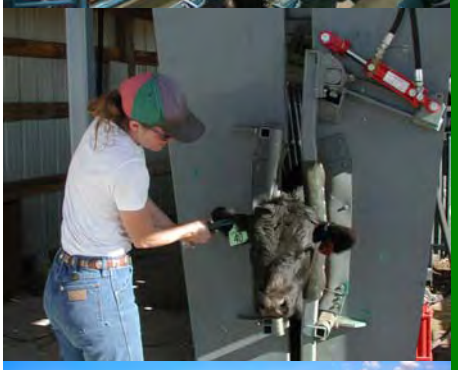


The National Animal Identification System (NAIS)

Pilot Projects/Field Trials Summary

2004 Initial Pilot Projects Final Report

2005-07 Project Descriptions

May 2007

USDA

PROGRESS AND STATUS OF THE NAIS

I. EXECUTIVE SUMMARY: NAIS PILOT PROJECTS AND FIELD TRIALS

This final report provides a review of 16 pilot projects that were supported by Federal Commodity Credit Corporation (CCC) funds from the initial National Animal Identification System (NAIS) implementation effort in fiscal year (FY) 2004 and the description of the field and assessment projects selected in late 2005. Collectively, the 16 initial projects represented the first stage of the NAIS pilot project program. This program supports the States and Tribes, who play a lead role in the administration of NAIS, in carrying out field trials and research projects that resolve questions and concerns about NAIS processes, technologies, and costs. Approximately $6.6 million was spent to carry out these projects, representing slightly more than 50 percent of funds made available for NAIS through the CCC in FY 2004. This figure accounts for less than 6 percent of the total funding ($118 million) USDA has received for NAIS to date.

The results of these projects have significant merit with regard to NAIS implementation. Most importantly, the projects showed that animal identification and tracing can be implemented successfully in a production environment. The projects gave stakeholders "hands-on" experience using identification technologies and, as a result, delivered practical solutions for their routine use. In fact, many of the projects tested the technology in real-world scenarios, integrating animal identification and movement reporting into everyday commerce. These efforts have provided critical information and, in some cases, documented data about the day-to-day use of animal identification and tracing technology.

For example, the project results demonstrate successful advancements in automated data capture, which is essential for animal identification and tracing to function effectively in commercial production environments. Demonstrations conducted early on in the projects produced only 50-60 percent read rates (percent of animals whose identification code was recorded) when using low-frequency RFID. Project coordinators identified a variety of issues that affect the effectiveness of tags and scanners (data capture) in real-world scenarios. These include the read range of the scanner, the readability of tags, the location where the scanning takes place, and any interference from existing structures and other factors. After studying these issues and identifying practical solutions, many of the final project summaries now report read rates of 90-99 percent. This drastic improvement was a direct result of the continued evaluation, trial and error that occurred throughout the pilot projects.

II. 2004 INITIAL PILOT PROJECTS AND FIELD TRIALS

OVERVIEW AND OBJECTIVES

For this first stage of the NAIS pilot project program, projects focused on:

1. the testing of protocols and procedures that were being recommended for NAIS to determine their practicality;
2. developing or further testing the integration of solutions for data collection; and
3. other issues that supported topics of interest or concern to the Species Working Groups, with those recommended as needing testing or further development as the priority, including projects to demonstrate:
   - the system's ability to maintain normal animal flow through livestock auctions and subsequent premises while reporting animal movement data;
   - the value of State Brand Inspection Programs to support the implementation of the NAIS;
   - the feasibility and practicality of incorporating the commercial transportation industry for collecting animal movement data; and
   - the effectiveness of group/lot identification for animal health management.

USDA did not request or require the testing of any specific technology for these projects. However, the participating States chose to use low-frequency radio frequency identification (RFID) technology in all of the 16 pilot projects; these decisions were made solely by the States/Tribes conducting the projects. It is also important to understand that the results of these projects should not be interpreted as hard science. The pilot projects were developed in applied situations to demonstrate the feasibility of identification technologies and document their performance in those specific situations. Many factors affect the performance of any animal identification technology, especially low-frequency RFID. Therefore, any comparison of products noted in this report should only be interpreted as an observation for that particular project unless specifically noted in the project results.

AWARDS AND EXPENDITURES OF FUNDS

In April 2004, $18.8 million was made available to USDA. Through this fund, 41 States and 2 Tribes received funding totaling approximately $13 million. All agreements required a plan for the implementation of premises registration. Sixteen cooperative agreements had pilot projects approved as part of their work plan. As of March 2007, $11.5 million has been expended.

To estimate the funds specifically utilized for each part of the work plans

with pilot project activities, the assumption was made that $110,000 of the total award amount was used to support premises registration activities (including outreach to producers). This provides the basis to note that $6.6 million was used to support the pilot projects and $4.8 million was expended on premises registration activities.

Summary of Awards and Expenditures for Initial Projects Funded through CCC Funds 04
March 26, 2007

State	1 = Pilot Project	CCC 2004		Funds for Project Pilot[1]		Funds Premises Reg	
		Awards	Expenditures	Allocation	Expenditures	Allocation	Expenditures
Alabama		$115,000	$115,000	$0	$0	$115,000	$115,000
Alaska			$0	$0	$0	$0	$0
Arizona			$110,000	$0	$0	$0	$110,000
Arkansas		$115,000	$115,000	$0	$0	$115,000	$115,000
California	1	$752,000	$670,072	$642,000	$560,072	$110,000	$110,000
Colorado	1	$1,214,579	$937,140	$1,104,579	$827,140	$110,000	$110,000
Connecticut			$0	$0	$0	$0	$0
Delaware			$0	$0	$0	$0	$0
Florida	1	$531,840	$531,840	$421,840	$421,840	$110,000	$110,000
Georgia		$120,000	$77,480	$0	$0	$120,000	$77,480
Hawaii			$0	$0	$0	$0	$0
Idaho	1	$1,164,000	$770,941	$1,054,000	$660,941	$110,000	$110,000
Illinois		$130,000	$130,000	$0	$0	$130,000	$130,000
Indiana		$130,000	$101,622	$0	$0	$130,000	$101,622
Iowa		$130,000	$130,000	$0	$0	$130,000	$130,000
Kansas	1	$805,000	$523,531	$695,000	$413,531	$110,000	$110,000
Kentucky	1	$269,093	$246,002	$159,093	$136,002	$110,000	$110,000
Louisiana		$100,000	$4,873	$0	$0	$100,000	$4,873
Maine		$78,343	$78,343	$0	$0	$78,343	$78,343
Maryland		$105,000	$61,015	$0	$0	$105,000	$61,015
Massachusetts			$0	$0	$0	$0	$0
Michigan		$120,000	$103,876	$0	$0	$120,000	$103,876
Minnesota	1	$434,578	$430,372	$324,578	$320,372	$110,000	$110,000
Mississippi		$153,327	$124,806	$0	$0	$153,327	$124,806
Missouri		$433,064	$467,166	$0	$0	$433,064	$467,166
Montana	1	$431,928	$431,928	$321,928	$321,928	$110,000	$110,000
Nebraska		$130,000	$125,401	$0	$0	$130,000	$125,401
Nevada		$99,999	$49,817	$0	$0	$99,999	$49,817
New Hampshire			$0	$0	$0	$0	$0
New Jersey		$100,000	$100,000	$0	$0	$100,000	$100,000
New Mexico			$110,000	$0	$0	$0	$110,000
New York		$115,000	$93,000	$0	$0	$115,000	$93,000
North Carolina		$120,000	$97,388	$0	$0	$120,000	$97,388
North Dakota	1	$515,000	$468,631	$405,000	$358,631	$110,000	$110,000
Ohio		$130,000	$117,135	$0	$0	$130,000	$117,135
Oklahoma	1	$675,000	$516,213	$565,000	$406,213	$110,000	$110,000
Oregon			$0	$0	$0	$0	$0
Pennsylvania	1	$615,000	$614,147	$505,000	$504,147	$110,000	$110,000
Rhode Island			$0	$0	$0	$0	$0
South Carolina		$199,865	$186,727	$0	$0	$199,865	$186,727

South Dakota	1	$505,240	$481,032	$395,240	$371,032	$110,000	$110,000
Tennessee		$130,000	$130,000	$0	$0	$130,000	$130,000
Texas	1	$1,000,000	$1,000,000	$890,000	$890,000	$110,000	$110,000
Utah	1	$182,100	$149,586	$72,100	$39,586	$110,000	$110,000
Vermont		$100,000	$84,059	$0	$0	$100,000	$84,059
Virginia		$115,000	$112,636	$0	$0	$115,000	$112,636
Washington		$115,000	$100,956	$0	$0	$115,000	$100,956
West Virginia		$100,000	$95,090	$0	$0	$100,000	$95,090
Wisconsin		$100,000	$100,000	$0	$0	$100,000	$100,000
Wyoming	1	$361,929	$361,929	$251,929	$251,929	$110,000	$110,000
Tribes	1	$250,000	$235,176	$140,000	$125,176	$110,000	$110,000
Total	**16** [2]	**$12,991,885**	**$11,489,928**	**$7,947,287**	**$6,608,540**	**$5,044,598**	**$4,881,388**

[1] *For cooperative agreements with pilot projects the assumption was made that $110,000 of the total award amount was used to support premises registration activities (including outreach to producers).*

[2] *Arizona and New Mexico received funding through the cooperative agreement awarded to Colorado. Utah participated in the Northwest pilot project (Idaho). Arizona, California and Oregon participated and received funds through the Southwest project administered by California*

SUMMARY OF LESSONS LEARNED

The initial pilot projects produced a number of valuable lessons learned and other key findings. An overview of these results is provided below.

- *The retention rate of RFID button-button tags is significantly higher than anticipated.* In the Southwest pilot project, a producer with 6,000 tagged animals reported a retention rate of nearly 100 percent, compared with a 96-98 percent rate for visual tags. Other participating producers found similarly high retention rates with properly-placed RFID tags.
- *The use of RFID at the auction market can reduce the need to restrain animals when recording their individual ID numbers.* The Minnesota project concluded that RFID technology in this environment can actually improve animal and human safety.
- *Using the group/lot method of animal identification can significantly reduce a major barrier for producers to participate in NAIS.* In the Northwest region, groups of animals are often moved and managed together in situations where uniquely identifying them is virtually impossible without causing a serious and often detrimental change in the way business is conducted. The Northwest pilot project found that group/lot animal identification mirrors the natural flow of commerce in this region. The project concluded that group/lot identification is an important option for western cattle operations, but also acknowledged that individual identification is necessary if animals are commingled with cattle from other premises.
- *RFID technology is not a "plug-and-play" application and must be customized to individual locations—the needs of which vary tremendously.*

In the Texas pilot project, the sites chosen for testing were often ill-suited for immediate installation of equipment and required a time-intensive process of site surveys and collaboration with facility owners to prevent any interference with the natural flow of commerce. Several facilities in the Southwest pilot project also required modifications (i.e., retrofitting existing facilities) to resolve interference problems with the panel readers. Overall, the majority of projects reported that the RFID/reader technology required careful setup, calibration, modification, and use.

- *Proper tag application and placement has a direct and significant impact on the retention and readability of the tags.* The Kentucky pilot project shows that RFID ear tag application and placement alone can account for as much as 40 percent of the variation in read rates and retention.

- *In certain environments, the automated recording of animals' identification as they are loaded onto and off-loaded from trucks is critical for successful animal tracing.* While RFID technology is promising to achieve this goal, the Kansas pilot project found that improvements and advancements in the technology are still needed to make the "on-board" RFID systems more rugged. The project found that the available hardware/software needs to be refined to require less human intervention. In addition, it is important for service providers to be fully integrated (share information across systems), to ensure that checks and balances can be programmed as needed in the transportation environment.

