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Identification and Analysis of the Current and Potential Benefits of a National Livestock Traceability System in Canada

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EXECUTIVE SUMMARY

Traceability of food and food ingredients was identified as a policy priority in the Federal-Provincial-Territorial governments' Agricultural Policy Framework. The Food Safety and Quality Policy Directorate (FSQPD) of Agriculture and Agri-Food Canada (AAFC) define traceability as: *the ability to follow an item, or a group of items, whether animal, plant, food product or ingredient, from one point in the supply chain to another, either backwards or forwards*. Farm to slaughter livestock traceability systems are being implemented in Canada largely by industry groups, but implementation is occurring at different rates and varies in scope across different species groups. While animal identification is in place for some species groups, premise identification is not yet national although has begun in some provinces and across some species groups. National standards exist for identification of animals and premises, but have not yet been endorsed by a nationally-recognized body. To date, tracking of animal movement only occurs in Quebec. The concept of a national livestock traceability system is therefore under discussion. An assessment of the benefits and costs of a national traceability system informs this policy discussion. The remit of this study was to provide a qualitative analysis of the potential benefits of a national farm to slaughter livestock traceability system for Canada. An assessment of the costs of a national livestock traceability system is being undertaken separately.

A framework was developed identifying potential categories of benefits, including both direct benefits and benefits which could be enabled by a traceability system. In-depth semi-structured interviews with industry representatives were undertaken to explore examples of benefits and gather information on the likely magnitude and distribution of the benefits.

A review of the traceability literature reveals that traceability systems perform a diverse set of roles, driven by private sector incentives to improve supply-side cost management and demand-side product differentiation, but are also driven by public sector goals with respect to reducing the social costs of food safety problems. Firms have an incentive to adopt traceability systems to improve supply chain management, including cost savings from improved logistics and inventory management, increased transportation efficiency and accuracy, and savings in labour costs. In the event of a food safety problem, accurate traceability systems also enable firms to manage food recalls more efficiently, reducing the size, and therefore the costs of a recall, while containing the damage to brand name capital. Traceability also serves broader public functions with respect to reducing the impacts and negative spillover effects of food safety and herd health problems. A third set of roles for traceability systems reflects demand-side incentives, including reducing information costs for consumers, implementing product differentiation strategies, and providing more accurate economic signals to producers.

Five main categories of benefits from a (national) livestock traceability system were identified: (i) risk; (ii) production management; (iii) supply chain (upstream); (iv) market enhancing (downstream), and (v) governance. Individual benefits, and whether they are direct or enabling, are described in **Table E1**. A qualitative assessment of the likely magnitude of the benefits and

their distribution across producers, the agri-food industry, and society as a whole is featured in **Table E2**. The following discussion highlights the key benefits.

Risk Reduction

Risk reduction/risk management benefits are the largest potential benefit category from a livestock traceability system. All are direct benefits, i.e. they flow directly from the ability to trace livestock, while one (trade) has both direct and enabling features. Five key benefits were identified (**Table E1**). ***Livestock disease management*** is a significant benefit, particularly to the agri-food sector and producers (including feedlots), but also (although likely of smaller magnitude) to society as a whole. Accurate and timely traceability of livestock can reduce the costs of a disease outbreak by reducing the scope and scale of the necessary mitigation responses (e.g. slaughtering potentially affected herds). The risk reduction benefits are particularly important for export-dependent sectors. A traceability system provides ***incentives for good practice*** by encouraging due diligence among producers and the agri-food sector with respect to food safety and animal health management practices. A traceability system assists with ***maintaining reputation/consumer confidence*** in the event of a herd health or food safety problem. Industry stakeholders generally perceived this to be of minor importance currently for domestic consumers as they believe that Canadian consumers have a great deal of confidence in the safety and integrity of the food supply, however, there was a recognition that this could become a significant benefit from a national traceability system if a major incident occurs domestically. For access to international markets, the ability of a traceability system to maintain or restore consumer confidence was perceived as particularly important. Traceability also delivers international ***trade*** and market access benefits by facilitating compliance with importing country regulations (e.g. with respect to age verification or preserving disease-free status regionally). These are anticipated to be major benefits to producers and the agri-food industry, while much smaller in magnitude for society as a whole. A major potential benefit to society (consumers) of a livestock traceability system is ***food safety*** and the protection of ***public health*** from infectious zoonotic diseases. To the extent that a traceability system is effective in quickly identifying and isolating affected animals, this benefit is potentially the most significant direct benefit for society from a traceability system.

Production Management

Production management benefits refer to improvements to internal production management practices and production efficiencies that could be enabled by a traceability system. Four key benefits are identified (**Table E1**). As a category, production management benefits were perceived as relatively small in magnitude currently but with the potential to become medium-sized benefits. Given the nature of these benefits, all benefits accrue to either producers and/or the agri-food sector (**Table E2**). For producers (including feedlots), a traceability system has the potential to facilitate ***enhanced individual animal management*** within the enterprise, for example monitoring feed, weight and yield gain, monitoring animal health, tracking parentage and genetics to improve breeding stock, etc. For first-stage processors (slaughtering), traceability including animal identification facilitates ***just-in-time management of the processing plant and the segmentation of production runs*** through more accurate scheduling of deliveries. Potential production management benefits flow from the ***reduced incentive to cheat*** due to greater

information and better control over the production process, for example, verifiable vaccine records and age verification. This benefit is expected to be of medium magnitude for feedlots and the agri-food industry (packers).

Supply Chain Management

Supply chain management benefits are external to the enterprise and relate to improved processes and information flows back along the supply chain. These are not direct benefits of traceability but result from the potential of a traceability system to facilitate/enable these additional benefits. In general, these are perceived as relatively small at the present time but with the potential to be of medium significance in terms of magnitude. Four such benefits were identified (**Table E1**), with benefits being distributed to varying degrees across producers and the agri-food sector (**Table E2**). Within this category, the major benefit is likely to flow from *reducing information asymmetry with respect to the quality of supplies*. For example, animal identification linked to individual animal information reduces the incentive to pool low quality or unhealthy animals with high quality or healthy animals. More accurate market signals flow to producers with respect to the production attributes that are valued by the buyer. This is expected to be a major potential benefit to producers (primarily second-stage producers such as feedlots) and the agri-food sector (i.e. packers). First stage producers (e.g. cow-calf operators) benefit if this leads to higher average prices given reduced quality uncertainty for buyers. As an outcome of the improvements in information flow, industry stakeholders identified a *better operating atmosphere* and increased trust between firms in the supply chain as a potential benefit. For the agri-food sector (and to a lesser extent producers – feedlots), *improved logistics and inventory management* and better *coordination of supplies* are also potential benefits that could be enabled by a traceability system.

Market Enhancing

Market enhancing benefits result from improved information flows forwards through the value chain and the facilitation of quality verifications. Again, traceability systems per se will not necessarily deliver these benefits, but they are enabled by the presence of the traceability infrastructure. While these are perceived as relatively minor at present, there is widespread recognition that these benefits have the *potential* to be of greater value to producers and the agri-food sector and, to a lesser extent, consumers (**Table E2**). This category had the largest number of potential benefits (seven) (**Table E1**). Of particular note was the potential for a traceability system to piggyback the *flow of carcass quality information* back to producers and the *sharing of animal management information* forwards through the value chain. Jointly these factors can improve market signals and provide an arena for the payment of premiums on valued carcass and production traits. This could be a major benefit to producers, but also a fairly significant benefit to the processing sector. *Real-time results* through real-time matching of animal type/quality with specific market requirements (e.g. chute side access to animal ID, improved sorting of animals) are a potential benefit to the processing sector. Moving forwards in the value chain, *quality verification enables product differentiation* based on quality assurances verified through traceability technology (e.g. DNA technology). Product differentiation strategies could also be based on the notion of enhanced *connectivity* between consumers and producers, i.e. accompanying a product with its ‘story’, although this benefit will probably remain relatively

minor. Perhaps more significant could be the *credibility* that having a traceability system affords to quality assurances, with consumers also benefiting to a certain degree due to greater trust of quality claims. Greater *certainty of ownership* when animals are pooled during production, transit or at the point of slaughter may help reduce monitoring costs, ensuring that the seller is appropriately rewarded for the right animals and that the buyer gets what he/she paid for.

Governance

Governance benefits relate to system administration and management advantages that flow from having one national cross-species livestock identification system. As a category of benefits, a qualitative assessment suggests that these are likely to be relatively minor compared to the other benefit categories, although by no means insignificant (**Table E2**). Four key benefits reside in this category, two direct and two enabling (**Table E1**). In terms of direct benefits, having *one national traceability portal* has significant advantages in terms of the effectiveness and improved coordination of crisis response, reduction of duplication and the facilitation of inter-provincial communications and transactions. There are potential economies of scale advantages, and industry stakeholders recognized the value of having common standards and a common format for traceability information that enhanced the effectiveness of the traceability function. As such, this benefit is likely to be particularly significant for society (effective crisis management response by government), fairly important for the agri-food sector and of minor significance for producers. For producers, a direct benefit from a single national traceability system is *preventing being locked-in to proprietary traceability systems*. This could be a problem if producers need to make asset-specific investments to participate in a supply-chain based traceability system that is unique to a particular buyer. Stakeholder interviews revealed little concern over this issue, probably in part due to the fact that an industry-wide animal identification system already exists in the cattle industry and is under development in the hog and sheep sectors so that proprietary lock-in has not become an issue. A traceability system could enable *research to improve quality* by facilitating the linking of quality improvements to changes in production methods in a systematic way across the industry. This benefit is one which could evolve over time into a larger magnitude than is currently perceived to be the case. Finally, a national traceability system enables greater *collaborative synergy* across species groups by acting as a forum through which species groups can work together, facilitating networking and sharing of ideas on the design and implementation of effective traceability systems. Management of cross-species disease issues is also facilitated by a national traceability system. This benefit is likely to be of moderate size for producers and the agri-food industry and of relatively minor significance for government.

Implications and Conclusions

The analysis suggests that many potential benefits flow from traceability systems. The direct benefits, and those of largest likely magnitude as perceived by industry stakeholders, relate to risk reduction/risk management, containing animal diseases, minimizing impacts on industry reputation, maintaining access to export markets, etc. A variety of enabling benefits flow from having an accessible, functional traceability infrastructure in place. Whether these enabling benefits become a reality depends on the effectiveness with which a traceability system is implemented, the accessibility and compatibility of the traceability infrastructure with other

stages of the supply chain, and the degree of buy-in by producers and the agri-food industry. Many of the production management, supply chain and market enhancing enabling benefits from traceability could flow as easily from a species-specific traceability system as from a national (single portal) livestock traceability system. It is in the areas of risk management and governance that the potential benefits from a national, single portal, system appear to be the most significant.

By design, this study has only considered the benefits side of the equation. Equally important will be a consideration of the costs of designing, implementing and operating a national traceability system. Also by design, this study has presented a largely qualitative assessment of potential benefits. Quantification of these benefits would likely require a combination of approaches including scenario analysis with respect to market losses avoided (risk), simulation analysis of potential market and supply chain benefits, and primary consumer research to better understand how Canadian consumers respond to perceived risks in the event of a food safety or animal health crisis (negative demand response), and how they respond to credible quality assurances and product differentiation strategies (positive demand response).

Table E1. Traceability Benefits, by Category and Benefit Type		
Category	Benefit (can be immediate (existing) or potential (probabilities))	Benefit type
RISK		
1	Livestock disease management In case of animal disease outbreak, better ability to source, isolate and control, reduce spread, faster, more accurate response, reduces costs and increases loss avoidance ie. fewer herds slaughtered, preserving daily operations or reducing lost days, business as usual for non affected, preserves reputation	DIRECT
2	Incentive for good practice Encourages better due diligence of individual firms because accountability is an incentive for good management practice	DIRECT
3	Reputation/Consumer confidence/Credibility Increase, maintain or regain foreign market access, increase, maintain or regain domestic consumer confidence, build and reinforce firm/industry/Canada's reputation, build and reinforce credibility of the industry/product/Canada	DIRECT
4	Trade Maintain or gain market access, ability to regionalize outbreaks preserving disease free region for maintaining export (GIS/premise ID)	ENABLING & DIRECT
5	Food Safety & public health Public health protection	DIRECT
PRODUCTION MANAGEMENT (internal)		
1	Enhanced individual management, best practice, greater efficiency micromanaging within enterprise - tracking and greater information at hand to reduce costs, better allocate resources, identify problems earlier, monitor and track individual animals inputs, health,	ENABLING
2	JIT management of plant or segment production runs ie. by market, timing and scheduling, transport, planning production run,	ENABLING
3	Insurance benefits - reduction in premiums	ENABLING
4	Reduced incentives to cheat with greater information, better control, More information enables improved production of desired qualities	ENABLING
SUPPLY CHAIN (external, moving backward in value chain)		
1	Reduce information asymmetry with respect to quality of supplies reduce incentive to pool poor quality animals with healthy, reduces risk to purchaser, raises overall quality	ENABLING
2	Better operating atmosphere because of #1 above, overall risk is reduced, improving trust through the industry, better business environment, gain synergy	ENABLING
3	Improved logistics & inventory management between supply chain members Advance manifests for delivery, adapting to transport issues, advance planning, disaster planning	ENABLING
4	Coordination of supplies with external vendors quality segmentation of production runs	ENABLING

Table E1 continued. Traceability Benefits, by Category and Benefit Type

Category	Benefit (can be immediate (existing) or potential (probabilities))	Benefit type
MARKET ENHANCING (moving forward in value chain)		
	1 Enables flow of individual carcass quality information (backwards to producers) Incentive to produce improved quality (grid price vs. live pricing per animal), price and demand signals are attached to the carcass, increase revenues for producers and possibly other members of value chain based upon quality produced	ENABLING
	2 Sharing animal management information (forward into flow) feeding regimes, health, vaccines, timing, supplements etc enables better decisions and accurate quality assessments per animal. Can also improve accuracy of information through ability of electronic system to reduce errors and save time.	ENABLING
	3 Quality verification enables product differentiation accessing niche markets, meet consumer demands, develop and grow markets, find premium markets	ENABLING
	4 Real Time Results ie. sorting real time matching of quality with market demands, saving time, labour and reduces losses ie. Chute side access, advance manifests, instant weight feedback, real time monitoring, transportation delays, shrinkage	ENABLING
	5 Certainty of ownership - connect transaction between seller and buyer, ensures buyer gets what he expected, seller gets paid for his animal, reduces monitoring costs	ENABLING
	6 Connectivity potential to market personal relationships to consumer (ie. now your producer), proof of Canadian or local origin, branding Canada or a specific brand	ENABLING
	7 Trust credibility of quality assurances due to traceability ie. organic, hormone-free, grass-fed, free range, heritage	ENABLING
GOVERNANCE (system administration and management)		
	1 One national system/portal efficient, facilitates interprovincial trade, network complementarity, reduces duplication, regulatory benefits, better coordination of disaster response, various species systems can communicate, 1 data management system,	DIRECT
	2 Prevention of being locked in to proprietary tracing systems avoid asset specific investment that is tied to a proprietary system which then reduces ability to switch at a later date (ie. better that the government run it rather than a private corporation) less distrust of governing body	DIRECT
	3 Research to improve quality problems - on issues not previously known as requiring research, systems approach, HACCP approach across industry, public, agrifood	ENABLING
	4 Collaborative Synergy forum for species groups to work together, inter-species support and networking	ENABLING

