Evolving Standards and Industries in an Era of Market Integration: Opportunities and Obstacles within the North American Livestock Complex

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A paper prepared for the

Fifth Annual North American Agrifood Market Integration Consortium Workshop

New Generation of NAFTA Standards

May 21—23, 2008

Omni Hotel (downtown)

Austin, Texas

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Introduction

International trade in livestock and livestock products has grown and livestock-related markets have become significantly more integrated in recent decades. Increased trade and globalization have occurred simultaneously with the emergence and dominance of large-scale live animal and livestock product production and processing. Traditional animal husbandry techniques have become industrialized, technology-driven processes, most livestock industry sectors have concentrated.

However, international livestock and livestock product market integration is not without risks. Old, well known, and well understood animal disease threats remain and continue to present challenges to market integration (e.g., Foot and Mouth Disease-FMD, tuberculosis), while emerging diseases threaten market processes and stability (e.g., Bovine Spongiform Encephalopathy - BSE). In addition, global market integration has made it possible for little known, exotic, or emerging disease issues to rapidly impair market functioning, food safety, and both animal and human health worldwide. As live animal and livestock product importing and exporting nations have become more integrated and dependent on trade flows, the potential for animal disease outbreaks to disrupt the global marketing system has increased. In addition, the threat of bioterrorism has intensified.

Discoveries of BSE-infected cattle in North America since 2003 provide a recent, chilling example of how failed risk management can lead to extreme disruptions and significant economic losses throughout all the NAFTA countries. The case of BSE was examined in detail by Caswell and Sparling (2005) who concluded that more complete agricultural and food market integration in the NAFTA countries will require fuller regulatory integration. LeRoy, Weerehewa, and Anderson (2005) examined BSE-related disruptions in NAFTA beef and pork markets and concluded that the Canadian governmental response to the BSE crisis increased market intervention and manipulation to the detriment of Canadian cattle producers. Gervais and Schroeder (2005) concluded that the North American BSE discoveries and related political and judicial decisions have changed livestock industry structure, increased costs, and reduced the competitiveness of the North American beef industry. Simply put, a handful of BSE-infected cattle have resulted in reduced livestock industry market integration throughout North America,

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while simultaneously revealing the need for additional dimensions of integration (e.g., regulatory) not well addressed by the three-country trade agreement currently in effect. The discovery of BSE in North America also has created opportunities for new variants of non-tariff barriers which have little animal or human health impact but which protect selected interest groups to the detriment of the larger market.

BSE is a dramatic example of an emergent livestock disease which poses a threat to animal and human health. However, BSE is not readily passed between animals or between livestock and humans. BSE is instead a function of the now prohibited practice of feeding dead bovines to live bovines. The etiology of BSE in the NAFTA countries should render the disease as (almost) a trade non-issue. Yet, billions of dollars in financial and economic losses occurred and continue to accrue as a result of BSE. BSE is not contagious, although it is transmissable, and has an incubation period of 4-6 years. Discovery of BSE-infected cattle in the United States and Canada led to intensive efforts to comprehensively trace and identify herdmates, siblings, or other animals exposed to the same risk factors as the cattle confirmed to have BSE. As a result of the BSE situation, animal health authorities in the United States concluded that the nation's existing system of animal tracking and identification made comprehensive tracing nearly impossible.

Other animal diseases which have potentially large economic, human, and/or animal health impacts include Exotic Newcastle Disease (affecting birds) and Foot and Mouth Disease (affecting cloven-hoofed species). Both of these diseases are highly contagious, and well known for their abilities to spread widely and rapidly before animals manifest obvious clinical signs (NRC 2005). Monkeypox exemplifies the threats posed by emerging tropical animal diseases which until recently were rarely found outside of their native ranges. Monkeypox can be misdiagnosed as mild smallpox, was first found in the United States in 2003, and is believed to have been introduced into the United States by exotic rodents imported from Africa.

Control and management of recent outbreaks of Monkeypox and Exotic Newcastle Disease in the United States were both negatively impacted by the noncommercial structure and nature of both small-scale poultry and exotic companion animal ownership and trading (NRC 2005). In both disease cases, animal health infrastructure was not accustomed to dealing with nor focused on noncommercial production or non-farmed species.

Severe acute respiratory syndrome (SARS) was reported in Asia in early 2003, and rapidly spread throughout the world by human travelers. SARS is believed to be zoonotic in nature, probably originating in wild species traded in exotic animal markets. SARS revealed the potential for a flu-like virus to disrupt trade, travel, and economic activity globally by outpacing both animal and human health authorities. Virulent strains of avian influenza (notably H5N1 in recent years) are believed to have similar zoonotic origins as SARS (making the jump from animals to humans in crowded, unsanitary, production and marketing conditions). Avian influenza is widely believed to be the greatest global zoonotic threat with respect to potential pandemics.

Despite all the recent mass media attention given to the exotic and relatively rare animal and zoonotic diseases discussed above, other, less headline-grabbing disease threats remain. Tuberculosis continues to be a disease which impacts domestic and international livestock movements and trade, including within and between the NAFTA countries. Additionally, food

borne illnesses in humans which originate in livestock and meat products pose large human health and economic risks. *Salmonella enteriditis*, *Escherichia coli O157:H7*, and *Listeria monocytogenes* are just three of the pathogens which can disrupt markets and trade as well as kill or seriously debilitate people who consume contaminated food products.

Animal and zoonotic diseases and pathogens have coexisted with livestock and humans for a very long time. However, globalization and multilateral trade dependencies have brought new urgency to the systems and infrastructure which exist for preventing, detecting, diagnosing, and managing disease threats such as those discussed above. When markets are integrated, with both animals and livestock products flowing relatively unimpeded across oceans, continents, and borders, pathogens can be expected to also flow. Multilateral trade liberalization has been viewed as a means to exploit competitive advantage, spur economic development and growth, and bring about increased economic efficiency and social welfare in nations which liberalize their trading regimes. NAFTA and the Uruguay Round Agreement on Agriculture were supposed to eliminate or reduce trade barriers, integrate food and agricultural markets (including livestock, meat, and milk products), and result in net economic gains. To a large extent, borders in the North American livestock complex have been transcended. However, growing livestock and zoonotic disease and livestock-related food safety concerns have recently led many to question the future of liberalized trade in animals and animal products. Even ardent free-traders are finding it increasingly difficult to argue that animal and zoonotic disease and food safety concerns are not legitimate problems in today's globalized food market as a result of numerous high profile disease and food contamination incidents in recent years.

Sanitary and Phytosanitary Measures and Technical Trade Barriers

Sanitary and phytosanitary (SPS) measures include all relevant laws, decrees, regulations, requirements, and production methods that are designed to protect human, animal, or plant life and health (USDA-ERS 2008). The WTO allows member countries to set their own SPS standards using sound science. However, WTO member countries regularly disagree over SPS standards as they relate to livestock and livestock products. It is relatively common for trading nations to restrict imports based on food safety and health concerns even when international human and animal health organizations conclude there is no health risk.

Measures that restrict entrance of products that fail to meet an importing country's health, quality, safety, or environmental standards are known as technical trade barriers (Roberts, Josling, and Orden 1999). Technical trade barriers mainly result from differential SPS standards, often based on differential calculations of risk and uncertainty, and have been used as a means to limit other countries' access to domestic markets. While technical trade barriers *can* be founded on legitimate science-based sanitary or phytosanitary concerns, they also may function as just another protectionist non-tariff barrier.

Roberts, Josling, and Orden (1999) noted that technical trade barriers can be welfare enhancing if they correct market inefficiencies stemming from externalities associated with the production, distribution, and consumption of the affected products. Technical trade barriers can

help a nation achieve sanitary and phytosanitary regulatory goals (not to mention socio-economic goals), provided domestic industries are subjected to the same regulations. Such trade barriers can lead and have led to numerous international trade conflicts and disputes, where the root of the conflicts lies in differential calculations of risk, social concerns, and consumer preferences.

Regulatory Integration of the North American Livestock Complex: Focus on Animal Identification and Traceability Efforts[1]

Animal Identification and Traceability Motivations and Characteristics

As noted above, international trade in livestock and meat products is inherently linked to risks from foreign animal disease outbreaks and bioterrorism. While the WTO-SPS agreement sets out the rules and procedures for establishing and lifting trade restrictions due to sanitary and food safety reasons, an affected country's ability to identify and eliminate the cause of the problem plays a central role in this process. The ability of a nation to deal with livestock disease outbreaks and food safety threats is primarily determined by the effectiveness of existing animal identification and traceability systems. However, traceability is only one of a number of areas where requirements can be defined with respect to emerging standards and market integration within the livestock complex. Caswell and Sparling (2005) have identified seven areas for an integrated NAFTA BSE management policy. Although some might argue that it is not the most important one, we focus on traceability here for two reasons. First, opposite to the other areas which are to a large extent disease specific, animal identification and traceability are functional across diseases. In addition, the emergence of corresponding standards is a fairly recent phenomenon and in full progress.

As of mid-2008, NAFTA-country governments are continuing their efforts to expand regulation of the North American livestock complex through mandatory individual animal identification and traceability. Similar initiatives are underway in other countries because live animal identification is widely recognized as the foundation of any livestock and meat product traceability system that provides coverage along the animal product supply chain both domestically and in international trade. Several international organizations with well-established roles in standards and guideline settings for a wide array of products (i.e., OIE, Codex, ISO and GS1) also clearly have a role to play in the development of standards in animal identification and traceability systems.

