Implementation & Economic Impacts of a Traceability Program on Beef Industry Stakeholders

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INTRODUCTION

Animal Identification (ID) and traceability systems have advanced in recent years, evolving from basic plastic ear tags, to radio frequency identification (RFID) tags, and even retinal imaging and DNA identification. The major beef exporting countries have had traceability systems implemented for several years in an effort to better protect animal health and to improve export market growth. Beef importing countries are also beginning to require such traceability systems as a prerequisite to market access. International animal health, food safety, and many trade associations have recognized the importance and added value of an effective animal traceability system. However, the United States is lagging behind in the implementation and utilization of a national traceability system. This factsheet provides an overview of what a national traceability program could look like, the technology it would require, the components of the system, and the economic costs of such a system.

WHY NOW?

Traceability of livestock has increasingly become a focus for the USDA, the National Cattlemen's Beef Association, and other beef industry stakeholders, such as high-volume beef-exporting states. The focus on traceability within the United States began after several international animal disease outbreaks—most notably Bovine Spongiform Encephalopathy (BSE) and Foot & Mouth Disease (FMD)—including the December 2003 BSE outbreak in the state of Washington. Mitigating adverse future impacts of such outbreaks, as well as maintaining export markets through a positive international perception of U.S. beef has become a top priority for the industry.

Measuring the potential impacts of an outbreak has been considered from many different perspectives, and all suggest a significant negative impact to the industry; so much so, that the National Cattlemen's Beef Association included traceability in their Long-Range Plan for 2016-2020. However, determining the true costs and impacts of a traceability program within the United States is difficult due to the nature of the U.S. supply chain, but is crucial as a national traceability program is imminent. Understanding the potential economic impact of a traceability program is important, especially in a large beef producing state such as Kansas. In addition, it is important to recognize which segments of the industry may be affected the most.

An efficient and properly structured national individual animal identification system offers advantages for both the individual producer and the beef industry as a whole. At the national level, individual animal identification aids in endemic and transboundary disease prevention and control, quality assurance, and maintenance and possible expansion of export markets. The U.S. beef cattle industry is highly segmented and geographically dispersed, with animals typically managed by multiple owners in multiple sites throughout the production cycle. An individualized animal identification system would provide national coordination of source information, animal movement, and pathogen tracking in the event of the unintentional or deliberate introduction of a foreign animal disease such as FMD or BSE (Disney et al. 2001). Such a system would allow for within- and between-state animal traceability focused on disease control and eradication programs. In addition, individual animal identification would allow "backtracking" should quality, safety, or environmental concerns arise (McKean 2001).

A national identification system would allow for the U.S. to document the absence of a disease(s) to aid in opening access to specific export markets, like Japan. Implementation of national identification systems in other countries, such as those in the European Union, could present future trade barriers to the United States if an animal identification system is not adopted (Ammendrup and Fussel 2001). At the individual producer level, animal traceability provides a method of which to track inventory, prevent fraud, increase efficiency, provide quality assurance, and potentially increase genetic improvements (Hunt 1998). Animal identification systems provide a way to trace carcasses to the animal, farm operation, or stage of production in the case where a food safety concern arises. It would also allow trace-back of carcasses contaminated with foodborne pathogens such as E. coli.

The ability to track larger numbers of carcasses in a packing plant and to track the quality of subsequent cuts to specific animals and therefore, specific genetics has the potential to provide producers with the ability to advance genetic selection. An animal identification system provides the infrastructure to identify health and medical history of an animal at each change of ownership or stage of production (figure 1).