Table E2. Distribution and Magnitude of Traceability Benefits

Category & Overall Magnitude

RISK + + +			
Benefit (can be immediate (existing) or potential (probabilities))	Distribution & Magnitude		
	Producer	Agri-food	Society
1 Livestock disease management	+++^	+++^	+
2 Incentive for good practice	+++^	+++^	+
3 Reputation/Consumer confidence/Credibility	+>+++^	+>+++^	-
4 Trade	+++^	+++^	+
5 Food safety & public health	-	-	+++
PRODUCTION MANAGEMENT (internal) +>+ +			
1 Enhanced individual management, best practice	++	+	-
2 JIT management of plant or segment production runs	+	++	-
3 Insurance benefits	-	+	-
4 Reduced incentives to cheat	++	++	-
SUPPLY CHAIN (external, moving backward in value chain) +>+ +			
1 Reduce information asymmetry with respect to quality of supplies	+++	+++	-
2 Better operating atmosphere	++	++	-
3 Improved logistics & inventory management	+	++	-
4 Coordination of supplies	+	++	-
MARKET ENHANCING (moving forward in value chain) +>+ + +			
1 Enables flow of individual carcass quality information (backwards)	+++	++	-
2 Sharing animal management information	+	++	-
3 Quality verification enables product differentiation	+^	++^	+
4 Real-time results ie.Sorting	+	++	-
5 Certainty of ownership	++	+	-
6 Connectivity	+^	+^	-
7 Trust - credibility of quality assurances	+^	++^	+
GOVERNANCE (system administration and management) +			
1 One national system/portal	+^	++^	+++*
2 Prevention of being locked in to proprietary tracing systems	+	+	-
3 Research to improve quality problems - on issues not previously known as requiring research	+>+++	+>+++	-
4 Collaborative Synergy	++	++	+*

NOTE: Magnitudes are based upon the responses given by industry stakeholders

Magnitude of benefit

- insignificant
- + small
- ++ medium
- +++ large
- +>+++ low current but potentially large in the future
- ^ even larger if exporting

Definitions

- Producer Farmers and feedlots
- Agri-food Auctions, sales barns, abattoirs, packers/processors
- Society Canadian consumers and/or government
- * indicates benefit mainly affects government

Identification and Analysis of the Current and Potential Benefits of a National Livestock Traceability System in Canada

Introduction

The ability to trace food and its intermediate ingredients back through the various stages of the supply chain has become a focal issue for the agri-food industry as well as policy makers, both domestic and international (Hobbs, 2004). As a response to recent food safety and/or contamination events, traceability has emerged as a mechanism to manage potential future incidents (Hobbs, A.L. et al., 2002; Meuwissen et al., 2003; Buhr, 2003; Beulens et al., 2005).

Traceability also has demand side origins as Canadian consumers are increasingly interested in acquiring information pertaining to the production, processing, distribution and safety of their food supply. The same can be said of consumers on a global scale, particularly those for whom affluence provides a myriad of food products among which they must choose (Beulens et al., 2005; Buhr, 2003). The meat and livestock sectors are of particular interest to consumers due to the risk of disease and, for some, animal welfare concerns (Hobbs, A.L. et al., 2002; Hobbs, 2003).

The Canadian meat and livestock industries have been pro-actively putting traceability systems in place. These initiatives vary in terms of species groups, participation levels, jurisdiction and administration as well as in their depth and breadth of coverage. Animal identification, premises identification and animal movements are major components of these systems, but not all Canadian examples include all three.

Given the current diversity in traceability systems, the question arises as to whether the Canadian meat and livestock industry would benefit from a single national livestock traceability system. This paper provides a discussion of the current and potential benefits of such a national system. It should be noted that this discourse must be balanced with an examination of the costs of the same system, but such an examination is beyond the scope of this paper.

The report is structured as follows: following a brief literature review, the methodology and analytical framework are outlined. A brief description of the current status of farm to slaughter traceability within the sheep, hogs, dairy and cattle sectors is provided. A large portion of the report is devoted to discussing the five benefit categories with examples drawn from stakeholder interviews. The report concludes with a summary section and general conclusions.

The Diverse Roles of Traceability

A consumer will not knowingly consume unsafe food even though they generally cannot detect whether or not their food is safe prior to purchase. Contamination (E. Coli, salmonella, dioxins in feed), tampering (cyanide laced grapes) or the presence of animal disease (BSE) are generally not detectable by a consumer at any point during the purchase or consumption of the product. In

both these situations, there is consumer uncertainty due to incomplete or asymmetric information, and as a result, useful information cannot easily be obtained. Traceability systems have been introduced as a means of addressing information deficiencies pertaining to quality and safety in the food chain. Traceability systems provide a means to build consumer confidence and trust in the regulatory infrastructure that is charged with ensuring the safety of food as it moves through the supply chain.

The types and forms of traceability systems vary greatly from industry to industry, and from country to country. The concept of traceability is subject to a range of interpretations, functions, definitions, drivers and stakeholders. The EU's General Food Law legislates mandatory traceability, with a set of regulations affecting the entire food industry, primarily in response to high profile food safety incidents, and preceded by earlier legislation requiring cattle identification and traceability (Hobbs, 2006; Schwägele, 2005). In contrast, the US approach centres on private sector initiatives (Hobbs et al., 2001). Canada and Australia, on the other hand, have focused their traceability systems on being a means to manage risk and trade relationships.

Tracing and tracking are central elements of traceability systems. Tracing is the ability to examine backwards (upstream) along the supply chain while tracking is the ability to move forwards (downstream). Tracking facilitates the ex ante provision of credible information to the consumer on the product's quality attributes prior to purchase or consumption. Tracing provides ex post traceability to the product's origin, location, and possibly prior movement of the product if there is a quality concern or safety scare (Meuwissen et al., 2003; Schwägele, 2005; Hobbs, 2007).

The transparency of the traceability system refers to the provision of information to consumers. Transparency is the degree to which the public is able to access information on the procedures, processes, practices and quality assurances on the food product as facilitated by the traceability system (Liddell and Bailey, 2001).

The 'breadth' of a traceability system refers to the amount of information provided from its records. For example, types of feed and supplements used, use of genetically modified (GM) inputs, environmentally sensitive practices, country of origin for inputs, producer information, etc. The 'depth' of a traceability system refers to how far back or forwards the system can trace or track to, for example, an intermediate step in the supply chain ('farm to abattoir') or the entire chain ('farm to fork') (Golan et al. 2004).

'Precision' in a traceability system relates to the degree of assurance or credibility with which the system can pinpoint the movement of a specific product (Golan et al. 2004). For example, does the system trace a strawberry to the date or time it was frozen, to the processing facility that froze it, to the processing run that boxed it or to the actual box, to the field or section of field it was grown? High degrees of precision can have high corresponding costs and allow considerable product differentiation. The degree of precision required in a traceability system varies depending on specific product traits and industry characteristics. At a prairie grain elevator, crops are segregated by type (spring wheat, barley, canary seed), but the individual harvest of each farmer is pooled with others (Bob, Charlie and Jim's wheat) which may not necessarily preserve information about each specific producer or their crop. In contrast, a processing facility

servicing the organic beef market may keep information pertaining to the production, origin and cuts obtained for each individual carcass.

While there is general agreement on the broad function of traceability systems and that they can provide benefits, less is known about the specific benefits expected from these systems and to whom those benefits will accrue. Livestock supply chains have many actors that will be affected when incorporating these systems into their operations. They all have an interest in the range of expected benefits, who will be the beneficiaries and the size of the benefits. The aim of this study is to fill in some of the information gaps regarding benefits of traceability.

Methodology

After reviewing the current literature on traceability (summarized above), the research team then collaboratively designed an interview guide – a copy of the interview guide can be found in Appendix 1. The interviews were conducted to ascertain the perspectives of industry stakeholders on a national livestock traceability system for Canada. A broad list of stakeholders willing to participate in a telephone interview process were contacted in each of the beef (including dairy), hog and sheep industries. Interviewees were drawn from different parts of the country. Stakeholders included producers, auctions and markets, industry associations, packers and service providers.

It must be noted that this study focuses upon the benefits of a national traceability system. There will also be associated costs arising from such a system, but these are beyond the scope of the terms of reference of this project. Costs as well as benefits must be considered in any balanced discussion of traceability.

For the purposes of this study, the immediate or potential benefits of any livestock traceability system were categorized into five functional areas. These are:

- ***Risk Reduction/Management*** – in the areas of livestock disease management, exposure to liability, protection of reputation, international trade and food safety.
- ***Production Management*** – benefits that could be gained from improved management practices and production efficiencies at an individual premise.
- ***Supply Chain*** – benefits that can be captured through more efficient relationships between market players in the industry; including improved processes and information flows back along the supply chain
- ***Market Enhancing*** – benefits from improved information flows forwards through the value chain and the facilitation of quality verification; including increasing the size of the market and its profitability arising from better marketing and improved competitiveness.
- ***Governance*** – benefits accrued in managing the system, its administration, organization, systems benefits from one national cross-species approach to traceability.

Within each of these functional areas, benefits could be further classified as being either a *direct benefit* of the traceability system or an *enabling benefit* where the existence of the traceability system provides the benefit. Generally, it was expected that most benefits within the Risk

Management area are direct benefits. Enabling benefits are those for which the existence of the traceability system facilitates the capturing of additional benefits. Many of the marketing, supply chain and production related benefits can be classified as enabling.

For each of the three livestock groups, these categories held different implications and not all categories presented benefits for each livestock group. The different livestock species utilize unique identification systems that provide some existing form of traceability. Depending upon what level their existing systems operated on, and their market focus, the benefits gained (and costs incurred) from a national system varied significantly. Further, benefits were not perceived as being evenly distributed among participants in the supply chain. Each of the three livestock groups are discussed separately in recognition of their unique situations.

Finally, measuring the value of benefits of a national traceability system would require a major research effort and, hence, is beyond the scope and terms of reference for this study. Rather, for this discussion, anecdotes or rough magnitudes are offered whenever possible. Costs are also used as a proxy for measuring benefit as the system will mitigate or reduce these costs, hence, providing an approximation of the potential benefit.

It is important to remember that the results are based on stakeholder interviews, and as such represent the perceptions of these respondents – and therefore may not be based on solid research by the respondents or a set of verifiable facts. They represent opinions of stakeholders in the various livestock industries, and other interpretations are possible. Perceptions of benefits are important, however, because they will, in part, determine the acceptability of any system and they will likely have a part in shaping any system that is put in place. In many cases, perceptions are all there is to go on because research is lacking and experience largely absent.

Current Canadian Traceability Systems

Sheep

Of the three livestock groups, the sheep industry is unique in that it is not export-oriented, and domestic demand far outstrips the industry's ability to meet supply at internationally competitive prices. Imports are used to satisfy domestic demand.

The industry uses a pink ear tag traceability system that provides information based on an individual animal's unique number. With this system, stakeholders indicated that the industry is achieving 96 percent traceback and the system has been proven to be effective. The ear tags are cumbersome and not user friendly (cannot be easily read or machine-read as they lack a barcode) but are preferred by producers due to their low cost. The tags cannot offer an option to facilitate a flow of information along the supply chain. Additionally, the ear tags tend to fall out, requiring additional time and labour from producers or at markets to re-attach them. Producers are also required to complete extra paperwork to comply with the system. Radio frequency identification (RFID) tags are available but have not been popular due to their cost.

The existing system is capable of providing direct traceability benefits, but the system is relatively slow and cumbersome. Industry stakeholders believe there are benefits from a National

Livestock Traceability System (NLTS) but are unsure whether those benefits will be significantly higher than those potentially provided by the current system. Producers with closed flocks¹ will receive relatively lower benefits from traceability as their exposure to animal disease risk is less than in the case where a flock takes in animals from other premises.

For the sheep industry, the enabling benefits of traceability could provide more value in terms of facilitating information flow to assist with production and supply chain management. However, specific conditions must be present in order for producers and industry to be able to capture these enabling benefits. These will be discussed in a later section.

Benefit are expected all along the value chain (producers, auctions and abattoirs/slaughterhouses) from an NLTS. It was suggested that sheep producers could expect only small benefits unless the system enables payment on the basis of the specific quality actually achieved by each individual animal.

Hogs

The industry currently identifies all hogs with a shoulder slap tattoo prior to slaughter. This facilitates producer payment and provides some degree of traceability. Industry sources indicate that producers benefit from the flow of basic information on carcass quality as they are paid according to grading parameters. Grades are based on a formula using the US price and carcass lean content. It was suggested that for producers to benefit from a national traceability system, they must have access to their data on the market performance of their own animals to assist in farm management decisions – inventory control, farm operations, etc. This is required for producers to capture enabling benefits.

The industry has a full national hog traceability plan, with implementation timelines set for 2008. Hog producers and the industry have been demanding full traceability having observed the impact that multiple food safety and contamination incidents have had on their foreign counterparts' ability to access international markets. The Canadian industry became painfully aware of their vulnerability and exposure without traceability after witnessing the impact of swine diseases on their export competitors and want a system sooner rather than later. Traceability appears to have been accepted by members of the hog industry based primarily upon its disease control abilities.

The results of the interviews suggest a NLTS would offer minor incremental benefits over the existing system in terms of production-based disease control, cross-species collaboration particularly for inter-species infections (i.e. Foot and Mouth Disease (FMD)) as well as open communications with other existing systems, such as Agri-Tracabilite Quebec (ATQ).

Within the Canadian hog industry, it would appear from the interview responses that a NLTS would need to offer different incentives and drivers for various members of the value chain; that is for some enabling benefits would be more valuable, while for others direct benefits would be a priority.

¹ A closed flock is a self contained one where replacement members are bred from within the flock.

Dairy

The Canadian dairy industry is close to having a traceability and identification system from birth through to the marketplace. High participation of dairy producers in the existing dairy herd improvement (DHI) program, and breed improvement and purebred cattle programs means that appropriate records are already kept and that the majority of dairy cattle are tagged and recorded shortly after birth. The system uses the National Livestock Identification for Dairy (NLID) number as a unique identifier in their record systems. The program requires tags be registered to the farm of origin. Tag numbers can then be traced back to the registry when the animal is slaughtered. Regulations state that cattle must be identified with an approved tag at the time they move off the farm of origin (Murray, 2004).

The dairy industry in Quebec has full traceability including reporting of animal movements. Outside of Quebec, the dairy identification system offers direct and enabling benefits as it tracks performance, health and parentage but has some gaps in that it does not record movement, or the activation and retirement of tags. In the non-ATQ dairy sector, each animal is assigned a unique number which facilitates control and management of everything from scheduling of milking, to feeding regimes, to vaccine use.