- *Animal identification number (AIN) radio frequency (RF) eartags used for NAIS can also support value-added opportunities.* Florida's pilot project demonstrated the market-driven benefits of electronic animal identification and tracing. In one segment of the project, 6,500 individually identified cattle qualified as source-verified beef and yielded monetary premiums (totaling $56,000) during an industry-sponsored heifer sale. In another segment of the project, the Seminole Tribe also realized market-driven benefits when calves with electronic identification garnered premium amounts in a video auction sale.

- *Information collection for NAIS can be achieved effectively through programs producers are already engaged in for management and/or marketing.* For example, the Pennsylvania project built upon the existing infrastructure of the national Dairy Herd Improvement (DHI) program. The DHI system proved to be an effective partner in collecting data for NAIS data collection, and did so in a producer-friendly manner by using systems already in place and utilized by many producers. The Northwest Pilot Project also found that producers are most eager to participate in animal identification and tracing when existing systems are utilized for data collection.

- *Producers' access to technology—or lack thereof—is a key factor impacting participation in animal identification and tracing systems.* The Southeastern Network Pilot Project found that only approximately 15 percent of producers involved in the project had internet access and used e-mail. The Northwest Pilot Project also found that many producers do

not have convenient access to technology, or were not comfortable using the technology. Results from both projects highlight the need for non-electronic data collection methods requiring minimal action on the part of producers.

- *Buy-in for animal identification and tracing must extend beyond producers to include others involved in the production chain.* In several projects, data collection was hindered because individuals in key industry segments (i.e., auction markets, slaughter facilities, and commercial transporters) lacked understanding of the technology and basic procedures involved with animal identification and tracing systems. During the Minnesota pilot project, the participating slaughter facility did not report equipment failures to State officials or manufacturers because the problems did not interfere with the facility's own operations. Such results demonstrate that outreach, education, and market incentives will be especially important within these groups to achieve the animal tracing goals of NAIS.
- *The cost-effectiveness of LF-RFID must be evaluated according to species.* The Montana pilot project found that individually identifying all animals in a sheep production system would be too expensive unless it could create value-added benefits. A subsequent project is now being conducted to evaluate the potential use of group lot ID systems within sheep marketing channels.
- *Participants at all levels of production need to be well-informed about basic procedural matters related to animal identification.* The North Dakota CalfAID project found that facility owners were often unaware of the purpose of the project's RFID tags. As a result of the common practice at feedlots and other such facilities to remove all eartags from animals upon arrival, the potential outcomes of the project were lost. It will be especially important to educate the entire industry about animal identification practices to prevent the removal of official identification devices.
- *Workable options are available for producers who want to identify their animals electronically without the added expense of reader equipment.* Producers in the Northwest pilot project found value in using "matched set pairs" of eartags. A group/lot visual tag was used for day-to-day management purposes and then matched with an individual RFID tag number—without the use of an RFID reader or software—when the animal moved off the premises. The project also determined that this method can work well with other related management and marketing programs, such as process-, age-, and source-verification.
- *The level of training equipment operators receive directly impacts data collection and, ultimately, the system's success.* In the Oklahoma project, employees at most locations were either unprepared or unwilling to properly operate computer equipment, resulting in poor data capture rates. However, the South Dakota project reported that equipment performance improved with operator training and experience. In fact, all facilities in this project experienced improved read rates as employees

became more familiar with the equipment.

- *The use of electronic identification allows for more accurate and efficient recordkeeping.* During the Southwest pilot project, many producers who were exposed to RFID technology for the first time reported a significant reduction in data entry errors. It was also reported that the use of the technology enhanced business practices and, as a result, reduced labor costs.
- *Calves can be tagged successfully with RFID devices at a very young age.* In the Tri-National project (Arizona), dairy calves from 3 to 5 days old were tagged upon arrival at a participating calf ranch and then shipped to a feedlot at 6 to 8 weeks of age. The project reported acceptable tag retention rates.
- *Effective, producer-focused outreach and education is critical to the success of an animal identification system.* The Texas pilot project reported that the biggest challenge in implementing animal identification was not the technology itself, but rather the attitudes among livestock owners towards the technology. State and industry outreach efforts were able to address many common misconceptions about the capabilities of RFID technology and foster participation in the project. Explaining the need for and value of animal identification, with a specific focus on how identification devices can add value to livestock, was particularly effective in garnering producer support.

OUTSTANDING ISSUES

The initial pilot projects also found that there are existing gaps in the current technologies and, based on these findings, identified advancements and/or expectations of future technologies. These outstanding issues are summarized below.

- *The read-range of RFID must be improved so that animals in certain environments can be read at farther distances.* In some livestock management or handling operations (e.g., markets), this will be necessary to avoid the reconfiguration of facilities and to maintain the movement of animals through these operations at the "rate of commerce."
- *More user-based information and guidance documentation is needed on the capabilities of RFID reading systems, how they function, and how individual users can evaluate opportunities specific to their business/operation.* Additional research and support of resources focused on these end results would enable the development of reference manuals for producers, market operators, and other individuals considering the integration of RFID technology. Such unbiased documentation could provide insight on how the necessary gates, walkways, corrals, etc. can be designed and set up to achieve acceptable animal flow and read rates through a facility.
- *RFID readers should be standardized to maximize the performance capabilities of both Half and Full Duplex technologies.* The need for such standardization was evident in the Southwest pilot project: readers that

were tuned to read specific manufacturer tags caused lower performance when reading other vendor tags.

- *RFID readers must be capable of re-tuning automatically to adjust to interferences (i.e., electric motors, florescent lights, etc.) in variable environments.* Equipment distributors in the Texas pilot project found that existing structures within the markets often impeded the proper functioning of identification and tracing equipment. Resolving these problems quickly required timely customer service by the equipment distributor. Because local on-site service is often not available, RFID readers with auto-tune capabilities could help prevent unnecessary delays and downtime. Auto-tuning panel RFID readers, while provided by some companies, needs to become the norm, or at least more widely available.
- *Additional research is needed to determine the optimum location to place RFID tags.* The Pennsylvania pilot project recommended placing tags at the top of the ear (rather than in the manufacturer's suggested location) for improved tag-reading. The Southeastern pilot project reported that best results were obtained by placing tags in the mid-third of the ear. Further research on the issue of tag placement would help resolve these conflicting results.
- *Scanning systems will require further testing to assess their maximum capabilities.* The South Dakota project reported that markets had not received enough electronically identified cattle to fully test the scanning systems. In addition, the sale barns in that pilot did not receive enough tagged cattle to test their systems during full-scale operation.
- *More documentation is needed to understand the effects of extreme temperatures, particularly in cold climates, on RFID technology.* The Montana pilot project reported that temperature affected the read range of RFID tags and readers, but did not affect readability. The effect of temperature on read range varied by model of tag-reading device. Further evaluation of this issue would help determine the extent to which temperature/climate variations should be considered in the design of RFID tags and readers.
- *Defining acceptable read rates in differing environments is critical, as is establishing the requirements or protocols for administering RFID tags.* The read rates in many of the field trials improved over time, but rates of 100 percent may not be realistic or is cost-prohibitive. A study to recommend adequate levels of recording animal identification codes in order to achieve adequate traceability is warranted; processes to administer the "no-reads" should also be developed.
- *In order to justify the integration of electronic data collection systems based on RFID, livestock markets must have the capability to interface these systems with their existing business accounting systems.* Otherwise, markets cannot achieve efficiency in the management of their operations. Current systems at livestock markets are not geared to store and administer RFID codes. Further research is needed to determine the software revisions needed at these facilities and the most practical approach for integrating new and existing systems.

FLORIDA PILOT PROJECT

Participants: Florida Department of Agriculture and Consumer Services (FDACS)
Seminole Tribe of Florida
Florida Cattlemen's Association
Florida Association of Livestock Markets
Florida A&M University
University of Florida

Funding Expenditure: $421,840

SYNOPSIS

The Florida Pilot Project (FPP) tested applications and aided the implementation of identification and tracing elements of NAIS in various settings. The FPP approached the latter by focusing on value-added opportunities for producers. All electronic identification was low frequency, radio frequency identification (LF-RFID). The project was broken down into four segments: the calf segment, the cull cow segment, the Seminole Tribe of Florida segment (which also pertains to cattle), and the equine segment.

Calf Segment

Approximately 17,000 Florida calves were electronically identified and shipped to feedlots in Texas and Kansas. The purpose of this segment was to evaluate: (1) tag retention, and (2) the compatibility of electronic identification devices and technology with the Interstate Certificate of Veterinary Inspection (ICVI) system.

Cull Cow Segment

6,500 cattle that were individually identified by conventional or electronic means and traced through the processing system qualified as source-verified beef in the cull cow segment of the FPP. Industry-sponsored incentives yielded monetary premiums (totaling $56,000) for these animals during a Florida Cattlemen's Association heifer sale. As part of this segment, education and outreach activities were conducted through contract partners to increase participation in NAIS.

Seminole Tribe of Florida Segment

More than 12,000 cows and calves were electronically identified in this segment of the project, which allowed the Seminole Tribe of Florida to incorporate individual animal identification for information management and value-added opportunities. The identification of cattle aided in the Seminole Tribe of Florida's computerized record management of 68 individual herd owners' cattle that are managed in commingled herds. RFID readers and electronic scales were installed as part of this segment of the FPP. Market-driven benefits were realized when calves with RFID garnered premium amounts in a video auction sale.

Equine Segment

Through the equine segment of the FPP, 200 horses were implanted with microchips; microchip readers were installed at the State's agricultural interdiction stations; and FDACS personnel were trained to use the technology. The initial reading of microchips generated broader interest among equine

owners in using this technology. The microchip technology was evaluated in concert with the use of equine "smart cards," part of the Florida Equine Interstate Passport Card program that was implemented during the FPP. Each tamper-resistant card has a photograph of the horse along with the animal's test history and health certification. Ten States now accept these cards in equine movements. Premises registration is now required in order to obtain this passport card.

LESSONS LEARNED

The FPP demonstrated the value-added potential of electronic identification and tracing in cattle programs, increased producer participation in NAIS, and resulted in the generation of unique identification numbers for several thousand head of cattle. FPP management reports that the project produced valuable feedback for participating cattle producers in terms of performance and health-related information.

IDAHO/NORTHWEST PILOT PROJECT

Participants: California, Hawaii, Idaho, Nevada, Oregon, Utah, and Washington
Funding Expenditure: $660,941

- IDAHO

SYNOPSIS

The initial objective of the Idaho Coalition NAIS Project was to involve project partners in a cooperative effort to explore feasible options for implementing NAIS in Idaho that would translate into practical solutions for the State's beef, dairy, sheep, and cervidae industries.

RFID placement and data collection for cattle segment

Projects were implemented to familiarize Idaho State Department of Agriculture (ISDA) staff, project stakeholders, and producers in the State with the technology involved. This also gave State officials the opportunity to engage in open dialogue with producers about the project. Unfortunately, there were not enough tagged animals or programs that presented premiums for cattle running through a livestock market. Most of those animals that were tagged were moved by private treaty.

Cattle tagging and reading demonstrations were held in several environments for different users, including: a dairy and dairy heifer buyer; a rodeo producer; beef producer on the range; veterinarian; beef feedlot; and livestock market. Several tests were also set up for testing read rates during a shipping (loading or unloading) scenario. For all of these demonstrations, animals were tagged and data was used for different purposes – health management, to demonstrate tag retention, and record-keeping – and overall to familiarize users with the technology and to determine the most effective technology.