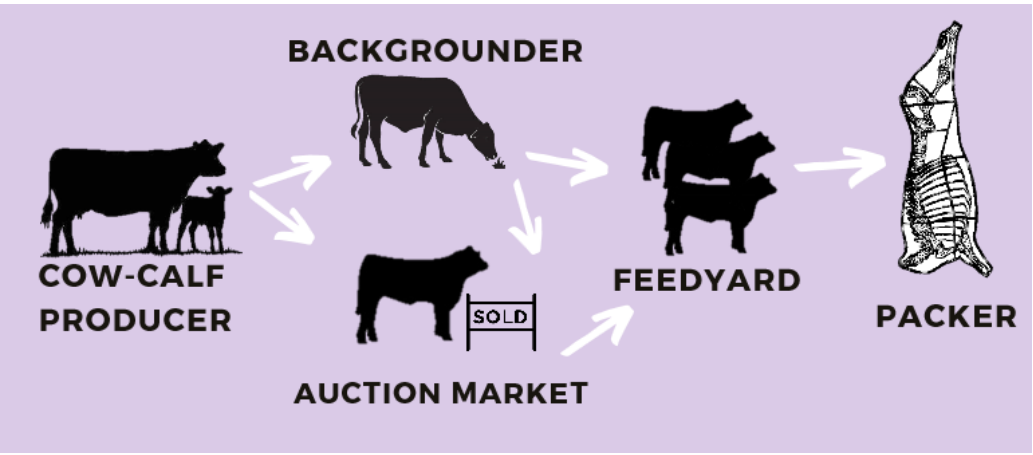

Figure 1. Typical U.S. Beef Production Cycle

THE TECHNOLOGY & IDENTIFICATION SYSTEM COMPONENTS

A practical system that would meet the objectives of the national identification system must include a unique and permanent identification number for each animal before it leaves that herd of origin and enters the cattle market. While visual identification methods such as tattoos and hot iron brands may be permanent, they do not identify animals as unique individuals of a single herd, indicate herd of origin, meet the international requirements as a valid form of identification, or facilitate the recall or collections of important information in an accurate and timely manner.

Visual animal identification tools, such as metal and plastic tags, brands, and tattoos have been used by producers across the United States. However, with the push towards a national traceability program, the need for a unique individual animal identification system has directed the industry towards the use of electronic and biometric animal identification methods. Table 1 includes a short summary of commonly used animal identification methods and their characteristics.

Table 1. Animal Identification Methods: Costs and Characteristics[1]

	Read Distance Required	Ease of Reading	Retention	Cost	Ease of Application	Animal Restraint Needed	Tamper Resistance	Cost of Data Collection at Slaughter	Ease of Data Collection at Slaughter
Plastic dangle tag	feet	varies[1]	varies[2]	$0.30-$1.50	easy	yes	easy to remove, difficult to alter	low	easy
Back tag	feet	varies[3]	short	$0.02-$0.03	very easy	no	easy to remove, difficult to alter	low	very easy
Brand	yards	varies	long	cheap[4]	somewhat difficult[5]	yes	good	N/A	N/A
Tattoo	inches	varies[6]	varies[6]	cheap[7]	somewhat difficult[5]	yes	good	N/A	N/A
RFID ear tag	inches to feet	easy	good to moderate	$1.00-$4.50	easy	yes	easy to remove, difficult to alter	moderate to high	automated
DNA	N/A	lab required testing	lifetime	very costly	test takes time	no	highly reliable	any tissue will work	easy

[1]Some tags can be covered with dirt while others are more resistant.
[2]Larger tags have a shorter retention than smaller or button type tags because they get caught and tear out or break.
[3]Tags can curl if not glued on properly.
[4]Initial costs include brand registration, one-time purchase of branding-iron, & labor, over time these are minimal.
[5]Requires training and skill to properly apply brands and tattoos.
[6]Tattoos fade over time.
[7]Initial costs include tattooing instrument and ink, over time these are minimal.

[1]Table 1 is a summarized and condensed version from the National Institute for Animal Agriculture report 2003.

A functional individual animal electronic identification system requires the integration of the transponder (electronic tag), a reader, and a data accumulation device to record the data contained on the animal's tag. This system is a data accumulation method that requires no manual notation or keyboard input. Any additional technology requirements beyond the data capture is purely up to the producer. For cow-calf producers this means that to meet the minimal future regulations, they need only purchase the approved tags. However, for producers that wish to utilize the information to improve efficiency or meet customer requirements, then hardware and software compatibility becomes an important consideration. A depiction of how the CattleTrace UHF RFID system works can be seen in figure 2.

