World Society for the Protection of Animals

WHAT'S ON YOUR PLATE?

The Hidden Costs of Industrial Animal Agriculture in Canada

WSPA

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Foreword

From the Family to the Factory Farm: The Hidden Cost of Change.

One of the most significant changes in the history of Canada occurred in the past generation but few noticed. One of the great contributions of the study "What's on Your Plate? The Hidden Costs of Industrial Animal Agriculture in Canada" by the World Society for the Protection of Animals (WSPA) is that it documents the shift in Canada from small and medium size farms to large intensive livestock operations. Farming used to be the backbone of Canadian economic and social history but the urbanization of Canada combined with a decline of the family farm, have radically transformed this tradition. The impact of this marked change in Canadian life is the core thesis of the WSPA publication.

My grandfather and uncle farmed in North Battleford, Saskatchewan. Some of my fondest memories of growing up in the 1950s and 1960s are our summer visits to the old homestead, where my uncle would pull me up on the tractor to sit on his knee and I would accompany him on chores like feeding the chickens and milking the cows (the squawking chickens pecking for food scared me mightily, milking the cows was much more serene). On my uncle's farm, as with his neighbours, there were small numbers of several types of animal that were part of a unit largely devoted to wheat. Different crops and animals were integrated into an operation that seemed in harmony with the land and the environment. The animals were 'free-range', living in the barn, going to pasture or wandering about the farm yard (especially the chickens!). Wendell Berry, the poet and farmer from Kentucky, describes the idylls I remember from my youth looking up at the sky while feeling the good earth below:

> Go with your love to the fields.
> Lie down in the shade. Rest your head
> in her lap. Swear allegiance
> to what is nighest your thoughts.

But that world is gone now. Dr. Alison Blay-Palmer, in her "Overview" contribution, highlights that the number of farms has decreased by 60 percent since 1956, with overall farm size increasing by 141 percent. The number of Canadians living in cities has more than doubled since then, while the population in rural communities has increased at a much more modest twenty percent, reflecting both the flight from the farm and immigration. Earl Butz, an American Secretary of Agriculture, told farmers to "get big or get out" and that is precisely what has occurred.

Livestock production has been the beneficiary of this "get big or get out" philosophy. Industrial animal agriculture uses intensive production line methods to produce tremendous volumes of meat, dairy and eggs as quickly and cheaply as possible. Michael Pollan, in the *Omnivore's Dilemma*, has written a best seller about this phenomena in the American context, and the WSPA study demonstrates that the same conditions exist in Canada. More than 700 million animals are now raised for food every year in Canada, 21 times greater than the human population.

There are undoubted benefits in the shift to industrial agriculture. For one thing, it has given us cheap food. For another, it is a large part of our economy (according to Blay-Palmer, the food industry employs about one in eight in Canadians and accounts for 8.2 percent of GDP). In 2007, the meat processing industry had total shipments valued at $21 billion. In 2010, Canada exported $2.7 billion worth of pork products to 130 countries, and $1.3 billion of beef to 60 countries. These are impressive numbers.

Yet, the focus of the WSPA study is that there are many hidden costs connected to this impressive economic achievement. Four broad categories of costs stand out: public health, the environment, community development, and animal welfare.

Several contributors to the study highlight the connection between public health and current practices in industrial agriculture. Dr. Eva Pip reports that “all known groups of animal pathogens have been reported within the intensive livestock industry in Canada”. Mad cow disease, or bovine spongiform encephalopathy (BSE), for example, devastated Canadian livestock exports with the discovery in 2003 that an Alberta cow had BSE. This Canadian collapse followed a similar crisis in Britain in the 1990s when British scientists confirmed a link between consumption of beef from cattle with BSE to a new variant of Creutzfeldt-Jakob disease. Risk experts William Leiss and Douglas Powell in *Mad Cows and Mother’s Milk* describe BSE as “a slowly progressing fatal nervous disorder of adult cattle that causes a characteristic staggering gait and is similar to a handful of rare neurological diseases that affect humans and other animals.” As Dr. George Khachatourians, Dr. Darren Korber, and Dr. John R. Lawrence write in their contribution to the volume, the BSE crisis in Britain “showed that the inclusion of brain and brainstem parts in the renderings for animal feeds has disastrous consequences for both livestock and human consumers of the meat.”

In general, the WSPA study shows that in Canada, the precautionary principle is rarely applied to the livestock-food industry and that it takes a crisis, like BSE in 2003, to move Ottawa to adopt the best in world standards. To improve this record, the study recommends that “the federal government should increase systematic means of oversight in animal pathogen-monitoring program by creating a robust national database for food animals that allows 48-hour trace-back data through phases of their production.”

In the 10,000 year history of agriculture, Dr. Tony Weis writes, mixed livestock populations have been part of integrated farming systems that depended on local cycles of nutrients and energy (i.e. our family farm in Saskatchewan). But with the dramatic increase of consumption of livestock, which Weis calls the ‘meatification of diets’, animal agriculture has become one of the top contributors to the planet’s environmental problems. Animal agriculture accounts for 18 percent of human caused greenhouse gases and is a major contributor to water stress and freshwater pollution. Seventy percent of the arable land on our planet is currently used to grow crops for animal feed and agriculture takes eight percent of all water use.

Canadians know this first-hand as tremendous freshwater bodies, like Lake Winnipeg, the 10th largest freshwater lake in the world, mutates before our very eyes. Industrial agriculture produces huge volumes of manure in small areas and this waste is sprayed on to fields where it seeps into the ground water and is eventually discharged into our lakes. The discharge of nutrients like nitrogen and phosphorus causes eutrophication, which in turn produces toxic algae. Members of

■ **Blue-green algae blooms cover hundreds of square kilometres of Lake Winnipeg – now considered the worst of any freshwater lake in the world.**

my family, for example, have been taken to the hospital after being exposed to Lake Winnipeg's ever expanding algae blooms. The International Institute for Sustainable Development says "Lake Winnipeg, which drains the Canadian Prairies, is the most eutrophic large lake in the world." This decline in the health of the Lake is because "phosphorus emissions flowing off agricultural lands and originating from intensive livestock or dairy operations contribute a fair share of the phosphorus load that ends up in Lake Winnipeg." To save Lake Winnipeg, the hog farm industry has to change: as when Wendell Berry preaches "do unto those downstream as you would have those upstream do to you."

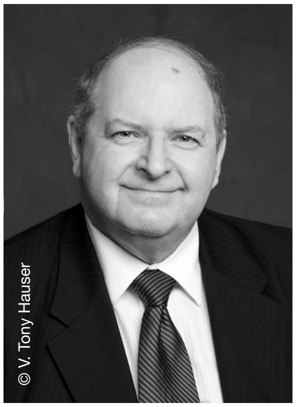
Berry also emphasizes the value of community in rural life, a major theme of the WSPA study. He writes, "A community is the mental and spiritual condition of knowing that the place is shared, and that the people who share the place define and limit the possibilities of each other's lives. It is the knowledge that people have of each other, their concern for each other, their trust in each other, the freedom with which they come and go among themselves." But this vision of rural community, one which I once saw first-hand in Saskatchewan, is now altered by the dramatic transformation of agriculture. Darrin Qualman writes in his article in the study that packer concentration and competition from factory farms have pushed out three out of four Canadian farms that were raising hogs 20 years ago and a similar expulsion is occurring in the cattle finishing sector.

With farmers squeezed by low prices and high costs, half of the farm families had one or both partners working off the farm to make ends meet, though farming is more than a full-time job. As a result, farmers are leaving their profession in droves: in 1991, there were 390,000 Canadians in farming but by 2006 there were only 327,000. In 1991, there were 78,000 young farmers taking over from their parents, in 2006 only 30,000. If the trend continues, who will be left to grow the food? Dr. Blay-Palmer rightly notes "once we have made a commitment to Canadian farmers we also need to compensate them fairly for the food they provide."

In her book *Ordinary Vices*, Judith M. Shklar, the Harvard philosopher, makes the case that physical cruelty "the willful inflecting of physical pain on a weaker being" was one of humankind's worst sins. She argues that in the ranking of vices, we should put cruelty first as the worst thing we do. Yet as powerfully argued by Dr. Ian J.H. Duncan and Dr. Bernard E. Rollin in their contribution "Farm Animal Welfare in Canada: Major Problems and Prospects", in our treatment of animals, cruelty occurs every day. We subject animals to live in crates where they cannot walk, run, turn around, or lie down. We amputate toes from turkey and clip the teeth of piglets. Such practices reflect our values: do we see ourselves as a species that according to Genesis "Shall have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth" or are we stewards of the earth, pledged to use our intelligence to treat all humanely and to pass on an improved planet to future generations?

In *Ethical Water*, Robert Sandford and Merrell Ann-Phare describe the tradition of Canada's first nations, who "view the earth as a living entity comprised of a spiritual being in a multitude of forms, including plants, animals, rocks, air, and water ... Water washes us and the earth clean." Stewards are not cruel. For that reason alone the WSPA study is right to recommend that federal, provincial and territorial governments should prohibit painful mutilations of animals without anesthetic.

Industrial agriculture has given us plentiful and cheap food, but at great cost. The value of the WSPA study is that these costs are described in detail so that Canadians can be better informed about the trade-offs in our agricultural policies. Beyond contributing to education, each chapter in the study has detailed recommendations on how to improve the situation. Agriculture's mission, according to Wendell Berry, is to "maintain its people in health, and this applies equally to the people who eat and to the people who produce the food." Canada's current system of agriculture is far from healthy. But it could become so by all of us accepting the responsibility to be stewards rather than exploiters. This study is a good beginning down that road.



Thomas S. Axworthy has had a distinguished career in government, academia, and philanthropy. Early in his career, he served as Senior Policy Advisor and Principal Secretary to Prime Minister Pierre Trudeau, before leaving politics to teach. In 1984, Dr. Axworthy went to Harvard University as a Fellow of the Institute of Politics at the Kennedy School of Government. He was subsequently appointed visiting Mackenzie King Chair of Canadian Studies. Dr. Axworthy helped to create the Historica Foundation in 1999 to improve teaching and learning of Canadian history, becoming its Executive Director until 2005. For his contribution to heritage and public policy he was made an Officer of the Order of Canada in 2002. In 2003, he became Chair of the Centre for the Study of Democracy, School of Policy Studies, Queen's University, pursuing the themes of expanded human rights and responsibilities, democratic reform, Canadian-American relations, and modern liberalism that characterized his research, teaching and advocacy career. He was awarded an honorary LLD at Wilfrid Laurier University (2003), the Public Affairs Association Award of Distinction (2008), and the Queen's Diamond Jubilee Medal (2012). In 2009, he became President and CEO of the Walter & Duncan Gordon Foundation. He is also a distinguished senior fellow at the Munk School of Global Affairs and a senior fellow at Massey College. In 2011, Dr. Axworthy was appointed as the Secretary General of the InterAction Council, comprised of more than thirty former heads of state.

About the Contributors

Overview

Dr. Alison Blay-Palmer is an Associate Professor at Wilfrid Laurier University in the Department of Geography and Environmental Studies where she researches resilient food systems and sustainable communities. She is the author of *Food Fears: From Industrial to Sustainable Food Systems*, the editor of *Imagining Sustainable Food Systems: Theory and Practice* and several journal articles. Her research developing Sustainable Food Systems Report Card explores the opportunities and challenges for developing a more integrated understanding of the Canadian food system. She is also involved in work to get more local food into Ontario hospitals and long-term care facilities and is leading a project to better understand community food projects across Ontario.

Rural Communities

Dr. John Ikerd is a Professor Emeritus of Agricultural and Applied Economics at the University of Missouri, Columbia. Raised on a small dairy farm in southwest Missouri, he went on to receive his BS, MS and PhD degrees in agricultural economics from the University of Missouri. He is the author of several books, including *Sustainable Capitalism: A Matter of Common Sense*, *Small Farms are Real Farms: Sustaining People Through Agriculture* and *Crisis and Opportunity: Sustainability in American Agriculture.*

Darrin Qualman is the former Director of Research for the National Farmers Union. He farmed for most of his life in Saskatchewan and is currently working on a book that examines the core processes of civilizations. He is the author of several reports, including *The Farm Crisis, Bigger Farms, and the Myths of Competition and Efficiency* and, with Nettie Wiebe, *The Structural Adjustment of Canadian Agriculture.*

Dr. Jennifer Sumner received her PhD in Rural Studies from the University of Guelph. Currently she is the Ontario Institute for Studies in Education (OISE) Coordinator for Adult Education for Sustainability. Her areas of research have included sustainability, globalization, rural communities and rural women, organic agriculture, food, and the civil commons and the social economy. She is the author of several books, including *Sustainability and the Civil Commons: Rural Communities in the Age of Globalization.*

Dr. Tony Winson is a Professor in the Department of Sociology and Anthropology, University of Guelph. He has been writing on agriculture, food and rural development issues for more than twenty years. His latest book, *Disrupted Lives: Labour and Community in the New Rural Economy* examines economic restructuring, work, and the factors underlying sustainability in small manufacturing-dependent rural communities in several regions of Ontario. It won the John Porter prize of the Canadian Sociology Association. His research areas include sustaining rural communities and local ecologies, rural community restructuring, political economy of the Canadian agro-food complex, agrarian social structure and its relationship to politics and the State.

Public Health

Dr. George Khachatourians is a Professor in the Department of Food and Bioproduct Sciences at the University of Saskatchewan. He was a member of the Government of Canada Task Force on Biotechnology (1980-81), under Minister John Roberts, that produced Biotechnology: A Development Plan for Canada (1981). He has authored more than 550 scientific papers, 68 chapters, and published 10 books on agriculture and food production, agriculturally important microorganisms, applied mycology, biotechnology, genomics and bioinformatics, regulating agricultural biotechnology, and transgenic crops. He is one of only seven people to receive the highest level of certification from the Canadian College of Microbiologists for his contributions to the advancement of knowledge in microbiology. He is considered an international authority in microbial and food technologies.

Dr. Darren Korber is a Professor of Food and Bioproduct Sciences at the University of Saskatchewan. He has authored 78 refereed journal publications and journal reviews or book chapters. His research interests are in target areas dealing with food, water and environmental microbiology, with special emphasis on the mechanisms for antimicrobial resistance in food-borne pathogens, effects of antimicrobials in aquatic biofilm systems and the prevalence and distribution of *E. coli* 0157 in natural environments.

Dr. John R. Lawrence is an Adjunct Professor in the Department of Food and Bioproduct Sciences, University of Saskatchewan and an Associate Editor of the Canadian Journal of Microbiology. His expertise is in assessing risks to Canadians and their environment posed by pollutants or other harmful substances, with a particular focus on aquatic ecosystems. Dr. Lawrence received the Canadian Society for Microbiologists Fisher Award for significant contributions to the field of microbiology and the Von Hertwig prize for interdisciplinary collaborative research.

Dr. Eva Pip is a Professor in the Department of Biology at the University of Winnipeg. Her research areas include the environmental and health effects of intensive livestock operations, water quality, toxicology and public health. Dr. Pip is the author of more than 100 publications including *Urban Drinking Water Quality* and several journal articles related to water contamination.

Animal Welfare

Dr. Ian Duncan is Professor Emeritus in the Department of Animal and Poultry Science at the University of Guelph and is Emeritus Chair of Animal Welfare at that University (the oldest University Chair in Animal Welfare in North America). He has a BSc in Agriculture with Honours in Animal Husbandry from Edinburgh University and he did research for his PhD at the Poultry Research Centre, Edinburgh. He was one of the first people to bring a scientific approach to solving animal welfare problems. Dr. Duncan has published more than 150 scientific papers and in 2011, was the first recipient of the Medal for Outstanding Contributions to Animal Welfare Science awarded by the Universities Federation for Animal Welfare (UFAW).

Dr. Bernard E. Rollin is a Professor of Philosophy, Biomedical Sciences and Animal Sciences, and a Bioethicist at Colorado State University. He earned his PhD from Columbia, and was a Fulbright Fellow at the University of Edinburgh. Dr. Rollin taught the world's first course in veterinary medical ethics and is a principal architect of federal legislation dealing with the welfare of experimental animals. He is the author of several journal articles and books, including *The Unheeded Cry: Animal Consciousness, Animal Pain and Scientific Change*, *Farm Animal Welfare* and *Science and Ethics*. Dr. Rollin has consulted for various agencies around the world on many aspects of animal welfare and was a member of the Pew Commission on Industrial Farm Animal Production.

Environment

Dr. Tony Weis has a PhD in Geography from Queen's University and is an Associate Professor at the University of Western Ontario, Geography Department. His research spans the field of agrarian political economy and political ecology. He has recently focused his research on the worsening food crises and problems associated with the industrial grain-oilseed-livestock complex. This will be the subject of his upcoming book, *The Ecological Hoofprint: The Global Burden of Industrial Livestock*. Dr. Weis also authored *The Global Food Economy: The Battle for the Future of Farming* in addition to several journal articles and book chapters.

Consumer Support for Healthy, Humane and Sustainable Food

Eleanor Boyle is an educator and writer who focuses on how we can make our food systems and meal choices sustainable and compassionate. Believing in a two-pronged approach to better food systems: bottom-up through strong citizen action and top-down through visionary food policy, she was delighted to be part of WSPA's project. Dr. Boyle has earned degrees in Psychology, Neuroscience and most recently an MSc in Food Policy from the Centre for Food Policy at City University in London, England. Having written articles on animal sentience and on the impacts of animal agriculture on the environment, she continues to educate people on food issues. She was a guest speaker at the 2011 National Conference to End Factory Farming which saw animal welfare, environmental and public health advocates come together in Arlington, VA. Dr. Boyle is author of a book being released in 2012 by New Society Publishers, entitled *High Steaks: Why and How to Eat Less Meat*.

About the External Reviewers

Dr. Lauren Baker, PhD (Environmental Studies), York University

Dr. Baker is the Coordinator for the Toronto Food Policy Council at Toronto Public Health, and was the founding Director of Sustain Ontario: The Alliance for Healthy Food and Farming. She has over 15 years' experience developing local food initiatives and working on food policy issues. She is a research associate with the Centre for Studies in Food Security at Ryerson University, and lectures at the University of Toronto.

Dr. Jennifer Clapp, BA (Economics), University of Michigan, MSc., PhD. (International Relations), London School of Economics

Dr. Clapp is a professor at the University of Waterloo's Department of Environment and Resource Studies and Chair of the Centre for International Governance and Innovation (CIGI). She is also the co-editor of the journal of Global Environmental Politics, Editorial Board Member of the Journal of Global Governance and Contributing Editor for Alternatives Journal.

Elaine L. Hughes, Professor, BSc., LL.B. (Alberta), LL.M. (UBC)

Professor Elaine L. Hughes is a full time member of the Law Faculty of the University of Alberta, Edmonton, where she has been teaching since 1989. She teaches Canadian and international environmental law, public land and natural resources law, and animal welfare law. She is widely published in the domestic and international environmental law fields, and has several animal law publications to her credit as well. She is also a past member of the University's Animal Policy and Welfare Committee.

Fred Tait is a farmer and farm activist who has been farming for over 60 years in Rosendale Manitoba. He was the former Vice President of the National Farmers Union and former President of Hog Watch Manitoba.

Dr. Wayne Roberts, PhD (Social and Economic History), University of Toronto

Dr. Roberts is a Canadian food policy analyst and author of several books including, The No-Nonsense Guide to World Food. As the former manager of the Toronto Food Policy Council, he helped develop the city's Environmental Plan and Food Charter. He received the Canadian Environment Award for his contribution to sustainable living and the University of Toronto Arbor Award for his role establishing food studies as a field of study at the University. Dr. Roberts currently serves on the Steering Committee of Food Secure Canada.


WSPA

About WSPA

The World Society for the Protection of Animals (WSPA) seeks to create a world where animal welfare matters and animal cruelty has ended. To achieve this we work directly with animals and with the people and organizations that can influence their treatment to ensure animals are treated with respect and compassion.

We campaign effectively to combat the world's most intense and large-scale animal welfare issues, bringing about lasting change by:

- helping people understand the critical importance of good animal welfare
- encouraging the implementation of animal-friendly practices and solutions through changes in national policy
- building the science based evidence for change
- encouraging a worldwide movement towards better animal welfare.

Locally, we bring about improvements in the way animals are treated by engaging directly with communities and owners. Working on the ground with local partners for greatest effect, we are active in more than 50 countries.

Globally, we engage with national governments, the United Nations, the Food and Agriculture Organization and the World Organization for Animal Health, ensuring that animals and their welfare find a place in the most pressing global debates.

WSPA is the world leader in animal-focussed disaster response and risk reduction. When disaster strikes, WSPA is the organization that makes sure that animals, which are so vital for community recovery, are not forgotten. WSPA is a world-leading expert in disaster management, risk reduction and response.

Animals play a vital role in our lives, whether we rely on them for food, revenue, transportation, companionship, or to help maintain balanced ecosystems. The rearing and use of animals has a major impact on the global environment and on society, particularly in terms of rural livelihoods, public health, greenhouse gas emissions, land use and biodiversity. Ensuring the welfare and responsible use of these animals is an effective tool to help achieve sustainable development, deliver poverty alleviation and enhance wellbeing. It is central to tackling specific environmental and public health issues including climate change, disaster management, deforestation, pollution, water, food security and gender equality.

We believe that for farming to be truly sustainable, it must have a proper regard for people, the environment, rural communities and animal welfare. Welfare-friendly and sustainable farms across the world are proving every day that rearing animals in better conditions brings a host of surprising benefits to people and the planet.

Executive Summary

About the Project

In the fall of 2010, with a generous donation from Canadians for the Ethical Treatment of Food Animals (CETFA), the World Society for the Protection of Animals (WSPA) commissioned a multidisciplinary review of the wide-ranging impacts of Canada's animal agricultural practices. Inspired by the Pew Commission's Report on Industrial Farm Animal Production (www.ncifap.org) in the United States, we invited a diverse team of contributors, recognized in their respective fields, to provide their assessment of the problems in Canada, based on their research and experiences. The contributors were also asked to collaborate with others in their field to develop policy recommendations. The report was then reviewed by an exemplary panel of experts to provide feedback and strengthen. The result is the first comprehensive Canadian examination of the impacts of industrial animal agriculture on animal welfare, the environment, public health and rural communities and solutions for addressing them. We hope it will be used to stimulate and promote a public policy discussion about the changes necessary to encourage a widespread transition to a more humane and sustainable food system in Canada.

Introduction

The most dramatic changes in the history of animal agriculture took place during the 20th century as extensive pastoral farming systems, made up of small and medium-sized farms were replaced with large, intensive systems, commonly referred to as Intensive Livestock Operations (ILOs). Traditionally, smaller numbers of animals were raised in environments they were more biologically suited for. They were often raised with other species and alongside diverse crops on family-owned and controlled farms. Most were what we would today call 'free-range.' Now, significantly more animals are being raised on fewer farms which are increasingly owned and controlled by a few large corporations. Since 1956, the number of farms in Canada has decreased by 60 percent, while the average farm size has increased by 141 percent. Around 700 million animals are now raised for food every year in Canada – that's 21 times greater than the human population. A drive through the countryside may not provide evidence of this, as most farm animals remain hidden from view.

Industrial animal agriculture uses intensive 'production line' methods to produce greater volumes of meat, dairy and eggs as quickly and as cheaply as possible. It is characterized by high stocking densities and/or close confinement, forced growth rates, high mechanization and low labour requirements. While this system has resulted in a remarkable increase in food production, it comes at great expense to animal welfare, environmental sustainability, human health and rural communities.

The costs of this industrial system are substantial and growing and, like farm animals, they remain largely hidden. The result is a misleading picture of the true costs associated with the production and consumption of intensively produced meat, dairy and eggs. What consumers don't pay for upfront, will be paid for later in terms of escalating health care costs, environmental remediation, and the cost of depleted water and energy resources.

Public Health

ILOs are associated with a diverse array of health problems in surrounding communities through odour, air and water pollution. The crowded and stressful conditions under which animals are housed contributes greatly to the spread of diseases transmissible to other animals and even humans by encouraging the propagation, redistribution, transmission and spread of pathogens. Overcrowding, poor hygiene, inadequate ventilation and stress greatly impact the animals' ability to resist infection. These conditions have led to the routine use of antibiotics which in turn has contributed to the development of antibiotic resistant bacteria, rendering important human and veterinary drugs ineffective.

Food-borne Illness

An estimated 11 to 13 million Canadians suffer from food-borne infections every year costing our health care system between 12 and 14 billion dollars. More than 7,000 Canadians suffered from Salmonellosis in just one year. Canadians learned during the Listeriosis outbreak of 2008 that food-borne bacteria can prove fatal. What's perhaps not as clear, as Dr. Pip points out, is that "contamination with *Listeria monocytogenes*...is widespread in manure as well as dairy products and cooked and raw meat products sold in Canada." The crowded and unsanitary conditions that many animals are raised in can no longer be ignored in our quest to improve food safety. As Pip explains, these 'standard' practices "must undergo a drastic overhaul, and contamination risks to drinking water supplies must be more stringently monitored and enforced."

Spreading Pathogens and Disease

The majority of all human infectious diseases come from animals. More than 500 different pathogens (viruses, bacteria, parasites etc.) can be transmitted from animals to humans through the consumption of meat and animal by-products, contact with live animals (bites, cuts and scratches), dust inhalation, exposure to manure, contaminated clothing and equipment, transport routes and vehicles, meat-packing plant waste and contaminated water and soil. As Pip warns, many of these pathogens can stay on the farm and in our environment for long periods of time, "creating endemics in animal herds and poultry flocks, and also endangering farm workers, neighbours and wildlife."

The spread of animal viruses to humans is a serious public health concern as they can mutate at rapid rates and recombine to yield highly infectious human strains. As Pip explains, "ILOs facilitate large-scale viral incubation and genetic reassortment that may lead to new varieties of influenza and initiate human flu pandemics." Avian Flu was likely transmitted from poultry, to pigs and then to humans. There have been numerous cases of Swine Flu infecting people living near hog farms as well as the workers and veterinarians.

Farm Workers at Risk

The people most at risk are the farm workers who Pip says spend much of the day in a closed environment, with limited air circulation, exposed to a high concentration of dust, harmful gases (from the manure), harsh chemicals (to kill pests and sanitize) as well as urine, feces and other pathogen vectors. Exposure to pathogens increase when sick animals are not identified and segregated, when dying animals are not promptly removed and when facilities and equipment are not thoroughly cleaned. These risks are heightened on industrial farms where with “fewer workers than on traditional farms, sick and dying animals may be easily overlooked in the crowded and dark, confined conditions.”

Dangerous Feed

The sheer number of animals that are slaughtered for food every year in Canada poses a significant health risk as it necessitates the disposal of an increasing volume of animal parts, deemed unsuitable for human consumption, that are rendered for livestock feed. As Khachatourians, Korber and Lawrence explain, this results “in the inevitable inclusion of overlooked animals of questionable health” including “animals that have been sent to market before symptoms have become evident, or obviously distressed animals (downers)...”

The health risks are perhaps most exemplified by Mad Cow disease caused by bovine spongiform encephalopathy (BSE). The fatal disease is believed to be caused by feeding herbivorous cattle, the remains of infected cattle – particularly brain and spinal cord materials, which have been deemed ‘specified risk material’ (SRM). A number of animal rendering by-products, including gelatin and blood meal may also harbour BSE, which remains infective despite standard processing methods. Consuming the meat of BSE-infected animals causes new variant Creutzfeldt-Jacob disease (nvCJD) in humans.

Farm animals in some countries are routinely fed manure and litter from poultry farms as a cost-saving measure – a practice which may be exposing animals and consumers to SRM as well as antibiotics, hormones and pathogens. Although illegal in Canada, some producers continue with the custom and risk prosecution.

Untreated Manure Disposal

Raw, untreated livestock waste is commonly applied directly on farmland and used as a fertilizer to grow the food we eat. According to Environment Canada, farm animals produced 177 million tonnes of manure in 2001. It would take about 2.4 billion people to produce the same amount of human waste. To make matters worse, manure disposal methods are poorly monitored and documented and when they are, they seldom follow standardized practices or comply with regulations. The associated health risks are best exemplified by the Walkerton tragedy. In 2000, seven people died and more than 2,300 became severely ill in the small Ontario town when their drinking water was contaminated with *E. coli* 0157:H7. The source of this highly dangerous bacteria strain was cattle manure.

The increasing number and expansion of ILOs in close proximity to each other means that much of the manure produced needs to be transported longer distances for disposal. To cut down on transport costs, manure is often over-applied in local areas or illegally dumped in ditches and streams. Given the significant health risk, Khachatourians, Korber and Lawrence warn, “public and legislative scrutiny of ... how manure is handled and where it goes is long overdue.”

Antibiotics and Antibiotic Resistance

According to the Union of Concerned Scientists, 70 percent of antibiotics in the US are given to farm animals instead of people. While we don't know exactly how many drugs Canadian farm animals receive because the quantities are not tracked, experts say "agriculture accounts for the highest volume of antibiotic use." A Health Canada Advisory Committee found that "as much as 50 percent or greater of the volume of antibiotics produced or imported are given to farm animals and a significant portion is used to increase growth and prevent disease."

Some animals raised for food are given antibiotics to prevent and treat infectious disease and promote growth or performance. Farm animals today are routinely given low doses of antibiotics to prevent them from getting sick in the first place; a necessity given the conditions in which they are raised. Decreasing the demands placed on the animal's immune system has the added benefit of directing more energy towards weight gain. Health Canada's Advisory Committee reports that "growth promoters account for a considerable amount of the total antibiotic exposure..." and "are not used under veterinary prescription, nor to treat infections in animals." Consequently, antibiotics "are now present in many Canadian soils and surface waters at measurable concentrations," writes Khachatourians, Korber and Lawrence as "the drugs and their metabolites are excreted in animal waste and escape into the environment..."

As Khachatourians, Korber and Lawrence explain, "the primary issue is that some antibiotics used for animals are identical to those prescribed for human use" making the indiscriminate, unregulated use of antibiotics for growth promotion "most inappropriate." The continuous exposure to these drugs acts as a powerful selection force for the propagation of antibiotic resistant strains of bacteria (ABRB). The crowded conditions on ILOs further encourages the spread of these bacteria strains. The stress animals experience can also increase the levels of resistance. As a result, "multiple-drug resistant 'super bugs' are now ubiquitous in the environment at large." They are found in our groundwater – even in air samples behind animal transport trucks.

The increasing development of resistant bacteria can have serious implications for the effectiveness of human and animal medicine. It has been estimated to infect more than two million people in the US annually, causing 90,000 deaths. Physicians are forced to prescribe more expensive antibiotics or abandon treatment altogether. Only seven new antibiotics were approved between 1998 and 2004 suggesting an emerging global health risk if antibiotic resistance continues to grow without replacement drugs. It is for this reason that the European Union (EU) banned the 'growth promoting' use of antibiotics in agriculture in 2006. The Canadian Medical Association and the American Medical Associations now support a similar ban in North America.

The economic benefits farmers receive from using antibiotics are not always sufficient to offset the additional cost of the drugs. Society pays a hefty price too as the cost of drugs would nearly triple if resistance rises to endemic levels. Considering the length of time needed to develop new antibiotics, the pursuit of 'cheap' food, is not really worth the risk that life-saving antibiotics may fail.

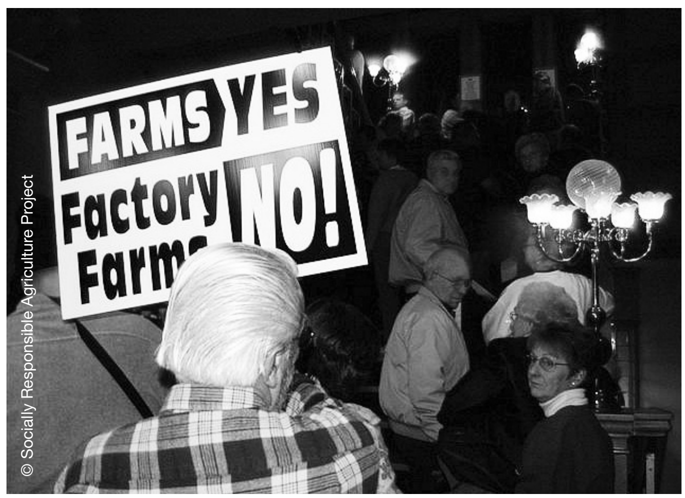
Rural Communities

ILOs were promoted by corporate and government representatives as a means to stimulate local economies, create jobs and new markets, improve social services, and lure outside investment. Instead, writes Qualman, “rural Canada witnessed the closure of meatpacking plants, the boarding-up of main street windows, a rural-youth diaspora and the destruction of family farms.” The increasing consolidation and mechanization of agricultural systems and practices has led to a hollowing out of rural communities – with capital, people and infrastructure abandoning these communities for the full service economies of larger communities.

The viability and liveability of rural communities is put in jeopardy as ILOs proliferate, especially for those families who rely on farming as their chief source of income. ILOs drain money from communities as more tax dollars are needed to address the associated health, environmental, social and traffic problems. In spite of the significant costs ILOs bring to the host community, they are typically taxed at the same rates as the traditional family farmer.

“Get Big or Get Out”: Forced to Consolidate

Winson explains how “the financial ruin of farmers held hostage by soaring debt loads and high fixed costs” facilitated the increasing trend towards ILOs throughout the 80s and 90s. The costs of farm inputs, such as machinery and drugs, increased nearly twice as fast as the price paid for farm products, creating a ‘cost-price squeeze’. As a consequence, farmers were under growing pressure to “get big or get out”. Those not forced out of business, were forced to consolidate and by the 1980s, the largest 20 percent of farms accounted for approximately 80 percent of gross annual sales. Farming today is predominately controlled by a small number of very large agricultural companies and their increased level of production has caused farm prices to crash.



■ **Fewer, bigger farms put rural families and communities in jeopardy, especially those relying on farming as their main source of income.**

Rising Debt and Unemployment

While farm productivity has significantly multiplied over the last three decades, farm debt loads have soared by 700 percent. It is not unusual for a farm to carry a debt of about $23 for every net dollar earned. It’s no wonder more farmers have to seek off-farm employment to supplement their income. According to a report on rural communities by the Canadian Senate Standing Committee on Agriculture and Forestry, “real net market farm income has hovered at or below zero since about 1987, with government program payments accounting for almost all of the farm sector’s realized net income over this period.”

Communities without laws to protect them from ILOs tend to have higher poverty and unemployment rates. Winson writes, "industrialized agriculture is characterized by some of the very things that pose a direct threat to traditional agricultural employment" being "capital-intensive in terms of both production and distribution, relying on technology as opposed to people." A typical intensive pig farm with 2,400 sows might employ 15 people but puts as many as 50 traditional farmers out of business.

Subsidies

Qualman demonstrates how ILO expansion is a 'lose-lose-lose' proposition for family farmers, rural communities and even the ILOs themselves. Canada's hog production sector would not even be viable were it not for multi-million dollar taxpayer-funded subsidies. Since 1996, taxpayers have given more than $4 billion to hog producers, with nearly three-quarters going to the largest corporations. In 2009, the largest 28 percent (with annual revenues greater than $1 million) collected 72 percent of the support. Federal and provincial governments have facilitated the proliferation of ILOs and the size of them by steadily increasing the maximum subsidy per operation. Each operation can now receive up to $3 million per year – triple what they could have received 13 years ago – essentially working to triple the size of the ILO. In addition, there are tax exemptions for building materials, subsidies to packers and tens of billions of dollars worth of subsidies paid to grain farmers which facilitate the production and sale of feed grains below actual costs of production. All of this demonstrates that our food system is actually very inefficient. Many ILOs would not be able to turn a profit without these subsidies.

Diminishing Quality of Life

Sumner and Ikerd explain how ILOs impact the quality of life in rural communities in three main ways: they disrupt rural life, deny democratic rights of rural people, and threaten public health in rural areas. Increased traffic problems, insect infestations and the prevalence of noxious odours can affect people's decision on where to live, not to mention property values and has likely contributed to the decline in the number and proportion of Canadians living in rural areas.

According to Sumner and Ikerd, "ILOs frequently pit neighbours against neighbours and local officials against their constituents. The conflicts invariably strain and often rip the social fabric of rural communities. This is perhaps the most damaging and longest-lasting impact of ILOs on the quality of life in rural communities." ILO owners employ a variety of tactics to stifle local opposition to their operations. They have eroded local democracy by fighting to get 'right-to-farm' legislation passed and to shift decision-making authority to the provincial government level where it is easier for them to exert their political influence. Decisions are now made by provincially appointed regulators, largely comprised of industry peers rather than by municipal or county governments with the input of local residents. This can lead to the 'political deskilling' of rural communities whereby individuals subsequently start losing their ability to articulate a position and organize.

