have allowed us to provide an overview of the general situation in Mexico on the production and legal environmental protection front in hog production. In Quebec, a direct access to data and information sources led to some conclusions between environmental regulation and production.

An analysis of the legal tools used to provide incentives to encourage the application of environmental protection is presented. Mainly, the existing general and specific environmental regulations that impact hog production were identified and analyzed. This involves the identification and analysis of the different approaches, methods and principles used to ensure environmental protection regarding water, soil and air pollution. The data available allow for a legal and economic analysis of the objectives underlying the mandatory and non-mandatory approaches to environmental regulation. Also, the regulatory analysis described above is contrasted against an examination of general legal principles such as non-contractual obligations.

The CEC framework (1999) emphasizes the use of both qualitative and quantitative approaches to research. In particular, the use of qualitative research, as in this research, to analyze a case situation are suggested. Industry specialists have been interviewed both in Canada and in Mexico to discuss the connection between the use of natural resources in hog production and the potential impacts on trade. This research is interdisciplinary in nature (economics, management and law) and is being conducted using approaches specific to the objectives of the analysis. A review of the information available from the academic literature, government agencies, and industry was conducted. Many data sources and conclusions derived from the analyses were submitted to individuals for their comment and opinion on the interpretation of the data and both regions. The case research was undertaken to take into account the pressures for environmental regulation (local v. international) and see whether these are linked to trade imperatives. The cases report on production and exports trend data. In addition, data on regulatory environmental initiatives to manage manure and other environmental initiatives are analyzed. The CEC framework (1999) provides a means to structure the analysis to link environmental regulation to trade within the evolving NAFTA institutional framework.

The paper is organized as follows. In Section 2 there is an overview section on agriculture, the environment and trade. Section 3 presents and provides the definitions for the various economic instruments that deal with environmental regulation in agricultural production. Sections 4 and 5 look at production and trade data for the cases of Canada and Mexico. A discussion and conclusion, in Section 6, links economic instruments of environmental regulation with specific illustration of applications and the situations found in Canada and Mexico to further illustrate how these have been applied in practice.

2.0 Agriculture, Environment and Trade

The interaction between agricultural production and the environment will be discussed in the next section. Pollution problems associated with agriculture production are often different than those in other industrial sectors. This next section provides a brief review of agricultural production and how it impacts the environment. This is followed by a discussion on trade and

the environment. Increased trade amongst the three countries under NAFTA will impact the production undertaken in each country and this has environmental implications.

2.1 Interaction between Agriculture and the Environment

A by-product of agricultural production is the residuals that are left in the environment (Weersink et al., 1998). These residuals can be found in soil, water or air and can move over time and space. The size, concentration and movement of these residuals depend on the physical characteristics of the farm, for example soil type and typography, management practices that are undertaken, such as tillage practices, manure handling and storage, and climate conditions, such as the amount and timing of rainfall. The impact of these residuals on-farm can be loss of productivity that will increase the cost of production for the producer. Off-farm costs, such as soil erosion and decreased water quality, are usually much larger and these costs are borne by other individuals in society (Braden and Lovejoy, 1990).

The impact of agricultural production on the environment is different from other industrial sectors for the following reasons: (1) the uncertainty in cause and effect relationships, (2) the large number of heterogeneous farms, and (3) the amount of non-point source pollution (Weersink et al., 1998). A large amount of the environmental impact from agriculture comes from residuals traveling through soil and concentrating or entering water systems. The movement of residuals through soil is poorly understood and thus it becomes difficult to identify from which field or farm the residuals originated from. This uncertainty in the relationship between farming practice, residual movement and environmental impact makes it difficult to identify an individual decision-maker with the environmental impact. In addition, the environmental impact from agricultural production will depend on the physical characteristics of the farm. As a result, the approach taken for environmental protection will have to take into account the heterogeneous mix of farms. Thus, an approach taken in one region may not be applicable in other regions with different physical characteristics. Finally, a large amount of agricultural pollution is characterized as being a non-point source of pollution. In these cases the source of pollution cannot be identified back to a particular location. This makes policy design for environment protection more difficult because one does not have the exact location of the cause of the environmental effect.

Policy for environmental protection in most industries addresses the problem of point sources of pollution, with homogeneous production process and a well-known cause and effect relationship between the pollutant and the environment. In the agricultural sector this is not the case. As a result, the approaches used in most other industries do not have the same effect on the agriculture sector.

2.2 Trade and the Environment

Multilateral trade agreements between countries provide the opportunity, for one or all countries party to the agreement, to increase output to satisfy the industrial and consumer demands in the other countries. This increase in economic growth, in terms of output, can have an impact on the environment when there exists a relationship between industrial output and pollution. Various

authors have looked at the impact of trade on the environment in terms of changes in industrial inputs and outputs (Runge, 1995; Ulph, 1997), and transboundary pollution (Ulph, 1997), while other authors have analyzed the impact of trade on the environment in terms of incentives for firm behavior; in terms of plant location decisions and innovation (Tietenberg, 2000; Porter, 1991). The industrial location issue known as "race-to-the-bottom" is one of the focus of analysis defined by the CEC framework (CEC, 1999).

The theory of free trade is based on countries specializing their production in products that they have a comparative advantage in, as oppose to producing all goods themselves. Countries will have a comparative advantage in producing a good if it is relatively more efficient in producing that good than others. With this specialization, countries will use their relatively abundant resources and conserve their scarce resources. As a result trade promotes allocative efficiency relative to a self-sufficiency situation. However, this changes the input and output mix of an economy relative to the no-trade situation. These changes will have a scale effect on production in terms of both inputs and outputs. On the input side, this may result in increase use of particular inputs, for example land, water and air, which result in increased levels of pollution relative to the no-trade situation. Similarly, it would change the output mix of the economy, both in terms of relative and absolute outputs. It is usually thought that allocative efficiency impacts will have a positive effect on the environment, scale effects will be negative and output mix effects will be positive (Runge, 1995; Perman et al., 1999).

Transboundary pollution problems occur because of the spatial dimension of production and consumption. In this case, production or consumption in one country can effect the environmental quality in another country. Examples of these sorts of problems include air quality between Mexico and the United States and acid rain problems between the United States and Canada. Transboundary pollution problems can become more intense with the increased output that may result in one country's comparative advantage in production. Thus, a large number of plants could locate close to the border and increase the pollution problem. In these situations, trade policy could be used to reduce the importation of those goods that are associated with transboundary pollution (Ulph, 1997).

Some authors and groups (CEC, 1999; Tietenberg, 2000) have looked at the impact of freer trade on firms' decision making with respect to plant location and the adoption of technology. For example, if one country has stricter environmental regulations than another country, then firms may relocate to those jurisdictions that have lower environmental requirements because of the corresponding lower cost of production. This would result in "pollution havens" where firms would migrate (Tietenberg, 2000). Individuals who live in countries or regions that have these lower standards may feel pressured to accept this decrease in environmental quality in order to keep employment opportunities.

M. Porter (1991) has argued that firms that reside in areas with higher environmental standards have a competitive advantage and not a disadvantage. This is because firms in this environment must be innovative and they will use this innovation to their competitive advantage. For example, firms in this situation would evaluate their whole production process to find areas where they could decrease costs, improve efficiency, and decrease pollution.

The literature is inconclusive on the impact of freer trade on the environment. The environmental impact of expanded trade will depend on a number of variables including: competitive advantage of the various parties, spatial location and the difference in the current environmental regulation. Institutional development in terms of policy development, implementation, and enforcement will determine the ultimate impact on the environment.

3.0 Mandatory versus Non-Mandatory Approaches to Environmental Protection

Environmental questions have become an important concern with the expansion of agricultural trade within NAFTA countries. The policy options available to decision makers to address these concerns fall into two broad categories (1) mandatory and (2) non-mandatory approaches to environmental protection. The mandatory approach to environmental protection has been used in the past to regulate industrial pollution. This approach includes command and control regulations such as emission or effluent standards.

The non-mandatory approach uses economic incentives to influence the production and management decisions of the firm. These non-mandatory approaches can be broken down into two groups (1) taxes, subsidies and tradable permits and (2) voluntary programs. These voluntary programs are often referred to as business-led initiatives, or business environmental management (BEM) initiatives, and rely on individual firm initiative to take proactive steps in environmental management (Carpentier and Erwin, 2002).

In the next sections, we discuss the interaction between agricultural production and the environment with respect to the means chosen for environmental management. Section 3.1 contains a brief description of the mandatory approach to environmental protection with its advantages and disadvantages. The non-mandatory approach is described in section 3.2. Section 3.3 summarizes the incentives to participate in non-mandatory approaches and compares the efficiency of mandatory and non-mandatory approaches.

3.1 Mandatory Approach

Mandatory policies are those that require a quantitative or qualitative control on production. These controls can be in terms of output produced (either pollution output or final output), inputs used, technology required or the timing and location of polluting activities (Perman et al., 1999). These types of regulations are often referred to as command and control regulations and the most common of these are emission standards and effluent standards. The timing of hog manure spreading in Quebec over certain months of the year is an example of a mandatory policy.

This approach requires the state to identify an environmental objective and to quantify an environmental target. Once this is done, a standard can be developed that will fulfill the environmental target taking into account the number of firms in the region. In addition, the state must identify a penalty for those who violate the standard. This penalty must be set high enough to be a deterrent for breaking the standard (Perman et al., 1999; Randall, 1987). The advantage of a mandatory policy is that if a clear environmental target can be identified then it can be obtained with these controls as long as transaction costs are not too high.

The disadvantage of a mandatory approach is the potential size of the transaction costs. These costs will include information costs of determining the environmental target and setting the appropriate standard and monitoring costs to ensure that they are meeting the standards. Finally, there are enforcement costs for those firms who violate the standard. Violators have to be penalized with fines or other actions and these must be collected upon (Randall, 1987).

In addition to these transactions costs that would occur in a static timeframe, there are also dynamic transaction costs. Over time the number of firms or the output from the sector or the number of individuals in a region may change. Any changes in these variables require the standard be adjusted. As a result, the standard will have to adjust to this dynamic change in the region (Perman et al., 1999).

Finally, the development of emission or effluent standard usually requires a capital investment by the firm. In these situations, it becomes difficult for regulators to change the standard once the firm has made a financial obligation in good faith to fulfill the standard. This results in grand fathering firms with previous standards that make it difficult for the approach to satisfy its environmental target over time.

3.2 Economic Instruments

The non-mandatory approach provides the firm or decision-making unit with the flexibility to adjust to the financial incentives or market demands. The first group of policies provides incentives for firms or decision-making units to adjust their behavior in response to such things as Pigovian taxes or subsidies or tradable pollution permits. The second group of policies is voluntary for the decision-making unit. These can be broken down further into three groups: (1) public voluntary programs, (2) bilateral initiatives, and (3) unilateral initiatives (Alberini and Sergerson, 2002; Carpentier and Erwin, 2002; Khanna, 2001).

