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REVIEWS

REVIEW: Animal Identification Systems in North America

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ABSTRACT

The threat of a livestock disease outbreak or other animal health events in North America is real. However, predicting both the timing and severity of an outbreak can be extremely difficult. Animal identification and traceability programs can help limit the spread of disease. The overall objective of this review is to evaluate and compare animal identification and traceability systems in North America. Mandated animal identification programs, which exist for Canadian cattle and sheep and Mexican cattle, are designed to control and eradicate trade-limiting diseases and to maintain or gain access to international markets. In contrast, the United States has chosen to implement the National Animal Identification System as a voluntary program for cattle, sheep, and swine. However, the US sheep industry has operated with a mandatory National Scrapie Eradication Program since 2001, and the US pork industry has independently implemented a mandatory swine premises registry, which targeted 100% compliance by December 31, 2007, and a mandatory swine identification program targeting full compliance by December 31, 2008. Likewise, the Canadian National Hog Traceability and Identification System will become a mandatory program in 2008. It is recognized that a country's ability to respond to an animal disease outbreak is greatly enhanced with the implementation of a national animal identification program.

Key words: animal identification, traceability, Canada, Mexico, North America, United States

INTRODUCTION

The globalization of agriculture has expanded market opportunities for North American livestock producers. With the globalization of agriculture, the risk of animal disease outbreaks has heightened through the increased volume of animal transactions occurring in North America. The 1997 outbreak of classical swine fever in the Netherlands and recent outbreaks of foot-and-mouth disease and highly pathogenic avian influenza in many regions of the world clearly demonstrate that even countries with relatively sophisticated prevention and response programs are not impervious to debilitating animal disease outbreaks. A robust and comprehensive animal identification system capable of tracing animal movements and identifying infected premises with rapid individual animal-level precision could significantly enhance disease eradication efforts.

Animal identification programs throughout the world are not new ideas, but have existed for over 3,800 yr as a way to find and identify animals in the event of loss or theft, to enhance the value of livestock, and to control and eradicate various animal diseases (Blancou, 2001). But, as times change and disease concerns intensify, countries can implement comprehensive farm animal identification systems at the national level to satisfy consumer and export market concerns and to protect the integrity of the national livestock population (Barcos, 2001; USDA-APHIS, 2004; Smith et al., 2005). Specifically, with established animal identification programs already in place in Australia, Canada, and the European Union (among others), the United States is under competitive pressure to develop identification programs to serve its livestock industries (Barcos, 2001; USDA-APHIS, 2005b).

The primary objective of this review is to evaluate and compare animal identification and traceability systems in North America. In addition, the development of the US National Animal Identification System (**NAIS**) for cattle, sheep, and swine is discussed. The review of Canadian initiatives includes the Canadian Sheep Identification Program, the Canadian Hog Identification and Traceability System, and perhaps,

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most importantly, the Canadian Cattle Identification Agency (**CCIA**), which was the first industry organization in Canada to address animal identification. The review of Mexican identification programs is, unfortunately, limited in scope because most of the information reported pertains to the National Individual Cattle Identification System, which was developed with the intent of assuring that the United States would allow importation of its beef cattle.

The remainder of the paper will analyze each country individually, beginning with the United States, followed by Canada, and then Mexico. Specifically, discussions are presented on the original mandate for animal identification programs, followed by a review of the literature regarding the identification programs for cattle, sheep, and swine within each country. This review is 1 of 4 reviews that describe 1) cattle identification in selected countries outside North America (Bowling et al., 2008); 2) swine identification in selected countries outside North America (Meisinger et al., 2008); and 3) identification of sheep in selected countries outside North America (Bass et al., 2008). When taken as group, these 4 reviews offer insight into animal identification and traceability throughout several countries of the world.

REVIEW AND DISCUSSION

United States of America

Animal identification programs have existed in the United States since the 1940s as part of an extensive program to eradicate bovine brucellosis from the national cowherd. The brucellosis vaccination tag and corresponding ear tattoo provided an effective and very successful animal identification program (USDA-APHIS, 2005a). Since 2001, the US sheep industry has used the mandatory National Scrapie Eradication Program (**NSEP**) to help eliminate scrapie from the national sheep flock (Wolf, 2006). The combination of the NSEP flock assignment system with the visual-based individual identification tracking system fulfills the traceability needs of the scrapie program (USDA-APHIS, 2006c). The US pork industry has used an identification system since 1988 to successfully eradicate pseudorabies from the commercial swine herd (National Pork Producers Council, 2007). Since that time, the National Pork Producers Council and the National Pork Board have worked together to expand the pseudorabies identification program into a national swine identification system capable of controlling and eradicating all swine diseases of concern (National Pork Producers Council, 2007b). However, as diseases near eradication, the need for control programs decrease and without animal identification systems in place, there will be nothing available to complete the disease eradication program (USDA-APHIS, 2005a).