Environment

Animal agriculture is one of the top three causes of the most significant environmental problems facing our planet. It contributes more greenhouse gas (GHG) emissions, uses more water, more land and is the largest threat to biodiversity than any other single human activity. The trend towards increasing intensification is exacerbating these environmental problems, using more energy and contributing more air and water pollution to a planet that is already past its carrying capacity.

As Weis points out, “rising meat consumption has increasingly been recognized as a major, multidimensional environmental issue on a world scale” and Canada has among the highest per capita meat consumption rates. Canadians currently consume 102 kg of meat per capita per year—two-and-a-half times the global average. As citizens of other nations become richer, they aspire to eat more meat—to close ‘the meat gap.’ Per capita meat consumption in China has increased 15-fold in the past 50 years—with each citizen now consuming just under 60 kg per year. If two-thirds of our growing global population start eating meat at the Canadian rate, global meat consumption would nearly triple from current levels, and the global farmland base would have to more than double—requiring massive environmental destruction. Nothing can be clearer: globalizing Canadian levels of per-capita meat consumption is impossible. This necessarily implies that Canadian consumptions levels are too high, and must come down.

“Through most of the 10,000 year history of agriculture, small, mixed livestock populations have been part of integrated farming systems,” Weis explains. The animals scavenged for wastes, produced valuable fertilizer and foraged on land not suitable for cultivation. In contrast, animals on ILOs are removed from the landscape and now distanced from their feed, the energy sources and their waste. While this transformation has enabled standardization and mechanization to increase the ‘efficiency’ of meat production, Weis reminds us that “...these reduced economic costs are only made possible by the fact that so many environmental costs are simply not counted (or are externalized).”

Land Use, Degradation and Biodiversity Loss

One of the main reasons why meat production has become more inefficient and environmentally destructive is because we are now feeding farm animals grains (e.g. barley, maize) and oilseeds (e.g. canola, soybeans) on land that would otherwise be used to produce food directly for people. Intensive livestock production occupies one-third of the earth’s arable land, largely because of the land needed to grow animal feed.

ILOs and the feed crops they are dependant upon, are a major threat to biodiversity in Canada having reduced our Tallgrass Prairie and Carolinian Forest ecosystems to miniscule patches and destroyed the habitat for several species of wildlife. What is further troubling, roughly half of Canada’s ‘species at risk’ are found on agricultural lands.

Livestock feed is typically grown in monoculture (one-crop) systems, which accelerate soil erosion and diminish the soil ecosystem, causing a host of environmental problems. Monocultures require more fertilizer to compensate for the higher loss of nutrients, more pesticides to compensate for increased pest problems and are more water-intensive because of reduced soil moisture retention and thirstier seed varieties selected for higher yields. Excessive irrigation is a major factor contributing to the salinization of agricultural land in Canada, decreasing yields by up to 75 percent and costing farmers millions in annual income.

ILOs concentrate high volumes of manure in a small area so it must be cleaned out, transported and stored with environmental costs at each step. This contrasts markedly with traditional farming systems where smaller numbers of animals were raised on larger areas of land and the volume of animal waste did not exceed the land's capacity to absorb it. The waste was typically collected in straw bedding and composted, killing potentially harmful pathogens, before being applied onto fields as a rich source of nutrients. What was once a valuable resource is now a source of pollution, laden with drug residues, heavy metals, pathogens and higher than beneficial concentrations of nutrients.

Animal waste today is typically spread or sprayed onto fields as a fertilizer, where there is a persistent risk it will get into the groundwater or contaminate surface water when it runs off fields. Alternatively, it may be captured in waste lagoons, where there are also high risks of water contamination as a result of leakages and spills.

Water Consumption and Pollution

Agriculture uses more water than any other human activity and roughly half of that used in industrialized countries is used to produce feed crops. ILOs also require large volumes of water for the animals to drink, to flush the wastes down gutters and to clean out the barn. To put it into perspective, 100 times more water is needed to produce 1 kg of animal protein than to produce 1 kg of plant protein.

As Weis points out, "much of the freshwater used in feed crop irrigation, running ILOs and slaughterhouses ends up very polluted." The industrial fertilizers and manure slurry that is applied to farm fields carry concentrated nutrients (nitrogen and phosphorous) into our lakes and rivers. This stimulates the growth of algae, which depletes the water of oxygen when it decomposes, killing fish and other aquatic life. This process, known as 'cultural eutrophication', has been identified in water bodies surrounding industrial agriculture and has long been recognized as a major environmental problem in Canadian government reports.

Energy and Atmosphere

On a per capita basis, Canada is one of the largest GHG emitters in the world and livestock production is a major contributor to this problem. According to the United Nations Food and Agriculture Organization (FAO), animal agriculture accounts for nearly one-fifth of the world's human-caused GHG emissions. This is equivalent to releasing more than seven billion tonnes of carbon dioxide (CO_2) into the atmosphere every year. That's twice the global warming potential of all the world's cars!

The sheer rise in the livestock population means more CO_2 is emitted as the animals respire, more methane is emitted as they digest (particularly from ruminants), and the vast quantities of manure and urine they produce is contributing more nitrous oxide and methane to our fragile atmosphere.

ILOs are more energy intensive than traditional farming systems, requiring more fossil fuels to keep the barn running, manage the wastes and to produce livestock feed. High volumes of fossil fuels are used to operate large machinery, store and process the feed and manufacture and transport industrial fertilizers. Weis reports that "Canada's agricultural sector annually consumes industrial fertilizer far above world averages, and a large share of the ensuing production is destined for ILOs." The carbon footprint increases as the distance between the different stages of production and consumption increases.

ILOs are also responsible for a range of air pollutants, including viruses, bacteria and fungal spores that can be carried in the air, affecting the health of farm workers and nearby communities. The most potent odours and gases are released from the anaerobic (oxygen-deprived) and long-term storage of manure and urine.

Animal Welfare

Traditionally, farmed animals were reared in natural environments that they were biologically suited for, and failure to respect their nature would threaten their productivity. The advent of modern industrialized methods of livestock rearing has allowed us to subvert the animals' nature. Duncan and Rollins liken this to 'putting square pegs in round holes' by subjecting animals to "environments for which they were ill-suited, yet still assure productivity and profitability."

They identify three aspects of industrial animal agriculture as having a deleterious effect on animal welfare: 1) environments that severely restrict and frustrate animals, 2) procedures that cause pain to animals, and 3) suffering caused by inappropriate genetic selection.

Environments that Severely Restrict and Frustrate Animals

The vast majority of veal produced in Canada comes from calves that have been housed in 90 cm wide crates for at least part of their lives and for many of them their entire lives. They can't walk, run, play, turn around or fully lie down to rest. They are denied bedding as well as any normal social interaction with their mothers or other calves. Milk-fed calves suffer further as a result of their diet which, in order to produce 'white veal' is deficient in iron and fibre, resulting in frustration, pathological lesions as well as behavioural abnormalities. "There can be no doubt that veal crates severely reduce welfare," conclude Duncan and Rollin.

Uncomfortable and hungry, sows are kept in gestation stalls for most of their pregnancy. These stalls severely frustrate sows and are being phased out in Europe and in some US states.

Also problematic are the battery cages, used to house laying hens. More than 95 percent of eggs in Canada come from hens confined to barren, sloped, wire-frame cages which restrict their ability to move, turn around and spread their wings. Confined five to seven birds to a cage, they are further frustrated by being denied the opportunity to lay their eggs in a nest or perch, behaviours that studies show are very important. At the end of a laying year, many hens suffer from osteoporosis, bone weakness and broken bones, problems exacerbated due to their inability to exercise.

While pigs are typically reared in group housing, the vast majority of breeding sows are kept in gestation stalls, not much bigger than themselves, for most of their pregnancy. While they may be able to stand and lie down, the stalls are so restrictive that the sows injure themselves by changing between these two positions. They are also frustrated by being denied the opportunity to forage, wallow, build a nest, explore and interact socially with others of their kind. Sows suffer further as their food is restricted to achieve optimal reproduction success, leaving them perpetually hungry. As a result, 91.5 percent of stalled sows show signs of stereotyped behaviours such as bar biting, which Duncan and Rollin say is "generally accepted as a sign of reduced welfare." As with laying hens, a lack of exercise leads to a decrease in bone density, putting animals at greater risk of bone fracture when transported to slaughter.

Procedures that Cause Pain to Animals

"A reasonable place to begin restoring common decency to animal agriculture," say Duncan and Rollin, "is to end the painful mutilations" that are routinely performed without anaesthetic. For example, most piglets have their teeth clipped, tails docked and ears notched. Males are also castrated. Turkeys have their toes amputated. Beef calves are dehorned, castrated and sometimes branded, despite the fact that it has been estimated to cost the Canadian beef industry $9.5 million annually due to hide damage. All of these procedures are painful and are regularly performed across North America without any pain relief. To reduce the problem of feather pecking and cannibalism in a modern egg barn, the vast majority of chicks have the upper portion of their beak severed with a hot blade. None of these mutilations would be necessary, the authors argue, if we weren't trying to force square pegs into round holes. More humane and sustainable farming systems and practices would negate the need for these mutilations.

Suffering Caused by Inappropriate Genetic Selection

According to Duncan and Rollin, the blame for many of these animal welfare problems can be laid at the feet of breeding strategies. Animal breeding companies have selected genetic traits for faster growth, food conversion efficiency and higher milk and egg production, creating the most 'efficient' production animal but at the expense of animal welfare. They cite, as an example, efforts to breed pigs to increase leanness in meat, which has led to an increased incidence of Porcine Stress Syndrome (PSS). This not only results in poor welfare but may lead to poor quality meat when pigs become stressed during slaughter. Increased incidences of more agitated and unmanageable beef cattle (known as gate crashers) have also been linked with genetic selection for rapid growth and high lean yield. Similarly there is increasing concern that very high-producing dairy cows are at greater risk of pain due to lameness and metabolic diseases. Say the authors: "When welfare problems are caused by breeding practices, then environmental solutions are likely to be limited." Clearly, there is sufficient evidence to demonstrate the need to curtail genetic selection for even higher production. The challenge will be in persuading the primary breeding companies to select for higher welfare instead.

Conclusion

Industrial animal agriculture has given us deceptively cheap food, as it comes at a very high price to our health, rural communities, our environment and the animals themselves. It is producing drug resistant super bugs, destroying our planet's life support system and transforming the social fabric and vitality of our rural communities. This food system was built on the false premise that inexpensive feed, cheap energy and free and abundant water would be available forever, but we now know these resources are limited and need to be conserved for ourselves and for future generations. Ultimately peak oil, climate change and water depletion will change our food production and consumption practices for us, but by then it will be too late. The ramifications are serious and deserve the attention of all levels of government in Canada. Governments need to act now to address the negative impacts of industrial animal agriculture through meaningful and forward thinking policy changes. The longer we wait, the more these problems will grow, and the harder it will become to find effective and sustainable solutions.

It is clear that many farmers and rural communities have not benefited from our now dominant system of livestock production. There is an urgent need, as Blay-Palmer recommends, "to compensate farmers fairly for the food they provide."

Making it mandatory for food labels to identify production methods is a good place to start. Consumers have the right to know how their food is produced and access to this type of information will help them make more humane and sustainable choices. It is the very least the government can do to encourage consumer behaviour that benefits animals and society as a whole and to support farmers that wish to exceed government regulations.

Fortunately, Canadians are increasingly concerned about how and where their food is produced and are supporting more local, humane, sustainable and healthful foods. This is reflected in public opinion polls, consumer research, at the cash register and in the rising popularity of humane and sustainable food certification schemes. The fact that some of the biggest grocery and restaurant chains in North America are starting to adopt humane and sustainable food purchasing policies is another good indicator of where public preferences and demands are headed.

Canada should get ahead of this growing trend and join the many other countries that are encouraging a transition to more humane and sustainable food production. To do otherwise may risk the viability of Canadian livestock exports as consumers in other countries demand more. For example, the European Union and a number of US states have already banned or are in the process of phasing out sow stalls, veal crates and battery cages. Canada should keep pace with its agricultural trading partners and work towards phasing out intensive confinement systems too. It will be increasingly important in terms of international trade as well as the domestic market. In a 2010 WSPA study, 93 percent of Canadians said they would support laws ensuring that all farm animals are able to lie down, turn around, stretch their limbs and spread their wings.

Members of Health Canada's own advisory committee admitted that the use of antibiotics as "growth promoters facilitate animal husbandry practices that are unhealthy and therefore questionable on welfare grounds." This practice is one of many that allow us, as Duncan and Rollin point out, to "produce increased quantities of cheap food without concomitantly assuring animal welfare." Canada is one of the few industrialized countries that allows over-the-counter sales of antibiotics, without a veterinary prescription for farm animals. We can learn from countries like Sweden that banned these practices more than 20 years ago and still maintain a thriving agricultural sector. We should follow the lead of the EU which banned the use of hormones and non-therapeutic antibiotics in 2006.

Lastly we need to stop subsidizing farming methods that produce more problems than benefits to Canadians. Governments should redirect subsidies to support the farmers who need them the most rather than support ILOs and they should implement policies and incentives to encourage more humane and sustainable practices.

Key Recommendations

Our contributors have presented a number of policy recommendations to address the problems associated with ILOs. From these, WSPA presents 11 key recommendations that deserve the urgent attention of policy makers from all relevant levels of government. We believe these recommendations are the most important for encouraging a more humane and sustainable food system in Canada. Most would receive widespread public support.

1. The federal government should enact legislation requiring food be properly labelled according to origin and production methods. Canadians have the right to know how and where their food is produced. Legislation in Europe, for example, requires that all eggs be labelled as 'eggs from caged hens', 'barn eggs' or 'free-range egg'. Similar measures undertaken here would render visibility to the many hidden costs of food production.

2. Federal and provincial governments should prohibit painful mutilations without anaesthetic (e.g. branding, castration, teeth clipping, tail docking, beak trimming, dehorning).

3. Federal and provincial governments should work with industry and farmers to phase out the most restrictive of production systems (including battery cages for laying hens, crates for veal calves and gestation crates for sows) and ensure that animals can live free from intense frustration, fear, discomfort, deprivation, maternal separation, social stress and boredom.

4. Federal and provincial governments should redirect subsidies and programs so that family farmers are the primary beneficiaries and more humane and sustainable animal agriculture is encouraged. In order to better protect our environment, rural communities, increase food security and to maximize the number of family farms on the land, farm support programs should be directed toward family farms and capped at $400,000 per farmer annually. This cap would cover all potential losses for 95 percent of the farms.

5. To preserve the effectiveness of life-saving antibiotics the federal government (Health Canada and Agriculture Canada) must consider the Canadian Medical Association's call to require veterinary prescriptions for all agricultural antibiotic use. It is a matter of some urgency that the non-therapeutic use of antibiotics (i.e. growth promotion) be phased out in order to preserve life-saving antibiotics that are crucial in human and veterinary medicine. All veterinary prescriptions should be tracked and monitored.

6. Governments should recognize that ILOs have significant impacts on public health, our environment, animal welfare and rural communities and redirect policies and programs towards supporting community-based, humane and sustainable agriculture.

7. Animal breeding companies should produce animals that, if given a good environment, can live lives free from suffering.

8. Communities should have greater access to information and a stronger say in the establishment and enlargement of ILOs. When ILOs are established, the community should have the right-to-enact bylaws that will preserve their health, livelihoods, quality of life, property values and environment. Provincial and municipal governments should ensure that ‘right to farm’ legislation is not used at the expense of the surrounding community’s right to a high quality of life.

9. All levels of government should increase human capital in rural areas through encouraging immigration to rural areas, rural-based college and universities, and innovation that keeps rural communities economically viable without compromising their social, political or physical environments.

10. Provincial governments should reform supply management so that it continues to serve as a restraining force with regard to production-unit size and farm consolidation, while encouraging more humane and sustainable food production and an affordable entry to young and new farmers.

11. All levels of government should regulate ILOs like other major polluting industrial operations – subject to the same rules regarding waste treatment and pollutants and enforced by independent inspectors with the authority to issue stiff penalties for infractions.

Overview: How did we get here?

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While there have been remarkable increases in per unit meat production over the last decades, this has come largely at the expense of and disregard for animal, environmental, human and community well-being. 'Value' has been extracted from different points within the food system as the norm has shifted from relatively extensive, pastoral farming where animals are allowed to graze or forage in a free-range environment, to an intensive, industrial scale method of production where animals are raised in close confinement and denied the ability to engage in their natural behaviours. As the world moved to embrace modernization throughout the 20th century, the mantra for agriculture in developed countries as expounded by Earl Butz in 1968 was 'Get big or get out!'. Based on this line of thinking, large-scale, high-technology, intensive production systems were, and continue to be, increasingly advocated as essential to feeding the world's growing population. In the context of animal foods, this industrial approach has resulted in a narrowing of genetic resources, increased reliance on lab-bench technologies, an escalation of food safety issues, and a concentration of rearing and processing capacity (accompanied by a keen eye on keeping the retail price of food for North American consumers as low as possible to stimulate consumption). This approach has led to many economic 'costs' remaining externalized from the food system and effectively hidden from public view.

The result is a very narrow and misleading picture of the true economic impact and trade-offs from the production and consumption of animal foods where many of the effects from livestock are not widely understood. For example, as stated in its 2006 report, Livestock's Long Shadow, the United Nations Food and Agricultural Organization (FAO) explain that the amount of land used for grazing combined with the amount of land used to produce crops for animal feed means that livestock production uses 70 percent of all arable land (FAO, 2006).

This is forecast to grow dramatically as rising global population and relative affluence combine to increase future demand for meat. At the European Union Feed Additives and Premixtures Association meeting in 2009, Nan-Dirk Mulder, economist for Rabobank, told members that projections for global meat demand will have increased by 25 percent in 2015 and 23 percent more between 2015 and 2025 (Boloh, 2009)[1]. Given current rates of land use and projected increasing demand (56 percent of which is projected to come from Asia) (OECD and FAO, 2011), the numbers don't add up. There is simply not enough land to continue raising and eating animals at the scale that we have for the last few decades.

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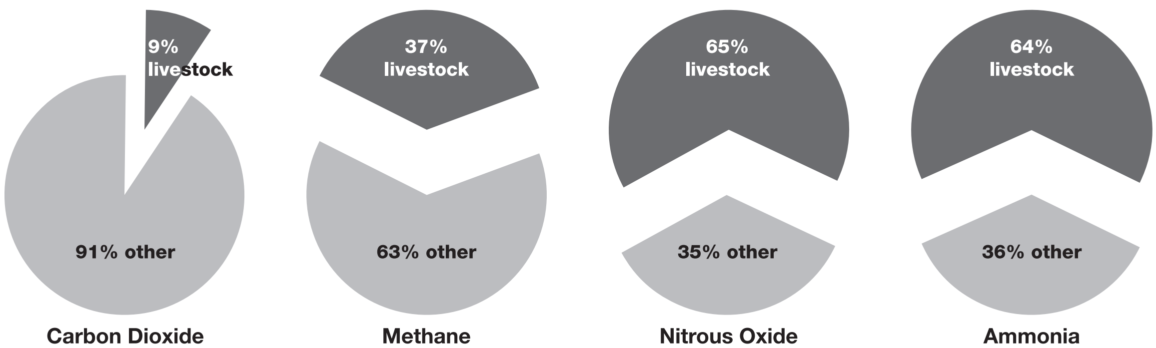
[1] These estimates were based on data from the Food and Agricultural Policy Research Institute, the Food and Agriculture Organization of the United Nations, the US Department of Agriculture (USDA), The European Commission and the Organization for Economic Cooperation and Development estimates.

There are also massive environmental costs, with livestock cited as responsible for eight percent of global human water use (FAO, 2006). The impact does not stop there, as

> [t]he livestock sector accounts for 9 percent of anthropogenic CO_2 emissions. The largest share of this derives from land-use changes – especially deforestation – caused by expansion of pastures and arable land for feed crops. Livestock are responsible for much larger shares of some gases with far higher potential to warm the atmosphere. The sector emits 37 percent of anthropogenic methane (with 23 times the global warming potential (GWP) of CO_2) most of that from enteric fermentation by ruminants. It emits 65 percent of anthropogenic nitrous oxide (with 296 times the GWP of CO_2), the great majority from manure. Livestock are also responsible for almost two-thirds (64 percent) of anthropogenic ammonia emissions, which contribute significantly to acid rain and acidification of ecosystems (FAO, 2006, xxi-xxii).

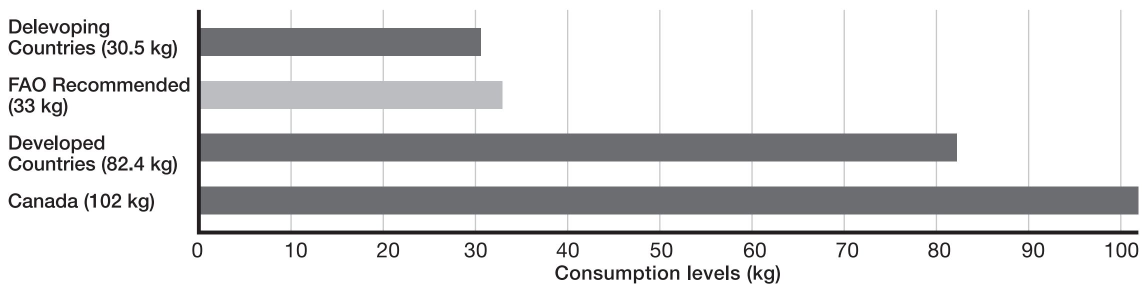
Global livestock's contribution to anthropogenic emissions



Overall, the current and future costs of animal production and consumption are substantial and growing. As well, there is increasing consolidation in the world meat industry. Mulder explains that the beef industry "is the most consolidated industry on a global level: [the] share of the top three beef companies has reached 23 percent, while the top three companies own 12 percent in the poultry market and eight percent in the pork market. Today, Brazilian and US meat companies dominate global ranking and drive global consolidation process" (Boloh, 2009). Mulder goes on to state that there are several reasons for these mergers and acquisitions, including: "bargaining power, retail needs (size, homogeneity and international purchasing), research and development, marketing and promotion, efficient production opportunities, distribution and export and risk mitigation" (Ibid).

At the same time as the world witnesses this escalation and intensification in production and demand, there are nearly one billion people relying on subsistence, pastoral livestock production for their very survival (FAO, 2006). These families are perched on the edge of severe food insecurity and are extremely susceptible to fluctuating world food prices. Some of the factors that aggravate their insecurity include investor speculation, increased use of biofuels derived from food products such as corn ethanol, dwindling wheat reserves, and the impacts of climate change (Clapp and Cohen, 2009). As the FAO explains, while animal products are an effective way of securing protein and some nutrients in developing countries, the gap between the developed and developing world is not closing very quickly. For example, in 2007 meat consumption in developing countries hovered below the annual recommended intake of 33 kg per person (at 30.5 kg) while developed countries consumed an average of 82.4 kg per capita. And this bifurcation between rich and poor is expected to grow even more pronounced (FAO, 2009). There is also the increasing urbanization of the world that will further exacerbate this problem.

Average amount of meat consumed annually per capita



The FAO sees the "maximum utilization of existing food resources" as imperative, given the limited potential for livestock expansion despite growing global populations and the increased demand for animal products (FAO, 2009). Therefore a discussion is needed on the importance of decreasing per capita meat consumption in the countries that currently consume it at an unsustainable rate, including Canada. In addition to this required reduction, we must explore the existing and emerging opportunities to produce animal products in a way that is less harmful to animals, and less destructive to ecological systems, communities and people. The challenges and opportunities are the subject of the rest of the chapter.

Canada in the global context

Consistent with other developed countries, Canada has experienced changes in population, the number of farms and their size, and rural and urban populations in the last 50 years. The most noteworthy trends include:

- the population has doubled since 1956 (Statistics Canada, 2006b)
- the number of farms has decreased by 60 percent (574, 993 in 1956 compared with 229, 373 in 2006) (Statistics Canada, 2006a)
- overall farm size has increased from an average of 302 acres to 728 acres which represents a 141 percent increase in farm size (Statistics Canada, 2006a)
- the average area of corn (for grain) per farm reporting has increased by 611 percent (18 acres in 1956 compared with 128 acres in 2006) (Statistics Canada, 2006a)
- the number of Canadians living in cities has more than doubled since the 1950s from nearly 11 million in 1956 to more than 25 million, while at the same time the rural population has increased at a much slower rate, from just over 5 million to just over 6 million (Statistics Canada, 2006). This represents a decrease in the proportion of rural communities from 33 per cent in 1956 to only 20 percent today (Statistics Canada, 2006b)

■ **The number of farms in Canada has decreased by 60 percent over the last 50 years. Fewer jobs and pollution threatens the quality of life in rural communities.**

As agriculture becomes increasingly consolidated, there is a greater emphasis on mechanization and technology resulting in fewer jobs and therefore less incentives to remain in rural communities. This combined with the pollution threats and quality of life challenges facing rural communities with Intensive Livestock Operations (ILOs) in their backyard, threaten the economic viability (and livability) of rural areas in Canada. As stated in a report on rural communities by the Standing Senate Committee on Agriculture and Forestry, due to "the seemingly irreversible trend of rural decline and the poverty that so often accompanies it, some have questioned rural Canada's continuing relevance." (2008). This poverty is not to be underestimated as,

> …real net market farm income has hovered at or below zero since about 1987, with government program payments accounting for almost all of the farm sector's realized net income over this period. Even the recent increase in a range of agricultural commodity prices caused by an increase in global demand, normally a very positive sign for farmers, has been tempered by rising input prices and the appreciation of the Canadian dollar, leaving aggregate farm business income flat or only slightly higher than it has been over the last 20 years (2008, p. 37).

Further, the Senate report points to the lack of attention to rural communities through policy and program funding that results in rural agricultural communities being largely ignored. The effect is a wealth extraction, and a hollowing out of community resources and human capital as people and infrastructure abandon rural communities in favour of the full service economies offered by larger communities. This in turn exerts even more pressure on farmers 'to get big or get out' as on-farm net incomes consistently hover close to or below zero.

Concentration is not confined to farms. Companies supplying inputs to farms, abattoirs and retailers continue to consolidate. So while the number of processed products on the grocery shelves and in freezer display cases continues to grow, healthy food choices are relatively more expensive and diminishing (Nestle, 2002). Aggravating this is the high cost of fruits and vegetables that also deters people from making healthy eating choices. So even as consumers express an interest in healthier and/or alternative animal products, retailers mediate constrained choice through their retail/distribution networks (Food Ethics Council, 2010).

In addition to these challenges are other externalized costs such as those linking increasing health care costs to a high consumption of animal products. As reported in Food Counts, a sustainable food systems report card for Canada, in 2009 the number of people self-reporting in the overweight or obese categories was 51.6 percent (59.2 percent for men and 34.9 percent for women) while the rate of diabetes was at 6.0 percent (6.6 for men and 5.3 percent for women). This national diabetes rate is an increase of more than 30 percent since 2003. The associated direct and indirect costs of diabetes are substantial and growing. In 2010 the Canadian Diabetes Association (CDA) reported that diabetes cost Canadians $12.2 billion with projected costs to escalate to $16.9 billion by 2020 (CDA, 2010). These rapidly escalating costs are related to diet, with the consumption of animal products as a major contributing factor. For example, in research studying over 60,000 people that compared eating vegetarian diets to non-vegetarian diets, it was determined that after lifestyle and BMI were considered, vegetarian diets were beneficial in protecting against type 2 diabetes (Tonstad et al., 2009). Therefore, encouraging a more plant-based diet (and ensuring there is access to fresh, affordable fruits and vegetables) is one way to combat the externalized costs of the industrialized food system while promoting greater overall health.

It cannot be ignored that the food industry is a critical part of the Canadian economy. It employs about one in eight Canadians and accounts for about 8.2 percent of GDP. The meat industry is significant in its own right within this larger food sector. According to the Canadian Meat Council, Canada exported $2.77 billion of pork to over 130 countries and $1.35 billion of beef to more than 60 countries[2] (2010). With total shipments valued at over $21 billion in 2007, the meat processing industry is the largest single sector in the food processing industry (Ibid). This presents a formidable force against changing the status quo that promotes fast food, large portions and export market development. On the consumption side, there have been minor decreases in red meat consumption (from 24.84 kg in 2007 down to 23.43 kg per person in 2008), as well as poultry (13.44 kg in 2007 to 13.40 kg per person in 2008) (Ibid). Despite these minor decreases, there is widespread support from the food industry for continued higher than needed quantities of meat consumption.

[2] This is happening at the same time as we are importing almost $1 billion in beef, veal (cattle and boneless, $563 million) and pork ($412 million) (FAO 2011).

Where do we go from here? Opportunities to shift the economic calculus for animal eating

Given the challenges for Canadians related to the production of animal products, there are many steps that can be taken to mitigate the negative effects of industrial animal agriculture. These opportunities can be organized into three categories: production, consumption and policy.

Production

There are many benefits that accrue from moving from intensive to extensive animal production systems. Increased consideration of the environment and moves to internalize ecological goods and services (EG&S) can be implemented to reward farmers who have: more diversified livestock; sequestered carbon; increased biodiversity; and improved water management. Table 1 provides a brief description of societal benefits associated with these practices and links to programs/management systems that incorporate them.

■ **Diverse livestock at White Oak Pastures in Georgia, US. This farm rears 650 grass-fed Angus breeding cows, as well as sheep (pictured in same pasture) and free-range poultry. Animals live on the pastures their entire lives and can perform natural behaviours. This style of farming has created quality meat for health-conscious American consumers, stable livelihoods for a local workforce and a less polluted rural landscape.**

For more on the White Oak Pastures case study visit www.wspa.ca/food

Table 1. Value of Ecological Goods and Services undertaken by farmers to society with links to case study material

Ecological good	Service to larger society	Sample projects*
Genetic Diversity	Animals reared outdoors are kept at lower stocking densities and can be less stressed because of it; herds/flocks often have greater resistance to disease because of their diversity. ILOs tend to raise animals that have been genetically altered for specific production traits thereby putting them at greater risk of disease and providing an impetus for antibiotics; reduced use of antibiotics means more tools to deal with human diseases	Encouraging small-scale diverse farming (e.g. allowing backyard chickens)
Carbon Sequestration	Through permanent pasture, carbon is stored underground thereby creating a more stable and livable climate	**Alternative Land Use Services (ALUS) Program** The program utilizes incentive-based approaches to conservation and environmental protection on private farms across Canada.
Biodiversity	Creates wildlife habitat for endangered species and promotes greater diversity of plant and animal species	**The Hedgerow Biodiversity Action Plan** The plan serves as a method of protecting species and habitats through conservation, public awareness and by placing an emphasis on a partnership approach.
Improved Water Management	Well managed use of manure on fields as fertilizer; low concentration of animals and appropriate riparian management means better quality watershed, reduced water costs and good quality water	**New York City Department of Environmental Protection** New York City's Watershed Agricultural Program demonstrates how municipalities can partner with farmers along their watershed to encourage an environmentally sound 'whole farming' approach.

*For more information on these sample projects visit: www.wspa.ca/food

Consumption

Thoughts from Colin Tudge are worth considering when deciding how to proceed as a meat eater. His advice is to use an ‘enlightened’ approach to agriculture that embraces “plenty of plants, not much meat and maximum variety” (Tudge, 2007, p. 57). Researchers at Cornell determined that if New York state were to follow a low-fat vegetarian diet, the state could feed almost 50 percent more people than it currently does (Peters et al., 2009). Peters also argues that due to high-quality land required to grow fruits and vegetables that keeping some animal products in one’s diet may be more efficient. Regardless of how much of one’s diet remains based on animal products, the reality is that the production phase of food is responsible for 83 percent of the average US household’s carbon footprint per year for food consumption. Only 11 percent of life-cycle greenhouse gas (GHG) emissions are based on transportation (Weber and Matthews, 2008). Therefore, energy and resource-intensive foods (which tend to be animal products) account for more of our carbon footprint per year than does our transportation.

As of 2007, Canadians consumed 98.83 kg per person – nearly three times the intake recommended by the FAO (33 kg per person), while people in developing countries continued to consume below the recommended intake (FAO, 2010). In 2007, in Malawi 5.90 kg of meat was consumed per person, in Haiti 13.60 kg of meat was consumed per person, and in Sri Lanka 6.82 kg of meat per person was consumed (Ibid).

Reducing the amount of meat consumed per capita could help reduce some of the stress on our health care system providing extra dollars that could be used to provide a ‘healthy food’ dividend to farmers. Reducing redundant trade[3] would be an important part of this approach. While some redundant trade may be inevitable given the huge size of Canada, this cross border swapping is often linked to trade deals and does not lend itself to the thorough support of Canadian farmers.

Once we have made a commitment to Canadian farmers we also need to compensate them fairly for the food they provide. While this may translate into higher prices, there are savings, and a perception of value (or benefits) needs to be understood by Canadians. These benefits range from economic value (e.g. small-scale, locally produced meat tends to not be injected with water and sodium thereby increasing the per-kilo value) to personal health and safety (e.g. consuming smaller amounts of higher quality animal foods produced with the highest standards of food safety). Equally important are the environmental benefits associated with small-scale, alternative production when compared to the industrial model of animal agriculture.

Policy

Any financial program for farmers needs to be founded on principles of fair trade and food system resilience. Farmers should be compensated for the benefits that they provide to Canadians, including producing food. Currently, most family farmers in Canada operate at the edge of profitability with the majority earning close to zero net income from their farms every year. For example, in Ontario the average farm lost $1,626 in 2007 and had a net profit of only $936 on average per farm. (Statistics Canada 2011; assumes same 2.2 percent decrease per annum in number of farmers between 2006 and 2010 as between 2001 and 2006). In order for farmers to use more humane and sustainable farming practices, we need to compensate them

[3] The practice of exporting and importing to and from a region that which is already being produced in that region.

for the value they are providing to society at large. This can be done through payment mechanisms, tax credits and other financial rewards.

In 2006 the FAO discussed the ways the Kyoto Protocol Clean Development Mechanism could be used to support farmers for carbon sequestration. The United Nations Framework Convention for Climate Change (UNFCCC) meetings in Cancun and the forthcoming discussions in South Africa will provide opportunities to discuss cross-cutting policies aimed at encouraging carbon sequestration (Carpenter, 2011) similar to those outlined in the 2006 report. They include:

> "Most family farmers in Canada operate at the edge of profitability with the majority earning close to zero net income from their farms every year."

Table 2. Potential Policy Initiatives based on FAO Recommendations

Water Use:	"full cost pricing of water (to cover supply costs, as well as economic and environmental externalities), regulatory frameworks for limiting inputs and scale, specifying required equipment and discharge levels, zoning regulations and taxes to discourage large-scale concentrations close to cities, as well as the development of secure water rights and water markets, and participatory management of watersheds" (FAO, 2006, p. xxii)
Biodiversity:	"[p]rotection of wild areas, buffer zones, conservation easements, tax credits and penalties can increase the amount of land where biodiversity conservation is prioritized. Efforts should extend more widely to integrate livestock production and producers into landscape management" (FAO, 2006, p. xxiii)
Full Cost Pricing and Fees:	"a crucial element in achieving greater efficiency is the correct pricing of natural resources such as land, water and use of waste sinks. Most frequently natural resources are free or underpriced, which leads to overexploitation and pollution. Often perverse subsidies directly encourage livestock producers to engage in environmentally damaging activities…A top priority is to achieve prices and fees that reflect the full economic and environmental costs, including all externalities" (FAO, 2006, p. xxiii)
Subsidies and Externalities:	"Damaging subsidies should be removed, and economic and environmental externalities should be built into prices by selective taxing of and/or fees for resource use, inputs and wastes. In some cases direct incentives may be needed" (FAO, 2006, p. xxiv)
Payment for Environmental Services:	"Payment for environmental services is an important framework, especially in relation to extensive grazing systems: herders, producers and landowners can be paid for specific environmental services such as regulation of water flows, soil conservation, conservation of natural landscape and wildlife habitats, or carbon sequestration. Provision of environmental services may emerge as a major purpose of extensive grassland-based production systems" (FAO, 2006, p. xxiv)

Conclusion

The increasing consolidation and industrialization of agriculture (particularly animal agriculture) has come at the cost of animal, environmental, human and community well-being. The high-technology, capital-intensive system of animal agriculture, while being touted as necessary to feed the world, ignores many of the massive costs that are continually externalized from the perceived costs. These will be discussed in greater depth in the sections that follow. The result has been a skewed, poorly informed vision of the real trade-offs associated with producing animal foods the way we do, ranging from issues of animal cruelty, epidemics of diet-related disease and illness, dire environmental conditions, and projections for greater food insecurity abroad in developing countries as population increases and relative affluence increase the demand for animal products. This urgency necessitates meaningful, forward-thinking institutional and policy frameworks.