3.2.1 Pigovian Tax or Subsidy

The Pigovian tax was designed to bring social costs and private costs together in order to obtain efficient decision-making (Randall, 1987). It was recognized that private costs often did not take into account the social costs of the production process and thus resulted in a market failure. In particular, often the environment is used for waste disposal and the firm does not have to pay for this input. Putting a price on this input, that is a tax, provides an incentive for the decision-maker to take the environment into consideration when production decisions are made. Decisions then reflect all relevant cost, not just private costs, and will result in a socially efficient solution (Perman et al,. 1999; Randall 1987).

The advantage of a Pigovian tax is that it provides for a socially efficient solution if the tax is set at the appropriate level. Second, with a tax the firm will choose that technology or approach that is most cost effective for its operation in terms of providing abatement. Third, the tax also provides an incentive for firms to invest in research and development to decrease its environmental impact. Any decrease in environmental impact will decrease the tax that would have to be paid to the state.

Disadvantages of the tax include the information required to set the tax at the appropriate level. The tax should be set at the value of the marginal damage at the efficient level of pollution (Perman et al., 1999). This tax rate can only be determined once the marginal damage and marginal benefit curves have been estimated for the pollution, a difficult objective to meet in practice. Another disadvantage of the tax is that firms have to be monitored to determine the level of pollution generated. This information will be used with the tax rate to determine the total cost to the firm. In addition, the implementation of a Pigovian tax often comes under-attack by industry who argue that it makes the sector less competitive. Finally, the tax rate would have to change as the marginal damage and marginal benefit curves change over time (Perman et al., 1999).

Though the Pigovian tax and subsidy provide the same level of abatement at the firm level, the choice of instrument will have an impact on the long run solution. A subsidy program attracts activity into the sector and thus increases the number of firms. This results in distributional impacts on the solution.

Pigovian taxes are used in the agriculture sector. In Mexico, a tax is paid for the right to discharge wastewater into the national water system.

3.2.2 Tradable Permits

A tradable permit system creates a property right to pollute for the firm. For this system to work, the following must be undertaken: (1) an authority must determine the target level of pollution and then generate the number of permits that is equal to that amount, (2) all firms must have permits for the pollution that they generate, (3) the mechanism for initial allocation of permits must be determined, and (4) emissions permits can be traded amongst firms (Perman et al., 1999). Firms with higher costs of abatement are willing to purchase permits from firms that have lower costs of abatement. The market price for permits is determined by the supply and demand for permits. Allowing for transferable permits ensures the target is met at least costs.

The advantage of the permit trading system is that once the target is set, firms can choose that combination of abatement and permits that best suits their situation. It supplies a given level of pollution abatement at least costs and firms with lower cost of abatement supplying more abatement and higher cost abatement firms supplying less. It provides an incentive for firms to invest in research and development in pollution abatement because they are able to sell any excess permits in the market (Randall, 1987).

The disadvantage of a permit trading systems is the cost associated with establishing an authority to oversee the development of permits and the initial allocation amongst firms. As with the other approaches, a pollution target must be established. Second, the initial allocation of permits can often be contentious. Third, polluting firms must be monitored to ensure that each firm has the required number of permits for the pollution that is generated. Finally, an enforcement system with penalties must be developed for firms that violate their permitted pollution level (Perman et al., 1999).

3.2.3 Public Voluntary Programs

These types of programs are based on a public agency determining the eligibility criteria for participating in the program and defining the rewards and obligations of the firms (Alberini and Segerson, 2002; Khanna, 2001). Individual firms are free to join the program, if they fulfill the eligibility criteria, and are willing to fulfill the obligations of the agency. Examples of public voluntary programs in agriculture include the Conservation Reserve Program and the Environmental Quality Incentives Program in the United States. These programs use a cost sharing arrangement where producers withdraw from production highly erodible lands and manage their nutrient applications in order to decrease non-point source pollution (Ribaudo and Caswell, 1999). In Quebec, a voluntary program has been developed to improve manure handling, storage and treatment. With this program producers receive a subsidy for the construction of manure handling systems if they meet government approval (MAPAQ, 2002).

The advantage of these types of programs is the flexibility for decision-makers to access the program. The firm level decision-maker can decide whether or not the rewards associated with the program are greater than the obligations. It should provide a cost effective means of obtaining a pollution target. The disadvantages of the program are that an agency has to determine the rewards, obligations and eligibility criteria, which is a cost to the agency. The agency will also have to monitor and enforce these agreements.

3.2.4 Bilateral Initiatives

An individual firm and a public agency enter into an agreement concerning pollution abatement. In this case, the rewards and obligations are negotiated between the firm and the agency (Alberini and Everson, 2002; Khanna 2001). Specific abatement targets are identified and binding contracts with the firm are signed. The major advantage of this program is the flexibility it provides for firms to develop pollution abatement strategies for their specific site. This can increase efficiency and innovation. However, it also increases information, monitoring and enforcement costs for the agency.

3.2.5 Unilateral Initiatives

These initiatives come from the firm and do not need approval from an environmental agency. The types of initiatives that fall into this group include: (1) individuals who develop their own environmental plan, (2) individuals who follow the guidelines of an association, and (3) individuals who follow the standards of a registered certified body (Khanna, 2001). Two examples of the last type of program in agriculture are farms that become certified organic and ISO 14000. Organic producers must follow certain production practices to qualify for organic certification. In January 2003, Du Breton Farms in Quebec completed the certification process for organic pork. This required them to document that all feed was certified organic and that the animals were provided safe and spacious housing (Macleod, 2003).

ISO 14000 is an international certification process that incorporates an environmental management system (EMS) into the operation of an individual firm. ISO 14000 is not a quantitative standard but a management process. Certification for ISO 14000 requires a third party audit of the organization (Kuhre, 1995). The five major steps to ISO 14000 are: (1) writing an environmental policy for the firm, (2) planning the firm's EMS, (3) implementing the EMS, (4) checking the EMS and taking corrective actions where necessary and (5) management review of the EMS (CSA 2002; Khanna 2001; Kuhre, 1995; Lussier et al., 1997; Wall et al., 2001).

Both organic production and ISO 14000 allow for the development of eco-labels that provide signals to consumers about the characteristic of the product (Khanna, 2001; Karl and Orwat, 1999). Educating consumers about the characteristics of a product can change their purchasing behavior. This can result in an increase in market share (Teisl et al., 2002) and/or a price premium being received for the product (Moon et al., 2002).

3.3 Incentives to Participate in Voluntary Initiatives

Traditionally, the profit-maximizing motivation of the firm was seen as a hindrance to voluntary initiatives because firms were assumed to be price takers who respond to exogenously determined environmental regulations (Cropper and Oats, 1992). This view has been revised by taking into account that voluntary initiatives may be in the firm's economic interest. The supporting arguments include: environmental stewardship incentives, market incentives, government incentives, regulatory avoidance and industry incentive (Alberini and Segerson, 2002; Khanna, 2001; Videras and Alberini, 2000).

Alberini and Segerson (2002) identify environmental stewardship as an incentive for adopting voluntary initiatives. Environmental stewardship is motivated by personal satisfaction or the utility generated from following particular production practices that are beneficial to the environment. This can also be motivated by a bequest value that would occur with the inter-generational transfer of the farm.

Market incentives for adopting voluntary initiatives are important if they can impact either the cost of production or the value of the output. Certification programs such as ISO 14000 are promoted as providing a management tool that can potentially decrease costs through better management of resources (Bansal and Bogner, 2002; Kuhre 1995; Wall et al, 2001). In addition, other input costs may decrease with a recognized initiative through decrease loan costs as a result of lower risk associated with the operation. Whether or not input costs increase or decrease depends on a number of factors that are particular to the firm, institutional arrangements and region (Bansal and Bogner, 2002).

Voluntary initiatives can increase the revenue of the firm by increasing market share or providing a price premium for the output produced with product differentiation using eco-labels (Moon et al. 2002; Teisl et al., 2002). Voluntary initiatives can also play a role in providing access to foreign markets with a recognized eco-label. The size of the market premium for differentiated products will depend on the long run supply and demand for the product.

Government can create the incentive to participate in voluntary initiatives by subsidizing the participation of the firm (Alberini and Segerson, 2002; Khanna 2001). The agency can support some or all of the financial obligations of the participant. This limits or protects the firm from the costs associated with the voluntary program. This type of assistance can include technical assistance and information. This approach was used in establishing the Ontario Environmental Farm Plan initiative. In this situation producers were given technical assistance and a $1,500 financial incentive to complete the Environmental Farm Plan (Weersink et al., 1998).

Firms can also be motivated to enter into voluntary initiatives as a means to avoid regulation (Alberini and Segerson, 2002; Khanna, 2001). Government can threaten to use mandatory regulation to motivate firms to participate in voluntary initiatives. A voluntary initiative program can have lower costs and greater flexibility for the firm than a mandatory regulation and thus would be a preferred option. The usefulness of this motivation will depend on the credibility of the threat by the government agency (Alberini and Segerson, 2002; Khanna, 2001).

Finally, governments may try to negotiate with industry associations for the establishment of voluntary initiatives (Alberini and Segerson, 2002). In this case, there is a potential for a free rider effect for individual firms who may not want to join the initiative if other firms will satisfy the government requirement. However, there is an additional incentive for firms that do join the initiative to provide additional abatement equal to the higher cost associated with mandatory regulations. Even though a sub-optimal number of firms participate, each individual firm that does may provide additional abatement to avoid the higher cost of mandatory regulation.

3.4 Efficiency of Mandatory and Non-Mandatory Approaches

The efficiency of mandatory and non-mandatory approaches to environmental protection will depend upon a large number of factors. It is usually assumed that approaches with the greatest degree of flexibility satisfy environmental goals at lower costs (Alberini and Segerson, 2002; Khanna, 2001). This is because firms are able to choose the most appropriate means to provide abatement at the least costs. Once flexibility is restricted, with such things as mandatory technology, individual abatement costs tend to increase. When comparing the two extremes, mandatory regulations with an identified technology versus a unilateral initiative, one would expect the abatement costs for the unilateral initiative would be lower (Segerson and Dawson, 2001). However, when the alternative approach provides flexibility, such as a permit trading system, then the cost differential between the permit trading system and a unilateral initiative would decrease.