In 2002, the National Institute for Animal Agriculture — recognizing the need for a national farm animal identification program that could enhance animal disease monitoring, surveillance, control, and eradication in the United States — created the National Identification Task Force (USAIP, 2003). Boasting representation from more than 30 livestock organizations, the Task Force developed the National Identification Work Plan, which was presented at the United States Animal Health Association (**USAHA**) meeting in October 2002 as a guideline for establishing a national animal identification system (USAIP, 2003). As a result of the work performed by the National Institute for Animal Agriculture and its associates, USDA-Animal and Plant Health Inspection Service (**USDA-APHIS**) established the National Identification Development Team, a joint state-federal-industry group, whose work produced the initial draft of the US Animal Identification Plan in September 2003 (USAIP, 2003). The US Animal Identification Plan established the foundation and standards for NAIS (USDA-APHIS, 2005a).

Originally written as a mandatory program, the USDA changed direction in August 2006 and published a revised "User Guide" in November 2006, stating that NAIS would become and remain a voluntary program at the federal level (USDA-APHIS, 2006a). Under these new revisions, producer participation in NAIS is not required, but instead suggested, to protect the health and marketability of their animals (USDA-APHIS, 2006a).

Today, NAIS remains a cooperative state-federal-industry effort administered by USDA-APHIS-Veterinary Services. According to USDA-APHIS (2007), Veterinary Services is responsible for developing and implementing an animal identification system that can 1) "enable industry partners and state and federal animal health officials to respond rapidly and effectively to animal health emergencies such as foreign animal disease outbreaks or program diseases with potentially significant animal health, public health, economic, or social consequences; 2) support ongoing animal health safeguarding and disease detection and response capabilities in order to complete current eradication programs; 3) protect United States exports and meet the growing international market demand for systems that provide timely animal identification capabilities, thus expanding international trade opportunities; and 4) protect domestic markets and consumer confidence, thus increasing overall consumer demand that benefits all producers."

The USDA's long-term goal is to provide to emergency responders the tools needed to identify all premises and animals that have had direct contact with a reportable foreign or domestic animal disease within 48 h of discovery (USDA-APHIS, 2007).

Premises registration, the foundation of NAIS, is fundamental to containing animal diseases, and is 1 of 3 key components critical to animal traceability — the other 2 being: animal identification and animal trac-

ing (USDA-APHIS, 2005a,b). As of February 11, 2008, 447,879 premises (i.e., 31.1% of estimated 1.4 million total premises) had registered with NAIS (USDA-APHIS, 2008). The USDA's goal is 100% premises registration by 2009, but it recognizes that this goal will probably be unattainable because of the decision to keep the program voluntary (USDA-APHIS, 2006a). Assigning a unique premises identification number (**PIN**) to each premises will provide select government officials the exact origin and location of an animal in the event of a disease investigation. With this information, animal health investigators can allocate limited resources more efficiently, establish a surveillance zone around an infected premises with greater celerity, and conduct more accurate epidemiological investigations to hasten disease containment and eradication (USDA-APHIS, 2007).

After premises registration is completed, participants can choose the level of involvement that best suits the needs and goals of their operation. Animal identification is the second component toward achieving full animal traceability. According to USDA-APHIS (2007), animal identification can be accomplished by 2 different means: 1) animals of the same species that move through the production chain as a group can be identified by a group or lot identification number instead of individual numbers; and 2) animals that move through commerce individually can be identified with a USDA-recognized animal identification number tag or device.

The third and final component of NAIS is reporting individual animal or group or lot movements to an animal tracking database (**ATD**). Under voluntary NAIS, private industry groups and states operate and maintain the ATD. Participants can choose the ATD they wish to use for reporting animal movements (USDA-APHIS, 2007). The degree of offered services and value-added features (i.e., age verification, USDA Process Verified Programs, USDA Beef Export Verification programs, etc.), as well as transaction costs, can vary widely between different private companies. The USDA operates a portal system that will enable animal health officials, in the event of a disease outbreak, to submit requests to the ATD for animal location and movement information (USDA-APHIS, 2007).