RFID placement and data collection for cervids segment

Tagging elk on ranch: In addition to cattle ranches, Idaho has a large cervidae population. With RFID tags provided through the USDA Chronic Wasting Disease (CWD) program and funds from the Animal ID grant, ISDA provided its investigators with the tools to read and capture RFIDs and add related data of each animal into a computerized system for use in CWD regulatory purposes.

Equipped with ruggedized laptop computers and wand readers, ISDA investigators tagged over 2,000 head of domestic elk. This process has streamlined the collection of regulatory data in Idaho.

Cervidae passive read RFID system: Idaho tagged 26 head of bull elk with Allflex Half-Duplex (HDX) low-frequency 134.2 KHz RFID tags placed near the root of the left ear. All elk were successfully identified during the 72-hour test. The actual timeframe required to inventory the elk actually took less than 36 hours. No animal handling was required during the entire test period. It took Ranger ID less than 30 minutes to install and configure the mobile detection system.

LESSONS LEARNED

- *RFID electronic ear tags had better retention than visual bangle tags*. However, functionality was excellent for all three tag systems used. Idaho identified only one non-functional tag (in 2006), which was returned to the manufacturer for analysis. The stability and life-span of RFID tags was good with no non-functional tags identified in those tags placed in 2005 and 2006. Of the tags placed prior to this project, only three tags have failed.
- *Tag application required training of personnel to ensure correct tag placement.* Idaho found that tags should be placed deep enough into the ear base (about 1½ inches from the inside attachment of the ear). Placing RFID eartags on top of the ear base or out on the pinna increased the loss rate and required repeat application to the back and base of the ear. State officials found it was important to emphasize that the eartags and applicators were manufacturer specific and could not be interchanged. however, ranchers did not feel this was a hindrance to utilizing RFID eartags.
- *It is unlikely that the tag application operation contributed to the transmission of the warts.* RFID eartags are designed for single use by all of the manufacturers. The stud/needle is used only once, consequently, there is no means to carry and inject material from one animal to another.
- *When working in the high speed of the ranch cattle processing operation, reader operators were initially concerned about interfering with the ongoing process and were too fast at trying to read the tag numbers.* Reader operators had to learn to slow down to allow reader activation after the activation button is pushed to permit the reader to capture the data for transmission to the computer. Reader operators became less impatient and more deliberate in their movements associated with tag reading minimizing the number of "rereads" in order to capture the number.
- *All readers have defined reading ranges and reading sites within the reader and operators had to learn the best read range and location to be effective.* In operations utilizing head catches, reader operators have to redouble efforts to effectively read the tags through deliberate and slow movements of the reader over the ear tag.
- *Adaptation of reader/computer systems to wireless communication was considered by the cooperators as the "best improvement" in RFID data collection.* Wireless systems reduced congestion in the work area that was associated with cabled systems. The direct connect BT system eliminated interference problems associated with the discoverable systems and also had a longer transmit range permitting computers to be placed indoors in inclement conditions.
- *Both software systems utilized in this project functioned as expected.* Both were simple and reliable for collection of RFID data and both programs will automatically and continuously collect individual numbers. The Excel program required purchase of a program called a "wedge" to read RFID data and transmit to an excel

program. The GAM program data can be exported on site to an excel spreadsheet; however, the data requires considerable massaging to make a simple, comprehensible report. GAM data was routinely uploaded to the GAM server for report generation which required internet access and 1-2 days for turnaround. GAM provided excellent support throughout the project.

- *Rancher/producers and cooperators were very receptive of RFID eartags for individual animal identification.* All were concerned about the retention, stability, etc. of the systems when compared to the cost and retention/stability of the standard visual system. We were able to demonstrate that RFID systems had better retention than visual systems and that tag failures were minimal although long term follow up would be needed.

- NORTHWEST PILOT PROJECT

SYNOPSIS

The Northwest Pilot Project (NWPP) used real-world production scenarios to test the effectiveness of a variety of identification methods, including both electronic and visual tags. To fully test these methods, the NWPP worked with an independent third party to create a temporary animal identification and tracking system (similar to the animal tracing component of NAIS). The interim system was designed not only to collect information, but also to transfer that information to permanent NAIS-approved databases in the future. A main goal of this project was to successfully track 27,000 livestock animals (approximately 135,000 animal movement events) within budget. In tracking animals within an interim system, the NWPP worked to identify issues that erode the integrity of data and the ability to trace animals back to their herd of origin.

The NWPP recruited producers who met certain criteria to participate in the project. Individual producer participants chose the identification methods and devices they would use to track their animals. The breadth and diversity of producers involved in the NWPP allowed for a wide variety of third party vendors (i.e., feedyards, packers, auction barns, etc.) to participate in the project. This variety of participants accurately reflected the competitiveness of a real marketplace, and, thus, modeled how a market-driven animal identification system would function.

Because of the unique animal management/production systems in the Northwestern United States, evaluating the day-to-day use of animal identification and tracking in this specific region of the country was particularly valuable. For example, there is a significant dependence in the Northwest on public lands grazing, which results in a lack of contact with animals for extended periods of time and the often unmanaged movement of cattle across State lines. This was one of many challenging situations for which the NWPP sought practical recommendations/solutions that could work for other producers in similar scenarios.

LESSONS LEARNED

The NWPP succeeded in identifying 30,351 animals, which exceeded the initial goal (27,000 animals registered). Overall, the NWPP was able to re-

cord 44,593 animal movements. While this number did not meet the NWPP's original goal, the project gave important insights about: (1) methods of identification that work best in the Northwest; (2) cost-saving options for electronic identification; and (3) challenges in motivating producers and livestock facilities to report animal movements.

Methods of Identification

The NWPP determined that the group/lot method of animal identification and tracking is one of the most important options for participants in the Northwest region. There were 207 group animal movements reported to the NWPP database. If these entries had been made as individual animal movements, they would represent approximately 21,946 movement events—nearly half of the total animal movements reported to the NWPP. In the Northwest region, groups of animals are often moved and managed together in situations where uniquely identifying them is virtually impossible without causing a serious and often detrimental change in the way business is conducted. Given the remote location of western cattle operations, reading an individual identification tag is difficult at best, if not impossible. In these types of scenarios, group/lot animal identification mirrors the natural flow of commerce and how business is conducted by these producers. Using this method in as many cases as possible has the potential to significantly reduce a major barrier for some operators to participate in NAIS.

Cost-Saving Identification Options

Another valuable identification tool for the Northwest region is the use of "matched set pairs," or matching an individual RFID tag with a group/lot visual tag. The individual RFID tag includes a 15-digit "Animal ID" number; the visual tag has room for both the 15-digit number and an additional number (i.e., herd management number or ID number for a marketing program). The visual tag can be used for day-to-day management purposes, such as separating groups of animals or matching a calf to its dam. The NWPP determined that, when the animals move from the premises, the producer can record the visual tag numbers and match them with the RFID tag numbers—without the use of an RFID reader or software. By eliminating the need for expensive equipment at the producer's operation, the "matched set pair" method offers a cost-saving option for producers who want to participate in electronic identification, but do not want the added expense of reader equipment. This method can also work well with other related management and marketing programs, such as process-, age-, and source-verification. The NWPP found that collecting information for NAIS can become an easy off-shoot of the efforts producers are making for other disease programs and marketing purposes. If NAIS has value in the marketplace, producers will be quicker to adopt and invest in the system because the marketplace itself will help pay for NAIS

implementation.

Challenges to Animal Reporting

As NAIS is currently designed, the system relies on producers and livestock facility managers (livestock markets, feedlots, packing plants) to report animal movements to State/private tracing databases. When the NWPP simulated the tracing system, many producers and facility managers who had previously agreed to report animal movements did not follow through with reporting—even when incentive payments were offered. The NWPP concluded that the main reason for this lack of participation/data entry from producers was that many of them did not have convenient access to technology (i.e., internet access, etc.) or were not comfortable using the technology. The NWPP determined that, for producers, having flexible ways to enter data into the NAIS system (other than electronic means that require computer knowledge) will be essential to gain participation

For the livestock facilities, there was a lack of electronic infrastructure at their locations to easily collect and transmit NAIS information. This was the primary reason for a lower-than-anticipated level of participation from these facilities. The NWPP concluded that a major infrastructure investment by the industry will be essential to streamline the process and provide adequate reading and reporting systems at this level in the production chain. States that participated in the NWPP are continuing to look for solutions and ways to help build this infrastructure throughout the Northwest region.

KANSAS PILOT PROJECT

Participants: Kansas Animal Health Department
Kansas Department of Agriculture
Kansas Livestock Association
Kansas State University
National Beef
U.S. Premium Beef

Funding Expenditure: $413,531

SYNOPSIS

This pilot project assessed the feasibility of using RFID technology in multi-deck commercial trailers to monitor movement of cattle and swine. Under this system, animals are identified not only individually but also as a full or mixed load lot. The primary purpose of the Kansas project was to address those frequent occurrences in which cattle are transported and unloaded into pastures or facilities that might not have acceptable equipment or chutes available to read RFID devices at loading or unloading. This project evaluated a novel approach of placing readers on the back of livestock haulers to facilitate the reading of RFID animal identification tags as animals entered or exited the trailers.

The tests compared different brands of RFID tags against one other, and also evaluated the readability of groups of animals with tag from multiple manufacturers (as opposed to tags from a single manufacturer). Initial test results showed that the brand of RFID tag made a substantial difference in performance. Another factor with a large impact was whether the test readings were conducted while loading or off-loading animals. The mixing of tag brands had an effect on performance, but a relatively small one.

A significant number of test readings were classified as incomplete because of factors including errors by the truck drivers in collecting data, shortcomings of the software, data not transmitting properly, and data not being received properly.

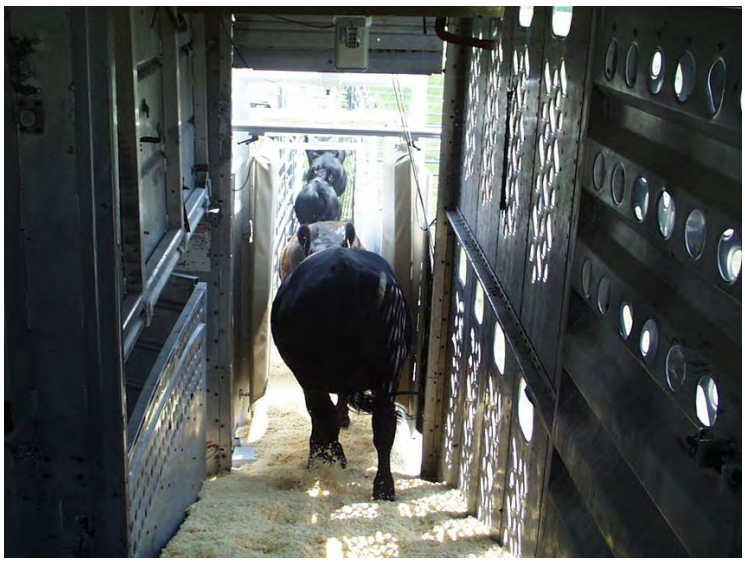
The proof-of-concept study concluded that (with the state of RFID and tag-

reader technology at the time of the project) about 75 percent of animal identification numbers could be accurately captured in a laboratory setting, and only 50 percent could be accurately captured in a real-world environment. The group felt that advancements in RFID reader technology and in data accumulation/ transmission—as well as greater availability of RFID transponders—would allow electronic animal identification to reach its full potential in environments where traditional RFID set-ups might not be available.