An efficient allocation of abatement would occur when the marginal cost of abatement for each firm is equal (Field and Olewiler, 2002). It has been demonstrated that a Pigovian tax can provide such a solution if the tax is set at the appropriate level (Randall, 1987). Whether or not a voluntary approach provides an efficient allocation depends on a number of factors. If the voluntary initiative is going to be negotiated between the regulator and the firm, then an efficient outcome is more likely if: (1) the regulator has a creditable mandatory threat, (2) the social cost

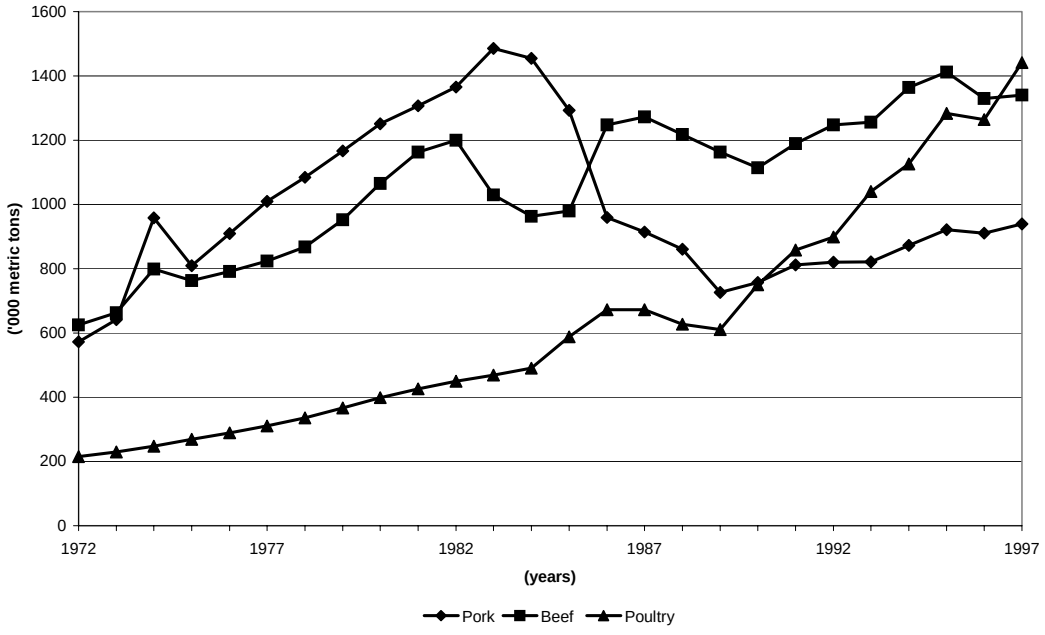
of subsidies are low and (3) the regulator has bargaining power with the firm (Segerson and Miceli, 1998).

Wu and Babcock (1999) compared the relative efficiency of voluntary and mandatory environmental regulations for the agriculture sector. They concluded that the efficiency of the voluntary approach relative to the mandatory approach depends on the deadweight loss associated with government expenditures for the voluntary approach and the private and public costs of the mandatory approach. If the deadweight loss of the voluntary approach is less than the difference between the private and public costs plus the implementation costs then the voluntary approach is more efficient (Wu and Babcock, 1999). When reviewing the Environmental Quality Incentive Program and the Oregon Salmon Habitat Recovery Program, these programs had the characteristics that favored the voluntary approach (Wu and Babcock, 1999).

4.0 Hog Production in Mexico

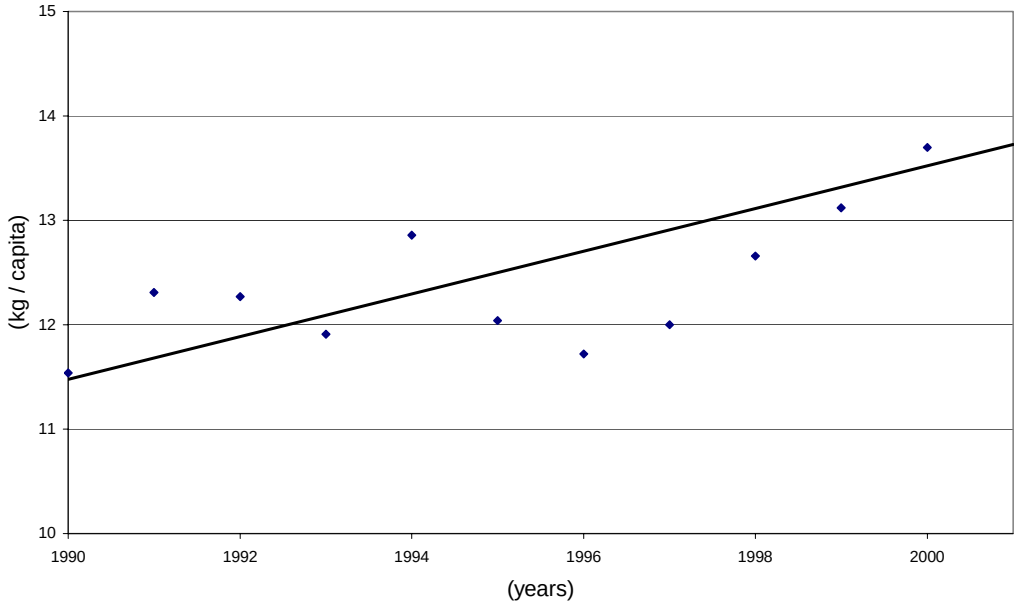
The pattern of emergence of the hog industry in Mexico since the early 1970s had been one of steep growth up until its massive collapse of 1984, and of re-growth since then. Prior to 1984, the industry had assimilated production technology allowing it to grow. As seen on figure 1, the hog production sector supplied nearly 50 percent of meat output at that time. In the early 1980s, the government had heavily subsidized animal feeds (sorghum). Following the withdrawal of that program in 1984 input costs increased which caused production to shrink until 1989 to nearly 1972 levels. By 2001, the industry has increased output to nearly 1984 levels. The sharp drop of 1984 is seen in figure 1. However, today's hog production is lower than both poultry and beef in terms of output measured in tons.

Figure 1. Pork, Beef, and Poultry Production in Mexico 1972 - 1997



But, hog production now trails beef and poultry consumption in the country. Consumers in Mexico have become more health conscious and prefer poultry meat because of the lower fat content of that protein source (Southard, 1999). Nonetheless, the per capita consumption of pork meat seen in figure 2 displays an upward growth trend of 30 percent between 1990 and 2001 (SAGAR, 1998).

Figure 2. Pork meat consumption trend in Mexico
1990 - 2001



Recent production trends for the most important producing states provide a more detailed picture of the local industry situation. Figure 3 highlights that production is concentrated in six states. In decreasing order of importance for 2001, these are: Jalisco (25 percent), Sonora (16 percent), Guanajuato (9 percent), Yucatán (8 percent), Puebla (8 percent), and Michoacán (5 percent). These six states represented 70 percent of the pork production in the country in 2001. This was up from 68% in 1994, when the NAFTA was introduced. From 1995 to 2000, the increase in output from these states was nearly flat, in both absolute and relative terms (see figures 4 and 5).

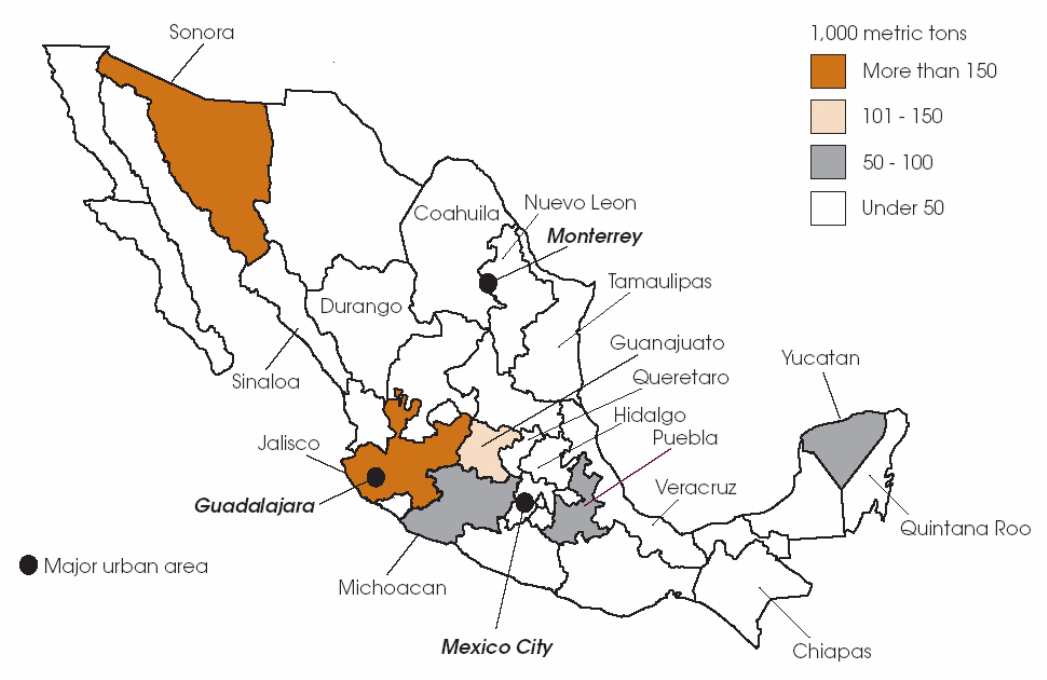


Figure 3. Location of pork production in Mexico
(Source: Southard (1999, 28))

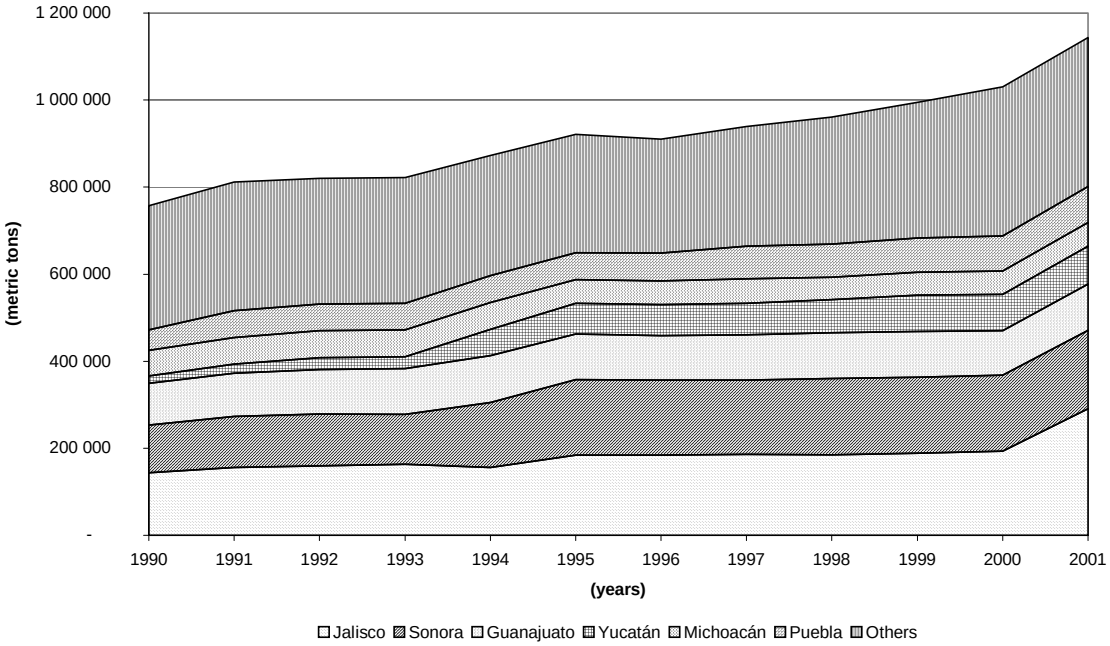
Pork production trends for the six major production states are presented in figure 4. There is an overall upward trend in production for these more production intensive areas. The percentage distribution of total output reported in figure 5 also shows a greater proportion of the total in the six states identified as major locations for hog production in Mexico. Clearly, more recent production figures show an upward trend between 1994 and 2001 of 31 percent for the country overall. During the 1994 – 2001 period, the six major production states experienced mixed growth patterns. For instance, Jalisco, already Mexico's largest pork producer, grew by 87 percent during that period, while Yacatán's output increased by 46 percent, and Sonora by 20 percent. Two of the largest production states, Michoachán and Guanajuato, had decreased output of 12 percent and 2 percent, respectively. The remainder of the country's growth in production was 33 percent. These states include: Tamulipas (95 percent), Nuevo Leon (13 percent), Quintana Roo (41 percent), and Hidalgo (7 percent).