It is assumed that traceability will protect animal and public health through improved risk management and disease control. As a result, exporting countries can acquire and maintain international market access. Traceability systems also can generate benefits for individual firms,

[1] Animal identification and traceability initiatives in the NAFTA countries, Australia, New Zealand, and the European Union are founded on numerous country-specific pieces of legislation. The legislative background of the initiatives and the systems themselves are explained and compared in Appendix I and Appendix II.

a specific supply or value chain, or an industry as a result of improvements in operations and supply chain management, market enhancement, product differentiation, and branding strategies. Consumer preferences and consumer trust impact more directly at the firm or industry level, while regulatory-driven traceability for animal and public health does not discriminate between particular suppliers.

Throughout the livestock complex, driving forces for traceability exist at both the animal/public health and firm/industry levels. Government and industry usually do not respond independently to existing and emerging threats and regulatory requirements usually do not arise without industry involvement. Also, industry-led initiatives often arise in response to government incentives or are aimed at avoiding perceived overregulation of industry[2].

The level of traceability within a livestock complex depends on a number of factors and is described in the three dimensions listed below:

- Breadth (Which information units about an animal or about animal products are documented and available?)
- Depth (Which stages of the supply chain are included or directly linked?)
- Precision (How narrowly defined is the smallest traceable unit/lot/batch with regard to time, quantity and location?).

Here, we focus on the supply chain up to slaughter, for which there are three elements of a complete traceability system for emergency preparedness and crisis management:

- Premises identification (ID),
- Animal identification, and
- Movement tracking.

The organization of traceability information and the ability to exchange the information are critical issues affecting market integration. At a minimum, standards and agreements for information exchange, data structure (codes and formats), technology (e.g., for ID tags and data input/readers), and data storage systems must be compatible. In addition, the clear definition of access rights to data and the protection and integrity of the databases are particularly sensitive issues. All these factors are at the root of controversies surrounding national identification and traceability systems and will likely receive more attention in the future.

Role of International Organizations in Animal Identification & Traceability

Standards set by the World Organization for Animal Health (OIE) and the Codex Alimentarius Commission (CAC) have been established by the WTO as scientifically-based norms for the SPS and TBT agreements. These two organizations recently have also incorporated traceability standards and principles in their codes (Chambers and Rutherford

[2] A very illustrative case of industry response to overt threats of overregulation is the German quality and safety seal (QS). It was initiated in 2001 by the German livestock sectors and meat industry to avoid additional regulation and monitoring of the industry. This intensified regulation was announced by the Federal Agricultural Minister and Green Party member Renate Kuenast in 2001 in case that the industry would not initiate an appropriate response to the BSE crisis caused by the first genuine (i.e., not imported) German cow diagnosed with BSE in November 2000 (Boecker et al. 2004).

2007). Due to their central role in WTO, these organizations' traceability guidelines are most relevant for government initiatives affecting the livestock complex. The CAC Code of Practice on Good Animal Feeding also defines requirements for traceability in the feed industry. But in essence, the OIE guidelines are more concrete in their prescriptions for the establishment of a traceability system. Under the OIE guidelines, the competent authority must be part of the veterinary administration, a legal framework and procedures must be established, traceability must be built on the three pillars of premises ID, animal ID, and movement tracking, and finally the system should span the entire food chain.

The leading role of OIE in the advance of animal identification and traceability systems is underscored by its director general's April 2008 comment, "Animal identification and product traceability from the farm to the fork must be progressively implemented worldwide" (Vallat 2008). He announced an international conference to be held in March 2009 with the following objectives: emphasize the importance and benefits of identification and traceability, raise awareness of existing OIE and Codex standards, determine future requirements for standards, and provide advice and assistance on implementing standards.

The International Organization for Standardization (ISO) and the GS1 also have established internationally accepted information and food safety standards. While the ISO is active in a variety of subjects, the standardization of traceability requirements is strongly influenced by the efforts of the CAC. The latest series of food safety standards, ISO 22005:2007, uses the CAC definition of traceability and complements previous initiatives which rely on the Hazard Analysis and Critical Control Point (HACCP) system for food hygiene. The broad approach of the ISO to information standards does not permit it to be a model for traceability systems. However, compliance is an accepted requirement internationally, as seen by the initiatives of Can-Trace, the U.S. National Animal Identification System (NAIS), and Canada's National Livestock Identification System (NLIS).

The focus of the GS1 is primarily product identification systems and technology. Contrary to the ISO, the GS1 has developed a thorough guide for implementing traceability, assisted by the creation of national branches and training facilities. The GS1 is the custodian of the internationally accepted EAN International-Uniform Code Council (EAN-UCC) coding standards and acts as a catalyst to implementing traceability programs. Although the role of the GS1 is to integrate established international standards (e.g., OIE, ISO, or CAC) into practice, rather than to develop new requirements, it is nonetheless accepted as the international authority for program development and technology standards. The Canadian Food Traceability Data Standard Version 2.0 developed by the joint industry-government initiative Can-Trace in 2004 (and updated in 2006) is based on both GS1 and ISO standards. GS1 is recognized as the body that sets all bar-coding standards. This voluntary standard defines the minimum data elements required to be collected, kept and shared between trading partners (Can-Trace 2006). Similarly, GS1 is recognized as a catalyst for New Zealand export industry traceability initiatives with the use of EAN standards (New Zealand 2006). This also applies to Australia where 100% of beef exporters and 21 of the top 25 processors are GS1 members (Meat and Livestock Australia).

Cross-Country Coordination of Efforts in Animal Identification and Traceability

Caswell and Sparling (2005) pointed out that cost-benefit considerations for animal health risk management measures, including animal identification and traceability systems, differ by country. Therefore, countries cannot coordinate policy closely unless they agree on which benefits and costs to take into account with which weights. This cannot simply be determined at the federal level, because needs and thus costs and benefits differ between states or provinces within a country. Hence, close policy coordination across countries becomes more difficult when efforts are concentrated on the simultaneous development of new or enhanced animal identification and traceability systems within each country. This is illustrated by the amount of technical details alone that need to be considered for integrating the United States' NAIS with existing animal health programs and databases. In addition, reservations and resistance by individuals and organizations have formed throughout the United States and found a voice through the internet (e.g., nonais.org, naissucks.com, stopanimalid.org). A similar case example is the attempt in Canada to establish a central multi-species livestock identification system through the Canadian Livestock Identification Agency (CLIA) which was stopped by resistance from industry to protect previous investments in traceability systems and to avoid duplication of efforts and costs.

Due to the complexity of updating risk management measures according to OIE requirements within each country, coordination across countries must be prioritized. Two factors complicate this process for animal identification and traceability. First, there are a number of requirements for more integrated risk management programs. Although two case studies conducted by Sparling and Caswell (2005) clearly point to the need for improved traceability capacities, its importance relative to other areas is difficult to determine. Second, animal diseases may or may not be species-specific, while the development, implementation, operation and maintenance of traceability systems certainly are. This is reflected in the first strategy for NAIS implementation, the prioritization by species which was based on four criteria (USDA-APHIS 2007):

1. Disease characteristics/issues
2. Needs and current state of animal identification
3. Disease tracing requirements and capabilities
4. Industry characteristics, such as economic value, number of animals or vulnerability to intentional harm.

Although no comparable information concerning prioritization criteria is available for Canada and Mexico, it appears top priority in the NAFTA countries is clearly given to the beef and dairy cattle sectors, because of their economic value and recent and current disease issues, such as BSE, FMD, and bovine tuberculosis. Due to potential human health hazards, avian influenza and the poultry sectors have received the greatest attention in risk management coordination efforts across countries so far. These concerns have culminated in the North American Plan for Avian and Pandemic Influenza that was agreed upon by the three NAFTA governments at the Montebello Summit in August 2007.

Furthermore, further steps toward intra-NAFTA policy coordination, albeit not regulatory integration, are documented in cross border emergency exercises, such Equinox 2005. Focusing on FMD, this exercise took place from March 21-23, 2005, as part of a series of exercises of the

North American Animal Health Committee. Managed by the Canadian Food Inspection Agency (CFIA) and the U.S. Department of Agriculture, the exercise involved emergency management centers in three Canadian provinces and three U.S. states, and evaluated human resource needs and the capacity of the existing different traceability systems to react in emergency situations (Marchand 2007). On a broader scope, the three NAFTA countries jointly share FMD response resources and have developed a combined approach for control measures (USDA-APHIS 2005).

Challenges to Animal Identification and Traceability in NAFTA and Other Countries

The EU, Australia, and New Zealand are the regions that are most proactive in the development of animal identification and traceability standards (See Appendix I and Appendix II). As has been pointed out by Harvey (2005), the European perspective on market or economic integration differs fundamentally from the North American one in that political and thus regulatory integration has been its major motivation. Hence, Caswell and Sparling (2005) conclude that "(t)he EU may not be the clearest model for NAFTA because it involves the building of a regulatory structure under a centralized government. Food Standards Australia New Zealand may be where to look for a model for NAFTA, because it seeks to integrate standards across countries." However, with regard to animal identification and traceability, the EU situation is hardly centralized or integrated at all but rather characterized by a transition period in which standards for the purpose of better cross-country coordination are being sought and developed.

The development and implementation of animal identification and traceability systems is a task that is currently focused on national levels. Even in the EU where a centralized regulatory framework exists, factual coordination, let alone integration across borders is virtually non-existent. This is certainly not due to the lack of awareness of the importance of such systems' cross border compatibility. Rather, in each country this task appears to be Herculean in nature due to the large number of stakeholders and government bodies involved at federal and state/provincial levels. Simultaneously integrating animal health management infrastructure, procedures, and standards that have developed historically in each country requires time and resources. In addition, fundamental concerns raised by stakeholders as well as conflicting interests between them provide further barriers in the development and implementation process.