LESSONS LEARNED

The Kansas project identified a number of factors important to address when successfully using RFID technology in a livestock transportation environment. Specifically:

- The on-board RFID system needs to be more rugged to withstand the rigors of daily use.
- The electronics of the on-board system need to be refined to remove hardware and software glitches.
- To minimize difficulties with systems communicating to one another, the companies serving as data service providers need to be fully engaged.
- For consumers to become and remain confident in RFID technology, marked improvements will need to be made in the quality of RFID transponders.
- Truck drivers need an extensive training program in order to grasp the complexity of an on-board system.
- The transportation industry will have a role in the NAIS; their acceptance will be integral.



MINNESOTA PILOT PROJECT

Participants: Minnesota Board of Animal Health
Central Livestock Association
Protein Sources
Funding Expenditure: $320,372

SYNOPSIS

The Minnesota Board of Animal Health (MBAH) conducted two separate projects: 1) the beef project, which tested the use and applicability of RFID technology in real-world settings, and 2) the swine project, which tested RFID in swine production environments.

The beef project focused on a small segment of the beef industry—an auction market. In order to test the RFID equipment in this setting, three Minnesota beef producers volunteered to participate with MBAH. State officials gave each producer 100 RFID ear tags to identify their cattle before the animals left their home premises; each producer received ISO-compliant RFID tags from three manufacturers (Digital Angel/Destron, Y-Tex Full Duplex, or Farnam Full Duplex). The majority of these animals were destined for one auction market, Central Livestock Association (CLA). Therefore, CLA was equipped with the appropriate technology to read/capture the RFID tag numbers when the cattle were unloaded for sale. In carrying out this project, the goal was to learn more about (1) the effectiveness of the reading systems/equipment, (2) which brands of tags were most functional, and (3) whether the RFID scanning process affected the flow of business.

The swine project focused on a large swine production company, Protein Sources, in Minnesota and northern Iowa. The overall purpose of the project was to evaluate the use of RFID tags for individual and group/lot identification in a large swine herd. MBAH provided the company with RFID ear tags (from Digital Angel/Destron), and the tags were applied to a small percentage of pigs at weaning. The individual tags were linked to the animals' group/lot ID in a central database. The animals were then tracked through all stages of swine production, from the birth premises to the packing plant.

LESSONS LEARNED

The results of MBAH's projects show that motivation to report animal movement data is a key factor in recording animal movements successfully. In both of these projects, there were no incentives for producers and market operators to report animal movements. As a result, the overall collection of data was sporadic. To help address this issue, MBAH expanded the beef project to include identifying animals as part of control/eradication programs for bovine tuberculosis and Johne's disease. This solution proved very successful. MBAH found that, with a third party (in this case, State officials) responsible for reporting animal movements, the collection and transmittal of data was much more consistent and effective.

Beef Project

Using RFID at the auction market reduced the need to restrain animals, as there is minimal handling involved when scanning ID tags. In this regard, MBAH found that using RFID technology in this environment can actually

improve animal and human safety. The major challenge in this project was a lack of participation on the part of producers. Only one of the three producers who volunteered for the project sent all of his 100 tagged calves to market by the end of the year; the other two producers had yet to market the majority of their 200 tagged animals by the end of the project.

The producer who marketed 100 calves tagged the animals on his premises several weeks before sending them to CLA. This producer reported excellent tag retention using Farnam brand full-duplex tags.

The beef project revealed that readability of RFID tags can vary. When expectations regarding LF RFID tag readability are not met, it is important to contact the manufacturer for assistance in determining lack of performance.

Swine Project

The use of RFID tags at Protein Sources was highly successful. In fact, the company found that RFID provided management value to swine producers in their day-to-day operations. The project demonstrated that the use of RFID in real production environments is not only feasible, but improves producers' overall bottom line when used properly.

Another key lesson of this project was the importance of creating incentives for slaughter facilities to report/resolve problems with RFID equipment. There was a high level of participation from swine producers in this project. However, a lack of communication from the slaughter facility to MBAH/Protein Sources was challenging. In particular, the scanning equipment at the facility failed, and this equipment failure was not reported to MBAH/Protein Sources. By the time MBAH identified this problem, all of the target pigs had passed through the system. MBAH was then unable to account for the final read of animals at slaughter. Because the equipment failure did not hinder or otherwise impact the slaughter facility's own operations, facility personnel felt little responsibility or sense of urgency to report the failure. This situation demonstrates how essential it is for all parties, from producers to slaughter facilities, to have direct "buy-in" (e.g., market incentives, etc.) for the successful reporting of animal movement data.

MONTANA PILOT PROJECT

Participants: Montana Stockgrowers Association
Montana Livestock Marketing Association
Montana Woolgrowers Association
Montana Department of Livestock
Montana State University
University of Nebraska

Funding Expenditure: $321,928

SYNOPSIS

The Montana project consists of four trials focused on, respectively, animal identification in cattle, animal identification in sheep, animal tracing in cattle, and animal tracing in sheep.

The bovine identification trials are examining the long-term retention and readability of a variety of commercially available LF-RFID tags in a cattle management environment on several ranches. They also tested whether temperature affected tags or tag-reading devices.

The bovine tracing trial looked at animal identification at a livestock auction market. 144 calves from three different ranches were tagged with LF-RFID tags at their ranch of origin and, on arrival at the auction market, scanned into that premises using a walk-through (ATL) reader. Another group of calves were tagged at the auction market and then scanned using an Allflex hand-held reader.

The goal of the sheep trials was to evaluate available technology for its value, simplicity, and flexibility of use within the sheep industry. The existing National Scrapie Eradication Program for sheep contains the most advanced Federal ID system in existence for any livestock species in the United States. However, this program is based primarily on visual tags and, therefore, may not support the goal of achieving 48-hour traceback.

The sheep identification trial involved tagging 1,200 ewes from 2 producer premises with LF-RFID tags. Tags were read and evaluated. For the sheep tracing trial, RFID tags were placed on 1,600 lambs from 6 producer premises prior to shipping. The lambs went to 4 feeder premises in 4 different States prior to being shipped to slaughter in Iowa. Animal movements were traced using a combination of group lot ID and individual animal ID. In both trials, a number of factors are being evaluated, including tag loss and infection rate, tag reading percentage, effect of animal flow and movement on tag reader effectiveness, impact of multiple tag placement sites on tag reader effectiveness, and user acceptability of reader/antennas under normal management conditions.

LESSONS LEARNED

The Montana trials have obtained a number of informative results.

Bovine Identification Trials

- Some progress was made in addressing producers concerns about the long-term retention and readability of electronic tags. Tag retention and scan rates were over 99 percent after one year after application. These animals were restrained in a cattle chute and a hand-held reader used.
- Differences in performance among commercially available readers and LF-RFID tags were documented. There was a significant difference in read range among the six different LF-RFID tag designs. There was also a significant difference in read range for the five hand-held readers used.
- Temperature affected the read range of RFID tags and readers, but did not affect readability. The effect of temperature on read range varied by model of tag-reading device.

Bovine Tracing Trial

- There was a much higher read rate for cattle that were tagged at the auction market and subsequently scanned by a hand-held reader (100 percent), versus cattle tagged at their ranch of origin and scanned at auction using a walk-through (ATL) reader (75 percent). However, the later scenario more accurately represents the desired method of scanning at an auction market.
- Nearby metal in the fencing interfered with the read field of the ATL scanner, contributing to the lower read rate.
- Results of this trial indicated that a portable, temporary technology solution for scanning animals at the auction market was not practical. Accordingly, a permanent reading alley with panel readers has been constructed at an auction market in Montana, and further trials will be necessary to effectively evaluate the technology at that facility.

Sheep Trials

- Preliminary results suggested that individual LF-RFID tags can be used to trace lambs through feeder and slaughter channels. Discounting tags that were lost due to improper tagging, tags loss was less than ¼ percent.
- Systems must be implemented that will allow ID readings to occur at the speed of the market. A hand-held reader worked well, but required animals to be stopped in a working chute.
- Currently, individual LF-RFID of all animals is too expensive to be practical in a sheep production system unless other benefits, such as improvements in production efficiency, can be derived from it. A subsequent project is being conducted to evaluate the potential use of group lot ID systems within sheep marketing channels.

NORTH DAKOTA PROJECT – "CALFAID"

Participants: North Dakota Board of Animal Health (coordinator)
North Dakota Stockmen's Association
Dickinson Research Extension Center
Funding Expenditure: $358,631

SYNOPSIS

The North Dakota Board of Animal Health partnered with the Dickinson Research Extension Center (DREC) to carry out an NAIS pilot project called CalfAID. The overall goal of the CalfAID project was to identify and document the physical and electronic processes needed to reach the long-term objective of NAIS—tracing animals to their source locations within 48 hours. The CalfAID project was designed to evaluate the beef industry's current capabilities related to electronic cattle identification and the ability to trace cattle.

After holding informational meetings and issuing news releases about the project, DREC selected 25 North Dakota interested producers to participate in CalfAID. The number of calves within the producers' herds totaled 5,170; each of the calves was identified with an electronic identification tag using low-frequency radio frequency identification (LF-RFID). The animals were destined for a variety of locations, including market auctions, feedlots, and slaughter facilities. After the calves were tagged, individual producers conducted business as usual. DREC then attempted to trace the calves through a temporary database system (similar to the animal tracing component of NAIS) as they moved through commerce, beginning once the calves were sold.

LESSONS LEARNED

The CalfAID project produced valuable data for advancing the implementation of NAIS. Specifically, the results of the project provide tangible figures that document: (1) the need for a more efficient, modernized system of animal tracing for the cattle industry; (2) the importance of educating producers and other industry members about basic procedural matters associated with animal tracing; and (3) meaningful cost estimates for individual producers who participate in animal tracing.

Need to Improve Current Tracing Capabilities

The CalfAID results confirm that the existing systems available to trace cattle (i.e., health certificates, brand records, etc.) are not 100 percent effective and are inadequate to support traceback within a 48-hour timeframe. By the end of the project, DREC personnel logged nearly 820 hours (40 hours per week for 5 months for 1 person) and traveled more than 1,400 miles attempting to trace the 5,170 calves. It is important to note that this effort accounted only for the identified calves during the course of the project, and not for any potentially exposed animals—which would also be necessary to locate in an animal disease investigation.

Although the project calves were identified with LF-RFID tags, none of the animals were traced electronically from birth to harvest. Instead, DREC resorted to manual traceback methods to locate the calves. This was due, in

large part, to the lack of electronic connectivity from one premises to another. DREC found that, for value-added purposes, a number of parties were simply unwilling to use the same database.

Procedural Issues

A major challenge in the CalfAID project was the lack of awareness among livestock facility owners about basic procedural matters involved with animal tracing. This lack of awareness proved to be a serious obstacle to the successful tracing of calves. For example, of the 1,122 calves moving to backgrounding facilities, 79 percent had their electronic tags removed by facility operators upon arrival. The tags were removed from an additional 18 percent of calves once they left these facilities and arrived at feedlots.

DREC found that facility operators/owners were often unaware of the purpose of the CalfAID RFID tags. They viewed the tags as "one more" form of identification and did not differentiate it from other tags (i.e., vaccination, herd management, etc.); such tags serve little value once the animal has left its home premises and are frequently removed as a result. In addition, many of the facilities used non-ISO (International Organization for Standardization) reader equipment which was often incompatible with CalfAID's ISO-compliant tags. The resulting problems with readability/scanning caused frustration among facility operators and also led to the removal of the tags. To achieve the animal tracing goals of NAIS, participants at all levels of production must be well-informed about basic procedural matters, such as regulations prohibiting the removal of official identification devices and the importance of using ISO-compliant technology.