The results of the interviews suggest that the Canadian dairy industry is supportive of a traceability system for mitigation of risk due to animal disease incidents. There is a belief that there are direct benefits in reducing the cost of production-related diseases, and enabling benefits in terms of cross-species synergies, and communications with other traceability systems. Dairy in Quebec has ATQ with full traceability, but dairy cattle in other provinces are not fully traceable. The ATQ system is not necessarily interactive with other systems.

Like sheep, dairy is not an export-dependent industry but culled dairy cattle are streamed into the cattle market for beef. Of note, several participants contacted were from Quebec and benefited from full traceability of ATQ. All cited a very positive experience with ATQ, noting that producer incomes appeared to have increased, and improvements in marketing relationships with their customer base have been gained.

For the Canadian dairy industry, the direct benefit of a NLTS in mitigating risk for animal disease management is perceived as the primary benefit but enabling benefits can impart significant value-added if the correct mechanisms are in place. It was suggested that at the present time the industry values direct benefits as being approximately 85 percent of the NLTS and enabling benefits at 15 percent. These latter benefits, although their potential values can be significant, are as yet perceived as being speculative and unproven.

Beef Cattle

Currently, all beef cattle in Canada are tagged with a Canadian Cattle Identification Agency (CCIA) tag at the herd of origin. Each tag identifies that specific animal with its herd of origin until it is first sold. From then on, the number and owner are not correlated. At the processing facility, a query is made of the CCIA database to verify age/birth of that animal. Thus the

intermediate steps between producer and packer are currently not directly traceable within the CCIA system.

Animals are sometimes bought and sold in lots, hence, are not necessarily traceable back to the producer or the previous owner (i.e. if a feedlot buys from an auction). Some auction markets use their own tags to facilitate payment between buyer and seller. A CCIA barcode could be used as a management tool and to facilitate information flows but is not usually. As yet, it is not seen as being robust enough to provide these additional benefits.

In the cattle industry, respondents believed that the cattle identification system is necessary to accessing foreign markets. As with the hog industry, without traceability, access to foreign markets can be denied and the export market can be lost for beef. It is strongly believed that in order to compete in these global markets, not only is traceability an absolute essential, the type and form of traceability system must also be compatible with the foreign government's expectations.

The direct benefit of a traceability system is as an animal disease management tool and is perceived as the key benefit to the cattle industry. However, enabling benefits are also seen as important in order to capture all possible benefits, hence increasing the value of the system and hopefully revenue for members.

Industry members stated that the current CCIA tag is attached at herd of origin, but the connection is lost after the first sale as auction markets and feedlots do not maintain information linkages between tags and any owners in between. Essentially, the current cattle ID system has coverage at its endpoints but not in the middle. Additionally, cattle are often tagged with another tag as a back up but the first and second tag numbers are not linked. As a result, some respondents think the tagging system lacks structure and is hard to control, with the CCIA lacking an adequate administration system.

In January 2006 the CCIA released an enhanced database (Canadian Livestock Tracking System). Within this revamped infrastructure functionality is included for account management, premise ID, animal movement and sighting and age verification; planned initiatives include value added quality assurances and group lot identification (CCIA, 2006). Currently producers can provide land location of their premises on a voluntary basis, which could enable CCIA to create a premise ID. Although the CCIA is adding additional functionality, the system does not currently include movement records and for various reasons, it is commonly perceived that the system cannot currently be used to generate additional benefits as there is no information flow along the entire chain.

The Current and Potential Benefits of a NLTS

Risk Management and Mitigation

Livestock Disease Management and Food Safety Risk Management

The most important and direct benefit of a national traceability system is perceived to be in the area of risk and disease management for livestock. The one unifying area of consensus from interviewees across all three livestock species was that some form of national traceability system would benefit all livestock industries in Canada. Most respondents believed that managing the risks associated with potential livestock disease ex-ante to an outbreak and assisting in controlling the spread of the disease ex-post are the primary *raison-d'etres* for such a system. Stakeholders agreed that a national traceability system would also benefit their individual livestock industries, as a national system would likely be able to respond more quickly in the case of an outbreak than existing systems. Within each livestock species, stakeholders also believed that a national traceability system would benefit their industry, even if it did not directly benefit their particular segment in the supply chain (e.g. an auction house in the cattle industry).

It is important to note that a national traceability system would not prevent an outbreak of animal disease. It would, however, ameliorate its effects and reduce adverse consequences for the industry. It is perceived that such a system would enable rapid control of the spread if an outbreak occurred, and significantly improve the accuracy of the response to it. The system is viewed by some respondents as a valuable insurance program where benefits would be lumpy and, in some cases might never arise. The enhanced ability to isolate and contain the outbreak to a specific location or region allows the affected industry the possibility of maintaining market activity or, if the market is closed, it can facilitate a more rapid re-opening, thus providing a benefit by reducing loss of export and domestic markets. Should the traceability system facilitate the containment of a disease to a region (zoning) leaving the industry in other regions unaffected, all participants' risk decreases.

The direct and, according to most of those contacted, the most valuable function of such a mechanism is that it creates an animal health management system that helps control the ex-post consequences associated with a disease outbreak. The ability to quickly trace an outbreak back to its source in a matter of hours as compared to days or weeks reduces the impacts of business interruptions (fewer days lost), loss of consumer confidence (the longer it takes to find the problem, the less they trust the food system), and industry interruption (everything in the supply chain stops). 'Time truly is money' in this case. The less time lost, the less the economic impact.

The major livestock disease management benefits of a NLTS are perceived by industry stakeholders to be:

- Lowering response time in stopping the spread of the problem, facilitating more rapid control and ease of detecting the source
- Providing for a more accurate and focused response
- The ability to regionalize or localize outbreaks
- Enabling more rapid reopening of markets

- Preventing the loss of markets
- Improving the control of production related diseases

These benefits are seen as accruing to the entire industry but may not be evenly distributed among members of the industry.

A possible approach to approximating the magnitude of a national traceability system's value in terms of animal health management can be in terms of the time saved. For instance, virtually all respondents believed that such a system would accelerate the ability to control the spread of an outbreak. For some respondents, this is its key feature.

At the simplest level, the value of an industry's economic activity can be used to determine a basic cost to that industry of an interruption lasting a few hours as compared to a few days or several months.

One respondent suggested that benefits of this sort could be as follows:

As a non-exporting industry, total farm gate receipts for the Canadian sheep industry were valued at roughly \$112 million in 2005² which translates into roughly \$306,000 daily. An outbreak halting the industry's activity for 3 days would cost \$920,000 in cash receipts alone, not including welfare, compensation, social costs or multiplier effects. If a national traceability system could shorten the interruptions duration, for instance, by 2 days, at the minimum, the industry would lose \$306,000 rather than \$920,000.

This may be an overestimate as some revenues would only be delayed rather than lost.

Although the Canadian sheep industry tends not to engage in export activities, respondents believed a national traceability system could possibly benefit their potential exports of breeding stock. A NLTS would enable exporters to confirm the genetics of an animal with a verifiable system but, as yet, purchasers of breeding stock are not requesting this type of traceability. Such a benefit could potentially facilitate growth in an export market for the sheep industry. It was the perception of some members of the industry that the export of a live sheep for breeding purposes may well earn greater revenue than a lamb going to slaughter and, thus, could marginally increase the earnings of an exporting producer.

At the moment, however, the US border is closed to Canadian sheep breeding stock due to a problem in the Alberta flock. An NLTS that would enable regionalization could potentially allow stock certified to be from Ontario to be exported, while ensuring the Alberta flock is not exported until concerns are addressed. The ability to export could then be narrowed according to desired attributes (breed, location of source farm).

Similarly, for the Canadian dairy sector, a national traceability system could provide an additional quality verification mechanism for the industry. Milk processors want accountable sourcing to ensure food safety in their products. Beyond the tracing of animals, it was suggested by a respondent that a NLTS could potentially facilitate traceability back to source of milk for food products containing milk or milk products. For milk producers, traceability could assist in maintaining marketing relationships or particular markets for their product. Similarly,

² AAFC Red Meat Factsheet, 2006

international customers of the milk industry are increasingly asking for traceability, thus a NLTS could facilitate the continued maintenance of existing relationships or assist in creating new exports.

For export oriented livestock industries, interview respondents suggested that the ex-ante benefits of NLTS were critical to maintain open export markets, as more foreign governments have made traceability a keystone condition for food imports.

It is believed that the speed and accuracy of a response to an outbreak contributes to the credibility of the system and is essential to retaining market access ex-ante and regaining access ex-post to an outbreak. Having traceability enables exporting activity (or allows to exports to continue), which in turn, help assure the survival of the industry. Essentially, to continue to export the industry must have traceability. In the case of an outbreak, the ability of a traceability system to contain the disease is crucial to 'getting back into the market', both domestically and internationally. A recent simulation by ATQ impressed industry stakeholders from other provinces when the system was able to track and locate the exact location and source of the 'outbreak' within a few hours.

For exporting industries, the direct benefits of a NLTS in terms of animal disease outbreak management and risk management have been equated at the minimum, to the value of export markets not lost.

As an example, one pork industry respondent suggested the following magnitudes for the benefits that might be expected:

Exports were valued at \$2.84 billion in 2005³, accounting for 55–60% of total production⁴. In 2005, Canadian hog producers broke new export records, selling over a million tonnes of pork to over 100 countries. Of note, in 2005, pork exports to the US declined by 5% but exports to Japan increased by 31%⁵. Japan is a market with increasingly stringent traceability requirements for its meat and meat products imports. As domestic sales of pork have been stable at best, with little or no growth, the importance of exports to the industry is obvious. It is strongly believed that without a NLTS, access to premium markets such as Japan will be denied.

Japan was identified by a number of respondents as a vital market for the pork industry for two reasons. Exports to Japan have grown considerably over the last few years, but the incremental benefit is the additional premium the industry was able to capture for those exports – premium earnings per unit exported.

For example, the George Morris Centre has calculated the incremental returns gained by the hog industry through exports to Japan:

³ Canadian Pork Council, 'Canadian Hog Industry Considers Future Competitiveness of Export Sector', Press Release, November 16, 2006

⁴ Canadian Pork Council, 'Canadian Hog Industry Considers Future Competitiveness of Export Sector', Press Release, November 16, 2006

⁵ AAFC, Red Meat Factsheet, 2006

- fresh chilled product resulted in about 50 cents/kilogram in incremental benefits or returns to the value of the loin.
- all chilled items exported to Japan are sold based on combination pricing, earning a premium of \$0.40-0.50/kg based on all chilled primal cuts exported
- during 2005, exports of fresh chilled product to Japan, Korea and Singapore totalled about 53,000 tonnes at an estimated C\$0.40 cent per kilogram premium. It can be asserted that the Canadian industry enjoyed incremental returns of up to \$21 million on chilled pork exports. That amounts to about \$1/head for every hog slaughtered in Canada.
- research conducted for the US Meat Export Federation (USMEF) which stated that loin exports received a premium of US\$0.17 cents per pound or just under US\$0.40 cents per kilogram. Surveys of US exporters found that export premiums exist for all major cuts such as bellies, loins, butts, tenderloins and picnics as well as credit items, feet, lips, diaphragms and brains. The average premium for the top ten exported items amounted to nearly US\$0.19/pound or US\$0.42 cents per kilogram (Grier, 2006).

The report continues that pork exports provide value to producers by firstly, reducing domestic supplies resulting in higher prices overall, and secondly, earning export premiums that can result from the value in exports exceeding the domestic value. “Combining the incremental values from offal and chilled cuts, it was argued that exports add up to \$9/head in value to the hog” (Grier, 2006).

The Canadian cattle industry is also highly export focused. In 2005, Canada exported nearly \$1.85 billion worth of beef and beef products to foreign markets⁶. Without access to foreign markets, some industry representatives suggested that the Canadian cattle industry is not sustainable at its current size, and a 60% loss in the value of the cattle inventory would not be unrealistic. Couched in other terms, should the Canadian cattle industry not be able to export, it was suggested that it would need to shrink by 50% in order to regain profitability. The cattle industry is well aware of the impact of losing access to export markets is due to the recent (2003 – 2005) BSE crisis.

A national traceability system can also assist in loss prevention for the beef industry. In 2004, one male offspring of the BSE infected cow from Washington State had been sold to a feedlot. That calf had no identification tag. As a precaution, U.S. authorities had more than 400 head of stock in that feedlot destroyed, mainly because they could not identify that single calf (Murray, 2004). Had that calf had a tag, the loss of the other 399 animals could have been prevented.

Cattle industry respondents state unequivocally that a national traceability system is a prerequisite to exporting; without one, exports will be hindered. The next level of traceability, premise identification, is seen as a priority in order to preserve existing export markets and help develop new value added opportunities which, in turn, will increase the industry’s revenue.

Similarly, a respondent from the Canadian dairy industry believes that the value of national traceability is the value of domestic markets not lost, be it for culled dairy cows or for milk and milk products. They see the primary benefit of traceability in mitigating risks associated with livestock disease management. However, for dairy, it was suggested that the ex-ante benefits of

⁶ CanFax Statistical Briefer, October 2006

an NLTS are equally as valuable as those arising ex-post. Traceability is seen as a valuable tool of quality assurance that maintains consumer confidence in the safety of the milk supply – and is the industry’s priority.

Interviewees believed that having a national traceability system in place would mitigate the effects of the next outbreak. Rapidity in finding the source provides reassurance to consumers that milk is safe and is produced by a healthy national herd. The Washington State cow found to have BSE in December 2003 had a Dairy Herd Identification (DHI) tag. This resulted in rapid tracebacks, and identification of herd mates and offspring through the DHI records and database (Murray, 2004).⁷

Others in the industry suggested that a NLTS offers the additional benefit of bringing species groups together to work towards reducing their combined exposure and risk from potential cross-species infectious disease, for instance Foot and Mouth Disease (FMD).

It is estimated that a Canadian outbreak of a swine-related disease, such as FMD, would cost an estimated \$13 to \$45 billion. Trade, welfare and processing implications would be enormous; border-dependent industries would suffer staggering losses. If the border was closed to hog and pork exports, it has been estimated that the production base would immediately shrink by 50 per cent. In a best-case scenario, it is suggested that the border would close for a minimum of 90 days.⁸ Interviewees stated that they did not believe that the Government of Canada could afford to provide offsetting compensation if there was an outbreak of FMD in the swine industry – implying that the cost of an outbreak would not be fully offset by any compensation that was forthcoming. Of course, this increases the benefits associated with a national system. It was felt that externality effects of an FMD outbreak could also be large. For instance, in the UK, measures put in place to control FMD included the halt of tourism in affected areas, causing major losses to that particular industry as an externality of FMD. If the disease outbreak was quickly controlled the externality, and associated costs, would not arise.

