International Food and Agribusiness Management Review
Volume 12, Issue 2, 2009

Lessons from the Canadian Cattle Industry for Developing the National Animal Identification System

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Abstract

The primary focus of animal identification programs, which are rapidly developing throughout the world, is to effectively respond to animal health emergencies that have the potential to cause devastating consequences to animal and public health. Additional benefits of an animal identification program include maintaining or expanding international trade, increased consumer confidence, and improved supply chain management. The primary objective of this paper is to provide a series of recommendations for the U.S. to consider as it continues to develop the National Animal Identification System. The secondary objective is to explain how some progressive operations, spanning all sectors of the live cattle and beef industry supply chain complex in Canada, have utilized the technology of the mandatory cattle identification program to improve management intensity.

Keywords: Animal Identification, Canadian Cattle Identification Agency, National Animal Identification System

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Introduction

Incredible population and economic growth in developing regions of the world and their need for animal protein has spurred export market expansion in order to capitalize on these opportunities. However, to expand export markets, it has been necessary to liberalize international trade practices. As a consequence, live animals and animal products—as well as people—are crossing international borders at unprecedented levels. The risk of introducing a foreign animal disease into the U.S.—via an unintentional circumstance or an intentional terrorist event—has increased significantly over the past decade. History has demonstrated that even countries with well-established disease prevention and response programs are not impervious to outbreaks or their debilitating repercussions. More importantly, their experiences have shown that appropriately developed farm-animal identification programs can significantly enhance disease eradication efforts. Such information systems can be used to facilitate more informed decision-making during difficult times.

Animal identification programs can enable animal industries and their partners to respond rapidly and effectively to animal health emergencies; support ongoing disease control and eradication programs; protect and, potentially, expand important export markets by satisfying the growing demands of trading partners for access to animal health-related information; protect domestic markets, as well as consumer confidence; and, above all, protect animal health and minimize the hardships associated with an animal disease outbreak (USDA-APHIS, 2007). Furthermore, animal identification programs—developed with consideration for the needs of animal production industries—will encourage the integration of this technology into everyday business operations, which can help management personnel become more responsive, flexible, and effective in dealing with industry changes. The Canadian cattle industry has operated with such an identification program since 2001.

Canada and, specifically, the Canadian cattle identification program was chosen for this study because of Canada's proximity to the U.S.; for the many production similarities that exist between the two countries; and, because the highly integrated cattle industries in Canada and the U.S. function very much like a single market. The primary objective of this paper is to provide a series of recommendations for the U.S. to consider as it continues to develop the National Animal Identification System (NAIS). The secondary objective is to explain how some progressive operations, spanning all sectors of the live cattle and beef industry supply chain complex in Canada (excluding the province of Quebec), have utilized the technology of the mandatory cattle identification program to improve management intensity. The information presented in this study was largely collected during a trip to Canada in June 2007. Interviews and site-visits were completed for a number of operations, which included the Canadian Cattle Identification Agency (CCIA),

cow/calf producers, feedlot operators, and beef packing plants. Agri-Traçabilité Quebec, which is the organization in the province of Quebec that is responsible for administering the mandatory identification and traceability system of Quebec agri-food products, was excluded from this study because, although it operates with a certain level of autonomy, it still concedes authority to the CCIA on national identification and traceability issues. A review of the Agri-Traçabilité Quebec animal identification system can be found in Murphy et al. (2008).

This paper begins with a review of the existing status of NAIS in the U.S., followed by brief reviews of bovine spongiform encephalopathy (BSE) in Canada and of the development of the CCIA. These sections are then followed by a discussion of how the Canadian cattle identification program has impacted traditional management practices and enhanced the ability of some firms to manage operations with greater efficiency and intensity. Finally, a comparison of the U.S. and Canadian beef industries is presented, followed by a series of recommendations for consideration by the U.S. as it continues to develop NAIS.