DREC personnel, with the help of producers and feedlot owners, were able to trace 85 percent of the study calves. However, with the assistance of professional brand inspectors, an additional ~14.5% were located. This only took an additional 8.5 hours combined for 3 brand inspectors. By using all forms of identification available, DREC and North Dakota brand inspectors accomplished tracing ~99.5% of the calves to the destination of the first premises. The CalfAID project revealed that while there is currently no perfect identification system available, their is great value in using all forms of identification available, including the brand inspection system.

The intent of the CalfAID project was to determine if animals were traceable. The intent was not to evaluate the proficiency of the systems with respect to the time it took to trace animals.

Cost Estimates

DREC was able to estimate the costs of animal tracing for individual calves in the project. This information has significant value for NAIS implementation, as it provides documented figures[1] for the costs of participating in an

[1] These figures show the costs of participating in an animal tracing system for value-added purposes—the data is not intended as an estimate of NAIS participation costs. If producers participate in NAIS animal identification and animal tracing, their costs will vary based on the particular identification/tracing services they choose. USDA has plans to conduct a benefit-cost analysis to more precisely forecast the potential economic effects of NAIS and provide a baseline for possible short- and long-term costs to NAIS participants.

animal tracing system for value-added purposes. The estimated costs from the CalfAID project are listed below:

- Tag, data management and verification—$5 per animal
- Calf working (labor/manpower), tag placement/documentation—$7 per animal
- Feedlot/packer electronic data management—$8 per animal
- ***Total estimated cost for tracing an animal—$20 per animal***

OKLAHOMA PILOT PROJECT

Participants: Oklahoma Depart of Agriculture, Food, and Forestry
Oklahoma Cattlemen's Association
Oklahoma Farm Bureau
Oklahoma Farmer's Union
Oklahoma Livestock Marketing Association
Oklahome Veterinary Medical Association

Funding Expenditure: $406,213

SYNOPSIS

The Oklahoma pilot project focused on implementing the NAIS in tracing animal movement at various marketing points. The project focused on beef cattle, and utilized RFID tag-reading setups at three different venues:

- Livestock auction markets (two facilities)
- Preconditioning facilities (two facilities)
- Gathering station (one facility)

The primary focus of the pilot was to integrate data-capture equipment at each location and test its effectiveness. RFID readers were set up in various combinations and configurations at both receiving and shipping chutes.

The pilot showed that the set-up configuration is very important to ensuring accurate reading of RFID tags and useful animal tracking. At most locations utilized for the Oklahoma pilot, a combination of poorly-trained employees and an unwillingness to alter the current chute set-up resulted in poor data capture rates.

LESSONS LEARNED

The project manager for the Oklahoma project identified a number of areas where animal tracing equipment set-up can be improved. Addressing the factors below is likely to result in higher read-rates and more successful systems.

- *Improper infrastructure drastically affected results.* Owners/operators were unwilling to alter their chutes for good performance—alleys were too wide for single-file reading, tag readers were too close to holding pens, and steel plates provided radio signal interference.
- *Customer service provided by manufacturers is critical to success.* Equipment providers did not supply adequate time or training. Manufacturers relied too much on location owner/operators to set up equipment.
- *Equipment relied too much on WiFi and Bluetooth wireless signals, which frequently failed.*
- *Location employees need to be adequately trained to operate equipment.* At all but one location, employees were either unprepared or unwilling to properly operate computer equipment.

PENNSYLVANIA PILOT PROJECT

Participants: Pennsylvania Department of Agriculture
National Dairy Herd Improvement Association
Funding Expenditure: $504,147

SYNOPSIS

The purpose of this project was to acquire NAIS premises ID among Pennsylvania dairy herds and begin field-testing RFID technology. The project was designed to build on the existing infrastructure of the national Dairy Herd Improvement (DHI) program. The DHI system has used animal identification and herd (premises) identification for over 100 years to provide management records for dairy producers. Through the DHI system, producers already collect and DHI maintains electronically most of the information needed by NAIS. Approximately 50 percent of the dairy herds in Pennsylvania and in the Nation are part of the DHI system. The project provided an opportunity to demonstrate that the data need for NAIS could be collected at the farm using existing DHI service providers and successfully transferred to PA HERDS, the State NAIS database.

Herd owners selected for participation in the project (a total of 210) signed an agreement that allowed their animal ID and movement data to be transferred to PA HERDS. In exchange they received RFID tags, assistance in tagging their animals, and their official Premises Identification Number. Two DHI field service providers, DairyOne and Lancaster DHI, applied nearly 50,000 Allflex full duplex tags to dairy animals and successfully delivered information to PA HERDS using two different data systems. In field testing, tags and tag-reading devices performed adequately. At the time of the project summary report, a total of 48,480 unique animal IDs had been submitted to PA HERDS.

LESSONS LEARNED

The Pennsylvania project demonstrated that the DHI system can be an effective partner in collecting data for NAIS, and do so in a manner that is "producer friendly" by using systems already in place and used by many producers. There is no need to develop a separate data collection system for NAIS. Producer confidentiality was not compromised as duplicate records were not made and NAIS data was stored solely on the State database.

Producer Interest in Participation

Because DHI producers are used to working with ID systems, they are receptive to NAIS and are interested in integrating RFID technology into their management systems. There were more producers interested in participating in this project than could be accommodated by the number of available tags. The project concluded that, if funds for additional ID projects become available, there are many producers who would be willing participants in those projects.

Successful Integration of Two Different Data Systems

Both field service providers, DairyOne and Lancaster DHI, trained staff to work with producers, install tags, and collect information for transfer to the State database. Tags were distributed and applied in a timely manner, and

data was successfully collected and transferred to the State database using the two different data transfer interfaces operated by the two service providers.

Tagging Results and Recommendations

Operations selected for the project offered the opportunity to work in all types of facilities. Stanchion/tie stall barns, various types of parlors, fence line head locks, and chutes were all used as tagging locations. The project concluded that:

- Fence line headlocks were generally the most efficient tagging locations; stanchion/tie stall barns and chutes were the slowest.
- Placing tags in an alternative location at the top of the ear (rather than in the manufacturer's suggested location) improved tag-reading.
- The location of the tags did not affect their retention rate over the twelve-month period of this cooperative agreement.
- Tag breakage problems resulted primarily from specific brands of tagging devices used to attach them, not from the tags themselves (or from tagging devices in general).
- The transition to RFID will be easier if calves are tagged at birth. Adult dairy cows should be tagged at a time other than milking time.

SOUTH DAKOTA PILOT PROJECT

Participants: South Dakota Animal Industry Board
South Dakota Department of Agriculture
Funding Expenditure: $371,032

SYNOPSIS

The South Dakota pilot project equipped livestock auction markets to scan cattle, collect animal identification data, and share data to the state-owned database in a way that did not alter the expected speed of commerce at the auction market facility. Eight sale barns were supplied with either panel or hand-held stick tag reading equipment designed with low frequency, radio frequency identification (LF-RFID) technology.

The primary focus of the pilot was to demonstrate the technology to both livestock auction facilities and producers while testing the implementation of the various set-ups. Participants were equipped at an average cost of $15,000, including up to $4,000 for any modification costs incurred in building a scanning alley.

The pilot showed that tag read-rates were high when equipment was properly installed and operator attended. Panel read rates tended to be 85-95 percent at the speed of commerce when equipment was functioning properly.

The SOUTH DAKOTA CERTIFIED ™ Beef and Enrolled Cattle program was launched by the South Dakota Department of Agriculture. This state-sponsored beef program implements premises ID, individual animal ID, and animal movement tracking for marketing initiatives.

The Adult Cull Swine project looked at official ear tags as a means to identify cull swine at sorting stations and packing plants. Test tags imprinted with varying fonts of ID numbers and US shields were evaluated for ease of recognition.

LESSONS LEARNED

Auction Market Project

The South Dakota project identified a number of factors that need to be addressed for successful implementation of animal tracing at livestock auction facilities.

- Signal interference was the most common cause of equipment failure. Trouble-shooting visits by equipment support personnel were necessary to re-evaluate facilities and determine causes of problems.
- *More information on proper scanning area design needs to be made available.* Because very little guidance was available, even from manufacturers, scanning alley design was done by trial-and-error. The participants frequently had to rely on guesswork when setting up facilities for good scan rates.
- *Equipment performance improves with operator training and experience.* Facilities that used the equipment more than once experienced improved read rates as employees became more familiar with the

equipment.

- *Markets have not received enough electronically identified cattle to fully test the scanning systems.* The sale barns in the pilot are not yet receiving enough tagged cattle to test their systems during full-scale operation.
- *Producer participation was a problem.* At some markets, producers would not allow employees to scan their cattle, and auction markets also experienced a drop-off in participation after Japanese markets were closed in early 2006.

SOUTH DAKOTA CERTIFIED ™ Beef Project

- *NAIS components can be used successfully in a marketing program involving producers, auction markets, feedlots, and packing plants.* By October, 2006, 150 producers and 13 processors were licensed in the program. The program continues to grow and add new participants.

Adult Cull Swine Project

- *Official tags on adult cull swine can be readily recognized visually in sorting station and packing plant situations.* Larger font size of official seal imprinted on tags increased ease of recognition.
- *It would be best if cull swine were tagged prior to arrival at the sorting station.* Snaring and tagging sows at the sorting station required extra labor and also caused sows to pile.

SOUTHEASTERN NETWORK PILOT PROJECT (KENTUCKY)

Participants: Kentucky Department of Agriculture
Southeastern Livestock Network, LLC (SELN), comprising:
Alabama, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia
Beef Information Exchange

Funding Expenditure: $136,002

SYNOPSIS

The Southeastern Network Pilot Project (SENPP) incorporated electronic technologies into the identification and data collection processes of auction market cattle sales. This in turn enabled the tracing of identified animals to a slaughterhouse and the reporting of their movements to the Southeastern Livestock Network's (SLN) database. Auction markets primarily use visual identification systems and paper-based data collection; computerized records in these markets are transaction-based and used primarily for accounting purposes. Ten stockyards, one slaughter facility/packing plant, and producers with cull cows participated in the project, which culminated in several trial sales of slaughter cows conducted between July and September in 2005. These sales successfully generated animal movement data conforming to NAIS standards and in so doing, demonstrated the potential for electronic identification to enhance the accuracy and speed of animal identification in the auction marketing system.

In order to determine how best to incorporate electronic technologies, the SENPP evaluated the effectiveness of readers and, to a lesser degree, RFID tags, in existing auction market environments with alleys of varying width. Since the NAIS will be market-driven and technology neutral, this aspect of the SENPP proved especially useful in identifying and defining needs and expectations of readers in an auction marketing system environment. Two companies

(Boontech and Allflex) have adapted prototypes in ongoing reader development projects to incorporate changes as a result of SENPP findings. (One of these—Boontech's—is a reader system designed for use in wide alleys. This system was tested separately during "special sales" of more than 10,000 animals, with a maximum of 2,700 animals being run

through in a single day, and demonstrated read rates that were repeatedly over 90 percent.) The SENPP's comparative findings were meaningful not just in terms of accuracy and performance, but also with regard to cost effectiveness, user-friendliness, portability, and sensitivity to environmental conditions.

Readers were generally mounted at locations such as the entry or exit to the scales where key data collection is already occurring as part of existing systems. When possible, the readers were directly linked to the software operating at the location and the identification numbers were captured and associated with the individual animals as part of the transactional record. The mounted reader systems performed with accuracy rates ranging from 89 to 99 percent on animals moving through sales at a normal pace. At the slaughterhouse (FPL Foods), the dual-panel reader systems mounted as part of the SENPP recorded the arrival of project animals at rates consistently higher than 90 percent. Arrivals were reported to the plant via a secure internet connection. Existing software systems at the slaughterhouse were used to collect, date, and report project animals' movements to the SLN database.