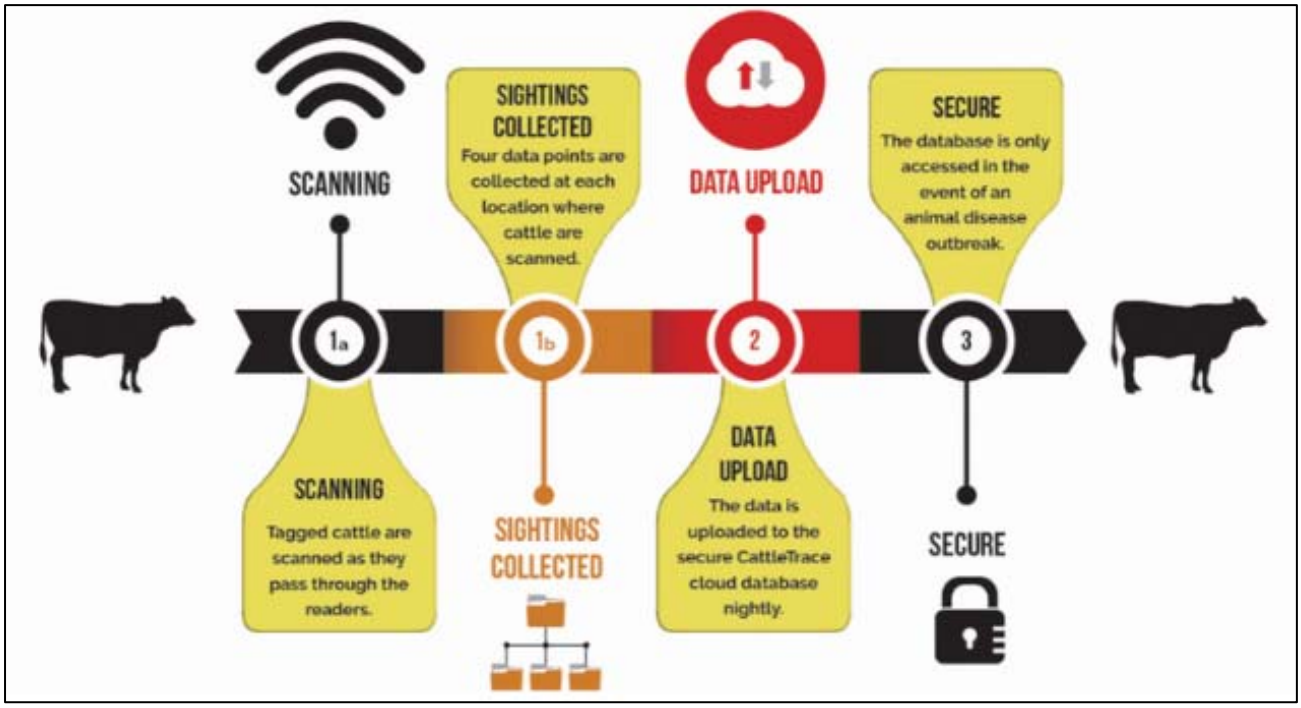

Figure 2. CattleTrace UHF RFID Data Collection Process

RADIO FREQUENCY IDENTIFICATION

RFID is an automatic identification and data capture system that comprises one or more readers and one or more transponders. These systems read or write data to specific tags or transponders present in a radio frequency (RF) field projected from RF reading/writing equipment. Data are typically contained in one or more bits to provide identification and other information about the animal to which the tag is attached. There are low, intermediate, and high frequency tags, each having pros and cons. Ultra-high frequency (UHF) is a form of RFID (or EID) technology, operating at 850 to 960 MHz and has higher read rates – up to 1500 tags/second. UHF also has a longer read range, with line-of-sight communication of 25-30 feet for stationary readers. The longer read ranges and higher data read rates allow for groups of cattle to be read as they move through current production systems – i.e. alleyways in livestock markets and feedyards. There is no current international standard for UHF at this time, but there are interim data standards outlined by the USDA.

FROM PILOT TO PRACTICE

In 2018, the CattleTrace pilot program was launched with the support of industry stakeholders to begin directing the beef industry towards a cohesive traceability program. The CattleTrace program extends from beginning-to-end of the beef industry and includes participants from all segments of production. Current participation from beef industry stakeholders includes many cow-calf producers, 12 livestock markets, 2 backgrounders, 16 feedlots, and 3 major packers (4 locations). While the CattleTrace program began in Kansas, multiple states are now part of the system with various private and public organizations establishing partnerships in an effort to illustrate how a national traceability program may look in the future (figure 3).