Policy Recommendations

- As the People's Food Policy recommends, government policy at all levels should be re-oriented and harmonized to shift away from commodity-based, export-focused agriculture and toward a community-based, sustainability-focused agriculture that prioritizes healthy eating for all Canadians. Policy success should be measured by net farm income, a decrease in obesity, diabetes and other diet-related diseases and health problems, and animal health and welfare improvements rather than by export volume.
- Enact legislation requiring food to be properly labelled with information on its origin, nutritional information and production methods (e.g. animal husbandry methods). Consumers have the right to know how and where their food is produced. This will help provide some visibility to the many hidden costs of meat production.
- Make farming a viable form of employment again by rewarding farmers for the ecological goods and services they provide to society. It is worth mentioning that this was also recommended by the Standing Senate Committee on Agriculture and Forestry in their 2008 report, "Beyond Freefall: Halting Rural Poverty". The federal government should work with provinces to develop an Environmental Goods and Services or Alternative Land Use Services (ALUS) program.
- Reverse the trend towards ILOs by encouraging more farms and more farmers instead of promoting corporate concentration. This can be achieved by redirecting government support away from ILOs and towards small farmers. According to the Christian Farmers Federation of Ontario, "A Place for All", small farmers need support in accessing: capital, local processing, local markets and marketing skills. Many farmer and food groups have also been asking for alternative food safety regulations to accommodate small-scale farmers similar to those established by EU. Industrial-scale farms and processors need more rigorous regulations and inspections but small producers and processors say this is a major barrier to change as some of the requirements are difficult and expensive to meet. The Standing Senate Committee on Agriculture and Forestry has also recommended changing food inspection regulations to ease the entry of local producers and organic growers into the market, while increasing the scrutiny of foreign food to ensure a level playing field for Canadian producers.
- Canadian municipalities should follow in the footsteps of Munich, Ghent (Belgium), San Francisco and other cities around the world in encouraging their residents to reduce meat consumption. This will help reduce GHG emissions and alleviate some of the current (and projected) pressure on our healthcare system. Most importantly, it will ensure current and future generations have a quality of life and life expectancy that is even healthier and longer than their parents, not less, as it is currently projected to be by the Canadian Standing Committee on Health.
- Adopt a 'just in case' not a 'just in time' attitude towards food (Tansey 2011) so that food commodities are once again treated differently from other commodities such as gold and oil.

References

Alternative Land Use Services (ALUS) (Tyrchniewicz Consulting). (2007). A Preliminary Overview of Potential Cost Reductions and Financial Benefits to Canada.
Retrieved from: http://tyrchniewiczconsulting.com/PDFs/Evaluation_ALUS.pdf

Blay-Palmer, A., Turner, J. & Kornelsen, S. (2012). Measuring success: Sustainable food systems report card. In (eds.) M. Koc., J. Sumner and T. Winson *Critical Perspectives in Food Studies*., Oxford University Press.

Boloh, Y. (2009). Dramatic changes ahead for global meat industry. *Feed International*.
Retrieved from: http://www.fi-digital.com/fi/200910/?pg=20#pg20

Canadian Meat Council. (2010). Canadian Livestock and Meat Industry – 2010 Industry statistics: executive summary.
Retrieved from: http://www.cmc-cvc.com/english/industry_statistic_e.asp

Carpenter, S., (2011). Clean Development Mechanism (CDM) as a real option for Carbon Capture & Storage (CCS) – How do we get there? *Carbon Capture Journal*.
Retrieved from: http://www.carboncapturejournal.com/displaynews.php?NewsID=806

Canadian Diabetes Association (CDA). (2010). Access, equity and prosperity for all: Recommendations by the Canadian Diabetes Association for the 2011 Federal Budget.
Retrieved from: http://www.diabetes.ca/documents/get-involved/Brief-house-of-commons-EN.pdf

Clapp, J, & Cohen, M.J. (2009). The global food crisis: governance challenges and opportunities. Waterloo: The Centre for International Governance Innovation and Wilfrid Laurier University Press.

FAO Statistics Division (FAOSTAT). P*roduction & Resource STAT Calculators (Livestock Primary)*. Rome: FAO.
Retrieved from: http://faostat.fao.org/site/569/default.aspx#ancor

Food and Agriculture Organization of the United Nations (FAO). (2006). Livestock's long shadow: Environmental issues and options. Retrieved from: http://www.fao.org/docrep/010/a0701e/a0701e00.HTM

Food and Agriculture Organization of the United Nations (FAO). (2009). Meat consumption. Retrieved from: http://www.fao.org/ag/againfo/themes/en/meat/background.html

Food and Agriculture Organization of the United Nations (FAO). (2010). Livestock and fish primary equivalent, FAOSTAT on-line statistical service. Retrieved from: http://faostat.fao.org/site/291/default.aspx

Food Ethics Council. (2010). Retrieved from: http://www.foodethicscouncil.org/

Government of Canada. (2008). Beyond freefall: Halting rural poverty. Final Report of the Senate Standing Committee on Agriculture and Forestry. Ottawa: Joyce Fairbairn, Chair.
Retrieved from: http://www.parl.gc.ca/Content/SEN/Committee/392/agri/rep/rep09jun08-e.pdf

GRAIN. (2006). Fowl play: The poultry industry's central role in the bird flu crisis. *GRAIN Briefings*.
Retrieved from: http://www.grain.org/briefings/?id=194

Lang, S. (2007). Diet for small planet may be most efficient if it includes dairy and a little meat, Cornell researchers report. *Cornell Chronicle Online*. Retrieved from: http://www.news.cornell.edu/stories/Oct07/diets.ag.footprint.sl.html

Nestle, M. (2002). *Food Politics*. Berkley, CA: University of California Press.

New York City Department of Environmental Protection. (2010). New York: New York City and Seven Upstate New York Counties – Effective watershed management earns filtration waiver for New York.
Retrieved from: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-NY-NY-City-7-Upstate-Counties.pdf

Ochterski, J. (2005). Enhancing pastures for grassland bird habitat. *Cornell University Cooperative Extension*.
Retrieved from: http://www.fingerlakesrcd.org/Documents/Grassland percent20Bird percent20Habitat.pdf

Organization for Economic and Co-operation and Development (OECD) and Food and Agriculture Organization of the United Nations (FAO). (2011). Retrieved from: http://www.agri-outlook.org/dataoecd/2/36/48184304.pdf

Peters, C. J., Bills, N.L., Wilkins, J.L. & Fick., G.W. (2009). Foodshed analysis and its relevance to sustainability. *Renewable Agriculture and Food Systems*, 24, 1-7.

Statistics Canada (2006a). Agricultural Census Section 1 – A statistical portrait of agriculture, Canada and provinces: census years 1921 to 2006. Retrieved from: http://www.statcan.gc.ca/pub/95-632-x/2007000/t/4185570-eng.htm#

Statistics Canada. (2006b). Census: Population, urban and rural, by province and territory. Retrieved from: http://www40.statcan.ca/l01/cst01/demo62a-eng.htm

Statistics Canada. (2011). Net Farm Income. Retrieved from: http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=0020009

Statistics Canada. (2011). Net Farm Income – Agriculture economic statistics. Retrieved from: http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=21-010-X&lang=eng

Tansey, G. (2011). Choosing the future and avoiding world war three – food is the key. *Canadian Association for Food Studies Annual Conference*, Fredericton, NB, May 28-30, 2011.

Tonstad, S., Butler, T., Yan, R. & Fraser, G.E. (2009). Type of vegetarian diet, body weight, and prevalence of type 2 diabetes". *Diabetes Care*, 32 (5), 791-796.

Tudge, C. (2007). *Feeding people is easy*. Italy: Pari Publishing.

Weber C. L. & Matthews, H.S. (2008). Food-Miles and the relative climate impacts of food choices in the United States. *Environmental Science & Technology*. 42 (10), 3508-3513.

Public Health

Impacts of Industrial Animal Agriculture on Public Health

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The agriculture and agri-food system is a substantial contributor to the Canadian economy, adding eight percent to Canada's gross domestic product (GDP) in 2005, with livestock production (including red meats, dairy and poultry) accounting for 50 percent of agriculture's farm cash receipts (CFA, 2007). The demand for increased animal production, in the two decades past, has justified expansions of intensive livestock operations (ILO) in Ontario, Alberta, Manitoba, Saskatchewan, Nova Scotia and New Brunswick; in Manitoba for example, the population of hogs has far exceeded that of people. Current projections estimate that global animal agriculture outputs will need to double by the year 2050 (Pelletier and Tyedmers, 2010) to keep up with the growing human demand for animal protein, and possibly more as catches from marine fisheries decline worldwide. Therefore it is essential to anticipate and examine the question of the sustainability of large-scale animal production, including concerns about the role of food animals in propagating human pathogens and adverse consequences for human and environmental health, especially in view of the substantial amount of animal agriculture already occurring in Canada.

> "It is essential to anticipate and examine the question of the sustainability of large-scale animal production, including concerns about the role of food animals in propagating human pathogens…"

The long-term trend in the Canadian livestock industry has been towards a decrease in the number of livestock farms and a steady increase in average farm size, with larger and more specialized vertically integrated operations and associated greater concentrations of untreated waste requiring disposal. The overall trends of industrial-scale livestock production should be a serious concern to policymakers. Can a production system based on ILO models be sustainable? Overall, the ILO scheme of production has created a significant paradigmatic shift in the farming and food production system, with associated health, societal and moral issues, and hidden environmental and economic costs.

In Saskatchewan for example, the central piece of legislation is the Agricultural Operations Act (1995), which addresses both monitoring and enforcement of environmental standards. Questions related to ILOs and municipality bylaws, which relate to local environment and health, are referred to the Department of Saskatchewan Environment and Resource Management (SERM), which can request an environmental assessment. According to the Saskatchewan Association of Rural Municipalities (SARM), of the 298 rural municipalities, 171 do not have any planning or zoning bylaws that would affect ILOs, and the only requirements for project approval are provincial guidelines (CSALE, 1996). Only a few municipalities have some sort of zoning or public roadways bylaws that would effectively impact ILOs.

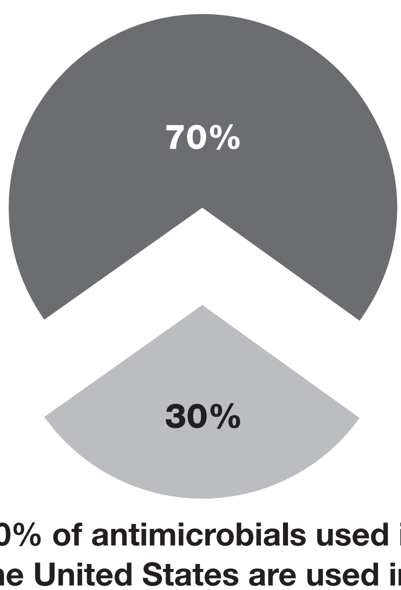
Antibiotics and Antibiotic Resistance

Antibiotics are chemicals which at a particular concentration inhibit growth of micro-organisms. These chemicals originate from medical, veterinary, agricultural and industrial applications and are now present in many Canadian soils and surface waters at measurable concentrations. For example, Waiser et al. (2010) reported erythromycin, clindamycin, trimethoprim, sulfamethazine, norfloxacin, and sulfamethoxozole at sub-lethal/sub-inhibitory (ng L^{-1}) concentrations in Wascana Creek, Saskatchewan.

Livestock are administered antibiotics for three reasons: to treat infectious disease, to reduce the risk of infectious diseases, and to promote growth or performance. Routine administration to healthy animals has a number of drawbacks: 1) antibiotic resistant bacteria (ABRB) are generated through selection, mutation, or acquisition of resistant genes from other organisms through exchange of genetic material; 2) antibiotic residues and metabolites may persist in the animal products and may be ingested by consumers (e.g. in the 1990s Japan rejected some shipments of Canadian pork due to unacceptable drug residues); and 3) drugs and their metabolites are excreted in animal waste and escape into the environment, appearing at low concentrations even in drinking water.

> "These chemicals…are now in many Canadian soils and surface waters at measureable concentrations."

Attempts to estimate the amount of antibiotics used in food animal production are often thwarted by varying definitions of the terms: 'therapeutic,' 'non-therapeutic,' and 'growth-promoting', and the overlapping areas of uncertainty among them. A universally accepted definition of the various types of use is necessary to gather meaningful data regarding antimicrobial use and to formulate policies governing the use of antimicrobials in food animals and ILOs specifically (e.g. Mellon et al., 2001; WHO, 2000). In countries where reliable data is available, as much as 50 percent or greater of the volume of antibiotics produced or imported is given to farm animals and a significant portion is used to increase growth and prevent disease (Health Canada, 2002). The Union of Concerned Scientists has estimated that 70 percent of antimicrobials in the United States are used in food animal production (Mellon et al., 2001).



70% of antimicrobials used in the United States are used in food animal production.

"…agriculture accounts for the highest volume of antibiotic use…"

At the recent 144th annual general meeting of the Canadian Medical Association, Dr. Bill Mackie stated that "agriculture accounts for the highest volume of antibiotic use" (Vogel, 2011). Through an on-farm interview questionnaire, Rajić et al., (2006) examined antibiotic administration through feed, water or injections at approximately 25 percent of the swine farms in Alberta. In the 12-month period preceding 2006, the majority of these farms administered a chlortetracycline/sulfamethazine/penicillin combination and tylosin and lincomycin in feed for weaners and growers/finishers, respectively. In Ontario, Dunlop et al. (1998) found that a significant proportion of hog producers administered antimicrobials only for growth promotion purposes, while those who did not use them believed they were not necessary. Bush et al. (2002) investigated the use of antibiotics in 895 swine operations in the US in 2000 and found that 82.7 percent of farms that raised nursery pigs were given antibiotic feed for growth promotion or prophylactic purposes.

Sub-therapeutic levels of antibiotics in animal feed suppress, but do not kill, the pathogens for which they are intended, and animals appear clinically healthy but are not pathogen-free. Continuous exposure of pathogens to low doses acts as a powerful selection force for the propagation of strains which have acquired resistance either through mutation or acquisition of resistant plasmids and confined animal facilities are primary sources of such strains (WHO, 1997; Mathew et al., 1998; Witte, 1998; Stine et al., 2007). The antibiotic resistant bacteria can then be transferred to people.

The controversy around the routine use of antibiotics in feed arises from evidence that low-dose antibiotics in feed or water can increase the rate and efficiency of weight gain in varying degrees by fending off illness and decreasing demand on the animal's immune system so more energy goes into putting on weight. According to a Health Canada Advisory Committee on Animal Uses of Antimicrobials, "Growth promoters account for a considerable amount of the total antimicrobial exposure. In addition, they are not used under veterinary prescription, nor to treat infections in animals. Some members believed that growth promoters facilitate animal husbandry practices that are unhealthy and therefore questionable on welfare grounds" (Health Canada, 2002).

The primary issue is that some antibiotics used for animals are identical to those prescribed for human use. The indiscriminate prophylactic use of antibiotics therefore is most inappropriate, especially when solely justified under the rubric of growth promotion. As incidents involving resistance increase, infections with ABRB become more difficult and expensive to treat, rendering approved antibiotics ineffective and forcing physicians to use expensive 'drugs of last resort', while veterinarians may abandon treatment. Over the period of 1998 to 2004, only seven new antibiotics were approved in the US (Spellberg et al. 2008) and this may suggest a pending global health risk as antibiotic

"'Growth promoters account for a considerable amount of the total antimicrobial exposure…they are not used under veterinary prescription nor to treat infections in animals.'"

– Health Canada Advisory Committee on Animal Uses of Antimicrobials

> "The primary issue is that some antibiotics used for animals are identical to those prescribed for human use."

resistance continues to grow without replacement drugs (Shlaes et al., 2004). It is for this reason that much earlier the Canadian Medical Association in 1998 called for Canada to ban sub-therapeutic doses of antibiotic use for livestock growth promotion (McGeer, 1998; Khachatourians, 1998), while the American Medical Association passed a resolution opposing the use of antibiotics on healthy farm animals in June, 2001.

ABRB and multiple-drug resistant 'super-bugs' are now ubiquitous in the environment at large. Zoonoses contribute to the reservoir of ABRB in the enteric commensals (i.e. intestinal flora) of animals (Mirzaagha et al., 2011; Alexander et al., 2011). Non-pathogenic (benign) components of enteric flora may acquire antibiotic resistance which is then cross-transferable to pathogens, accelerating the rate at which resistant pathogens appear. Thus "non-pathogenic *E. coli* from swine may represent a considerable reservoir of antibiotic resistance genes that might be transferable to pathogens" (Sunde et al., 1998). Resistance gene characteristics in the flora of healthy pigs have been shown to be correlated with characteristics in clinical isolates of human pathogens (Sunde and Sorum, 1999). Furthermore, antimicrobial resistance need not be solely the result of antibiotic drug exposure. The stressful conditions in which the animals are managed may themselves trigger changes in the characteristics of the microbial gut fauna.

■ **Close contact between animals and their waste encourages antibiotic resistant bacteria dissemination.**

The longer an antibiotic is in use, the greater the probability of resistance, with serious implications for both animals and humans. In ILOs, the close contact between animals and their waste encourages ABRB dissemination. ABRB can spread to humans through exposure, ingestion or inhalation. ABRB are more frequent in communities where antibiotics are in common use.

Recent instances of livestock-associated methicillin resistant *Staphylococcus aureus* sequence type 398 (MRSA ST398) were identified in the general human population in Saskatchewan, Manitoba (Golding et al., 2010) and Ontario (Khanna et al. 2008). According to Golding et al. (2010), MRSA ST398 was first reported in 1998 in children in Chicago, then in 2004 in pigs, and eventually in pig farmers in the Netherlands, before spreading throughout the European Union to North America, thus demonstrating that MRSA associated with pigs can be prevalent in humans.

Numerous other examples have been reported. Swine isolates of *Campylobacter coli* have demonstrated increased rates of resistance to streptomycin and macrolides (Aarestrup et al., 1997) as well as erythromycin (Davies et al., 1996). *Pseudomonas* isolated from Danish pig farms has shown multi-antibiotic resistance (Jensen et al., 2001).

A study of retail turkey meat from Southern Ontario, estimated the prevalence of *Campylobacter*, *Salmonella*, and *E. coli* isolated from 465 raw, fresh retail turkeys purchased at grocery stores (Cook et al., 2009). The antimicrobial susceptibility patterns were determined and assessed for potential public health risk. From February 2003 to May 2004, *Campylobacter* isolates were recovered from 46 percent of samples; the prevalence of resistance to one or more common antimicrobials was 81 percent of samples. *Salmonella* isolates were recovered from 24 percent of samples, with 49 percent showing resistance to one or more antimicrobials, and 13 percent were resistant to five or more antimicrobials. *E. coli* isolates were recovered from 95 percent of samples with the prevalence of resistance to one or more antimicrobials at seven percent, and 18 percent of samples were resistant to five or more antimicrobials.

The association between livestock and poultry, with the development of ABRB heightens fears of new resistant strains "jumping" between species (Khachatourians, 1998; WHO, 2002). In general, those infections which arose from ABRB are not only diverse and complex but have increased to a level that is impacting the cost of health care. An estimate of the annual number of infections due to ABRB in the US is more than two million people (90,000 die), with a cost of $4-5 billion. The problem of resistance has intensified worldwide (Spellberg et al., 2008; Harrison and Lederberg, 1998).

ABRB from ILOs have been recovered both inside and downwind of the facility, as well as in groundwater (Gibbs et al., 2006). Air and surface samples collected from vehicles travelling behind trucks carrying broiler chickens in open crates from ILO to slaughterhouse contained an increased number of total aerobic bacteria including both susceptible and antibiotic resistant *enterococci* (Rule et al., 2008).

Both the pathogens and antibiotics are found in manure and thus may potentially continue to interact

"[Antibiotic resistant bacteria] from [intensive livestock operations] have been recovered both inside and downwind of the facility, as well as in groundwater."

in the environment. Carlson and Mabury (2006) studied agricultural soils treated with manure in Ontario and identified three growth promoting antibiotics: tylosin, chlortetracycline and monensin. They detected up to two percent of the initial concentration of chlortetracycline at a 25-35 cm depth. While it has been thought that only very small amounts end up in groundwater, a report from Germany (Hamscher et al., 2005) indicates that antibiotics not only remain in the plow layers, but can also be recovered 1.4 metres below the soil surface and may leach into groundwater. Aust et al. (2008) and Cessna et al. (2011) showed that feedlot operations in Lethbridge, Alberta using subtherapeutic levels of tylosin, chlortetracycline and sulfamethazine persisted significantly within feedlots; run-off and downward transport carried 7-40 percent of antibiotics to the surrounding environments. Although composting was shown to dissipate antibiotics through microbially driven decomposition over time, at high antibiotic concentrations degradation was inhibited because the antibiotics adversely affected microorganisms involved in decomposition. Different antibiotic resistant genes were observed to be significantly higher in manure and in the amended soil samples after its land application was monitored for a period of four months. In another study (Lawrence and Korber, unpublished data), the South Saskatchewan River has proven to be a source of highly drug resistant bacteria like *Delftia* and *Pseudomonas* spp., with resistance to 15 out of 17 antibiotics specified by the Centers for Disease Control (CDC) National Antimicrobial Resistance Monitoring System (NARMS) panel.

Additional concerns stem from the fact that most pharmaceuticals are designed to interact with a biological intracellular target (membrane receptor sites, ribosomes, enzymes, nucleic acids, etc.) present not only in humans, but animals and sometimes plants as well (e.g. plastids). Thus, while dilution in aquatic systems may reduce the effective concentration of antibiotics, they are constantly being added so their presence becomes pseudo-persistent (Daughton and Ternes, 1999).

Data on environmental degradation rates remain sparse. The extended periods of low-dose exposure facilitate the development of antibiotic resistance factors (R-plasmids) and ABRB; the former of which may in turn be passed on to other bacteria. Chronic exposures to low pharmaceutical and high nutrient concentrations may in turn lead to continual and undetected or unnoticed ecosystem effects and may increase the probability of unexpected ecosystem change (Pomati et al., 2004). Despite the perceived ecotoxicological risk, little community-based research has been carried out to determine their combined environmental effects (Bound and Voulvoulis, 2004; Thomas and Hilton, 2004).

The status of antibiotic resistant bacteria is monitored by the Public Health Agency of Canada (PHAC), under the Canadian Integrated Program on Antimicrobial Resistance Surveillance (CIPARS), established as an agency of Health Canada in 2004. PHAC was confirmed as a legal entity in December 2006 by the Public Health Agency of Canada Act, along with the multi-disciplinary C-EnterNet team which includes experts with unique combinations of training in epidemiology, veterinary medicine, environmental microbiology and public health. PHAC is the main agency responsible for studying, surveillance and reporting of public health in Canada. Contrary to public expectation surrounding the 2002 Health Canada report on the use of antibiotics in food animals, of the 38 recommendations that were made as a result of deliberations, most haven't yet been implemented (Binkley, 2011). The authors of this report whose members were based in academia, animal welfare, consumer interest groups, the feed industry, the food-animal industry, human medicine, the pharmaceutical industry, public health, and veterinary medicine state the following, "the medical community in Canada recognizes that the most serious resistance problems in people are attributable to overuse in human medicine. Nevertheless, large quantities of antimicrobial drugs are used in food-animal production, many of which are the same, or close relatives of drugs used in humans." Additionally, in 2009 the Canadian Institute for Environmental Law and Policy (CIELAP) released a report urging the Canadian government to reduce and phase out the use of antibiotics and hormones in farm animals (CIELAP, 2009). The report states that major effort, both inside and outside government agencies, will be needed to ban and further restrict antibiotic and hormone growth promoters and prophylactic use of antibiotics in animal husbandry. CIELAP recommends the following:

1. Health Canada, through its Veterinary Drugs Directorate, should take steps to implement an immediate ban on the use of antibiotics as animal growth promoters and enhancers of animal feed efficiency, where those classes of antibiotics are of high importance for human therapeutic use.
2. Similarly, these classes of drugs should undergo immediate review and possible restriction for therapeutic uses in animals.
3. Hormones and antibiotics used for animal growth promotion should also be phased out entirely within 6 years (2015), with priorities determined by risk assessment and practical economic considerations.
4. In this initiative, well-designed, inclusive consultation with farmers, consumers, environmental and health professionals, provincial agencies, and many other interested individuals and organizations is of paramount importance. These consultations should commence in the near future and take place over the 6-year period of phasing out the use of hormones and antibiotics for growth promotion. Information programs, dialogue, and exploration of economic and trade implications should be supported by government.
5. Economic incentives should be developed to support changes to farming practices that assist farmers making a transition away from drug use in animal husbandry and at the same time enhancing animal welfare and/or ecological services such as habitat preservation or improvement. (2009, p. 6)

As per the 2002 Health Canada report, it appears unlikely that the goal of 2015 will be met.

A call for the elimination of antibiotic feed additives used for growth promotion was made from 1995-2000 in Sweden, The Netherlands and Denmark, and since 2006 a ban has been in effect in the EU on the use of antibiotics for growth promotion in livestock, a move which is supported by the European Surveillance of Veterinary Antimicrobial Consumption Project (ESVAC). Past North American efforts to restrict the agricultural use of antibiotics have had only limited support, but the EU, which has incrementally arrived at the withdrawal of non-therapeutic antibiotics use in food producing animals, has been the clear 'success story' (Cogliani et al., 2011). When these measures were taken, contrary to concerns that pathogen load would increase, a significant decrease has been observed (DANMAP, 2009).

Both the FDA in the US and Health Canada promote the 'judicious use' of antimicrobial drugs in farm animals (Health Canada, 2003). The FDA indicated that antibiotics should be limited to treating or controlling infectious disease in animals or to preventing infections before an outbreak occurs. Contrary to numerous public and government studies and recommendations, there has been a reluctance in Canada to improve monitoring and enforcement of judicious use. Quantities of antibiotic use in agriculture are still not tracked and a veterinary prescription is not always needed to purchase antibiotics (McEwen, 2010). Therefore, we continue with past practices at our peril.

The powerful agricultural lobbies often prevail over public health advocates, and industry leaders in their media coverage can (and does) spin scientific evidence to an overall ‘lack of conclusivity’ (Russell, 2010). Such discord is promoted by those who warn that the banning of any antibiotic usage in animals based on the ‘precautionary principle’ in the absence of a full quantitative risk assessment is likely to be wasted at best and even harmful to both animal and human health (Phillips et al., 2004).

The economic effect of removing antibiotics used for growth promotion in commercial broiler chickens in the US is a noteworthy example (Graham et al., 2007). The authors used data published by the Perdue company (the third largest poultry producer in the US; 2010 with sales of $4.6 billion) in which a non-randomized controlled trial of antibiotic use was conducted involving seven million broiler chickens to evaluate the impact of removing antibiotics from production. The results showed positive production changes were associated with antibiotic use, but were insufficient to offset the cost of the antibiotics. The net effect of using antibiotics was a lost value of $0.0093 per chicken (about 0.45 percent of total cost). Therefore the authors found no basis for the claim that the use of growth promoting antibiotics lowers the cost of production. Although this study did not include veterinary cost changes or changes in performance variability associated with their removal, it does provide a baseline for additional discussion and study.

A consensus-making process is needed for livestock producers, animal health experts, the medical community, and government agencies to collectively consider effective strategies that consider risk and benefit assessments, microbial risk assessment, and the feasibility of ILOs that can safeguard human and animal health while minimizing ABRB (Mathew et al., 2007). Realistically, however, the economic implications will for many producers and politicians be the primary consideration: if the status quo is allowed to continue, the loss of trade with countries that take a stricter approach will need to be weighed (Miller et al., 2006). Certainly the EU took this into account when it implemented its ban for growth-promoting purposes in response to both perceived risk and public opinion.

Manure Storage, Handling and Transportation

Manure is an inevitable copious by-product of livestock production. Canadian livestock produced 177 million tonnes of manure in 2001, roughly equivalent to the fecal waste of 2.4 billion people (Environment Canada, 2008). Unlike human waste, much of which is routed through sewage treatment plants, the vast majority of ILO outputs are raw, untreated waste, that is most commonly applied directly to the environment in close contact with food crops. When applied judiciously to land, it provides nutrients, offsets the cost of fertilizer, improves soil tilth and organic matter content, and increases water holding capacity (Agnew, 2010). While the application of manure offers several benefits to the soil, poor management practices can result in nutrient, pathogen, heavy metal and salt build up in the topsoil, reducing the soil’s capacity to support

■ **A drainage ditch cuts through a manured field in western Manitoba. Poor management of manure application can lead to pathogen, heavy metal and salt build-up in top soil.**

healthy plant growth (Agnew, 2010). Kumar et al. (2005) at University of Minnesota have shown that plants grown in soils fertilized with manure can absorb certain antibiotics from the manure, presenting potential human risks associated with the consumption of vegetables grown in manure-treated soils.

Regulatory requirements for manure and compost use are prescribed by the Fertilizers Act administered by the Canadian Food Inspection Agency (CFIA). Often, the disposal of manure does not follow standardized practices and lacks proper monitoring, documentation and enforcement. As a result, the presence of toxic chemicals and pathogenic organisms, which persist in soil and water, and in or on crops, become a public health concern. Without standard operating protocols and records, the task of public health tracking of any particular concern is problematic. Record keeping regarding handling, storage and disposal practices of ILOs is required for good management practices.

Manure is a significant carrier of pathogens (see above). Vidovic and Korber (2006) examined *E. coli* O157 distribution frequency, and genetic variability among Saskatchewan feedlot cattle in a two-year study and found an overall *E. coli* O157

> "Often the disposal of manure does not follow standardized practices and lacks proper monitoring, documentation and enforcement."

> "Frequency of *E.coli* was correlated with cattle density and numbers."

prevalence rate of 15.6 percent. Frequency of *E. coli* was correlated with cattle density and numbers. Significant genetic diversity existed amongst the isolates, most of which were indigenous to specific feedlots, and a number of the isolated strains were either multi-drug resistant, or resistant to sulfisoxazole and tetracycline.

Longevity of pathogens remains a concern, as many types of pathogens can survive for extended periods in manure, particularly at lower temperatures, challenging the popular belief that composted manure is free from viable pathogenic bacteria or spores (Inglis et al., 2010; Reuter et al., 2011). In Arkansas, the leading US poultry producing state, 90 percent of the statewide surface water bodies sampled by the Arkansas Department of Pollution Control and Ecology yielded fecal coliform counts in excess of the primary water contact standards (Moore et al., 1995).

The increase in numbers of ILOs and expansion of existing operations, often in close proximity to each other, necessitates the transportation of manure to more distant locations for disposal. In many cases, transportation is not cost effective with increasing distance, resulting in excessive application to more convenient fields, or even illegal dumping in ditches and streams (Moore et al., 1995). The economics of transporting (relatively concentrated) poultry litter was investigated in Virginia by Bosch and Nappit (1992), who found that transfer from areas of high to low poultry production was not occurring, and concluded that regulations as well as government subsidies are needed for poultry growers to have a plan for safe manure disposal. Public and legislative scrutiny of the legal, economic, health and enforcement ramifications of how manure is handled and where it goes is much overdue.

Animal Rendering and Feed

A particular problem associated with the processing of ILO products is their large volume. While a variety of products are readily sold to consumers, parts unsuitable or undesirable are subject to rendering for feed production. The enormous numbers of animals processed every day result in the inevitable inclusion of overlooked animals of questionable health: these may be animals that have been sent to market before symptoms have become evident, or obviously distressed animals (downers) may be brutally prodded or dragged to the kill floor. Carcasses of animals that have died from unknown causes may also be collected from farms and feedlots by specialized trucks, also destined for the rendering tanks.

In the 1990s, the bovine spongiform encephalopathy (BSE) crisis in Britain showed that the inclusion of brain and brainstem parts in the renderings for animal feeds has disastrous consequences for both livestock and human consumers of the meat. Subsequent to these pivotal events, a number of safeguards were implemented in Canada, including bans on the importation of British cattle (1990), prohibition on the use of ruminant animal parts for ruminant feed, heightened BSE surveillance, and bans on the transport and slaughter of "downer" cattle. On 12 July 2007, Canadian government regulations concerning enhanced animal health

■ **BSE-infected cows being incinerated in the UK during the 1990s. Consuming meat from infected animals led to hundreds of deaths worldwide.**

safeguards came into effect to further eliminate BSE from Canada. Certain cattle tissues most capable of transmitting BSE, known as specified risk material (SRM), were banned from ruminant feeds, pet foods and fertilizers, and guidelines were formulated for alternative disposal of cattle mortalities.

The CFIA regulates the import, manufacture and sale of livestock feed under the authority of the federal Feeds Act and Regulation. Any ingredient added to commercial livestock rations must first be approved and listed. This legislation stipulates that, besides being nutritious, ingredients and mixed feeds must also be safe for humans, animals and the environment.

The feeding of any form of poultry manure and poultry litter to livestock is illegal in Canada, although some countries still routinely recycle such litter as a cost-saving measure, arguing that poultry excreta contain undigested feed and grit that otherwise would be wasted (Kirby, 2010). This practice concentrates

"The enormous numbers of animals processed everyday result in the inevitable inclusion of overlooked animals of questionable health… animals that have been sent to market before symptoms have become evident or obviously distressed animals…"

and recycles antibiotics and hormones, as well as pathogens such as *Salmonella*, which contaminates the meat as well as the interior contents of eggs.

The CFIA published its Information Note on the Feeding of Poultry Manure to Cattle in December 1998. Feeding cattle with poultry waste may inadvertently result in the ingestion of ruminant meat and bone meal by cattle and contravene the Health of Animals Regulations. Although the practice has shown significant decline, some producers continue with the custom and risk prosecution (CFIA, 2012). Inadequate heat treatment during rendering and processing of feed may also expose animals to poultry pathogens, as well as drug residues and other chemicals which may harm livestock, or result in the transfer of drugs and their metabolites through animal products (e.g. meat and milk) to humans.

Antibiotic use in commercially produced feed must comply with Health Canada's Food and Drugs Act and Regulations and be subject to the CFIA's Feeds Act and Regulations. The details for use of feed additive drugs approved by Health Canada are listed in the Summary of Feed Drug Clearances (SFDC), a companion to the Compendium of Medicating Ingredient Brochures (CMIB), and include: bacitracin, bambermycins, chlortetracycline, lasalocid, lincomycin, monensin, penicillin, salinomycin, tylosin and virginiamycin. The intent of the Medicated Feeds Regulations under the federal Health of Animals Act is to specify correct dosages and try to safeguard against cross-contamination between feed batches, whether in commercially produced or farm-produced feeds.

With the exception of bambermycins and the ionophores (lasalocid, monensin and salinomycin), all of the above drugs are for growth promotion and can be readily purchased online, at licensed retail outlets, or through direct purchase from the manufacturer or distributor. Thus, the current system allows unrestricted access by farmers (who may or may not possess adequate education regarding proper use) to pharmaceuticals and potentially toxic chemicals, without a prescription or veterinarian's oversight. Thus it is not possible to check whether correct dosages are administered, or even if purchasers are adhering to appropriate and approved uses for which each product is registered. Injudicious use may have unintended consequences for humans (sulphamethazine for example is a carcinogen). The results of this unregulated arrangement end up in our food supply, as well as our environment, with unknown eventual costs for our health care system.

Policy Recommendations

- To preserve the effectiveness of life-saving antibiotics, the federal government must consider the Canadian Medical Association's recommendations and phase-out the use of non-therapeutic antibiotics (used for growth promotion) and other agricultural antibiotics that are crucial in human and veterinary medicine. A critical first step is for provincial governments to follow Quebec's lead and require veterinary prescriptions for all antibiotics used in animal agriculture.
- The federal government should make ILO regulation a joint Federal-Provincial jurisdiction requiring in each and every case a mandatory full life cycle analysis to fully assess their integrated impacts on Canadian life.
- The federal government must establish a mechanism for tracking and monitoring quantities of antibiotics used in agriculture. Establishing a universally accepted definition of the various types of antibiotic use is the necessary first step.
- The federal government should prohibit the use of the new generation of antimicrobials used in poultry feed and drinks which are crucial in the treatment of certain human and veterinary infections.
- The federal government should increase systematic means of oversight in animal pathogen-monitoring program by creating a robust national database for food animals that allows 48-hour trace-back data through phases of their production.
- The federal government through PHAC and CFIA should provide leadership in risk management and public accountability by wide scale reporting of zoonoses, emerging food pathogens and food-borne infections.
- In order to protect the health of the environment and people from the disposal of antibiotics and release of resistant bacteria, governments should develop and implement a new system to deal with ILO and animal processing wastes.
- The federal government should provide incentives for stimulating the food-animal industry's use of alternatives to the use of antibiotics (e.g. use of pre- and pro-biotic augmented feeds).