The hog industry in Mexico has been described as comprising three types of operations (Southard, 1999). These are technology enhanced production systems, small commercial production systems, and traditional backyard production systems (SAGAR, 1998; Southard, 1999). These production systems are characteristic of the geographical location of the operation and the degree of upward vertical and horizontal coordination with the remainder of the supply chain. There are large differences between states.

The most technologically advanced swine production units are based in the north central state of Sonora and to a much lesser extent Sinaloa. But also, some are emerging in non-traditional areas as well (Southard, 1999). These operations use state of the art technology such

as three-site production techniques. The production process helps maintain some degree of conformance to production standards, including the maintenance of nutritional consistency. The product tends to be standardized. Sanitary and biosecurity measures are being implemented to maintain the zones as disease free. If these production facilities are integrated with a slaughter facility they may be part of the TIF ("*Tipo Inspection Federal*") model, the only facilities that are allowed to expert pork. Roughly a third of the national herd was slaughtered through these facilities in 1997 (SAGAR, 1998).

Figure 4. Pork Production Trends for Six Major States in Mexico 1990 - 2001

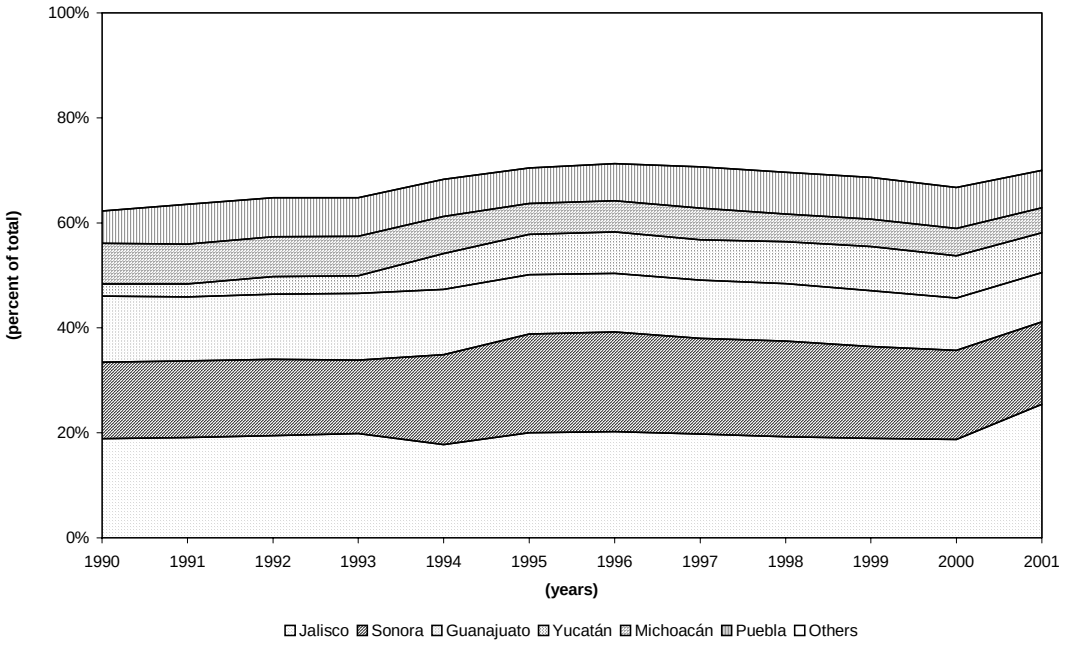


The Pacifico-Centro region is responsible for 40% of the country's pork production in 2001. This region includes the states of Jalisco, Guanajuato, and Michoacan. These states include operations that use middle to advanced production technology. Efforts are made to use balanced feed diets and to develop specialized facilities. Only a small proportion of the operations use three-site production methods. These operations are located near Mexico City and are a main source of supply into that market. Animal feeds are produced locally to lower input and transportation costs (Mendez and Lara, 1996). About one third of the pork was slaughtered in this area in 1997 (SAGAR, 1998). The consistency of hogs is not maintained and slaughter facilities used are municipal or private ones serving the local market. These slaughter facilities do not necessarily meet the standards found in TIF facilities.

The "backyard" type production is found everywhere in the country and constitute a sizable contribution of national output. This accounts for approximately one third of the national output. This mostly involves family labor and does not use specialized facilities. It helps generate complementary income for these families. This production does not enter traditional distribution

channels, but efforts are underway to improve sanitary conditions associated with this type of production.

Figure 5. Pork Production Distribution Trends for Six Major States in Mexico 1990 - 2001



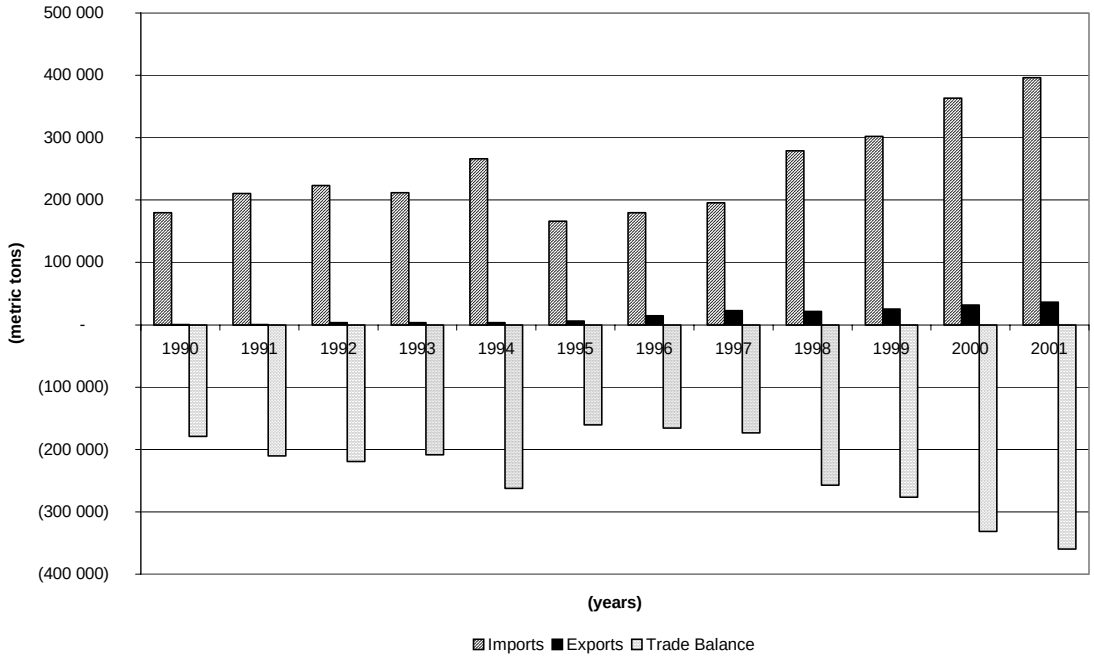
Although, there has been a constant upward trend in pork production since 1990, it is clear that the total domestic disappearance also has risen by 32 percent between 1994 and 2001, from 1,135 million tons to 1,503 million tons. As a result, the country has been increasingly reliant on imports (see figure 6). From 19,2 percent of the total apparent consumption in 1990, pork meat imports have reached 26,4 percent in 2001. The trend in pork meat trade balance deficit can be seen on figure 6. Imports are expanding rapidly and the trade deficit in pork meat is increasing. This occurred even with poultry meat becoming an important substitute for pork meat processing, as can be seen from the poultry production trend in figure 1 (Sagarnaga et al., 1999).

NAFTA has created pressures to establish production standards similar to the ones found in the Unites States and in Canada. The operations have become more concerned with financial viability. Only a handful of enterprises from Canada and the US that have established hog production facilities in Mexico.

With respect to the link between trade and the preservation of the natural resources and of the environment, there are no specific limitations at the present time (Espejo, 1998). The most important aspect is sanitary that can restrict exports to the United States. Though the environment is not currently a limitation to trade, it does not mean that it may not become important in the near future (Espejo, 1998).

It is an objective to maintain a significant increase in pork production in Mexico. As things stand, hog inventories will have to increase to meet these goals and this means greater pressure on natural resources and the environment. One can also anticipate that operations that could help meet these production levels would be larger in size and more technologically enhanced, which in turns implies more intensive production methods. As reported in Southard (1999), larger hog operations have an advantage in cost structure and other credit access conditions, unavailable to smaller operations. Smaller operations have also seen their margins squeezed because they are not vertically coordinated with upstream feed milling activities allowing them to gain from high volume throughput.

Figure 6. Imports and Exports Trends in Mexico
1990 - 2001



Since 1989, gains in hog production have been realized by increasing hog inventory rather than by the widespread introduction of new farming techniques. If this trend continues, more pressure on water and land resources will result (Espejo, 1998). The diffusion of management techniques to reduce the environmental impacts is slow and not sufficiently known.

4.1 Mexico's Legal Response to Environmental Impacts

The Mexican legal response to the environmental impact of hog production is relatively weak. On the one hand, agricultural laws do not restrict the size of production and, on the other hand, environmental laws are both recent and unconstraining.

Jurisdiction over implementing hog production regulations is split between the national, state level and municipal levels. The national government remains the predominant actor in this regard – through its power to regulate - although some attempts have been undertaken to increase the law.

At the national level, the General Law on Ecological Balance and Environmental Protection (LGEEPA) has provided environmental protection since 1988. Similar to the Quebec Agriculture Act, the LGEEPA was significantly revised in 1996 to better allocate resources and establish delegation of environment-related powers. Nevertheless, the LGEEPA only marginally protects the environment in respect of agricultural activities as it leaves many of the activities outside of its scope. For example, neither agricultural wastes nor odors from agricultural sources are included within its scope. While its article 28 provides for an environmental impact assessment process in the case of intensive livestock operations, this requirement has never been implemented.

The major federal environmental protection regulation resulting from agricultural activities is found in the regulations dealing with the protection of public water. Representing a significant improvement in the protection of public water, the National Water Law establishes a system of permits and licenses for water use and discharge to which specific conditions are attached. As a result, although the LGEEPA itself does not deal with agricultural wastes, farming wastewater discharges as well as other forms of wastewater discharge that has the capacity to infiltrate the soil or subsoil, pollute a recipient body of water or disturb, impede or alter the natural function and capacity of any water reservoir owned by the Nation are prohibited. As a consequence of this prohibition, farmers tend to place the manure they would otherwise dispose in waterways into land (Speir et al., 2003, p. 111).