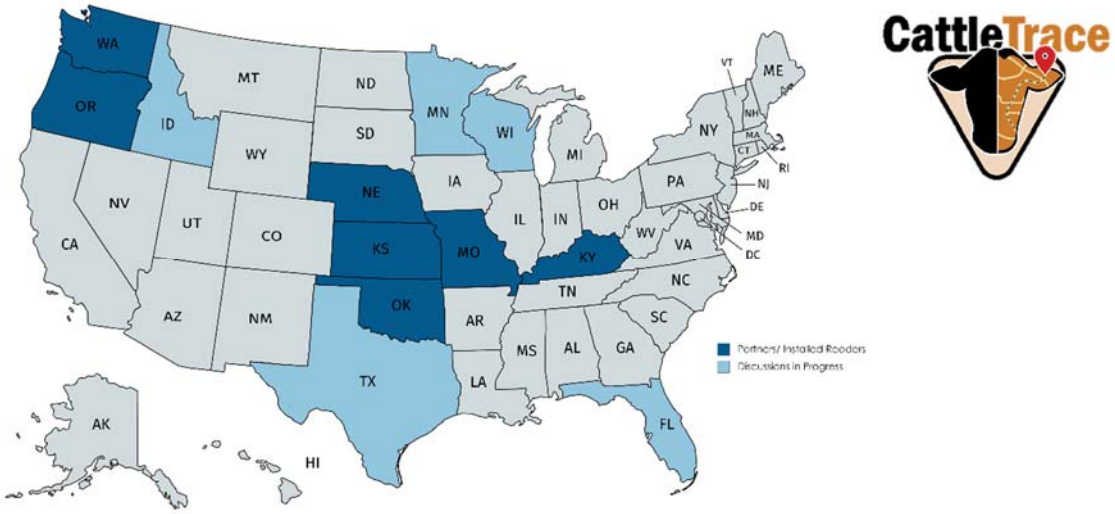

Figure 3. CattleTrace Partner Map

The system for individual animal disease traceability is complex and must be implemented prior to a disease outbreak to be effective. To be successful, the process for cattle producers must be simple, fast and affordable. One of the major concerns with previous attempts at animal traceability was the ability of a system to operate at the speed of commerce. A truly hands-free system would address this concern.

Technology necessary for data acquisition and management, including UHF tags and tag reading systems, and data management programs, has greatly improved since this type of system was previously tested, and the advent of a more convenient system operating at the speed of commerce is now possible. The CattleTrace pilot is a chance to seamlessly incorporate data collection and management practices that improve biosecurity. CattleTrace is utilizing UHF RFID ear tags, which have been distributed and applied to over 50,000 head of cattle across the country.

Pilot Program Objectives

To address this industry-wide priority, a collaborative partnership among Kansas State University, Kansas Department of Agriculture, Kansas Livestock Association and individual producer stakeholders was organized to accomplish the following objectives:

1. **Develop a purpose-built infrastructure for an animal disease traceability system;**
2. **Evaluate the efficiency and capabilities of the animal disease traceability system and infrastructure; and**
3. **Determine the value of an animal disease traceability system throughout the supply chain.**

The purpose-built infrastructure of this system has the potential to open doors to new value-added opportunities in the beef supply chain, including but not limited to: inventory management, animal health management, operational efficiencies, and enhanced domestic and international trade. Ultimately, the CattleTrace pilot will help inform and guide efforts to implement a cattle disease traceability system on a national level.

ECONOMICS OF A RFID ELECTRONIC IDENTIFICATION SYSTEM

The costs of the RFID system can be broken down into variable and fixed costs. Costs incurred on a per head basis (e.g. the electronic tag) are considered variable costs because they are directly related to the number of head in the herd. Because variable costs are on a per head basis, they will be similar across similarly sized operations. Fixed costs are those associated with the various components (e.g. hardware, software) that are constant, regardless of the number of animals. These costs will vary tremendously across operations due to variability in herd size. Economies of scale exist in regard to "fixed costs" components of an RFID system such that the per-unit costs will be lower for larger operations.