A 2002 study by the government of Australia determined that a short FMD outbreak (where markets reopen 3 months after the disease was eradicated) would cost cumulative export revenue losses of AUS\$3 billion. An outbreak that took 12 months to control would lose AUS\$9 billion in export revenues. In addition, control and compensations costs were estimated to be AUS\$30 million and AUS\$450 million respectively.⁹

Other respondents suggested that a national traceability system could, in addition, assist in the management of domestic or regional production diseases that may not be catastrophic enough to close markets but affect herd health sufficiently that there is value in eradicating them.

In sheep, for surface diseases such as rot, it was suggested that a traceability system would be helpful in isolating or zoning to localize and reduce the flock’s infection. Even with the reduced

⁷ Murray, Blair, Govt of Ontario, OMAFRA, ‘Traceability’, February 2004. Available at: http://www.omafra.gov.on.ca/english/livestock/dairy/facts/info_trace.ht

⁸ Canadian Pork Council, Traceability Background, <http://www.cpc-ccp.com/Traceability/Background.pdf>

⁹ *Impact of a Foot and Mouth Disease Outbreak on Australia*. Productivity Commission, Research Report, 2002, AusInfo, Canberra

exposure enjoyed by closed herds, some risk of infection exists when males are brought in for breeding. A traceability system, it is believed, would help reduce this risk

In hogs, it was suggested that a NLTS supported by cooperation between veterinarians and producers, could address regional, non-reportable production diseases. One estimate of annual losses in the Canadian swine industry due to infectious disease suggests values up to \$80 million.¹⁰ One respondent suggested that Circle Virus is causing a 30 percent loss in animals which could be addressed by a traceability system's ability to track movement and the use of premise-based reporting¹¹.

Non-fatal diseases also cause economic loss. For instance, the incidence of swine influenza, although generally not fatal, stunts growth and increases delay to market. Swine influenza is also of concern due to its zoonotic potential, thus a national traceability system would assist in monitoring by tracing an outbreak to its source. Of note, one respondent suggested that primary producers in the hog industry want a NLTS mainly for exotic animal disease risk mitigation. Food safety is not the motivating factor for producers.

For the dairy industry, a respondent suggested that there are 25-26 serious production diseases where a NLTS could: (1) help formulate future outbreak plan and; (2) eradicate the disease. Although not diseases warranting market closures, they impose sufficient economic costs to justify their mitigation and/or eradication.

Johne's Disease (paratuberculosis) in cattle is an example. A recent study involving Ontario dairy herds found that test positive cows had 2% - 6% less milk production, while in cattle generally, an overall loss per cow for each herd was \$123 - \$195¹². A U.S. survey showed that on large farms Johne's Disease positive herds produced US\$200 per cow less income due to lower production and earlier culling (Rodenburg (2004). The primary risk factor for a herd becoming infected with Johne's Disease is through the purchase of infected stock, thus infection prevention and control are essential in preventing losses. Johne's Disease affects sheep as well as cattle. Thus, it was perceived that the traceability system could become a tool to prevent these losses, and may help reduce inter-species transmission.

Another production disease, the mastitis-causing bacteria, *Staphylococcus aureus* (Staph.aureus) is transmitted from mother to calf. The only real source of new infections is infected cows in the herd. Subclinical Staph. aureus infections decrease milk production, and occasionally cause clinical cases as well. Established infections in older cows are almost impossible to cure, treatments are only partially effective and often, culling is the only way to remove the organism and thus prevent exposure for other cows and heifers (Rodenburg, 2004). It was suggested that a traceability system could assist in the tracking and monitoring of this infection.

¹⁰ Canadian Research Network on Swine Infectious Diseases, available at <http://www.medvet.umontreal.ca/reseau/ang/index.htm>

¹¹ As discussed with hog industry members

¹² Manitoba Agriculture, Food and Rural Initiatives, Animal Health <http://www.gov.mb.ca/agriculture/livestock/anhealth/jaa07s00.html>

Several respondents speculated that there are myriad other production-related livestock diseases for which a NLTS could assist in planning for and in eradication.

There are also expected to be benefits of an NLTS in facilitating cross-species communication and interaction related to disease control. The sheep industry, for example, is at risk of potential infections from the goat industry, cattle can be at risk from sheep etc. A NLTS could assist in the tracking of potential cross-species contamination, the value of which is the cost saving if an outbreak in two or more livestock industries is prevented.

Incentive for Good Practice and Accountability

Another means to measure the risk mitigating benefits of a traceability system is its ability to provide incentives for an industry or supply chain to pursue best practice and accountability. This category of benefit is perceived to be of significant direct value for many industry respondents. They suggested that when producers are paid on the basis of averages for their livestock, there is little incentive to produce better quality animals. According to several industry representatives, the incentive is, in fact, to produce lower quality as producers will be paid the same for a low quality as for a high quality animal. As one industry observer put it:

the incentive to mix “duds” into the herd for sale is high, as the owner of the “dud” cannot be identified, which in turn reduces the overall value of the herd for sale, reducing incomes for that group of suppliers. This is what anonymity in the supply chain permits.

Hogs

Linkages along the hog industry supply chain that increase the efficacy of payment-for-quality and facilitate some information flow on carcass lean yield already exist – but the system only provides an approximation of carcass quality¹³. It was suggested by one respondent that traceability may add an additional level of trust by reducing mistakes.

Dairy

For the dairy sector, one industry representative believed that a traceability system would force the “substandard up to par”. The interviewee observed that there is currently a “mishmash of ID tags” that confuse and complicate the existing system. They felt a national traceability system would standardize the identification system and enable the setting of a minimum standard that everyone in the industry would have to meet.

Cattle

The cattle industry has traceability at ‘either end of the chain, but needs it in the middle’. It was suggested that these gaps in traceability are points in the supply chain where anonymity provides a disincentive to pursue best management practice or improvements. Producing lower quality has the same result as producing high quality, thus the incentive to mix “duds” into the lot of animals for sale is high, as the owner of the “dud” cannot be identified, which in turn reduces the overall value of the lot for sale, reducing incomes for that group of suppliers. It was suggested that the

¹³ See Hog Market Contracting in Western Canada - August 2006, Alberta Agriculture and Food, [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/sis10957](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sis10957) for a description of pork contracting mechanisms and incentives.

current system also encourages the passing on of problems because anonymity prevented tracing back.

It was felt that a national traceability system would improve accountability in the supply chain, act as an incentive for good practice thereby reducing overall risk, and help improve earnings per animal. This is discussed in more detail in the upcoming section on supply chain benefits.

Reputation/Consumer Confidence/Credibility

The value of traceability in terms of enhancing reputation (either of a firm, brand or all of Canada) and contributing to consumer confidence is mixed, depending upon the market (domestic or international). In the domestic Canadian market, respondents from all three livestock groups agreed that traceability would not assist in enhancing reputation, gaining consumer confidence or ensuring credibility as Canadian consumers simply expect that their food supply is safe.

It was felt that consumers tend to be complacent regarding food safety until a crisis arises. At this point, whether quick containment is achieved or not is the only time they become aware of food safety. In other words, the perception was that consumers do not care unless there is bad news, thus “no news is good news”. Industry representatives believed consumer confidence is a fragile commodity; despite being currently high, an uncontrolled outbreak can easily shatter opinion, with lasting consequences (e.g. the lack of trust in food safety in the UK).

For this reason, livestock industry members recognize that although that there is little current domestic consumer demand for traceability, another widespread food scare could quickly reverse the situation. The chorus demanding food traceability in this situation will be ‘loud if not shrill’. In the words of one respondent, ‘from zero to catastrophe’. They went on to say that the hog industry is approaching traceability now in preparation for the next, ‘inevitable’ food scare, ensuring a rapid, well organized, accurate reaction, in ‘preparing for the next one’.

It is believed by some respondents that the excellent international reputation Canada enjoys in disease management is an attribute foreign consumers will be willing to pay for. A NLTS will be one means to reinforce and support Canada’s reputation in foreign markets, as well as being able to provide a reliable proof of origin. However, the actual value of this is expected to vary depending on the end market and the product.

For international markets and their consumers, stakeholders from all of the livestock groups believe that traceability is an essential aspect of winning and keeping an excellent reputation as well as gaining and maintaining confidence regarding the safety of imported Canadian food products. For instance, as cited previously, the meat export segments of the hog and cattle industries are adapting to the Japanese consumer who is deeply interested in food safety and is willing to pay for its reassurance via traceability. The NLTS can further enhance the ability to export livestock and related products by providing reassurance to foreign consumers and governments. Thus for exporters, traceability is a critical aspect of their marketing strategies.

Respondents also recognize that an NLTS may not be sufficient to guarantee market access in the case of an outbreak – ‘just because you have traceability does not mean we will keep the border open for you’. Discussions at trade negotiations are examining the benefits of regionalization with traceability, so that only the affected region is not allowed to export, rather than the entire nation’s output. It is recognized that the NLTS may help shorten the amount of time the markets are closed or permit exports on a regionalized basis.

It was suggested that, over the longer term, a NLTS will have greater impact on reputation and confidence as consumers in general become better informed. Education efforts to increase their sensitivity towards unsafe or unverified food could increase the appreciation of an NLTS.

In terms of reputation, consumer confidence or credibility, representatives from the individual livestock groups believe an NLTS offers:

Sheep

- Few benefits as the industry is not engaged in large scale exporting.
- Domestic markets are not currently requesting traceability.

Hogs

- Food safety is not a concern for domestic consumers
- The industry’s producers are interested in traceability primarily for management of foreign animal disease and control, not for food safety.
- Industry stakeholders believed that an NLTS would enhance the industry’s reputation internationally, facilitating exports.

Dairy

- Confidence in system increased markedly with improvement in compliance due to change from paper (62% compliance) to electronic system (80% compliance)

Cattle

- Domestic consumers have high confidence because of good inspection system, no major domestic food safety scares, even with BSE.
- Packers perceive the value of traceability as a significant contributor to a positive reputation (e.g., the \$30/head premium paid in Japan).
- Bigger benefits of traceability on reputation achievable on higher value cuts.
- Existing system is well respected. It opened market to demanding purchasers despite some holes in logistics (i.e. without full traceability up and down chain).
- A national traceability system can be a significant reputation and confidence builder internationally, allowing small specialized producer to benefit by catering to export demands.

Finally, it is perceived that a national traceability system would be a tool towards building goodwill across the supply chain, to all different end-user groups, both domestic and foreign, despite uneven distribution of its final value within each chain. It is generally believed that the system would enhance and reinforce reputations for safety and quality along the supply chain, not only to the final retail consumer, by providing a means of accountable quality verification.

Production Management

Production benefits are defined as those that could be gained from improved management practices (operational efficiencies and information management) at an individual farm or other business premise. The benefits expected in production management arise largely due to enabling factors rather than being direct. Overall, the benefits of traceability in terms of production management are achieved in time savings, reduced costs, labour savings, improved accuracy and reduced errors.

Sheep

A national traceability tag on farm is believed to result in considerable labour savings and can provide additional information to assist the producer. Currently, the most popular tag used in the sheep industry is not machine-readable as it does not have a barcode¹⁴. It has a unique number which is stored in a central database. Producers must manually track the movement of each animal using this number. The industry traces sheep starting with the national database for flock of origin and follows through subsequent producers' movement records. Industry members stated that the system is effective but not rapid. Interviewees also stated that reading the number is an effort as the tag is prone to falling off or the number wears away with time. With the ability to track on farm from birth, an individual animal's data being easily readable and retrievable, the traceability system will help reduce paperwork and errors. A tag that is easily scanned will reduce human error in reading the tag.

An interviewee suggested that each individual animal's identification number can be used to manage the overall flock's health. Producers could then track feed, breeding, loading and inventory. Record keeping is also expected to be simplified, but many of these benefits can only be achieved through the widespread acceptance and use of electronic technology.

It is believed that if the tag is used for every operation that involves the individual animal, i.e. every time it is weighed, the correct weight will be attributed to the correct animal. This would allow changes to feeding that could lead to maximizing the benefit attainable from the feeding regime.

For weaning, respondents feel the traceability tag enables better monitoring of new weanlings health by monitoring their weight. Each animal's vaccination record, feeding regime, timing of feed and supplements can all be easily tracked and managed. Animals can rapidly be sorted by weight, to apportion and time their feeding routines for the best gains.

A participant in the study suggested that sorting by weight, for instance, would allow the printing of a manifest of all 100lbs animals prior to transport. This can save hours of work. It was reported that one producer was able to reduce labour from two full-time positions to one and a half as a result of an electronic animal identification system.

¹⁴ The Ketchum Kurl Lock #3 is the minimum required tag for the industry, is the least expensive and therefore most common. The industry does offer RFID tags or tags with barcodes but interviewees stated that these are far less popular due to their higher cost per tag.

These benefits are perceived to be of particular value to producers with large flocks, or breeding stock providers and organizations – and are generally only achievable using electronic technology. Industry members stated that if the RFID tag were to be free for producers, many more should be willing to use them as a management tool for on-farm administration.

An national traceability system is also believed to enable enhanced quality assurance in sheep breeding stock by verifying parentage. Currently, no verifiable standards on quality of breeding stock exist.

Hogs

One producer representative claimed that a NLTS would enable the information on individual animal attributes to be returned back to the original producer, who could then use this information in better herd management. The producer, however, needs access to their own information within the system.

In terms of production management, a national traceability system is expected to enable better coordination of production activities. For example, in the coordination of delivery and transport, should weather become an issue, last minute changes in delivery and transport can be made. The system could provide advance notification of a delay, trucking can be postponed and the animals do not shrink while delayed.

Another example where the NLTS is believed to offer benefits is to assist in the situation where the US border is closed to live hogs. The NLTS would help facilitate movement of product domestically. It would enable producers to determine the best locations to reroute live animal movements; for example; e.g. from Alberta to Ontario.

A NLTS is also thought to facilitate better emergency management and disaster planning. For example, should an ice storm disrupt power supply, the traceability system could be used to determine where restoring power to barns is crucial. The system could also enable better tracking of disposal in case of a major disease outbreak.

Dairy

According to a Quebec dairy producer, the value of a national traceability system is proven by the ATQ in terms of farm management. The ATQ registration number is used every day, assists in determining when to breed, tracking feed, best time for milking, when to sell. For virtually every daily activity, the registration number is an essential tool.

The dairy industry's NLID tag is used by 70 percent of the producers who breed their herds. However, the NLID excludes those that are not breeding their herds. A national traceability system would, hence, ensure greater coverage of the dairy herd. It is also believed that the benefits of traceability have been proven by ATQ through the significant improvements in the reliability of good information. The reduction of errors is important in maintaining credibility.

Cattle

It is expected that the most important production management benefit of a traceability system for a producer is the ability to track and verify the history and information for each animal in his herd in order to increase yield per animal. This could be achieved through:

- Tracking parentage and genetics of the individual herd to weed out poorer stock and to improve the overall production attributes of the individual herd; e.g. reduced back fat.
- Better feeding regimes; if, for example, a specific pattern emerges in feeding that results in better carcass weight or cut out weight.
- Efficacy of supplements; e.g. to determine if the use of supplements assisted in weight gain.