Although the judgment by Caswell and Sparling (2005) that complete NAFTA regulatory integration is unlikely in the short term can be confirmed, a number of observations point to continued policy coordination and different avenues toward market integration. Also, in this process the role of international organizations and compliance with their standards will become increasingly important. In line with risk prioritization, cross border coordination for emergency preparedness is increasingly being based on OIE standards and will also help identify and overcome barriers to effective exchange of information due to differences in traceability standards. An example would be the Equinox 2005 exercise, but the joint efforts in emergency preparedness for avian influenza could also benefit other sectors.

In cases where different standards have evolved over time, international organizations could serve as intermediaries who provide a "switch board" or interface for effective communication between the different standards. This appears to be most relevant for premises registration, as is illustrated in the partnership between On-Trace (an industry/government collaboration in Ontario) and GS1 announced in March 2008 for integrating the Ontario Premises Registry, and the Global Location Standard operated by GS1. However, while it is important that exporting countries pursue common standards, this practice is already being pursued by the increasingly competitive market for international food safety and bio-security systems (New Zealand 2006).

Also, if an important importing country switches to one particular standard or technology for animal identification and traceability, exporting countries might follow suit. While a trend toward using RFID technology has already been observed in the past, it remains to be seen how the USDA's decision to require a particular RFID ear tag for the NAIS for cattle affects the other two NAFTA countries. Similarly, where comparable industry characteristics allow such a transfer, successful traceability systems may serve as models for other countries and industries. However, it is doubtful that relatively small, homogeneous and heavily export-oriented sectors where we currently observe the most advanced traceability systems will be functioning models for heterogeneous sectors in large countries. Where sectors are integrated through substantial trade flows a standard developed in one country might be more readily adopted in the other. Although no information about its implementation in the U.S. cattle industry is available yet, the standards developed by Canadian Cattle Identification Agency (CCIA) for the Canadian Cattle Identification Program have been announced to serve as the basis for a U.S. National Livestock Traceability System run by FoodLogiQ which is headquartered in Durham, NC (FoodLogiQ 2007).

Regulatory Environment of the Livestock Complex

The North American livestock and meat regulatory environment in the past has ranged from the non-existent to the development of localized efforts prohibiting the movement of livestock that were thought to be carrying infectious and damaging animal illnesses. The iconic American cattle drive is believed to have created the need for local prohibitions on passage of cattle suspected of carrying disease, polluting rangelands, and contaminating watering holes as they moved north from Texas in the years following the Civil War. As a result, live animal trade barriers between U.S. states were created. Conflict resolution was simple and direct and the last man standing after the gun fight won. This situation is not historically unique or only in the distant past as evidenced by events in Afghanistan in 2007. In the recent situation, nomadic Afghan tribesmen migrating from high mountain ranges to the central highlands had a blood bath with more than three thousand local people killed over the traditional movement of livestock (reported in the *Kabul Times*, April 3, 2008).

The current live animal regulatory environment is evolving and now includes current practices of branding or otherwise marking animals, visual checking of animals, as well as selective testing for diseases such as tuberculosis and brucellosis, and will likely move to more comprehensive testing for BSE and other livestock diseases. For meat, more testing regimes for a variety of pathogens have been introduced. Visual inspection systems, long the rule for meat inspection, are no longer satisfactory when meat is held for two or more weeks in a fresh state, albeit under atmospheric control and/or in vacuum packed containers.

In an older system swinging sides of meat under refrigeration certainly could also grow unhealthy microbes, but since the outer surface wasn't usually broken, the carcass remained edible and the surface tissue was removed just prior to consumption. Olfactory inspection as well as visual inspection could usually detect most instances of "bad" meat; however, many of the newer disease and food safety threats are less able to be detected by these older methods. The scale of meat packing and breadth of distribution of the products makes recalls very expensive. Recent events have demonstrated that the firm-level costs of product recalls can be so high that the firms cannot continue financially and thus fail.

Future changes in meat inspection will involve a three step process. The first will be more testing at the meat packing level for a greater range disease causing bacteria. Second, an enhanced meat tracking and traceback system to speed recall efforts and narrow the focus and scope of the recalls. The third will involve improved animal management and handling practices on the farm and ranch to reduce the chances of introducing or increasing the ability to contain a disease causing organism. Given the increasing level of trade more port inspections or addition certification of importing country's inspection system can be expected.

In the face of this additional emphasis on inspection and testing, recommendations for GAP and GMP will be needed; however, it is uncertain whether process standardization, process mandates, and regulatory harmonization will contribute significantly to reducing food safety and disease threats. It is somewhat more obvious that individual firms and operators will have to increase the level and quality of practices and processes as the costs of food safety and disease failures can be catastrophic. Thus, private sector insurance premiums for liability insurance are likely to play a large role in dictating "good" practices in the future, and it may be that insurance driven mandates can more efficiently reduce food safety and disease threats (relative to increased regulation) within the North American livestock complex, as well as be more palatable to some industry segments.

Regulatory Integration vs. Market Integration

It has been argued that regulatory integration will be essential for the NAFTA countries to achieve higher levels of market integration (Hahn et al. 2005; Knutson and Ochoa 2007). Regulatory integration implies harmonization of SPS standards, or at least equivalence agreements between the three countries. Furthermore, regulatory integration with other countries beyond the NAFTA region will be required to support broader market integration.

However, questions must be raised as to the feasibility of additional livestock and animal products regulatory integration both within NAFTA and between NAFTA and other countries. Further regulatory integration likely implies process or production standards (Caswell and Sparling 2005). Such standards could dictate acceptable inputs or means of production (Roberts, Josling, and Orden 1999). In a perfectly integrated regulatory system, mandated standards for production, handling, processing or management at all stages along the supply chain would be harmonized across nations. Such standardization has the potential to defeat the purpose of market integration designed to exploit comparative advantages along the supply chain. Process standardization would also be a moving target given shifting consumer preferences and evolving social ethics regarding agricultural animals in the NAFTA countries and beyond. Process standards incorporating HACCP methodologies or regulations that specify time or temperature requirements during food processing seem to be good candidates for harmonization (Caswell and Sparling 2005); however, process standards at lower levels of the supply chain (e.g., cow-calf production, shipping, confined feeding, slaughter) will continue to be elusive and controversial. Furthermore, regulatory approaches to food safety that attempt to standardize processes or production methods are likely to retard innovation and decrease economic efficiency (Unnevehr and Jensen 1999).

Obstacles to Increased Regulation of the North American Livestock Complex

The agriculture section of NAFTA has been controversial since the initiation of the agreement, and is likely to remain so in the future. Similar to the WTO, integration of food and agricultural markets within NAFTA has been limited by special regulatory and technical barriers. Future integration within NAFTA countries is believed to be strongly dependent upon overcoming these barriers through harmonization, increased equivalency or alignment of technical SPS regulations. Increased specialization and exploitation of comparative advantage under NAFTA have led to net economic benefits and positive gains from trade within the NAFTA countries; however, these gains will be limited in the future (and could be eroded) if the three countries do not continue with market integration. Yet, despite widespread (although not unanimous) recognition of the economic opportunities created by NAFTA, additional or even continuation of current market integration will face significant challenges in the future. While economic explanations provide some insight into the nature of these challenges, some of the rationale for opposing current and future market integration may be better understood in socio-cultural and ecological contexts.

Protectionist behavior by individuals, firms, and industries is well understood as a reason to oppose market integration under trading regimes such as NAFTA. It is widely recognized that although there are net positive gains from trade, not everyone (or every firm, or every industry) will benefit from trade. Thus, the potential losers attempt to protect their interests and maintain the status quo. Therefore, economists can understand, explain, and predict protectionist behavior. But, what if the resistance to market integration is more than simply the aggregate of resistance by a nation's losing firms or industries? What if resistance to market integration (including regulatory harmonization) is more deeply founded on fundamental, instinctual, ecologically founded rationale and deep socio-cultural priorities? What is the future of regulatory harmonization and market integration we assume that resistance is deeply imbedded in culture and human instinct, rather than simple protectionist impulses?

Socio-Cultural Position of Livestock Production

The multiple roles of livestock in traditional societies have long been recognized by anthropologists, human ecologists, and other social scientists. In these societies, livestock are mobile stores of wealth and status. And even though the United States has a very advanced economy, livestock continue to be viewed as "banks-on-the-hoof" by many producers (Eastman et al. 2000). For many North American producers, cattle and the land used to produce them are investments, savings, and financial safe-havens. Cattle provide emergency funds, and are also a stable supply of high quality meat for family consumption. Other species such as hogs provide similar benefits; however, the lifestyle values of beef cattle production have been the most thoroughly examined at this point.

Similar to their counterparts in traditional societies, cattle production also can be a source of identity and a socio-cultural touchstone. Gentner and Tanaka (2002) found that half of western U.S. public land ranchers earn less than 22% of their total income from ranching, that a ranch business "profit motivation" is a relatively low-ranked objective for all types of ranchers, and that public land ranchers are strongly motivated to be in ranching for tradition, family, and

lifestyle reasons (i.e., cultural objectives). Pope (1987) concluded that "romance, recreation, the achievement of a desired social status, or simply the maintenance of a family tradition" are the primary motives for many western U.S. cattle producers. Cattle producers in Northern Mexico also express strong cultural and lifestyle reasons for their involvement in the beef cattle industry (Carmona Martinez et al. 2007).