The seriousness with which Mexico protects public water is further illustrated by two general water standards[2] adopted under the Federal Metrology and Standardization Law (LFMN)[3]. Those standards do not apply to specific sectors or activities but rather aim at protecting recipient bodies of water in themselves. In order to achieve this goal, maximum contaminant limits are established to control discharges resulting from any economic activity. Any entity discharging wastes into bodies of water must track the level of its discharges. Finally, public authorities sample and analyze wastewater discharges in order to verify compliance with established limits.

[2] NOM-001-ECOLO-1996 "Establishing the maximum contaminant limits for wastewaters discharges into national bodies of water" and NOM-002-ECOLO-1996 "Establishing the maximum contaminant limits for wastewaters discharges into urban and municipal sewer system".

[3] DOF, May 1997. This Act provides for a framework for future development of standards for products and process that threaten safety, health or the environment. Note that although this Act establishes that livestock production is subject to development of such standards, none has been adopted yet.

While constituting the only major pieces of environmental protection in respect of hog production, the National Water Law and the LFMN standards have been criticized for their weaknesses as well as for their inadequate application to hog production. A constant lack of resources leads to poor technical support that, in turn, leads to a lack of enforcement. Further, the LFMN standards have been criticized as adopting an "after-pollution" regulatory approach, requiring compensation for harm done, rather than being proactive by taking a preventive approach[4].

Initially centralized at the national level, environmental laws are increasingly becoming a state or municipal competence. However, none of the states have amended their environmental laws to reflect the 1996 LGEEPA amendments.

Conditions to the operation of agricultural activities are established under state legislation and vary from state to state. An important aspect of state power over the environment is their ability to exempt the application of national environmental laws within the state through the state's adoption of its own environmental technical standards. Another state power is the ability to require environmental impact assessments for the operation of waste treatment facilities, sanitary landfills, and wastewater or non-hazardous solid waste disposal. However, as in other matters, state powers related to environmental impact assessment are often delegated to municipalities through the signature of coordination agreements. It is believed that local governments will achieve the end goal. Therefore, unlike Quebec, the trend in Mexico is a process of "municipalization" with a development of municipal environmental protection by-laws applicable to livestock activities.

As for substantive law, Mexican regulations related to hog production are weak in several respects. First, no minimum distance separation (MDS) are required in Mexico between livestock operations and property lines, other structures or other livestock operations although exceptions are to be found in some municipal by-laws on livestock activities in urban areas. Second, despite the fact that municipalities now require building permits and land use permits for new facilities (with no size specification)[5], there often are no environmental requirements associated with livestock building permits. Third, although restrictions on discharges into water bodies exist, waste management is generally unregulated. Fourth, although intensive livestock operations are normally subject to environmental assessment impacts, unwritten practices of some states exempt agricultural and livestock operations from these procedures due to the economic significance of the agriculture sector[6]. Fifth, there is currently no requirement for a manure management plan in Mexico and no recommendations on the use of manure as fertilizer. Finally, Mexico has no moratorium on new facilities or expansions, although the construction or expansion of new facilities is prohibited in a few zones, namely in urban areas.

In conclusion, Mexico's legal response to environmental concerns resulting from hog production appears minimal and can generally be summarized as the prohibition of waste discharges into water bodies. While a general low priority given to environmental policy partially explains this situation, the political and economical context plays a major role as well.

[4] For a detail analysis of the standards, see Speir et al (2003, pp. 95-100).
[5] Municipalities also require the following two permits: land tax registry and animal health certificates for the movement of animals and products.
[6] I.e. the Guanajuato case study, in Speir et al (2003, p. 104).

One example of this is the reluctance to make long-term investments necessary for effluent treatment systems resulting from the fast growing towns and small cities, which force farmers to move away.

5.0 Hog Production in Quebec

Hog production is a key economic activity of agricultural production in Quebec (MAPAQ, 1998; Van Nieuwenhuyse, 2002). Producers are grouped into the *Fédération des producteurs de porc du Québec* ("Federation of Quebec pork producers") and horizontal coordination is practiced for the commercialization of live hogs. The Quebec government has been increasingly involved as a regulator in the environmental management of hog production.

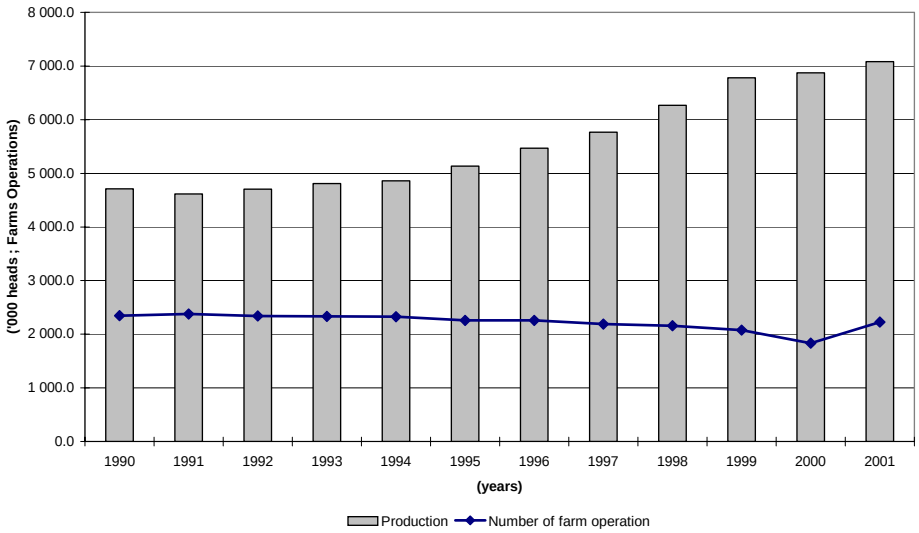
Following pressures from the public over the years, the production has experienced increasing environment stringency. A moratorium on the expansion of hog production was introduced in Quebec on June 14, 2001. The *Bureau d'audiences publiques en environnement* (BAPE – "Bureau of public hearings on the environment") is currently running hearings on the environmental sustainability (including economic and sociological) of hog production in Quebec. These hearings began on October 22, 2002, and the final report of the BAPE is due on September 15, 2003 (see <www.bape.gouv.qc.ca/sections/mandats/prod-porcine/index.htm>).

The consumption of pork meat in Quebec is about 25 kg per capita per year. This is about twice the amount reported for Mexico (see figure 2).

Looking back at the evolution of production in this sector provides some perspective of its importance to the province's agrifood accounts. Quebec's agrifood trade balance has been positive since 1995, this is mostly due to exports of products from the pork industry.

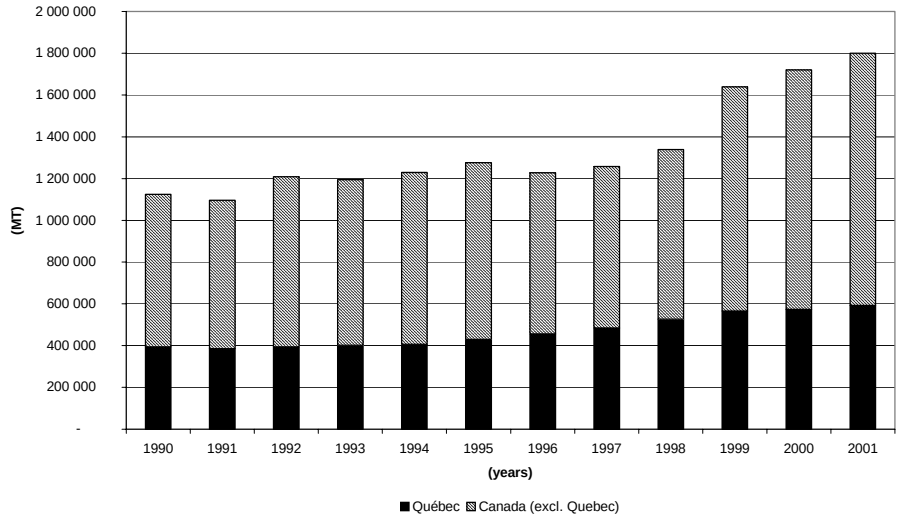
Figure 7 shows the trends in total hog marketing in Quebec and the trend in the number of farm

Figure 7. Total Hog Marketed in Quebec and Number of Operations
1990 - 2001
(Source: Statistics Canada)



operations in the sector. Since 1994, the year of reference for the introduction of NAFTA, the number of farm units have declined by 4 percent (figure 7). However, the number of hogs marketed during the 1994 – 2001 period has risen by 46 percent, and revenue by 79 percent.

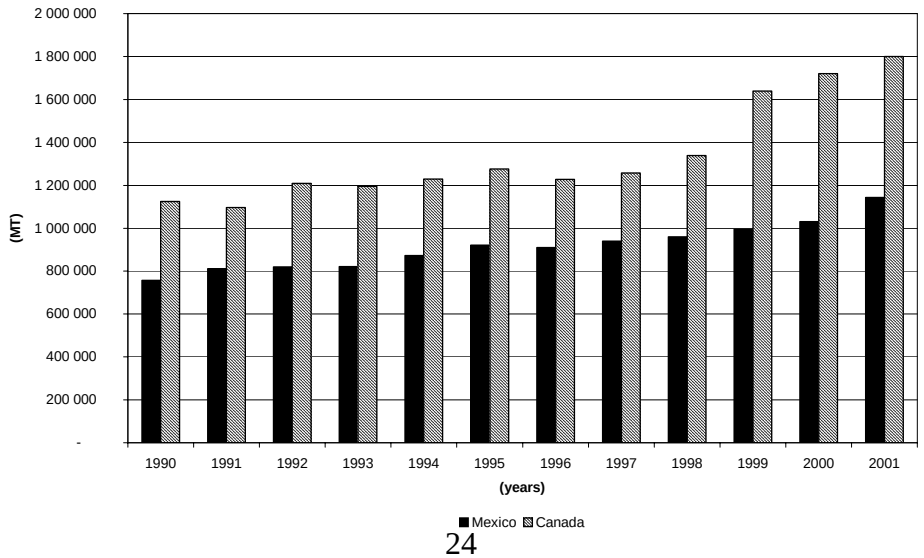
Figure 8. Pork Production: Quebec and Canada (excl. Quebec)
1990 - 2001
(source: Statistics Canada)



These trends clearly show how the industry has progressed in terms of output and larger production units.

