

Introduction

North America enjoys highly efficient livestock production systems that have adapted and evolved to meet changing conditions. New products are developed to meet changing consumer preferences. New production systems reduce costs. Contracts replace open markets and redefine the relationships among the stakeholders in the system. Technological developments increase farm-level productivity, processing efficiency, distribution systems and marketing. Every facet of the animal food chain—from genetics to retail and food service outlets—is adjusting to the rapid pace of change.

To take advantage of emerging opportunities for further growth, the industry must address certain challenges. With help from technology, production economies are moving the industry to fewer and larger production units. This has led to concerns about impacts on environmental quality, control of animal disease, food safety, worker availability and safety, and animal welfare.

Consumers not only want high-quality products, but they also often demand more specific information about animal production and processing practices. The industry is developing systems to trace animal products from farm to plate. Small, independent producers face fewer traditional market outlets and may need to affiliate with large integrators, market directly to consumers or join with other producers in various alliances to participate in emerging value chains. Consolidation has left a number of rural communities without a viable animal agriculture industry, while, in a few communities, rapid expansion of the industry has strained public services.

Globalization and trade provide new customers and new competition from low-cost, high-quality operations, challenging the North American industry to continue to adapt and innovate. There is concern that some segments of the industry may move offshore to reduce costs and avoid various regulatory constraints. However, other countries are increasing environmental constraints to deal with expanding, concentrated production of livestock. The North American livestock industry must adapt to these competitive challenges if it is to serve the burgeoning markets for meat products in developing economies.

The remainder of this chapter provides a broad overview of the factors influencing animal agriculture in North America and the opportunities and challenges it faces in today's world. It provides background and a platform for the seven Working Group reports that follow:

- Economics of animal production, processing and marketing
- Consumer demand
- Global competitiveness and trade
- Food safety, biosecurity and animal health
- Environmental challenges and opportunities
- Community and labor issues
- Animal welfare

The report concludes by outlining possible future actions for government, industry, academics and consumers.

The Industry Today

Beef—The North American beef cow herd was estimated at 49.2 million head in 2004. North American beef cows account for 21 percent of the world total. U.S. beef cattle are two-thirds of the North American herd, while Mexico accounts for 23 percent and Canada 10 percent. The most significant trend during the past 25 years is the growth in both the Canadian and Mexican beef cow herd and calf crop relative to those of the United States. In 2004, North American beef production of 14.9 million metric tons (mmt) on a carcass weight equivalent (cwe) basis accounted for a quarter of world beef production. The United States produces about 80 percent of North American beef, while Mexico averages about 12 percent of production and Canada about 8 percent.

Swine—The number of North American breeding sows has declined during the last two decades, but due to improvements in reproductive efficiency, pig numbers have not. Sow numbers were estimated at 8.5 million head in 2004, compared with 11.7 million head in 1980. The North American pig crop has been greater than 10 percent of the world total since the early 1990s. The United States accounts for approximately 70 percent of the North American pig crop, with Canada producing 20 percent and Mexico producing about 10 percent. The most significant trend during the past 25 years is the

growth in the number of Canadian sows and pigs relative to that of the United States. North American pork production was 12.4 mmt in 2004, accounting for 10 percent of world pork production. While world pork production increased to 100.9 mmt in 2004 from 69.9 mmt in 1990, North America has averaged 12 mmt production during the last five years, behind only China at 47 mmt and the European Union (EU) at 21 mmt. Pork production in North America and the EU has remained relatively stable since 1999, while China's production has more than doubled.

Poultry—U.S. poultry production has increased threefold during the past two decades. The majority of this expansion was in fresh/frozen broilers and turkeys. Production growth was spurred by the availability of low-cost feed grains, capital and technology for expansion, and a well-integrated, efficient production and marketing system. Poultry meat production in North America was 21.2 mmt in 2004, about 88 percent of which was broiler meat. The United States has seen a steady increase in poultry meat production to 17.8 mmt in 2004 from 6.3 mmt in 1980. The United States accounts for 84 percent of North American poultry production while Mexico accounts for 11 percent and Canada 5 percent.

The three North American countries accounted for 35 percent of world poultry meat production in 2004, down from a high of 39 percent in 1993. The main reason for the decline in North American world share was due to a 300 percent increase in Chinese production and a 257 percent increase in Brazilian production.