References

Aarestrup, F.M. et al. (1997). Antimicrobial susceptibility patterns of thermophilic Campylobacter spp. from humans, pigs, cattle, and broilers in Denmark. *Antimicrob. Agents Chemother.*, 41, 2244-2250.

Agnew, J.M. (2010) Thesis: Odour and greenhouse gas emissions from manure spreading. Department of Agricultural and Bioresource Engineering Thesis (Ph.D.) – University of Saskatchewan.

AHI. (2002). Survey Shows Decline in Antibiotics Use in Animals. Animal Health Institute.

Alexander et al. (2011). Longitudinal characterization of antimicrobial resistance genes in feces shed from cattle fed sub-therapeutic antibiotics. *BMC Microbiol.*, 11, 19.

Aust, M.O. et al. (2008). Distribution of sulfamethazine, chlortetracycline and tylosin in manure and soil of Canadian feedlots after sub-therapeutic use in cattle. *Environ. Pollution.*, 156, 1243-1251

Binkley, A. (2011, March 22). Health Canada's antibiotic resistance plan sits idle. *Ontario Farmer*. pp. 4A.

Bosch, D.J. & Napit, K.B. (1992). Economics of transporting poultry litter to achieve more effective use as fertilizer. *J. Soil Water Conservation.*, 47, 342-346.

Bound, J.P. & Voulvoulis, N. (2004). Pharmaceuticals in the aquatic environment – a comparison of risk assessment strategies. *Chemosphere.*, 56, 1143-1155.

Bush, E.J. et al. (2002). Use of antibiotics and feed additives in weaned market pigs by U.S. pork producers. *Proc. Am. Assoc. Swine Vet. Annu. Meet.*, Kansas City, USA, pp. 329-331.

Canadian Institute for Environmental Law and Policy (Susan Holtz). (2009). Reducing and Phasing Out the Use of Antibiotics and Hormone Growth Promoters in Canadian Agriculture.
Retrieved from: http://www.cielap.org/pdf/AHGPs.pdf

Carlson, J.C. & Mabury, S.A. (2006). Dissipation kinetics and mobility of chlorotetracycline, tylosin, and monensin in an agricultural soil in Northumberland County, Ontario, Canada. *Enviorn. Toxicol. Chem.*, 25, 1-10.

Cessna, A.J. et al. (2010). Veterinary antimicrobials in feedlot manure: dissipation during composting, effects on composting processes and extent in ground water. *J. Environ. Quality*, 40,188-198.

CFA, (2007). Retrieved from: http://www40.statcan.ca/l01/cst01/agri03a-eng.htm

CFIA. (2012) "RG-2 Regulatory Guidance: Feeding of Poultry Manure to Cattle Prohibited." Retrieved from:
http://www.inspection.gc.ca/animals/feeds/regulatory-guidance/rg-2/eng/1328859106165/1328859287377
Last modified: February 10, 2012.

Cogliani, C. et al. (2011). Restricting antimicrobial use in food animals: Lessons from Europe. *Microbe,* 6, 274-279.

Cook, A. et al. (2009). Antimicrobial resistance in *Campylobacter, Salmonella* and *Escherichia coli* isolated from retail turkey meat from Southern Ontario, Canada. *J. Food Protect.*, 72, 473-481.

CSALE. (1996). Expanding intensive livestock operations in Saskatchewan: Environmental and legal constraints. University of Saskatchewan. Retrieved from: http://www.aginfonet.com/agricarta/content/csale/paper3/contents.html

DANMAP. (2009). Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, foods and humans in Denmark. *The Danish Integrated Antimicrobial Resistance Monitoring and Research Programme Report*. ISSN 1600-2032. Retrieved from: http://www.danmap.org

Daughton C.G. & Ternes, T.A. (1999). Pharmaceuticals and personal care products in the environment: Agents of subtle change? *Environ Health Perspect.*, 107, 907-938.

Davies P. et al., (1996). Erythromycin resistance of *Campylobacter* isolates from pigs. *Vet Rec.*, 139, 244.

Dunlop, R.H. et al. (1998). Antimicrobial drug use and related management practices among Ontario swine producers. *Can Vet Jour.*, 39, 87-96.

Environment Canada. (2008). Microbial Source Tracking: New forensic approaches to identify sources of fecal pollution. Retrieved from: http://www.ec.gc.ca/scitech/4B40916E-16D3-4357-97EB-A6DF7005D1B3/MST_En.pdf

Gibbs, S.C. et al., (2006). Isolation of antibiotic-resistant bacteria from the air plume downwind of a swine confined or concentrated animal feeding operation. *Environ. Health Perspect.*, 114, 1032-1037.

Golding, G.R. et al., (2010). Livestock-associated methicillin resistant *Staphylococcus aureus* sequence type 398 in humans. *Canada Emerg Infect Dis.*, 16, 587-594.

Graham, J. et al., (2007). Growth promoting antibiotics in food animal production: An economic analysis. *Public Health Rep.*, 122, 79-87.

Hamscher, G. et al., (2003). Antibiotics in dust originating from a pig-fattening farm: A new source of health hazard for farmers? *Environ. Health Perspect.*, 111,1590-1594.

Harrison, P.F. & Lederberg, J. (eds). (1998). Antimicrobial Resistance: Issues and Options. Washington, DC: National Academy Press.

Health Canada (Advisory Committee on animal uses of antimicrobials and impact on resistance and human health). (2002). Uses of antimicrobials in food animals in Canada: Impact on resistance and human health. Retrieved from: http://publications.gc.ca/collections/collection_2008/hc-sc/H164-68-2002E.pdf

Health Canada. (2003). For Your Information: Antimicrobial Resistance. Retrieved from: http://www.hc-sc.gc.ca/dhp-mps/vet/faq/amr-ram_fyi-pvi-eng.php

Inglis, G.D. et al., (2010). Prolonged survival of *Camphylobacter* species in bovine manure compost. *Appl. Environ. Microbiol.*, 76, 1110-1119.

Jensen, L.B. et al., (2001). Antimicrobial resistance among *Pseudomonas* spp. and the *Bacillus cereus* group isolated from Danish agricultural soil. *Environ. Int.*, 26, 581-587.

Khachatourians, G.G. (1998) Agricultural use of antibiotics and the evolution and transfer of antibiotic-resistant bacteria. *Can. Med. Assoc. J.*, 159, 1129-1136.

Khanna, T. et al., (2008). Methicillin resistant *Staphylococcus aureus* colonization in pigs and pig farmers. *Vet. Microbiol.*, 128, 298-303.

Kumar, K. (2005). Antibiotic uptake by plants from soil fertilized with animal manure. *J. Environ. Qual.*, 34, 2082-2085.

Kirby, D. (2010). *Animal Factory: The Looming Threat of Industrial Pig, Dairy and Poultry Farms to Humans and the Environment*. New York, NY: St. Martin's Press.

Mathew, A.G. et al., (2007). Antibiotic resistance in bacteria associated with food animals: a United States perspective of livestock production. *Foodborne Pathog. Dis.*, 4, 115-133.

Mathew, A.G. (1998). Incidence of antibiotic resistance in fecal *Escherichia coli* isolated from commercial swine farms. *J. Anim. Sci.,* 76, 429-434.

McEwen, S. (2010). Antimicrobial resistance in food animal production. Retrieved from: http://antibioticawareness.ca/wp-content/uploads/downloads/Factsheet_FoodAnimal_en.pdf

McGeer, A. (1998). Agricultural antibiotics and resistance in human pathogens: Villain or scapegoat? *Can. Med. Assoc. J.,* 159, 1119-1120.

Mellon, M. et al., (2001). Hogging It! Estimates of antimicrobial abuse in livestock. Washington, DC: Union of Concerned Scientists. Retrieved from: http://www.ucsusa.org/food_and_environment/antibiotics_and_food/hogging-it-estimates-of-antimicrobial-abuse-in-livestock.html

Miller, G.Y. et al., (2006). Stakeholder position paper: economist's perspectives on antibiotic use in animals. *Prev. Vet. Med.*, 73, 163-168.

Mirzaagha, P. et al., (2011). Distribution and characterization of ampicillin- and tetracycline-resistant *Escherichia coli* from feedlot cattle fed sub-therapeutic antimicrobials. *BMC Microbiol.*, 11, 78.

Moore, Jr., P.A. et al., (1995). Poultry manure management: Environmentally sound options. *J. Soil and Water Cons.*, 50, 321-327.

Pelletier, N. & Tyedmers, P. (2010). Forecasting potential global environmental costs of livestock production 2000-2050. *Nat. Acad. Sci., Proceedings* (USA) 107, 18371-18374.

Phillips, I, et al., (2004). Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data. *J. Antimicrob. Chemother.*, 53, 28-52.

Pomati, F. et al., (2004). Effects of erythromycin, tetracycline and ibuprofen on the growth of *Synechocystis* sp. and Lemna minor. *Aquat. Toxicol.*, 67, 387-396.

Rajić, A. et al., (2006). Reported antibiotic use in 90 swine farms in Alberta. *Can. Vet. J.*, 47, 446-452.

Reuter, T. et al., (2011). Viability of *Bacillus licheniformis* and *Bacillus thuringiensis* spores as a model for predicting the fate of Bacillus anthracis spores during composting of livestock mortalities. *Appl. Environ. Microbiol.*, 77, 1588-1592.

Rule, A.M. et al., (2008). Food animal transport: A potential source of community exposure to health hazards from industrial farming (CAFOs). *J. Infection and Public Health*, 1, 33-39.

Russell, J. (2010). Antibiotics: Resistance and residues. Lean Trimmings Prime, *US National Meat Assoc. Magazine*, Summer 2010 pp.11-12.

Shlaes, D.M. et al., (2004). Antibiotic discovery: State of the state. *Amer. Soc. Microbiology News*. 70, 275-281.

Spellberg, B. et al., (2008). The epidemic of antibiotic-resistant infections: A call to action for the medical community from the Infectious Disease Society of America. *Clin. Infect. Dis.*, 46, 155-164.

Stine, O.C. et al., (2007). Widespread distribution of tetracycline resistance genes in a confined animal feeding facility. *Int. J. Antimicrob. Agents*, 29, 348-352.

Sunde M., & Sorum, H. (1999). Characterization of integrons in *Escherichia coli* of the normal intestinal flora of swine. *Microb. Drug Resist.*, 5, 279-287.

Thomas, K.V. & Hilton,M.J. (2004). The occurrence of selected human pharmaceutical compounds in UK estuaries. *Mar. Pollut. Bull.,* 49, 436-44.

Vidovic, S. & Korber, D.R. (2006). Prevalence of *Escherichia coli* O157 in Saskatchewan cattle: Characterization of isolates by using random amplified polymorphic DNA PCR, antibiotic resistance profiles, and pathogenicity determinants. *Appl. Environ. Microbiol.*, 72, 4347-4355.

Vogel, L. (2011). (News) CMA urges prescription-only antibiotics for agricultural use. CMAJ. 183, no. 13.

Waiser, M.J. et al., (2010). Effluent-dominated streams. Part 2: Presence and possible effects of pharmaceuticals and personal care products in Wascana Creek, Saskatchewan, Canada. *Environ. Toxicol. Chem.*, 30, 508-519.

Witte, W. (1998). Medical consequences of antibiotic use in agriculture. *Science* 279, 996-997.

World Health Organization (WHO). (1997). The medical impact of the use of antimicrobials in food animals. WHO/EMC/ZOO/97.4. Berlin, Germany; October 13-17.

World Health Organization (WHO). (2000). Retrieved from: http://www.who.int/infectious-disease-report/2000/

World Health Organization (WHO). (2002). Impacts of antimicrobial growth promoter termination in Denmark. In: International Invitational Symposium: Beyond Antimicrobial Growth Promoters in Food Animal Production. Panel wir (ed). WHO Department of Communicable Diseases, Prevention and Eradication: Foulum, Denmark.

World Health Organization, (2003). Emerging issues in water and infectious disease. Geneva, World Health Organization.

Pathogens and Public Health

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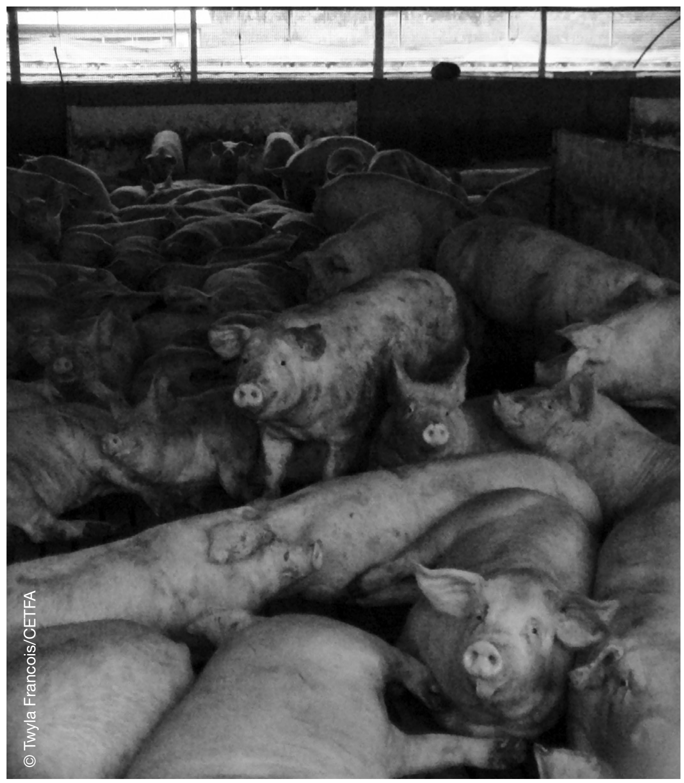
ILOs are of concern for human health because the crowded and stressful conditions – the industrial pig crates, battery cages and confined feeding facilities – under which the animals and poultry are housed breed pathogens. Many of these disease-causing agents (which are now increasingly resistant to therapeutic drugs) can have serious consequences for humans, other livestock, pets and wildlife. All known groups of animal pathogens have been reported within the intensive livestock industry in Canada.

Diseases which can circulate between animal vertebrates and humans are called zoonoses. More than 500 different infectious agents (viruses, bacteria, fungi, protozoa, multi-cellular parasites and insects, as well as certain known prion proteins (e.g. bovine spongiform encephalopathy (BSE) and new variant Creutzfeldt-Jakob disease (nvCJD) can be transmitted to humans from animals. This number is continually mounting as new strains of pathogens emerge and organisms previously known to cause disease in animals are shown to have the potential for cross-infecting humans.

Routes of infection are various: entry through cuts, scratches or mucosa, ingestion of contaminated food and drinking water, inhalation, and injection through insect and animal bites and needle sticks.



A crowded and filthy pig finishing barn in Ontario.

Pathogens

Prions

Prions are infective agents which consist of abnormally folded protein. Prions are resistant to most agents that generally inactivate other pathogens (and are therefore indestructible under processing or adverse environmental conditions) and they somehow stimulate surrounding proteins in exposed animals to adopt abnormal shapes. The latency period for prions are long and can be up to several decades, making containment difficult since infection can be spread asymptomatically and the outcome is without exception eventually fatal. Prions are believed to be the infectious agent in BSE, a fatal neurodegenerative disease in cattle. While cattle are the best known hosts, pigs and chickens may also become infected, but are likely slaughtered before any symptoms become apparent (Pearce, 1996). In the 1990s BSE was identified in cattle imported from the United Kingdom into Canada (Chen et al., 1996); cases were then found in Alberta and Manitoba.

The consumption of the meat of infected animals is associated with Creutzfeldt-Jacob disease (CJD) in humans (Will, 1999), and now occurs as an even more lethal human variant (Patterson and Painter, 1999).

Processed feed contaminated with infected animal tissues is the primary cause of BSE outbreaks in livestock. Thus ensuing ruminant (e.g. cattle, sheep, goats) feed bans were followed by a decline, but not eradication, of the epidemic in cattle (Pattison, 1998). In Europe, BSE cases have continued to arise in cattle despite the meat and bone meal bans in ruminant feed. Increased BSE occurrences in cattle have been consistently correlated with areas of high pig density (e.g. Abrial et al., 2005) through cross-contamination from feed destined for non-ruminant animals, which continued to present a risk. According to Schwermer et al. (2002), in Switzerland "[p]ig density is considered an indicator for the probability of contamination of cattle feed with feed containing meat and bone meal that is intended for other species..". In Germany, "[t]here was a clear indication that the occurrence of BSE was associated with the presence of pigs and/or poultry on the farm" (Pottgiesser et al., 2006). In Canada, contaminated pet food may also have been a contributory factor (Yo, 2006). Since BSE can remain infective through a number of standard meat and bone meal processing methods (Taylor et al., 1995), products of animal origin, including by-products of rendering plants, such as animal meal, blood meal, bone meal, and gelatin may potentially harbor BSE (Hahn, 1999).

> "In Europe, BSE cases have continued to arise in cattle despite the meat and bone meal bans in ruminant feed. Increased BSE occurrences in cattle have been consistently correlated with areas of high pig density through cross-contamination from feed destined for non-ruminant animals…"

Matthews and Cooke (2003) have raised the possibility of other transmissible spongiform encephalopathies (TSEs) in pigs and Kofler et al. (2006) suggest that

TSEs might be transmissible to pigs through feed. Johnson et al. (2006) have shown that prions adsorb to soil particles and thus burial of infected carcasses may introduce prions into the environment that remain infective and create reservoirs which initiate and perpetuate disease in both livestock and wildlife.

Viruses

Viruses are infectious agents that consist of nucleic acid enclosed in a protein capsid, and require living host cells to reproduce, but may remain infective in the environment for extended periods. Viruses, shed as a result of infection or vaccination, are abundant in manure (Haas et al., 1995). Animal products including processed meat may also harbour viruses; for example, the hog cholera virus can survive in sausage products for at least two months (Panina et al., 1992). Viruses can mutate at rapid rates, and human and animal varieties can recombine to yield highly infectious human strains. ILOs facilitate large-scale viral incubation and genetic reassortment (Meulemans, 1999) that may lead to new varieties of influenza (Lekcharoensuk et al., 2006) and initiate human flu pandemics (Ludwig et al., 1995). Both influenza A and C have been demonstrated to be transferable between pigs and humans (Kimura et al., 1997). Numerous cases of transmission of swine influenza to humans have been reported, including barn workers (Myers et al., 2006) and farm family members, farm residents and people who entered the hog barn (Olsen et al., 2002), as well as swine veterinarians and meat processing workers (Myers et al., 2006). Even strains of influenza which originate in species other than pigs, may undergo modification in the latter, so that they become infective for humans. Avian influenza virus, for example, likely was transmitted from poultry to pigs, and then to humans (Webster et al., 1995).

Other viruses that may be transferred from livestock to humans include rabies (Pip, 2000) and rotavirus enteritis, which has been documented in Canadian swine herds (Wilson et al., 1999). Hepatitis E virus can be transmitted to humans from swine (Yazaki et al., 2003; Worm et al., 2002; Gerba and Smith 2005) and is capable of producing novel variants (Yoo et al., 2001). It was reported that hepatitis E "is highly prevalent in commercial swine populations in Canada", with a sero-prevalence (i.e. the number of animals in a population that tested positive based on blood serum) specimens, that has approached 90 percent in Quebec herds.

Bacteria

A large number of pathogenic bacteria may be transmitted from livestock to humans. *Escherichia coli*, is ubiquitous in animal and human waste and may cause illness through propagation of the bacteria themselves or through their toxins (Moxley and Duhamel, 1999). Among Ontario swine, *E. coli* enteritis (Hamburger disease) was cited as the most common infectious enteric disease (Wilson et al., 1999). In southeastern Manitoba, *E. coli* concentrations in streams adjacent to a hog and poultry operation were found to spike after field application of manure and after precipitation events (Pip and Reinisch, 2011). In Walkerton, Ontario, *E. coli* 0157:H7, a particularly toxigenic strain, was found in the water supply that had been contaminated with cattle manure causing fatal human hemolytic uremic syndrome (Guan and Holley, 2003). Seven people died and more than 2,300 fell ill as a result of the outbreak (O'Connor, 2002). *E. coli* 0157:H7 has been shown to survive at least 100 days in frozen bovine manure at -20°C (Kudva et al., 1998).

■ ***E. coli* found in the water supply of Walkerton, Ontaio was linked to manure from a nearby farm.**

Salmonella strains also occur at Canadian livestock and slaughterhouse facilities and produce diarrhoea and food poisoning symptoms (Wilson et al., 1999). These bacteria may survive more than a month in warm manure pits (Plym-Forshell, 1995). *Yersinia enterocolitica* causes yersiniosis in humans, a serious enteric illness that may be misdiagnosed as appendicitis. Japan has reported this pathogen in pork imported from Canada (Fukushima et al., 1997). In Quebec, environmental contamination by this organism was shown to come from hog farms (Pilon et al., 2000). In 1998 alone, more than 7,000 Canadians suffered from salmonellosis (Health Canada, 2002).

Campylobacter coli has shown increasing trends of human infection in intensive livestock regions in Europe (Nielsen et al., 1997) and outbreaks traced to manure contamination have occurred in Canada as well (Guan and Holley, 2003). Contact with water contaminated with *Pseudomonas aeruginosa* can produce a wide range of human illnesses including respiratory, eye, ear and skin infections. De Freitas et al. (2003) found *Pseudomonas* to be the dominant bacterial species in soils receiving hog manure in eastern Saskatchewan.

Contamination with *Listeria monocytogenes*, which has been responsible for a number of Canadian deaths (Wilson and Keelan, 2008), is widespread in manure as well as dairy products, and cooked and raw meat products sold in Canada (McKellar et al., 1994). This bacterium may be spread from carcasses to processing equipment (Gill and Jones, 1995). Inadequately cleaned equipment has been the cause of several massive processed meat recalls in Canada during recent years.

In cattle, bovine tuberculosis caused by *Mycobacterium* remains a concern because it can infect humans, where it may manifest decades after the initial infection (Grange and Yates, 1994). It may be transferred to pigs, deer and bison (O'Reilly and Daborn, 1995) and is currently a concern in elk in Riding Mountain National Park in Manitoba. Outbreaks have occurred in Canadian cattle herds (Munro et al., 1999). Farm and slaughterhouse workers may develop pulmonary disease from exposure to this pathogen (O'Reilly and Daborn, 1995). Anthrax (*Bacillus anthracis*) has caused periodic outbreaks in cattle, for example in Saskatchewan (Heath and Brewitt, 1982) and in 2000 at a number of cattle farms in southeastern Manitoba. Intensive swine operations may also be susceptible to anthrax (Redmond et al. 1997).

According to Paradis et al. (2007), *Lawsonia intracellularis* "appears to be widespread in Canada", as are *Aeromonas* spp. in Canadian slaughterhouses (Gill and Jones, 1995; Borch et al., 1996). Other bacterial pathogens that have been reported in livestock and animal products include *Shigella* spp. (Ueda et al., 1963), and *Arcobacter* spp. (Harvey et al., 1999). *Helicobacter pylori*, which causes duodenal ulcers in humans, has been isolated from pigs and calves (Seidel et al., 1996). The potential human pathogens *Rahnella*, *Serratia*, *Leclercia* and *Proteus* were identified in a Saskatchewan field receiving cattle manure (de Freitas et al., 2003).

Protozoa

Parasitic protozoa are a public health concern because they may cause severe illness or death, and their cysts are resistant to chlorination of drinking water supplies. *Cryptosporidium parvum* was first described in 1955 and was considered to be limited to poultry and assuredly of no risk to human health, until in 1976 it was found to be transmissible to humans as well (Nadakavukaren, 2000). Livestock manures are a significant potential source of *Cryptosporidium* infection; unfortunately infected livestock may not show symptoms; indeed infection rates may be higher in non-diarrheic pigs than in diarrheic ones (Quilez et al., 1996). Cattle manure presents a particularly elevated risk of *Cryptosporidium* contamination of watersheds where cattle operations located near waterways or in areas with a high risk of inundation (Graczyk et al., 2000). In Canada, *Cryptosporidium* as well as *Giardia* (which causes giardiasis or beaver fever) appear to be prevalent in Canadian farm livestock (Olson et al., 1997; Faubert and Litvinsky, 2000; O'Handley et al., 2000; Olson and Guselle, 2000), and these organisms have been identified in a number of Canadian drinking water supplies. Survival times in manure and the environment are greater at cold temperatures (Guan and Holley, 2003).

Like many protozoan infections, the cosmopolitan *Entamoeba polecki* is asymptomatic in swine but may infect humans (Soalymani-Mahammadi and Petri, 2006). Two species of *Sarcocystis* are thus far reported to infect humans: *S. hominis*, which is associated with consumption of contaminated raw beef and produces gastrointestinal distress, and *S. suihominis*, which produces more severe but similar symptoms and is transmitted to humans through consumption of undercooked contaminated pork. It has appeared in pigs and humans in Europe (Solaymani-Mahammadi and Petri, 2006) and Japan (Saito et al., 1998). *Blastocystis hominis* has been reported in pigs worldwide, with a large array of zoonotic hosts (Olson and Guselle, 2000), and potential pig-to-human transmission (see Solaymani-Mahammadi and Petri, 2006). A human infection with the parasitic ciliate *Balantidium coli* was traced to exposure to infected pig manure in Manitoba (CH, 1999).

Helminthic Parasites

Helminthic parasite infections in livestock and humans may be caused by nematodes (roundworms) or flatworms (tapeworms and flukes). *Ascaris lumbricoides/suum* is a large (up to 40 cm long) roundworm which lives in the intestines of people and hogs. It can cause severe illness (ascariasis), because generally a number of worms are present, and in extreme cases intestinal obstruction may occur. Pancreatitis is a frequent indicator (Chen and Li, 1994). Cross-transmission between pigs and humans may occur; while *A. lumbricoides* and *A. suum* were once thought to be distinct species, they are now regarded as ecotypes (Maruyama et al., 1997).

In a Saskatchewan pig barn, egg development was found to be considerably extended at cooler temperatures in fall, winter and early spring (Wagner and Polley, 1999). Outdoors, *Ascaris* eggs (as well as of another nematode pig parasite, *Trichuris suis*) survived longer during cold weather months, and eggs buried in soil survived longer than those exposed on the surface (Larsen and Roepstorff, 1999). *Ascaris eggs*, as well as cysts of the protozoans *Giardia* and *Cryptosporidium* may contaminate fruits and vegetables via manure fertilizer (Robertson and Gjerde, 2000). Wagner and Polley (1997) found that almost half of market hogs in a Saskatchewan survey were infected, while an Alberta survey found that 60 percent of hog farms yielded this parasite.

The nematode *Trichinella spiralis* appears to be transmitted exclusively through handling and consumption of contaminated pork products (Gamble, 1997) which contain the encysted parasite. Human trichinosis is a global problem, but is most prevalent in areas where pork consumption is high (Taratuto and Venturiello, 1997). The illness may be fatal. Often misdiagnosed as influenza, it may be introduced to new areas through importation of animal products (Dupouy-Camet, 2000). While Canada has been relatively free of *Trichinella*, sporadic outbreaks in domestic swine and wild boar have been reported in Nova Scotia and Ontario (Greenbloom et al., 1997; Appleyard and Gajadhar, 2000). The parasite may circulate in wildlife (Dupouy-Camet, 2000; Appleyard and Gajadhar, 2000). *Trichinella spiralis nativa* from various areas of Canada have shown high infectivity rates for carnivores (Smith, 1985); the latter author also found that the parasite could appear in the manure of hogs exposed to the parasite, even if they did not actually develop infections. Human infections by other related pig-borne nematode parasites not previously thought to infect humans have now been discovered, e.g. *Trichinella pseudospiralis* (Jongwutiwes et al., 1998; Geerts et al., 2002) and *T. papuae* (Geerts et al., 2002).

The pork tapeworm, *Taenia solium*, and the beef tapeworm, *Taenia saginata*, have complex life cycles which involve an intermediate and a definitive host. Consumption of undercooked meat containing *cysticerci* (encysted larvae) results in development of the adult tapeworm in the human intestine (taeniasis), which produces eggs that are shed in the host's feces. Consumption of eggs of the pork tapeworm [but not the beef tapeworm (Galan-Puchades and Fuentes, 2000)], as for example in food or water contaminated by manure, results in development of *cysticerci* at various sites in the body (cysticercosis). Cysticercosis has been reported in Canadian feedlot cattle (Borman-Eby et al., 1994). If *cysticerci* develop in humans from ingestion of eggs, their impact on health depends on their location: those situated in a vital area or organ may present the potential for serious dysfunction. Pork tapeworm cysticerci in the brain cause neurocysticercosis, which may lead to epileptic seizures (Wandra et al., 2000). Pork tapeworm *neurocysticerci* have also been associated with human brain tumors and blood cancers (Herrera et al., 2000). According to Hawk et al. (2005), "In North America, the largest number of neurosurgical cases stemming from parasitic infections involves the larval form of *Taenia solium*." Taeniid eggs have been shown to travel substantial distances once released to the environment (Torgerson et al., 1995).

Fungi

Fungal spores and toxins inhaled by industry workers can cause respiratory illnesses. Toxigenic species of *Aspergillus* and *Penicillium* may contaminate animal feed as well as the final pork products (Hohler, 1998). *Aspergillus* may colonize the lungs and cause potentially fatal aspergillosis. Among the toxins, Ochratoxin A is "nephrotoxic, hepatotoxic, teratogenic, carcinogenic and immunosuppressive" (Hohler, 1998) and has been reported in human blood in Manitoba (Frohlich et al., 1991) with "two possible points of entry [being] contaminated grain and pork products."

Pathogen Transfer

Pathogens can be transmitted in various ways. Infection may result from contact with affected animals through cuts and scratches, bites, needle sticks, and inhalation of aerosols and dusts. Spreading and dumping of manure, and sludge from slaughterhouses and processing plants, which contains both excreta and body fluids and tissues, may contaminate air, surface and ground water, cropland and landfills. Wide-ranging wildlife such as migratory birds may carry pathogens great distances and introduce them to new domestic and industrial animal contexts, as may long-distance hauling of live animals, carcasses and manure. Collateral contact with livestock and waste by insects and household pets may further enable re-inoculation and propagation (Khachatourians, 1998).

Pathogens may persist in the raw and processed food products and rendered by-products, while manure application may contaminate non-animal products such as vegetables (Guan and Holley, 2003). Freezing does not kill most pathogens. Thus exposure routes are many and various: direct contact with infected animals and animal products, exposure to manure, lagoons, spread fields, composting and landfill sites, contaminated clothing and equipment, transport routes and vehicles, meat-packing plant waste, contaminated water, contaminated human food and contaminated animal feed. Many of these pathogens can recycle for extended periods on farms and in the environment, creating endemics in animal herds and poultry flocks, and also endangering farm workers, neighbours and wildlife. Pathogens can be further disseminated from rural to urban communities, with the potential for global reach, through commuters and travellers, and international trade in contaminated animal products. With the expansion of global markets, the contemporary ease of travel, and the inability to inspect all products for all pathogens, it is now possible to transport quickly a wide variety of diseases to areas where they were not previously present. An example of this is *Sarcocystis suihominis*, a parasite of pigs and people transmitted to humans through undercooked pork consumption, which has been found in Japan where it had been formerly unknown (Saito et al., 1998). Thus the potential is great that as intensive global animal production expands, new pathogens will inevitably gain entry into Canada.

Occupational Risks

Workers at ILOs as well as in the animal transport, meat packing and animal product industries are the most at risk of becoming infected or becoming carriers from direct exposure to animal pathogens. Livestock and poultry with subclinical infections can appear healthy, yet may be carrying or shedding infectious agents.

Limited air circulation or ventilation in confined ILOs and continuous contact with waste allow unrestricted circulation of pathogens. Handling, medication, manipulation of equipment engendering fear and pain, and veterinary procedures on terrified animals are associated with significant risks of injury and infection in workers. The possibility for farm worker exposure to zoonotic pathogens increases when sick animals are not identified and segregated, when dying animals and carcasses are not promptly removed and destroyed, and when facilities and equipment are not adequately cleaned. Since mechanization at ILOs tends to result in fewer workers than on traditional family farms, sick and dying animals may be more easily overlooked in the crowded and dark, confined conditions.

Thu et al. (1998) have concluded that the ILO model may not be as profitable when occupational health impacts and costs are considered. In addition to risks from exposure to pathogens, industry workers are prone to numerous other health risks. Types of human health problems associated with livestock production come from direct physical contact such as allergic contact dermatitis, allergic rhinitis, chronic bronchitis and asthma, bites, and traumatic injury inflicted by animals or accidents involving falls and equipment such as restraints and electric prods. Other health problems include drug sensitivities and allergies, food-borne illnesses, 'Farmer's lung', hypersensitivity pneumonitis, mucous membrane irritation, organic dust toxic syndrome (ODTS), and exposure to ectoparasites. The closed environments of buildings concentrate particulate dust, micro-organisms, bacterial endotoxins and fungal mycotoxins, urine and feces, blood, saliva, mucus, milk and amniotic fluids, vomit, and residues from feed or animal and bird bodies. These materials are aerosolized and then inhaled. Approximately 33 percent of swine confinement workers in the US were reported to suffer from ODTS (Thorne et al., 1996). At some operations, workers may either not have access to adequate protective clothing and face masks, or do not use them because they are too restrictive.

The health impacts of exposure to swine odour are both psychological and physical (Schiffman et al., 1998). Anaerobic decomposition of liquid manure may generate nearly 400 volatile organic compounds (Halverson, 2000). Hydrogen sulphide, ammonia, carbon dioxide, methane and carbon monoxide are present in high concentrations in barns. Acute poisoning from hydrogen sulphide gas released from manure storage facilities can cause sudden loss of consciousness ('knockdown') and fatalities. In September 1998, three Saskatchewan workers were killed after being overcome by gas in a manure truck holding tank and another was seriously injured while trying to rescue them (Saskatchewan Labour, 1998). Similarly a number of workers have died on Hutterite colony farms in Manitoba in the 1990s while cleaning out hog manure tanks, and when co-workers attempted their rescues.

Phosphine gas is released during anaerobic fermentation of manure (Eismann et al., 1997). According to Glindemann and Bergmann (1995), "pig slurry generates about one magnitude more [phosphine] than cattle slurry" and fresh fecal slurry generates the highest concentrations. This gas is extremely toxic, and is also used as a fumigant of grain and feed.

■ **OPP Constable guards a manure tank after fumes killed farm workers outside Drayton, Ontario in August 2000. They were believed to have inhaled methane gas after climbing into a nearly empty tank to repair a faulty part.**

Other risks include various organic insecticidal fumigants used in ILOs, which can lead to severe illness or death. Barn disinfectants, antiseptics and surfactants can cause lung, skin and eye irritation. Toxic antifungal paints and wood preservatives such as pentachlorophenol used in wooden feed storage bins are known carcinogens. All of these substances may be inhaled, absorbed through skin, or contaminate food.

Environment and Public Health

Irresponsible manure composting, storage, handling and application or disposal can contribute to human health problems associated with odour and toxic gases (Jenkinson, 2001), as well as pathogen escape and microbial and parasitic contamination of food. Application of manure near water bodies provides a ready source of pathogen contamination (Pip and Reinsich, 2011). Spring meltwater (particularly when manure is applied in winter to snow or frozen soil), flooding and any excessive rainfall or runoff from animal manures further promotes pathogen escape and transport (Pip and Reinsich, 2011).

Animal vaccines containing live attenuated viruses cause subsequent prolonged shedding of virus particles which can remain viable in the environment under favourable conditions (Kida, 1997), where they can contaminate water supplies and crops. Additional issues relate to the presence of heavy metals, salts, and hormones and growth promoters in ILO waste (see Pip, 2000), which can enter surface and ground water (Kolpin et al., 1999; Pip and Reinisch, 2011) and affect drinking and irrigation water supplies far from the original source. Foreign objects such as used syringes, gloves and animal tissues and body fluids may also be applied onto crops with the waste. In Manitoba at a number of Hutterite colonies, hog manure storage lagoons receive human waste as well.