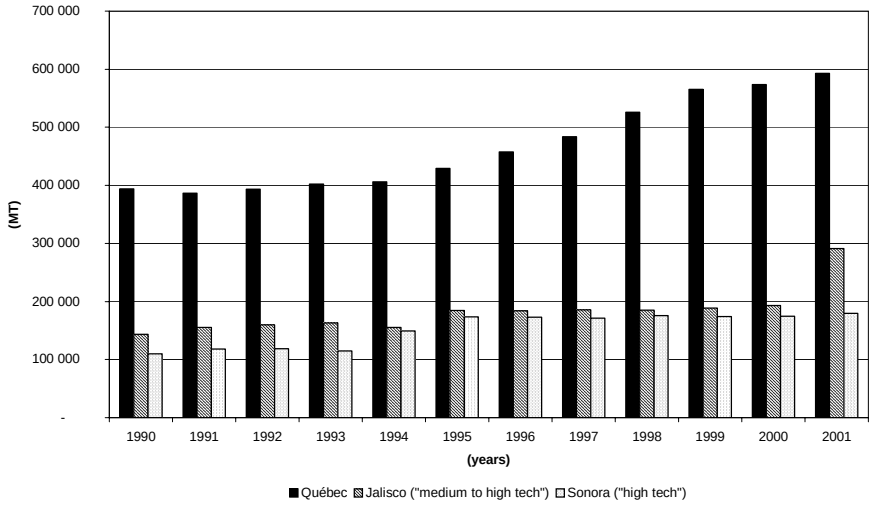
Quebec hog production represents approximately 35 percent of the total production in Canada. The production trends in Quebec are parallel to the ones observed at the national level over the 1994 to 2001 period. The Quebec production has increased by 46 percent during the 1994-2001 period. Total pork products for Quebec reached 592,5 metric tons in 2001, while in Canada (excluding Quebec) 1 207,1 metric tons of pork products were marketed. Overall national output was 1 800 metric tons in 2001.

Figure 9. Pork Production in Mexico and Canada
1990 - 2001
(Source: SAGAR, Satistics Canada)



A comparison of trends in overall output between Canada and Mexico shows varying speeds of growth between 1994 and 2001. During that period, Mexico's pork production increased by 31 percent, while Canada's production has risen by 46 percent. Recall that in 1984, Mexico's output was 1,4 million metric tons, a level that Canada achieved only by 1999. As seen on figure 9, since 1990, Mexico's production represents, on average, 68 percent of Canada's production measured in metric tons.

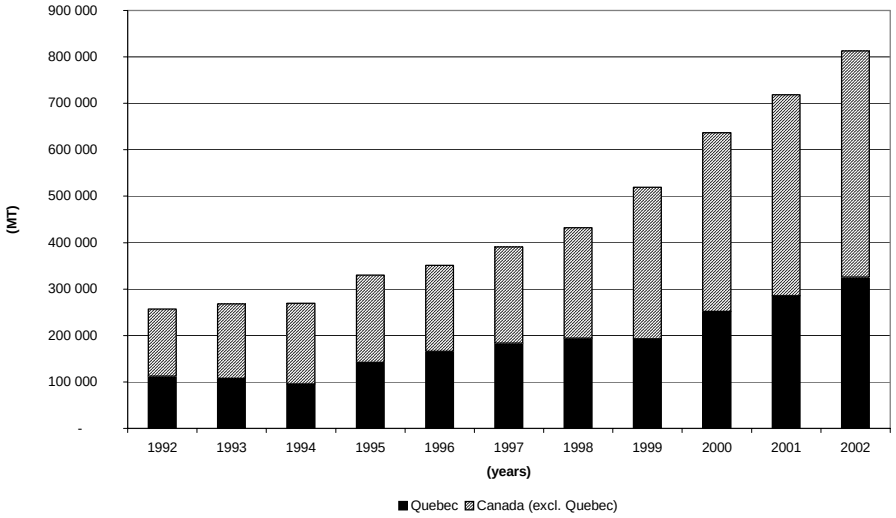
Figure 10. Pork Production in Quebec vs. Jalisco and Sonora
1990 - 2001
(Source: SAGAR, Satistics Canada)



Another interesting point is that Quebec's output in pork is on average half of that of Mexico's. Figure 10 compares Quebec's production with two states in Mexico. On Figure 10, production trends compare Quebec with Jalisco, the most important production state in Mexico, and Sonora, another important production area located in the north of the country. Recall that Sonora possesses state of the art production facilities and these operations tend to be vertically coordinated for feeds and they can export their products to the United States. Jalisco, on the other hand, has a larger production volume, but its production is destined to the markets of large cities. As can be seen, the output in Jalisco, has skyrocketed by 87 percent during the 1994-2001 period, while the growth in Sonora, has followed a more modest growth pattern of 20 percent. The production levels of Jalisco and Sonora represent about 40 percent and 29 percent of Quebec's production on average, respectively, for the period considered.

The increase in pork production in Canada and Quebec has translated into important gains in exports. During the 1994 – 2002 period, Quebec exports have increased by 190 percent, to reach an actual export level of 326 024 metric tons in 2002 (figure 11). In Canada, the increase in exports was faster at 216 percent for the same period. Quebec's share of Canadian exports of pork products is about 42 percent.

Figure 11. Total Pork Exports: Quebec and Canada
1992 - 2002
(source: Statistics Canada)



Quebec pork exports to Mexico are approximately 1,5 percent of total exports. Recent trends of exports to Mexico from Canada and Quebec are given in figure 12. As can be seen in figure 13, the overall share of Quebec's exports to Mexico within Canada is declining. Because, the lack of infrastructure for delivering hogs to Mexico this activity is limited (MAPAQ, 1998).

Figure 12. Total Pork Exports to Mexico: Quebec and Canada (excl. Quebec)
1999 - 2002
(source: Statistics Canada)

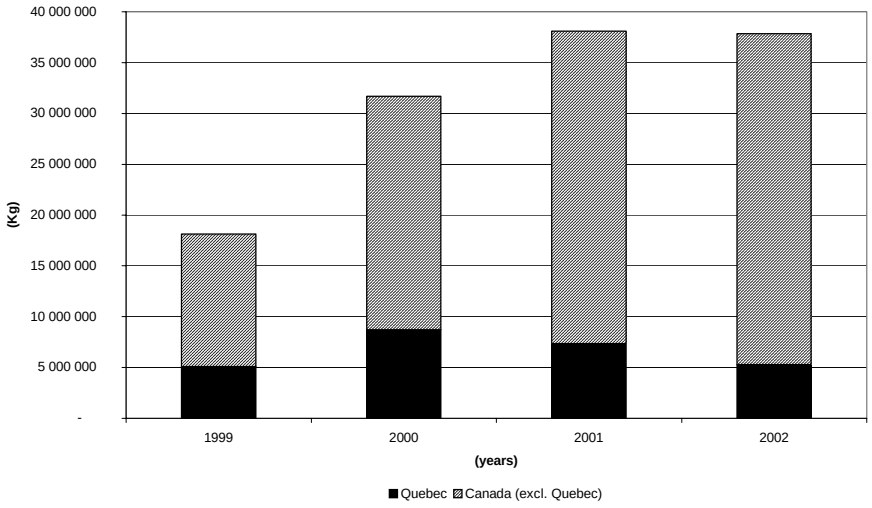
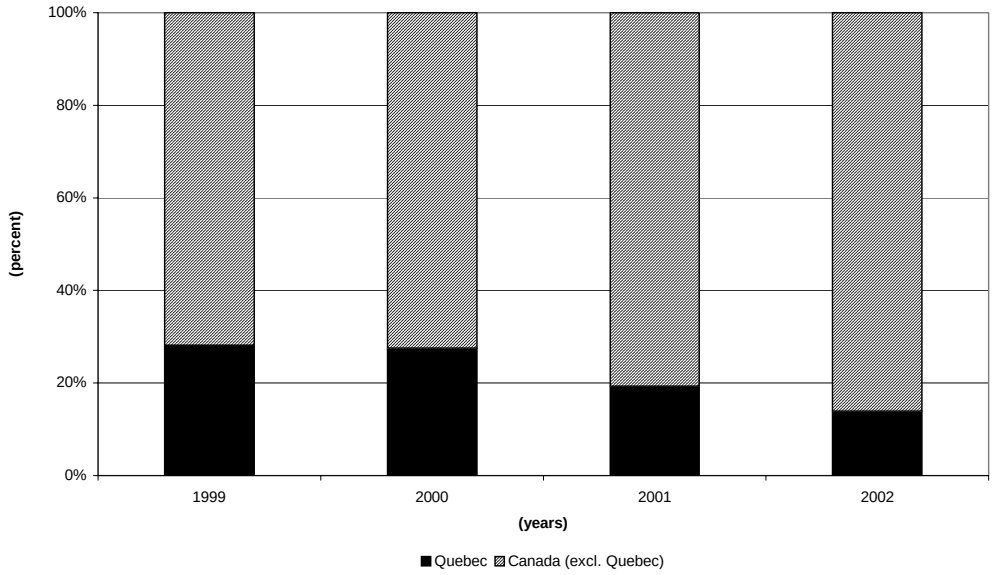


**Figure 13. Total Pork Export Shares: Quebec and Canada (excl. Quebec)
1999 - 2002
(source: Statistics Canada)**



5.1 Quebec's Legal Response to Environmental Impacts

Unlike in Mexico, it is the provinces that regulate the environmental impact of agricultural practices in Canada. In Quebec, three legal instruments apply to agricultural practices but only one – the Agriculture Act - deals specifically with agricultural activities. While the Environment Quality Act establishes a general prohibition against pollution[7], it is the Agriculture Act that establishes legal limits under which pollution resulting from agriculture activities is accepted. No specific legislation or regulation applies to hog production in particular.

Initially adopted in the 1970s, the Agriculture Act aims at ensuring the sustainable development of agricultural activities. In other words, it attempts to encourage agriculture while protecting the environment from potential harms arising out of this activity. While the Agricultural Act constitute the general legal framework applicable to agricultural activities, a regulation was adopted in 1981 to deal specifically with environmental concerns arising from livestock operations. This new regime aimed principally at preventing water pollution although a non-binding instrument was also adopted in 1981 to prevent air pollution arising from livestock operations. Since then, the Quebec legal structure related to environmental regulation of livestock operations has been frequently amended in order to achieve a balance between encouraging agriculture and protecting the environment within the context of the Quebec economy.

[7] Section 1(5) of the Environment Quality Act defines a "contaminant" as "a solid, liquid or gaseous matter, a microorganism, a sound, a vibration, rays, heat, an odour, a radiation or a combination of any of them likely to alter the quality of the environment in any way".

From the beginning of the major environmental consideration in 1981 to the present, we can describe three main periods. The first of these covers the years 1981 to 1996 and is characterized by the adoption of strict measures to protect the environment. In 1996, the Quebec government implemented a major amendment to the initial Agricultural Act, starting the second period that continued until 2001. This second period is characterized by the pursuit of environmental protection while being a little bit more accommodating to the growing hog industry. Finally, the post-2001 period exhibits a trend to simplify environmental regulations in order to encourage agricultural activities. In other words, while these approximately 20 years of legal development followed a constant path towards "environmentally friendly agricultural activities", the pre-1996 period placed the emphasis on the environment while the post-1996 period put the emphasis on a better cooperation between the environment and economic development.