NAIS Cattle Industry Working Group. The 2004 USAHA meeting concluded with resounding support of NAIS, and species-specific working groups were established to gather and report grassroots input into the development of NAIS. Arguably, the NAIS Cattle Industry Working Group had the greatest challenge before them, working with an industry that was the most vocally opposed to NAIS from the very beginning.

Guiding principals were put forth by the Cattle Industry Working Group recommending that radio-frequency identification (**RFID**) tags be the technology adopted to identify individual animals. It also suggested that producer data and information be kept confidential, exempt from the Freedom of Information Act, and that only approved animal health authorities have access to the NAIS database (USDA-APHIS, 2006b). The Cattle Industry Working Group also listed specific situations that would necessitate the need for the owner or seller to apply an official RFID tag, such as change of ownership, interstate movement, or multiple owners commingling their cattle (USDA-APHIS, 2006b). However, there has been very little consensus developed by the cattle industry with regard to the best approach or methodology for cattle identification.

NAIS Sheep Working Group. The NAIS Sheep Working Group, per the USAHA challenge, recommended that NAIS comply and evolve with the existing mandatory NSEP, which has been operating since 2001 (Wolf, 2006). The Sheep Working Group further recommended that the Scrapie Flock Identification (**SFID**) number should be tied to the assigned NAIS PIN in the database. Moreover, the Sheep Working Group conceded that a purely visual identification system — which they currently endorse — could not achieve 48-h traceback because of possible transcription errors and the inability to read and report visual tag numbers in real time, but have expressed interest in pursuing more reliable and accurate RFID technology as it develops and becomes more affordable (American Sheep Industry Association, 2006; Wolf, 2006).

Unique to the United States sheep industry, in comparison to other livestock industries, is the cost-sharing agreement between producers and the federal and state governments. Producers are responsible for administering the NSEP ear tag, maintaining basic records, and retrieving data upon request, whereas the governments' responsibilities include allocating PINs, placing tag orders, distributing tags, and providing infrastructure support and maintenance of the database (USDA-APHIS, 2006c).

According to USDA-APHIS (2006c): 1) APHIS-approved NSEP tags are issued with an individual animal number and the producer's SFID number, which together provide enough information to satisfy the identification requirements of the NSEP. 2) The printed SFID number is a combination of the producer's state postal code followed by an alphanumeric number that is unique to each animal. 3) Replacing the SFID number with the 15-digit "840" number or printing the SFID and individual numbers in a smaller print with a larger printed "840" number would produce unacceptable levels of transcription errors. (The "840" number is the USA country code set by the International Organization for Standardization. An official animal identification number is 15-digits, with 840 as the first 3 digits followed by a 12-digit individual animal identification number).

The Sheep Working Group also recommended that individual identification and movement recording occur only when sheep commingle,

like at intra- and inter-state exhibitions and at breeding stock and cull sheep sales (American Sheep Industry Association, 2006). Furthermore, they recommended that group or lot identification apply to slaughter and feeder lambs, sheep moving intra- and inter-state for management purposes without changing ownership or commingling, and intra-state movement for grazing purposes with commingling of slaughter and feeder lambs (USDA-APHIS, 2006c). It is proposed that the group or lot identification number (**GLIN**) be a 15-character number that would include the 7-digit NAIS premises identification number, the current date, and the lot number assembled that day (USDA-APHIS, 2006c). The sending producer would assign the GLIN, and the receiving premises would report the group's arrival to NAIS. The new owner would be responsible for retaining these records for 5 years after the GLIN is terminated (USDA-APHIS, 2006c).

NAIS Pork Industry Identification Working Group. The US pork industry has operated with an identification system since 1988 as part of a successful effort to eradicate pseudorabies from the commercial swine herd (National Pork Producers Council, 2007a). Since 1988, the National Pork Producers Council, in cooperation with the National Pork Board, has worked to expand the infrastructure of its current identification system into a national swine identification system (National Pork Producers Council, 2007b). Their collaborative efforts have created a mandatory swine premises identification registry that worked to achieve 100% compliance by December 31, 2007 (National Pork Producers Council, 2007a). Likewise, a mandatory swine identification program has been proposed that will require 100% compliance by December 31, 2008 (National Pork Producers Council, 2007b). The National Pork Board was the first national livestock organization to support NAIS and was awarded $400,000 in USDA funding to hire regional coordinators to assist state producer associations and identification officials with premises registration (National Pork Producers Council, 2007a).