The typical producer in the Southeast—a significant feeder calf production area—is small and heavily reliant on auction markets. As a result, the SENPP exposed many producers, in addition to markets and marketers, to low frequency radio identification devices (LF-RFID). (Reader performance was gauged using both kinds of tags that are compliant with international standards—full-duplex and half-duplex.) The SENPP found that these producers generally supported the idea of improving current systems so that State animal health officials could access more accurate data in a timely fashion. However, a large percentage of them believed that the NAIS would disadvantage small producers and the existing auction system.

Most producers were willing to register their premises with the NAIS once SENPP managers explained the purpose of premises identification. However, the SENPP was conducted using a mock premises identification system due to the small number of producers with NAIS-registered premises. For the mock premises identification system, a unique identifier was generated for each market, producer, buyer, and the slaughterhouse; each entry included geographical information sufficient to drive mapping functions.

LESSONS LEARNED

Producer Participation

A continuing theme throughout the SENPP was that education and outreach went a long way in addressing producers' questions about, and reluctance to participate in, an electronic identification program. SENPP surveys also found that approximately 15percent of producers have internet access and use e-mail. This highlights the need for non-electronic data collection methods requiring minimal action on the part of producers.

Reader Performance

While the SENPP documented noteworthy differences in performance among RFID tags, the single most important variable affecting read rates was placement of the tags. The SENPP conducted a trial testing for this variable alone and found a read rate of 100 percent for tags placed in the

mid-third of the ear versus a read rate of 40 percent for tags placed in the top of the ear. Tags placed in the lower part of the ear resulted in high rates of tag loss and often infection and/or necrosis in the animal as well. Best results were obtained by placing the tags in the mid-third of the ear.

Most reductions in readers' performance could be attributed to alley systems that were increasingly wide or systems that were inflexible with regard to reading variable sizes of animals. Additionally, heavy-use reader installations at the slaughterhouse posed significant issues in terms of system maintenance and monitoring. Users must understand that these reader systems require periodic maintenance and monitoring in order to perform consistently.

Integration with Auction Market Systems

Integration with Auction Market Systems. The project found that the integration of NAIS data collection into existing, transaction-based auction market systems is time-consuming, but also well worth the effort. Of six software providers initially involved in this project, four were able to offer workable solutions. (One provider did not have the labor to complete the necessary programming changes. Another used this as an opportunity to perform a complete rewrite of its software package; the rewrite was not complete in time for the software to be included in the project.) The resulting systems varied greatly in terms of simplicity. One system in particular (GCS)—which had already been in use in the Canadian market—demonstrated during the project just how useful and user-friendly these systems can become.

Progressive software suppliers are already collecting data via integrated RFID readers. To expedite the development of software systems that are both NAIS-compliant and based on existing systems, project management found that it would be useful to define for software suppliers exactly what information and capabilities are needed. For instance, letting suppliers know the exact nature of the data to be collected, the format with which it must be compatible, as well as how, when, and to whom it will be passed would facilitate the development of successful, integrated systems. The more existing systems can be successfully used as data collection tools, the greater producer participation in the NAIS will be.

SOUTHWEST PILOT PROJECT (CALIFORNIA, ARIZONA, OREGON AND TEXAS)

Participants: California Department of Food and Agriculture
University of California-Davis (including Cooperative Extension)
Arizona Department of Agriculture
Oregon Department of Agriculture
Texas Animal Health Commission[2]

Funding Expenditure: $560,072

SYNOPSIS

For the Southwest Pilot Project (SWPP)—part of the larger Southwest Premises Registration and Animal Tracking Project—CDFA coordinated the implementation of a system to track animals' in-state and interstate movements in various segments of the dairy and dairy-beef industries. Animals were identified electronically using low frequency, radio frequency identification devices (LF-RFID). Of more than 31,000 animal movements tracked during the project, the vast majority—27,179—took place in California; 3,634 took place in Arizona; 546 occurred in Oregon.[3] More than 5,400 animals were tracked through two movements; over 2,800 animals were tracked through three or more movements. 4,951 cull cows from over 600 premises (dairies) were tracked through harvest and drew premium prices: $20 above market price for cattle born on the premises and $15 more per head for cattle with documentation that were not born on the premises.

Ten producers were surveyed to evaluate various aspects of the project including tag application, reader performance, and the user-friendliness of tracking software. Surveyed producers owned 98,000 animals and represented three dairies, four calf growers, two feedlots, and one beef cow-calf operation. On average, the ten operations interact with 25 other premises each year and 80 percent of the operations move animals daily.

Producer choice and existing systems determined which ISO-compliant RFID tags and readers were used during the SWPP. For tags, producers could choose full duplex (FDX) (provided by Temple Tags or Allflex), or half duplex (HDX) (provided by Allflex). With regard to readers, stationary readers (provided by Holstein/FAIR and Allflex) were only installed in higher traffic facilities such as calf growers and feedlots. Portable or handheld readers (provided by Temple and Allflex) were provided to the larger facilities as well. Handheld readers (supplied by AgInfoLink) were provided

[2] The TAHC was initially scheduled to participate in the SWPP but significantly reduced its contributions due to commitments with other pilot projects.

[3] The small number for Oregon does not accurately reflect its participation in the project. 2,555 tagged dairy calves originated in Oregon, but were not entered into the tracking database while in Oregon because of unspecified technical challenges. The 546 movements listed for Oregon were entered into the tracking database once the animals arrived in California. In addition to the 2,555 dairy calves, more than 9,000 cows were tagged in Oregon during the project.

to smaller facilities. Several dairies were not provided with readers because the calf grower was better equipped with labor resources to visually read the tags.

Holstein/FAIR and AgInfoLink submitted software systems that were used to capture and submit identification data to each company's database. Some producers also used third-party solutions, some of which were "homegrown systems", to submit data. AgInfoLink's Track Trace system central database was the final repository for data. Holstein/FAIR regularly submitted data updates to Track Trace, and AgInfoLink provided services to connect additional third-party databases to its central database. The SWPP provided funding for AgInfoLink's services.

The Track Trace system is accessible to users through an internet connection and provides the ability to conduct animal movement tracing on index animals and cohorts. It is combined with a user interface that incorporates GIS (geographic information system) software. CDFA wanted data ultimately to be submitted to one system.

With regard to premises registration, California interfaced its existing, compliant premises registration system with the NAIS premises registration. Oregon utilized California's premises registration system until it was capable of directly registering premises with the NAIS. Arizona registered premises separately through a compliant system during this project.

LESSONS LEARNED

Electronic Identification

Many producers who were exposed to electronic identification technology for the first time as part of this project reported that it greatly reduced data entry errors. At least one producer reported a reduction in labor cost resulting from the electronic technology's enhancement of business practices.

Market forces seemed to drive electronic identification more than NAIS. Producers were particularly interested in participating in programs such as Beef Export Verification, Quality Systems Assessment, and Process Verified Program. Confusion existed as to how participating in NAIS differs from participating in these programs.

Tags and Tag Placement

The SWPP did not comparatively evaluate tags. Although producers sometimes perceived performance differences between HDX and FDX tags, the differences were not elaborated on and were attributed to certain readers being tuned to certain manufacturer tags. The most noteworthy observations about tags pertain to their placement.

Producers who provided tag retention information reported the rate for RFID to be good, but found that proper tag placement was a significant factor in retention. One producer with 6,000 tagged animals reported a retention rate of nearly 100 percent, compared with a 96-98 percent rate for visual tags. An-

other producer, with 206 tagged steers, reported a retention rate of 98 percent. A third producer found good retention rates with properly-placed tags, but in cases of improperly placed tags—or tags that were placed using equipment that had not been properly sanitized—infection rates were as a high as 25 percent and retention was compromised. In most cases involving infection, the tags had been placed very close to the base of the ear and ultimately had to be removed. Healing time lasted several weeks.

Project findings indicate that the tagging problems are especially apparent in animals tagged at dairies, and therefore may indicate protocol and management issues at those operations. In any case, several RFID tag vendors are developing outreach materials to address proper placement of tags and sanitation of tagging equipment.

Producers also noted that some tag applicators could be improved so that they do not require as much force to place an ear tag. The significant amount of force currently required presents a challenge for operations with large numbers of animals.

Readers

Improvements are needed to enable stationary panel readers to perform at the speed of commerce. For instance, panel readers that were tuned to read specific manufacturer tags caused delays when reading other vendor tags. Another common observation was that panel readers should have a greater read range. During the project, several facilities had to be modified—some of them substantially—to address interference problems. This often required the retrofitting of existing facilities or the construction of new ones. Several producers were willing to accommodate these changes because of the improved management efficiency facilitated by electronic identification.

Portable or handheld readers received an above-average rating for design and durability and the reader technology evolved considerably through the course of the project. When the SWPP began, many portable readers required tethered connections to data storage devices; wireless technology soon became widely available and as a result was used during the project. One company increased the volume of its portable reader after hearing from producers during the project that the reader's beep (when a tag was read) was too low.

SWPP managers encourage software companies to do more focus group work with producers and to field test software and hardware extensively before releasing it on the market, especially to resolve problems experienced during the SWPP. For instance, the occasional loss of wireless Bluetooth connections was disruptive, and the problem was compounded when using reader units that power down (i.e. go into sleep mode). Also, software and

hardware incompatibilities existed among the various handheld LF-RFID units.

Software

Participating producers had an acceptable level of computer knowledge; many also had employees with some level of computer experience. Several producers emphasized the need for improvements in a majority of the software systems' user interface designs; namely, they should be simplified. While several producers did experience user interface or other technical problems, they also remarked on the reliability of vendors' technical support and availability to answer questions. (Producers who used the Holstein/FAIR software were not among those surveyed.)

TRI-NATIONAL PILOT PROJECT (ARIZONA, COLORADO, NEW MEXICO)

Participants: Arizona Department of Agriculture
Hopi Tribal Nation
Colorado Department of Agriculture (Administrator)
Colorado State University
New Mexico Livestock Board
New Mexico University
Navajo Nation

Funding Expenditure: $827,140

- ARIZONA

SYNOPSIS

Arizona officials conducted a pilot project testing low frequency, radio frequency identification device (LF-RFID) technology in auction and calf ranch environments. This is in addition to their participation in the Southwest Pilot Project (coordinated by the California Department of Agriculture), through which 3,634 animal movements in Arizona were tracked.

Auction

The Sun Valley Auction in Holbrook, Arizona, was outfitted with two panel readers, a laptop computer, and a personal digital assistant (PDA) to record the movement of individually identified cattle from the Hopi Tribal Nation's seven grazing districts entering the livestock market facility. The software program and equipment was purchased from Colorado-based RMS Research Management Systems, Inc.

Ranch

At the Kennedy Acres Calf Ranch in Casa Grande, Arizona, dairy calves from 3 to 5 days old were tagged upon arrival with RFIDs. The ranch owner used a wand and personal digital assistant (PDA) to read the information. The RFID tags were read again after 45 days when the calves entered walking pens. When the calves were 6 to 8 weeks old and weighed approximately 250 pounds, they were loaded single-file onto trucks for shipping to a feedlot.

LESSONS LEARNED

The tag retention rates through a calf ranch development program were acceptable and demonstrate that days-old dairy calves can be tagged successfully with LF-RFID devices.

As of February 2007, the read rate on beef calves coming into the Sun Valley Auction livestock market was 100 percent. The retention rate and readability at the livestock market—or the point of first commingling—demonstrated the potential for increased economic return on calves that are identified before leaving the premises of origin.