The combined effect of the 2001 amendment to the Agriculture Act and the previous changes to the Act was to switch regulatory control over agricultural operations from municipalities to the provincial government. These changes affect hog producers in the same manner as they affect other agricultural producers.

The timing of these changes is also of interest. The 1996 major amendment to the initial Agricultural Act occurred two years after the entry into force of the new Quebec Civil Code and of the NAFTA.

5.2 The 1981 environmental requirements on livestock operations

Water pollution resulting from agricultural activities was the first environmental concern to be regulated under the Environment Quality Act and its regulation[8]. Air pollution was also dealt with, although in a non binding instrument.

The 1981 regulation of water pollution arising from livestock operations[9] established three principal pillars. The first required operators to obtain authorization certificates in the five following activities: new livestock operations facilities, extension of facilities, replacement of livestock, increase of livestock and manure storage facilities. The second was the imposition of MDS for the localization of livestock operations and manure storage facilities. For example, the MDS requirements for the field storage of solid manure from watercourses were set at 300 meters, which is one of the more rigorous standards in Canada. Finally, the legislation also created MDS in respect of manure spreading as well as certain conditions and limits regarding the period of spreading, minimum land space required and so on. The 1981 measures were soon complemented by two major moratoriums, both of which had a significant impact on hog production operations. Adopted in 1984, the first moratorium prohibited any transformation of a livestock operation into a liquid manure management livestock operation in some areas of Quebec. This prohibition did not, however, apply when the producer owned the land or when the solid manure was treated according to governmental procedures. This prohibition is commonly known as "limited activities". A second moratorium was adopted in 1987. It applied to 13

[8] *Regulation respecting the prevention of water pollution in livestock operations, supra*, note 5.
[9] *Regulation respecting the prevention of water pollution in livestock operations*, c. Q-2, r. 18, division VI.

municipalities without the inclusion of any exceptions and to 39 others with exceptions depending on whether the produced owned the underlying land.

Defined as a contaminant and controlled by the Environment Quality Act, air pollution resulting from livestock operations is also regulated by the 1981 Guideline[10] – a non-binding instrument. This Guideline established MDS between livestock operations or manure storage facilities and residential areas and protected buildings.

5.3 The 1996 move towards the sustainable development of hog production

The protection of the environment resulting from agricultural activities underwent a major revision in 1996 with respect to water and soil protection. The 1981 regime on manure spreading control was replaced by a longer and more complex regime on manure spreading control through the new 1997 Regulation [11]. No major changes occurred with respect to air, dust and noise pollution.

5.3.1 Water and Soil Pollution from Hog Production

The scope of MDS was significantly enlarged in 1997 through a regulation that not only protected water, but also neighbors from odor pollution. This regulation establishes not only a general prohibition against depositing or discharging waste (including manure) into water or soil but also a general prohibition against the deposit, receipt or storage of livestock waste other than at a site authorized for that purpose under the Environment Quality Act or at a site exempted from such authorization[12].

The conditions and limits on the spreading of fertilizing substances[13] were also extended in 1997. The period of authorized use, authorized areas, and so on were more strictly controlled. In addition, the 1997 regulation required farmers to maintain a spreading register for each parcel in the agricultural operation for each annual growing season.

The regulation also introduced the requirement to create a "Plan agro-environmental de fertilization" (PAEF) that helps determine the limit of manure spreading for each parcel[14]. Specific requirements also apply to the elaboration, preparation and retention of this Plan[15]. This PAEF was only required in some livestock operations, depending on the size of the operation, the type of manure management (solid or liquid), the quantity of manure spread, and so on.

The third main change brought about in 1997 was the introduction of a stronger distinction between (1) the construction and development of livestock facilities and livestock

[10] Directive relative à la protection contre la pollution de l'air provenant des établissements de production animale.
[11] *Regulation respecting the reduction of pollution from agricultural sources*, c. Q-2, r. 18.2.
[12] The waste still must be deposited in accordance with the specific provisions of the 1997 regulation dealing with general manure management standards, *Regulation respecting the reduction of pollution from agricultural sources* s*upra*, note 6.
[13] Prescribed in Division III of the *Regulation respecting the reduction of pollution from agricultural sources.*
[14] Sections 14 to 26. According the regulation, *supra*, note 6, the spreading of livestock waste or farm compost is permitted only for the purpose of fertilizing the soil of a parcel in an agricultural operation
[15] The Plan must be retained for two years after the end of its termination. Note that the PAEF has to be distinguished from the plan de fertilization.

waste storage sites, and (2) their utilization. Location, construction and development standards were created with respect to the construction and development of these facilities.[16] Expedition, transportation, spreading, storage and discharge permits in respect of livestock waste are required for the exploitation of these facilities. A ministerial authorization is also required for a wide range of activities[17].

Finally, limited activity zones (ZAL) were created. Within those ZALs, severe restrictions apply to manure spreading in order to better manage the surplus of manure. For instance, manure-spreading agreements had to be entered into with manure management organizations (OGF) established under the regulation.

5.3.2 Odor Pollution

While the initial draft of the 1997 regulation aimed at covering air, water and soil pollution, the odor control regime was established by the 1998 Guidelines for determining minimum distances to ensure odor management in rural areas[18] which replaced the 1996 version[19]. Like the 1981 Guidelines, these 1998 guidelines do not have the status as regulations; they only apply to government officials with a mandate to apply the Environment Quality Act.

While the 1997 regulation falls within the scope of the Environment Quality Act and, as a consequence, under the power of the Quebec Minister of the Environment, the 1998 Guidelines fall within the power of regulation of each municipality as established by the Act respecting land use planning and development[20]. However, the municipal powers have now to be shared with the provincial government in respect of agricultural areas.

The Guidelines establish MDS for livestock facilities, farm manure storage sites located more than 150 meters from livestock facilities and for spreading farm manure. The MDS for livestock facilities are computed using a formula combining seven parameters specific to the category of neighboring unit in question: number of animal units, base distance, odor load, type of manure, project type, attenuation factor and usage factor. Under the project type parameter, the vested rights related to expanding small existing farms is recognized. Vested rights are also recognized for operations with 100 animal units or fewer under certain circumstances.

[16] Section 27 to 48.
[17] The erection of a livestock facility and the erection or laying-out of a storage or a yard; the operation of these facilities; alterations to a livestock building in order to increase the capacity for housing livestock; alterations to or enlargement of a yard; enlargement of a livestock building; alterations to or enlargement of a storage; an increase in the number of livestock units beyond the defined maximum; the replacement of livestock in a livestock building or a yard by other livestock if it results in an increase in the volume of waste or an increase in the number of livestock units, or replacement by suidae; and the replacement of solid manure management by liquid manure management in a livestock building or storage.
[18] Guidelines for determining minimum distances to ensure odor management in rural areas, c. P-41.1, r. 1.1v Directive relative à la détermination des distances séparatrices relatives à la gestion des odeurs en milieu agricole, (1998) 130 G.O.Q., partie 2, 1582.
[19] Directive du ministère de l'Environnement et de la Faune relative à la protection contre la pollution de l'air provenant des établissements de production animale, (1996) 128 G.O.Q., partie 2, 5438, mod. (1997) 129 G.O.Q., ptie 2, 6911.
[20] Section 113 al. 3.

A reciprocity principle contained in the Guidelines implies that MDS requirements must be respected by both the agricultural operator and his or her neighbors. In other words, "if there already exists an agricultural use at the time a non-agricultural use is being planned in a non-agricultural land adjacent to a agricultural land, the distance to be respected is the same as if the reverse situation had occurred, that is, the distance to be respected is the same if the adjacent non-agricultural use had existed prior to the implementation of the said agricultural use." As will be explained below, this reciprocity rule was changed in favor of farmers.

5.3.3 Dust and Noise Pollution

Dust and noise pollution resulting from agricultural production is not subject to the Agricultural Act. Thus, such pollution is only subject to the general regime of prohibition of introducing contaminants into environment as defined by section 20 of the Environment Quality Act. Draft legislation on noise pollution[21] was published in 1997 but was never adopted.

5.3.4 The status of the 1984 and 1987 moratorium

Besides the 1996 amendment to the Agricultural Act, 1996 represented significant modifications to the 1984 and 1987 moratoriums. The 1987 absolute moratorium banning the extension and erection of new livestock operation based on a liquid manure management was abolished in 1996. On the contrary, the 1984 "limited activities" moratorium was not only maintained but also reinforced. This moratorium applied to 140 municipalities in 1996. As indicated earlier, this moratorium banned (a) the erection or extension of any facilities, (b) the replacement of one type of livestock by another and (c) the increase of livestock, all unless the hog producer owned the land on which the manure spreading was to occur or unless the manure was treated according to governmental procedures, such as in cooperation with an OGF.

5.4 The 2001 Emphasis on the Right to Produce

While the 1996 Agricultural Act both changed the regime applicable to the protection of agricultural land and introduced a complex regime of odor control, it also introduced the notion of a right to produce ("*droit de produire*"). The changes brought about by the 2001 Agriculture Act are based on this right to produce, which are designed to simplify and facilitate agricultural production.

The 2001 amendments to the Agricultural Act responded the to Quebec farmers union's concerns (the Union des producteurs agricoles) that the then-existing regime prevented the development and extension of agricultural farms. These amendments were aimed at erasing the negative economic effects of the odor control regime implemented by the 1996 amendments. In other words, the 2001 Agricultural Act aimed at facilitating the development and extension of agricultural activities in agricultural zones.

Three measures have been used to facilitate the development of agricultural production. First, the 2001 Agricultural Act aimed at limiting the impact of new non-agricultural construction in agricultural zones. Second, it created specific and explicit rights to install and

[21] *Projet de règlement sur les bruits résultants d'activités agricoles*, (1997) 129 G.O.Q., partie 2, p. 3525.

enlarge livestock facilities in this zone. Third, the Act enlarged the scope of immunity applicable to agricultural producers.

These three measures do not, however, undermine the 1997 regulation dealing with environmental concerns arising from livestock operations since a 2002 regulation[22] on agricultural operations complemented and reinforced the existing regulation. For instance, a PAEF is now required for almost all livestock operations except very small ones.

5.4.1 New Alternatives to MDS

1. An alternative to distance separation requirement

Section 79.2.1. of the 2001 Act limits the erection or enlargement of a building used or intended to be used for a non-agricultural purpose. This is because such construction could have the effect of modifying the MDS required between the livestock facilities and the non-agricultural facilities, thus limiting the potential to expand agricultural activities. By imposing this restriction, the legislator made the right to extend agricultural activities a priority for the benefit of farmers.

Two types of limitations exist to the construction ban on non-agricultural facilities. First, the non-erection of enlargement applies only on the side of the building facing the breeding unit. Further, "a municipality may not refuse to issue a building permit for the sole reason of non-compliance with that condition".

The second limit to the erection or enlargement of non-agricultural facilities was created where an erection or enlargement made in conformity with the above requirement encroaches upon the space that, under separation distance requirements, must be left open between the land in question and any neighboring breeding unit. In this case, the MDS requirements applicable at the time of the erection or enlargement of the building continues to apply to the expansion of agricultural activities on any neighboring breeding unit without taking into account the location of the building or its enlargement. In others words, the MDS requirements for the extended agricultural activities are calculated as if the erection or enlargement of non-agricultural facilities had not occurred.