It is also important to recognize investment in a RFID system is a multiyear investment, rather than annual. The annualized cost of hardware and software components that will last multiple years should include a charge for depreciation as well as for interest. Depreciation refers to the cost associated with the investment wearing out (either physically or due to obsolescence). Interest costs reflect either borrowed money or the money tied up in RFID components that could have been invested elsewhere. Variable costs can be either annual purchases (e.g. tags for calves) or multiyear investments (e.g. tags for cows). Fixed costs can include annual purchases (e.g. subscription fees) or multiyear investments (e.g. readers).

Estimating the cost of any traceability systems requires a large set of assumptions in effort to reflect the true cost of such a system. One of these assumptions is that certain components of the system will be used outside of the RFID system. For example, a computer or data accumulator will be used for other tasks within the operation. Additionally, if the components are used for multiple herds or enterprises, the costs need to be associated to the herd or enterprise appropriately. It is assumed that cow/calf producers will only need to incur the costs associated with tagging the animals, while the auction markets, backgrounders, and feedlots must incur costs associated with reading all animal tags and replacing any tags that were lost in transition.

Additional assumptions regarding human and animal injury during tagging and reading were taken into consideration along with the potential shrink. These assumptions were all outlined in a report compiled by the CattleTrace pilot program.

An example of the estimated costs of implementing a complete RFID system for cow/calf herds of various sizes are outlined in table 2 and table 3. Table 2 includes the estimated costs for producers who tag animals at birth, while table 3 includes the cost estimates for producers that tag at time of first marketing. Previous studies, and industry stakeholders have suggested that the largest economic impact will be on cow-calf producers, and our results confirm this. A majority of the costs to stockers and commercial feedlots are associated with data management and component costs; however, these costs are spread over a large number of head.

Table 2. Summary of CattleTrace Costs for Cow/Calf Operations by Size of Operation, Tagging at Birth

	Size of Operation, number of head						
	1 to 49	50 to 99	100 to 499	500 to 999	1,000 to 1,999	2,000 to 4,999	5,000+
Total annual cost, $/operation	$52	$185	$490	$1,747	$3,259	$6,693	$21,266
Total annual costs, $/head sold	$4.12	$3.49	$3.45	$3.38	$3.38	$3.37	$3.36
Total annual cost, $/cow	$3.48	$2.95	$2.92	$2.86	$2.85	$2.85	$2.84
Total number of operations	230,905	58,406	51,029	2,999	714	193	39
Total industry cost	$11,956,219	$10,826,487	$25,006,011	$5,238,931	$2,326,619	$1,290,365	$835,118

Table 3. Summary of CattleTrace Costs for Beef Cow/Calf Operations by Size of Operation, Tagging at Time of Marketing

	Size of Operation, number of head						
	1 to 49	50 to 99	100 to 499	500 to 999	1000 to 1999	2000 to 4999	5000+
Total annual cost, $/operation	$90	$348	$922	$3,311	$6,164	$12,644	$40,254
Total annual costs, $/head sold	$7.17	$6.55	$6.50	$6.41	$6.39	$6.37	$6.36
Total annual cost, $/cow	$6.06	$5.53	$5.49	$5.41	$5.40	$5.38	$5.37
Total number of operations	359,645	35,344	22,026	1,201	286	77	16
Total industry cost	$32,402,461	$12,291,338	$20,300,091	$3,977,370	$1,762,999	$976,339	$633,188

Livestock markets are often one of the stops for cattle during the production cycle. Table 4 provides a summary of the estimated costs for implementing a traceability system for livestock markets and auction houses. Livestock markets were divided into small, medium, and large categories based on the average number of head sold annually. These costs were also based on the assumption that cattle were tagged before arriving at the market, and only cattle whose tags were lost during transport are needed to be replaced.