Animal Identification and Traceability Systems in the United States

The U.S. has utilized cattle identification programs since the 1940s as part of an effort to eradicate brucellosis from the national cowherd. However, as the disease neared eradication the need for a control program disappeared and the program was scaled-back without an identification system in place to finish the program (USDA-APHIS, 2005). In 2003, the first draft of the U.S. Animal Identification Plan, the product of a government and industry collaboration, was released, thereby establishing the foundation for NAIS (USDA-APHIS, 2005). The USDA initiated the implementation of NAIS in 2004 shortly after the discovery of the first U.S. case of BSE in Washington State in December 2003. According to Murphy et al. (2008), NAIS was originally written as a mandatory program, but in the face of strong opposition, the USDA changed directions and published a revised "User Guide" in November 2006, which stated that NAIS would become a voluntary program at the federal level (USDA-APHIS, 2007). Today, NAIS remains voluntary at the Federal level and is administered by Veterinary Services of the USDA-Animal and Plant Health Inspection Service (APHIS). Smith et al. (2005) reported that the U.S. is "lagging behind many countries in developing traceability systems for food in general and especially for livestock, poultry and their products (page 174)."

Premises registration, the foundation of NAIS, was originally targeted for 100% compliance by 2009, but the USDA conceded that the decision to pursue a voluntary animal identification program would likely make this goal unattainable (USDA-APHIS, 2006). According to USDA-APHIS (2007), approximately $118 million in Federal funds to develop and implement NAIS had been made available by the end of fiscal year 2007, of which roughly 60% of these funds were administered to States and Tribes to carry out NAIS activities at the local level.

There are currently no mandatory beef traceability systems in the U.S., but voluntary traceability systems, such as USDA Process Verified and USDA Quality System Assessment Programs, are growing in popularity as firms along the beef supply chain try to satisfy consumer demands for more information about the origin, production, and processing of their food products (Souza-Monteiro and Caswell, 2004; Smith et al., 2005).

Bovine Spongiform Encephalopathy in Canada

Canada has used animal identification programs since the 1920s to contain outbreaks of foot-and-mouth disease and to eradicate bovine brucellosis and tuberculosis from the national cow herd. The program was decommissioned in 1985 and traceability remained inactive until 1990 when the National Advisory Board on Animal Health was created to assess the vulnerability of the Canadian livestock industry to animal health-related concerns, such as the BSE crisis that had emerged in the United Kingdom (Canadian Livestock Identification Agency, 2005). Per the suggestions of the National Advisory Board, Agriculture and Agri-Food Canada (Canadian equivalent to the USDA) implemented a national BSE surveillance program in 1992.

In 1997, the U.S. and Canada enacted similar preemptive feed bans to prohibit feeding ruminant-derived protein (i.e., ruminant meat and bone meal) back to ruminant animals as a strategy to reduce the risk and, ultimately, to prevent the unintentional spread of BSE. However, on May 20, 2003, Canada reported its first case of indigenous BSE. Shortly thereafter, on December 23, 2003, the U.S. reported its first case of BSE in Washington State that was later traced back to its Canadian herd-of-origin. At the time of the researchers' visit, Canada had reported 10 additional cases of indigenous BSE and the U.S. had reported two additional cases of the disease—both indigenous—in cows thought to be from Alabama and Texas.

Investigations into Canada's other cases of BSE revealed that some of the animals that tested positive for the disease were born after the feed ban was enacted (Sanderson and Hobbs, 2006; Canadian Food Inspection Agency, 2007). Furthermore, epidemiological evidence indicated that an extremely low level of infectivity persisted in Canada's feed system during the late 1990s and early 2000s (Canadian Food Inspection Agency, 2007). It was presumed that poor initial compliance and weak enforcement of the ban permitted the feeding of banned materials after the ban-enactment date, which caused the cases of BSE in cattle that were born post-feed ban (Sanderson and Hobbs, 2006).