The U.S. cow-calf sector has always been lightly regulated; however, the appearance of BSE in the United States in late 2003 resulted in severe economic impacts to the U.S. livestock sector, and renewed interest in animal health regulatory activity. The result was the NAIS, designed to expand regulation of livestock due to interstate commerce and related movements of pest or disease threats (O'Brien 2006). The NAIS is a technical, command and control, regulatory approach to perfecting the supply chain and preventing market and trade disruptions. At the current time, this regulatory initiative has received significant pushback from a large portion of the U.S. livestock industry, and its future is in doubt (regardless of the pronouncements of the federal and various state governments reporting progress on achieving the goals of NAIS). Contrary to most of U.S. agriculture, the U.S. cow-calf industry has not become highly concentrated nor has it experienced dramatic increases in productivity due to technological advances over the last several decades. It remains a very geographically dispersed industry, and one which includes large numbers of small-scale, non-commercial producers.

Increased regulation of livestock production in the United States through mandatory animal identification and traceability, through process standards, through mandated Good Agricultural Practices (GAP), or other command and control interventions designed to integrate NAFTA livestock complex markets, harmonize North American livestock regulations, and facilitate trade are unlikely to be well received by a majority of cow-calf producers in the United States. This is primarily due to the deeply ingrained socio-cultural aspects of cow-calf production and traditional small-scale lifestyle agriculture in the United States. Opponents of NAIS claim that it is unconstitutional, violates their property rights, invades their privacy, and is a loss of freedom. It is extremely likely that their opinions of additional regulation or NAFTA regulatory harmonization will be similar in nature. NAIS proponents have promoted individual animal identification's role in maintaining international market access and cattle and meat trade flows. This justification has not been well received by many cow-calf producers, who have a strong protectionist streak, and for whom international trade is viewed as a threat to their industry. In their opinion, shutting off beef exports would be a small price to pay for shutting off live cattle imports (e.g., imports with which they directly compete). Loss of freedom through increased and pervasive regulation is likely not viewed as negatively in Canada (MacLachlan 2006). The much higher dependence on external markets for both Canadian and Mexican livestock industries likely softens those producers' antipathies toward regulations believed to increase and facilitate NAFTA market integration, although Mexican cattle producers in the northern states have a long history of animosity toward their federal government.

Thus, increased regulation of live animal production in the United States designed to increase market integration of the North American beef-cattle sector is likely to founder based on the socio-cultural position of beef cattle production. Part of the opposition to NAIS in the United States has been based on the belief that NAIS will not be a structurally neutral regulatory mandate. Small producers believe that NAIS is biased against smaller producers, and is being driven by large-scale feeding and packing interests. Technology mandates (including for the

purpose of improving animal and human health) contributed significantly to structural change in the U.S. dairy industry over the last 50+ years. The drive for modern management and the concurrent adoption of new technologies in the dairy industry have resulted in ever smaller numbers of ever larger dairies; currently, many U.S. beef cattle producers appear to sense the same forces at work with current regulatory efforts designed to integrate markets and facilitate trade. These cattle producers would likely agree with the Darrow Report's basic contention regarding 1930s National Recovery Administration codes, which was that most of the codes had been written primarily by big business and were decidedly advantageous to big business (Goldman 1952).

To assume that the segment of the U.S. livestock complex which resists increased regulation, mandatory standards, and North American market integration will disappear anytime soon is unrealistic. However, it is conceivable that multiple-track live cattle production and marketing systems will eventually arise in the United States, similar to those which exist in other countries, where there are clear distinctions between export and domestic market channels. This type of segmented marketing system would allow the private sector to set performance standards, innovate throughout the supply chain, respond to customer and consumer demands and likely increase economic efficiency beyond that which would exist in a command and control system which seeks to cover every animal and every producer with homogeneous, one-size-fits-all regulations.

Ecology of the North American Livestock Complex

The application of ecological principles to systems other than the natural world is a growing area of study (May et al. 2008; Sheffi 2005). For example, the concepts of resilience, sustainability, robustness, and regime shift are being extended to the financial sector and are providing new insight into how to understand and deal with systemic risk (Kambhu et al. 2007). Systemic risk refers to the risk or probability of breakdowns in an entire system (Kaufman and Scott 2003). Resilience is the potential of a system to resist change, recover, or reorganize from a disturbance. Sustainability is the capacity of a system to adapt and maintain processes, functions, biological diversity (in the case of a living ecosystem), and productivity over long periods of time. Robustness refers to the ability of a complex system to maintain its stability even though some elements or parameters within the system change. Complex systems experience a regime shift when they flip from one relative stable state to another. Regime shifts can happen rapidly, as when a tipping point is reached, or when cascading effects occur.

The concept of resilience also describes the ability of a firm, an organization, an enterprise, or an integrated supply chain to recover and/or increase competitive advantage in the face of disruptions. Resilience within firms, organizations, or industries is developed by increasing redundancy, building flexibility, and changing the corporate culture (Sheffi 2005). Biodiversity helps maintain ecosystem functions through redundancy and through the support of a broad portfolio of organisms. Higher biodiversity implies that a natural system will be better able to recover, evolve, and adapt to change. The parallel to a market system, an industry, or an organization implies that such a system best maintains its functions in the face of shocks when there is redundancy, or a broad portfolio of functions, firms, processes, procedures, and agents. Although there is likely to be a tradeoff between resilience and short-run efficiency, resilient

systems will be better positioned to survive and thrive in the event of low probability, high impact events.

Ecosystems that have a high degree of genetic homogeneity, or characterized as monocultures, are less resilient, less robust, and less sustainable. Crop monocultures are notoriously vulnerable and susceptible to pests and diseases (e.g., Southern Leaf Corn Blight, Irish Potato Famine). Regulatory harmonization implies a regulatory policy that is monocultural, stable, and one that may have an intrinsically high risk of catastrophic failure. Harmonization may mean a resistance to alternatives and to innovation through technical and institutional inertia, as well as reduced evolutionary capacity and resistance to change by vested interests. Regulatory diversity would be analogous to ecosystem biodiversity, and could be expected to provide greater evolutionary capacity of a system, as well as dynamic error tolerance. Theoretically, such a system would be more resilient and sustainable in the face of high impact events.

Many firms, industries, and supply chains within the North American livestock and meat complex have sacrificed resilience for short term gains and are highly vulnerable to severe disruptions. Production and processing of some food and agricultural commodities is becoming increasingly concentrated in a few firms, geographic concentration and specialization continues, and genetic homogeneity is the rule for many products. The drive for process standardization and regulatory harmonization within the North American livestock and meat complex is likely to result in an even more monocultural, less resilient, and less sustainable overall system. The brittleness of the region's livestock and meat complex should be of great concern, due to growing awareness of high impact events that can seriously disrupt the system, and drive firms out of business (especially in light of recent firm failures and subsequent ripple effects).

In retrospect, the occurrence of BSE in North America was inevitable after the disease had been found in Europe. BSE, as an animal and human health threat, or food safety threat, or high impact industry destabilizer, was not a Black Swan (Taleb 2007). Based on Taleb (2007), a Black Swan is an outlier which carries an extreme impact, and which lies outside the realm of regular expectations because nothing in the past can convincingly point to its possibility. Thus, at this point the following question must be asked: Will current efforts to harmonize livestock and meat complex regulations, standardize livestock and meat processes, and integrate markets within the three NAFTA countries provide short-run commercial benefits simultaneously with reduced system resilience and increased vulnerability to Black Swan health or food safety threats that we cannot even imagine at this point in time? Furthermore, are current efforts at regulatory reform and increased regulation in the North American livestock complex akin to generals who are always fighting the last war? Previous "wars" in food safety and livestock disease issues as well as animal identification and traceability "campaigns" have involved the diseases and pathogens discussed at the beginning of this paper. Future food safety threats, and livestock and zoonotic diseases may not be anything like today's known threats. Thus, how well will monocultural regulations, standards, and processes be able to deal with these unimaginable threats?

What Degree of Standardization and Harmonization Is Possible or Desirable?

While "perfect" harmonization of the North American livestock and livestock products complex is probably neither feasible nor acceptable for a variety of reasons (including socio-cultural and industry-ecological), additional progress likely can be made within the NAFTA countries regarding facilitation of trade. In such an environment, the role of good agricultural practices (GAP) and good management practices (GMP) in dealing with livestock disease and food safety issues will likely grow. If so, it will be incumbent on regulators, policymakers, and industry leaders to recognize the differences in livestock and animal product production systems which exist within and between the three NAFTA nations, and the extent to which these differences will impede standardization of GAP and GMP. "Good practices" have many competing definitions as to what is "good", based on climate, natural resources, financial and human capital, technology, consumer preferences, producer attitudes, broad and emerging social ethics and preferences regarding animal welfare and agricultural structure, as well as environmental concerns. Thus, it will be difficult to apply one standard or even a few standards to livestock and animal product production processes throughout the NAFTA region or elsewhere. As noted above, numerous challenges and questions continue to confront animal identification and traceability efforts even though NAFTA countries (and others) have devoted significant resources toward creating and standardizing these systems in recent years. These initiatives represent a large increase in regulation of the region's livestock complex; however, their comprehensive, successful implementation, and their actual efficacy are uncertain. Furthermore, these systems currently are far from comprehensive, functional, harmonized, or standardized (see Appendix I and Appendix II).