In 2006, the NAIS Pork Industry Identification Working Group submitted for review a draft proposal of program standards to the NAIS subcommittee that described their support of group or lot identification for market swine that move as groups within swine production systems, but acknowledged that individual identification, with bar code or RFID tags, is needed when animals commingle outside of the production system, excluding animals en route to harvest (USDA-APHIS, 2006d). Movement and inventory reconciliation records are retained by the owner, production system, or market for 3 yr after the event and are made available to the USDA upon request (USDA-APHIS, 2006d).

Inter-state movement of swine and semen will continue to be monitored and reported through a Certificate of Veterinary Inspection for an individual animal and an Inter-State Movement Report for a group of animals (USDA-APHIS, 2006d). The PIN of the shipping and receiving premises is required on the Certificate of Veterinary Inspection or Inter-State Movement Report (USDA-APHIS, 2006d). Likewise, market swine en route to harvest are accompanied by documents identifying the shipment-originating premises and will continue to be collected and maintained by the abattoir or market in accordance with the Packers and Stockyards Act (USDA-APHIS, 2006d).

Canada

The Agricultural Policy Framework, which was implemented in 2002, was created to establish 80% full-chain traceability of all domestic products by 2008 (Canadian Livestock Identification Agency, 2005). As a cornerstone of this program, a national animal identification system that encompassed all pertinent livestock species was created. Traceability in Canada, however, existed long before this mandate. The first program, created in the 1920s by the Canadian Department of Agriculture, was responsible for containing foot-and-mouth disease outbreaks and for eradicating bovine brucellosis and tuberculosis in cattle (Quigley, 2006). The program was decommissioned in 1985 and traceability remained inactive until 1990, when the cattle and swine sectors, meat packing industry, and government agencies collaborated to create the National Advisory Board on Animal Health (Canadian Livestock Identification Agency, 2005). In 1992, the Canadian Food Inspection Agency (**CFIA**), in response to requests by the National Advisory Board on Animal Health, implemented a national bovine spongiform encephalopathy (**BSE**) surveillance program, which quickly proved its value with the discovery of BSE in 1993 in an Alberta cow imported from Great Britain. The BSE incident was a wake-up call for the Canadian beef industry. The infected cow was purebred and tracing its herdmates and offspring was relatively easy. Had the cow been raised or imported for commercial purposes it could have been impossible to trace the cow back to its origin (Quigley, 2006).

Canadian Cattle Identification Agency. Incorporated in 1998 as a collaborative effort between the Canadian beef industry and the CFIA, the CCIA achieved full operation in 2001 as a voluntary program and gained mandatory program status in July 2002, under the regulatory framework of the Federal Health of Animals Act. In 2004, Federal Health of Animals Act regulations (known hereafter as the Health of Animals Regulations) were amended to accomplish 3 important goals: 1) enhance enforcement of the CCIA and increase BSE surveillance levels; 2) accelerate the development of a more comprehensive livestock and poultry identification program; and, (3) increase Health Canada's capacity to respond to BSE (Canadian Livestock Identification Agency, 2005). Under the mandatory program, all bison,

cattle, and sheep upon departure from the herd of origin or upon importation into Canada are required to bear individual identification in the form of an official CCIA ear tag (Canadian Livestock Identification Agency, 2005).

The CCIA is a subsidiary of the Canadian Cattlemen's Association and hence, an industry-owned, industry-led initiative that operates at arms-length under a board of directors that represents all sectors of the cattle industry (Quigley, 2006). The CFIA, Agriculture and Agri-Food Canada, and other government officials are involved in the organization, but only as ex-officio, non-voting members (Quigley, 2006). As explained by J. Stitt (CCIA, Calgary, Alberta, Canada, personal communication), as an industry-owned program, the CCIA is not subject to access of public information rights granted by the Freedom of Information and Protection of Privacy Act — which is the Canadian equivalent to the Freedom of Information Act in the United States — but is under the jurisdiction of the CFIA as stipulated in the Health of Animals Regulations.

The CCIA was the first industry organization in Canada to address animal identification, and as a result encountered tremendous producer-level discontent. However, on May 20, 2003, less than a year after the program became mandatory, the first indigenous case of BSE was discovered in Canada. All the negative attention questioning the relevance of the CCIA quickly changed to cautious optimism as the beef industry hoped that the presence of an identification system would expedite the reopening of international markets to Canadian beef. 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. Today, the CCIA reports achieving 97 to 100% program compliance (Canadian Cattle Identification Agency, 2007b). The CCIA also facilitated the traceback of the Canadian "Christmas cow" found in Washington state on December 23, 2003, to its herd of origin in Alberta (Lazar, 2007).