The Canadian cattle industry is so heavily dependent on export markets (i.e., 50% of live cattle sold in Canada pre-BSE were exported as either live animals or meat

[Boame, Parsons, and Trant, 2004]) that when the U.S. and other international markets closed their doors to live cattle and beef products on May 23, 2003 due to fears of BSE—live cattle prices fell into a devastating tail-spin. Fed cattle prices in Canada fell 65%, from $108 (CAD) per hundred-weight in April to $38 in July (Livestock Marketing Information Center, 2008). Boame, Parsons, and Trant (2004) reported that in 2002, 99.6% of Canadian live cattle exports and 84% of Canadian beef exports went to the U.S.

The loss of valuable export markets for Canadian beef products following its first case of BSE, compounded with Canada's dependence on these foreign markets, prompted the Canadian Food Inspection Agency (CFIA) to enhance the feed restrictions of the original 1997 feed ban. The new regulations prohibit the inclusion of bovine specified risk materials (SRMs) in all animal feed, pet food, and fertilizer (Canadian Food Inspection Agency, 2007). The "enhanced feed ban" became effective on July 12, 2007. Its primary goal is to prevent more than 99% of potential BSE infectivity from entering the feed system.

Keddy (2008) said that under the enhanced feed ban, Canadian beef packers must segregate and dispose of SRMs at a cost ranging from $10 to $50 per head. The U.S. Food and Drug Administration's enhanced feed ban was published on April 25, 2008 and will take effect on April 27, 2009. The new feed regulations prohibit certain cattle-derived materials such as the brains and spinal cords from cattle 30 months of age and older (among other identified materials) from being included in the food and feed of all animals (DHHS-FDA, 2008). Dessureault and Myles (2008b) reported that the Canadian cattle industry is lobbying the government of Canada to harmonize its feed ban regulations with those of the U.S. in order for Canadian beef packers to remain competitive. It is argued that Canada's more stringent feed ban regulations, which ban more SRMs from feed than does the U.S. rule (and also applies to fertilizer, while the U.S. rule does not) put Canadian beef packers at a competitive disadvantage with U.S. plants (Dessureault and Myles, 2008b).

In early 2008, a producer-owned cull cattle packing plant in Ontario, which started operations during the BSE crisis, filed for bankruptcy due to unfavorable financial conditions. The company reported that one of the contributing factors which led to its demise was the rigorous SRM regulations that imposed additional costs on Canadian plants that provided American processors a $39 (CAD) per cow cost advantage (Dessureault and Myles, 2008a). In addition to the aforementioned plant in Ontario, the costs of complying with the new regulations also have been noted as contributing factors in the closure of cattle producer-funded beef plants in Alberta and Quebec that started operations post-BSE (Keddy, 2008).

The Canadian Cattle Identification Agency

The CCIA was incorporated in 1998 as a collaborative effort between the Canadian beef industry and the CFIA to proactively protect the safety and integrity of the Canadian cattle herd. It achieved full operation as a voluntary program in 2001. The CCIA began—and remains today—an industry-owned, industry-led initiative, operating as an independent subsidiary of the Canadian Cattlemen's Association with a board of directors representing all sectors of the Canadian cattle industry. The CFIA, as well as government officials from Agriculture and Agri-Food Canada and other pertinent federal agencies, serves on the CCIA's board, but all serve as non-voting members. Lawrence et al. (2003) states that the Canadian government is responsible for enforcing industry participation and compliance, and has the authority to access the CCIA's database for animal health investigations. The history and development of the CCIA are explained in greater detail in Murphy et al. (2008).

The CCIA became a mandatory program on July 1, 2002. Under the mandatory program, all bison, cattle, and sheep leaving the herd-of-origin or upon importation into Canada are required to bear an official CCIA ear tag. McConkey (2007) explained that the CCIA was developed at a total cost of $4 million (CAD), which was absorbed by the Canadian government, and is able to retain its self-sufficient autonomy by collecting $0.20 from the sale of each ear tag—regardless of the ear tag purchase price—to cover administrative costs.