Dairy—Cow's milk production in North America was estimated to total 95.4 mmt in 2004, or 15.6 percent of the world's milk output. U.S. production represented 81 percent of North American milk output, while Mexico made up approximately 10 percent and Canada about 8 percent. The North American dairy herd consisted of 16.9 million head in 2004, with the U.S. herd totaling 9.01 million head, 6.80 million head in Mexico and 1.08 million head in Canada. India is the world's largest producer of milk (87.2 mmt), but almost 60 percent of this total is buffalo milk. North America trails the 25 EU countries that combine to produce 131.1 mmt of cow's milk. During the past two decades, Mexican milk production increased by one-third, while the United States and Canada saw output grow by 19 percent and 6 percent, respectively. In the United States and Canada, the increases in output have come from fewer cows and sharp improvements in milk productivity per cow, primarily from enhanced genetics. Mexico's dairy herd has increased in number.

Evolution of the Industry

The latter half of the 20th century was an era of increasing consolidation and specialization in agriculture. Animal

production on farms moved from providing food for farm families and the local community to specialized economic enterprises. As indicated in Table 1, the percent of U.S. farms with livestock decreased dramatically during the last century, particularly in the past 30 years. This trend is most acute in dairy, swine and poultry. This trend is also evident in Canada, but comparable statistics are not available for Mexico.

Table 1. Animal Production on Farms, Canada and the United States

Year	Number of Farms	Percent of Farms Producing			
		Beef	Dairy	Swine	Chicken
United States					
2002	2,128,982	37.4%	4.3%	3.7%	1.5%
1974	2,314,013	44.3%	17.4%	20.3%	1.5%
1920	6,118,956	29.7%	74.6%	79.3%	
Canada					
2001	230,540	52.9%	9.5%	6.7%	11.5%
1971	258,716	96.1%	56.2%	47.3%	46.2%
1921	711,090	84.2%		63.4%	82.4%

Source: U.S. Census of Agriculture; Census of Agriculture, Statistics Canada, Recensement de l'agriculture, Statistique Canada.

With specialization came significant increases in productivity. In the United States, the number of pigs per litter has risen about 50 percent during the past 60 years. Milk production per cow has risen more than threefold. Broiler production has increased more than tenfold. This time of increasing specialization and productivity growth was also a time of significant public investment in agricultural research and outreach to farmers.

Geography: The geography of animal processing facilities changed during the 20th century. Until mid-century, red meat processing facilities were located in or near large urban areas. Poultry processing was generally small in scale. In the mid-20th century, red meat processing starting moving out of the cities to small towns in the Midwest and Great Plains. Poultry processing began to concentrate in the Southeast, the Delmarva Peninsula on the East Coast and the West Coast as the industry integrated and consolidated.

The location of animal production also changed during the 20th century. U.S. beef feedlots moved from the Midwest to the Great Plains. In Canada, the cattle feeding industry

concentrated in Alberta, although it has a significant presence in all provinces. The Mexican beef industry is mainly pasture-based. In northern states, the industry exports feeder cattle to the United States, while other regions serve the Mexico City market.

The U.S. dairy industry has expanded in central California, the Mountain West and the Great Plains, and has a reduced presence in the Southeast and the Northeast. There is still a large dairy industry in the upper Midwest, but this region no longer dominates the industry as it did 50 years ago. The Canadian dairy industry is centered in Ontario and Quebec. Average herd size remains small at about 60 cows because of the government's supply management system. The bulk of the Mexican dairy industry is small and traditional, but development of ultra-high temperature (UHT) fluid milk products has spurred recent growth in large-scale, modern dairies to serve Mexico City and other urban markets.

There has been a dramatic increase in U.S. swine production in North Carolina and in the Plains of Oklahoma, Texas and Kansas. However, Iowa remains the leading swine production state. Canada has experienced large increases in swine production in the Prairie Provinces, particularly Manitoba. Large-scale production facilities have become the norm in the United States and Canada. The Mexican swine industry is still dominated by small traditional herds, but large-scale production units similar to those in the United States and Canada are increasing in the states of Chihuahua and Vera Cruz.