Each year, a number of barn fires, ventilation failures, or disease epidemics result in the death or destruction of thousands of animals at the affected operations. Such mass mortalities present overwhelming disposal and health safety problems. Diseased carcasses are burned and buried in shallow earthen pits; others are simply bulldozed into piles, covered with some soil and composted. Such events create great risks for water contamination through leaching, and pathogen escape via scavengers.

Nitrate is the most often detected pollutant of groundwater in agricultural areas (Keeney, 1987), where it may lead to closure of water wells (see Pip, 2000). In contaminated drinking water, nitrate may present a serious threat to health: nitrate and its interconversion product, nitrite, are associated with methemoglobinemia (particularly in infants and children up to eight years in age), pathologic changes in bronchi and lung parenchyma, recurrent respiratory tract infections, changes in thyroid volume, and gastric cancer, and has been linked with non-Hodgkin's lymphoma and spontaneous abortion, as well as behavioural effects (see Pip, 2000).

Under conditions of excess soil nitrate, crops may bioaccumulate nitrogen, which may render the crop toxic. In forages, soil nitrate may lead to production of cyanide compounds in the feed, causing nitrate toxicosis in livestock that may be fatal (see Pip, 2000). Certain crops destined for human consumption (e.g. spinach, beets, celery, lettuce, radishes) may bioaccumulate nitrogen to levels that present risks to human health. A number of vegetable recalls have occurred in Canada in recent years for this reason (Health Canada, unpublished data).

Excessive application rates, application on slopes, or application near bodies of water can lead to surface runoff and eutrophication through phosphorus and nitrogen escape, creating the potential for toxic and potentially lethal cyanobacterial blooms in surface water (see Pip, 2000), rendering drinking water sources unusable for extended periods of time.

Food-borne Pathogens

Food and water-borne infections, disease, and illness may have single or multiple microbial causes. Ingested prions, fungi, bacteria, viruses and parasites can be responsible for human illness, with short or prolonged latency periods after exposure, and people may have food/water-borne illness without recognizing it or attributing it to a specific source. If illness is severe enough for medical care to be sought, physicians often misdiagnose (the classic '24-hour bug'), and may even institute a wrong or harmful treatment (e.g. antibiotics for a viral infection). Despite the difficulty of evaluating the full extent of economic and health costs related to these illnesses, Health Canada estimates that the current annual cost related to food-borne illnesses, and related deaths, is between $12 and 14 billion involving between 11 and 13 million Canadians (Canadian Partnership for Consumer Food Safety Education).

Our trade in food supply has global reach, with many international sources contributing to the potential for pathogen exposure and exchange. The risk increases if the food is stored too long or at improper temperatures, undercooked or improperly handled after cooking (e.g. Cook et al., 2009). A number of bacteria (e.g. *E. coli*, *Salmonella*, *Campylobacter*, *Yersinia*) are found in food animals that are deemed healthy but present a contamination risk when the animal is butchered and processed.

The source of pathogenic micro-organisms in food products can be quite varied as contamination can occur at any point in the chain of custody from producer to consumer, including the farm (e.g. manure contamination, using rendered animals as feed), transport vehicle, abattoir, processing plant, packaging and shipping facility, retailer, as well as premises where food is stored, handled, prepared and served. Some pathogens survive food processing protocols, and organisms may cross-contaminate other foods prepared or stored at the same location.

Proper sanitation and hygienic measures throughout the chain of custody, as well as monitoring and enforcement of regulations pertaining to domestic food quality standards and international food trade are critical in the control of food-borne illnesses. Education of food industry workers and consumers in safe food handling practices is also essential. 'Standard' practices used in ILOs (e.g. crowding, poor sanitation, manure management techniques) must undergo a drastic overhaul, and contamination risks to drinking water supplies must be more stringently monitored and enforced.

Policy Recommendations

- Provincial governments should set standards on ILO manure handling/spreading (e.g. injection as opposed to spraying; no winter manure spreading), create the administrative means for compliance and impose stricter penalties for infractions.
- All levels of government should improve overall monitoring and enforcement, whether dealing with food pathogens, manure spreading, or disposal or waste.
- The federal government should boost the presence of the CFIA, meat inspectors and veterinarians at processing plants to ensure greater enforcement of regulations.
- Federal and provincial governments should review what constitutes 'standard practices' in the ILO and meat packing industry to reduce pathogen spread in the light of current knowledge of the link between animal health and animal welfare.
- The CFIA should monitor food products for a wider array of pathogens.
- The federal government should create legislation for labour standards involving food animal workers in monitoring, surveillance and enforcement of public health/environmental safety through measures such as accreditation and certification.
- Workplace safety standards at ILOs should be enforced via unannounced visits.
- Provincial governments should monitor downstream water quality from ILOs (above a set threshold limit) on a regular basis and make it mandatory for large operations to have monitoring wells. The results should be accessible to the public.
- Protect the environment and wildlife through more stringent and enforced rules and regulations regarding intensive animal production (e.g. banning direct access of cattle to streams and watercourses, mandatory buffers for residences, shielding of lagoons with straw to deter waterfowl landings and pathogen spread).
- Provincial governments should stringently monitor water use by ILO facilities to ensure that groundwater/surface water depletion does not adversely affect other users.
- Provincial governments should establish a 24-hour hotline for the public to report apparent problems. A separate office should be established to deal uniformly with these incidents involving ILOs in each province.
- Local residents must have recognized input into the licensing and approval process for ILOs.

References

Abrial D., Calavas D., Jarrige N., & Ducrot C. (2005). Poultry, pig and the risk of BSE following the feed ban in France – a spatial analysis. *Vet. Res*., 3 6, 615-628.

Appleyard G.D., & Gajadhar, A.A. (2000). A review of trichinellosis in people and wildlife in Canada. *Can. J. Public Health*, 91, 293-297.

Borch, E., Nesbakken T., & Christensen, H. (1996). Hazard identification in swine slaughter with respect to foodborne bacteria. *Int. J. Food Microbiol.*, 30, 9-25.

Borman-Eby H.A.C., Ayim D.S., & Small C. (1994). *Cysticercus bovis* in cattle in two Beef feedlots in southern Ontario. *Can. Vet. J.*, 35, 711-713.

Canadian Partnership for Consumer Food Safety Education. Food Safety Tips: Factsheet. Cambridge, ON. Retrieved from: www.canfightbac.org/cpcfse/en/safety/safety_factsheets/foodborne_illness/

CH. (1999). Citizens' Hearing on Pork Production and the Environment. Brandon, Manitoba. October, 1999.

Chen D., Li X. (1994). Forty-two patients with acute *ascaris pancreatitis* in China. *J. Gastroenterol*, 29, 676-678.

Chen S.S., Charlton K.M., Balachandran A.V., O'Connor B.P., & Jenson C.C. (1996). Bovine spongiform encephalopathy identified in a cow imported to Canada from the United Kingdom – a case report. *Can. Vet. J.*, 37, 38-40.

De Freitas J.R., Schoenau J.J., Boyetchko S.M., & Cyrenne S.A. (2003). Soil microbial populations, community composition, and activity as affected by repeated applications of hog and cattle manure in eastern Saskatchewan. *Can. J. Microbiol.*, 49, 538-548.

Dupouy-Camet J. (2000). Trichinellosis: a worldwide zoonosis. *Vet. Parasitol*, 93, 191 200.

Eismann F., Glindemann D., Bergmann A., & Kuschk P. (1997). Balancing phosphine in Manure fermentation. *J. Environ. Sci. Health B*, 32, 955-968.

Faubert G.M., & Litvinsky Y. (2000). Natural transmission of Cryptosporidium parvum between dams and calves on a dairy farm. *J. Parasitol*, 86, 495-500.

Frohlich A.A., Marquardt R.R., & Ominski, K.H. (1991). Ochratoxin A as a contaminant in the human food chain: a Canadian perspective. *IARC Sci. Publ.*, No. 115: 139-143.

Fukushima H., Hoshina K., Itogawa H., & Gomyoda M. (1997). Introduction into Japan of pathogenic Yersinia through imported pork, beef and fowl. *Int. J. Food Microbiol.*, 35, 205-212.

Gajadhar, A.A. Aramini J.J., Tiffin G., & Bisaillon J.R. (1998). Prevalence of *Toxoplasma gondii* in Canadian market-age pigs. *J. Parasitol*, 84, 759-763.

Galan-Puchades M.T., & Fuentes M.V. (2000). The Asian Taenia and the possibility of cysticercosis. *Korean J. Parasitol*, 38, 1-7.

Glindemann D., & Bergmann A. (1995). Spontaneous emission of phosphine from animal slurry treatment processing. *Zentralbl. Hyg. Umweltmed*,198, 49-56.

Grange J.M., & Yates M.D. (1994). Zoonotic aspects of Mycobacterium bovis infection. *Vet. Microbiol.*, 40, 137-151.

Greenbloom S.L., Martin-Smith P., Isaacs S., Marshall B., Kittle D.C., Kain K.C., & Keystone, J.S. (1997). Outbreak of trichinosis in Ontario secondary to Ingestion of wild boar meat. *Can. J. Public Health*, 88, 52-56.

Haas B., Ahl R., Bohm R., & Strauch D. (1995). Inactivation of viruses in liquid manure. *Rev. Sci.Tech.*, 14, 435-445.

Hahn H. (1999). Animal meal: production and determination in feedstuffs and the origin of bovine spongiform encephalopathy. *Naturwissenschaften*, 86, 62-70.

Harvey R.B., Anderson R.C., Young C.R., Hume M.E., Genovese K.J., Ziprin R.L., ... Ostrosky-Wegman, P. (2000). Possible association between *Taenia solium cysticercosis* and cancer: increased frequency of DNA damage in Peripheral lymphocytes from neurocysticercosis patients. *Trans R Soc Trop Med Hyg.*, 94, 61-65.

Hawk, M.W., Shahlaie, K., Kim, K.D., & Theis, J.H. (2005). *Neurocysticercosis*: a review. *Surg. Neurol.*, 63, 123-132.

Health Canada. (2002). Uses of Antimicrobials in Food Animals in Canada: Impact on Resistance and Human Health. Retrieved from: www.hc-sc.gc.ca/dhp-mps/pubs/vet/amr-ram_final_report-rapport_06-27_cp-pc-eng.php#a2

Gamble H.R. (1997). Parasites associated with pork and pork products. *Rev. Sci. Tech.*, 16, 496-506.

Geerts S., de Borchgrave J., Dorny P., & Brandt, J. (2002). *Trichinellosis*: old facts and new developments. *Verh. K. Acad. Geneeskd. Belg.*, 64, 233-248.

Gill C.O., & Jones T. (1995). The presence of *Aeromonas*, *Listeria* and *Yersinia* in carcass processing equipment at two pig slaughtering plants. *Food Microbiol.*, 12, 135-141.

Graczyk, T.K., Evans, B.M., Shiff, C.J., Karreman, H.J., & Patz, J.A. (2000). Environmental and geographical factors contributing to watershed contamination with Cryptosporidium parvum oocysts. *Environ. Res.*, 82, 263-271.

Guan, T.Y., & Holley, R.A. (2003). Pathogen survival in swine manure environments and transmission of human enteric illness- a review. *J. Environ. Qual.*, 32, 383-392.

Halverson, M. (2000). The Price We Pay for Corporate Hogs. U.S. Institute for Agriculture and Trade Policy, Minneapolis, MN.

Heath, K.B., & Brewitt, J.M. (1982). A winter outbreak of anthrax in cattle in Saskatchewan. *Can Vet. J.*, 23, 302-303.

Hohler, D. (1998). Ochratoxin A in food and feed: occurrence, legislation and mode of action. *Z. Ernahrungswiss*, 37, 2-12.

Johnson, C.J., Phillips, K.E., Schramm, P.T., McKenzie, D., & Aiken, J.M. (2006). Prions adhere to soil minerals and remain infectious. *PLoS Pathog*. 2(4): e32. doi: 10:1371/journal.ppat.0020032

Jongwutiwes, S., Chantachum, N., Kraivichian, P., Siriyasatien, P., Putaporntip, C., Tamburrini, A., Pozio, E. (1998). First outbreak of human trichinellosis caused by *Trichinella pseudospiralis*. *Clin. Infect. Dis.*, 26, 111-115.

Keeney, D.R. (1987). Sources of nitrate to groundwater. *CRC Crit. Rev. Environ. Contam.*, 10, 257-304.

Kida, H. (1997). Ecology of influenza viruses in animals and the mechanism of emergence of new pandemic strains. *Nippon Rinsho*, 55, 2521-2526.

Kimura, H., Abiko, C., Peng, G., Muraki, Y., Sugawara, K., Hongo, S., … Nakamura K. (1997). Interspecies transmission of influenza C virus between humans and pigs. *Virus Res.*, 48, 71-79.

Kofler, M., Seuberlich, T., Maurer, E., Heim, D., Doherr, M., Zurbriggen A., & Botteron, C. (2006). TSE surveillance in small ruminants and pigs: a pilot study. *Schweiz. Arch. Tierheilkd*, 148, 341-342.

Kolpin, D., Riley, D., Meyer, M.T., Weyer, P., & Thurman, M. (1999). Pharm-chemical contamination: a reconnaissance for antibiotics in Iowa streams, 1999. Workbook for AFO Workshop, Animal Feeding Operations: Effects on Hydrologic Resources and the Environment, Fort Collins, Colorado. August 30-Sept 1, 1999.

Kudva, I.T., Blanch, K., Hovde, C.J. (1998). Analysis of *Escherichia coli* O157:H7 survival in ovine or bovine manure and manure slurry. *Appl. Env. Microbiol.*, 64, 3166-3174.

Larsen, M.N., & Roepstorff, A. (1999). Seasonal variation in development and survival of *Ascaris suum* and *Trichuris suis* eggs on pastures. *Parasitol.*, 119, 209-220.

Lekcharoensuk, P., Lager, K.M., Vemulapalli, R., Woodruff, M., Vincent, A.L., & Richt, J.A. (2006). Novel swine influenza virus subtype H3N1, United States. *Emerg. Infect. Dis.*, 12, 787-794.

Ludwig, S., Stitz, L., Planz, O., Van, H., Fitch, W.M., & Scholtissek, C. (1995). European swine virus as a possible source for the next influenza pandemic? *Virol.*, 212, 555-561.

Maruyama, H., Nawa, Y., Noda, S., & Mimori, T. (1997). An outbreak of ascariasis with Marked eosinophilia in the southern part of Kyushu District, Japan, caused by infection with swine ascaris. *Southeast Asian J. Trop. Med. Public Health 28 Suppl.*, 1, 194-196.

Matthews, D., & Cooke, B.C. (2003). The potential for transmissible spongiform encephalopathies in non-ruminant livestock and fish. *Rev. Sci. Tech.*, 22, 283-296.

McKellar, R.C., Moir, R., & Kalab, M. (1994). Factors influencing the survival and growth of *Listeria monocytogenes* on the surface of Canadian retail wieners. *J. Food Protect.*, 57, 387-392.

Meulemans, G. (1999). Inter-species transmission of the influenza virus. *Bull. Mem. Acad. R. Med. Belg.*, 154, 263-270.

Moxley, R.A., & Duhamel, G.E. (1999). Comparative pathology of bacterial enteric diseases of swine. *Adv. Exp. Med. Biol.*, 473, 83-101.

Munro, F.A., Dohoo, I.R., McNab, W.B., & Spangler, L. (1999). Risk factors for the between-Herd spread of *Mycobacterium bovis* in Canadian cattle and cervids between 1985 and 1994. *Prev. Vet. Med.*, 41, 119-133.

Myers, K.P., Olsen, C.W., Setterquist, S.F., Capuano, A.W., Donham, K.J., Thacker, E.L., … Gray G.C. (2006). Are swine workers in the United States at increased risk of infection with zoonotic influenza virus? *Clin. Infect. Dis.*, 42, 14-20.

Nadakavukaren, A. (2000). Our Global Environment. Prospect Heights, IL: Waveland Press.

Nielsen, E.M., Engberg, J., & Madsen, M. (1997). Distribution of serotypes of *Campylobacter jejuni* and *C. coli* from Danish patients, poultry, cattle and swine. *FEMS Immunol. Med. Microbiol.*, 19, 47-56.

O'Connor, D.R. (2002). *Report of the Walkerton Inquiry: Part 1 – The Events of May 2000 and Related Issues.* The Walkerton Inquiry, Toronto, ON. Retrieved from: www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/part1/WI_Summary.pdf

O'Handley, R.M., Olson, M.E., Fraser, D., Adams, P., & Thompson, R.C. (2000). Prevalence and genotypic characterisation of Giardia in dairy calves from Western Australia and Western Canada. *Vet. Parasitol.*, 90, 193-200.

Olsen, C.W., Brammer, L., Easterday, B.C., Arden, N., Baker, I., & Cox, N.J. (2002). Serologic evidence of H1 swine influenza virus infection in swine farm residents and employees. *Emerg. Infect. Dis.*, 8, 814-819.

Olson, M.E., & Guselle, N. (2000). Are pig parasites a human health risk? *Adv. Pork Prod.*, 11, 153-162.

Olson, M.E., Thorlakson, C.L., Deselliers, L., Morck, D.W., & McAllister, T.A. (1997). *Giardia* and *Cryptosporidium* in Canadian farm animals. *Vet. Parasitol.*, 68, 375-381.

O'Reilly, L.M., & Daborn, C.J. (1995). The epidemiology of *Mycobacterium bovis* infections in animals and man: a review. *Tuber. Lung Dis.*, 76 Suppl. 1, 1-46.

Panina, G.F., Civardi, A., Cordioli, P., Massirio, I., Scatozza, F., Baldini, P., & Palmia, F. (1992). Survival of hog cholera virus (HCV) in sausage meat products (Italian salami). *Int. J. Food Microbiol.*, 17, 19-25.

Paradis, M.A., Gottschalk, M., Rajic, A., Ravel, A., Wilson, J.B., Aramini, J., … C.P. Dick, C.P. (2007). Seroprevalence of *Lawsonia intracellularis* in different swine populations in 3 provinces in Canada. *Can. Vet. J.*, 48, 57-62.

Patterson, W.J., & Painter, M.J. (1999). Bovine spongiform encephalopathy and the new variant Creutzfeldt-Jakob disease: an overview. *Commun. Dis. Public Health*, 2, 5-13.

Pattison, J. (1998). The emergence of bovine spongiform encephalopathy and related diseases. *Emerg. Infect. Dis.*, 4, 390-394.

Pearce, F. (1996). BSE may lurk in pigs and chickens. *New Scientist*, April 6, 1996. P. 5.

Pilon, J., Higgins, R., & Quessy, S. (2000). Epidemiological study of *Yersinia enterocolitica* in swine herds in Quebec. *Can. Vet. J.*, 41, 383-387.

Pip, E. (2000). A review of the effects of the livestock industry on the environment and human health. www.beyondfactoryfarming.org/documents/hogdoc.pdf. Accessed 23 November 2010.

Pip, E., & Reinisch, A. Stream water quality associated with a livestock/poultry production operation in southeastern Manitoba, Canada. In press.

Plym-Forshell, L. (1995). Survival of salmonellas and Ascaris suum eggs in a thermophilic biogas plant. *Acta Vet. Scand.*, 36, 79-85.

Prescott, J.F. (1997). Antibiotics: miracle drugs or pig food? *Can. Vet. J.*, 38, 763-766.

Quilez, J., Sanchez-Acedo, C., Clavel, A., del Cacho, E., & Lopez-Bernad, F. (1996). Prevalence of Cryptosporidium infections in pigs in Aragon (northeastern Spain). *Vet. Parasitol.*, 67, 83-88.

Redmond, C., Hall, G.A.,Turnbull, P.C., & Gillgan, J.S. (1997). Experimentally assessed public health risks associated with pigs from farms experiencing anthrax. *Vet. Rec.*, 141, 244-247.

Robertson, L.J., & Gjerde, B. (2000). Isolation and enumeration of giardia cysts, cryptosporidium oocysts, and ascaris eggs from fruits and vegetables. *J. Food Protect.*, 63, 775-778.

Saito, M., Shibata, Y., Ohno, A., Kubo, M., Shimura, K., & Itagaki, H. (1998). Sarcocystis suihominis detected for the first time from pigs in Japan. *J. Vet. Med. Sci.*, 60, 307-309.

Schiffman, S.S., Sattely-Miller, E.A., Suggs, M.S., & Graham, B.G. (1998). Mood changes experienced by persons living near commercial swine operations. In K.M. Thu & E.P. Durrenberger (Eds), *Pigs, Profits and Rural Communitie*s (pp. 84-102). Albany, NY: State University of New York Press.

Schwermer, H., Rufenacht, J., Doherr, M.G., & Heim, D. (2002). Geographic distribution of BSE in Switzerland. *Schweiz. Arch. Tierheilkd*, 144, 701-708.

Seidel, K.E., Kampschulte, J., Lehn, N., & Bauer, J. (1996). *Helicobacter pylori*: antibodies in sera of pigs and calves. *Berl. Munch. Tierarztl. Wochenschr,* 109, 434-439.

Smith, H.J. (1985). Infectivity of Canadian isolates of Trichinella spiralis native for swine, rats and carnivores. *Can. J. Comp. Med.*, 49, 88-90.

Solaymani-Mahammadi, S., & Petri, W.A. Jr. (2006). Zoonotic implications of the swine-transmitted protozoal infections. *Vet. Parasit.*, 140, 189-203.

Taratuto, A.L., & Venturiello, S.M. (1997). Trichinosis. *Brain Pathol.*, 7, 663-672.

Taylor, D.M., Woodgate, S.L., & Atkinson, M.J. (1995). Inactivation of the bovine spongiform encephalopathy agent by rendering procedures. *Vet. Rec.*, 137, 605-610.

Torgerson, P.R., Pilkington, J., Gulland, F.M., & Gemmell, M.A. (1995). Further evidence for the long distance dispersal of taeniid eggs. *Int. J. Parasitol.*, 25, 265-267.

Ueda, S., Sasaki, S., & Ninomiya, W. (1963). *Shigella* organisms isolated from slaughtered cattle and hogs. *Nippon Juiqaku Zasshi.*, 25,127-128.

Wagner, B., & Polley, L. (1997). *Ascaris suum* prevalence and intensity: an abattoir survey of market hogs in Saskatchewan. *Vet. Parasitol.*, 73, 309-313.

Wagner, B., & Polley, L. (1999). *Ascaris suum*: seasonal egg development rates in a Saskatchewan pig barn. *Vet. Parasitol.*, 85, 71-78.

Wandra, T., Subahar, R., Simanjuntak, G.M., Margono, S.S., Suroso, T., Okamoto, M., … Ito, A. (2000). Resurgence of cases of epileptic seizures and burns associated with cysticercosis in Assologaima, Jayawijaya, Irian Jaya, Indonesia, 1991-95. *Trans. R. Soc. Trop. Med. Hyg.* ,94, 46-50.

Webster, R.G., Sharp G.B., & Claas E.C. (1995). Interspecies transmission of influenza viruses. *Am. J. Respir. Crit. Care Med.*, 152, S25-S30.

Will, RG. (1999). The transmission of prions to humans. *Acta Paediatr. Suppl.*, 88, 28-32.

Wilson, K., & Keelan, J. (2008). Learning from *Listeria*: the autonomy of the Public Health Agency of Canada. *Can. Med. Assoc. J.*,179, 877-879.

Wilson, J.B., Pauling, G.E., McEwen, B.J., Smart, N., Carman, P.S., & Dick, C.P. (1999). A descriptive study of the frequency and characteristics of proliferative enteropathy in swine in Ontario by analyzing routine animal health surveillance data. *Can. Vet. J.*, 40, 713-717.

Yo, I.H.T. (2006). The effects on the exportation of pet food in relation to Canada becoming a bovine spongiform encephalopathy (BSE) affected country. Ahead of the Curve: OVMA Conf. Proc. 26-28 January 2006, p. 310.

Yoo, D., Willson, P., Pei, Y., Hayes, M.A., Deckert, A., Dewey, C.E., … Giulivi, A. (2001). Prevalence of hepatitis E virus in Canadian swine herds and identification of a novel variant of swine hepatitis E virus. *Clin. Diagn. Lab. Immunol.*, 8, 1213-1219.

Rural Communities

The Rural Economy

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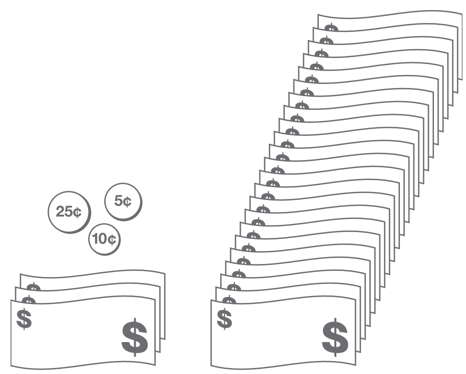
Rural economies of the northern and western parts of Canada have historically been oriented mainly towards either grain farming and/or resource extraction, principally forestry and mining. Western grain farming has experienced a long period of depressed wheat prices since the boom years of the 1970s. Low grain prices together with rising costs of inputs such as farm machinery and chemicals, what is referred to as the 'cost-price squeeze', has had serious consequences for farmers generally, and especially Western grain farmers.[4] This has only been exacerbated with the increasing use of genetically modified seeds and their patented genes, which must be purchased each year from the few transnational companies that developed them. Wiebe notes that over the last fifty years, farm input prices have increased nearly twice as fast as farm product prices. Many farmers faced with the pressures of the cost-price squeeze have been forced out of business over the last thirty years and the remaining farmers have consolidated their holdings and diversified into other crops, such as canola, while many farm families have sought off-farm employment.

Looking at Canadian agriculture as a whole, while farm productivity has increased impressively since the 1970s, farm debt loads have soared since then. In the 1970s farms carried a debt of $3.40 for every net dollar earned. Over the last three decades or so this has climbed substantially, so that in recent years farms carry a debt of about $23 for every net dollar earned, an increase of some seven hundred percent (Wiebe, forthcoming).



1970s
$3.40

2000s
$23.00

In the 1970s farms carried a debt of $3.40 for every net dollar earned. Recently that debt has climbed to $23 for every net dollar earned.

The last decade witnessed a continuing decline in the number of farms alongside the consolidation of the remaining farm operations. Already by the 1980s some 20 percent of farms accounted for approximately 80 percent of gross annual sales. This trend continues with the number of census-tracked farms in Canada falling by 7.1 percent from 2001 to 2006 (Senate Standing Committee on Agriculture and Forestry, 2008). The Committee states that

> [w]hile it is important to recognize that 'rural' is more than just agriculture, it is equally important to recognize that the term evokes, for many Canadians, iconic images of small farms surrounded by field crops and rolling landscapes; of livestock in fields and barns; of grain elevators, threshers and rural food markets. Increasingly, however, these images are becoming more the stuff of childhood bedtime picture books and Hollywood lore than contemporary reality. The rural landscape may look familiar but for the most part, agriculture in Canada is nothing like it used to be. The small family farm is disappearing or at least changing radically, and with it, much of what [people] think of as rural Canada (2008, p. 35).

[4] For a discussion of the cost price squeeze in Canadian agriculture, see Winson, 1993, p. 93.

Within this changing landscape, a small number of very large corporate agricultural operations have emerged, many of which are involved in a diverse array of sectors. This decline in traditional farming has put rural communities in a precarious position. Qualman describes this position in detail, explaining that because rural communities are

> [f]aced with this huge outflow of wealth from rural areas, and often unable to understand the global economic system which drives the outflow, rural citizens and communities begin to see themselves as poor. They begin to see growing food, producing wood, or mining minerals as unimportant – 'yesterday's industries' – and to see Internet merchandising and mutual-fund management as the valuable activities in the new economy. Misinterpreting their situation, and unable to understand why they have no local money for investment, they go looking for outside investment as a salvation. The mantra in rural Canada is that towns and villages need to attract outside investment in order to create jobs and save the community. To this end, well-meaning mayors, rural councillors, country officials, and citizens work to attract barley-malting plants, pasta plants, and hog mega-barns. This view and strategy is reinforced by every level of Canadian government (2001, p. 28).

While ILOs bring with them promises for regional economic development via jobs, increased spending, and improved social services, the reality is that industrialized agriculture is characterized by some of the very things that pose a direct threat to traditional agricultural employment. Industrial agriculture is capital-intensive in terms of both production and distribution, relying on technology as opposed to people. However, these risks are not made clear to residents.

"While ILOs bring with them promises for jobs, increased spending and improved social services, the reality is that industrialized agriculture is characterized by some of the very things that pose a direct threat to traditional agricultural employment."

Rural Poverty

There is a generally recognized lack of research focused on rural poverty in Canada (Agriculture Canada, 2007). From the studies that do exist, the scope of rural poverty depends to some extent on the measures used, with a low income cutoff and a market basket measure being the two most commonly employed to gauge poverty. Rural poverty rates were more or less equivalent to urban poverty rates in the 1980s, but since then urban poverty rates have been higher than rural rates, likely due to the rapid acceleration of housing costs in the major Canadian cities over the last 20 years (Senate Standing Committee on Agriculture and Forestry, 2008). Using the incidence of low income as the measure, in 2001 poverty rates were approximately 19 percent in urban areas and 14 percent in rural areas. In 2001, unemployment in rural Canada was about 7.2 percent compared to 5.4 percent in urban Canada (Ibid).

A recent review of the existing literature that speaks to the issue of poverty in rural areas notes the following as explanatory of rural poverty in this context:

> Compared to their urban counterparts, rural residents tend to have lower educational levels, lower literacy levels, lower levels of general knowledge and computer skills … fewer months of employment and jobs that pay well. It is certain that these circumstances also apply to residents of urban areas, but these circumstances are generally more common in rural communities (Government of Canada, 2008).

While this may be true, it is worth acknowledging that wealth extraction from rural areas is an issue that should not be ignored in any discussion of rural poverty. For example, rural western Canada can be described as

> a vast wealth-creation machine. If you throw a stone in a rural area, you hit an oil field or a grain field; a potash, uranium, diamond, coal or gold mine; a herd of cattle; or a stand of timber. This great wealth, however, is not captured in rural areas. Instead, rural areas are struggling: farmers are facing bankruptcy, stores are closing, schools are increasingly empty, young people are leaving, roads are disintegrating, and the economy is contracting (Qualman, 2001, p. 28).

Understanding that rural poverty can be the result of various challenges acting in concert with practices of 'wealth extraction', provide context for why many communities are "lured by the corporate promises of more jobs, increased tax base, and the false promise of corporate livestock production as a viable future for farmers" (Ikerd, 2003, p. 34). By accepting ILOs, "[e]conomically depressed rural communities will be able to afford better schools, better health care, and expanded social services and will attract a greater variety of retail outlets – restaurants, movie theatres, and maybe even a Wal-Mart." (Ikerd, 2003, p. 34).

The Phases Leading To ILOs in Rural Canada

Weida sees social and economic conditions in rural areas as being impacted by two major phases. The first phase (during the 1960s and 1970s) saw the financial ruin of farmers held hostage by soaring debt loads and high fixed costs during a prolonged plateau in crop prices. One of the impacts of this initial phase was the loss of rural communities "whose base of support was directly linked to the failed farms that had surrounded them" (Weida, 2003, p. 111). This meant that primarily communities with stronger, alternative bases of support survived. This in turn created the second phase, defined by the increasing trend towards ILOs throughout the 1980s and 1990s.

The rural communities that boasted 'full service economies' survived in largely by parting[5] from farming areas and the communities that surrounded them. As these communities benefited from economic growth separate from agriculture, these areas became increasingly enticing to surrounding agriculturally-focused areas, boasting the benefits of the full service economies that non-agricultural economic success had generated (Weida, 2003, p. 112).

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[5] Weida proposes a change in defining rural agricultural areas, as there was a time when 'rural' and 'agriculture' were seen as synonymous, however a community's ability to survive severe agricultural disruption indicates agriculture is no longer the main economic driving force of many rural communities.

Rural Depopulation

As of 2006, 20 percent of Canadians lived in rural communities. This is down from 24 percent in 1986 (Statistics Canada, 2006). The conditions of rural agricultural communities are said to "degrade the lifestyle of residents and render agricultural land attractive only to owners who do not live on the land"[6] (2003, p. 114). Weida acknowledges that depopulation in rural areas, "did not initially occur by design", however the legal and economic factors that were intended to suppress opposition to ILOs, have become drivers for rural depopulation (2003, p. 114). Some of these legal and economic measures include:

- ***Buying out the biggest complainers:*** The simplest way for ILOs to 'deal with' allegations of nuisance from residents is to buy their property, indicating that despite the cost, ILOs have an informed understanding that the level of pollution is not acceptable to residents in the surrounding areas.
- ***Utilizing right-to-farm legislation:*** Because ILOs are considered agricultural operations they attempt to avoid lawsuits relating to water and air pollution and can use their influence to disable municipal or county level regulation of pollution (moving the process to the provincial level where their influence is more difficult to ignore).
- ***Costs of environmental clean up:*** Even when agreements are made that demand agricultural operations take a greater role in waste management or pollution effects, this has little to no effect on ILOs but a massive effect on small operations, leading to rural agricultural depopulation.
- ***Loss of right of exclusive use:*** Being unable to control air pollution on one's property is a denial of the right of exclusive use in that odour and insect issues are physical impairments and thus constitute trespass and right of exclusion. However given that compensation for misuse of property cannot be assured, many residents resort to short-term economic gain at the cost of long-term social benefits.

The Role of Rural Residential Areas in Locating ILOs in Rural Agricultural Areas

ILOs keep almost all information regarding the planned activities for an area private from the rural residents. As has been previously implied, the rural residential community tends to have greater influence over decision making than those living in rural agricultural areas both in terms of population and business interests. Therefore it is imperative that ILOs create acceptable terms for rural residents, incentivizing the proposed plans, however vague. These agreements may be overtly stated but tend towards being legally unenforceable. ILOs promise jobs and economic stimulation of the region, and because these are issues that are important to rural residents in these areas, it works in their favour to accept. However ILOs have much more information about the actual agreement (referred to as 'asymmetrical information') and therefore can use this information to their advantage. Worse than this even, residents are not given the information necessary to critically assess the physical, social and economic details of the proposed agreement. Unfortunately it is the less powerful rural agricultural residents who are hardest hit by these decisions and therefore maximize their short-term gains by selling their property to ILOs (Weida, 2003).

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[6] Typically ILOs have very few employees and these employees often live far from the actual ILO.

> "ILOs keep almost all information regarding the planned activities for an area private from the rural residents…residents are not given the information necessary to critically assess the physical, social and economic details…"

Despite promises of regional economic development, ILOs are, simply put – incompatible with the requirements of this sort of economic development, which assumes that money stays within a given region. Three main ways that ILOs are structured so as not to aid in regional economic development are discussed:

- ***Employment:*** Being capital-intensive, ILOs have been designed to minimize the number of workers required to run operations and this minimizes jobs created and therefore economic impact (Weida, 2003). A typical ILO pig operation with 2,400 sows employs about 15 people, however this operation will put as many as 50 traditional farmers out of business and force the ones that survive to seek off-farm employment (Qualman, 2001).
- ***Taxation:*** Because ILOs are at times treated as industries and taxed accordingly, but other times treated as small businesses, these sorts of dual designations can greatly impact a community (i.e. if a designation lowers taxable income, it also lowers taxes paid in the actual province). In a municipality, taxes are composed primarily of property taxes. Often ILOs are taxed at rates similar to other agricultural activities, however the additional costs associated with ILOs (e.g. social, health or traffic costs) are not accounted for and therefore must be paid for by the local government who must increase property taxes to pay for these costs (Weida, 2003).
- ***Local business impacts:*** When ILOs create environmental issues, this can negatively impact a community's ability to develop economically. Communities without laws protecting against corporate farming have tended towards higher poverty and unemployment rates (Weida, 2003, p. 129).

Epp's description of struggling rural populations, though anecdotal, offers a powerful narrative that should not be ignored. Rural communities

> commonly use the language of abandonment. They feel they are on their own in defending their communities. Some of them are tired from struggles to save schools, hospitals, rail-lines, post offices, and their own farms, or from spreading volunteer energies too thinly to keep churches, hockey teams, and cultural activities alive. They have watched friends move away. And then they hear—they may or may not be properly notified—that land is being assembled, that neighbours have been approached for permission to spread manure, and that an application has been submitted for a development permit to build a 5,000 or 6,000 or 7,000-sow barn complex. (2003, pp. 180-181)

Given that rural areas are described by many as wealth-creation-machines, it is imperative our policies protect the interests of those living in these communities.