In September 2006, the CCIA transitioned from visual dangle-tag bar code technology to radio frequency identification devices (RFID). To facilitate this transition, bar code tags were recognized in young animals until December 31, 2007, and will be recognized indefinitely on mature breeding stock (Stitt, 2007). Under rare occurrences, when cattle mistakenly bear both a bar code tag and an RFID tag, the bar code tag takes precedence as it is assumed that it was applied first (McConkey, 2007). Initially, a 5% allowance for lost CCIA tags was acceptable, but following the first case of BSE in 2003, this policy was changed to zero-tolerance (McConkey, 2007). One exception to the zero-tolerance policy applies to cattle arriving at packing plants without proper CCIA identification because it is possible that tags could be lost during transport and, under such conditions, it would not be feasible to re-tag animals (McConkey, 2007).

As an industry-led initiative, the CCIA has the innate ability to conform its services to satisfy ever-changing market demands. Cow/calf producers can submit birth date information to the CCIA database to age-verify their calves using one of two options, which acknowledges the different levels of management intensity practiced in the industry (McConkey, 2007). Producers can submit birth date information for individual calves or for a group of calves.

The CFIA recognizes CCIA birth certificates as an alternative to dentition for age-verification of domestic meat, as well as for live animal and meat exports (McConkey, 2007). Purebred registration papers, as stand-alone documents, are not an accepted alternative to birth certificates for age-verification. Purebred animals must be verified by the CCIA. However, registration papers can provide supporting information should a discrepancy arise to avoid unnecessary over-thirty-months of age designation (McConkey, 2007). Auction markets, feedlots, packing plants, and producers can query the CCIA database for birth certificates, but during the queries, no identifying information (i.e., herd-of-origin) is released and users are unable to search for random information (McConkey, 2007).

McConkey (2007) explained that when an animal dies, either on-farm (with disposal on-site or at a rendering plant) or harvested at a packing plant, the responsible party is required to "retire" the individual tag numbers within 30 days of the event using one of three approved electronic reporting methods: (1) direct retirement using the CCIA web service; (2) electronically submit a Microsoft Excel® spreadsheet file to the CCIA, which is then entered into the database by CCIA office personnel; or (3) use CCIA web service programming to connect to private databases through the internet using a back-door approach to retrieve and retire tag numbers[1]. Originally, the CCIA permitted producers and small abattoirs to retire tag numbers by submitting (by phone or fax) the required information, but as part of their mandate to move to total electronic reporting, they have discontinued this service. Producers that do not have access to the internet can assign a third-party to submit animal records on their behalf (McConkey, 2007).

The CCIA was developed using the "bookends" analogy; with the birth record representing the left bookend and the reporting of animal death or export (tag number retirement) representing the right bookend. More specifically, the CCIA is a farm-of-origin to point-of-slaughter, -export, or -death cattle identification and traceability system (Lawrence et al., 2003). Identity preservation of individual animals beyond the point of harvest (i.e., as meat) is not mandatory, but as will be explained in the following sections, is a service that some firms in the beef industry are developing in order to satisfy consumer concerns about the source of, and/or the use of specific production-practices in generation of their food. McConkey (2007) believed that the bookends approach accounts for 90% of the pertinent details of traceability while the remaining 10% of traceability accounts for 90% of the work. Additionally, McConkey (2007) believed that incorporating the bookends approach with feedlot reporting of animal movements would account for 99% of the pertinent details of cattle traceability. In other words, he believed that filling in the information between the bookends, which would most likely be achieved through animal movement reporting, would place a heavy burden on cattle producers that would disproportionately outweigh the gains achieved in traceability. Smith et al.

[1] Tag number "retirement" is the Canadian equivalent to tag number "termination" in the U.S.

(2005) said that "it is easy to identify, very difficult to accomplish traceability, and even more difficult to verify identity, traceability and claims about livestock and meat (page 176)."

Cattle Industry Interviews and Site Visits

The cattle industry in Canada has had to endure tremendous adversity over the past few years as a result of the occurrence of BSE and, more recently, because of labor shortages due to unprecedented expansion in the oil and gas industries, as well as because of a rapidly appreciating Canadian dollar.