Packers/processors

- With a full national traceability system, beef processing plants, abattoirs and packers could enjoy the possibility of lower insurance premiums. Facilities using ATQ believe that if all their supply was traceable, their insurance premiums would decrease.
- A traceability system could facilitate timing of production runs. For instance, if the processor knows that in two weeks they will have big load of Angus cattle for specific cuts which must remain segregated, they could plan their production runs around that specific load. Some processors/packing plants, however, are able to do this type of planning now, without a NLTS.
- At a packing plant, both RFID and barcode tag system are used, where the barcode is scanned as the primary tag. A mis-scanned tag takes time to hand enter, losing roughly 10 seconds per incident. This is not a problem if the run only has a few mis-scans, but if there are many, the time begins to accumulate. Mis-scans happen if the tag is dirty, or is a different colour, broken, or missing. It was indicated that current scanners have a 70 percent read rate. The plant must still have 100 percent entered, thus when running at 279 head/hour, the 30 percent mis-scan rate significantly slows down the line
- If a tag cannot be scanned, it is read manually with a universal reader. Then, staff must query two databases (CCIA and ATQ in Quebec) in order to get the age of the animal. As ATQ keeps its database separately, two queries are needed. Once again, it takes roughly 10 seconds to manually query a tag. The NLTS would consolidate the effort into a single query.
- If a national traceability system can be used to scan eartags for each animal, it can facilitate advance warning of these eartags before arrival and unloading at the processor or packer. Advance notice of each group of lot numbers is a time saver.
- If farmer has 1000 head, and is shipping 100/day, on Monday, Tuesday and Wednesday, advance notice of these numbers is given to the processor who then has an easier time managing their logistics and inventory. The processor can then track movement of animals prior to shipping. Currently, the registration numbers are entered manually after processing has taken place. Advance notice would enable better tracking for logistics which saves labour and time in receiving. Further, the electronic data system reduces paperwork and errors.
- Similarly, the packer will be instantly aware if a single animal is sick out of a shipment. The national traceability system will allow the packer to know the animal's history from barn to his door and what possible elements of contamination occurred along the way.

Currently, CFIA has access to this information but no-one else. A NLTS could open this up increasing transparency.

- At abattoirs, the electronic traceability system would reduce mistakes regarding animals' ages due to human error. As a result, credibility could be improved.

Supply Chain Management

Benefits arising from improvement in supply chain coordination are those that can be captured through more efficient relationships between market players in the industry, including improved processes and information flows along the supply chain. The majority of the potential benefits identified in this section arise from the enabling features of a national traceability system rather than direct benefits.

Hogs

It is believed that a national traceability system has the potential to improve supply chain relationship through better tracking, i.e. providing just in time management similar to FedEx's package tracking system. High end food service will appreciate the value of traceability in pork as they seek a higher level of quality assurance and products attributes in response to consumer interest.

The role of national traceability system in facilitating pork exports has a direct benefit on the domestic market. Exporting allows pork marketers to:

discriminate between markets in which a specific cut is more or less preferred. This prevents burdensome supplies of relatively unwanted cuts from driving down domestic prices for all pork cuts. Thus, only the most demanded products are sold at their respective price points, with other cuts exported elsewhere to countries where they are preferred. Alternatively, the distribution of pork products in the domestic Canadian market would be essentially fixed according to the yield of cuts from the carcass, absent pork exports (Grier, 2006).

Being able to sell more cuts from the same carcass at higher values internationally prevents a domestic market glut in pork and preserves higher revenues for the industry.

Cattle

It is virtually the unanimous opinion amongst all participating stakeholders in the cattle industry that a national traceability system would "erase (the) bias towards mediocrity built into (the industry)" because the current system permits anonymity along the supply chain.

Feeder cattle wearing the CCIA tag are usually identifiable to the herd of origin, if the tag was activated. Once the animal is sold through either an auction or directly to a feedlot, the ability to trace its ownership is lost as animals are sold in groups or lots. An industry respondent stated that the value of an NLTS would be to "fill in the holes". The current cattle system has "traceability on the ends" but "needs the middle connection". The gaps in the current system may encourage free riding on quality.

A NLTS could attach an identified animal to each of its steps along the supply chain. By maintaining the identity of individual animals along the entire supply chain, payment for individual animal's specific attributes can be facilitated, rather than the use of averages. With an full traceability system problems must be addressed as they will be traceable. There would be potential consequences arising from poor management decisions and/or shirking.

With accountability through the supply chain, industry respondents said they expected the quality of the livestock moving along the supply chain would improve, earnings along the chain will also improve and there will be greater confidence throughout the supply chain as each firm is accountable. There will be fewer questions regarding payment, whether that was the correct information about that animal (i.e. "no switcheroos"), thus raising the lowest common denominator by creating a minimum standard of risk in the industry. Currently, the industry is typified by different sensitivity levels based on accountability and liability along the chain.

Cattle industry members in Quebec cited a significant improvement in the overall operating atmosphere and industry confidence and trust amongst industry members with the implementation of ATQ. The ATQ system assisted in building trust in the relationships along the supply chain, because the system made sure everyone "knew that each member of the chain was doing things right". Prior to the implementation of the ATQ, members of the cattle industry sought alliances with supply chain members they knew they could trust, a far less efficient means of managing supply chain relationships.

Specific anecdotal benefits of a comprehensive national traceability system related to greater supply chain accountability include:

For a processor/packer:

- the possible limitation of a recall's extent. For instance, one run from one day recalled rather than an entire week's production because of the ability to trace the problem to a specific feedlot rather than all supplying feedlots for that day or run
- Foreign objects; e.g., an injection needle is found in the top butt. The processor would be able to know who left it there.
- E-Coli. Although contamination is not easy to trace, currently all cases of e.coli are attributed to the packer, even if the contamination occurred earlier.

For the industry:

- Greater clarity in recalls for abattoirs, packers, processors and consumers.
- Reassurance in quality of purchases – fewer 'duds' inserted into the sale so overall herd quality improves. Purchasers get what they pay for and get what they expected. Some examples using purely hypothetical values and parameters were provided by an interviewee:
 - A feedlot bids and pays for 5 cattle at auction in February, all of which weigh the same, 1000 lbs. What they don't know is that two of those cattle were born in May (nine months ago), the other three in September (five months ago). Thus, the three born in September are actually worth more being younger but match the weight of their older counterparts. The two born in May are worth less being older but gaining relatively less than their younger counterparts. Yet the feedlot paid the same price for all five animals based on the averaging system.

- A market buys ten cattle from an auction at \$1/lb (buying low). They then sell to a feedlot for \$2/lb. Assuming a realistic 7 – 10 percent death rate, one cow from this group dies at the feedlot. The market still doubled their initial investment, despite selling one animal in poorer health, while the feedlot still paid a premium even though one animal was of poorer quality.

A comprehensive traceability system could attribute more information to each individual animal and the feedlot would pay the correct price for each animal based on its specific attributes. Producers of high quality and other desired attributes will generate repeat business and remain in operation. Businesses that consistently provide poor quality or fail to follow best management practices would not be able to stay in business. It was claimed that this change in the incentive system is needed the most and will have the greatest effect at the wholesale level where accountability is currently low.

Finally, for producers, there may be some enabling benefits should individual carcass traits be traced back to their livestock. Currently, cow/calf operators are paid according to the attributes demanded at the initial sale after herd of origin; i.e. a certain weight class, specific colour, facial patterning, etc. These are basic attributes that add little value. However, if individual attributes such as back fat, cut out ratios, etc. on each individual animal could be passed back from the packer to the initial producer, a greater premium would be paid as these qualities add considerable value.

However, it is expected that one of the largest benefits to be gained from accountability in the supply chain is the synergies of working together in a less antagonistic atmosphere. Increasing accountability reduces risk which, in turn, increases the level of overall trust in the industry. Different segments of the beef cattle industry can work together towards improved genetics in breeding stocks and better meat products.

For producers/processors it was suggested that a comprehensive national traceability system could facilitate individual animal management to indicate productivity/output per animal. It was claimed that the processor does not send individual animal tag numbers back with carcass information or, if they do, the carcass information is averaged out with no specific information per animal. The NLTS could facilitate the specific tag number coming back with specific details about each animal's output; e.g. back fat percent, number of cuts, high end cuts, wastage, etc. The processor has an incentive to send this information back to the producer because they will get what they pay for and have better relationships with suppliers. The NLTS will help trace the efficient production of animals to the farmer, enabling processors to choose good suppliers over bad ones, and for producers to (1) become good suppliers and; (2) be rewarded for it.

It was also suggested that ATQ has proven that a NLTS will also improve confidence in transactions. Mistakes cannot be hidden as information is shared on the database. For instance, with ATQ, the animals grade comes from the producer himself, the grading producer/abattoir pays for the grade and at the end of the process, the grade and carcass information are returned back to producer on an individual animal basis. Essentially, it is claimed that the ATQ's ability to track back to the source of problems induces better behaviour amongst players, reduces

opportunism, and encourages better self discipline as individual firm's reputations are on the line with every shipment.

Abattoirs can improve their internal logistics as animals can be treated individually, and easily followed; e.g. one specific trait, such as Angus, could easily be kept together to facilitate the supplying of a specific niche market.

Others suggested that a comprehensive national traceability system will improve the efficiency of the supply chain, reduce the cost of transactions at each step in the supply chain and provides verification of transactions in terms of which animal, their individual traits, who bought, who sold, where, etc. It was felt that the system could save time and reduce errors thereby lowering labour costs and the burden of paperwork.

Market Enhancing

Market enhancing benefits are those that arise from improved information flows forward through the value chain, facilitating quality verification, increasing the size of the market and its profitability through better marketing and improved competitiveness. Benefits in this section appear to be a function of the enabling capacity of a national traceability system rather than direct benefits. Due to the different stages of development for traceability systems in each livestock industry, and the variety in their structures, market enhancing benefits derived from an national livestock traceability system vary considerably.

There are two basic themes identified by respondents by which a traceability system would facilitate greater competitive advantages for firms and industry. These are:

- Quality assurance where a traceability system can verify and substantiate label claims such as organic, 'certified free range', 'Sterling Silver', 'Maple Leaf Prime', 'veggie fed', etc. The traceability system ensures that label claims can be substantiated and verified, adding an element of security for the purchaser. Label claims are an additional marketing tool for firms making them, enabling them to differentiate their product. A credible traceability system can provide a service to sellers in supporting this differentiation. The value of this varies depending on the claim, the product, the brand and the industry.
- Carcass information flowing back from slaughter to producers would enable the producer to know what attributes are valued and facilitate the production of animals that embodied those attributes. They could then receive premiums for these attributes (i.e. colour, marbling, size of premium cuts, retail cut out value) based on individual carcasses rather than general characteristics (i.e. fat coverage, lean yield). Producers would be paid for better quality. Processors would benefit from having a better quality supply of livestock to work with.

When a producer is paid according to grading parameters that approximate the value of a carcass, respondents suggested that problems associated with averaging, as discussed earlier, are reduced. The producer will attempt to meet the specified grading parameters because he/she is paid for

what he produces (e.g. paid for Canada A1 grade as determined by estimates of lean yield). However, with a comprehensive traceability system, the flow back down the supply chain of more specific and detailed information about each carcass could provide the producer with the means to achieve higher end premiums (i.e. retail cut out value, percentage of back fat, etc.). It was suggested that having this type of information would enable the producer to change his production to provide these more valuable attributes.

It is expected that a traceability system would enable the following market enhancing benefits for each livestock group.

Sheep

Currently, sheep producers can receive feedback on the grading parameters for each lamb slaughtered as part of their sales contract and it is upon these parameters that they are paid. Thus, producers are paid according to the quality of product they produce. Yet, one respondent believed that with an NLTS the feedback could become more specific and the premium for quality could be increased. For instance, rather being paid according to the range stipulated by general grading parameters (i.e. the amount of fat coverage on a carcass), if a producer could be paid according to the specific slaughter/carcass qualities (retail cut out weight) exhibited by each individual lamb, the incentive would be to produce a better lamb each time. This would further enhance quality.

Industry representatives suggested that benefits are expected to arise as a result of:

- Carcass information flowing through back from slaughter to producer would enable the producer to be paid an additional premium for specific qualities (size of cut, retail cut out weight) per individual lamb rather than general characteristics (fat coverage). Producers would be paid for better quality.
- Ensuring compliance with better information reporting; e.g. reporting deaths benefiting the industry
- Facilitating 'know your producer' connection with consumers, benefiting the producer
- Adding confidence to a local farm/firm's brand, but a brand cannot be based upon traceability alone. Traceability could support the brand.

Hogs

For the pork sector, some of the potential benefits that would lead to market enhancement were expected to be as follows:

- Traceability is facilitating quality assurance/food safety for which Japanese consumers are willing to pay a premium.
 - Russia, Brazil, Japan and US pork industries lost competitive advantage due to their inability to facilitate quality assurance.
 - Maple Leaf Food's system in Japan enabled the receipt of a five percent premium.
- Carcass information flowing back from slaughter to producer would allow the producer to target production towards high value attributes. They would be able to sell a more desirable product to processors who benefit from having a better supply of animals. Producers could also be paid premiums for specific qualities (size of cuts, colour) per individual hog rather than general characteristics (lean yield)

- Better information to assist producers with marketing. This information would enable some producers to capture niche markets.
- Processors require more information beyond simple estimates of lean content and weight in order to make optimum use of pork carcasses. Estimates of each prima cut's lean content, along with their expected size and weight on the slaughter floor would be useful in sorting carcasses in the chiller, prior to cutting the following day. It would also be of considerable value to have an estimate of meat quality (e.g. meat colour, drip, marbling, tenderness) ¹⁵. A NLTS could facilitate this flow of information.
- Better information to service niche markets; e.g. particular demands for colour, type of feed, etc. The flow of information would identify animals with an attribute, and target that niche market. There are generally better premiums in niche markets

Dairy

Respondents from the dairy sector suggested the following market enhancing benefits:

- Using the existing information provided by the ATQ, producers can and have improved their marketability via target marketing. Further, the industry can utilize the system to verify marketing claims - e.g. suppose claim is "Angus", the existence of the traceability system will enable the claim to be substantiated.
- Real time reporting – saves time and labour via access to timely, accurate information
- In terms of quality verification, an NLTS is not important to the final end consumer, but is for large retail customers (e.g. McDonald's). The value of an NLTS here is the value of that relationship or contract
- The NLTS could be a means for a consumer to know the producer but would initially require a program of consumer education about traceability.

Cattle

The benefits of a national traceability system are perceived to be distributed differently along the cattle/beef supply chain. It was agreed, however, that the industry must have a national traceability system as prerequisite to be competitive in world markets.

The following general industry wide benefits were suggested by beef industry participants in the interviews:

- While there is no premium in the US market for traceability, Asian markets demand and will pay for traceability. Asia is also where demand for beef is growing most rapidly. Competing countries to Canada such as Australia and New Zealand are using and marketing traceability in Asian markets, hence, traceability is essential to compete in these growing markets. One source indicated that Tesco in the UK reportedly pays a \$5-6 premium per carcass for DNA traceability
- A comprehensive traceability system is expected to assist in substantiating the verification of quality and with assurance of claims such as 'heritage', Angus, Red Poll, grass-fed, organic, etc.