Impacts on Quality of Life

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The only thing on which proponents and opponents of Intensive Livestock Operations (ILOs) agree is that ILOs frequently pit neighbours against neighbours and local officials against their constituents. The conflicts invariably strain and often rip the social fabric of rural communities. This is perhaps the most damaging and longest-lasting impact of ILOs on the quality of life in rural communities.[7]

ILOs impact the quality of life in rural communities in three main ways: they disrupt rural life, deny democratic rights of rural people, and threaten public health in rural areas.

ILOs Disrupt Rural Life

Pervasive odours from ILOs seriously impact the aesthetic quality of rural life and lead to reduced property values, as documented by the Canadian Environmental Law Association (2000). These odours “can affect well-being by eliciting unpleasant sensations, triggering possible harmful reflexes, modifying olfactory function, and other physiological reactions. Annoyance and depression can result from exposure... along with nausea, vomiting, headache, shallow breathing, coughing, sleep disturbances, and loss of appetite” (Paton, 2003, pp. 82-83).

The Pew Commission on Industrial Farm Animal Production (2008) concluded that the smell of ILOs, “can have dramatic consequences for surrounding communities, where lives are rooted in enjoying the outdoors” (p. 42). According to the Commission,

■ **The smell of ILOs can have dramatic consequences for surrounding communities.**

[7] Quality of life refers to the standard of living, or degree of happiness, comfort, etc., enjoyed by an individual or group in any period or place (OED, 2011).

> Freedom and independence associated with life oriented toward the outdoors gives way to feelings of violation, isolation, and infringement. Social gatherings are affected through the disruption of routines that normally provide a sense of belonging and identity – backyard barbecues, church attendance, and visits with friends and family (p. 42).

Documentation of community disruptions by ILOs are prevalent in the United States. More than five decades of research on the impacts of industrialized farming have confirmed the inability of local residents to enjoy their properties due to odours, health risks associated with insect infestations and an inability to open windows or go outside in nice weather (Lobao, 2001; Hribar, 2010; Wing and Wolf, 1999). These and other related factors have led to declining property values, economic instability, and increased economic and social inequity in areas where ILOs locate. Weida (2003) explains the economic impacts felt by the surrounding residents of an ILO as a 'shifting' of costs, in that the ILOs are not ultimately the ones that foot the bill; it is the neighbouring properties that do by way of lower sales and taxable value of neighbouring properties (p. 114).

ILOs Deny Democratic Rights

Rural residents who are concerned about ILOs "find that they have no protection and almost no rights," according to the Canadian Environmental Law Association (2000, p. 5). Tait (2002) argues that ILOs erode democracy in general. ILO owners have responded to the growth of county-level regulation by attempting to remove any ability to regulate air and water pollution from the counties, thus relocating authority in provincial governments where ILOs can more easily exert their political influence (Weida, 2002). By utilizing "'right-to-farm' legislation, all provinces, regardless of the party in power, have curtailed rural residents' common-law rights to be free of agricultural pollution" (Brubaker, 2007, p. 10). In 2001, the Alberta government amended the Agricultural Operation Practices Act (AOPA), "citing the livestock industry's economic importance" (Brubaker, 2007, p. 78). Similar to other right-to-farm legislation, amending this act "attempted to move disputes between farmers and their neighbours from the common law to provincially appointed regulators – the Natural Resources Conservation board (NRCB), the Farmers' Advocate, and an Agricultural Practices Review Committee largely comprised of industry peers" (Brubaker, 2007, p. 78). This move shifted decision making power from the municipal and county levels to the NRCB, and is only one example of the way ILOs have influenced citizens' abilities to provide input and shape decisions about ILOs in their communities.

- **Rural residents who are concerned about ILOs find that they have no protection and almost no rights.**

"By utilizing 'right-to-farm' legislation, all provinces, regardless of the party in power, have curtailed rural residents' common-law rights to be free of agricultural pollution."

In the United States, Robert Kennedy Jr., a prominent environmental lawyer, maintains that owners of intensive hog operations in North Carolina infringe on the democratic rights of rural residents by bribing local politicians to ensure that legislation favours corporate interests, and not the interests of rural communities (in Suzuki, 2003). And in Texas, laws require a person suing another for a nuisance to pay all court cost for both sides—whether or not they win (Weida, 2002). This denial of rights leads to 'political deskilling' in rural communities – meaning loss of ability to articulate a position, listen, strategize, research, find a consensus, depersonalize conflict and build external alliances (Epp, 2001, p. 316).

ILOs Threaten the Health of Communities

The widespread community health risks associated with ILOs have been thoroughly documented in numerous scientific studies linking these operations to contamination of air, water, soil, and foods with toxic chemicals, infectious diseases, antibiotic resistant bacteria, and *E. coli* 0157:H7. "While pervasive odour seriously impacts quality of life and property values, the odour may also impact health" (Canadian Environmental Law Association 2000, p. 4). Residents of rural communities have reported physical and psychological problems associated with odour from ILOs (Lobao, 2001). Research also shows that even non-toxic smells can produce aversive reactions, including stress-related illness (Paton, 2002).

Using the example of pig barns, some of the associated symptoms of exposure to the harmful chemicals generated include: "[r]espiratory tract irritation, rhinitis, sinusitis, bronchitis, asthma, and odour related psychological symptoms" (Paton, 2003, p. 86). US farm workers have been affected by the ammonia emitted by ILOs resulting in acute and chronic bronchitis, chronic obstructive airways disease, and interstitial lung disease, affecting up to 30 percent of workers in some ILOs (Hribar, 2010). A Saskatchewan study noted that after three hours of work in a pig barn, a large number of veterinary students surveyed, reported flu-like symptoms. Cough, nasal and throat irritation were reported by 91 percent of the students. It is worth noting that wearing a mask during the three hours had no significant impact on the symptoms (Paton, 2003). Hribar (2010) found in the US that human health can suffer from degraded water quality, or from diseases spread from ILOs. For example, effects of ILOs on area schools and children have included a greater risk of asthmatic symptoms.

The Expulsion of Farm Families

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In the 1980s and '90s, corporate and government representatives began promoting ILOs in Canada. Proponents billed these operations as 'win-win-win' solutions: local economies would boom, spurred by job creation and investment; grain farmers would prosper by supplying feed-grains to new markets; and local livestock farmers would benefit as increased production secured processing plants and suppliers, to the benefit of small and large-scale producers alike.[8] These best-case scenarios never materialized. Instead, those with an eye on rural Canada witnessed the closure of meatpacking plants, the boarding-up of main street windows, a rural-youth diaspora,[9] and the destruction of family farms—with the expulsion of farmers most rapid in sectors where ILO production expanded most aggressively.

■ **The expulsion of family farms is most rapid in areas where ILO expansion has been the most aggressive.**

The effects of ILOs in Canada are most evident in sectors such as hog production and cattle finishing, because supply management systems in this country slow the move toward huge production units in the dairy and, to a lesser extent, poultry sectors. Canada's hog sector showcases the negative effects of ILO proliferation (discussed below), and the sector provides a cautionary tale regarding what may be happening slowly to dairy and poultry farms today, and what will happen rapidly if supply management is dismantled.

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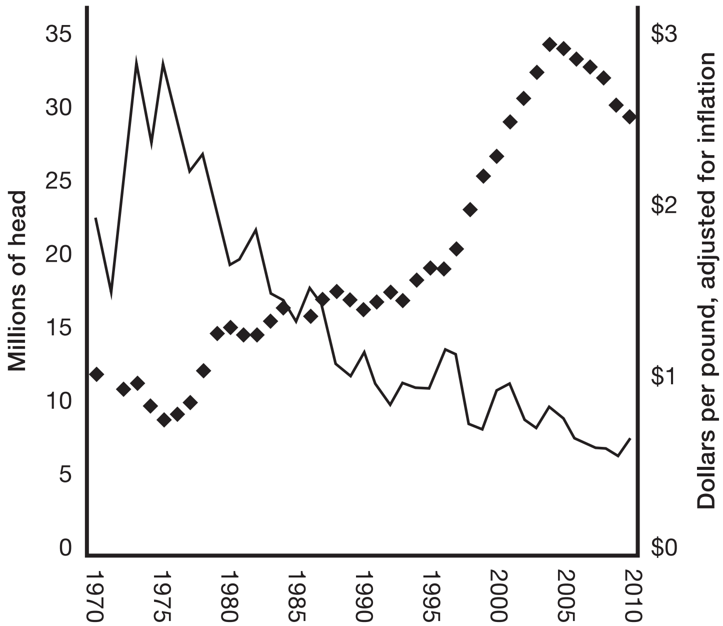
[8] To illustrate, here are four of many quotes: 1. A 1998 pamphlet for a proposed Saskatchewan hog ILO says "After construction the barn will employ 10 full-time workers. This will help to stabilize the population and tax base. It will also help keep services like schools operating. ... The new market opportunities provided by the hog industry expansion will ensure more demand for feed grain resulting in upward pressure on prices." (Brightwater Stock Farms Ltd., "Fact Sheet: Annual Economic Benefits for the R.M. of Rosedale and Hanley," 1998.) 2. Puratone, one of Canada's largest hog producers, said this regarding its plans to produce more hogs: "This expansion will create new jobs in rural Manitoba and will provide even more opportunity for local farmers to market their products close to home." (June 23, 1999 news release. See www.grainnet.com/articles/UGG_and_ENSIS_Investment_in_Puratone_Complete-4117.html). 3. Saskatchewan Minister of Agriculture and Food Eric Upshall said this in 1997 when announcing a $250,000 investment in a 100,000-hog-per-year ILO complex: "This investment reflects our government's commitment to the hog industry. It's an industry that adds value to our agricultural products, creates jobs and helps diversify the economy of rural Saskatchewan." (Government of Saskatchewan News Release, "SOCO Invests in Sinnett Pork Farm Ltd.," August 15, 1997) and 4. Manitoba's Agriculture Minister Enns said this in 1996: "The Manitoba hog industry has an unprecedented opportunity to be a catalyst for job growth. ... With every additional 1,000 hogs that are produced and processed in Manitoba, we can gain six new jobs." (Government of Manitoba news release, "New Hog Marketing Regulations Take Effect July 1: Enns," March 19, 1996.)

[9] Statistics Canada's 1991 Census of Agriculture recorded 18,440 farmers under the age of 35. The 2006 Census recorded only 7,070—a loss of 62%! It is almost certain that the 2011 Census of Agriculture will record another large drop.

Figure 1. Canadian hog production and representative prices: 1970-2010



◆ Canadian hog production
—— Ontario hog price, annualized, adjusted for inflation

Sources: Statistics Canada CANSIM tables 002-0043, 003-0088, and 003-0070.

One negative impact of ILOs is the destruction of family farms—the corporate takeover and 'de-farmer-ization' of livestock production. Such destruction is completely predictable, for a number of reasons. First, as hog ILOs proliferated in the US and Canada, and as corporate producers in Canada doubled and redoubled national hog output, these operations helped to crash prices. Figure 1 shows the post-1975 hog production increase and the attendant price decrease—production went up four-fold and prices fell to one-fourth their former levels, a predictable supply-and-demand response. As prices fell, profitability crumbled. Figure 1 uses inflation-adjusted Ontario prices, but graphs of prices from other provinces look the same.

Though production increases contributed to the price-and-profit problem, so did corporate concentration. Starting in 1995,[10] Maple Leaf Foods remade the Canadian pork sector in the mold of the US:[11] large, vertically integrated production units; huge packing plants; low wages;[12] and two or three dominant corporations. Maple Leaf consolidated its position by buying competitors[13] and closing packing plants. Over the past decade, Maple Leaf closed plants in

[10] In 1991, Maple Leaf Foods Inc. is created through the merger of Maple Leaf Mills Limited and Canada Packers Inc. In 1995 McCain Capital Corporation and the Ontario Teachers Pension Plan Board acquire controlling interest in Maple Leaf Foods Inc. from Hillsdown Holdings plc. In 1999 Maple Leaf's pork processing operation in Brandon, Manitoba begins production. (Summarized from Maple Leaf Foods Inc. "Our History Timeline," online at www.mapleleaffoods.com/en/corporate/company-info/our-rich-history/history-timeline/)

[11] Presentation by Don Hrapchak, General Manager of SPI Marketing Group, National Farmers Union Convention, Regina, Saskatchewan, November 28, 2001.

[12] As evidence, consider this quote from a 1997 letter to workers from Maple Leaf CEO Michael McCain: "If the mediator's report is rejected and a strike occurs, Maple Leaf will close the plant in Edmonton, it will never re-open. . . . Your choices on Thursday are very clear: Accept the mediator's recommendation and continue working, or reject the mediator's recommendation, strike, and the plant will be closed permanently." Sixty percent of workers voted to reject the company's offer. Maple Leaf made good on its threat and closed the plant in November 1997. Shortly after that closure, striking workers at Maple Leaf's Burlington, Ontario plant voted to accept a contract that dropped the average salary in that plant from $33,000 to $20,000; the company had said it would close the Burlington plant if workers rejected the pay cut. (See Mary MacArthur, "Maple Leaf says it will close plant if workers strike," Western Producer, August 14, 1997. Tracey Tjaden, "Union accuses Maple Leaf of buying votes to end strike," Western Producer, March 12, 1998. Tracey Tjaden, Maple Leaf workers accept new contracts," Western Producer, April 2, 1998.)

[13] Maple Leaf Foods Inc., News Release, "Maple Leaf Closes Acquisition of Schneider Foods," April 5, 2004.

> "Three out of four Canadian farms that were raising hogs 20 years ago have been pushed out."

Saskatchewan,[14] New Brunswick,[15] Nova Scotia,[16] Prince Edward Island (Maple Leaf walked away from the PEI plant in 2006;[17] it closed in 2008[18]), and elsewhere (AAFC, 2011). Closures in the Maritimes have left that region without a major hog slaughter plant and forced farmers to truck most of their hogs to Quebec (Mussel et al., 2010, p. 10). According to the George Morris Centre, corporate consolidation has left just "two main packers in Canada: Olymel, based in Montreal and Maple Leaf, based in Toronto. These two firms account for approximately two-thirds of the slaughter capacity in Canada" (Mussel et al., 2010, p. 12). Family farm hog producers must now compete against each other and against ILOs to get their hogs into a shrinking number of plants. And as large packers exercise more control within the pork supply chain, these corporations capture dollars that previously flowed to farmers and rural economies.

Low prices, negative margins, packer concentration, and competition from vertically-linked ILOs have forced farm families out of hog production. Three out of four Canadian farms that were raising hogs 20 years ago have been pushed out (Statistics Canada, CANSIM 003-0089; Statistics Canada, 1997). There remain in Canada fewer than 7,000 farms raising hogs, down from nearly 30,000 twenty years ago. Moreover, the reality is even worse than the 7,000-farm figure suggests. The George Morris Centre writes that "approximately 50-55 percent of Quebec's production [of nearly 8 million hogs] is in the hands of about 25 operations. . . . In Ontario . . . fewer than 10 producers each having 5,000 or more sows represent approximately 25 percent of the province's herd" (Mussel et al., 2010, pp. 8-11). In Western Canada, production is even more concentrated. If national data were available, it would show that the bulk of Canada's hog production now comes from a few hundred very large producers.

A similar expulsion of family farmers has occurred in the cattle finishing sector. Approximately 100 feedlots, each with a one-time capacity of more than 5,000 head, finish the majority of Canadian fed cattle (CanFax, 2011). Were it not for the restraining effects of supply management, the same expulsion would be occurring in the dairy, poultry, and egg sectors. Though even in those sectors, moves toward large, concentrated production units are visible. For example, 25 percent of poultry and egg producers—the largest 1,215 operations, with annual poultry and egg revenues over $1 million each—capture 75 percent of poultry and egg revenues (Statistics Canada, 2011).

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[14] Maple Leaf Foods Inc., News Release, "Saskatoon Primary Pork Processing Operation to Close by June 1st," March 1, 2007.

[15] Maple Leaf Foods Inc., News Release, "Hub Meat Packers Announces Business Realignment," June 12, 2002.

[16] CBC News, "Berwick meat packing plant to close," November 17, 2010. Online at http://www.cbc.ca/news/canada/nova-scotia/story/2010/11/17/ns-maple-leaf-foods-berwick.html

[17] CBC News, "Island, Quebec group looking at meat plant, July 12, 2006. Online at http://www.cbc.ca/news/canada/prince-edward-island/story/2007/08/30/www.cbc.ca/news/story/2006/07/11/gpm-buyer.html

[18] Staff writers, "Only Island hog plant shuts for good March 28," The Guardian, March 18th, 2008.

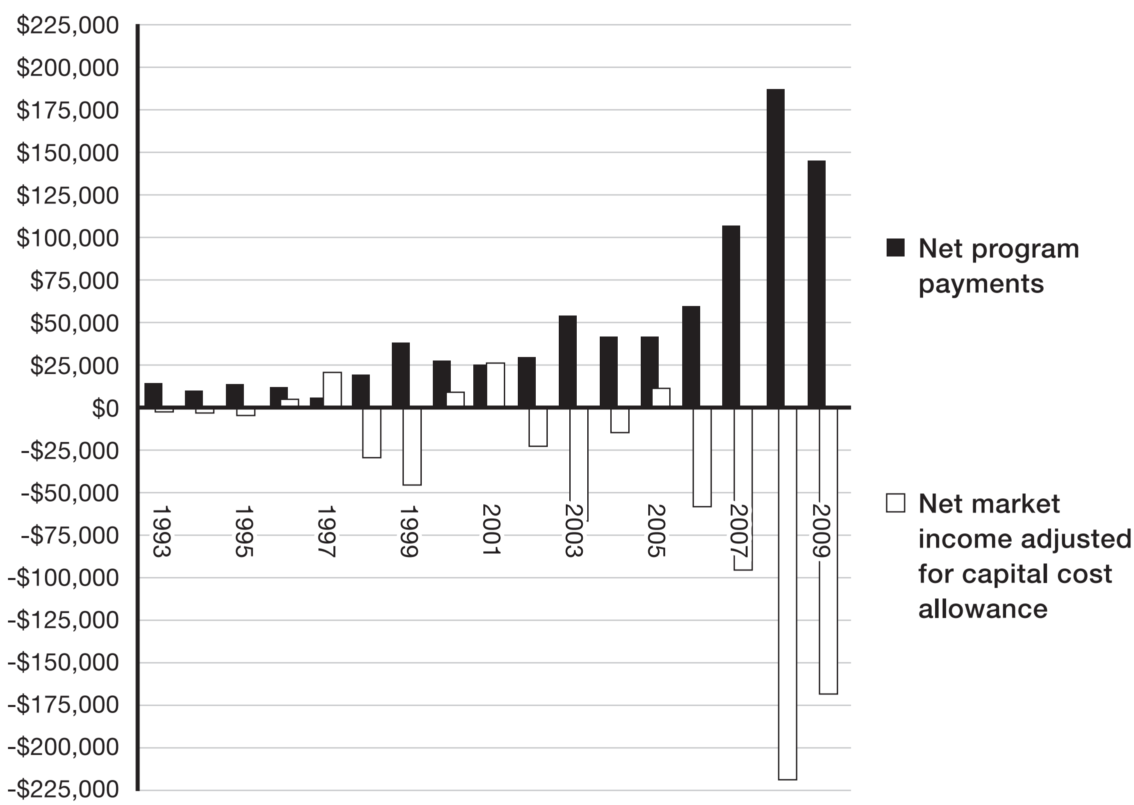
Taxpayers Subsidize the Industrialization of Agriculture

ILO expansion in Canada is a lose-lose-lose proposition. Not only do family farms lose, communities lose, and even the large industrial livestock producers themselves lose. Collectively, they lose billions of dollars. Few have been able to make consistent profits and many have been kept in production only by the chronic resuscitating effect of taxpayer-funded subsidy payments.

> "Without tax-funded subsidies, hog ILOs couldn't exist."

Figure 2 shows that as hog ILOs have proliferated and barns swelled, these large producers have generated ever-larger losses (the lower, white bars) and required ever-larger taxpayer-funded farm aid payments (the upper, dark bars). Net market income is the profit or loss an operation earns by selling its products; subsidy payments are excluded. Net market income here takes into account capital cost allowance—building and machinery costs. In recent years, support payments to the average hog ILO ranged from $100,000 to nearly $200,000 per operation, with the largest producers getting much more, as we will see below. Without tax-funded subsidies, hog ILOs couldn't exist.

Figure 2. Hogs producers' average net market income and program payments, per farm: 1993-2009



Source: Statistics Canada, CANSIM table 002-0053.

In aggregate, billions of taxpayers' dollars have flowed to the corporations and large farms that produce most of our pigs. Table 1 provides details of tax-funded transfers to hog producers, mostly ILOs.

Table 1: Hog producers' net market income and net program payments, aggregate: 1996-2009

Year	Number of operations	Net market income (adjusted for CCA) (millions of dollars)	Net program payments (millions of dollars)
1996	12,330	$9	$101
1997	11,580	$300	$38
1998	10,300	-$199	$131
1999	9,710	-$295	$235
2000	9,840	$27	$162
2001	9,810	$128	$132
2002	9,370	-$138	$154
2003	8,850	-$378	$277
2004	8,590	-$122	$210
2005	8,250	$56	$179
2006	7,690	-$265	$268
2007	7,040	-$404	$439
2008	6,080	-$816	$695
2009	5,870	-$614	$517
14-year totals		**-$2,711**	**$3,538**

Sources: Statistics Canada, "Canadian Farm Financial Database: Taxation data program"; Statistics Canada, "Statistics on Income of Farm Operators – 2009," Cat. No. 21-206-X.

In the period from 1996 to 2009, inclusive, in nearly every year, the hog sector's net income ('profit') was provided entirely by tax-funded aid payments. In only two years did the sector generate significant positive net income: 1997 and 2001. Over the 14-year period, taxpayer-funded transfers to hog operations totalled more than $3.5 billion. If 2010 data were available, it would bring the total to more than $4 billion. But the data reveals even more when one looks at the largest operations. In 2009, the largest 28 percent of hog operations—ILOs with revenues greater than $1 million per year—collected 72 percent of the farm support dollar for the sector. Together, in one year, these

"In the period from 1996 to 2009, inclusive, in nearly every year, the hog sector's net income was provided entirely by tax-funded aid payments…taxpayer-funded transfers to hog operations totalled more than $3.5 billion."

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million- and multi-million-dollar operations captured more than a third of a billion dollars in taxpayers' money (Statistics Canada, 2011).

The federal and provincial governments have nurtured ILO expansion by steadily increasing farm aid payment 'caps,' raising them from $875,000 per corporate operation in the 1998 to 2004 period, to $3 million per year per operation after 2004. By tripling the maximum payment, federal and provincial governments effectively tripled the maximum potential size of ILOs, and vastly increased the potential flow of public dollars to the largest corporate producers.

In addition to billions of dollars paid directly to hog producers, there were other subsidies: tax exemptions on building materials,[19] subsidies to packers,[20] and tens-of-billions of dollars in subsidies to grain farmers (Statistics Canada, 2011)—subsidies that facilitate the production and sale of feed-grains below actual costs of production, an indirect subsidy to ILOs. Tufts University in Massachusetts has published a series of reports showing the flow-through of grain subsidy dollars to the benefit of the largest players in the US livestock sector.[21] One Tufts report states:

> Factory hog operations saw the price of feed drop to 26 percent below production costs during the 1997-2005 period. . . . Smithfield, which controls nearly 30 percent of the US pork market, saved an estimated $2.54 billion on feed in those nine years. . . . Industrial livestock companies have clearly been major winners from policies that lowered feed prices and increased production (Starmer and Wise, 2007, pp. 2-3).

The Tufts studies make clear that feedgrain subsidies benefited the largest livestock producers the most, and had no positive effect on the smaller operations that grew their own feed and thus had to shoulder the full costs of production for that feed. The Tufts studies draw a direct link: subsidies spur the creation of ILOs. They say:

> The implicit subsidy to industrial feed has contributed to the consolidation of factory hog operations. With a 15 percent discount on operating costs compared to hog farmers who grew their own feed crops, factory farms enjoyed a competitive advantage. . . (Starmer and Wise 2007, p. 3-4)

ILOs are as much a result of government policies and public subsidies as they are a result of their purported efficiencies and economies of scale. Moreover, their chronic draw on the public purse seems to belie claims of efficiency.

[19] Government of Saskatchewan offered tax breaks on building materials for ILO barns. Quote: "The Saskatchewan government hopes its new tax incentive will help triple hog production by 2005 and create jobs." "Tax break may see more hog barns, jobs," Western Producer, March 27, 1997.

[20] Robert Arnason, "Brandon sewage plant to get $33 million upgrade," Western Producer, September 28, 2009.

[21] See Timothy A. Wise and Elanor Starmer, "Industrial Livestock Companies' Gains from Low Feed Prices, 1997-2005," Policy Brief No. 07-01, Global Development and Environment Institute, Tufts University; Starmer and Wise, "Living High on the Hog: Factory Farms, Federal Policy, and the Structural Transformation of Swine Production," Working Paper No. 07-04, Global Development and Environment Institute, Tufts University; and Starmer and Wise, "Feeding at the Trough: Industrial Livestock Firms Saved $35 billion from Low Feed Prices," Policy Brief No. 07-03, Global Development and Environment Institute, Tufts University.

Conclusion

The Pew Commission on Industrial Farm Animal Production (2008, p. 49) concluded that "the industrialization of American agriculture has transformed the character of agriculture itself and, in so doing, the social fabric of rural America." Among other findings, it noted that

> Quality of life in rural communities has also declined… because the linkages that once bound locally owned farms with the community have dissolved in many places and the social fabric of many communities has begun to fray. These changes are evident in negative attitudes about trust, neighborliness, community division, networks of acquaintanceship, democratic values, and community involvement, as well as increased crime and teen pregnancy rates, civil suits, and stress (p. 49).

The findings of the Pew Commission are indicative of not only what is currently happening in Canada, but also what the future holds for rural communities. There is a pressing need for more research on these issues within the Canadian context to understand, and help prevent, a decline in the quality of rural life. Additionally, there are several recommendations for how better to support our rural communities when it comes to their legitimate concerns about ILOs.

Policy Recommendations

Rural Economy:

- Have knowledgeable regulators monitoring ILOs to ensure all rural residents are given access to the information necessary to make informed decisions about an ILO in their community.
- Promote, through legislation, a democratic approach to ILO expansions, and overarching economic growth policies should be based on long-term community visions.
- Increase human capital through encouraging: immigration to rural areas, rural-based college and universities and innovation that keeps rural communities competitive without compromising their social, political or physical environments.
- Create legislation that requires ILOs to be more wholly accountable for the full costs to society of their operations, and in particular the heavy environmental burden they typically entail.
- Utilize a fairer tax scheme that incorporates the full costs of ILOs on the community (i.e. they should be taxed and regulated like an industry rather than a traditional family farm)
- Encourage and support more research on rural poverty in Canada.

Quality of Life:

- ILOs larger than a specific size should be subject to the same regulations regarding waste treatment and emissions of pollutants as any other industry.
- Citizens in rural communities should be granted an explicit right to enact local bylaws with environmental requirements exceeding those of provincial and federal governments, when necessary, to protect the public from risks posed by ILOs.
- Citizens in rural communities should be involved in the decision-making processes regarding ILOs from the very first phases of consideration.
- Following the principle of subsidiarity (whereby decision-making devolves to those most affected by the decision), people in rural communities should make the final decision regarding the establishment or enlargement of ILOs.
- Right-to-farm legislation should be rescinded and common-law rights of those affected by agricultural nuisances ought to be restored.
- Further research needs to be conducted on the quality of life impacts that ILOs have on rural Canadians. While much research has been done in the American context, it is imperative Canadians have our own research that critically assesses this important issue.

Valuing Family Farms:

- Protect and strengthen supply management and also incrementally alter its quota allocation system so that it serves as a restraining force with regard to production-unit size and farm consolidation, and so that it provides a welcome and affordable entry to young and new farmers and those who want to operate small or mixed farms.
- Cap and target farm support programs so that this public money accomplishes the public purpose of maximizing the number of family farms on the land. (e.g. $3 million caps are inappropriate; 95 percent of Canada's farm operations would be fully covered by a cap of $400,000, and such a cap would alleviate the current situation wherein taxpayer money is facilitating ILO proliferation).
- Ban packer ownership of livestock ('captive supply') and the vertical integration of packers into livestock production.
- Encourage Canadian research and data collection that focuses explicitly on family farms; as well as research that provides comprehensive and wide ranging data regarding ILOs and their effects on family farms, the national economy, and the overall Canadian food system.

The Future of Farming in Canada:

- The current ILO standard of concentrating too many animals in too little a space has had numerous negative effects on rural communities, family farms, and farm workers. It is understood that many ILO facilities have relatively short life spans and many will need to be replaced in coming years, giving an opportunity to cost-effectively move to a different production model. Thus, we recommend a move to smaller, decentralized, more numerous, locally-owned and operated production units, as well as government policies, regulations, and incentives that will ensure a steady and orderly shift toward smaller units.
- As production units are decentralized and waste deconcentrated, manure disposal problems can become more manageable. Nevertheless, even for these smaller, decentralized operations, appropriate and effective regulations are needed and must be enforced. If any large ILO operations remain, there is little reason that these should not be required to meet the same waste disposal standards of other industrial operations.

References

AAFC. (2011). Agriculture and Agri-Food Canada, "Red Meat Market Information: Federally Inspected Hog Slaughter Plants," various years. Retrieved from: http://agr.gc.ca/redmeat/almrt30cal_eng.htm

Agriculture Canada. (2007). Rural Poverty Discussion Paper. Ottawa: A. Burns, D. Bruce & A. Marlin. Retrieved from: www.rural.gc.ca/RURAL/display-afficher.do?id=1247088095854&lang=eng

Brubaker, E. (2007). *Greener Pastures: Decentralizing the Regulation of Agricultural Pollution.* Toronto: The University of Toronto Press.

Canadian Environmental Law Association. (2000). "Discussion Paper on Intensive Agricultural Operations in Ontario." Brief No. 384. Submission to the Ministries of Agriculture, Food, and Rural Affairs and Environment.

CanFax. (2011). "Alberta & Saskatchewan Feedlot Demographics," January 1. Note that according to CanFax, "Alberta and Saskatchewan together feed 70 percent of Canada's finished cattle production."

Donham, K.J., Wing, S., Osterberg, D., Flora, J.L., Hodne, C., Kendall, M. &…Thorne, S. (2006). "Community Health and Socioeconomic Issues Surrounding Concentrated Animal Feeding Operations." *Environmental Health Perspectives*, Vol. 115, No. 2, 317-320.

Epp, R. (2001). "The Political De-Skilling of Rural Communities," In R. Epp & D. Whitson (Eds.), *Writing Off the Rural West: Globalization, Governments and the Transformation of Rural Communities*. (pp. 301-324). Edmonton: The University of Alberta Press/Parkland Institute.

Epp, R. (2003). "Beyond Our Own Backyards: Factory Farming and the Political Economy of Extraction" In A. M. Ervin (Ed.), *Beyond Factory Farming: Corporate Hog Barns and the Threat To Public Health, the Environment, and Rural Communities*. Saskatoon, Saskatchewan. Canadian Centre for Policy Alternatives – Saskatchewan.

Government of Canada. (2008). *Beyond FreeFall: Halting Rural Poverty: Final Report of the Senate Standing Committee on Agriculture and Forestry*. Ottawa. Retrieved from: www.parl.gc.ca/Content/SEN/Committee/392/agri/rep/rep09jun08-e.pdf

Hribar, C. (2010). *Concentrated Animal Feeding Operations and Their Impact on Communities*. National Association of Local Boards of Health. Retrieved from: www.nalboh.org

Ikerd, J. (2003). Corporate Livestock Production: Implications for Rural North America. In A. M. Ervin (Ed.), *Beyond Factory Farming: Corporate Hog Barns and the Threat To Public Health, the Environment, and Rural Communities*. Saskatoon, SK: Canadian Centre for Policy Alternatives-Saskatchewan.

Lobao, L.M. (2001). Industrialized Farming and Its Relationship to Community Well-Being: Report Prepared for the State of South Dakota, Office of the Attorney General. Expert testimony for the United States District Court, District of South Dakota, Central Division.

McCallum, J. (1980). *Unequal Beginnings: Agriculture and Economic Development in Quebec and Ontario*. Toronto: University of Toronto Press.

Mussell, A., Oginskyy, A., Grier, K., Morin, M., Lachance, M.P. & Whittington, L. (2010, December). An Overview of the Canadian Swine-Pork Sector. George Morris Centre, Centre de dévelopment du porc du Québec Inc., & Prairie Swine Centre.

OED. (2011). "Quality of Life" Oxford English Dictionary. Retrieved from: www.oed.com

Paton, B. (2003). The Smell of Intensive Pig Production on the Canadian Prairies. In A. M. Ervin (Ed.), *Beyond Factory Farming: Corporate Hog Barns and the Threat To Public Health, the Environment, and Rural Communities*. Saskatoon, SK: Canadian Centre for Policy Alternatives – Saskatchewan.

Pew Commission on Industrial Farm Animal Production (PCIFAP) (2008). Putting Meat on the Table: Industrial Farm Animal Production in America. Retrieved from: www.ncifap.org

Qualman, D. (2001). Corporate Hog Farming, The View From the Family Farm. In R. Epp & D. Whitson (Eds.), *Writing Off the Rural West: Globalization, Governments and the Transformation of Rural Communities* (pp. 21-39). Edmonton: The University of Alberta Press/Parkland Institute.

Starmer, E. & Wise, T. (2007, December). Feeding at the Trough: Industrial Livestock Firms Saved $35 billion From Low Feed Prices, Global Development and Environment Institute, Tufts University, Policy Brief No. 07-03.

Statistics Canada CANSIM table 002-0043. "Farm product prices, crops and livestock, monthly."

Statistics Canada CANSIM table 002-0053. "Average net program payments and average net market income of farms, by farm type, incorporated and unincorporated sectors, Canada and provinces, annual."

Statistics Canada CANSIM table 003-0070. "Average prices for selected livestock, monthly."

Statistics Canada CANSIM table 003-0088. "Hogs statistics, supply and disposition of hogs, quarterly."

Statistics Canada. (1997). CANSIM table 003-0089. "Hogs statistics, number of farms reporting and average number of hogs per farm, quarterly."

Statistics Canada. (2011). "Canadian Farm Financial Database: Taxation data program," online at http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&CANSIMFile=CFFD-BDFEAC\ESAS_SESA-eng.htm

Statistics Canada. (1997). Historical Overview of Canadian Agriculture, Cat. No. 93-358, August 14. Statistics Canada. 2006. Population, urban and rural, by province and territory.
Retrieved from: http://www40.statcan.ca/l01/cst01/demo62a-eng.htm

Tait, F. (2003). Pork, Politics and Power. In A. M. Ervin (Ed.), *Beyond Factory Farming: Corporate Hog Barns and the Threat To Public Health, the Environment, and Rural Communities*. Saskatoon, SK: Canadian Centre for Policy Alternatives – Saskatchewan.

Wiebe, N. Forthcoming. The Farm Crisis. In M. Koc, J. Sumner & T. Winson (Eds.), *Critical Perspectives in Food Studies*. Toronto: Oxford University Press.

Weida, W. J. (2002). "The Hog ILO, Its Implications for Rural Economies in Canada and the US and Comments on the Report to Joint Agricultural and Rural Affairs Committee and Planning and Development Committee and Council." Retreived from: www.sraproject.org/

Weida, B. (2003)."The ILO and Depopulation of Rural Agricultural Areas: Implications for Rural Economies in Canada and the US" In A. M. Ervin (Ed.), *Beyond Factory Farming: Corporate Hog Barns and the Threat To Public Health, the Environment, and Rural Communities*. Saskatoon, SK: Canadian Centre for Policy Alternatives – Saskatchewan.

Wing, S. & Wolf, S. (1999, May 6). Intensive Livestock Operations, Health and Quality of Life Among Eastern North Carolina Residents. Report prepared for the North Carolina Department of Health and Human Services.

Winson, A. (1985). The Uneven Development of Canadian Agriculture: Farming in the Maritimes and Ontario. *Canadian Journal of Sociology*, 10, 4, Fall.

Winson, A. (1993). *The Intimate Commodity: Food and the Development of the Agro Industrial Complex in Canada*. Toronto: Garamond Press.

Supply Management

What is Supply Management?

Darrin Qualman

In Canada, production of milk, chickens, turkeys, eggs, and baby chicks (hatching eggs) is governed by our supply management system. Supply management sets and stabilizes production volumes and farmers' prices, matching farmers' output to Canadian needs.