This new provision of the 2001 Agriculture Act is another indication of the legislature's intention to facilitate the development and extension of livestock production. This contrasts with the 1996 Act under which a reciprocity rule governed. Another provision reinforces the primacy of the development of agricultural activities over the construction of non-agricultural facilities. No MDS requirement and no other agricultural use standards[23] apply to a residence built by a non-farmer in the reserved area without the authorization of the Quebec Commission for the protection of agricultural land ("*Commission de protection du territoire agricole du Québec"*).

Finally, the 2001 legislation limited the nature of MDS requirements applicable to livestock producers. Notwithstanding MDS requirements, manure storage works and other works

[22] Règlement sur les exploitations agricoles, 2002.
[23] Such standards may originate from the exercise of the powers provided for in section 113 of the Act respecting land use planning and development, chapter A-19.1.

aimed at reducing pollution or works aimed at reducing the inconvenience caused by the odors from a breeding unit may be erected on the space that would normally need to be left open under separation distance requirements. The only limitation to this provision is that the works cannot be erected on the side facing the building used for a purpose other than an agricultural purpose the location of which would entail the greatest restriction on the potential for expanding the agricultural activities of that breeding unit if the separation distance requirements were taken into account.

It should be noted that commentators have criticized the lack of consideration of "dominating winds" in the choice of the place where the works would be erected.

2. The right to extend activities

The 2001 Act also created a right to extend a breeding unit, which is defined as "a livestock facility or, where there is more than one facility, of all the livestock facilities in respect of which a point on the perimeter of one facility is less than 150 meters from the neighboring livestock facility, and of storage works, if any, for the manure from the animals in the facility or facilities."

By using this new terminology, the legislator aimed at not limiting the right to extend activities to the producer. A producer may thus benefit from this right to extend for each livestock facility that is located at a distance of more than 150 meters.

While this right to expand is subject to a number of conditions enunciated in section 79.2.5 of the 2001 Act (i.e. the number of livestock units, the odor coefficient of the categories or groups of animals), no conformity with the Environment Quality Act, the 1997 regulation or with authorization permit granted under this Act or regulation is required.

5.4.2 Civil Liability Immunity

The entry into force of the new Civil Code of Quebec in 1994 created a new cause of action to neighbors who suffer harm beyond normal neighborhood annoyances. These are considered to be annoyances that are beyond the limit of tolerance neighbors owe each other, according to the nature or location of their land or local custom.

This cause of action opened the door to claims against annoyances caused by agricultural activities. In 1996, an argument based on abnormal neighborhood annoyances was discussed in the Messier c. Agromex inc. case. The plaintiff, M. Messier, suited Agromex inc, a farm producer, alleging that the spreading of manure by Agromex contaminated his wells and drinking water. The court decided in favor of the plaintiff and held the farmer liable due to the abnormal annoyances caused by the spreading of manure.

The 2001 Agricultural Act sought to reverse this decision. Although the case dealt with water pollution, the new amendments aimed at avoiding the same result in cases dealing with dust, noise and odors as long as the regulatory requirements are satisfied.

Both the 1998 Guidelines on distance separation and the 2001 Act clearly responded to the fear of expanded civil liability for farmers. The first step was taken by the 1998 Guidelines that replaced the former qualification of odors. While odors were originally considered to be a

"contaminant", the 1998 Guidelines now define them as "annoyances".

Section. 79.19 of the 2001 Act expressly excludes civil liability for annoyances resulting from agricultural activities by stating that: "In an agricultural zone, the inconvenience caused by dust, noise or odors resulting from agricultural activities does not exceed the limit of tolerance neighbors owe each other, insofar as the activities are exercised". The 2001 Act also excludes liability for dust, noise and odors when the producer conforms with the Act's various requirements. Neither an injunction nor compensation can be claimed. The burden of proof is borne by the plaintiff. This immunity regime does not apply when there is no gross and intentional fault. The exclusion of the general regime of liability when abnormal annoyances occur – as established by section 976 of the Civil Code of Quebec – highlights the importance of the determination of regulatory norms. The more flexible these norms are, the larger the immunity accruing to the farmer becomes. As already mentioned, this immunity only applies when regulatory requirements have been satisfied. However, in certain circumstances, pollution by dust, noise or odor are not regulated. As a result, an action against the farmer could be based on article 20 of the Environment Quality Act that protects the victim of pollution by a contaminant. The 1995 Giguère v. Turcotte case illustrate this point.[24]

While the immunity of farmers against civil actions related to dust, noise and odor is explained by the nature of their activities, two criticisms can be made. First, Quebec barely enforces its environmental laws as the implementation of articles 14 and 15 of North American Agreement on Environmental Cooperation has demonstrated. Second, the absolute nature of the immunity has been questioned.[25] This exclusion of immunity was recommended in the case where agricultural activities causing damage do not constitute a normal agricultural practice,[26] but this change was not integrated in the 2001 Act.

With this "absolute" immunity of the farmers – not limited to normal agricultural practice -, Quebec not only remains the only province in Canada with such a large immunity regime for farmers but also increased this immunity with the 2001 Act.

6.0 Discussion and Conclusion

Quebec hog production has increased substantially over the last 20 years. A growing export market to the United States, Japan, and Russia has driven this expansion. Associated with this increase in production is an increase in the residuals that flow into the environment. Given that the regulation of intensive livestock operation falls under provincial jurisdiction in Canada, the Quebec government has had to adjust its laws over time to take into account the expansion of the sector.

The expansion of hog production has also resulted in an expansion of the regulations that control the impact of this production on the environment. The original Environmental Quality Act restricted the direct deposit of hog manure into watercourses and required a distance set back from watercourses when manure was spread. The 1997 revisions expanded the distance

[24] *Giguère c. Turcotte*, C.S. Beauce (St-Joseph –de-Beauce), n. 350-05-000131-910, 15 juin 1995.
[25] Rapport Brière, Rapport de consultation sur certains problèmes d'application du régime de protection des activities agricoles en zone agricole, 25 octobre 2000, 69 p. et 6 annexes.
[26] Rapport Brière, p. 27-28.

requirements to include not only watercourses but the potential problem of odors affecting neighbors. The 1997 amendment also took into account the potential problem of manure on soil. In this regard, the statute outlined restricting on: (1) the timing of manure spreading (in terms of time of year), (2) the amount to be spread per hectare, (3) the requirement of a fertilization field plan that must balance fertilizer input with soil and crop requirements. This legislation also required that more variables be taken into account when determining distance set backs for odor problems.

The revised act also clearly delineates the rules for storage and placing of facilities. The storage facility must be within a certain distance from the livestock facility. The storage requirements includes: (1) the size of the storage facility, in order for it to hold a certain number of days of manure, and (2) must adhere to certain construction requirements.

The site requirements for livestock facilities were increased with the 1997 revision of the law. In particular, the livestock facility location relative to other agriculture and non-agriculture facilities located on adjacent lands must be accounted for.

The 1997 revision to the law is a clear indication that as hog production expanded the concern for its impact on the environment also expanded. These changes are an expansion of mandatory (command and control) regulations on hog production. One would expect that hog producers in Quebec would not embrace the expansion of mandatory regulations and that they would use their political power to modify these regulations.

The 2001 revision of the Agriculture Act was an attempt by agricultural producers and their representatives (UPA) to establish a producer's right to farm and as a result potentially dampens the earlier regulatory control. However, the revision only minimally impacts facility location, distance set backs, and producer liability. Finally, it is interesting to note that 2001 is also the year that the Government introduced a two-year moratorium on hog production expansion in most regions of the province.

An increase in mandatory regulations can have an impact on producer incentives and the incentives of their representative organizations. For example, in 1997 the *Federation des producteurs de porcs du Quebec* (FPPQ) conducted an agro-environmental census on Quebec hog farms to determine the state of environmental management on Quebec hog farms. This information was used to prepare 11 agro-environmental action plans for each region of the province. This information could be used by operations to modify their existing practices (FPPQ, 2003).

This increase in regulation across all provinces in Canada provided the incentive for the Canadian Pork Council (CPC) to take action on developing a Hog Management Strategy in 1997 (CPC, 2002). In 2001, the CPC had the Canadian Standard Association (CSA) develop a detail framework for the implementation of an environmental management (EMS) standard. The draft standard that has been developed follows the principles of ISO 14000 certification. A pilot study on 15 farms has been started to implement this draft EMS standard and should be completed by March 2003 (CPC, 2002).

This increase in mandatory regulation that affects hog production in Quebec and Canada has resulted in producer groups attempting to develop voluntary mechanisms to deal with environmental problems. The theoretical literature has indicated that as the threat or actual implementation of mandatory regulations increases, there will be an incentive for individual producers to take the lead to develop voluntary business lead initiatives. The incentive for doing so is the increase in flexibility for the producer and the cost effectiveness of these solutions. This provides producers with an opportunity to avoid further mandatory regulations.

Hog production was increasing in Mexico with the assistance of a feed subsidy program from 1979 to 1984. Along with this increase in production was a corresponding increase in the residues going into the environment from this production. The removal of the feed subsidy program resulted in a dramatic decrease in hog production and a similar decrease in environmental impact. By 1989, hog production in Mexico had decreased by 43 percent from its peak in 1985. As a result, the need for environmental legislation specific to hog production had decreased with the decrease in production. Current production trends in Mexico have output approaching the levels produced in 1984. This may explain the relative lack of legislation directed towards hog production in Mexico.

Current industry objectives are to expand the output of the hog sector in Mexico. With this expansion and its corresponding pollution, it can be expected that mandatory and non-mandatory regulations, financial instruments such as taxes and subsidies, will also increase. This increase in regulation will provide an institutional setting that will provide incentives for business decisions. These incentives could follow the Quebec model, with increased restrictions on manure discharge, management and facility location. As with all regulations, enforcement is of particular importance and must be seen as a credible threat if the regulations are to be adhered to.

If mandatory regulations are increased in Mexico, then the choice of voluntary business-led initiatives by firms may be expected if the threat of mandatory regulations is considered real. The NAFTA agreement may provide an additional leaver for providing additional incentives for firms to develop voluntary business-led initiatives if they create either market access or price premiums in the North American market.

The theoretical literature on voluntary business-led initiatives is clear that the threat of mandatory regulations plays an important role in generating the incentives for firms to develop these initiatives. This requires that enforcement of regulations must be undertaken. The institutional structure associated with the mandatory regulation and enforcement will impact on the incentives given to firms. Quebec and Mexico have taken different approaches to this institutional structure. Quebec uses a provincial government approach to address such questions as agricultural zoning and the sitting of facilities while Mexico has decentralized this responsibility towards the county/municipal level of government. This approach is similar to other provincial jurisdictions in Canada (Speir et al., 2003). Whether the institutional structure for regulation and enforcement should be done at higher or lower levels of jurisdiction is an empirical question that is not addressed in this paper.

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