The noncommercial nature of much of the North American livestock complex further complicates the role of standards in dealing with livestock-related food safety and disease issues. As noted above, the noncommercial character of the people and producers owning livestock and fowl has impeded disease management in the past and is likely to do so in the future. For example, many non-commercially oriented as well as larger, commercial cow-calf producers in the United States are not convinced that their industry needs international trade or that trade is desirable. These producers are likely to reject recommended practices or standards oriented toward further integration of the North American livestock complex. They are likely to fear the structural impacts of increased regulation, regulatory harmonization within the NAFTA countries, and increased NAFTA livestock and meat market integration. They are also likely to have a low opinion of OIE bureaucrats' prescriptions for their industry. While non-commercial, or small-scale, or non-trade oriented cattle producers may not represent the majority of production, the do comprise a large number of livestock producers. These types of producers may be considered under-performers, and headed for extinction sooner rather than later, but they are a large and vocal part of the North American livestock complex. They have been extremely vocal within the United States in their opposition to industry regulation through NAIS. The extent to which similar pushback could occur in Mexico and Canada is unknown, as the export market orientation of these nations' livestock sectors likely reduces their anti-trade impulses.

Thornsbury and Fairchild (2004) recently addressed the role of consumers in international trade policy by asking if consumers were "kings" or "pawns" in the international food system. If consumers are indeed kings, then the principle of consumer sovereignty would dictate that domestic consumer preferences trump international trade standards. Alternatively, if

consumers are pawns, then trading nations will engage in protectionism under the guise of consumer sovereignty. The proponents of increased regulatory integration and harmonization in the interest of international trade appear to have little interest in consumers as kings, but strong faith in mass manufacturing, mass marketing, and mass attitudes, as well as the ability of regulatory engineering's ability to perfect markets and supply chains (ostensibly for the benefit of consumers, but also providing benefits to some firms). Some futurists claim that many advanced industrial nations are at the end of giant, mass markets and are currently migrating to specialty products and market niches in order to preserve their competitive positions within the global economy (Anderson 2006). Thus, while the North American livestock complex appears to be on the verge of further standardization, commodification, and more concentration, other industries have recognized that consumer values and consumer-driven product customization are their keys to survival. Applying ecological principles to this complex leads to the question of whether additional standardization, commodification, concentration, harmonization, and monoculturization increase the possibility of a breakdown of the entire livestock and animal products system as it confronts new and currently unknown threats. The development of multiple market channels or segments within the North American livestock complex would likely increase the resilience and robustness of the entire system, decrease systemic risk, preserve the cultural values of livestock production at the farm and ranch level, and better meet emerging consumer demands.

Appendix I: Animal Identification & Traceability Systems in NAFTA Countries

Canada

The Canadian Food Inspection Agency (CFIA) is responsible for animal health, in particular for responding to foreign animal disease (FAD) incursions into Canada, as mandated under a number of pieces of legislation, principally the Health of Animals Act and Meat Inspection Act. The CFIA reports to the Minister of Agriculture and Agri-Food (AAFC), and the effectiveness of CFIA activities is assessed by Health Canada. The general guidelines for preparation for and response to animal health incidents are laid out in the Animal Health Functional Plan (AHFP) which describes the division of labor and responsibilities between the Field (District), Region, Area, and National levels (CFIA 2008). To be truly effective, emergency response involves collaboration with other federal and provincial departments, municipalities, stakeholders, and public and international agencies. These collaborations are described in the CFIA Emergency Response Plan and, in the case of an animal health incident, in the Foreign Animal Disease Emergency Support (FADES) Plans that were drafted in conjunction with each province.

Canada has responded to the food safety and animal health challenges through a number of government and industry-led initiatives at the federal and provincial level[3] (Hobbs et al. 2007). The report on traceability in Canada and abroad by Chambers and Rutherford (2007) describes ten such initiatives in the livestock sector, plus six in the poultry sector. The simultaneous activities at federal and provincial levels make it difficult to clearly identify and analyze the 'one' response for each livestock sector for the whole country.

Under the leadership of the Ministry for Agriculture and Agri-Food (AAFC) the concept of a national livestock identification system (NLIS) has been investigated. Starting with the creation of the Canadian Livestock Identification Agency in 2004, a national standards framework has subsequently been completed. Recently, two reports about the benefits and costs of such a system have been released by AAFC (Hobbs et al. 2007; Gardner Pinfold 2007). The original goal was to develop one multi-species traceability system that would host the three pillars of premises ID, animal ID, and movement tracking. However, this goal has been dropped (Axelson 2007), because Canada already has several functioning systems so that duplication of efforts and costs would have been the outcome (see also Highmoor 2006).

In consequence, it has been agreed that the development of livestock and poultry identification and traceability systems will be a collaborative effort by industry and government. The systems will be implemented and managed by industry (Axelson 2007). This includes data base management and control. Since one of the guiding principles in this process is that one species group's actions not jeopardize another species' health status, species groups are collaborating to influence traceability policy and strategies. For the three pillars of traceability systems, the following responsibilities have been agreed.

[3] Actually, all regulatory processes require coordination among the Federal, Provincial and Territorial political entities in Canada. This coordination is usually done through F/P/T (Federal/Provincial/Territorial) Committees. For the sake of brevity, however, we will include the Canadian Territories under the 'Provincial' level.

- Premises ID: provincial governments
- Animal ID: CFIA
- Animal movement tracking: Each species traceability system

The progress in the three pillars varies considerably between provinces. Quebec has been the leading province in this regard, as government and the agricultural producers union have jointly created Agri-Traçabilité Québec (ATQ) which became mandatory in 2001. However, ATQ is not readily compatible with the traceability systems that are emerging in or across the other provinces, as standards and minimum requirements deviate between them.

At the same time the province of Ontario is seeking integration with global standards for premises ID. OnTrace, an industry/government collaboration, announced in March 2008 a partnership with GS1 for integrating the Ontario Premises Registry and the Global Location Standard operated by GS1.

There is agreement that the traceability data can only be accessed for authorized crisis management purposes by authorized users (Axelson 2007) and that linking with product tracking after slaughter is pursued. While the above mentioned initiatives thus deliberately stop short of the business value of traceability, both federal and provincial governments support pilot projects and proof of concept studies and the dissemination of their results to further the practical knowledge and awareness of traceability systems as a business support tool to increase competitiveness (Kittelsen 2008). For example, in 2007/08 the Ontario Ministry of Agriculture and Rural Affairs provided support to 120 operations to implement traceability systems and conducted nine on-farm and eleven post-farm gate pilot projects. In the vast majority of these 140 cases, the Can-Trace Canadian Food Traceability Data Standard Version 2.0 was used.

The Federal Health of Animals Act and Regulations pertain to the Canadian Cattle Identification Program, which is mandatory and enforced by CFIA. Full enforcement of the program by the Canadian Food Inspection Agency, with monetary penalties, began on July 1, 2002 (CCIA 2008). The Canadian Cattle Identification Agency which is in charge of implementing the system was formed in 1998 as an industry-led initiative. Stitt (2007) reported that voluntary uptake prior to enforcement was 65% to 75%. Further, national standards have been or are being developed for premises identification, animal/group identification, identification devices (tags), tag distribution, audits, data reporting, zoning and age verification. For dairy, the National Livestock Identification for Dairy (NLID) is the umbrella organization for the co-ordination of all dairy tagging in Canada, except in Quebec where tags are issued by ATQ. While ATQ maintains its own database in Quebec, NLID uses the CCIA database in the remaining provinces. Although the system covers each animal from birth to export or slaughter (tag/ID number retirement), no animal movements are recorded (Hobbs et al. 2007).

The Canadian Sheep Identification Program (CSIP) was launched on January 1, 2004. It is administered by the Canadian Sheep Federation (CSF). It is a mandatory program and enforced by CFIA. In its Strategic Plan 2006 to 2010 for the CSIP the Federation has outlined the timelines for further program elements on a voluntary basis relating to premises ID and animal movement documentation (CSF 2005). Based on the CCIA data standard and database, CSIP

provides the minimum national standard for sheep identification in the country, except for Quebec where ATQ requirements exceed those of CSIP. While ATQ requires ear tags to be RFID, they are not machine-readable for the rest of the country. The program covers an animal's life from farm of origin to slaughter or export. Animal movements have to be documented for breeding, slaughter (other than to a provincially or federally registered abattoir) and for temporary purposes (e.g., exhibitions, community pastures, vet clinics). Premises ID has been identified as one of the key strategic directions for the CSIP (CSF 2005) but responsibility resides with provincial governments.

The Canadian Pork Council (CPC) and its members are in the process of developing the National Identification and Traceability System for Canadian Hogs with implementation timelines set for 2008 (CPC 2008). While this system is being developed in consultation with CFIA and will become subject to federal regulations, it is not mandatory (Chambers and Rutherford 2007). For producer identification and payment purposes, all hogs are currently identified with a shoulder slap tattoo prior to going to slaughter. As some areas in Canada collect this slaughter information in a database, CPC has recognized the potential of the current tattoo numbering strategy for a national hog ID and traceability system. As part of the current activities for the development of an animal identification and traceability system, the identification and registration of all premises with hogs in Canada has been delegated to the provincial level of CPC membership and initiated in collaboration with the Provincial governments. Further, a swine slaughter database and an ID and traceability movement reporting system is being developed. Provincial pork organizations will be responsible for collecting and verifying these data.