Without supply management, farmers who produce milk, eggs, and poultry would be in a bind. Unlike grain farmers, farmers who produce livestock and livestock products cannot store their products for months or years if short-term supplies are high and prices low. Therefore, processors have an advantage when negotiating with farmers, and production and prices can fluctuate significantly, often misaligning production with demand. Supply management is intended to eliminate the potential power imbalance and smooth fluctuations.

Canada's supply management system utilizes three main mechanisms or "pillars":

1. Production controls

Based on estimates of consumption, national and provincial quotas are set for dairy, egg, and poultry production. Individual farms then match their production to the amount of quota they hold. Farmers can buy and sell quota and thereby expand or reduce their output. Farmers are penalized if they over- or under-produce.

2. Prices based on farmers' costs of production

By utilizing farmers' actual production-cost data, supply management's price-setting mechanisms ensure that most farmers can pay their bills and earn a stable income to support their families.

3. Import controls

Supply management matches production by Canadian farmers to demand in Canadian markets. But surging and ebbing imports could destroy this balance. Canada uses tariffs to limit and manage the inflow of foreign dairy products, poultry, and eggs, allowing significant access to foreign producers but ensuring predictable supplies in Canadian markets.

Our supply management system has many benefits. The system:

- Prevents overproduction, wasted food, and the need to ‘dump’ surpluses into world markets, to the detriment of developing-nation producers;
- Helps localize and regionalize food production and processing;
- Raises efficiency by ensuring processing plants run at full capacity and by rationalizing the transport of dairy and other products;
- Provides fair, adequate, and stable prices to farmers and delivers dairy and poultry products to citizens at prices in line with retail prices in other nations;[22]
- Reduces farm support costs to taxpayers because it allows farmers to earn adequate incomes by selling their products.

Though a good system overall, supply management has shortcomings. One is that the cost of the production quota needed to form a viable farming operation tends to rise. High quota values/costs create an incentive for current farmers to exit and a barrier to new farmers wanting to enter, thus contributing to consolidation and production-unit enlargement.

[22] Retail prices of Canadian poultry, eggs, and milk compare favourably to other nations, even moreso if one takes into account higher taxpayer-financed subsidies in some nations, Canada’s often higher (often climate- and geography-related) production costs, and the higher percentage of the retail price farmers here receive. See Daniel-Mercier Gouin (Groupe de recherche en économie et politique agricoles, Département d’économie agroalimentaire et des sciences de la consommation, Université Laval), Supply Management in the Dairy Sector: Still an Appropriate Regulation Method, September 2004, pp. 46, 52-56; Daniel-Mercier Gouin, Comparative Analysis of the Performance of Poultry Sector Regulatory Systems in Canada, United States, France and Australia, Summary, November 2005, pp. 6-7; Fédération des producteurs de lait du Quebec, Supply Management and Collective Milk Marketing: Recognizing the Agricultural Exception, April 2010, p. 8; and Paul Waldie, “Canadians Don’t Know the Price of Milk,” Globe and Mail, Nov. 23, 2010.

Supply Management Barriers to Humane and Sustainable Egg Production

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Although Canada's supply management system has many benefits as Darrin Qualman has noted, it has also presented many barriers to small farmers who use alternative production practices, often to increase welfare standards or sustainability. While supply management creates income and supply stability, some producers argue it also encourages industrial scale conformity (O'Reilly, 2008).

In Canada, the transition to higher welfare practices within the supply managed sectors has progressed slowly, and is particularly contentious within the egg industry. Supply management seemingly favours the large egg producers that keep hens in battery cages because 1) they produce a uniform product in predictable amounts that is sufficiently served by a general marketing campaign; 2) they benefit from greater economies of scale and are more likely able to afford the high price of quota; and 3) the price the marketing board sets for eggs is based on the cheaper cost of producing eggs from caged hens.

Each year, the national egg marketing board – Egg Farmers of Canada – decides whether or not there will be an increase or decrease in egg production, and how this change in registered quota will be allocated among the provinces. Each province then has its own egg marketing board, which is responsible for allocating the quota to either regular (conventional) or specialty and cage-free (free-run, free-range, organic) egg production. When there is an increase, all registered producers receive a percentage over and above their existing quota levels (at no charge), while new and non-registered producers must either buy quota, or be granted quota by the provincial egg board through some other means (e.g. British Columbia (BC) recently implemented a lottery system).

Non-registered egg farmers are allowed to keep a small number of hens without purchasing quota and the maximum number varies province to province. In Ontario, an egg farmer can have up to 100 laying hens without quota for farm gate sales. However, some farmers are permitted to keep up to 500 hens without quota because they were grandfathered into the regulations (FarmStart, 2011). Prince Edward Island farmers are allowed to have up to 299 hens without purchasing quota but the egg producers association wants to decrease that number (CBC News, 2010). If a farmer wants a bigger flock, he/she has to purchase quota.

As of September 2011, the cost of quota was $240 per hen in Ontario, 17 percent higher than the previous year (The Farm Team, 2011). In Quebec, the price of quota increased by 120 percent between 2002 and 2007 (Commission sur l'avenir de l'agriculture et de l'agroalimentaire québécois, 2008). Since the egg industry is 'regulated', quota value is not a reflection of an open, competitive market. Instead it is established by a sealed bidding process wherein quota is bought and sold on a private 'quota exchange' that is overseen by the provincial egg boards. Most often quota is purchased by the largest quota holders that are involved in battery cage egg production because they can afford the extraordinary cost of tying up large amounts of capital.

Some small-scale producers believe it doesn't make any economic sense for them to purchase quota to meet increasing demand for their cage-free eggs (S. Cooper, personal communication, September 2011). They have significantly higher production costs which in turn, reduce the affordability of purchasing quota, paying the levy and grading their own eggs. The price the marketing board sets for cage-free eggs may not adequately consider the higher production costs associated with more humane and sustainable farming methods. For example, organic farmers have to be compensated for the higher costs of certifying their farms, using certified feed, hiring additional labour, needing more land and furnishing their barns with perches and nest boxes. A formal cost of production analysis by the marketing boards would confirm whether the set price for cage-free eggs is sufficient. In addition, many cage-free producers feel it is totally inequitable that they have to pay a levy to support a system that doesn't support them, and compensate large-scale cage egg producers for the losses they created from producing surplus eggs.

The very fact there is a surplus of conventional eggs calls into question the effectiveness of a system that is supposed to match changing consumer demands with supply. Polls indicate Canadians are becoming increasingly concerned about how their food is produced and more supportive of higher animal welfare standards (Harris/Decima, 2010; Harris/Decima, 2009; Harris/Decima, 2008; Decima Research, 2005). Several academic institutions and major grocery and restaurant chains have adopted cage-free egg purchasing policies – a good indicator of where the market is headed (McConnachie, 2010; WSPA, 2011). Additionally, a number of food businesses such as Unilever (for its Hellmann's brand mayonnaise) and Compass Group have expressed their intent to use more cage-free eggs once more consistent supply and reasonable pricing becomes available in Canada (McConnachie, 2010).

Despite the steadily increasing demand for more humane food such as cage-free eggs, grocery store shelves do not reflect a commensurate selection of choice to the consumer. Because stores typically stock and sell what the industry provides them[23], consumers looking for cage free eggs may face the difficult choice of going home empty handed, visiting a second or third store or settling for conventional battery cage eggs. Consequently, in some provinces a black market for cage-free eggs is emerging with farmers selling ungraded eggs outside the farm gate[24] to consumers who are willing to pay more for them (Elton, 2010).

However, farmers are prohibited from selling ungraded eggs outside the farm gate in most provinces, and it is expensive for farmers to set up their own grading station. As well,

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[23] Supply is even more restricted if retailers want additional product from a particular brand or egg producer whose bid for additional quota has been denied by the provincial egg board. If there is insufficient domestic supply of cage-free eggs, retailers are also dependent on the graders' willingness to locate product from the US through an import permit. Graders can choose not to import. Stores can use their buying power to pressure graders/producers into providing more differentiated products, but should the industry fail to meet their requirements, stores have no recourse unless they can convince the Federal Department of Foreign Affairs and International Trade to grant them an import permit.

[24] According to Egg Farmers of Ontario, 'farm gate sales' are "an egg sale transaction that takes place right at the farm – where the eggs are produced on the producer's own farm, are clean and not leaking and are sold or offered for sale only on the farm premises to consumers for their own consumption." However there is a movement to have farmers' markets recognized as an extension of the farm gate.

- **Demand is increasing for more humane food options, like eggs from hens raised in a free-range system rather than those from hens kept in battery cages**

cage-free producers face another challenge: finding a nearby grader that will buy their 'specialty eggs'. Conveniently located grading stations are difficult to find because the major graders are consolidating and centralizing their stations, putting smaller and regional grading stations out of business in an effort to control the market. Investigative journalist Jim Romahn says that "Burnbrae and Gray Ridge own more than 90 percent of the egg-grading business in Ontario, they both have dominant companies in Quebec and they have other significant operations in other provinces, including BC, Alberta and Manitoba" (Romahn, 2011a).

As a way to encourage new farmers and alternative production systems, some farmers and farming organizations have recommended an increase in the number of hens a farmer can have without quota (FarmStart, 2010; H. Stoll, personal communication, June 2011). According to Svante Lind, a former producer and grader of cage-free eggs, a quota and levy exemption for 3,000 cage-free hens would encourage more economically viable alternative egg production in Ontario (Lind, 2009). Mr. Lind closed down his grading station because he couldn't get enough eggs to keep the operation profitable and blames supply management and the biggest egg companies which control it. "...the market is controlled by two major national individuals, at the expense of small Canadian family farms. These individuals have enormous influence and control the egg marketing boards....Many family farms are left with no alternative but to conform, or cease cage-free production, grading and local marketing altogether," says Mr. Lind (Lind, 2008) who is now suing these companies for allegedly conspiring to drive him out of the egg grading business. It is an allegation that investigative journalist Jim Romahn discovered has been made before (Romahn, 2011b).

Under public pressure from consumers, farmers and animal advocates, some provinces are taking progressive steps to increase cage-free production. Following a public hearing process, the BC Farm Industry Review Board (BCFIRB) – a quasi-judicial appeal body sanctioned by the BC Ministry of Agriculture and commodity marketing boards – directed their provincial egg board to increase production of cage-free 'specialty' eggs after determining it was under-serving consumer demand (BCFIRB, 2010; Shore, 2010a). BC now allocates the highest amount of their registered provincial quota (soon to be 15 percent) to cage-free production, but still falls short of local demand (Bejaei et al, 2011; Shore, 2010b). In comparison, Quebec only allocated 1.7 percent of its registered quota to cage-free production in 2010 (La Fédération des producteurs d'oeufs de consommation du Québec, 2011). As well, BC's quota allocation method has been heavily criticized for not distributing to qualified, barn-ready applicants (McConnachie, 2010). As one organic egg grader reportedly told the Vancouver Sun, "I have to short my customers about 40 percent on their orders because I can't get enough product. If we weren't shorting our market, our growth could be 50 to 60 percent, but there's a very limited supply" (Shore, 2010a). This grader tried to convince the BC Egg Marketing Board that they needed to allocate more quota towards cage-free production to meet demand, but the Board disagreed with his request. Furthermore, cage-free eggs were imported from the US and other provinces to meet some of BC's demand, despite the fact that local farmers were ready and able to produce these eggs (Sakalauskas, 2010; McConnachie, 2010).

Some farmers have complained that the core of the problem stems from the composition and authority of the marketing boards which are dominated by the major egg companies (Romahn, 2011b; S. Lind, personal communication, September 2011). The bias towards the production systems of the dominant players appears clear, and a more diverse board membership would go a long way to dilute vested interests. Ann Slater, President of the Ecological Farmers Association of Ontario says "having an organic farmer sitting at the board table could be quite helpful in pushing for the changes needed to better facilitate organic and niche production" (Slater, 2007) while others have suggested the need to establish a separate marketing board for 'specialty' producers.

A recent report by FarmStart, an organization that encourages new farmers to develop local, ecologically sound and economically viable enterprises, presents a number of options for reforming supply management, including:

- increasing quota exemptions
- developing alternative markets that are not subject to quotas
- decreasing minimum quota levels
- establishing separate quotas for specialty products
- offering exemptions for specialty products
- offering exemptions for producers who sell through direct marketing
- setting aside a certain amount of processing capacity for alternative producers

We should be providing more incentives to encourage production practices that meet higher animal welfare and environmental standards, not obstructing and penalizing them. Provincial governments and marketing boards should take heed of the global trend towards improving farm animal welfare – an issue of increasing importance to international trade.

Policy recommendations

Provincial governments and the boards that supervise the marketing boards should:

- Commission a market analysis of cage-free egg production in their province and ensure quota is being allocated to meet the increasing demand.
- Direct marketing boards to implement a fair egg pricing system that compensates for the higher cost of producing cage-free eggs and incorporates the external costs to public health and the environment resulting from caged production.
- Use producer levies to further stimulate the market for locally, humanely and sustainably produced eggs and help farmers transition to cage-free production systems.
- Review options for reforming supply management so that it fosters rather than restricts the production of humane and sustainable food. Options and recommendations for reform have been presented by FarmStart in "New Farmers and Alternative Markets Within the Supply Management System" and George Leroux in his 2004 report, "Recommendations for Managing Specialty Agri-Food Products in BC's Supply Managed System" prepared for the BC Minister of Agriculture Food and Fisheries.
- Investigate ways to restructure marketing boards so that the perspectives of alternative producers (organic, free-run, etc.) food retailers and consumers are represented and have the ability to influence decisions that impact their livelihoods.

References

Bejaei, M., Wiseman, K., & Cheng, K.M. (2011). "Influences of demographic characteristics, attitudes, and preferences of consumers on table egg consumption in British Columbia, Canada." *Poult Sci.*, 90 (5), 1088-95.

British Columbia Farm Industry Review Board (BCFIRB). (2010). Prior Approval Review of the British Columbia Egg Marketing Board 2010 Quota Distribution Policy. November 5, 2010. pp. 14-15.

CBC News. (2010, Feb 17). Small egg producers dispute need for new rules. *CBC*.

Commission sur l'avenir de l'agriculture et de l'agroalimentaire québécois. (2008). *Agriculture et agroalimentaire : assurer et bâtir l'avenir*.

Decima Research. (2005). *WSPA/CCFA – Farm Animal Welfare*. This study was commissioned by the WSPA and the Canadian Coalition for Farm Animals (CCFA) and conducted by Decima Research between November 10-13, 2005. A total of 1028 Canadians were surveyed, and the corresponding margin of error is +/- 3.1%, 19 times out of 20.

Elton, Sarah. (2010, Feb 23). The 'egg police' crack down on local grey market eggs. *Globe and Mail*.

FarmStart. (2010, June). *New Farmers and Alternative Markets Within the Supply Management System*. Metcalf Food Solutions.

Harris/Decima. (2010). *WSPA – Humane Treatment of Animals*. This study was commissioned by the WSPA and conducted by Harris/Decima between October 26 - November 7, 2010. A total of 1,007 Canadians were surveyed, and the corresponding margin of error is +/- 3.1%, 19 times out of 20.

Harris/Decima. (2009). *VHS – Battery Cages*. This study was commissioned by VHS and conducted by Harris/Decima between December 3-13 2009. A total of 2,012 Canadians were surveyed using teleVox (telephone omnibus), and the corresponding margin of error is +/- 2.2%, 19 times out of 20.

Harris/Decima. (2008). *WSPA – Farm Animal Welfare*. This study was commissioned by WSPA and conducted by Harris/Decima between January 10-13, 2008. Results are based on a sample of 1,013 Canadians, and the corresponding margin of error is ±3.1%, 19 times out of 20.

La Fédération des producteurs d'oeufs de consommation du Québec (FPOCQ) (2011, avril 14). Rapport annuel 10-11. p. 17.

Lind, Svante. (2008, Sept 19). Letter to the Right Honourable Stephen Harper. Verified Eggs Canada. Retrieved from: www.humanefood.ca/pdf%20links/Supply_management_letter.pdf

Lind, Svante. (2009, May 5). Traceability guidance, solutions and improvements to better satisfy Canadian consumers' demands for product value, food safety and bird welfare. Verified Eggs Canada Proposal. Blackstock, ON.

McConnachie, Leanne. (2010, July 10). VHS Letter to BCFIRB and BCEMB regarding BCEMEB New Producer Program Lottery Review. p. 18-16. Retrieved from: www.firb.gov.bc.ca/reports/eggs/10_jul_16_stakeholder_submissions.pdf

O'Reilly, Gwen. (2008). Orderly Marketing in Canada. Canadian Organic Growers. Winter Newsletter 2008. p. 30-33. Retrieved from: www.cog.ca/documents/TCOG/08Winter-MarketingWinter08.pdf

Romahn, Jim. (2011a). Hudson buys Vermont's largest farm. Agri 007 Blog Post. May 24 2011. Retrieved from: http://agri007.blogspot.com/2011/05/hudson-buys-vermonts-largest-farm.html

Romahn, Jim. (2011b). Egg industry business deals. *Agri 007 Blog Post*. July 7 2011.
Retrieved from: http://agri007.blogspot.com/2011/07/egg-industry-business-deals.html
Gray Ridge squeezes competitors. *Agri 007 Blog Post*. April 28 2011.
Retrieved from: http://agri007.blogspot.com/2011/04/gray-ridge-squeezes-competitors.html
BC's small egg graders disgruntled. *Agri 007 Blog Post*. Aug12 2011.
Retrieved from: http://agri007.blogspot.com/2011/08/bcs-small-egg-graders-disgruntled.html

Sakalauskas, A. (2010, Aug 4). 2010 Quota Distribution Policy. BCEMB. pp. 4-5.

Shore, Randy. (2010a). Cracks are showing in the egg market. The public wants cage-free eggs, so why is the industry so slow to respond? *Vancouver Sun*. April 10 2011. Retrieved from: www.canada.com/story_print.html?id=194986b3-c29e-4d62-b18c-0ac580594c3d

Shore, Randy. (2010b). BC farmers to boost production of specialty eggs. *Vancouver Sun*. Dec 1 2010. Retrieved from: www.canada.com/story_print.html?id=9180bbf1-92e5-434f-aa04-3ced3c3c6155&sponsor

Slater, Ann. (2008). President's Message from the September/October 2007 edition of Ecological Farming in Ontario. Canadian Organic Growers. Winter Newsletter 2008. p. 31. Retrieved from: www.cog.ca/documents/TCOG/08Winter-MarketingWinter08.pdf

The Farm Team. (2011). Quota History. Retrieved from: www.farmsincanada.ca/quota_history.html

WSPA. (2011). Leaders Choosing Cage Free Eggs. Retrieved from: www.choosecagefree.ca/leaders.html

Environment

The Environmental Impacts of Intensive Livestock Operations in Canada

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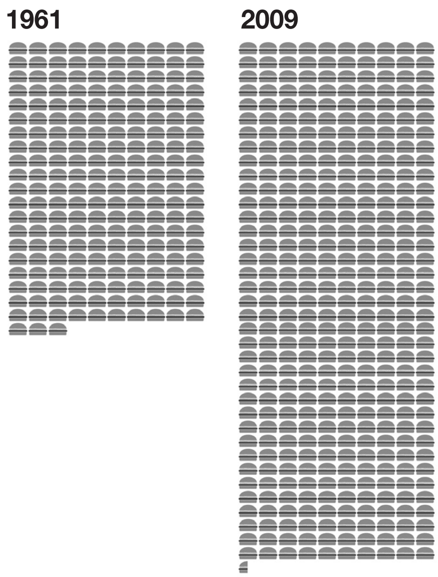
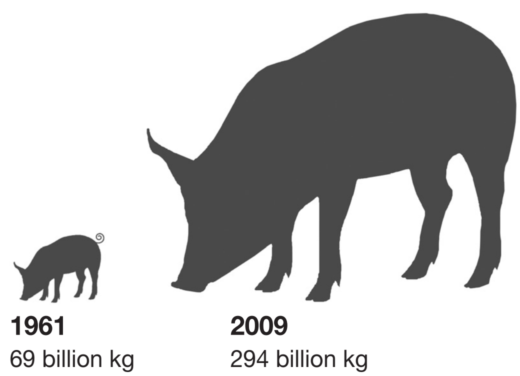
Introduction: The meatification of diets and the industrialization of livestock production



In 1961, the average person consumed 23 kg of meat a year; by 2009 the amount had jumped to 42 kg a year.

The consumption of meat, eggs, dairy, and seafood products has increased dramatically on a world scale, and for decades animal products have been among the fastest growing segments of global food consumption patterns. Over the past half century, world meat production nearly quadrupled, resulting in a sharp rise in per capita meat consumption. In 1961, in a world of roughly three billion people, the average person on earth consumed 23 kg of meat. In 2009, in a world of roughly seven billion people, the average person on earth consumed 42 kg of meat, as well as much more milk and eggs.[25] Rising meat consumption has increasingly been recognized as a major, multidimensional environmental issue on a world scale (D'Silva and Webster, 2010; Jarosz, 2009; Goodland and Anhang, 2009; Pew Commission on Industrial Farm Production (PCIFAP), 2008; Halweil and Nierenberg, 2008; Steinfeld et al., 2006; Nierenberg, 2005; WorldWatch, 2004; Pimentel and Pimentel, 2003; Rifkin, 1992; Mason and Singer, 1990).

The shift of animal products from the periphery of human consumption patterns, where it has been for most of the history of agriculture, to the centre, is a recent phenomenon that has been described as the 'meatification' of diets (Weis, 2010a; 2007). The meatification of diets is, however, highly uneven on a world scale, with increases tied very closely to affluence. Simply put, wealthy countries consume far more animal products per capita than do poorer countries, and wealthy people in poor countries tend to consume far more animal products than do the poor majorities (Halweil

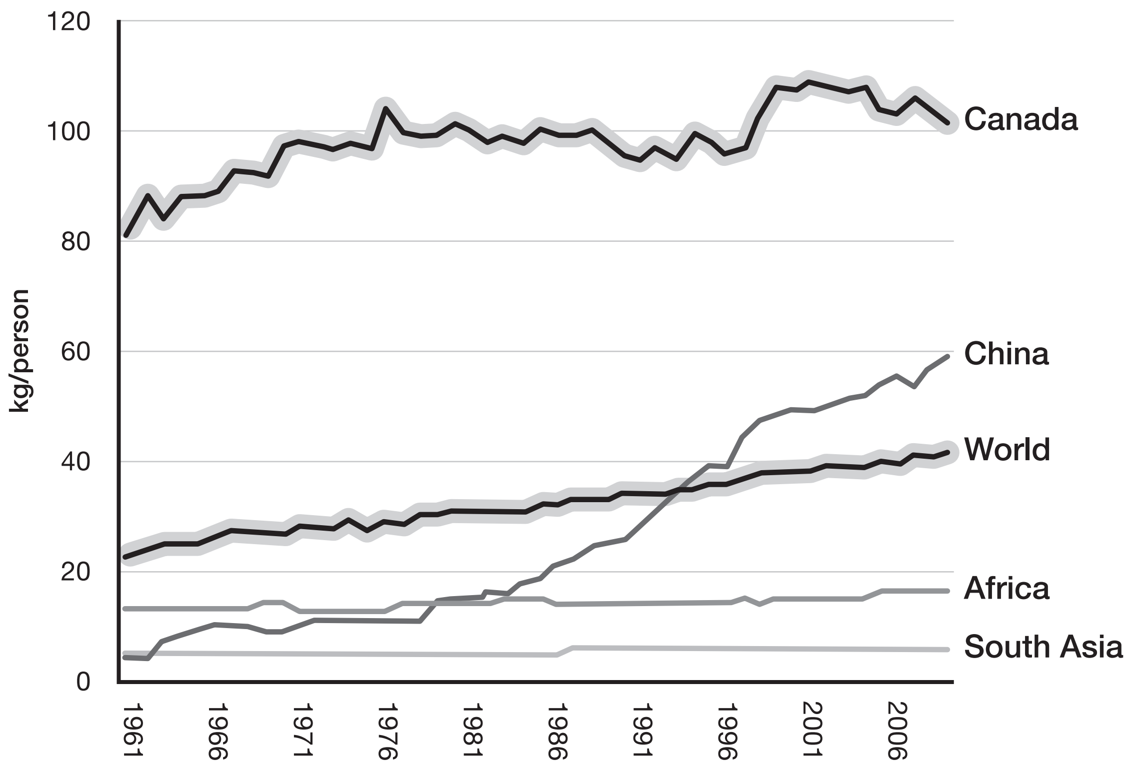


The increase in meat consumption coupled with global population growth means that people are eating more than four times the amount of meat they were consuming 50 years ago.

[25] These statistics are derived from FAOSTAT (2011).

and Nierenberg, 2008; Nierenberg, 2005; Myers and Kent, 2003).[26] Canada sits near the top of the world animal 'protein ladder'. In 2009, Canada's per capita meat consumption was 102 kg, six times more than the average in Africa (16 kg) and 17 times more than the average in South Asia (6 kg). Catching up to levels of meat consumption in wealthy countries like Canada is a significant aspect of development aspirations in fast-industrializing countries like China, where per capita meat consumption soared from 4 to 59 kg over the past half-century.[27] China now produces and consumes roughly half of the world's total pig meat (Schneider, 2011; Nierenberg, 2005) (see Figure 1).

Figure 1. Per Capita Meat Consumption, selected examples



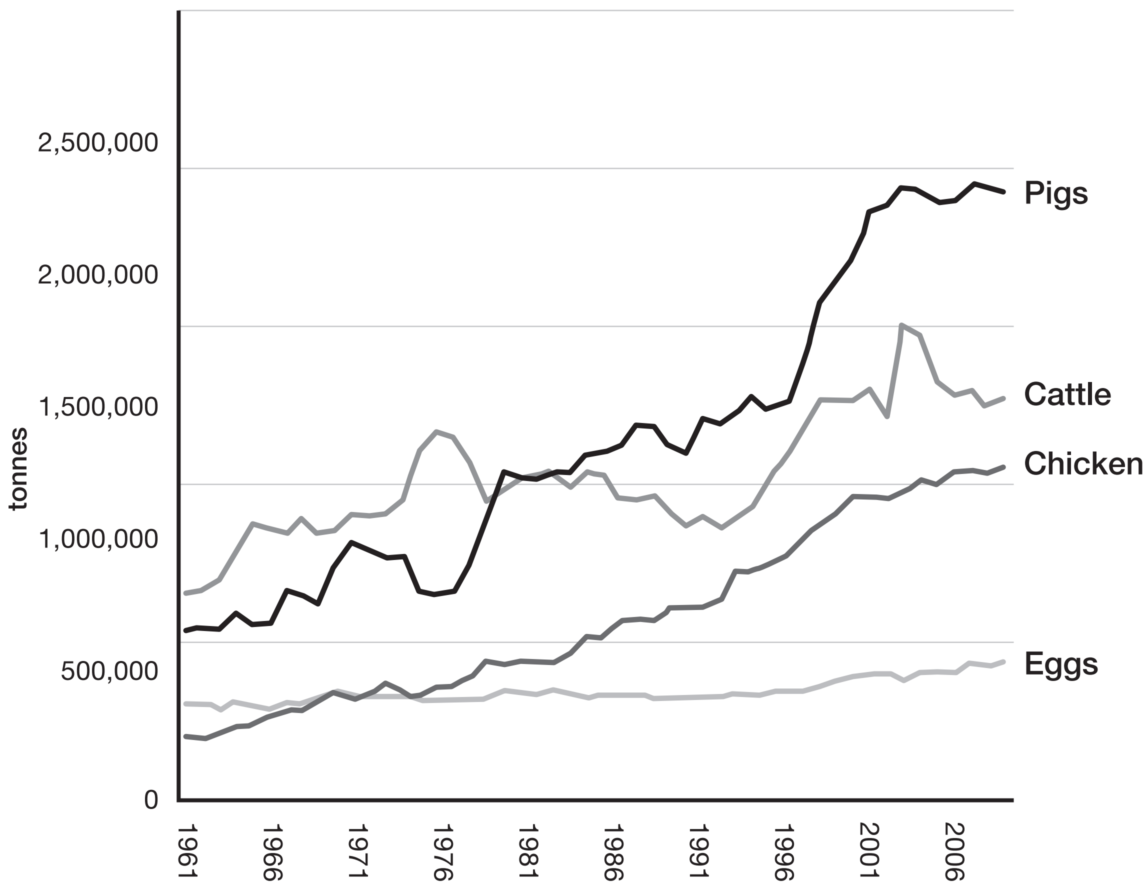
Source: FAOSTATS

[26] For example, the annual per capita consumption of meat in industrialized countries rose from 62 kg in the mid-1960s to 88 kg by the late 1990s, and is expected to top 100 kg by 2030, while for annual per capita meat consumption in developing countries was only 10 kg in the mid-1960s, 26 kg by the late 1990s, and is projected to rise to almost 37 kg by 2030 (FAO, 2003). Though this broad picture is valuable, it conceals wide disparities between and within developing countries.

[27] These statistics for per capita meat consumption were derived by adding total production and imports and subtracting exports, then averaging these against the total population (FAOSTAT, 2011).

The industrialization of livestock production – and what are variously labelled 'Intensive Livestock Operations' (ILOs), 'concentrated animal feeding operations' (CAFOs), or simply factory farming – is driving this global picture of rising and uneven animal production and consumption (Weis, 2010a; Steinfeld et al., 2006; Pimentel, 2004; Myers and Kent, 2003). ILOs are a core feature of 'the industrial grain-oilseed-livestock complex', a system of agriculture in which large-scale, input-intensive grain and oilseed monocultures (and a very small range of crop varieties) dominate agricultural landscapes, and large volumes of production are cycled through soaring populations of concentrated livestock, predominantly pigs, poultry, and cattle (Weis, 2010ab; 2007).[28] In Canada, roughly 80 percent of the total volume of agricultural production comes from the industrial grain-oilseed-livestock complex (Weis, 2010c), with meat production concentrated on pigs (43 percent in 2010), cattle (29 percent), and chickens (24 percent) (see Figure 2). In 2010, this involved the slaughter of over 640 million chickens, over 21 million pigs, and almost four million cows.

Figure 2. Meat and Egg Production in Canada, 1961 - 2009



Source: FAOSTATS

[28] The industrialization of livestock production has also profoundly narrowed the genetic base for farmed animals and contributed to the extinction of some livestock breeds. The FAO's Global Databank for Farm Animal Genetic Resources lists more than 7600 livestock breeds, of which 190 have recently become extinct and 1500 are identified as being 'at risk' of extinction (FAO, 2007).

> "From 1976 to 2006, the number of pigs on an average Canadian farm leapt 14-fold...while the number of farmers raising pigs fell more than 5-fold."

The competitive pressures associated with industrialization have placed a long-term squeeze on farmers, who must grow in scale in order to cope with thin margins, producing a steep decline in farming livelihoods. From 1976 to 2006, the number of pigs on an average Canadian farm leapt 14-fold, the number of hens and chickens on an average Canadian farm grew more than 6-fold, and the number of cattle on an average Canadian farm doubled. Over the same period, the number of farmers raising pigs fell more than 5-fold, the number of farmers raising chickens declined more than 4-fold, and the number of farmers raising cattle fell by half (StatsCan, 2007, Tables 2.12; 2.13; 2.16). Beyond its environmental impacts, the ever-increasing industrialization of agriculture and livestock production is also clearly destroying many agricultural livelihoods.

Unpacking the environmental burden of ILOs

Through most of the 10,000 year history of agriculture, small, mixed livestock populations have been part of integrated farming systems that depend on locally-oriented cycles of nutrients and energy. Within these systems, relatively small livestock populations have historically scavenged on farm and household wastes, pastured on fallowed land, produced valuable fertilizer, and provided traction, as well as foraging on inedible grasses and plants on land not suitable for cultivation.[29] In contrast, within the industrial grain-oilseed-livestock complex, crops and animals are physically disarticulated within landscapes, which are biologically simplified and standardized to enable mechanization and economies of scale. Crops and livestock are then re-articulated through feed concentrates which move across greater distances, not only within landscapes, but across countries and increasingly even as internationally traded commodities. The resulting output has allowed livestock populations to soar beyond former densities and meat consumption to rise to historically unprecedented levels.

But this bounty is highly unstable. The process of simplification and standardization either creates or magnifies a range of biological and physical instabilities, such as soil erosion and pest and disease problems. These are, in turn, overridden through an array of external inputs, or 'biophysical overrides', including fertilizers, agro-chemicals, and animal pharmaceuticals. This system can thus be seen to hinge on constant flows of feed, water, energy, fertilizers, agro-chemicals, animal pharmaceuticals and other inputs – or 'biophysical overrides' – which must frequently be transported over long distances (Weis, 2010b; McIntyre et al. 2009; Barker, 2007).

One of the underlying premises behind ILOs is that intensive confinement, concentrated feed, and long-term genetic enhancements increase the efficiency of meat production, accelerating animal growth and reproduction and thereby reducing costs. Yet these reduced economic

[29] This is not to romanticize the stability of all pre-industrial agriculture, as declining soil fertility has been at the root of the decline of civilizations through history (Montgomery, 2007).

costs are only made possible by the fact that so many environmental costs are simply not counted (or are *externalized*). The image of ILOs as an efficient system of production belies:

> "[r]educed economic costs are only made possible by the fact that so many environmental costs are simply not counted."

- the biophysical instabilities associated with the industrialization of grain, oilseed, and livestock production;
- the biophysical overrides this system demands and the associated environmental costs (that are embedded both in their manufacture and movement); and,
- the inherent inefficiencies in cycling feed through livestock to produce food, as much of the protein and other nutritional content of grains and oilseeds is burned in the metabolism of livestock before it is converted into edible animal protein (Godfray et al., 2010; Goodland and Anhang, 2009; PCIFAP, 2008; Pimentel, 2004; Pimentel and Pimentel, 2003; Gilland, 2002).[30]

Thus, the environmental burden of ILOs must be appreciated at two levels:

1) the resource budgets and pollution burdens of industrial grains and oilseeds consumed, inefficiently, in ILOs; and,

2) the resource budgets and pollution burdens of ILOs themselves.

Taken together, the industrialization of livestock and the meatification of diets can be seen to exert a large 'ecological hoofprint' (Weis, 2010a; 2007), as feed conversion inefficiencies and ILOs serve to greatly magnify agriculture's land, water, energy, and resource budget as well as its pollution burden (Weis, 2010a; Jarosz, 2009; McMichael et al., 2007; Leitzmann, 2003; Pimentel and Pimentel, 2003; Gilland, 2002; Mason and Singer, 1990). While many of these dynamics intersect, they are approached here at three basic levels: land, water, and atmosphere.

Land use, degradation, and biodiversity loss

Livestock production occupies roughly 30 percent of the earth's ice-free land surface, much of this through grazing on pastures and rangelands, while industrial livestock production effectively occupies one-third of all arable land through its pull on world grain and oilseed harvests (see Figure 3).[31] Together, this makes livestock production "by far the single largest anthropogenic user of land" and the leading cause of land degradation, with overgrazing on dry rangelands a leading cause of desertification (Steinfeld et al., 2006: xxi). This vast land footprint makes agriculture the "largest threat to biodiversity and ecosystem function of any single human activity" (MEA, 2005: 777). The loss of ecosystems and biodiversity is sometimes described

[30] This varies considerably from species to species. In general, monogastric animals like poultry and pigs make more efficient use of concentrate feed than do cattle, sheep, and goats, but metabolic losses still mean much greater land and resource usage in comparison to plant-centred diets (Pimentel, 2004; Pimentel and Pimentel, 2003).

[31] Roughly one-tenth of the earth's land surface is classed as arable. Industrially-reared livestock consume more than a third of the world's grain harvest, and a much greater share of all oilseeds (Steinfeld et al., 2006).

in terms of 'ecosystem services' in order to translate ecological degradation into measurable economic costs and highlight the underappreciated dependence of human societies upon natural processes, from large-scale biogeochemical cycles to pollination and soil formation. On a world scale, livestock has its most devastating impact on biodiversity where tropical rainforests are destroyed to make way for low-density cattle ranching.[32] However, the expansion of ranching and feed crop production has also displaced large areas of forests, wetlands, and native grasslands in temperate countries.

Figure 3. The magnitude of livestock production in global land use

Total land for grazing	Pastures and rangelands degraded by overgrazing, compassion, and erosion	Total land in feed crops
3433 million hectares 26% of ice-free land surface	20% of total pasture and rangeland	471 million hectares 33% of arable land

Source: Steinfeld et al., 2006, 271

In Canada, agriculture occupies roughly seven percent of the total land area (FPTGC, 2010), a much smaller share than in most of the world as a result of Canada's vast boreal forest and northern lands. Canada's arable lands are dominated by wheat, coarse grains (e.g. barley, maize), and oilseeds (e.g. canola, soybeans), with most coarse grains and oilseeds devoted to livestock feed. Extensive pasture and ranching and feedlot production are also very important in the western provinces.