Cow/Calf Operations

From the moment the CCIA was created, outspoken criticism by mainly cow/calf producers and auction market operators questioned the need for, and relevance of, an identification system (Lawrence et al., 2003). However, following the discovery of a case of BSE in May 2003, most of the vocal opposition quietly changed to cautious optimism as cattlemen hoped that the Canadian cattle identification program would expedite the reopening of international markets to Canadian beef. Murphy et al. (2008) states, "although the influence that the CCIA had on expediting the normalization of foreign beef markets might not be known, there is general consensus within the Canadian beef industry that it was an invaluable tool during the BSE investigations (page 281)." Furthermore, Murphy et al. (2008) believed the existence of the CCIA sends a very clear message to the world that Canada takes the identification and traceability of its animals very seriously. Lawrence et al. (2003) and McConkey (2007) believed that the CCIA was a valuable tool in the trace-back of infected animals to their herd-of-origin and the trace-forward of potentially exposed herd-mates and offspring away from the herd-of-origin. It also facilitated the trace-back of the BSE-positive cow found in Washington State to its herd-of-origin in Canada.

The interviewed cow/calf operations indicated that the use of RFID tags and its associated technology had improved the efficiency of managing and maintaining production data because it enabled them to electronically record mating choices, vaccination protocols, calving and veterinary records, as well as any other information they deemed important to herd management. Furthermore, individual histories were created for each cow, which they used to identify animals with low fertility, dystocia problems, poor milking, etc., for culling from the herd. They strongly believed that managing animal records electronically improved their profitability by identifying inferior cows and sires faster than a traditional paper-based record management system. Overall, it was clear during the interviews and site visits that the more progressive cow/calf producers (and feedlot operators) were exploiting the benefits of the cattle identification program to stream-line collection

and analysis of production data, which enabled them to make more effective and efficient management decisions.

Cattle Feeding Operations

Depending on the operation, in Canada, the first tag number entry for each animal occurs when the animal arrives at the feedlot. RFID panel readers located on the loading/unloading chutes automatically record the CCIA tag number for each animal. It was explained that this initial step facilitated easier load-number reconciliation, electronically identified the origin of the shipment, and created the basis for individual animal passports or feeding histories, which minimized unintentional transcription errors of animal data and significantly reduced labor costs associated with collecting and managing this information. One feedlot manager explained that their operation did not practice an "all-in, all-out" philosophy when marketing their finished cattle and used individual animal passports to identify cattle that were mixed with different groups during the latter stages of finishing.

Cattle that arrive without proper CCIA identification are given a new tag and that number is reported to the CCIA with any identifying information (i.e., owner, herd-of-origin, etc.) that is available to the feedlot. The cost of purchasing and administering the new CCIA tag is transferred back to the animal owner. Similar to what is done by the progressive cow/calf operations, the feedlots also electronically record vaccination and growth implant protocols, as well as veterinary medical records, which are used to satisfy the verification requirements of different feeding programs (e.g. "Never Ever 3" and organic beef program cattle) [2]. The protocols initiated by these Canadian feedlots for managing animal records are very similar to the record keeping requirements of USDA Process Verified and USDA Quality System Assessment Programs.

When finished cattle leave the feedlots, they are identified upon exit by the same RFID-panel readers located on the loading/unloading chutes that initiated their passport on arrival. This method is used to not only identify the animals that are destined for harvest each day and to automatically record their CCIA tag numbers, but it also circumvents the need to excessively handle and stress finished cattle before loading. Absolute reconciliation of CCIA tag numbers occurs at the packing plant and is reported back to the feedlot.

[2] According to USDA-AMS (2007), the "Never Ever 3" marketing program, which would be applied under an approved USDA Process Verified Program, is a verified marketing claim that guarantees a said program animal did not, at any point in its life, receive antibiotics, growth promotants, or animal by-products (mammalian or avian). Any animal that receives or is fed any of the "Never Ever 3" components must be identified as non-conforming and removed from the program (USDA-AMS, 2007).