Markets and Contracting: The markets for animals and animal products continue to evolve. Direct consumer sales, robust cash and futures markets, farmer-owned cooperatives, and production contracts are among the marketing institutions that have changed to meet the needs of the industry. These institutions have generated a number of public policy issues and business conflicts through the years. Contract law and the Uniform Commercial Code evolved to address business transactions between farmers and processors. In the United States, the Packers and Stockyards Act of 1921 was passed to address farmer concerns about the market power of meat packers. Cooperatives emerged in the dairy industry to give farmers a way to market a perishable product at a "fair" price. In recent years, production contracts between growers and integrated processors have become the norm in the poultry and swine industries. While these contracts offer benefits and certainty to producers and to processors, questions continue to be raised concerning business conflicts and public policy issues.

Concentration: While thousands of farms are still involved in animal production, animal ownership has become more concentrated in some segments of animal agriculture. Meat and milk processing have also become more concentrated. Slaughter facilities have grown in size and specialization.

Between 1980 and 2000, the number of medium- to large-scale cattle slaughtering plants in the United States fell to 170 from 600, and the number of hog slaughtering plants fell to 180 from 500. The top four firms account for 84 percent of steer and heifer processing, 64 percent of pork processing, and 49 percent of broiler processing. By 1997, 80 percent of all steers and heifers slaughtered in the United States were processed in plants with annual capacity of more than 500,000 head, and 88 percent of the hogs were slaughtered in plants with annual capacity of more than 1 million head.

Although meat and poultry processing continue to concentrate, much economic power has shifted to the retail grocery chains, which have experienced major consolidation, domestically, in North America and worldwide. Wal-Mart is now the leading grocer in the United States, and the top four firms account for 46 percent of all grocery sales in the United States. (Hendrickson et al., 2001).

The Challenges

Economics of Production, Processing and Marketing

The drive to reduce the cost of production and improve the quality and consistency of livestock products has consolidated the production and processing sectors into fewer and larger firms. There is increased use of formal contractual agreements and a greater interdependence between producers and processors. The next generation of efficiencies will be gained from supply chain management that provides more quality and cost control, reduced food safety risk, more efficient scheduling of facilities and labor, and quicker response to changing consumer demands. Small to mid-size operations are looking to increase revenue by marketing differentiated products in niche markets, or cooperate with peers to capture cost advantages enjoyed by larger producers.

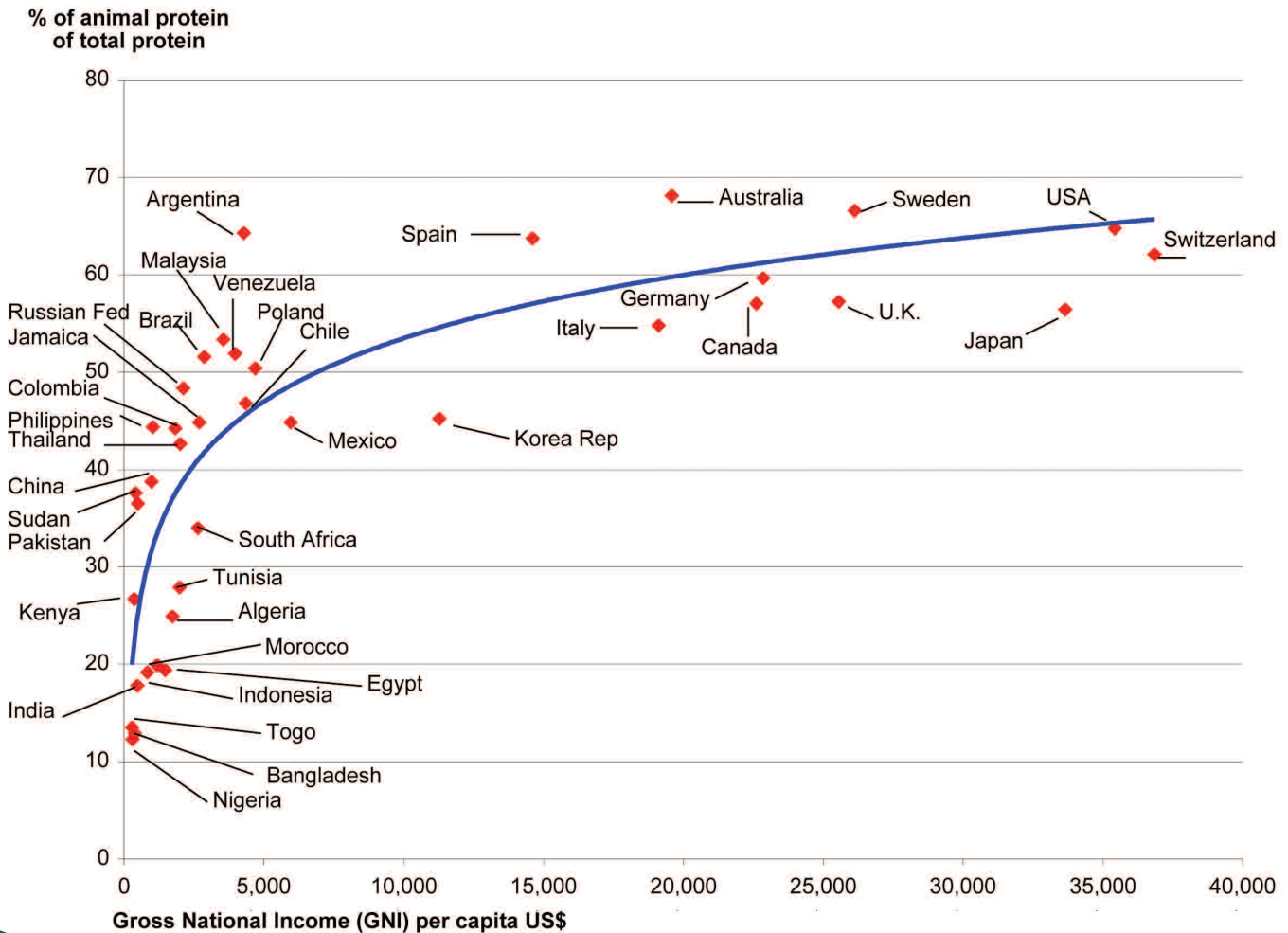
The chapter discusses in greater detail issues of scale economies, production systems, market contracts and policy options regarding:

- The forces driving integrated livestock production, processing and distribution systems;
- The competitiveness of North American animal agriculture to attract the capital, management and skilled labor needed for the future;
- Government policy or industry initiatives needed to promote economic viability of small to mid-size livestock farms; and
- Implications of environmental regulations and changing energy policy on production and processing in North America.

Consumer Demand

The demand for meat and other animal based foods is largely related to income and consumer tastes and preferences. Two fundamental trends affect demand for animal-based products: income growth and demographic changes. In developed countries, consumer tastes and preferences change, but total demand grows relatively slowly (Figure 1). While the demand has shifted for specific products, total demand has grown at about the rate of population growth. The changing demand for specific meat products results from concerns about diet and health, functional characteristics of products such as convenience, food safety, and perceived values associated with the place or techniques of production. More dynamic growth in demand for animal-based protein results from the fact that incomes are rising in many developing economies with large populations. The rapid increase in per-capita income, particularly in China, has generated a significant increase in per-capita meat consumption. Similar income and consumption trends are occurring in India, Indonesia, Chile and other developing countries of Asia and Latin America.

Figure 1.
Animal Protein as a Share of Total Protein



Source: Based on data through 2002 from FAO and World Bank.

The Consumer Demand Chapter addresses a series of policy questions, including:

- How do government policies related to diet and health impact food demand?
- What is the appropriate division of responsibility between the public and private sectors on the issues of traceability and certification?

Global Competitiveness and Trade

Until recently, international trade in animals and animal products has been limited in volume. Most countries restrict trade in animal products to protect their domestic markets and industries from disease and to protect food safety and human health. Almost all countries except Australia and New Zealand protect their dairy industries with domestic support programs, export subsidies or import tariffs. In North America, Canada and the United States restrict most dairy imports. Canada restricts most poultry imports. NAFTA reduced many of the barriers to livestock trade in North America, particularly for beef and swine. The World Trade Organization (WTO) and other recent trade agreements have started reducing market barriers to trade in animal products.

Worldwide meat demand is increasing rapidly, particularly in developing countries. In some countries, growing demand has outstripped the production capacity of domestic industries, forcing many developing countries to rely on international trade. Modern technologies utilized for mass production of livestock and poultry are readily transferable to developing economies. While in the short run countries may choose to satisfy animal production shortfalls from imports, the long-run goal may be to produce domestically by importing feed grains and soybeans or producing their own feed.

Animal agriculture production is becoming more highly integrated and concentrated, with leading integrators often having operations in more than a single country. These firms have the flexibility to shift sources of supply and markets. Capital and technology is mobile, and production and processing can be located nearly anywhere. However, importing grain for livestock into a region that cannot produce enough feed also imports nutrients that may not be able to recycle through local crop production, creating an environmental challenge.