Since its inception in 1998, the CCIA has progressed from use of visual dangle-tag bar code technology to use of newer and superior RFID technology for cattle and bison (Sanderson and Hobbs, 2006), as of September 1, 2006. To facilitate the transition to RFID, bar code tags were recognized in young animals until December 31, 2007, and recognized indefinitely on mature breeding stock (Sanderson and Hobbs, 2006).

Service centers, such as veterinary offices and feed stores that sell official CCIA ear tags, are responsible for recording the assignment of tags numbers to producers and submitting this information to the CCIA database within 24 h (Canadian Cattle Identification Agency, 2006). Producers are not responsible for maintaining tag number allocation records; however, they are responsible for ensuring that animals leaving the herd of origin are properly identified with a CCIA tag (Canadian Livestock Identification Agency, 2005). The CFIA, which is the federal government agency charged with safeguarding the Canadian food system, is responsible for enforcing the program and administering monetary fines for non-compliance (Sanderson and Hobbs, 2006). [The CFIA is responsible for ensuring that the CCIA satisfies its regulatory obligations such as mandatory traceback and traceability. According to J. Stitt (CCIA, Calgary, Alberta, Canada, personal communication), the CFIA accomplishes this task by auditing third party-endorsed CCIA data audit protocols and by performing on-farm audits at the cow-calf, feeder, auction market, and packing plant levels by CFIA employees or accredited veterinarians. The auditing programs developed by the CFIA validate the authenticity and integrity of the Canadian cattle identification program to a level that satisfies the requirements and concerns of international animal health regulatory bodies, such as the World Organization for Animal Health and the USDA.] Individuals charged with selling, transporting, or commingling cattle without official CCIA identification face a $500 fine for each animal in non-compliance. If fines are paid within 15 d they are reduced to $250 (J. Stitt, CCIA, Calgary, Alberta, Canada, personal communication). Furthermore, individuals caught removing, tampering, or re-using official CCIA ear tags can face criminal charges under the Health of Animals Regulations.

One aspect of the Health of Animals Regulations was that it did not address or develop a mechanism for authorizing mandatory premises registration, which made it necessary to start with voluntary participation (Sanderson and Hobbs, 2006). Although premises registration is slowly garnering more attention, the herd-of-origin information collected (i.e., owner's name, phone number, and address) and submitted by service centers at tag purchase effectively meets the objectives of the CCIA (Quigley, 2006). Premises registration surpasses the aforementioned herd-of-origin information by also reporting geographic information system coordinates and the legal land description (J. Stitt, CCIA, Calgary, Alberta, Canada, personal communication). Premises registration culminates with the assignment of a unique PIN to a producer.

The CFIA recognizes CCIA birth certificates as an alternative to dentition for age verification for domestic meat inspection purposes and for live animal and meat exports (Canadian Cattle Identification Agency, 2007a). Purebred registration papers, as stand-alone documents, are not an accepted alternative for age verification. Originally, birth certificates were only available to producers to print and submit to packing plants as paper copies. Today, individuals or companies with validated authorization are able to query the

CCIA database for birth certificates (Sanderson and Hobbs, 2006). As of May 8, 2007, 3.7 million birth dates had been submitted to the CCIA database (Canadian Cattle Identification Agency, 2007b), of which 62.3% were based on actual calving dates and 37.7% on calving start date (Canadian Cattle Identification Agency, 2007b). Furthermore, the CCIA reports that 61.0% of ruminant animals (beef and dairy cattle and bison) born since January 2005 are age-verified (Canadian Cattle Identification Agency, 2007b).

The final component of the CCIA is the retirement of individual animal tag numbers within 30 d after an animal dies. Tag number "retirement" is the Canadian equivalent to tag number "termination" in the United States.

Agri-Traçabilité Quebec. Agri-Traçabilité Quebec is the Quebec organizational equivalent of the CCIA. It is an autonomous, not-for-profit organization created in 2001 to implement a mandatory identification and farm-to-table tracing system for agricultural products in Quebec (Canadian Livestock Identification Agency, 2005). Agri-Traçabilité Quebec received $21.5 million in grants from the government of Quebec to assist with implementing livestock identification and traceability systems for the cattle, sheep, and swine sectors by 2005 (Canadian Livestock Identification Agency, 2005).