- COLORADO

SYNOPSIS

Colorado was interested in finding ways to utilize existing infrastructure, primarily brand inspectors, in reading, recording, and reporting of animal IDs. In addition, there was concern with verification of identity for lost tags or animals of high risk, such as elk facilities with Chronic Wasting Disease. This variety of objectives resulted in several projects trying to determine what equipment and resources would be necessary for NAIS to successfully move into the second and third phases.

Brand Inspector Segment

Various locations were set up with LF-RFID equipment to determine anticipated read rates for portable systems. Brand inspectors would use this portable system to read, record, and report animal IDs during normal movement inspections. This meant that all readings were performed on the same day that equipment was set up at the location. Locations included remote ranch loading corrals, ranch headquarters, university research facilities, commercial sale barns, and commercial feedlots. An unexpected inclusion to this segment occurred when Canadian cattle were allowed back into the United States for slaughter and into finishing feedlots. Brand inspectors at feedlots read, recorded, and reported all official identifiers on the Canadian cattle as they were processed into the feedlots.

Identity Verification Segment

Colorado State University (CSU) assisted the Colorado Department of Agriculture in establishing a research project to determine if it is possible to verify identity of livestock in a disease or quarantine situation. Retinal imaging and DNA testing, two forms of biometrics, were performed on cattle at a CSU research facility.

Equine Passport Segment

It is almost an understatement to say that equine exhibitions and activities, like rodeos, trail rides, and roping, are a major part of Western agriculture. The transient nature of these animals and the health concerns that come along with their mobility creates the opportunity to not only identify, read, record, and report animal IDs as part of NAIS, but also provide a real-time animal health information system. The concept of a passport for equines is rather simple to understand, but ironing out the specifics to make this concept a reality is extremely difficult.

LESSONS LEARNED

Colorado's lessons are rather basic but can be devastating when overlooked. While NAIS continues to develop, there is an ongoing need for real-world application and issues that must be tested and resolved.

- Proper animal handling becomes crucial to successful readings. The proper facilities and personnel that understand and execute safe and humane handling practices are more likely to increase read rates. Awareness of light reflections, sounds, and other distractions that may be introduced through use of readers or retrofitting facilities is vital for successful animal ID reads.

- When stationary readers were utilized, panels needed to be insulated from metal, and placement at distances of 30 inches or less between antennas helped increase read rates.
- Because of the lack of "plug and play" equipment, the need for trained employees is important. Additionally, the need for trained equipment maintenance personnel will increase as more technology is introduced into the marketplace. This includes, but is not limited to, individuals more knowledgeable in computer software, programming, and reader applications.
- While significantly improving the range and scope of activities and speed to respond, contracting with a private database manager was not enough of an advantage for Colorado to continue to support the use of private systems over public systems.
- Canadian cattle were successfully read (Bar-Code and LF-RFID tags) into feedlots through the use of brand inspectors and dedicated feedlot personnel. After reading nearly 50,000 head of cattle, it became very apparent that LF-RFID significantly increases the ease and capture rate of individual identifiers.
- Biometrics can and do verify the identity of animals and would be ideal for certain applications, including high-risk livestock. The DNA research was published in the Professional Animal Scientist, *Case Study: Use of DNA Fingerprinting for Verifying Identity of Individual Cattle Within a Forty-Eight Hour Response Period*.
- Identification of equines using NAIS Equine Species Working Group recommendations is highly successful with minimum risk of infection, no noticeable reactions to injection, and no implant migration.
- Equines are typically handled easily by hand, and it would seem acceptable to use wired RFID readers. However, due to the animal's size and potential to be spooked, it is safer to use wireless readers to prevent human or animal entanglement.
- A passport system for the equine industry would be beneficial to help manage animal health and provide any animal movement records that may be a part of NAIS.

- NEW MEXICO LIVESTOCK BOARD

SYNOPSIS

New Mexico producers are accustomed to long-standing brand certification and health inspection programs of the New Mexico Livestock Board. For this reason, the Board's pilot project focused primarily on educating producers within the State, as well as members of the Board itself, in the use of animal identification technologies that were not yet commonly employed, and that could have possible points of continuity or integration within existing livestock programs and practices.

The Board's project included four field trials—three chosen at the start of the project, and one that developed in response to responsibilities the Board

assumed within the course of the pilot. The first of the four began in early 2005. During that time, Board officials conducted retinal scans, a biometric, unalterable animal identification technology, on most of the 4-H and FFA calves that had been nominated for the New Mexico State fair from Quay County, an agricultural region in northeast New Mexico. Follow-up retinal scans were conducted at the Quay County fair, then, subsequently, at the State fair itself. Board officials then trained fair members to compare the retinal images of cattle taken at the events against the earlier images of the nominated cattle in order to associate the two images, with an eye towards possible discrepancies. The goal of the trial was to determine whether retinal imaging was a practical means of identifying individual animals, and their ownership in this case, for the fairs.

The second project was a coordinated effort with extension agents at New Mexico State University. Through these efforts, university faculty conducted tests of many radio frequency identification device (RFID) tags in cattle at two testing centers, in order to ascertain the devices' retention rates in "real world" scenarios. The faculty then summarized their studies and provided educational forums to share their findings with livestock owners and Board personnel.

The third project was a partnership among the Livestock Board, the Arizona Department of Agriculture, the Navajo nation and the Hopi nation. At a local livestock auction, members from each of the organizations set up and tested panel RFID readers in order to test the rate at which the readers scanned the RFID tags of consigned animals. They also tested the wireless technology that transmitted the data collected by the readers to the auction's central computer.

The fourth field trial was unforeseen at the start of the project. In 2005, New Mexico changed its statutes to give the Livestock Board oversight for the licensing and monitoring of equine rescue facilities within the State. To help create adequate records of neglected, abused and abandoned horses that came to the facilities, and to facilitate care for these animals, the Board used pilot project funds to implant all horses on rescue premises with a radio frequency microchip.

LESSONS LEARNED

Successes

The Livestock Board discovered that much of the identification they tested could be employed successfully within livestock venues in the State. After a few initial glitches, officials at the State fair found retinal scans to be an efficient means of uniquely identifying livestock, and as a result of this effort, they plan to use retinal imaging for all calves that are exhibited in 2007. Through the field trials at New Mexico University, 1,700 cattle and 350 sheep have received RFID tags, and faculty members have discovered that, with the proper application and maintenance, the retention rate for those tags is more than 98 percent. The equine identification initiative proved to be popular both with the general public and with horse owners themselves, and, since the inception of the program, the State legislature has given more responsibility to the Board for the care of horses within the State.

Problems Encountered

Only the field trial employing panel readers proved to be unsuccessful. Although the reader functioned properly, and the read rate for the tags was extremely high, the auction's computer database was too antiquated to receive and properly process the identification information transmitted to it. This project demonstrated that, in order to integrate electronic information transfer, livestock markets must have the capability to interface with existing animal identification technology in their business accounting systems.

The Role of Education

Through the trials, the Board also came to realize that further incorporating animal identification technologies within the State would require a systematic effort of further research and outreach.

TEXAS PILOT PROJECT

Participants: Texas Animal Health Commission
Funding Expenditure: $890,000

SYNOPSIS

The Texas Animal Health Commission (TAHC) designed an NAIS pilot project to investigate various existing market channels, what they termed "natural flow environments," where radio frequency identification (RFID) and animal tracing might be employed within NAIS. They then documented the challenges encountered in each situation when identification and tracing technology was introduced into these channels. In so doing, the TAHC project was focused on gaining knowledge of the various factors that might keep individuals from participating in various aspects of NAIS and learning why identification equipment did not function properly within a given marketplace.

TAHC officials selected livestock markets, order buyers, and feedyards and paired these potential recipients with various tag distributors, reader manufacturers, and animal tracking database providers. TAHC supposed that, in a system driven by the free market, producers would not turn exclusively to one provider of any given identification or tracing service.

Once locations were determined and vendors agreed upon, TAHC worked with the equipment vendors to survey the sites comprehensively and propose the best means of retrofitting the existing structures with identification equipment. When the proprietor of a market agreed to the proposal, readers were installed and animal tracking databases set up, and employees were trained on how to use both the hardware and software associated with the systems.

At this point, TAHC sought out beef and dairy cattle owners who regularly used the sites and made RFID ear tags available to them. Various RFID tag manufacturers then distributed and applied the devices. In all, 48,536 cattle were tagged with unique individual identification during this phase of the project. RFID technology was also tested with captive cervids, sheep, and goats, although on a much smaller scale.

For the remainder of the pilot project, the sites reported, at quarterly intervals and with the guidance of the data service providers, the rate at which the readers had been successful in reading the tags and transferring the data to the databases as identified cattle passed through the market.

This pilot project is noteworthy for two reasons. First, the TAHC did not merely simulate real-world scenarios at a mock site(s), but actually integrated animal identification technology into the everyday commerce of livestock markets within the State. Second, TAHC officials learned that animal identification and animal tracing can indeed work within the marketplace, but only with a great degree of flexibility, dialogue, and cooperation on the part of all parties involved.

LESSONS LEARNED

TAHC's effort was successful in that nearly 49,000 cattle were uniquely identified, and more than 62,000 distinct animal movements recorded. By

the end of the pilot project, readers installed at the various sites were consistently detecting the movements of cattle through the market with 95 percent accuracy. However, some challenges were identified that still need to be overcome.

Installation challenges

The sites chosen for testing the readers were often ill-suited for immediate installation of the equipment. This led the equipment distributors to conduct multiple, detailed sight surveys, and to submit proposals to the facility owners that were as minimally invasive as possible to the natural flow of commerce. The process became quite lengthy, often lasting a few months. Furthermore, after their initial enthusiasm, several of the proprietors of the markets became hesitant to change their infrastructure in order to accommodate the devices.

Fostering participation

TAHC also encountered problems when distributing animal identification devices. During the course of the pilot project, public attitudes regarding animal identification in general, and NAIS in particular, were perceived as becoming increasingly negative within the State. As a result, Texas animal health officials and the identification companies themselves became tasked with shaping public perception about animal identification in order to foster participation in the project.

In the end, while State and industry efforts were able to address many of the misconceptions regarding the nature of RFID and NAIS, and a number of producers did eventually request ear tags, TAHC discovered that some livestock owners simply will not identify their animals, even if the identification devices are subsidized by the State. In addition, producers who may initially foresee some benefit from participating in animal identification and animal tracing may be dissuaded by pressure from their peers from identifying their animals. Finally, the commission found that, even among those producers who did elect to tag their cattle, there existed a widespread perception that animal identification does not lead to an increase in the value of an animal at market.

Equipment challenges

Despite the efforts of equipment distributors to tailor their equipment to the livestock market in which it would be used, several markets initially reported extremely low “read rates.” The equipment distributors found that existing structures within the markets often impeded the ability of the identification and tracing equipment to function properly. Usually, the problems were usually resolved quickly, but did require timely customer service by the equipment distributor.

Conclusions

Implementing animal tracing within the State will not occur quickly or unilaterally. For tracing to become a reality, equipment manufacturers and animal health officials will have to work collaboratively with the livestock markets throughout the State to customize solutions for each facility. Similarly, because upgrading the markets in Texas would be both lengthy and labor-

intensive, the State would have to provide the proprietors of each facility with either compelling arguments or tangible incentives for implementing animal tracing within their operation, especially if the proprietors would have to assume the majority of the costs associated with the upgrade. Proprietors are unlikely to change their way of doing business without a strong reason to do.

The biggest challenge associated with implementing animal identification within the State would not be associated with the technology itself, which functioned well by the end of the pilot project, but rather with fostering positive attitudes among livestock owners towards the technology. Efforts to implement animal identification will need to be preceded by extensive outreach campaigns explaining the need for and value of animal identification, with a specific focus on how animal identification devices have the potential to add to the value of livestock.