¹⁵ Jones, SDM, The Canadian Pork Carcass Grading System and the 1992 National Carcass Cut Out , Agriculture and Agri-Food Canada , <http://mark.asci.ncsu.edu/nsif/96proc/jones.htm>

- The more information available regarding each individual animal increases the ability to promote it (i.e.: its condition (for feeder cattle), history, vaccines, feed, etc.), all of which help to increase its sale price, which in turn benefits the producer. The buyer is assured of a quality product. If producers were able to access information on each animal's full cut out value through traceability, they could improve their overall product and, subsequently, revenue.
- The traceability system could facilitate real time results for all segments of the supply chain, improving efficiency, reducing errors, saving time and/or labour.
- A traceability system could facilitate niche marketing for different products, potentially capturing premiums. This is applicable in domestic markets or in global markets where traceability can enable differentiation through national market demands

Specific examples of the benefits perceived as likely to accrue to specific segments of the beef cattle industry due to traceability are:

Producer or Integrated Producer Processor

- The benefit of a national traceability system for an integrated, non-exporting producer/processor is expected to manifest itself as an animal management tool based upon individual animals that will increase profitability per animal. The motivation to participate in NLTS is not for food safety as the perceived risk not high enough. A traceability system is viewed as offering an opportunity for increasing the firm's own competitiveness via genetic improvement (parentage for positive traits), and tracking of inputs (vaccines, feeding etc) for maximum efficacy and timing.
- The single most important perceived benefit is the ability to determine what changes are necessary to improve quality to earn additional premiums. For example, this could be accomplished by increasing the total rib-eye area and reducing back-fat by tracking genetics. One respondent suggested that 10 percent reduction in back-fat will increase profitability by 50 percent/head or \$5 / head for a good cut. This can make a conservative difference of \$50/animal up to \$200/head for a good carcass due to the better distribution between fat and good meat. Additional premiums can be achieved by increasing the proportion of meat to wastage as well as increasing the "right" kind of meat by improving marbling, portion control, cut size, etc.
- It was also felt that traceability would facilitate real time results. Using RFID tags at the chute side scale would provide information on the exact gain each animal made. When weaning calves, if any animals have smaller gains or have lost weight, health problems may be indicated. Individual animals can be instantly pulled and checked, reducing sick time and weight loss. Attending to their illness right away means a more rapid response in solving a problem, saving production time.
- Traceability might also provide an additional means to connect to consumers although some processors are already able to do this without an NLTS. If the NLTS could give consumer a story, it is another facet that could be taken advantage of during marketing. For example, Sunterra meats are sold in Japan with a story discussing how the animals were raised.

Packer/processor

- A national traceability system would ensure that existing wholesale customers (i.e. Macdonald's) would continue to purchase from the firm because of traceability back to the farm level. The value of this benefit is the value of the marketing relationship.
- Additional revenues can be generated if new markets for verifiable product can be found; e.g. hormone-free veal, which would earn a premium over existing veal products.
- Real time results would allow for better carcass management. For instance, carcasses with specific marbling characteristics could be sorted as they come off the line. Feed lots with readers can instantly determine which animals have had vaccines, what treatments, feed, etc. rather than being told they have all had vaccines, when in fact several have not.
- Traceability could provide increased knowledge of the health of cattle over their lifetime. Lifetime health may affect tenderness in addition to fat content. The traceability system would be able to track the correlation between fat content, overall health and tenderness.
- A NLTS could potentially enable faster access to information than current systems if it is designed correctly. The NLTS could validate and control the information collected. For instance, currently, information from cattle wearing CCIA tags can be found on their website, but interviewees suggested that the site is not fast enough, even for something as simple as birthdate verification. Should more information be available, the system must be able to respond more quickly. Dial-up access to the Internet is too slow. As the existing system is not working well, it was suggested that packers are not capturing all of the potential benefits of the system.
- Better information regarding niche markets allows better delivery of attributes that are specific to individual markets. In some markets, this improvement in the quality of information will make a significant difference. For instance, a traceability system can assist in determining new or extra uses for existing carcasses.
- One packer believes that traceability could assist in connecting with consumers. The connection would be central to finding out what consumers value on a cut, and enable the packer to tailor production to meeting what consumers want

Auction/ livestock markets

- There is the potential for the NLTS to improve livestock financing in Canada as it would enable confirmation of ownership with premise ID and full traceability. When a banking institution lends to a cattle operation (i.e. \$10 million to feedlot), should the operation fail, the banks must reclaim the cattle in part settlement of the loan. Currently, they sort the cattle by the brand which leaves the question of true ownership open. There is no way to accurately determine which bank is entitled to which cattle. This increases risk for banks, which in turn is built into their perceived reticence to lend to the industry. With a NLTS, ownership of the cattle is easily verified.
- Some marketing information deficiencies may be reduced. For instance, producers may state that all cattle being sold to the auction have had vaccinations but some may not have been vaccinated and die. This is a loss if they are in the auction's facility. A traceability system is expected to increase accountability for the livestock purchased by the auction.
- The national traceability system tag may be sufficient to replace an auction's own individual premise tag system that is currently in use. For instance, in Ontario, many auction houses use their own tagging system to connect the seller and buyer of cattle. The

tag indicates ownership and transfers to the new owner. The auction market needs to tag 2000 cattle this way with each sale. Thus, a small amount would be saved on tag expenditures and on labour.

Governance

Benefits from improved governance are those that accrue from managing the system – its administration, organization, research opportunities, and technology, and include systems benefit from one national cross-species approach to traceability. Benefits in this area are expected fall in both the direct and enabling categories.

The livestock groups believed there are benefits accruing from an NLTS in terms of management and administration, as well as from improvements to the technical ‘nuts and bolts’ of the system.

A key enabling benefit expected to arise from a NLTS are the synergies gained with a unified collaborative livestock voice across the species. At the core, all livestock groups essentially want the same thing in determining where the animal has been, what and with whom it had contact, and possible exposure to contaminants. They also share common goals in controlling potential disease outbreaks. Hence, the opportunity and ability for the species to communicate and collaborate together is an important benefit. Another essential benefit was the ability to work together to prevent disease outbreaks across species, thereby reducing risks posed by one livestock group for another.

It is also perceived that a joint industry-government approach in administration of the system is useful. Many respondents believed that a consultative effort to create relevant policy, followed by a mandate legislated by government, supported by both regulatory and non-regulatory tools, and managed by industry, is the best approach.

However, the view is also that the system must be sufficiently flexible to adapt to each industry’s unique needs, structure, endowments, and existing identification systems. It is believed that a mandate by government may be a necessary mechanism to ensure high compliance as democratic industry organizations may not be able to garner acceptance and induce diligence without official sanction.

Governance benefits tended to accrue overall to the industry, with specific benefits being distributed according to the nature of the governance mechanism.

A NLTS is viewed as also providing governance benefits in terms of:

- Economies of scale with one IT system rather than a multiples of completely different systems
 - Information gathered in the same format
 - Reduction of errors
 - Real time electronic system for timely response.
 - Standard technology throughout the system

- Simplification (using one reader rather than two or three, querying a single database rather than two) which saves time and labour
- Reducing duplication and replication in traceability efforts amongst provinces and/or across industries.
- Cross species disease control. Groups can work together towards managing or eradicating diseases that collectively affect their respective livestock industries.
- Setting standards to reduce risk posed by other species.
- United voice across species in the case of some zoonotic diseases
- Groups more advanced in traceability can assist and pass knowledge to those just beginning in the process.

Specifically for each livestock group, an NLTS is seen as providing governance benefits via:

Sheep

- Potential cross species disease transmission. For sheep, the goat industry does not use an identification system, yet goats can pose an infection risk to sheep. Conversely, the sheep industry is not as advanced as the beef and dairy industries in terms of identification and traceability. As they are all interrelated at some level, the opportunity for industries to work together and learn from each other is very important
- In terms of research, traceability could assist with analysis of animal movement patterns, supply chain efficiencies, developing a genetic test for scrapie to identify flocks that are more susceptible.

Hogs

- A real time electronic system providing a timely response. Regardless of species (five lambs or 500 hogs), utilizing the same concepts, standards and technology by everyone in the supply and transaction chain, gives consistency which improves reliability and accuracy.
- Research into efficacy of feed grains, best results, etc.

Dairy

- Research for constant improvement, perhaps in trucking or as yet unstudied local or less prominent diseases
- Cross-jurisdiction access across provincial systems
- ATQ's electronic system showed 80 percent of animals were tracked accurately whereas the paper passport system is slow and only 62 percent of animals were accurately tracked. Confidence in system increased markedly with this improvement in compliance.

Cattle

- A belief that the system could increase the ability of the industry to meet changing consumer wants/needs/demands. Currently, the industry has difficulty satisfying new demands if they do not fit the current models. Research could help to: (1) adapt and update the industry's value parameters; (2) facilitate better market research to better enable target marketing e.g. consumer preferences, market definition.

- Could act as source to generate ideas – likely bring awareness of issues that were not previously apparent.
- Common accessibility across jurisdictions, species.
- A single system ensures multi systems can communicate, can act with regional specificity and forces existing systems to improve and update (i.e. to include movement between premises).

As can be seen from the information reported in this section, the interview process provided a large volume of qualitative information. While the presentation of this information in the preceding format makes for admittedly tedious reading in some places, it also can provide useful insights. Only through a detailed examination of the responses can the high degree of agreement regarding the expected benefits of traceability be discerned. This agreement is manifest across the various livestock species and up and down their individual supply chains. While there is inevitably a degree of repetition in reporting in this way, the verification of the convergence in views regarding livestock traceability increases the degree of confidence in the summary of the results that follows.

Benefit Summary

The analytical framework identifies five main categories of benefits from a (national) livestock traceability system: (i) risk; (ii) production management; (iii) supply chain (upstream); (iv) market enhancing (downstream), and (v) governance. Individual benefits, and whether they are direct or enabling, are summarized in Table 1. A qualitative assessment of the likely magnitude of the benefits and their distribution across producers, the agri-food industry, and society, as perceived by the industry stakeholders interviewed for this study, is featured in Table 2. Finally, Tables 3a, 3b and 3c provide anecdotal evidence of benefits from the sheep, hog and cattle/dairy sectors respectively. The benefit summary below draws on Tables 1, 2 and 3.

Risk Reduction

Risk reduction/risk management benefits are the largest potential benefit category from a livestock traceability system. All are direct benefits, i.e. they flow directly from the ability to trace livestock¹⁶. Five key benefits were identified (Table 1). ***Livestock disease management*** is a significant benefit, particularly to the agri-food sector and producers (including feedlots), but also (although likely of smaller magnitude) to society as a whole (Table 2). Accurate and timely traceability of livestock can reduce the costs of a disease impact by reducing the scope and scale of the necessary mitigation responses (e.g. slaughtering potentially affected herds). The risk reduction benefits are particularly important for export-dependent sectors. A traceability system provides ***incentives for good practice*** by encouraging due diligence among producers and the agri-food sector with respect to food safety and animal health management practices. A traceability system assists with ***maintaining reputation/consumer confidence*** in the event of a herd health or food safety problem. Industry stakeholders generally perceived this to be of minor importance currently for domestic consumers as they believe that Canadian consumers have a

¹⁶ With the exception of “trade” where traceability also has enabling benefits if it facilitates market access through additionally providing age verification information and/or achieving disease-free region status through the provision of premise ID and animal movement information on a regional basis.

great deal of confidence in the safety and integrity of the food supply, however, there was a recognition that this could become a significant benefit from a national traceability system if a major incident occurs domestically. For access to international markets, the ability of a traceability system to maintain or restore consumer confidence was perceived as particularly important. Traceability also delivers international *trade* and market access benefits by facilitating compliance with importing country regulations (e.g. with respect to age verification or preserving disease-free status regionally). Whether these benefits are realized may depend on the extent to which the traceability system facilitates credible age verification or has the necessary components (premise ID, animal movement records, animal identification) to establish the disease-free status of a region. These are anticipated to be major benefits to producers and the agri-food industry, while much smaller in magnitude for society as a whole. A major potential benefit to society (consumers) of a livestock traceability system is *food safety* and the protection of *public health* from infectious zoonotic diseases. To the extent that a traceability system is effective in quickly identifying and isolating affected animals, this benefit is potentially the most significant direct benefit for society from a traceability system.

Production Management

Production management benefits refer to improvements to internal production management practices and production efficiencies that could be enabled by a traceability system. Four key benefits are identified (Table 1). As a category, production management benefits were perceived as relatively small in magnitude currently but with the potential to become medium-sized benefits. Given the nature of these benefits, all benefits accrue to either producers and/or the agri-food sector and all are ‘enabling’ benefits from a traceability system (Table 2). For producers (including feedlots), a traceability system has the potential to facilitate *enhanced individual animal management* within the enterprise, for example monitoring feed, weight and yield gain, monitoring animal health, tracking parentage and genetics to improve breeding stock, etc. For first-stage processors (slaughtering), traceability including animal identification facilitates *just-in-time management of the processing plant and the segmentation of production runs* through more accurate scheduling of deliveries, or advance manifests, among other benefits. Potential production management benefits flow from the *reduced incentive to cheat* due to greater information and better control over the production process, for example, verifiable vaccine records and age verification. This benefit is expected to be of medium magnitude for feedlots and the agri-food industry (packers). Tables 3a, 3b and 3c summarize specific examples of these benefits.

Supply Chain Management

Supply chain management benefits are external to the enterprise and relate to improved processes and information flows back along the supply chain. These are not direct benefits of traceability but result from the potential of a traceability system to facilitate these additional benefits. In general, these are perceived as relatively small at the present time but with the potential to be of medium significance in terms of magnitude. Four such benefits were identified (Table 1), with benefits being distributed to varying degrees across producers and the agri-food sector (Table 2). Within this category, the major benefit is likely to flow from *reducing*

information asymmetry with respect to the quality of supplies. For example, animal identification linked to individual animal information reduces the incentive to pool low quality or unhealthy animals with high quality or healthy animals. More accurate market signals flow to producers with respect to the production attributes that are valued by the buyer (Tables 3a, 3b, 3c). This is expected to be a major potential benefits to producers (primarily second-stage producers such as feedlots) and the agri-food sector (i.e. packers). First stage producers (e.g. cow-calf operators) benefit if this leads to higher average prices given reduced quality uncertainty for buyers. As an outcome of the improvements in information flow, industry stakeholders identified a *better operating atmosphere* and increased trust between firms in the supply chain as a potential benefit. For the agri-food sector (and to a lesser extent producers – feedlots), *improved logistics and inventory management* and better *coordination of supplies* are also potential benefits that could be enabled by a traceability system.