Cattle Packing Plants

In the aftermath of the BSE crisis in Canada, some of the cattle producers frustrated with the lack of progress in reopening international markets to exports of Canadian live cattle and beef products, decided to invest in ventures that would reduce their dependency on the U.S. Several state-of-the-art, vertically-integrated beef packing plants were built across the country with money that was invested by producers who purchased shares in the company and, in return, were guaranteed "hook space" for their animals. The number of "hooks" each producer was guaranteed was correlated to the number of shares they purchased in the company. However, delayed access to important export markets, ever-increasing input costs, severe labor shortages and—consequently—the need to pay higher wages to attract and retain employees, as well as a rapidly appreciating Canadian dollar has put the financial stability of many of these operations into question.

Packing plants, ranging in daily slaughter capacity from several hundred to several thousand head, were toured and their management personnel were interviewed to clarify the process of integrating the Canadian cattle identification program into their daily operations. Likewise, it was important to establish if and how management used the mandatory identification program to improve production and distribution efficiency.

At each plant, an employee on the line was responsible for hand-scanning the CCIA bar code tags and for re-scanning any RFID tags missed by the panel reader that was positioned ahead of the workstation and immediately following stunning and exsanguination. If an animal did not have a tag, an arbitrary carcass identification number was assigned to the animal for in-house production records. All of the plants that participated in the study practiced real-time age-verification. Company computer systems would query the CCIA database for birth certificates, and responses were usually received within seconds of the initial query. Specifically, CCIA tag numbers were scanned after exsanguination and, by the time the carcass crossed the hot-weight carcass scale and was assigned a carcass tag, the birth date of that animal was available to be printed on the carcass tag.

A few of the more modern facilities (or those that had been renovated recently) used carcass rail trolleys embedded with RFID-microchips to maintain individual animal identification up to and, for some plants, past the point of fabrication. The carcass identification number was cross-referenced with the trolley RFID number at numerous points during processing and the trolley RFID number was used to identify carcasses at fabrication.

Several packing plants were electronically recording quality grades and yield grades, as well as chilled-carcass weights for each carcass at the chilled-carcass weight scale. This information was entered into the company's computer system by

an employee working at the scale, which was then reported—electronically—back to producers to assist with future management decisions. This step was completed by the packing plants with minimal effort due to the electronic identification.

In one packing plant, RFID-embedded carcass rail trolleys were scanned upon entry to the fabrication area and, using mechanized cutting boards embedded with RFID-microchips, was able to maintain the identity of each muscle-cut from an animal to a single box of product. A comparable trolley-tracking system for edible offal (e.g., liver, heart, tongue, etc.) retained the identity of such product destined for export. At retail, consumers could enter a number from the box label into the company's website and identify the ranch, feedlot and packer that produced that product.

In an assessment of traceability in the U.S. food supply, Golan et al. (2004) reported that financial incentives—and not government regulations—were the main drivers behind private sector endorsement of traceability systems. They concluded that private firms implemented traceability systems to improve supply chain management and coordination, to increase safety and quality control, to reduce recall expenses, and to expand sales of high-value products. At the time of our visit, one packing plant was sharing the rewards of traceability with their cattle suppliers by paying a premium for age-verified cattle.

A few packing plants also used the CCIA tag numbers to facilitate payment to producers that sold cattle on grid-value systems or for cattle that were designated to "Never Ever 3" and organic beef programs. Tag-loss rates within lots of cattle were recorded because quality and/or program information for animals without CCIA tags had to be entered manually into a computer before payment could be issued to the selling parties. The observed tag-loss rates were reported to the CFIA for review and enforcement purposes.

Comparisons of the U.S. and Canadian Cattle Industries

In consideration of the recommendations we present for developing NAIS, which are based upon our review of the Canadian cattle identification program, it is necessary to provide a fair comparison of the cattle industries in each respective country. In terms of size, the U.S. cattle industry is significantly larger. According to USDA-NASS (2008), in 2007 the U.S. had: approximately 757,900 beef cow operations, 32.9 million beef cows, and an average herd size of 43 head. The total inventory for cattle and calves was 97.0 million, and 34.3 million head of cattle were slaughtered in commercial facilities in 2007.