Finally, TAHC concluded that, once USDA began to implement the animal identification and animal tracing components of NAIS, there would exist a widespread perception and assumption that the technology associated with these components was ready for routine use. TAHC officials believe that every effort should be made to test the technology beforehand within real-world scenarios, and to document as thoroughly as possible where and when the technology failed, and, more importantly, why.

WYOMING PILOT PROJECT

Participants: Wyoming Livestock Board
Wyoming Department of Agriculture
Wyoming Wool Growers
Wyoming Stock Growers Association
University of Wyoming
Mountain States Lamb Cooperative

Funding Expenditure: $251,929

SYNOPSIS

Over a 60-day period, Wyoming State and Federal animal identification officials, with the assistance of non-profit industry organizations and university extension agents, conducted four field trials in Wyoming to test various types of radio frequency identification (RFID) devices and readers that might be used to trace the movements of sheep and cattle within NAIS. The administrators of the pilot project selected two sites for the project that closely mirrored the locations where brand inspections, currently the State's most prevalent form of recording animal movements, regularly occur. Originally, Wyoming officials intended to test all forms of RFID available at the time of the trial to determine which were most cost effective in "real world" scenarios. When this proved unfeasible, the pilot project was revised to test as many devices as possible within budget. By the end of the project, Wyoming had tested 5 identification devices and 4 readers.

The first field trial involved 139 tagged rams. Using a hand-held RFID reader, the Wyoming assistant animal ID coordinator was able to scan the movements of all the rams with 100 percent accuracy within 50 minutes. During the second test, which took place on another day at the same site, the coordinator scanned a new herd of rams with a panel reader. In 40 minutes, she was able to scan 135 of the animals. The reader was unable to read one of the tags, and several others had to touch the surface of the panel in order to be read.

The coordinator returned to the site a third time to scan another herd, this time with large and small panel readers from a different distributor. With the small reader, she was able to scan 135 rams within 35 minutes. A few of the animals needed to be rescanned for various reasons. The following day, a large panel reader was able to scan the animals within the same time period, although, on this occasion, many of the animals needed to be rescanned.

The coordinator also performed an additional test at another site, where 160 heifers had been individually identified with two different RFID devices. Using a hand-held device, the coordinator tested the read-range of each device. She discovered that one tag consistently read more accurately and at a farther distance than another.

By focusing primarily on the use of RFID devices with rams, Wyoming's project was able to target a livestock audience that was already familiar with animal identification because of the National Scrapie Eradication Program (NSEP), and that might, therefore, be among the early adopters of animal identification within NAIS. By endeavoring to recreate the test conditions

for the field trials on three separate occasions, the project was able to focus on the functionality of the various readers and identification devices themselves.

LESSONS LEARNED

With read rates often approaching 100 percent, Wyoming officials learned that animal identification and animal tracing were not impracticable within the State for the purposes of NAIS.

Because of the nature of their field tests, Wyoming also learned that a number of factors can cause a reader to fail to record the movement of an identified animal. Animal identification devices have different "read ranges." Thus, at a set distance, a reader may be able to scan one manufacturer's device, but not another's. This appears to be especially true when the devices are scanned by a hand-held reader.

Interference from existing structures at the site can affect the rate at which a panel reader is able to scan a device. After debriefing the equipment vendors on the low read rates during the second and third trials, Wyoming officials learned that wooden and metal structures near the readers impeded their ability to function properly.

Finally, Wyoming learned that the flow of identified livestock through commerce will differ depending on what type of reader scans the devices. Within their field trial, small panel readers had the highest read rate with the most effective speed of commerce.

III. 2005 – 2007 FIELD TRIALS AND RESEARCH PROJECTS

OVERVIEW AND OBJECTIVES

The lessons learned from the first stage of pilot projects have significantly furthered the development of NAIS with regard to low-frequency RFID. Based on these project results, USDA has recognized the need to explore other identification technologies, in addition to further investigations of low-frequency RFID, and continue building upon sources of outside ideas and innovations. Researching and evaluating all available technologies in real-world production scenarios is essential to advance NAIS strategically in specific areas. With this goal in mind, USDA has begun the second stage of NAIS pilot projects, specifically encouraging projects that:

- document and/or compare the effectiveness of individual animal identification devices;
- test automated data collection technology in markets and slaughter plants;
- evaluate systems used to collect/record animal identification numbers at production, marketing, and harvesting facilities; and
- advance the integration of data collection systems.

Following a competitive application and evaluation process, USDA awarded funding (with fiscal year 2005 monies) to the States for 7 pilot projects that are now ongoing. The projects address numerous livestock industries (i.e., beef cattle, dairy cattle, sheep, goats, swine, and Mexican imported feeder cattle) and a wide variety of technologies (i.e., several types of RFID, metal ear tags, retinal imaging, DNA, nose prints, and visual tags). Unique contributions from the projects include:

- An economic study focusing on the cost of NAIS implementation within a State (California); and
- An assessment of the impact of NAIS on harvesting and rendering facilities, bringing these industries into more focused and collective planning for NAIS compliance.

Additional information about the second stage of NAIS pilot projects are described in the remainder of this section.

CALIFORNIA

Participants: California State University-Chico;
California Poly State University-San Luis Obispo;
University of California-Davis

Funding Expenditure: $350,000

TITLE **Cost-Benefit Analysis of National Animal Identification**

FOCUS AND OBJECTIVES

In this project, the California Department of Food and Agriculture (CDFA) will work cooperatively with other named participants to perform an economic analysis of implementing NAIS, including State premises registration systems, identification systems (visual, LF RFID, DNA, retinal imaging), and the cost of reporting data.

The first part of the project will use an economic model to compare identification costs using electronic and conventional technologies across beef, dairy, and sheep industries. This analysis will consider different ID strategies for different segments of the industry (i.e., cow-calf, seedstock, stocker, feedlot) and size of operation. Using this economic model, investigators will assess the cost of compliance with NAIS; conduct risk assessments along different segments of an animal's life; compare the costs and benefits associated with incremental changes in technology; and identify alternative solutions to reduce the cost of animal ID technology.

The second part of the project will more clearly define the implementation costs for NAIS at the State level. In particular, this part of the project will evaluate the resources and costs needed to correctly train personnel of different ages and backgrounds to comply with NAIS; evaluate the costs and benefits of using existing brand inspection personnel to collect brand inspection data and facilitate compliance with NAIS; and evaluate the resources and costs needed for a State agency, such as CDFA, to provide service and maintain components of NAIS in California.

The information from this comprehensive cost-benefit evaluation should directly affect the confidence and success of NAIS implementation in the western States.

Livestock included: Dairy cattle; Beef cattle; and Sheep

COLORADO

Participants: Colorado State University; American Meat Institute
National Meat Association
Southwest Meat Association;
American Association of Meat Processors
National Renderers Association

Funding Expenditure: $295,227

TITLE **Assessing the Impact of NAIS with Regard to Beef, Pork, and Lamb Harvesting and Rendering Facilities in the US**

FOCUS AND OBJECTIVES

The project will identify potential approaches for collecting animal identification—both the Animal Identification Number (AIN) and the Group/Lot Identification (GIN) number—in abattoirs and rendering facilities. Additionally, the project will

evaluate the economic impacts on packing plants and renderers to collect animal termination records and submit the AIN and GIN data to animal movement databases. The ultimate goal of the project is to reach a consensus among U.S. harvesting and rendering facilities regarding how those in the beef, pork, and lamb industries (by species) prefer to: (1) collect "animal termination records," (2) archive those records, and (3) transfer the records to a database that would be accessible—expeditiously—to USDA.

Livestock included: Beef cattle; Dairy cattle; Swine; and Sheep

KANSAS

Participants: Kansas State University

Funding Expenditure: $441,430

TITLE

Evaluation of Active Ultra-Wide Frequency Devices to Meet the Criteria of the National Animal Identification System

FOCUS AND OBJECTIVES

The project will conduct numerous tests to evaluate the effectiveness of radio frequency technologies with the objectives to:

- Characterize the incidence and extent of electromagnetic interference affection RFID transponders and transceiver function in cattle auction markets, cattle abattoirs, and feedlot processing facilities**.**
- Determine the extent of variation of read range at best orientation of the eartag transponder to a stationary reader and its relationship to placement of RFID tag on the animal's ear.

Additionally, the project will determine the economic impact of individual animal identification scanning and recording by U.S. cattle auction. In particular, the objective will:

- Determine the amount of new investment cattle auctions would need to make in equipment, facilities and management to electronically capture the electronically AIN using RFID technology.
- Determine how auction size (volume of livestock handle), mix of species handled, and other auction characteristics affect costs of managing an RFID bases animal identification system.

Livestock included: Beef cattle

NEW MEXICO

Participants: Colorado State University

Funding Expenditure: $355,508

TITLE

Strengthening Identification of High-Risk Animals Using a Novel Identification Method

FOCUS AND OBJECTIVES

This project will test the effectiveness of an animal identification that uses retinal images, global positioning satellite (GPS) capabilities, and photographic documentation. In using this novel identification approach, the project seeks to provide a solution to assure that animal identity can be verified as needed and recovered in the event that ID devices/tags are lost or removed.

In particular, the project will assess OptiBrand technology to verify animal identification in imported Mexican feeder steer, spayed heifers, and roping steers in pasture, feedlot, and abattoirs. United States cattle imports from Mexico increased to more than 1.2 million head in 2003. Secure individual identification is necessary to allow traceback in the case of a foreign animal disease outbreak and could serve as a potential adjunct for animal ID and the bovine tuberculosis (TB) animal disease control program.

Livestock included: Beef cattle

PENNSYLVANIA

Participants: PA State University

Funding Expenditure: $205,856

TITLE **Investigate Methods to Address Levels of Resistance to the Implementation of the NAIS in the equine industry**

FOCUS AND OBJECTIVES The overall goal of the project is to develop an economically feasible method for identification of equine that is acceptable to horse owners and that can enhance the recording movements from activity to activity. Surveys completed by horse owners will help determine resistant factors

Livestock included: Horses

TENNESSEE

Participants: University of Tennessee;
Oklahoma State University
Oklahoma Dept. of Agriculture;
Tennessee Cattlemen's Association
Oklahoma Cattlemen's Association

Funding Expenditure: $142,984

TITLE **Evaluation of Active Ultra-Wide Frequency Devices to Meet the Criteria of the National Animal Identification System**

FOCUS AND OBJECTIVES In this project, numerous cooperators—including industry, university, and State representatives—will work together to evaluate the efficacy of an ultra-wide band RFID technology (Cattle Traq). Research will address the ability of this new ID technology to accurately and permanently identify individual beef cattle as they move through normal production environments—without hindering the flow of commerce or requiring substantial facility alteration. The project will assess performance in multiple production scenarios for beef cattle, including a typical farm setting, transport in both stock-trailers and tractor-trailers, livestock markets, a commercial loading facility, and a group scale.

Livestock included: Beef cattle

VIRGINIA

Participants: VA Cooperative Extension
VA Cattlemen's Association

Funding Expenditure: $220,000

TITLE

Implementation of NAIS Strategies in Livestock Markets

FOCUS AND OBJECTIVES

The project will thoroughly evaluate low frequency RFID tags from various manufacturers in several Virginia markets. Up to 500 producers will apply the AIN radio frequency tags at the premises of origin prior to marketing and readers in 10 different VA markets.

The objectives include:

- Compare the efficacy and cost of various RFID technologies when applied in a commercial livestock market environment.
- Investigate the impact of collecting individual Animal Identification Number (AIN) using existing NAIS compliant RFID tags on animal handling facilities, animal handling logistics and infrastructure in livestock markets.

Livestock included: Beef cattle; Dairy cattle; and Sheep