Market Enhancing

Market enhancing benefits result from improved information flows forwards through the value chain and the facilitation of quality verifications. Again, traceability systems per se will not necessarily deliver these benefits, but they are enabled by the presence of the traceability infrastructure. While these are currently perceived as relatively minor at present, there is widespread recognition that these benefits have the *potential* to be of greater value to producers and the agri-food sector and, to a lesser extent, consumers (Table 2). This was the largest category of benefits, with seven potential benefits identified (Table 1). Of particular note was the potential for a traceability system to piggyback the *flow of carcass quality information* back to producers and the *sharing of animal management information* forwards through the value chain. Jointly these factors can improve market signals and provide an arena for the payment of premiums on valued carcass and production traits (see Tables 3a, 3b and 3c). This could be a major benefit to producers, but also a fairly significant benefit to the processing sector. The potential to provide *real-time results* through real-time matching of animal type/quality with specific market requirements (e.g. chute side access to animal ID, improved sorting of animals) can enhance within-plant efficiencies for the processing sector. Moving forwards in the value chain, *quality verification enables product differentiation* based on quality assurances verified through traceability technology (e.g. DNA technology). Potential product differentiation strategies could also be based on the notion of enhanced *connectivity* between consumers and producers, i.e. accompanying a product with its ‘story’, although this benefit will probably remain a relatively minor niche market activity. Perhaps more significant could be the *credibility* that having a traceability system in place affords to quality assurances, with consumers also benefiting to a certain degree due to greater trust of quality claims. Greater *certainty of ownership* when animals are pooled during production, transit or at the point of slaughter may help reduce monitoring costs, ensuring that the seller is appropriately rewarded for the right animals and that the buyer gets what he/she paid for.

Governance

Governance benefits relate to system administration and management advantages that flow from having one national cross-species livestock identification system. As a category of benefits, a qualitative assessment suggests that these are likely to be relatively minor compared to the other

benefit categories, although by no means insignificant (Table 2). Four key benefits reside in this category, two direct and two enabling (Table 1). In terms of direct benefits, having ***one national traceability portal*** has significant advantages in terms of the effectiveness and improved coordination of crisis response, reduction of duplication and the facilitation of inter-provincial communications and transactions. There are potential economies of scale advantages, and industry stakeholders recognized the value of having common standards and a common format for traceability information that enhanced the effectiveness of the traceability function (see Tables 3a, 3b, 3c). As such, this benefit is likely to be particularly significant for society (effective crisis management response by government), fairly important for the agri-food sector and of minor significance for producers (see Table 2). For producers, a direct benefit from a single national traceability system lies in ***preventing being locked-in to proprietary traceability systems***. This could be a problem if producers need to make asset-specific investments to participate in a supply-chain based traceability system that is unique to a particular buyer. Stakeholder interviews revealed little concern over this issue, probably in part due to the fact that an industry-wide animal identification system already exists in the cattle industry, and is under development in the hog and sheep sectors so that proprietary lock-in has not become an issue in these sectors. A traceability system could enable ***research to improve quality*** by facilitating the linking of quality improvements to changes in production methods in a systematic way across the industry. This benefit is one which could evolve over time into a larger magnitude than is currently perceived to be the case. Finally, a national traceability system enables greater ***collaborative synergy*** across species groups by acting as a forum through which species groups can work together, facilitating networking and sharing of ideas on the design and implementation of effective traceability systems. Management of cross-species disease issues is also facilitated by a national traceability system. This benefit is likely to be of moderate size for producers and the agri-food industry and of relatively minor significance for government.

Table 1. Traceability Benefits, by Category and Benefit Type

Category	Benefit (can be immediate (existing) or potential (probabilities))	Benefit type
RISK		
1	Livestock disease management In case of animal disease outbreak, better ability to source, isolate and control, reduce spread, faster, more accurate response, reduces costs and increases loss avoidance ie. fewer herds slaughtered, preserving daily operations or reducing lost days, bu	DIRECT
2	Incentive for good practice Encourages better due diligence of individual firms because accountability is an incentive for good management practice	DIRECT
3	Reputation/Consumer confidence/Credibility Increase, maintain or regain foreign market access, increase, maintain or regain domestic consumer confidence, build and reinforce firm/industry/Canada's reputation, build and reinforce credibility of the industry/product/Canada	DIRECT
4	Trade Maintain or gain market access, ability to regionalize outbreaks preserving disease free region for maintaining export (GIS/premise ID)	ENABLING & DIRECT
5	Food Safety & public health Public health protection	DIRECT
PRODUCTION MANAGEMENT (internal)		
1	Enhanced individual management, best practice, greater efficiency micromanaging within enterprise - tracking and greater information at hand to reduce costs, better allocate resources, identify problems earlier, monitor and track individual animals inputs, health,	ENABLING
2	JIT management of plant or segment production runs ie. by market, timing and scheduling, transport, planning production run,	ENABLING
3	Insurance benefits - reduction in premiums	ENABLING
4	Reduced incentives to cheat with greater information, better control, With more information, incentive to increase risk as a means to reduce expenses is lessened.	ENABLING
SUPPLY CHAIN (external, moving backward in value chain)		
1	Reduce information asymmetry with respect to quality of supplies reduce incentive to pool poor quality animals with healthy, reduces risk to purchaser, raises overall quality	ENABLING
2	Better operating atmosphere because of #1 above, overall risk is reduced, improving trust through the industry, better business environment, gain synergy	ENABLING
3	Improved logistics & inventory management between supply chain members Advance manifests for delivery, adapting to transport issues, advance planning, disaster planning	ENABLING
4	Coordination of supplies with external vendors quality segmentation of production runs	ENABLING

Table 1 continued. Traceability Benefits, by Category and Benefit Type		
Category	Benefit (can be immediate (existing) or potential (probabilities))	Benefit type
MARKET ENHANCING (moving forward in value chain)		
1	Enables flow of individual carcass quality information (backwards to producers)	ENABLING
	Incentive to produce improved quality (grid price vs. live pricing per animal), price and demand signals are attached to the carcass, increase revenues for producers and possibly other members of value chain based upon quality produced	
2	Sharing animal management information (forward into flow)	ENABLING
	feeding regimes, health, vaccines, timing, supplements etc enables better decisions and accurate quality assessments per animal. Can also improve accuracy of information through ability of electronic system to reduce errors and save time.	
3	Quality verification enables product differentiation	ENABLING
	accessing niche markets, meet consumer demands, develop and grow markets, find premium markets	
4	Real Time Results ie. sorting	ENABLING
	real time matching of quality with market demands, saving time, labor and reduces losses ie. Chute side access, advance manifests, instant weight feedback, real time monitoring, transportation delays, shrinkage	
5	Certainty of ownership - connect transaction between seller and buyer, ensures buyer gets what he expected, seller gets paid for his animal, reduces monitoring costs	ENABLING
6	Connectivity	ENABLING
	potential to market personal relationships to consumer (ie. now your producer), proof of Canadian or local origin, branding Canada or a specific brand	
7	Trust	ENABLING
	credibility of quality assurances due to traceability ie. organic, hormone-free, grass-fed, free range, heritage	
GOVERNANCE (system administration and management)		
1	One national system/portal	DIRECT
	efficient, facilitates interprovincial trade, network complementarity, reduces duplication, regulatory benefits, better coordination of disaster response, various species systems can communicate, 1 data management system,	
2	Prevention of being locked in to proprietary tracing systems	DIRECT
	avoid asset specific investment that is tied to a proprietary system which then reduces ability to switch at a later date (ie. better that the government run it rather than a private corporation)	
	less distrust of governing body	
3	Research to improve quality problems - on issues not previously known as requiring research,	ENABLING
	systems approach, HACCP approach across industry, public, agrifood	
4	Collaborative Synergy	
	forum for species groups to work together, inter-species support and networking	ENABLING

Table 2. Distribution and Magnitude of Traceability Benefits

Category & Overall Magnitude

RISK + + +			
Benefit (can be immediate (existing) or potential (probabilities))	Distribution & Magnitude		
	Producer	Agri-food	Society
1 Livestock disease management	+++ [^]	+++ [^]	+
2 Incentive for good practice	+++ [^]	+++ [^]	+
3 Reputation/Consumer confidence/Credibility	+>+++ [^]	+>+++ [^]	-
4 Trade	+++ [^]	+++ [^]	+
5 Food safety & public health	-	-	+++
PRODUCTION MANAGEMENT (internal) +>+ +			
1 Enhanced individual management, best practice	++	+	-
2 JIT management of plant or segment production runs	+	++	-
3 Insurance benefits	-	+	-
4 Reduced incentives to cheat	++	++	-
SUPPLY CHAIN (external, moving backward in value chain) +>+ +			
1 Reduce information asymmetry with respect to quality of supplies	+++	+++	-
2 Better operating atmosphere	++	++	-
3 Improved logistics & inventory management	+	++	-
4 Coordination of supplies	+	++	-
MARKET ENHANCING (moving forward in value chain) +>+ + +			
1 Enables flow of individual carcass quality information (backwards)	+++	++	-
2 Sharing animal management information	+	++	-
3 Quality verification enables product differentiation	+ [^]	+++ [^]	+
4 Real-time results ie. Sorting	+	++	-
5 Certainty of ownership	++	+	-
6 Connectivity	+ [^]	+ [^]	-
7 Trust - credibility of quality assurances	+ [^]	+++ [^]	+
GOVERNANCE (system administration and management) +			
1 One national system/portal	+ [^]	+++ [^]	+++*
2 Prevention of being locked in to proprietary tracing systems	+	+	-

Magnitude of benefit		Definitions	
-	insignificant	Producer	Farmers and feedlots
+	small	Agri-food	Auctions, sales barns, abattoirs, packers/processors
++	medium	Society	Canadian consumers and/or government
+++	large	*	indicates benefit mainly affects government
+>++	low current but potentially large in the future		
[^]	even larger if exporting		

Table 3A. Examples of Traceability Benefits for the SHEEP Industry

Benefit (existing or potential)	Example	Value
RISK		
1 Livestock disease management	Domestic disease outbreak halts all activity in the sheep industry	total cash receipts \$112 million in 2005 = roughly \$306,000 daily. Multiply by number of days stoppage for a high estimate of value.
	cross-species disease infection from goats	ability to prevent exposure and infection.
2 Incentive for good practice		
3 Reputation/Consumer confidence/Credibility		
4 Trade	Regionalization could open exports in breeding stock	reopening of a closed export market
5 Food Safety		
PRODUCTION MANAGEMENT (internal)		
1 Enhanced individual management, best practice	Each individual animal's identification number can be used to manage the overall flock's health.	Individual animal information is available chute side, Producers can track feed, breeding, loading and inventory (who is missing). Record keeping is also simplified, but many of these benefits are achievable only through electronic technology
2 JIT management of plant or segment production runs	Sorting by weight, advance printing of shipping manifest	Saves hours of work, from 2 full-time positions to 1.5
3 Insurance benefits		
4 Reduced incentives to cheat	Enable tracking and quality assurance in breeding stock by verifying parentage.	Currently no verifiable standards on quality of breeding stock - nothing to verify genetics or quality of stock
SUPPLY CHAIN (external, moving backward in value chain)		
1 Reduce information asymmetry with respect to quality of supplies	greater detail on attributes beyond basic grading parameters that are general approximations of quality	the producer knows what attributes are valued, adjust towards producing them, & paid premiums for these attributes (ie. colour, marbling, size of premium cuts, retail cut out value) based on individual carcasses rather than general characteristics (ie fat coverage, lean yield)
2 Better operating atmosphere		
3 Improved logistics & inventory management	With the ability to track on farm from birth, with individual data easily readable and retrievable	reduced errors, better accuracy of information
4 Coordination of supplies		

Table 3A continued. Examples of Traceability Benefits for the SHEEP Industry

Benefit (existing or potential)	Example	Value
MARKET ENHANCING (moving forward in value chain)		
1 Enables flow of individual carcass quality information (backwards)	info flow back to producer on retail cut value per lamb	more detailed feedback on desired production, higher premium
2 Sharing animal management information	better compliance with reporting	disposals properly reported.
3 Quality verification enables product differentiation	Quality and label claims such as organic, heritage, grass fed	substantiates and maintains value of the claim
4 Real-time results ie.Sorting		
5 Certainty of ownership		
6 Connectivity		
7 Trust - credibility of quality assurances		
GOVERNANCE (system administration and management)		
1 Research to improve quality problems - on issues not previously known as requiring research	analysis of animal movement patterns, genetics	better production management and disease management
2 Prevention of being locked in to proprietary tracing systems		
3 One national system/portal	economies of scale	common standards & format of information gathered, saves time, increases accessibility
4 Collaborative Synergy	provision of opportunities to work together	communicating information, management of cross-species issues
NOTE: Examples in this table are not exhaustive. All examples and values were provided by industry stakeholders, more are available in the full report.		

Table 3B. Examples of Traceability Benefits for the Hog Industry

Benefit (existing or potential)	Example	Value
RISK		
1 Livestock disease management	Circle disease causes 30% loss of animals Outbreak of foot and mouth disease	mitigating 30% disease related loss mitigate portion of estimated \$13 - \$45 million expense
2 Incentive for good practice		
3 Reputation/Consumer confidence/Credibility	Excellent Canadian reputation substantiated by traceability	premium paid by Japanese consumer for Canadian pork products
4 Trade	Reducing domestic supplies, increasing overall prices + export premiums + incremental values from offal and chilled cuts	\$9/head increased value per hog
5 Food Safety	rapid and accurate response to animal disease outbreak	maintaining Canadian consumer confidence in safety of pork products
PRODUCTION MANAGEMENT (internal)		
1 Enhanced individual management, best practice	inventory control, monitoring feed regimes, timing and scheduling	more efficient use of inputs, time & labour savings
2 JIT management of plant or segment production runs		
3 insurance benefits		
4 Reduced incentives to cheat		
SUPPLY CHAIN (external, moving backward in value chain)		
1 Reduce information asymmetry with respect to quality of supplies	greater detail on attributes beyond basic grading parameters that are general approximations of quality	the producer knows what attributes are valued, adjust towards producing them, & paid premiums for these attributes (ie. colour, marbling, size of premium cuts, retail cut out value), based on individual carcasses rather than general characteristics (ie fat coverage, lean yield)
2 Better operating atmosphere		
3 Improved logistics & inventory management	flexible coordination of delivery and transport (ie.adjust for weather delays). The system could provide advance notification of delay	trucking can be postponed and animals do not shrink & lose value while delayed
4 Coordination of supplies		

Table 3B continued. Examples of Traceability Benefits for the Hog Industry

Benefit (existing or potential)	Example	Value
MARKET ENHANCING (moving forward in value chain)		
1 Enables flow of individual carcass quality information (backwards)	specific carcass characteristics flow back (ie. size of premium cuts) to producers rather than only general grading parameters (lean yield)	premiums paid for higher-value specific attributes
2 Sharing animal management information	more specific carcass information enables better use of carcass, ie. niche markets	more value derived from each individual carcass
3 Quality verification enables product differentiation	Quality assurance via DNA traceability, can create niche markets	Tesco in UK pays a \$5-6 premium/carcass
4 Real-time results ie.Sorting	lean content, expected size & weight of primal cuts available on the slaughter floor	sorting carcasses in chiller, prior to cutting the following day - saves time and organizing
5 Certainty of ownership		
6 Connectivity		
7 Trust - credibility of quality assurances		
GOVERNANCE (system administration and management)		
1 Research to improve quality problems - on issues not previously known as requiring research	feed research for efficacy	better feed regimes and products
2 Prevention of being locked in to proprietary tracing systems		
3 One national system/portal	real time system providing timely response	consistency, reliability, reduced errors
4 Collaborative Synergy	provision of opportunities to work together	communicating information, management of cross-species issues
NOTE: Examples in this table are not exhaustive. All examples and values were provided by industry stakeholders, more are available in the full report.		