In contrast, Canada has 60,947 beef cow operations, almost 4.9 million beef cows, and an average herd size of approximately 80 head (Statistics Canada, 2006; Canfax, 2008). Canada's total inventory for cattle and calves was 14.3 million, and 3.4 million head of cattle were slaughtered in 2007 (Canfax, 2008). In addition,

Canada exported to the U.S. almost 825,000 cattle for slaughter and roughly 516,000 feeder cattle and calves in 2007 (Agriculture and Agri-Food Canada, 2007).

Compared to cattle production in the U.S., the Canadian cattle industry has significantly fewer operations and, consequently, fewer people to educate about implementing an animal identification program. Furthermore, because exports make up a large proportion of total Canadian beef production, the average producer is probably more aware of the changing dynamics of the international beef trade and is probably more willing to implement changes that are needed to secure access to these important markets than a typical U.S. cattle producer, where exports are a smaller portion of the U.S. beef industry.

Recommendations for Implementing the U.S. National Animal Identification System

Based upon our observations of the Canadian cattle identification program, we offer a series of suggestions for the U.S. to consider as they continue to develop the National Animal Identification System (NAIS):

- NAIS should eventually be mandatory;
- A phase-in implementation of NAIS should be initiated;
- A national database should be developed to avoid database and regional differences that could create unnecessary confusion;
- Radio frequency identification device (RFID) technology should be standardized and specific requirements should be established for tag manufacturers to meet or exceed in order to be eligible to sell official NAIS tags;
- NAIS should be harmonized between North American Free Trade Agreement (NAFTA) partners to extend their potential value across borders.

Identification programs are a partnership that begins with producer participation and acceptance. If one of these elements is missing, the integrity of the entire program is disrupted. Unfortunately, producer participation needs to be mandated. It was reaffirmed by many of the interviewees that if participation in the CCIA became voluntary tomorrow—compliance would plummet. According to Lawrence et al. (2003), cattle identification in Canada declined from roughly 95% during the brucellosis eradication program to around 10% shortly after the program was decommissioned. Voluntary participation permits holes to exist within the information system that could seriously compromise its ability to respond to an animal disease outbreak. Furthermore, we believe that as the program establishes itself and producers become more receptive to its existence, the secondary merits of NAIS, which are intended to improve management practices, will become more evident to producers, and acceptance will grow.

Secondary benefits of a mandatory animal identification system that were observed in this study included age-, source- and process-verification, the ability to collect, store and analyze live animal performance data in an electronic format, and the ability to link carcass data to individual animals. Furthermore, some of the more progressive firms reported that the CCIA traceability system has improved inventory management and has reduced labor costs associated with handling and analyzing production data. Therefore, it is believed that the integration of these services into management practices could result in significant improvements in the management of supply chains that, as expressed by Golan et al. (2004) and Hobbs (2006), would translate into financial incentives substantial enough to encourage participation in traceability systems even without regulatory intervention. However, Hobbs (2006) characterized the capability of individual firms within the beef supply chain to provide consumers with credence attributes—which are product attributes that cannot be detected visually or evaluated after consumption without labeling—as limited in the absence of congruent information. But by integrating traceability systems with other firms and sectors of the beef supply chain complex, as could be achieved with a national mandatory traceability system, information asymmetries could be resolved easier and product quality and safety assurances could be validated through streamlined certification or verification processes, which would communicate these attributes to consumers with greater cost efficiency and confidence (Hobbs, 2006; Brocklebank et al., 2008). In other words, all sectors (i.e., cow/calf producers, feedlot operators, and beef processors) would have a shared responsibility to work together in a coordinated fashion to ensure credible and complete transfer of information among all firms in the supply chain (Meuwissen et al., 2003; Brocklebank et al., 2008).