Largely independent in their development, Agri-Traçabilité Quebec has chosen to embrace a more aggressive stance on animal identification than the CCIA. They mandated RFID technology from the very beginning and use CCIA-approved tags that are visually different from the standard CCIA tags. Other notable differences between the 2 entities includes Quebec's mandatory requirement that cattle be identified within 7 d of birth and that sheep be identified within 30 d of birth or upon leaving the herd of origin, whichever should arise first (Sanderson and Hobbs, 2006). Quebec has also mandated animal movement reporting between farms or production sites using unique site numbers, which are similar to premises identification numbers, to identify each premises (Sanderson and Hobbs, 2006). However, despite its autonomy, Agri-Traçabilité Quebec grants authority on national issues to the CCIA. For example, the CCIA, as the designated administrator of traceability in Canada, is responsible for assigning tag numbers to the provinces, which ensures the national distribution of a single set of conforming numbers (J. Stitt, CCIA, Calgary, Alberta, Canada, personal communication).

Canadian Sheep Identification Program. In 1998, the board of directors for the Canadian Sheep Federation voted to create the Canadian Sheep Identification Program (**CSIP**) using the CCIA as a model of development. It launched on January 1, 2004, with mandatory program status because of an amendment made to the Health of Animals Regulations (Canadian Sheep Federation, 2006a). Similar to the CCIA, the CSIP is an industry-initiated program that requires all sheep of any age leaving their flock of origin to bear an approved CSIP ear tag. However, one major difference between the 2 programs is that sheep producers, in an effort to keep costs low, chose not to mandate expensive bar code or RFID technology. According to the Canadian Sheep Federation (2006a, b), producers have the option of using dangle bar code or RFID tags or Ketchum Kurl Lock tags (Ketchum Manufacturing Inc., Brockville, Ontario, Canada), and are required to maintain individual animal movement records for all breeding sheep and all sheep greater than 18 mo of age entering or leaving their premises for 5 years, except for those going directly to harvest. Tags are purchased from official tag suppliers who collect flock or owner information and tag number allocation records and are then required to forward this information to the CCIA database within 24 h. Because the current identification method does not facilitate real-time electronic tag number retirement, a component of the Canadian Sheep Federation strategic plan is to transition to RFID technology by 2009 (Canadian Sheep Federation, 2006b).

In the event of a disease outbreak, CFIA investigators will determine the flock of origin through CCIA tag number allocation records and then use producer records to track the animal to its last premises (Canadian Sheep Federation, 2006b). Failure by producers to comply with tagging and record-keeping regulations will result in monetary fines similar to those applied to cattle producers charged with non-compliance. Likewise, regulations prohibit transporters and auction markets from accepting sheep that are not tagged with an official CSIP tag (Canadian Sheep Federation, 2006a). Producers responding to on-farm mortalities are required to remove and save the tags and record the cause of death, if known (Canadian Sheep Federation, 2006b).

National Hog Identification and Traceability System. The Canadian pork industry, represented by the National Identification and Traceability Working Committee, completed a series of pilot projects funded by the Agriculture and Agri-Food Canada-Canadian Food Safety Quality Program that culminated in 4 industry recommendations: 1) support the creation and mandatory implementation of a national livestock premises registry; 2) develop a National Hog Identification and Traceability System (**NHITS**) that would report all hog movements within 2 d of the event; 3) ensure that swine movement information from packing plants is collected and integrated into the NHITS for retirement; and 4) ensure that shoulder slap-tattoos for hogs going to harvest are unique and associated with a premises (Canadian Pork Council, 2005a, b). The National Identification and Traceability Working Committee concluded by stating that the NHITS cannot be effective unless it becomes mandatory. As a consequence of the Working Committee's

recommendations, the NHITS will gain mandatory program status in the summer of 2008 under amended Health of Animals Regulations (Canadian Pork Council, 2005d).