United States of America

U.S. regulations pertaining to traceability reflects the multiple jurisdictions involved in that area and is thus complex. Among the milestones in U.S. traceability requirements for foods are (Chambers and Rutherford 2007; Golan et al. 2004):

- The Meat Inspection Act, Poultry Inspection Act and Egg Inspection Act
- The Public Health Security and Bioterrorism Preparedness and Response Act [Bioterrorism Act] of 2002
- Country of Origin Labeling (COOL), as incorporated in the Farm Security and Rural Investment Act of 2002
- The Organic Foods Production Act

The National Animal Identification System (NAIS) is a cooperative State-Federal-Industry program under the administration of USDA's Animal and Plant Health Inspection Service (Chambers and Rutherford 2007) that is currently being implemented in the United States. Voluntary at the federal level but mandatory in some states, it is being phased in by implementing premises ID, animal ID, and animal movement tracking. The long-term goal of NAIS is to provide State and Federal officials with the ability to identify all animals and premises that have had direct contact with a disease of concern within 48 hours after discovery.

For a more immediate purpose, NAIS is supposed to integrate the various animal health and disease eradication programs at federal and state levels.

The USDA has released three major communication pieces about the program: a user guide, a program standards and technical reference, and a draft business plan. The latter was released in December 2007 and outlines the implementation of NAIS, requesting public comments until April 15, 2008. The official (non-draft) version will then be published in early May 2008. The business plan identifies seven strategy areas for advancing animal health traceability (USDA-APHIS 2007):

1. Prioritize NAIS Implementation by Species
2. Harmonize Animal Identification Programs
3. Standardize Data Elements of Disease Programs to Ensure Compatibility
4. Integrate Automated Data Capture Technology with Disease Programs
5. Partner with States, Tribes and Territories
6. Collaborate with Industry
7. Advance Identification Technologies

Given the complexity of the task, these strategies are primarily concerned with internal implementation and management issues (i.e., within the United States). Market integration and international trade are addressed under the second strategy concerning the harmonization of animal identification systems. The business plan emphasizes the need for standardizing animal identification with trading partners, in particular Canada and Mexico, due to the high degree of integration with the U.S. herd (USDA-APHIS 2007: 28). Further, the Animal Identification Subcommittee that has been jointly established by the North American Animal Health Committee is responsible for ensuring development of a compatible system, based on recommendations from the NAIS Species Working Groups. Finally, the leading role of international standard setting organizations, such as ISO and OIE, is acknowledged. Although no information is readily available about the implications for harmonization of data standards in the international trade context, the following data standards have been agreed upon (Hammerschmidt 2008):

- For premises ID, a 7 character PIN (premises identification number) has been set as the standard location identifier for all disease programs, health certificates (interstate certificates of veterinary inspection, ICVI) and import/export activities.

- For animal ID, a particular RFID tag (840) has been chosen as the only version so that all formerly accepted tags need to be phased out.

Opposite to the situation in Canada, it is stated explicitly by the USDA that the business plan will allow for integration of NAIS with voluntary marketing programs that are certified by USDA's Agricultural Marketing Service (AMS), such as USDA Process Verified, the Quality Systems Assessment and the Non-Hormone Treated Cattle Programs. Using NAIS would allow participants to meet the programs' animal identification requirements and would ensure eligibility of cattle for the AMS Export Verification Program for Japan (World Food Regulation Review 2008: 13).

Furthermore, USDA positions NAIS as helping meet the objectives and requirements of the Country of Origin Labeling (COOL) legislation for domestic sales (Hammerschmidt 2008). Although no final rule for implementing COOL for meat and poultry products has been published yet, USDA has announced plans to coordinate efforts for the development of a COOL "safe harbor" for NAIS participants (i.e., packers that use NAIS to determine the origin of their animal inputs will be recognized as complying with COOL requirements (World Food Regulation Review 2008: 13).

While NAIS is voluntary at the federal level, it can be made mandatory and allows for additional requirements at the state level. The close link between NAIS and animal disease eradication programs is illustrated through the series of bovine tuberculosis discoveries in some states and the USDA response of intensifying implementation of the animal identification system in these states. Despite this elevated relevancy of NAIS at the state level, Kirk (2008) points to the typical challenges of integrating a complex system like NAIS, such as incompatibility among databases and software, in particular after unannounced changes. A comprehensive list of comments concerning the many challenges ahead was compiled as an outcome of the National Institute for Animal Agriculture Annual Conference in Indianapolis (NIAA 2008).

Mexico

The Federal Law for Animal Health is the main piece of legislation regarding the diagnosis, prevention, control and eradication of pests and diseases in terrestrial animals. The Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) is responsible for the organization, coordination and implementation of the activities related to animal health.

The Mexican cattle identification system is organized at two levels. At the state level animal identification numbers are based on the registry and recognition of the hot-brands of each producer and issued with the aim of demonstrating ownership and controlling cattle theft. At the federal level identification numbers on metal ear tags are issued as part of the development of disease eradication campaigns against bovine tuberculosis and brucellosis. This procedure assigns a number to an animal, which is used during zoosanitary surveillance campaigns.

In 2003, SAGARPA launched the National System of Individual Cattle Identification (SINIIGA), linked to a National Livestock Census, as a basic tool for a national traceability system. The National Livestock Census is a database containing the registration of farmers and the production units of all livestock species (UPP) in Mexico to which a unique identification number is assigned. This database to date consists of more than 233,000 registered UPP, and is gradually increasing its scope to include all livestock production units in the country.

The official identification number assigned to each animal will be the only one recognized for registering an animal in official documents such as diagnostic test reports from official animal health campaigns, movements, and export of bovines (Gonzalez Undated). This identification system allows tracking of all movements and changes of locations the animal has during its entire life until export or death. All changes of location must be reported to governmental authorities.

Despite these recent efforts, the ability to trace back live cattle quickly is still limited for cattle exports from Mexico to the United States (Skaggs et al. 2004). The sanitary certificates required by the Mexican government for export of cattle report the animals' points of origin down to the municipio (county) level. Copies of these certificates are kept by USDA's Animal and Plant Health Inspection Service (APHIS), although no formal database for the purpose of subsequent analysis exists. Thus, traceability requires time consuming reviews of individual records.

Appendix II: Animal Identification & Traceability Systems in Other Regions

Australia and New Zealand

Australia and New Zealand both exercise shared State and Federal jurisdiction over agriculture (Chambers and Rutherford, 2007). Both countries have two major regulation regimes in place. The first is the Australia New Zealand Food Standards Code, which requires all food businesses to be registered and to implement Hazard Analysis and Critical Control Point (HACCP) or similarly based food safety schemes. In addition to this general specification, there are primary production and processing standards which are being developed for specific commodities. Second, the Country of Origin Labeling (COOL) requirement is in place as well as the Export Control Act and Orders. The typical 'one up, one down' requirement of traceability is included in all of these standards. It is a criminal offense in Australia (offense in New Zealand) to supply food that does not comply with relevant food standards (Chambers and Rutherford 2007).

Australia has a history of identifying and recording animal movements. In response to bovine brucellosis and tuberculosis, a cattle tracking system was introduced in the 1960s (Australia 2008). Central to this system was a Property Identification Code (PIC) that was aligned to each farm. This system was instrumental in disease monitoring and surveillance. The National Vendor Declaration (NVD) was introduced in 1996 and has been linked to the consignment of the PIC. However, due to government requirements, a separate NVD and tagging system is required for some industries and markets (Australia 2008).

In 1998, the Primary Industries Ministerial Council (PIMC) established the National Livestock Identification Scheme (NLIS) with cooperation of the Commonwealth as well as State and Territory Governments. State and Territory Departments then established and enforced the regulatory requirements of the new system. The Federal Department of Agriculture, Fisheries and Forestry (AFFA) may also establish and enforce regulatory requirements, where export markets are concerned. Under this system, cattle permanently carry a device that is embedded with a radio frequency microchip. The NLIS radio frequency chip (RFID) can be read at abattoirs, saleyards and on-farm. The Australian sheep and goat industry is also heavily involved with the NLIS. The scheme involves sheep being identified with a life-long ear tag containing the PIC (currently RFID exempt) indicating the place of birth. Movement is then traced through the NVD. The Australian pork industry is expected to comply with the NLIS framework by 2009 (Australia 2008).

A recent trend in the Australian livestock sector is the merger of the Livestock Production Assurance Program (LPA) with the NLIS and NVD programs (New Zealand 2006). The LPA is an on-farm food safety and quality assurance program, with standards designed to strengthen systems currently in place for the grass-fed production sector.

In New Zealand, the Animal Health Board operates the National Identification Program for beef and deer. In 2004, the Animal Identification and Traceability Working Group (AITWG) was established in order to assess domestic and international trends in animal identification and

traceability (Australia 2008). The working group has proposed an enhanced animal identification system that would include the unification of the current cattle and deer frameworks, recording all movements of cattle and deer to enable individual animal tracking, and establishing a core database that connects individual animals with properties and people (Australia 2008). It is believed that this infrastructure would be suitable for all other livestock industries but currently it is only planned to be mandatory for cattle and deer.

The industry response in Australia has been mixed. While government funding has greatly reduced the costs of implementing a traceability program, the funding has been correlated with the value of the industry rather than the need for traceability. The risks and potential damage from an outbreak of avian flu are greatest, but not targeted by the NLIS. The projected $20 million of further traceability funding is distributed between cattle ($15M), sheep and goats ($2.5M), and pigs ($1.2M).