Global trade-oriented animal agriculture systems are vulnerable to disruptive shocks and political pressures. For example, during the decade since NAFTA, the North American cattle and swine industries became more integrated, with animals and products moving quite freely across the borders. However, recent disease-related or market-driven border closings have disrupted this integration, produced price/market aberrations and reduced industry support for open trade policies.

This chapter addresses a number of issues that affect the future competitiveness of the North American livestock industry, such as:

- Will the animal food chain continue to integrate across borders, or will trade frictions reverse recent trends?
- Will NAFTA countries be able to harmonize agricultural programs and sanitary standards that reduce the risks that producers and processors face from border closings, if they invest based on an integrated livestock market?
- Can the animal agriculture industry in North America remain competitive in a global economy?

Food Safety and Animal Health

Ensuring a safe food supply is important to all nations. In the United States, the Pure Food and Drugs Act of 1906 was the first federal legislation focused on the safety of the food system. Adoption of the Uniform Pasteurized Milk Ordinance by most states and municipalities in the early 20th century assured a supply of safe, wholesome milk. In recent years, the development of Hazard Analysis and Critical Control Point (HACCP) systems has increased the ability to control food-borne diseases.

Incidences of *bovine spongiform encephalopathy* (BSE) and *E. coli* 0157:H7 contamination have brought demands for adoption of traceability and quality assurance systems to manage the animal products supply chain. The increasing dominance of international food retailers has been a key factor in the wide use of such systems, even when not demanded by regulations. The rapid growth of supermarkets in developing countries and trade agreements are also driving food safety concerns.

Animal disease is a major challenge to livestock production and impacts food biosecurity, national economies and public health. Joint efforts between research universities and public agencies have eradicated or controlled many animal diseases. Advances in veterinary medicine, basic research, educational programs and animal housing have contributed to this accomplishment. However, without vigilance and effective surveillance systems, even eradicated diseases can return. Potential terrorist attacks to the food system cannot be excluded. Driving forces in food safety and animal health across North America include questions about feed additives, biotechnology, food-borne diseases, links between animal and human diseases, and traceability.

This chapter explores a number of questions relative to the safety of animal-based food products and animal health, including:

- What is the future for antibiotic feeding in livestock production? Who will decide?
- What are the long-term public health impacts of food-borne pathogens in the North American and foreign markets?
- Can mandatory animal identification and traceability allow for faster resolution to animal disease-related border closings?

Environmental Issues

Environmental concerns and opportunities in animal agriculture encompass a wide range of issues important to various stakeholders. While water quality has long had much attention, air quality concerns involving odor and dust are becoming increasingly important with the proliferation of nuisance lawsuits and siting barriers. In the United States, recently revised Concentrated Animal Feeding Operation (CAFO) regulations require larger operations to meet nutrient application standards when applying animal manure to the land. Due to the consolidation of the production sector, the majority of livestock production is coming under regulatory oversight. Many states have, or are in the process of re-examining, current air and water quality regulations. In Canada, the federal and provincial environmental regulations for agriculture are coordinated through the Agricultural Policy Framework. Environmental regulation of agriculture in Mexico is centralized at the federal level, with state and local jurisdictions having minimal responsibilities.

Nutrient loading on farmland from manure application is a major concern. Nutrient application rates already exceed amounts that can be recycled effectively without impacting water supplies in some major producing areas. A key determinant of the industry's future geographic location will be environmental absorptive capacity. This suggests that the industry may move to those geographic parts of North America or elsewhere with lower population density and the driest climates. But access to water may limit this strategy. Conflicts over siting livestock facilities and land use will determine where the industry will prosper or decline. Establishing processes or strategies to resolve potential conflicts can benefit everyone.

There are scientific challenges for establishing measurable standards for offensive odors and then economically feasible methods to mitigate those odors. Separation from neighbors, bio-covers on waste handling and storage facilities, and the use of best management practices in manure disposal are odor-control mechanisms that will increasingly be required.

Strategies to solve byproduct disposal and environmental problems include the recycling of animal manure as a crop nutrient or conversion into productive resources to be used in agricultural and industrial processes or energy production. Adopting technologies to mitigate odors or minimize excess nutrients through changes in the feeding regime are other possibilities. An important question is whether technological solutions to manure disposal will be economically feasible.