Until recently, Canada did not have a national pig tattoo classification system. This regulatory shortcoming could have led to unnecessary mistakes and confusion by animal health investigators responding to a reportable disease event (Canadian Pork Council, 2005b). Records indicated that as many as 13.5 to 15.0% of shoulder slap-tattoo numbers in Canada were used by more than one premises (Canadian Pork Council, 2005a, b). In an effort to relieve this discrepancy, a national tattoo number standardization strategy was developed, which identified 4 key elements for improvement: 1) a 5-character shoulder slap-tattoo number classification be adopted for market hogs (including sows and boars not for breeding) going to harvest; 2) shoulder slap-tattoos be linked to premises, rather than pig owner, and, therefore, each owner could potentially have more than one unique tattoo number; 3) all tattoos be applied to market hogs before leaving the premises; and 4) provincial bodies are responsible for issuing, allocating, and managing all tattoo numbers within their province, thus ensuring that the information is integrated into the group-movement reporting system (Canadian Pork Council, 2005b, c). [Depending on the size of the operation, modern hog production may require using multiple isolated production units, which are owned by the same owner or company. In the event of an animal disease investigation, government officials will use the premises-associated shoulder-slap tattoo number to not only identify the owner, but also the exact location (premises) of origin or production. This initiative is intended to hasten disease containment and eradication and prevent investigators from assigning a single health status to a multi-site operation that would unnecessarily implicate or condemn unaffected production units.]

The last digit of each shoulder slap-tattoo represents the province from which the hog was maintained before harvest, and the first 4-digits are unique to each premises (Canadian Pork Council, 2005b). For example, Alberta has been issued a tattoo allocation range of 0000[6]-9999[6], and Prince Edward Island has been issued an allocation range of 0000[2]-4999[2] (Canadian Pork Council, 2005c). Each province is responsible for managing tattoo collections and for removing duplicate tattoos from the national tattoo database (Canadian Pork Council, 2005c).

According to the Canadian Pork Council (2005b), group or lot identification is accepted for hogs that move from site to site within one operation and ownership system or change ownership by verifiable means in groups. The producer or original premises designates a GLIN when the hogs leave the premises, and it is retired upon arrival by the receiving premises and reported to the national database (Canadian Pork Council, 2005a).

In instances when individual identification is required (i.e., breeding stock, commingled hogs, etc.), a visual ear tag displaying a unique identification number associated to that premises will satisfy the individual identification requirements (Canadian Pork Council, 2005b). Reporting individual animal movements is accomplished in a manner similar to the methods used for reporting group movements. In addition, producers can choose to report frequent (i.e., weekly) and predictable movements to the national database by automatically linking all their premises together (Canadian Pork Council, 2005b).

Mexico

Mexico established the National Individual Cattle Identification System (**SINIIGA**) in 2003 as a mandatory program that has been provided an unspecified period of time for implementation across the country (E. Luna-Martínez; Secretary of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA), Mexico, personal communication). It is a visual identification and manual entry (i.e., paper) based system that was designed with the assistance of France (S. Mercado; AgInfoLink, Dripping Springs, TX, personal communication). According to the National Confederation of Livestock Organizations (**CNOG**, 2007a), SINIIGA was the result of a dedicated effort between their organization and the Secretary of Agriculture, Livestock, Rural Development, Fisheries, and Food to protect the integrity of Mexican beef products, as well as prevent and control the spread of disease, specifically BSE, that could endanger human and animal health (CNOG, 2007a). Furthermore, Mexico believed that a rapid expansion of animal identification and traceability would allow them to capitalize on Canada's and the United States' BSE-related misfortunes and expand international beef market share (CNOG, 2007a, b).

According to CNOG (2007a), SINIIGA is linked to the National Livestock Census, a national database that collects and maintains registration information on producers and the Livestock Production Unit or premises. CNOG (2007a) reports that as of June 13, 2007, 233,000 premises were registered on the National Livestock Census and will gradually incorporate all premises in Mexico.

The short- and medium-term goals of SINIIGA is to provide a census update on the national livestock population, strengthen disease control efforts, trace animal products and by-products, improve marketing conditions, and help combat cattle rustling (CNOG, 2007a). Long-term goals include individually identifying all cattle in Mexico while simultaneously developing a Central Information Bank that will store information on all animals in the country such as owner and premises information, in addition to animal movement and health status data for the entire life

of the animal (CNOG, 2007a, b). It is SINIIGA's goal to develop whole-life traceability, beginning at birth and ending at death, harvest, or export (CNOG, 2007b).

The National Operations Center is responsible for coordinating all animal identification work throughout Mexico. Their responsibilities include administering resources to regional and local operation centers, filling ear tag orders, filing Bovine Identity Cards, and managing electronically submitted information (CNOG, 2007b).