Table 4. Summary of CattleTrace Costs for Livestock Markets by Size of Operation

	Size of Operation, number of head		
	1 to 29,999	30,000 to 59,999	60,000+
Total annual cost, $/operation	$2,131	$5,893	$15,519
Total annual costs, $/head sold	$0.14	$0.14	$0.14
Total annual cost, $/cow	$0.14	$0.14	$0.14
Total number of operations	488	329	223
Total industry cost	$1,039,807	$1,938,815	$3,460,806

Table 5. Summary of CattleTrace Costs for Backgrounding Operations by Size of Operation							
	Size of Operation, number of head						
	1 to 99	100 to 199	200 to 499	500 to 999	1,000 to 2,499	2,500 to 4,999	5,000+
Total annual cost, $/operation	$25	$60	$152	$216	$310	$593	$1,197
Total annual costs, $/head sold	$0.42	$0.29	$0.22	$0.22	$0.22	$0.21	$0.21
Total annual cost, $/head purchased	$0.83	$0.58	$0.44	$0.44	$0.43	$0.41	$0.40
Total number of operations	21,438	11,334	6,333	4,333	3,329	2,316	1,787
Total industry cost	$544,297	$681,644	$964,308	$936,145	$1,032,580	$1,373,057	$2,138,806

Backgrounders and stockers are also a common stopping point for cattle during the production cycle. Table 5 provides a summary of the estimated costs to the backgrounders/stockers segments due to implementing a national traceability program. Economics of scale were considered, and the estimates are based on the assumption that cattle were tagged prior to arrival and only those whose lost tags in transport needed to be retagged.

Table 6. Summary of CattleTrace Costs for Feedlot Operations by Size of Operation									
	Size of Operation, number of head								
	1 to 999	1,000 to 1,999	2,000 to 3,999	4,000 to 7,999	8,000 to 15,999	16,000 to 23,999	24,000 to 31,999	32,000 to 49,999	50,000+
Total annual cost, $/operation	$71	$388	$1,037	$2,131	$4,187	$7,816	$12,584	$21,430	$38,944
Total annual costs, $/head sold	$0.28	$0.21	$0.21	$0.21	$0.17	$0.17	$0.17	$0.17	$0.17
Total annual cost, $/head purchased	$0.55	$0.42	$0.42	$0.41	$0.33	$0.33	$0.33	$0.33	$0.33
Total number of operations	26,000	770	580	360	190	77	54	55	74
Total industry cost	$1,836,190	$298,440	$601,482	$767,162	$795,449	$601,834	$679,561	$1,178,649	$2,881,822

Feedlots are a common commingling location for cattle during the production cycle, and therefore is of great focus when implementing a traceability program. Feedlots vary in size across the United States, but the greatest concentration of feedlots can be found in the central plains of the United States. Table 6 provides a summary of the estimated traceability costs for implementing a national program for the feedlot sector.

Table 7. Summary of CattleTrace Costs for Packers by Size of Operation

	Size of Operation, average number of head		
	611,111	148,200	2,277
Total annual cost, $/operation	$9,996	$9,996	$404
Total annual costs, $/head	$0.016	$0.067	$0.178
Total Number of operations	29	19	82

The last stop for cattle during the production cycle is the packer, or processing plant. Over the past decade the number of packing plants has declined while the size or volume of processing has increased at individual plants. Table 7 is a summary of the estimated cost for packing plants to implement a national traceability program. The assumption here is that the packer will only be responsible for reading the tags and integrating the national traceability program into their record keeping system that will allow for group or lot tracking.

CONCLUSION

This publication is an overview of RFID technology and its application in a national identification program for the beef industry, and to help beef industry stakeholders understand how a national traceability program may impact their operations. When considering economies of scale, the cost of implementing CattleTrace ranged from $2.84 to $6.06/head for cow/calf producers. For backgrounders, the cost of implementing CattleTrace ranged from $0.40 to $0.83/head. The average cost for sale barns was $0.14/head, and the cost of implementing CattleTrace for feedlots ranged from $0.33 to $0.55/head. The average cost to packers ranged from $0.02 to $0.18/head.

The implementation of a national disease traceability program is inevitable, and beef industry stakeholders are helping to guide and shape the structure and characteristics of such a system. Understanding the implementation costs will allow producers to better understand how a national system will impact their operation. Additionally, by participating in the CattleTrace pilot program, producers and beef industry stakeholders can have input and directly impact the development of a national disease traceability system.

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