This chapter examines environmental challenges and opportunities, including:

- How do environmental considerations affect production and processing location decisions, and what policy changes are needed to address nuisance lawsuits?
- Do larger farms or smaller farms have an advantage in meeting future environmental regulations or other concerns related to social responsibility?
- What technological advances might reduce the impacts of animal agriculture on air and water quality, or turn waste into marketable products?
- Will industry-driven changes push technological advances even faster than government regulation?
- What is the impact on food prices and global competitiveness of alternative regulations?

Community and Labor Issues

Livestock production is a fundamental, value-added activity in the agricultural sector. The profitability and viability of the livestock industry are important to many rural communities in

North America. Basic commodities are converted into higher value products, creating additional revenue for growers and additional jobs in those industries that provide inputs, slaughter and process animals or their products, or buy livestock products. The economic health of the industry impacts employment, incomes in primary and related industries, and tax revenues. Increasingly, some states or local communities are looking at how to attract new livestock investment.

The contribution of viable and profitable livestock industries to the economic performance of many rural communities cannot be overstated. Not only do livestock production, processing and distribution create jobs directly in their respective sectors, but firms in these industries support their business activities with the purchase of products and services, thus creating additional jobs and economic activity. The employment and income multipliers for livestock production generate state and local tax revenues that support public services, particularly schools.

Large-scale production and processing facilities may also bring new populations into communities and increased demands for services. If employees from outside the community or with different ethnic backgrounds are attracted to the generally lower skilled jobs in the livestock industries, conflicts may develop in the local schools and other community organizations. Conflicts over facility location or siting decisions may occur, and concerns about surface or groundwater contamination may impact a larger group of community residents than just those located near the production or processing site.

The cost and availability of labor can have a significant impact on the structure and location of livestock production and processing, as well as on the efficiency of individual farms. Over time, labor is relatively mobile and moves among firms and regions if the financial rewards provide incentives to do so. Availability of labor may be a problem due to difficult working conditions and generally modest wage rates in the livestock production and processing industries. But the skills required in both production and processing are increasing. The industry may face higher wage and benefit costs and recurring training costs. In contrast to the past, the livestock industries may be sourcing from the mainstream of the labor market.

Issues addressed in this chapter include:

- Can modern animal agriculture be a positive economic and social force in rural communities?
- How has the immigration of workers from Mexico impacted the rural communities they left in Mexico and the rural communities in the United States and Canada where they now work and live?
- Will labor availability and costs impact animal agriculture location?

Animal Welfare

Animal welfare is a significant public policy issue. During the last six or seven years, 50 to 60 bills relating to animal welfare have been introduced in Congress annually, with even greater proliferation at the state level. The recent ban of gestation crates for sow housing in Florida, and standards specific to livestock and poultry production practices in New Jersey, were promulgated under anti-cruelty statutes.

Confinement facilities protect animals from the elements and predators and provide greater control of manure for environmental protection. However, large-scale farming systems are seen by some as exploitation of animals and not conducive to ensuring animal welfare. Some consumers want more information on how and where their food is raised. While farmers and ranchers generally still enjoy positive public opinion, confined feeding operations and other large-scale agriculture operations are not so fortunate.

This chapter examines a range of animal welfare issues, including:

- Will the market or the government set animal welfare standards?
- How will animal welfare issues impact future industry location and structure?
- What market opportunities arise from animal welfare issues?

Challenges and Opportunities

Animal agriculture in North America is at a crossroad, facing conflicting signals and forces. Demand for meat protein is on the rise in much of the world. It is clear that the North American animal industry can continue to be a major supplier to this increased demand. Technologies have reduced production, processing and marketing costs, yet many segments of the animal food chain operate on smaller and smaller margins. Industrialization and consolidation of the industry may facilitate traceability and product quality control. At the same time, emerging consumer demand in and supermarket entry into developing countries may provide more incentives for domestic production within those countries, as well as increasing import. This will also provide great opportunity for the North American livestock industry.

The seven chapters of this report provide its organizational framework, even though some issues must be addressed in several contexts. The opportunities and challenges are interrelated. Animal health and food safety are related to consumer demand and animal welfare. Global competitiveness is a function of production economics, environmental regulation, labor costs and productivity. Communities are impacted by air and water quality, the size and scope of production and processing operations, and labor force issues.

Farm Foundation's intent in launching this project was to integrate the knowledge of all stakeholders, examine the critical questions and help prepare the industry for the future.

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