Participants access the SINIIGA web site and enter in their premises number to electronically request tags (CNOG, 2006). The National Operations Center then assigns and distributes to the participant a series of designated numbered tags and the corresponding Bovine Identity Cards (CNOG, 2006, 2007a). Two ear tags are assigned by SINIIGA — a bar code dangle tag and a button tag (with no RFID microchip) — to each animal (CNOG, 2007a; S. Mercado; AgInfoLink, personal communication). Participants are asked to complete a separate Bovine Identity Card for each animal that enters or exits the premises for whatever reason, for reapplied ear tags in the event that the previous ear tags are lost or damaged, and for notification of animal death, harvest, export, or import (CNOG, 2007a). Once completed, the Bovine Identity Cards are mailed to the National Operations Center where the information is manually entered into the Central Information Bank for storage.

As explained by J. Davis (USDA-APHIS, Riverdale, MD, personal communication), import standards established by the United States require Mexican cattle to be identified with blue metal ear tags. The metal tags are administered by the Secretary of Agriculture, Livestock, Rural Development, Fisheries, and Food to cattle ranchers that furnish sanitary certificates indicating that their herd has tested negative for brucellosis (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). Exports of live Mexican beef cattle to the United States for direct harvest or to feedlots for additional finishing before harvesting require a blue metal ear tag and an accompanying export or sanitary certificate (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). These certificates report an animal's point of origin back to the municipal or county level (Skaggs et al., 2004). In many cases, the certificates list the origin of the animals near northern cities, but in actuality, the cattle owners have an office or gathering pen in the city and collect cattle for export throughout the entire region or country (Skaggs et al., 2004). Only feeder cattle (i.e., steers and spayed heifers) are eligible for export to the United States and are visually identified with a hip brand. Steers are branded with an "M" and spayed heifers branded with an "MX," both applied to the right hip (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). At the present time, imports of Mexican cattle for breeding purposes and Holstein cattle of any type are not allowed into the United States (J. Davis, USDA-APHIS, Riverdale, MD, personal communication).

Exports of Mexican sheep and goats into the United States require that animals be individually identified. Sheep exports intended for direct United States harvest are not allowed because of drug residue concerns (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). The withdrawal periods for these drugs are too long to satisfy US regulations, and consequently the safety of harvested Mexican lamb cannot be guaranteed (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). There are very few exports of Mexican feeder lambs into the United States, but lambs that are imported require individual identification with a blue metal ear tag and a valid sanitary certificate, similar to the restrictions applied to cattle.

Exports of Mexican swine and pork products are not allowed into the United States because of their current disease status (J. Davis, USDA-APHIS, Riverdale, MD, personal communication). As a result, it has proven difficult to find any information regarding a national identification system pertaining to swine traceability.

IMPLICATIONS

North America recognizes the need for permanent and comprehensive national farm animal identification systems. Systems that can protect the integrity of national livestock populations, as well as strengthen consumer and export market confidence in meat products, are becoming prerequisites to international trade. After witnessing the devastating effects of BSE on European and North American (Canada and the United States) beef markets, Mexico proactively implemented SINIIGA in 2003 to protect human and animal health and to capture international market share once belonging to Canada and the United States (CNOG, 2007a, b). The United States has chosen to implement a voluntary animal identification and traceability program (called NAIS) for cattle, sheep, and swine. Although NAIS is a voluntary program, the US sheep and pork industries have operated with a mandatory National Scrapie Eradication Program and swine premises registry that targeted 100% compliance by December 31, 2007, and a swine identification program aimed at full compliance by December 31, 2008. The CCIA, an industry-owned and industry-funded initiative, works in cooperation with the CFIA to ensure that the CCIA satisfies its regulatory obligations for mandatory traceback and traceability. Moreover, internationally accepted CCIA age verification has given Canada a competitive advantage over most US and Mexican producers in international markets. For many countries, age verification has become a prerequisite to Canadian beef trade (Canadian Cattle Identification Agency, 2007a). Using Canadian age verification as an example, it is imperative that as

countries implement and expand the capabilities of their animal identification programs, sound judgment and foresight is needed to ensure they are complimentary and applicable to the identification programs of their trading partners. The ability to access information stored on one country's database for "value-added" benefits in another country (i.e., under 20-mo beef for export to Japan), holds tremendous opportunity for all of North America. More importantly, in a disease outbreak, harmonized animal identification programs could expedite animal traceback to the herd of origin — regardless of the national origin — to ensure the continued well-being and prosperity of North American animal agriculture.

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