Furthermore, it is recommended that NAIS should be implemented as a phase-in program that would evolve to eventually include full industry-wide participation. When the Canadian cattle identification program became mandatory in July 2002, all cattle leaving their current place of production—which was not necessarily their herd-of-origin—required a CCIA tag. For example, feedlots sending finished cattle to harvest were forced to comply with these requirements, even though the "history" for these animals did not extend backward (chronologically) from the feedlot. Forced compliance at the feedlot level was viewed as an unnecessary expense for feedlot owners. It was suggested to the researcher's during an interview that NAIS should be implemented as a three-year phase-in program. The first year of implementation would require cow/calf producers to tag the current year's calf crop before they left the herd-of-origin. The second year would mandate that feedlots and packers accept only animals with official NAIS tags onto their premises. The third and final year of implementation would then extend to all other animals traveling through the system.

The aforementioned benefits would be more attainable to ordinary producers if only one centralized database existed. A single database would reduce confusion among

producers with regard to their obligations for complying with a mandatory NAIS and for shipping cattle into other States with different or more advanced identification programs. Moreover, producers would be ensured equal access to educational and technological support, free animal record transactions, easier reporting of—and access to—information that could improve management decision making (e.g., carcass data), as well as many other efficiencies inherent to a centralized database.

The CCIA, in its infancy, established stringent quality and technology requirements that manufacturers had to satisfy or exceed in order to gain authorized manufacturer status. This initiative, instantly harmonized technology across Canada (excluding Quebec). It eliminated unnecessary confusion relating to compliance responsibilities and encouraged operations to move forward with equipment purchases because it was known that a single set of equipment would function with all tags, regardless of manufacturer.

The final recommendation pertains to the importance of harmonizing NAIS with the pre-existing animal identification programs of its North American Free Trade Agreement partners—Canada and Mexico. Ensuring that each country's technology is compliant with its trading partners would facilitate cross-border exchange of valuable production data (e.g., age-verification, feedlot performance, carcass data, etc.) that would strengthen the integral relationship within the North American live cattle and beef industry supply chain complex. More importantly, harmonized programs would facilitate a quicker response to an animal disease outbreak and, possibly, minimize its deleterious impact on commerce. For a review of the structure, organization and current status of the National Individual Cattle Identification System in Mexico, see Murphy et al. (2008).

Tonsor and Schroeder (2006) performed a study of the Australian National Livestock Identification System similar to the study reported in this paper, which produced a list of recommendations that were consonant with our recommendations. Tonsor and Schroeder (2006) concluded that NAIS eventually needs to be: (1) mandatory, (2) free of regional differences, (3) able to support meat traceability and other advancements, (4) as simple as possible while ensuring sufficient traceback capabilities, (5) supplemented with adequate educational and support resources, and (6) possibly subsidized by the U.S. government to encourage implementation.

Conclusion

The development of NAIS is a priority of the U.S. Department of Agriculture. However, it was reaffirmed during the interviews and site visits that NAIS will eventually need to be a mandatory program. First and foremost, a mandatory animal identification program can protect animal health by facilitating a quick and

decisive response to an animal health emergency and potentially minimize its devastating consequences on the economy. However, the secondary benefits of a mandatory animal identification program also have to be considered because of their immense potential to improve the efficiency and the global competitiveness of all sectors involved in the U.S. live cattle and beef industry supply chain complex.

The Canadian cattle identification program has facilitated more intensive management systems for those operations willing to invest the resources needed to integrate this technology into their operations. The ability to access and manage production data in an electronic format can improve supply chain management and coordination; substantiate claims of value-added credence attributes (e.g., in natural and organic beef programs) and, thereby, differentiate their products from those of their competitors; and, assure the safety and wholesomeness of their products to domestic consumers. Furthermore, animal identification programs are becoming pre-requisites to international trade, and if the U.S. intends to regain and expand export markets that were lost following the discovery of a case of BSE in the U.S. (in 2003), it might be necessary to take a more aggressive stance on animal identification and traceability.

Acknowledgements

The authors gratefully acknowledge funding provided by the Colorado Department of Agriculture (CDA) – Interagency Agreement 07BAA00140 and the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS). The views expressed herein are those of the authors alone and should not be attributed to the CDA or USDA-APHIS.

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