Private industry actions, particularly in the poultry industry (with ten businesses), can trace back to a day's production (Australia 2008). However, this type of private initiative is rare, and it is more likely that traceability would not be pursued (or further pursued) by private industries. This is exemplified by the response to the NLIS by the Australia Beef Association (ABA). The ABA claims that legislation does not yet exist to complete the information chain from slaughter floor to consumer, that the previous system was superior, that the promised benefits are calculated from a zero starting point rather than the previous level, that a centralized database does not guarantee integrity and that the industry estimate of implementation costs are five times greater than first suggested (Australia 2008).

The recommendations of the New Zealand traceability working group have yet to be implemented, therefore it is premature to assess the industry response to the proposed changes. However, it is likely that a less developed livestock industry (in terms of traceability) will have a more favorable response than was previously outlined by the producer stakeholders of the Australian cattle industry.

Clearly, the export-oriented nature of Australian and New Zealand agriculture provides great incentives for a common set of standards or regulations for traceability. However, while it is important that exporting countries pursue common standards, this practice is already being pursued by the increasingly competitive market for international food safety and bio-security systems (New Zealand 2006). The integration of food safety standards between the two nations is covered by Food Standards Australia New Zealand (FSANZ). The FSANZ is an independent statutory agency established by the Food Standards Australia New Zealand Act 1991 (FNANZ 2007). The Governments of Australia and New Zealand are involved in the regulatory system which sets the food standards, including animal identification and traceability, for the two countries. The Parliamentary Secretary to the Minister for Health has executive responsibility for FSANZ.

The FSANZ maintains collaborative arrangements with primary producers and processors, manufacturers, retailers, consumer organizations, public health bodies and other stakeholder groups. The key priority of this collaboration is involvement in the Codex Alimentarius Commission (CAC). As exporting nations, the influence of CAC regulations is

vital as they are recognized by the two WTO agreements relevant to food: the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the WTO Agreement on Technical Barriers to Trade (TBT Agreement). Both nations are also involved members of the OIE, GS1 and ISO compliant, and are dedicated to exceed the import standards of all livestock trading partners.

In conclusion, the primary driver for traceability in Australia and New Zealand is foreign market access. This is either because of mandatory regulations, such as the European Food Law and the U.S. Bioterrorism Act, which are setting new benchmarks for traceability system requirements (Australia 2008), or from the perspective of customer specification. Risk management remains a secondary driver for traceability. From a global perspective, Australia's NLIS (and likely the upcoming NZ scheme) is contrasted by the USDA's NAIS system for animal tracking information. The NLIS has a clear government outlined traceability process while the information requirement of the NAIS is designed to promote privatization of traceability methods. This is due to differences in the industry involvement in establishing regulations, in the primary drivers for implementing traceability, and in the need for immediate global coordination.

European Union

Responsibility for traceability is shared between the Commission and Member States (Chambers and Rutherford 2007). Regulation pertains to three areas: general food traceability, animal identification, and labeling requirements. For animal identification and traceability separate sets of regulations exist for the following sectors:

- Bovine (cattle, buffalo, bison)
- Porcine (pigs)
- Ovine and caprine (sheep and goats)
- Equine and equidae (horses, donkeys, zebras and their crossings)
- Pets.

EU Member States have considerable flexibility with regard to developing, implementing, and enforcing their animal identification and traceability systems. Monitoring of these systems is the responsibility of the Food and Veterinary Office (FVO), which carries out about 250 inspections concerning food safety, animal health, animal welfare and plant health in EU Member States and third countries. With 25 Member States and five sectors for which animal identification and traceability is mandatory, 125 annual inspections would be required to cover each sector in each Member State. This would clearly overburden FVO inspection resources. Therefore, enforcement relies heavily on inspection by Member States. In fact, an annual inspection rate of ten per cent of bovine holdings is prescribed to the Member States, which can be lowered to five per cent if a fully operational national traceability data base is in place.

Given the small-scale structure of the EU beef and dairy cattle industries, such levels of inspection rates require enormous efforts. Since it could not be carried out otherwise, inspection for animal identification and traceability is linked with the general compliance inspection of farm

operations to determine eligibility for EU support. Thus, in addition to fundamental differences in motivations for market integration at the political levels in Europe and North America, there appears to be a fundamental difference in the acceptance of monitoring and inspection of farm operations by government agencies, which is an essential component of cross compliance in the EU. Hence, industry resistance and criticism of mandatory animal traceability has been less pronounced in the EU than in North America.

In its 2007 proposal for a new animal health strategy for the EU, the Commission acknowledged the need to adjust existing policy to EU growth, to changing and emerging animal health challenges, to the growth of trade in animals and animal products, and to advances in science and technology (EU 2007). The proposed strategy rests on four pillars:

- Prioritization of EU intervention
- A modern and appropriate animal health framework
- Better prevention, surveillance and crisis preparedness
- Science, innovation and research.

Next to on-farm biosecurity measures, border biosecurity and surveillance, and crisis preparedness and management, animal identification and traceability are elements of the third pillar. The strategy proposal frankly addresses a number of short comings of the current situation (EU 2007: 19), in particular:

- A slow, paper-based system of animal passports and holding registers
- National identification databases that are not connected between Member States.

In order to overcome these shortcomings, the EU has set three objectives for this part of the new animal health strategy:

- The online TRAde Control and Expert System (TRACES) which was implemented in 2004 (EU 2003) and is not yet fully functioning, is to become the single portal for all veterinary matters.
- Interoperability of national identification databases.
- Introduction of electronic procedures and sole reliance on them in the longer term.

Thus, despite overarching EU-wide mandatory animal identification and traceability, it is still a long way to standardization and actual integration in this regard. First, national animal identification and traceability systems vary greatly in their nature and sophistication, and reflect differences in national and industry interests as well as differences in traditions and attitudes. Large scale export-oriented sectors such as the Danish hog industry have the highest level of traceability implemented. Although not an EU member, Norway cooperates closely with the EU on animal health and food safety and has also reached comparable levels of traceability. This is certainly not due to its agricultural sectors' structure or export orientation but rather due to its long history of traceability and quality regulation. Norway has thus set the goal of establishing a national electronic traceability system by 2010 (Kittelsen 2008). Second, the national traceability systems mandated by EU regulation are not connected. Third, the documentation of

traceability for intra-EU trade and imports of animals and animal products is not fully coordinated for quick emergency response due to the lack a fully functioning electronic system. Therefore, the stated objectives of introducing electronic certification to replace paper certification for the movement of live animals and of creating a wider, integrated electronic system with a unified database encompassing all elements of the current system under certification, animal identification, and animal health and welfare status have to be rated as rather ambitious and not achievable in the short run. This is acknowledged in the following statement from the strategy proposal (EU 2007): “The gradual introduction of electronic identification raises the question of how, in the mid to long-term, the different elements of the traceability system for live animals can be combined and an EU integrated electronic system developed. Due to the cost/benefit ratio, small-scale livestock producers face specific challenges to introduce electronic identification. The future system should pay particular attention to the situation of SMEs (small and medium-sized enterprises), building on a thorough impact assessment.”

References

Anderson, C. 2006. *The Long Tail: Why the Future of Business is Selling Less of More*. New York, NY: Hyperion.

Australia. 2008. *Requirements for New Animal Products Traceability Systems*. Report by Government of Australia, Rural Industries Research and Development Corporation.

Axelson, R. 2007. Canada's Multi-Species Traceability Initiative. Presentation at ID · INFO EXPO 2007, Kansas City, August 28-30, 2007. Available online at (accessed April 25, 2008): http://animalagriculture.org/Proceedings/2007IDProceedings.asp.

Boecker, A., R. Herrmann, M. Gast, J. Seidemann. 2004. *Qualitaet von Nahrungsmitteln – Grundkozepte, Kriterien, Handlungsmoeglichkeiten* (Food quality - Basic Concepts, Criteria and Options for Action). Frankfurt: Peter Lang.

Can-Trace. 2006. Canadian Food Traceability Data Standard Version 2.0. Available online at (Accessed April 15): http://www.can-trace.org/portals/0/docs/CFTDS%20version%202.0%20FINAL.pdf.

Carmona Martinez, C., J. Martinez Nevarez, A. Diaz Samaniego, and R. Skaggs. 2007. *Results of a Survey of Cattle Exporters in Chihuahua, Mexico.* New Mexico Agricultural Experiment Station Research Bulletin 794.

Caswell, J.A. and D. Sparling. 2005(January). Risk Management in the Integrated NAFTA Lessons from the Case of BSE. North American Agrifood Market Integration: Current Situation and Perspectives. Huff, K.M. and Others (Eds.), Proceedings of the First North American Agricultural Market Integration Workshop, sponsored by Texas A&M University, University of Guelph, and Colegio de Mexico.

Canadian Food Inspection Agency (CFIA). 2006. Canadian Food Inspection Agency - Foot-and-Mouth Disease Hazard Specific Plan. Available online at: http://www.inspection.gc.ca/english/anima/heasan/disemala/fmdfie/plan/plan-indexe.shtml (accessed on April 14, 2008).

Canadian Food Inspection Agency (CFIA). 2008. Canadian Food Inspection Agency - Animal Health Functional Plan. Available online at: http://www.inspection.gc.ca/english/anima/heasan/man/ahfppfsa/ahfppfsa_1-4e.shtml (accessed on April 14, 2008).

Chambers, A. and S. Rutherford. 2007. *Traceability Initiatives in Canada and Abroad*. Report prepared for On-Trace Agri-Food Traceability Inc. by Monachus Consulting.

Canadian Pork Council (CPC). 2008. *Traceability and Identification - National Identification and Traceability System for Canadian Hogs.* Available online at the Canadian Pork Council website (accessed April 15): http://www.cpc-ccp.com/industry/traceability_e.cfm.