Table 3C. Examples of Traceability Benefits for the Beef Cattle & Dairy Industries

Benefit (existing or potential)	Example	Value
RISK		
1 Livestock disease management	Johne's disease in cattle 1 calf from BSE infected cow in a feedlot but cannot be identified	mitigate the loss of \$123 - \$195 per cow per herd not having to destroy entire inventory of 400 head
2 Incentive for good practice	removing anonymity from sales process	quality per animal improves, overall herd quality improves
3 Reputation/Consumer confidence/Credibility	reputation for safety enable exports to Japan	\$30/head premium in Japan
4 Trade	BSE	mitigates some losses if regionalization maintains some export markets
5 Food Safety		
PRODUCTION MANAGEMENT (internal)		
1 Enhanced individual management, best practice	Tracking parentage, genetics to weed out poorer stock, improve the overall production attributes of the herd. ie. reduced backfat, tracking feeding regimes for best results	improved yield (reduced fat, cut out value) per animal
2 JIT management of plant or segment production runs	capture each animal ID, have advance warning of volume arriving, prior to arrival and unloading at the processor or packer improved electronic readability of ID tags reduces misscans & manual queries	time savings improve on the current 30% misscan rate which can save 10 seconds per animal needed to complete a manual query
3 insurance benefits	packers/processors with full traceability of supply vaccines and age are verified. Individual vaccination records tracked to reduce loss via illness (say they've been vaccinated when they haven't and die).	reduction in facility's insurance premium
4 Reduced incentives to cheat		accountability improved, risk reduced, credibility maintained
SUPPLY CHAIN (external, moving backward in value chain)		
1 Reduce information asymmetry with respect to quality of supplies	incentive to insert poor quality stock into pooled sales removed needle found in top butt at processors	seller's overall average sale price increases, buyers assured quality of purchase, have reduced risk, get quality they expected able to determine which feedlot left it there - better accountability
2 Better operating atmosphere	improved trust, less risk for all members of supply chain, assured and ensured trust, overall confidence in the relationships	everyone "knew that each member of the chain was doing things right" - better use of time and resources
3 Improved logistics & inventory management	incentive to produce and sell better quality animals possible limitation of a recall's extent, ie. 1 run from 1 day recalled rather than an entire weeks production	overall herd quality improves, higher return per animal reduce losses in product, saves time and labour
4 Coordination of supplies	feeding and supplements	schedule deliveries as needed to reduce inventory, storage

Table 3C continued. Examples of Traceability Benefits for the Beef Cattle & Dairy Industries

Benefit (existing or potential)	Example	Value
MARKET ENHANCING (moving forward in value chain)		
1 Enables flow of individual carcass quality information (backwards)	Tracking genetics and production to improve ratio of high value meat to fat distribution (retail cut-out value).	A 10% reduction in backfat will increase profitability by \$5/head for a good cut or \$by 50/animal up to \$200/head for a good carcass
2 Sharing animal management information	more detailed information increases the ability to promote specific animal (ie: its condition (feeder cattle), history, vaccines, feed etc),	increase its sale price, benefits the producer. The buyer is assured a quality product.
3 Quality verification enables product differentiation	large retail clients for dairy industry ie. McDonalds want quality verification from milk suppliers	value of that marketing relationship
	new verified products for niche markets ie. hormone-free veal	niche market with premium pricing
4 Real-time results ie. Sorting	chute side scale would provide the exact weight gain each animal has made.	Monitor weight changes in weaning calves for instant indications of health issues
	better carcass management.	specific characteristics and attributes could be sorted into chillers as they come off the line
5 Certainty of ownership	sale and purchase of 1 group of 10 head, quality of all 10 animals is assured, rather than having some of poor quality slipped in	Risk reduction as buyer gets what he paid for, seller gets paid for what he produced.
6 Connectivity	sale to consumer with accompanying story	marketing tool to differentiate product
7 Trust - credibility of quality assurances	quality claims such as Angus, Red Poll, hormone free, grass fed, organic	substantiates and maintains value of the claim
GOVERNANCE (system administration and management)		
Research to improve quality problems -		
1 on issues not previously known as requiring research	facilitate systems approach to quality improvement	incorporate ability to adjust production to meet new demands
	facilitate better market research	target marketing
2 Prevention of being locked in to proprietary tracking systems		
3 One national system/portal	communications between different systems	greater ease in finding information, facilitate better awareness and decision making
	discrepancy reduction between government programs, greater efficiency	reduction of duplicate programs, greater specificity and accuracy regarding programs
4 Collaborative Synergy	provision of opportunities to work together	communicating information, management of cross-species issues
NOTE: Examples in this table are not exhaustive. All examples and values were provided by industry stakeholders, more are available in the full report.		

Conclusions and Caveats

The analysis suggests that many potential benefits flow from a traceability system. The direct benefits, and those of largest likely magnitude as perceived by industry stakeholders, relate to risk reduction/risk management: containing animal diseases, minimizing impacts on industry reputation, maintaining access to export markets, etc. A variety of enabling benefits potentially flow from having an accessible, functional and credible traceability infrastructure in place. For the most part, the enabling benefits relate to improved operational efficiencies and information flows, including enhanced internal production management processes, more effective supply chain coordination and the capture of product differentiation benefits through market enhancement activities.

Whether the enabling benefits become a reality depends on the effectiveness with which a national traceability system is implemented, the accessibility and compatibility of the traceability infrastructure with other stages of the supply chain (i.e. the extent to which information sharing is possible), and the degree of buy-in by producers and the agri-food industry. Clearly some producers will benefit more than others: those who are more willing or able to adjust their business models to capture additional benefits from operational improvements and enhanced information flows. In some cases, the early adopters or the entrepreneurial producers are already capturing production management benefits and/or can readily see the potential for market enhancing benefits from a traceability system. In other cases, scepticism remains regarding the extent to which the enabling benefits will be realized, and in large part this depends on the extent to which the implementation of a national livestock traceability system facilitates and does not stifle the incentives for market enhancement and improved supply chain management initiatives.

It appears that many of the production management, supply chain and market enhancing enabling benefits from traceability could flow as easily from a species-specific traceability system as from a national (single portal) livestock traceability system. For example, enhanced individual animal management, reducing information asymmetry with respect to quality of supplies, and facilitating quality verifications to downstream buyers are benefits that potentially could all flow from a modified version of the current Canadian cattle identification system. It is primarily in the areas of risk management and governance that the potential benefits from a national, single portal, system appear to be the most significant. Industry stakeholders recognized the value in being able to mitigate cross-species contamination problems, facilitating faster and more effective crisis management, and having common information standards to facilitate the exchange and flow of information. Thus, among the individuals interviewed for this study there was general support for the concept of a national livestock traceability system . . . provided that it was complementary to or did not detract from the existing traceability systems that were in place for their species or province. Therein lies the challenge. The industry stakeholders who most readily recognize the potential benefits of traceability are likely to be those who have already made a 'sunk' investment in developing traceability systems. Engendering further buy-in to the potential benefits of a national livestock traceability system will likely require that the resource and human capital investments already made are transferable to (or compatible with) a national system.

By design, this study has only considered the benefits side of the equation. In any final policy analysis, equally important will be a consideration of the costs of designing, implementing and operating a national traceability system, and the distribution of those costs across producers, the agri-food sector and society (consumers and government).

Also by design, this study has presented a largely qualitative assessment of potential benefits and a framework within which further analysis of benefits is possible. Quantification of these benefits would be challenging and would likely require a combination of approaches. For example, scenario analysis could be used to analyse enhanced disease management and the ability to avoid domestic and international market losses in the 'risk' category. This could be done using secondary data sources with respect to the relative size and importance of export markets, combined with assumptions about the vulnerability of the industry to disease outbreak, the extent and duration of the loss of market share due to regulatory barriers or shifts in consumer demand. Measuring societal benefits from reduced risk of food safety problems would require data on the outbreak of foodborne illnesses in Canada stemming from zoonotic diseases. Again, assumptions about the probability and severity of a disease outbreak with and without effective traceability would be necessary. Given estimates of the likely scale and severity of food safety problems avoided, estimates of the negative externality costs of those food safety problems could draw on a variety of methodologies from the food safety economics and health economics literatures (e.g. cost-of-illness, contingent valuation, etc).

Simulation analysis could be used to map out potential production management, market enhancing and supply chain management benefits under different assumptions regarding gains in operational efficiency and the potential supply response from improved market signals. Primary data collection would be necessary for this analysis; for example, surveys of supply chain members (producers, feedlots, intermediaries – auction houses, trucking companies – processors). Putting a dollar value on these potential benefits would be challenging. Stated preference (choice) experiments could provide an objective method of evaluating the *relative* importance of benefits from traceability systems, and the extent to which supply chain players are willing to trade-off the direct and enabling benefits of traceability against a range of implementation costs. Alternatively, the Delphi group technique, with representation from producers and the agri-food sector, combined with scenario analysis that describes supply chain scenarios with respect to traceability, could be used to gather primary data on industry reactions to potential benefits and costs, as well as providing insights into implementation strategies.

Any quantification of the enabling benefits of a traceability system would also require a range of assumptions about potential demand shifts due to enhanced product differentiation. While we can often make reasonably confident assumptions about the supply-side responses, quantifying demand-side shifts due to quality improvement, risk reduction, enhanced trust and credibility, etc. is much more difficult. Useful to inform this analysis would be primary consumer research to better understand how Canadian consumers respond to perceived risks in the event of a food safety or animal health crisis (negative demand response), and how they can be expected to respond to credible quality assurances and product differentiation strategies (positive demand response). Relevant consumer research techniques include stated preference (choice experiment) surveys and/or experimental auctions. Key questions to be investigated would include: Canadian consumers' risk perceptions (level of perceived risk and robustness to new information); the

credibility of quality assurances from different information sources; the extent to which traceability capability enhances the credibility of quality assurances; and consumer willingness-to-pay for enhanced cross-species traceability with and without additional quality verifications. The issue of *who* consumers trust for quality, safety, and traceability assurances is a key question for future research. The respective private and public sector roles in engendering or reinforcing public trust, and the factors that enhance or weaken trust are central to this issue.

Appendix 1

Interview Instrument Potential Benefits of a National Traceability System

1. RISK

a) Do you think a traceability system can assist in reducing the risks associated with animal diseases; what management benefits will it provide to your ability to manage risk for Producer (P), Agrifood Industry and Supply Chain (AF), Society (S)?
Magnitude or significance

b) (How) do you believe a traceability system can assist you in managing livestock disease issues? Magnitude of benefits?

c) What do you believe are the impacts of a traceability system in terms of your (P,AF,S) exposure to liability (increase, decrease?) if at all? Why?

d) Do you believe that a TS provides benefits to the industry as a whole in terms of improved livestock disease management; reduced risks? (elaborate)

e) What influence can a traceability system have on a (P,AF, brand, Canada's) reputation

f) To what extent would you consider the benefits of livestock disease/food safety/protecting reputation derived from a traceability system primary benefits or would you view a traceability system as providing 'enabling' benefits of e.g. infrastructure for bolting on quality assurances, etc.

g) Can a traceability system enhance the ability to export? How?

h) Will a traceability system in your industry improve consumer confidence relating to food safety? How? Significance or magnitude of this?

2. GOVERNANCE

a) How do you believe a traceability system should be managed?

b) Do you believe a traceability system can open up new avenues for research that can benefit your industry? (i.e. systems approach, HACCP approach across industry, public, agrifood)

c) Who benefits most from farm to slaughter livestock traceability systems, and why?

d) Which do you think will provide the greatest benefit - a publicly managed traceability system or a privately managed one? Why? (Be sure to force them to answer about benefits, not focus on relative costs.) Would having one national TS reduce the risk of producers being 'locked in' to

marketing relationships in private supply chain-based TS - or is that really not an issue with traceability systems in the private sector?

e) Who do you believe should oversee TS's to provide you with the greatest benefits? What sort of administrative structure and alliances would be most beneficial? Why?

f) What is the best way to manage a TS? Several or single? Private or public? Federal or provincial? By species?

g) What if any, do you believe are the benefits of 1 single national system for all livestock species from farm to slaughter?

h) Can existing species-based TS's work together? Does it make sense to combine them?

i) What would be required in order for a single national TS system to have international credibility? Domestic credibility?

j) What in your opinion is the largest single benefit of a national traceability system (i.e. try to get an idea of magnitudes)

k) Are there any bonus's for having a single national TS system that you can foresee

3. MARKET ENHANCING

a) Do you see TS helping (your, your members, P,AF) competitiveness, marketability? If so, how?

b) How can TS help improve \$ earned per carcass for producers?; i.e. By facilitating the flow of information on carcass quality

c) In what ways can the access to increased information via TS help to increase revenue at the individual enterprise (P,AF) level?

d) Can TS help facilitate real time results; i.e. Having chute-side access to ID information, facilitate sorting of animals pre-slaughter etc

e) Would TS reduce wait time for payment or confusion at sales? How?

f) Could TS be marketable as a way to connect to consumers?; i.e. know your producer

g) Could TS facilitate proof of origin or in branding 'Canada'

h) Do you believe that consumer trust would increase due to the quality assurance given by TS? Why/why not?

- i) Does having TS as a part of quality verification help meet consumer demands?
- j) what are the most important implications of a traceability system for individual producers

4. SUPPLY CHAIN

- a) In what ways do you believe that TS will help improve supply chain issues?
- b) Can TS reduce buyer's resistance to purchasing mixed loads or mixed lots of livestock from different farms? How?
- c) What improvements do you see happening in logistics and inventory mgmt due to TS?
- d) PROCESSORS - How can TS help coordinate production runs?

5. PRODUCTION MANAGEMENT

- a) In what ways do you see TS helping improve production management for a single establishment?
- b) How can TS assist (P,AF) in the management of their herds?
- c) How can TS assist in the timing of production runs to meet expected fluctuations in market demand?
- d) Do you believe there may be insurance benefits (lower insurance costs) accruing to firms using TS?

6. GENERAL

- a) What are likely to be the most significant impediments to implementing a national multi-species farm to slaughter livestock traceability system?
- b) Could you describe the current state of play of traceability systems in your industry and the extent to which your stakeholders/members/colleagues believe there are tangible benefits to traceability systems?
- c) Any additional comments on traceability systems, benefits, governance, etc that you consider relevant - or e.g. benefits we haven't considered here

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