Canadian Sheep Federation (CSF). 2005. *Canadian Sheep Identification Program – Strategic Plan 2006 to 2010*. Available online at the Canadian Sheep Federation website: http://www.cansheep.ca/english/Strategic%20Plan%202006-10.htm#_Toc155861195.

Eastman, C., C. Raish and A. McSweeney. 2000. Small Livestock Operations in Northern New Mexico. In: R. Jemison and C. Raish, Eds. *Livestock Management in the American Southwest: Ecology, Society, and Economics*. Amsterdam, Netherlands: Elsevier Science: pp. 523-554.

European Union. 2003. *TRACES – TRAde Control and Expert System*. Available online (accessed April 25, 2008): http://ec.europa.eu/food/animal/diseases/animo/tracesdc.ppt.

European Union. 2007. A New Animal Health Strategy for the European Union (2007-2013) where "Prevention is better than cure". Available online (accessed April 25): http://ec.europa.eu/food/animal/diseases/strategy/docs/animal_health_strategy_en.pdf.

FoodLogiQ. 2007. FoodLogiQ Announces U.S. National Livestock Traceability System (NLTS) as the Cornerstone of Nationwide Food Safety and Animal Health System. Press release issued at the ID-Info Expo 2007, Kansas City, Missouri, August 28, 2007. Available online at (accessed April 28): http://www.foodlogiq.com/news/pr_pages/FoodLogiQ_082807_NLTS.pdf.

Food Standards Australia New Zealand (FSANZ). 2007. Food Standards Australia New Zealand Website. Available online at (accessed April 22, 2008): www.foodstandards.gov.au.

Gardner Pinfold. 2007. *Costs of Traceability in Canada: Developing a Measurement Model.* Report prepared for Agriculture and Agri-Food Canada by Gardner Pinfold Consulting Economists Limited.

Gentner, B.G. and J.A. Tanaka. 2002. Classifying Federal Public Land Grazing Permittees. *Journal of Range Management* 55:2-11.

Gervais, J.P. and T.C. Schroeder. 2005(May). Structural Implications of Persistent Disharmony in North American Beef and Pork Industries. North American Agrifood Market Integration Workshop II: Agrifood Regulatory and Policy Integration under Stress, San Antonio, Texas.

Golan, E., B. Krissoff, F. Kuchler, L. Calvin, K. Nelson, G. Price. 2004. *Traceability in the U.S. Food Supply: Economic Theory and Industry Studies*. USDA – ERS, Agricultural Economic Report Number 830.

Goldman, E.F. 1952. *Rendezvous with Destiny*. Chicago: Ivan R. Dee.

Gonzalez, J.R. Undated. *SINIIGA y su Relación con las Campañas Zoosanitarias, la Movilización, la Exportación y la Importación de Bovinos*. Available online at: http://www.cnog.com.mx/SINIIGA/Docs/05%20Relacion%20con%20campanas%20zoosanitarias.pdf.

Hahn, W.F., M. Haley, D. Leuck, J.J. Miller, J. Perry, F. Taha and S. Zahniser. 2005(May). *Market Integration of the North American Animal Products Complex*, LDP-M-131-01, U.S. Department of Agriculture, Economic Research Service.

Hammerschmidt, N. 2008. A Business Plan to Advance Animal Disease Traceability - Brief Update. Presentation at the National Institute for Animal Agriculture Annual Conference. Indianapolis, April 1-3, 2008.

Harvey, D.R. 2005. European Perspective on Market Integration: Lessons from NAFTA. Huff, K.M. and Others (Eds.), Proceedings of the First North American Agricultural Market Integration Workshop, sponsored by Texas A&M University, University of Guelph, and Colegio de Mexico.

Highmoor, T. 2006. What's Up with Livestock Traceability in Canada? Comment for the Saskatchewan Beef Industry Committee. Available online at: http://www.skstockgrowers.com/images/E0129301/Traceability.pdf.

Hobbs, J.E., M.T. Yeung, W.A. Kerr. 2007. *Identification and Analysis of the Current and Potential Benefits of a National Livestock Traceability System in Canada*. Report prepared for Agriculture and Agri-Food Canada.

Kambhu, J., S. Weidman, and N. Krishnan. 2007. *New Directions for Understanding Systemic Risk*. Washington DC: The National Academies Press.

Kaufman, G.G. and K.E. Scott. 2003. What is Systemic Risk, and Do Rank Regulators Retard or Contribute to It? *The Independent Review* 7(3): 371-391.

Kirk, K. 2008. Michigan's Mandatory Livestock Identification Program. Presentation at the National Institute for Animal Agriculture Annual Conference. Indianapolis, April 1-3, 2008.

Kittelsen, H. 2008. Helge Kittelsen, CEO Tracetracker Canada Inc., Toronto. Personal Communication, April 21, 2008.

Knutson, R.D. and R.F. Ochoa. 2007 (October). *Status of Agrifood Regulatory Coordination Under the North American Free Trade Agreement*. United Nations ECLAC Office in Washington Studies and Perspectives Report #1. Washington DC.

LeRoy, D., J. Weerehewa, and D. Anderson. 2005(May). Disruption in the Supply Chain for Beef and Pork: What Has Happened and What Was NAFTA Doing? North American Agrifood Market Integration Workshop II: Agrifood Regulatory and Policy Integration under Stress, San Antonio, Texas.

MacLachlan, I. 2006. The Historical Development of Cattle Production in Canada. Unpublished manuscript. Available online: http://people.uleth.ca/~maclachlan/.

Marchand, L. 2007. Quebec's Comprehensive Traceability System: A Real World Solution. Presentation at ID · INFO EXPO 2007, Kansas City, August 28-30, 2007. Available online at (accessed April 25, 2008): http://animalagriculture.org/Proceedings/2007IDProceedings.asp

May, R.M., S.A. Levin, and G. Sugihara. 2008. Ecology for Bankers. *Nature* 451 (21 February): 893-895.

National Research Council (NRC). 2005. *Animal Health at the Crossroads: Preventing, Detecting, and Diagnosing Animal Diseases*. Washington DC: The National Academies Press.

New Zealand Trade and Enterprise. 2006. Traceability: A platform for product knowledge and value.

National Institute for Animal Agriculture (NIAA). 2008. NAIS Business Plan Comments - Submitted through a cooperative effort of the participants of the National Institute for Animal Agriculture ID-Info Expo 2008. Indianapolis, April 3, 2008.

O'Brien, D. 2006(October). Animal Identification and the Next Farm Bill. University of Arkansas School of Law, National Agricultural Law Center. Available online: http://www.nationalaglawcenter.org/assets/articles/obrien_animalid-newfarmbill.pdf.

Pope, C.A. 1987. More Than Economics Influences the Allocation of Rangeland Resources. *Choices* (4th Quarter):24-25.

Roberts, D., T.E. Josling, and D. Orden. 1999(March). *A Framework for Analyzing Technical Trade Barriers in Agricultural Markets*. Technical Bulletin No. 1876. U.S. Department of Agriculture, Economic Research Service, Market and Trade Economics Division.

Sheffi, Y. 2005. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. Cambridge, MA: MIT Press.

Skaggs, R., R. Acuna, A. Torell, and L. Southard. 2004. Live Cattle Exports from Mexico into the United States: Where do the Cattle Come From and Where Do They Go? *Choices Magazine* 15(1).

Sparling, D. and J.A. Caswell. 2005. Integrating NAFTA Animal Health Regulations: A Case Study Analysis. Paper presented at the International Conference on Sanitary & Phytosanitary (SPS) Risk Assessment Methodology. Washington DC, August 9-11, 2005. Available online at (accessed April 25): http://compepid.tuskegee.edu/RiskConference/proceedings.htm.

Stitt, J. 2007. The Canadian Livestock Traceability System – Industry Initiated, Industry Led – Protecting the Health and Safety of our Livestock Industry, Protecting Industry. Presentation at ID-Info Expo 2007, Kansas City, Missouri, August 28, 2007. Available online at (accessed April 15): http://www.animalagriculture.org/proceedings/IDINFOEXPO2007/1%20Tuesday/1%20Opening%20General%20Session/2%20Julie%20Stitt.pdf

Taleb, N.N. 2007. *The Black Swan: The Impact of the Highly Improbable*. New York, NY: Random House.

Thornsbury, S. and G. Fairchild. 2004. King or Pawn? Consumer Preferences in International Trade. *Choices* (1st Quarter): 35-37.

Unnevehr, L.J. and H.H. Jensen. 1999. The Economic Implications of Using HACCP as a Food Safety Regulatory Standard. *Food Policy* 24(6): 625-635.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS). 2005. USDA to Participate in North American Animal Disease Exercise. News Release by United States Department of Agriculture's Animal and Plant Health Inspection Service, March 18, 2005.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS). 2007. A Business Plan to Advance Animal Disease Traceability. USDA – Animal and Plant Health Inspection Service. Available online at (accessed on April 25, 2008): http://animalid.aphis.usda.gov/nais/index.shtml.

U.S. Department of Agriculture, Economic Research Service (USDA-ERS). 2008. USDA-ERS Briefing Room WTO. Available online: http://151.121.68.30/Briefing/WTO/.

Vallat, B. 2008. Animal identification and product traceability from the farm to the fork must be progressively implemented worldwide. Editorial from the OIE Director General (April 4, 2008). Available online at: http://www.oie.int/eng/edito/en_lastedito.htm; accessed April 21, 2008.

World Food Regulation Review. 2008. Incorporating International Food Safety News. Volume 17 (11, April 2008).