Both feed crop production and extensive grazing are major factors in the loss of ecosystems and biodiversity in Canada. Some biomes, like the Tallgrass Prairie in Manitoba and Saskatchewan and the Carolian Forest in Ontario, have been reduced to miniscule patches within landscapes dominated by ranching, monocultures, and ILOs. Among the major biomes in Canada, the greatest areal decline (relative to the extent at the time of European arrival) has been across native grasslands. This stems from the fact that the "natural disturbance regimes that historically maintained grasslands have been altered, in particular the suppression of fire and replacement of free-ranging bison with confined cattle have modified the structure and composition of native grasslands," change which has been compounded by the fact that "many of the richest soils have been cultivated, leaving remaining grasslands on less productive soils" (FPTGC, 2010, 19; Sampson and Knopf, 1994). The decline of mixed grass prairies by the early 1990s is evident in Figure 4.

[32] In recent years, industrial soybean production for animal feed has also become a major cause of forest clearance in the Brazilian Amazon.

Figure 4. Estimated historic and current declines of the mixed grass prairies in Canada

Mixed Grass	Historic (ha)	Early 1990s (ha)	Decline (%)
Alberta	8,700,000	3,400,000	61.0
Manitoba	600,000	300	99.9
Saskatchewan	2,500,000	467,500	81.3

Source: Sampson and Knopf, 1994

Historically, many farms in Canada had more forest patches, wetlands, and semi-natural areas next to cultivated fields, which support a range of plant and animal life. However, significant amounts of these areas have been cleared or drained for cropland since the 1980s, and this conversion, along with a generalized intensification of agricultural land use, has meant that "the capacity of agricultural landscapes to support wildlife in Canada has declined over the past 20 years" (FPTGC, 2010:79).[33] This trend is especially worrying since agricultural landscapes are known to provide some habitat for over 550 species of terrestrial vertebrates in Canada, including roughly half of all species recently classed as being 'at risk' (FPTGC, 2010).

In addition to reducing space for ecosystems and other species, the footprint of pastures and feed crop monocultures must be understood in terms of their impact on the quality of land they occupy. Overgrazing on arid pastureland is a significant problem in the Canadian west, especially in parts of Alberta where large cattle populations are confined at high densities, and in places like stream banks, trails, and watering areas where animals tend to concentrate. These excessive concentrations can negatively impact on soil health and plant diversity, through compaction, removal of groundcover, and erosion of exposed soils, with eroded materials eventually discharging into waterways (Steinfeld et al, 2006).

Feed crops, like all industrial monocultures, accelerate soil erosion and diminish soil biota, due to the reduced ground-cover, the absence of long-term fallowing periods, the lack of organic material from small livestock populations, and cycles of repeated compaction by heavy machinery from seeding to harvesting.[34] To compensate for diminished soil productivity (or 'override' this problem inherent in industrial monocultures) they depend on continuous flows of industrial fertilizers, principally nitrogen (N), phosphorous (P), and potassium (K) (McIntyre et al., 2009; Montgomery, 2007; Pimentel, 2006; McKenney, 2002; Warshall, 2002). Industrial monocultures also depend upon continuous flows of agro-chemicals to contain heightened pest problems, and these chemicals further diminish soil biota and raise a host of other health issues as they biologically accumulate (McIntyre et al., 2009; Moore, 2002). The problem of decreasing organic matter and soil erosion and runoff has long been recognized as a major problem for Canadian agriculture (Hall, 1998; Charest, 1991).

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[33] This report estimated that Canada lost roughly 5 percent of its total wetland area in only a decade and a half, from 1985 to 2001 (FPTGC, 2010).

[34] Across large areas of Canada, industrial farmers have increasingly adopted a process of 'direct seeding' or 'no till' planting, which reduces the erosive impacts historically associated with repeated tillage and leaves more groundcover. Like many technological fixes, this has reduced the degree of impacts, but has not solved the fundamental problems of soil erosion in monocultures.

■ **Untreated waste from ILOs is used as fertilizer and sprayed onto crops potentially spreading pathogens and other contaminants.**

Another impact of reduced soil cover and biota is diminished soil moisture retention capacity, and this along with the 'thirstier' nature of high-yielding seed types serves to heighten irrigation demands. In addition to increasing freshwater consumption and ecosystem disruption, discussed below, excessive irrigation is a major factor in the salinization of agricultural land (i.e. the presence of salt concentrations high enough to negatively affect yield and, at worst, render soils infertile). In 1984, a Senate Standing Committee sounded an alarm over the extent of salinization in Canada, estimating its cost at more than $1 billion in lost annual income for Canadian farmers, documenting how yields had been found to decline by 10 to 75 percent on affected lands in the Prairies (in spite of increasing fertilizer consumption), and warning that "we are clearly in danger of squandering the very soil resource on which our agricultural industry depends" (SSCAFF, 1984).

At the same time as the recycling of valuable organic matter has radically declined on industrial farms, ILOs are generating vast, unhealthy volumes of animal waste that require complex technological systems of management. In smaller-scale, integrated farming systems, animal wastes are distributed at low densities across a landscape or, when taken from barns and barnyards, often collected in straw bedding to compost before being applied onto fields. Because many potentially pathogenic micro-organisms die off in the

"The slurry of feces, urine, uneaten food, and water which emerges from ILOs is frequently laden with drug residues, heavy metals, pathogens, and heavy NPK loads…its usage can lead to the spread of pathogens that may contaminate crops…"

composting process, it reduces contamination risks while leaving behind a rich source of nutrients and humus to be recycled as fertilizer on the land (Shepherd Jr. et al., 2010; FAO, 2005). However, the great densities of animals generate much more feces and urine than can be absorbed in the immediate vicinity of these production sites, while unnatural animal diets (e.g. feed concentrates containing agro-chemical residues; supplements to enhance weight gain) and the biophysical overrides for animal health in unnatural densities (e.g. the proliferation of animal pharmaceuticals) make its handing and usage even more difficult, since the slurry of feces, urine, uneaten food, and water which emerges from ILOs is frequently laden with drug residues, heavy metals, pathogens, and heavy NPK loads (Steinfeld et al., 2006; FAO, 2005; Mallin and Cahoon, 2003; Bicudo and Goyal, 2003). Slurry is frequently stored in earthen lagoons, and sometimes in more solid tanks, and slurry is widely spread or sprayed onto fields as a fertilizer,[35] though its usage can lead to the spread of pathogens that may contaminate crops and reduce or inhibit seed germination (Mallin and Cahoon, 2003; Bicudo and Goyal, 2003; Paton, 2003). The slurry lagoons that dot the landscapes of the industrial grain-oilseed-livestock complex constitute hazardous micro-geographies, especially earthen structures susceptible to leakage or rupture (Mallin and Cahoon, 2003). (see Public Health section for more information on this).

The problems with soil degradation, the fertilizer and pesticide treadmills, and animal wastes are also deeply entwined with major problems 'downstream' from farms.

Water consumption and pollution

Agriculture exerts by far the largest pull on freshwater supplies of any human activity, and world food security has come to hinge upon the productivity of heavily irrigated croplands. This also ties agriculture heavily to a web of hydrological engineering, small and large, that has stopped the free flow of streams and rivers and radically transformed freshwater ecosystems across most of the world's arable land (McCully,1996). On a global scale, concerns about increasing freshwater scarcity and conflicts are rising, exacerbated by projections of rising temperatures and aridity and indications that some major agricultural regions (most notably the US Midwest) are drawing groundwater from aquifers far in excess of recharge rates (Weis, 2012; Gleick, 2011; McIntyre et al., 2009; FAO, 2006; Tilman et al., 2002; Briscoe, 2002; Pimentel et al., 1997).[36] Although Canada as a whole is endowed with abundant freshwater lakes and rivers, much of the rural population depends upon groundwater for it residential water supply, and a significant share of the country's agricultural sector also relies on groundwater, which means that the overdraft and contamination of these supplies has far-reaching consequences (Nowlan, 2005; Coote and Gregorich, 2000). Climate change is also projected to widely intensify water stress, and in Canada this risk is greatest in arid parts of the Prairies (IPCC, 2007).

As noted in the previous section, the reduced soil moisture retention in monocultures and the needs of high-yielding seed varieties increase water demands for agriculture. Within

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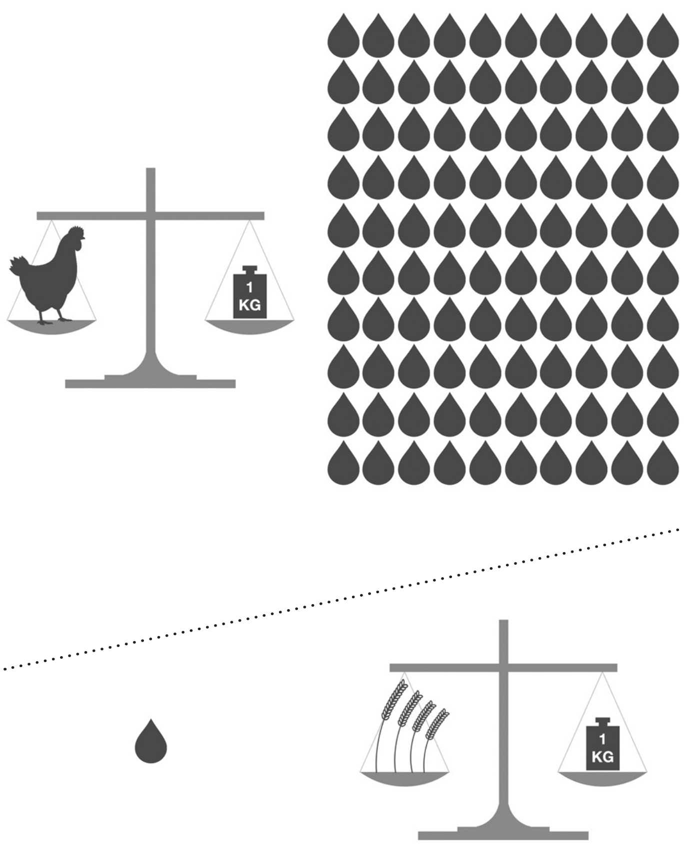
[35] *Biochemical oxygen demand* (BOD_5) is a key indicator of the organic pollution strength of wastewater, measuring the dissolved oxygen needed by aerobic microorganisms in water to break down the organic matter contained in a given sample over 5 days. A manageable level should be in the range of 5-30 mg BOD_5/L (the level human sewage must be reduced to before it can be discharged back into surface water). Typical livestock slurries and wastewater are vastly higher than this, indicating extremely concentrated organic wastes, and hence can be very hazardous if directly discharged into waterways (Pew Commission, 2008; Steinfeld et al., 2006).

[36] The FAO (2006) estimates that by 2025, close to 2 billion people could "be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions."

industrialized countries, roughly half of all the freshwater consumed by agriculture goes into feed crops (Steinfeld et al., 2006). Again, the inefficiencies associated with cycling large volumes of feed through livestock serve to greatly magnify the water budget contained in a unit of animal protein versus that contained in a unit of grain or oilseed protein, which grows further with the large water demands in ILOs and industrial slaughterhouses. ILOs require great volumes of water for animals' drinking needs, and even greater volumes for flushing their concentrated wastes down gutters, and for cleaning the confined spaces where they are kept (Steinfeld et al., 2006). Meat processing plants demand treated freshwater to clean carcasses, the kill-floor, and the disassembly lines. One estimate is that 19 to 38 L (5 to 10 gallons) of water gets used in the processing of one average-sized chicken (2.3 kg/5 lbs) (McMahon, 2007).

The production of 1 kg of animal protein requires 100 times more water than does the production of 1 kg of grain protein.



When the water budget associated with feed crop production and cycling inefficiencies is combined with the water budget of ILOs and industrial slaughterhouses, the result is that immensely more water is needed to produce 1 kg of animal protein than to produce 1 kg of plant-based protein. In the US, for instance, Pimentel and Pimentel (2003) calculate that the production of 1 kg of animal protein requires 100 times more water than does the production of 1 kg of grain protein.[37] This is especially unsustainable where groundwater is being drawn above recharge rates. One subtle but telling reflection of the large water demand associated with livestock production is that it is engrained in the application process for a water licence in Alberta, which includes "a guide for calculating the quantities of water needed for raising beef, hogs, chickens, and turkeys" (Nowlan, 2005, p. 32).

The other side of this consumption is the ensuing contamination, as much of the freshwater used in feed crop irrigation, running ILOs, and slaughterhouses ends up very polluted. The application of industrial fertilizers in feed crop production deposits more NPK than can be drawn up by crops in their growth. A portion of these excess nutrients, along with some of the agro-chemicals sprayed across landscapes, then runs off overland and concentrates in aquatic ecosystems or leaches into underground water supplies. The application of ILO slurries on fields, heavy manure

[37] This varies from species to species, with chicken production being the least water-intensive and beef production being by far the most (Pimentel and Pimentel, 2003; Pimentel et al., 1997).

concentrations on feedlots, and leakage or breaching of earthen lagoons further contribute to excess nutrient loads in freshwater ecosystems and underground reservoirs, through both overland flows and seepage. The seepage of untreated wastes from earthen lagoons can lead to severe groundwater contamination, and is attracting growing concern (McIntyre et al., 2009; PCIFAP, 2008; Steinfeld et al., 2006; Mallin and Cahoon, 2003; Bicudo and Goyal, 2003; McKinney et al., 2002; Hooda et al., 2000; MacMillan and Llewellyn, 2000; Pimentel et al., 1997).

The problems of nutrient loading have long been recognized in Canada (Paton, 2007; Charest, 1991), with the basic problem being that essential plant nutrients are transformed into pollutants as they get deposited at unnatural volumes and concentrated in the wrong places. When excess phosphorous and nitrogen concentrate downstream they can contribute to the growth of algal blooms, which take up some of the oxygen from water that fish and other organisms need, choking and shading out other aquatic life. This process, known as *cultural eutrophication* (cultural denoting its human causation) affects the health of both freshwater and coastal marine ecosystems on a global scale, and has been identified in water bodies surrounding sites of industrial agriculture in Canada (FPTGC, 2010; Mitchell, 2009; Schindler and Vallentyne, 2008). In addition to chronic nutrient surfeits, slurry field applications and feedlot manure can also carry health hazards, like pathogens and drug residues, into sources of water consumed by humans, livestock, and wildlife, and water bodies used for recreation (Bicudo and Goyal, 2003; Mallin and Cahoon, 2003).

Finally, the rising production of industrial livestock generates increasing volumes of wastewater in slaughterhouses, processing plants, dairies, and tanneries. This water is laden with both organic and inorganic residues from animal flesh, blood, skin, and feathers, with modern processing plants required to remove the majority of all soluble and particulate organic material, phosphates and ammonium in their wastewater prior to its discharge (Burton and Turner, 2003). However, unlike the problems stemming from things like fertilizer applications and runoff, feedlot manure, and earthen lagoons, this waste is much more strictly regulated, as it must be in compliance with local, provincial and federal environmental regulations. The rules, exemptions, inspections, oversight and penalties for ILOs are fundamentally different – and less rigorous – than the pollution control regime expected of virtually all other major industrial facilities, and there is no clear scientific justification for this discrepancy.[38]

"Slurry field applications and feedlot manure can also carry health hazards, like pathogens and drug residues, into sources of water consumed by humans, livestock, and wildlife, and water bodies used for recreation."

[38] In Alberta for instance, large industrial polluters are subject to strong environmental regulations with extensive enforcement provisions and fines up to $1 million. In contrast, ILOs are regulated by weaker agricultural regulations, exempt from lawsuits when their pollution harms people and the maximum fines available are set at $10,000. The Agricultural Operations Practices Act (AOPA) which regulates ILOs contains 'right to farm' provisions which exempt operations from nuisance lawsuits for air and other pollution that harms neighbours.

Energy and atmosphere

In recent years, much of the rising concern about the environmental impacts of livestock production has centered on its contribution to climate change. It is impossible to overstate the urgency of climate change mitigation, given the loud warnings given by climate scientists about how quickly the window is closing for making the scale of change that is necessary to contain the extent of warming within 'safe' thresholds (the most common target being to keep global average temperatures from rising more than two degrees above pre-industrial levels) (Joshi et al., 2011; Rogelj et al., 2011, Biello, 2011; IPCC, 2007; Schmidhuber and Tubiello, 2007). Mitigation essentially entails rapidly reducing greenhouse gas (GHG) emissions and enhancing carbon sequestration capacity.[39]

Canada is one of the largest GHG emitters in the world on a per capita basis, and has failed to seriously respond to the challenge of climate change mitigation (Germanwatch, 2011).[40] This can be seen as both a failure of global citizenship (Ackerman, 2009; Flannery, 2009; WorldWatch, 2009),[41] and something that poses great threats to ecosystem health, as climate change will affect ecosystems and species "in complex and unexpected ways that interact with other stressors, such as habitat fragmentation" (FPTGC, 2010, p. 6). Within Canada, climate change impacts are unfolding especially quickly and dramatically in the Arctic (IPCC, 2007; Berner et al., 2005).

Global livestock production is a major source of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions,[42] and together this amounts to almost one-fifth of the world's total anthropogenic GHG emissions (see Figure 5).[43]

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[39] This safe target is a matter of politics rather than science. This level of average warming is widely recognized to entail catastrophic outcomes for many parts of the world, in particular for small island states, low-lying mega-deltas, and the semi-arid tropics. The world is already committed to significant level of warming due to positive feedbacks (e.g. declining albedo due to melting ice, the loss of carbon sinks due to deforestation), the thermal lag associated with ocean warming, and the persistence of GHGs in the atmosphere.

[40] In 1997, Canada signed onto the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and committed to reduce its annual GHG emissions levels by 6 percent from 1990 levels. Over the subsequent two decades, annual GHG emissions instead rose by roughly 30 percent, and in 2011 Canada withdrew from the Kyoto Accord. Global environmental non-governmental organizations (NGOs) have consistently ranked Canada among the worst nations in the world in terms of climate change response. In its *Climate Change Performance Index 2012*, Germanwatch (2011) ranked Canada 51th out of 58 countries, classing both its GHG emissions level and its climate policy as being 'very poor'.

[41] The extremely regressive nature of climate change has long been recognized, as wealthy countries like Canada have much higher per capita GHG footprints than do countries of the Global South – unevenness which grows when historic emissions are considered – while many countries of the South are projected to face the impacts of climate change earliest, and most severely (Ackerman, 2009; Flannery, 2009; IPCC, 2007).

[42] CO_2 emissions are by far the greatest in terms of volume and has the biggest impact on warming, but the much greater per unit heat-trapping properties of methane (21 times greater than CO_2) and nitrous oxide (296 times greater that CO_2) mean that these emissions are also very significant in climate change, though they occur in much smaller volumes. Because CO_2 is the most significant GHG, methane and nitrous oxide are generally measured as CO_2 equivalents.

[43] The commonly cited estimate given by Steinfeld et al. (2006, p. 113) that world livestock production is responsible for 18 percent of annual GHG emissions is challenged by Goodland and Anhang (2009), who point to overlooked and undercounted data in insisting that the relative contribution of livestock to climate change is actually much greater.

Figure 5. Global GHG emissions from livestock production

GHG Emissions	Total (in CO_2 equivalent)	Carbon dioxide	Methane	Nitrous oxide
Percentage of world total	**18%** (including pasture degradation and land use change)	**9%** (not considering respiration)	**37%**	**65%** (including feed crops)

Source: Steinfeld et al., 2006, p. 271

On a world scale, livestock has its greatest impact on climate change through cattle ranching and feed crop expansion in tropical deforestation, noted earlier, as this entails both a one-time burst of carbon from these great sinks as well as a long-term loss of carbon sequestration capacity.[44] Whether on cleared rainforests or naturally arid lands, excessive livestock expansion is a major cause of desertification, and the declining soil health and reduced vegetation in landscapes undergoing desertification further reduces the volume of land-based carbon. The sheer rise in livestock populations is also a factor in climate change, as growing ruminants are a major source of methane emissions (generated by the enteric fermentation in the digestive process), increasing animal respiration produces CO_2, and rising volumes of manure and urine contribute nitrous oxide and methane emissions (Steinfeld et al., 2006).

Industrial livestock production is also tied to fossil energy consumption and rising GHG emissions in a range of ways, with the largest impact arising from the increasing feed crop production. As noted earlier, the environmental impacts of feed crop production must be situated against the basic inefficiency of cycling grains and oilseeds through animals to produce food, as metabolic losses mean that the footprint of industrial monocultures necessarily expands as levels of meat consumption and industrial meat production rise. The most obvious emissions from feed crop production stem from the fossil energy used in large farm machinery (e.g. harvesting, drying, etc.), storage and processing (e.g. milling, pelleting, etc.), and in moving feed over greater distances than occurred previously (via road, rail, and sea), but the fossil energy budgets run far deeper than this.

Industrial fertilizers contain a large fossil energy budget in their manufacture and transport, as fertilizers are bulky products that often move over long distances from factory to farm. Natural gas is the principle energy source in the manufacturing of synthetic nitrogen fertilizer, the most widely used industrial fertilizer, and fossil energy is also expended in the mining and refining of phosphorous

"Industrial livestock production is also tied to fossil energy consumption and rising GHG emissions in a range of ways, with the largest impact arising from the increasing feed crop production."

[44] In recent years, industrial soybean production for animal feed has also become a major cause of forest clearance in the Brazilian Amazon.

"Environment Canada (2010) reports that national agriculture greenhouse gas emissions rose by 19 percent between 1990 and 2009… with livestock production and industrial fertilizer key drivers of this growth."

and potassium fertilizers and in the production of agro-chemicals (much of which are petrochemical-based)[45]. This fossil energy budget involves CO_2 emissions, while the application of synthetic nitrogen fertilizers is a large source of nitrous oxide emissions. Another significant and related aspect of soil-related GHG emissions stems from the fact that soils are major carbon sinks and the loss of soil biota in industrial monocultures, described above, serves to both release soil carbon and reduce the carbon sequestration capacity of soils (McIntyre et al., 2009; PCIFAP, 2008; Montgomery, 2007; Steinfeld et al., 2006; Pimentel and Pimentel, 2006; McKenney, 2002). Canada's agricultural sector annually consumes industrial fertilizer far above world averages, and a large share of the ensuing production is destined for ILOs (Weis, 2010c; Steinfeld et al., 2006).

The running of ILOs also involves significant energy consumption and GHG emissions. The large volumes of feces and urine discussed in the preceding sections generate nitrous oxide and methane emissions. Massive concentrations of animals increase the energy needed for heating, lighting, cooling, ventilation, and waste management, with the energy demand of ILOs contingent on factors such as climate and the composition of electricity grids (Steinfeld et al., 2006). Increasing volumes of animal flesh and derivatives also heighten energy demand relative to plant-based protein, through industrial slaughter and processing plants, pasteurization and dairy production, and ultimately refrigeration, from packing and transport to retailing and storage (Sainz, 2003).[46] As with feed, livestock products are also moving across ever greater distances than in the past, both within countries and between them.

When the net energy demands of feed production and ILOs are considered together with the metabolic losses of cycling feed through animals, rising livestock production can be seen to greatly magnify the fossil energy budget and GHG emissions from agriculture. In the United States, for instance, Pimentel and Pimentel (2003) calculate that 2.2 kilocalorie (kcal) of fossil energy go into the production of 1 kcal of plant protein from industrial agriculture, whereas 25 kcal of fossil energy go into the production of 1 kcal of animal protein in ILOs, a figure which involves considerable differences from species to species.[47] Environment Canada (2010) reports that national agricultural GHG emissions rose by 19 percent between 1990 and 2009 (from 29 to 34 Mt CO_2 equivalent), with livestock production and industrial fertilizer key drivers of this growth.[48]

[45] In Alberta for instance, large industrial polluters are subject to strong environmental regulations with extensive enforcement provisions and fines up to $1 million. In contrast, ILOs are regulated by weaker agricultural regulations, exempt from lawsuits when their pollution harms people and the maximum fines available are set at $10,000. The Agricultural Operations Practices Act (AOPA) which regulates ILOs contains 'right to farm' provisions which exempt operations from nuisance lawsuits for air and other pollution that harms neighbours.

[46] The greater refrigerant and cooking demands associated with livestock products is a frequently underappreciated aspect of the overall energy budget, though it is incredibly complex to calculate with precision.

[47] Within ILOs, broiler chicken production is the least inefficient (4:1 kcal) converter of fossil energy input to animal protein output, followed by turkey (10:1), pig (14:1); milk (14:1), and beef (40:1), with milk and beef assuming a diet feed and forage) (Pimentel, 2004; Pimentel and Pimentel, 2003).

[48] By its calculations, agriculture constitutes 8 percent of Canada's total GHG emissions, which is a lower relative share than the world average – partly as a result of Canada's enormous energy-related emissions, and partly as a result of a relatively narrow definition of agricultural emissions.

In addition to GHG emissions and the macro-scale of climate change, ILOs also contribute to a range of air pollutants. Central to this are the hazardous micro-geographies of waste storage and slurry application discussed earlier, which are marked by potent odours and gases (in particular ammonia) that stem from the anaerobic (oxygen-deprived) storage and decomposition of large volumes of feces and urine for relatively long periods of time. In addition to often wretched 'smell-scapes' and sometimes toxic concentrations of gases, airborne ILO pollution can also carry microbial viruses, bacteria, and fungal spores that can negatively affect the health of farmers, farmworkers, livestock, and downwind communities (Paton, 2003; Marks, 2001).

Conclusion

Canadians have some of the largest per capita ecological footprints in the world, meaning that the consumption level of the average person depends upon much more resources and produces much more wastes than in most other parts of the world (Wackernagel and Rees, 1996). As this chapter has sought to explain, rising meat consumption and industrial livestock production are a big part of this outsized footprint; or, put another way, they exert a large ecological hoofprint. Levels of meat, eggs, and milk consumption and production in countries like Canada have no historic precedent, and one of the overarching themes of this chapter has been that there are tremendous biophysical inefficiencies associated with the transition from more plant-based diets to increasingly livestock-centered diets supplied by the industrial grain-oilseed-livestock complex, which entails that much more land, water, energy, and other resources be devoted to agriculture, and leads to more land and soil degradation, water consumption and pollution, fossil energy combustion, and GHG and other air pollution emissions (WorldWatch, 2004; Pimentel and Pimentel, 2003). So while the meatification of diets has long been held as a goal and measure of development, there are many reasons why it should instead be seen as a vector of environmental degradation and global inequality. Indeed, there are many indications that the biophysical basis of the industrial livestock system is unsustainable, and beginning to fracture, due principally to the intersecting and intensifying factors of climate change, land degradation, water depletion, and increasing demands on finite fossil fuel reserves.

A basic implication of this analysis is that the 'de-meatification' of diets and the deindustrialization of livestock production should be understood as urgent environmental priorities. At the forefront of this is climate change mitigation. As the Chair of the Intergovernmental Panel on Climate Change recently pointed out, reduced meat consumption is a fundamental step in climate change mitigation (Black, 2008), as this could potentially release land in production for ecosystem restoration and enhanced carbon sequestration and reduce the energy consumed in agriculture. This emphasis on reduced consumption also highlights the need to be wary of illusions that ILOs can be made more 'sustainable' through technological innovations, from genetic modification to enhance feed conversion efficiencies to cows wearing methane-capturing backpacks.

"Canadians have some of the largest per capita ecological footprints in the world..."

■ **A cow stands in her pen with a methane-capturing backpack at the National Institute of Agricultural Technology.**

Instead, there is a need to problematize long-held dietary aspirations and to rethink how efficiency is understood, with consideration for the many externalized costs that subsidize 'cheap' industrial grain, oilseed, and livestock products (and the long-distance movement of inputs and outputs which are embedded in them). In contrast to the dominant view of efficiency as high-yielding crops and animals and ever-rising output per farmer, a truly efficient system of agriculture would minimize external inputs, soil loss, and GHG emissions, and enhance nutrient cycles, soil formation, carbon sequestration. When a more comprehensive definition of efficiency is used, then low-input and more bio-diverse small farms, oriented towards more localized food economies, emerge as being far superior to industrial monocultures – an analysis that is emboldened by extensive evidence that small, more biodiverse farms have greater net productivity per land area than do industrial monocultures (Badgely et al., 2007; Altieri, 1995). Beyond climate change, the environmental basis for re-building alternatives to the industrial grain-oilseed-livestock complex can also be understood in light of the dynamics of land degradation, water stress, and the inevitable limits to fossil energy supplies. It should be clear that this analysis is not 'anti-farmer', as critics of industrial livestock have sometimes been portrayed – a tendency which Mason and Singer (1990) describe well. On the contrary, as was emphasized, the expansion of ILOs is part of a broader economic compulsion to 'get big or get out' which has destroyed many farming livelihoods. There is only one-third as many farmers in Canada today as there was three generations ago, and many who remain in farming are mired in extensive debt problems (Weis, 2010c; NFU, 2005). The reconstruction of a more sustainable agricultural system could go hand-in-hand with the reconstruction of more healthy, stable farming livelihoods.

Wherever there are deep systemic problems and the need for far-reaching changes, the question of policy design is a large one. In the case of ILOs, this is complicated on the consumption side by the fact that food choices and diet are not things that can be easily legislated, and on the production side by the expansive rights associated with property ownership in countries like Canada. Nevertheless, it is important to consider some of the ways that policies might help to effect a transition towards reduced meat consumption and production.

Policy recommendations

- **All levels of government must recognize the multidimensional pollution burden of ILOs.** While this might seem too obvious to note, the reality is that this recognition is simply not present at the moment, which is reflected in very minimal regulation, monitoring, and enforcement. The recognition that ILOs are a major source of pollution is a necessary first step towards more meaningful legislation on multiple fronts.

- **All levels of government should increase data collection, independent inspections, monitoring and information transparency.** At present, the capacity to collect environmental data from ILOs and monitor their impacts (e.g. waste storage, disposal, and slurry application) over time is very limited, which must be understood alongside extensive cutbacks to environmental monitoring capacity in Canada (and reductions in the monitoring capacities of Environment Canada and national and provincial Ministries of Natural Resources). Though the general impacts of ILOs on soils, water, and air, and ultimately human and ecosystem health are well-established, communities nevertheless frequently face a data vacuum in understanding the specific environmental implications of ILOs within their bioregions. Thus, there is a need for governments to enhance their environmental data collection and monitoring capacities – making inspections mandatory and independent rather than voluntary or industry-managed – which should be extended into the construction of a transparent, on-line 'data clearinghouse' that could improve people's ability to understand processes and impacts they are subjected to.

- **All levels of government should impose stricter regulations and penalties for environmental infractions and strengthen enforcement, while improving democracy over rural land use.** At the most basic level, ILOs should be regulated like other major polluting industrial operations, as there is no scientific justification for subjecting them to less rigorous pollution control regimes. The need for improved data collection and monitoring should also be tied to the need for much stricter regulation of effluent and much stricter penalties and enforcement of infractions, which together might work to reduce the scale of operations as well as internalizing some of the environmental costs of operations. Rural landowners are frequently very vocal in defense of their rights to use private property as they please, and this is sometimes portrayed as a basis of democratic freedoms. But what is one person's freedom to pollute is an infringement on other people's freedom to inhabit a clean environment. This can be seen very clearly where communities have mobilized against massive-scale ILOs. Thus, while increasing environmental regulations may tread on how some landowners view their rights, this would ultimately help to reduce how these rights, at present, tread on public and ecosystem health (to say nothing of the inter-species dimensions of freedom and the welfare of vast livestock populations, discussed in the Animal Welfare section), and thus might be seen as an expansion of democratic governance in rural land use.

- **Governments should reorient agricultural subsidies to build sustainable, low-input, local food systems.** At present, industrial agriculture is being subsidized not only through the array of environmental costs that are not being measured and accounted, but through government payments and as the focus of most of the government's public research capacity. But there are many hopeful movements which are actively working to build sustainable, low-input, and much more localized agriculture and food systems, seen in the growth of such things as: organic farming and organic farmer associations; community-supported agriculture (CSA) and local food boxes; the permaculture movement; farmer's markets; local procurement policies; and education and training programs aimed at assisting people from non-farm backgrounds to make transitions into organic farming. These movements would surely be enhanced if they moved from the margins of agricultural policy to the centre.

- **All those involved in dietary education should encourage environmentally sustainable diets.** As suggested, the need to question entrenched dietary aspirations is a fundamental basis for re-building more sustainable agricultural systems in Canada, and beyond. Food is entwined not only with human health but with the health of ecosystems, and it should be taught as such, from schools to libraries to doctors' offices.
- **The federal government must develop a strong national climate change mitigation strategy that addresses the increasing atmospheric hoofprint of industrial animal agriculture.** Canada is failing profoundly on climate change mitigation, and this must change if Canadians are to live with any sense of responsibility to the global community and to future generations. While agriculture is only one aspect of this failure, if Canada were to commit to the scale of mitigation targets of a magnitude that climate scientists are calling for it would fundamentally challenge the basis of industrial-grain-oilseed livestock complex.

References

Ackerman, F. (2009). *Can We Afford the Future? The Economics of a Warming World.* London: Zed Books.

Altieri, M. (1995). *Agroecology: The Science of Sustainable Agriculture.* Boulder, CO: Westview.

Asselin, J.M.R., Desjardins, R.L., Grace, B., & Janzen, H.H. (1998). *The Health of Our Air: Toward sustainable agriculture in Canada.* Ottawa: Agriculture and Agri-Food Canada.

Badgley, C., Moghtader, J., Quintero, E., Zakem, E. Chappell, M.J., Avilés-Vásquez, K., Samulon, A., ... I. Perfecto (2007). "Organic agriculture and the global food supply." *Renewable Agriculture and Food Systems*, 22(2), 86-108.

Barker, D. (2007). *The Rise and Predictable Fall of Globalized Industrial Agriculture.* San Francisco: International Forum on Globalization.

Berner, J., Symon, C., Arris, L., & Heal, O.W. (Eds.) (2005). *Arctic Climate Impact Assessment.* New York: Cambridge University Press.

Bicudo, J.R. & Goyal, S.M. (2003). 'Pathogens and manure management systems: A review.' *Environmental Technology*, 24(1),115-30.

Biello, D. (2011): 'Climate Negotiations Fail to Keep Pace with Science.' *Scientific American* (December 7). Retrieved from: www.scientificamerican.com/article.cfm?id=climate-negotiations-fail

Black, R. (2008, September 7). Shun meat, says UN climate chief. *BBC News*. Retrieved from: http://news.bbc.co.uk/2/hi/7600005.stm

Briscoe, M. (2002). Water: The Over-tapped Resource. In A. Kimbrell (Ed.), *The Fatal Harvest Reader: The Tragedy of Industrial Agriculture* (pp. 181-190). Washington: Island Press.

Burton, C. H. & Turner, C. (2003). *Manure management: treatment strategies for sustainable agriculture*, 2nd ed. Bedford, UK: Lister and Durling.

Canadian Agricultural Energy End-Use Data and Analysis Centre (2001). Direct Energy Use. *Agriculture and the Food Sectors – Separation by Farm Type and Location: Final Report to Natural Resources Canada*. Saskatoon: University of Saskatchewan,1-49.

Charest, J. (1991). *The State of Canada's Environment*. Ottawa: Minister of Supply and Services Canada.

Coote, D.R. & Gregorich, L.J. (2000). *The Health of Our Water: Toward sustainable agriculture in Canada, 2000*. Ottawa: Agriculture and Agri-Food Canada. Retrieved from: http://publications.gc.ca/collections/Collection/A15-2020-2000E.pdf

Cordell, D. & S. White (2011). Peak Phosphorus: Clarifying the Key Issues of a Vigorous Debate about Long-Term Phosphorus Security. *Sustainability*, 3, 2027-2049

D'Silva, J. & Webster, J. (Eds.) (2010). *The Meat Crisis: Developing More Sustainable Production and Consumption*. London: Earthscan.

Environment Canada – Greenhouse Gas Division. (2010). *National Inventory Report 1990-2008: Greenhouse Gas Sources and Sinks in Canada*. Ottawa: Environment Canada and Statistics Canada.

FAO Statistics Division (FAOSTAT). *Production & Resource STAT Calculators (Livestock Primary)*. Rome: FAO. Retrieved from: http://faostat.fao.org/site/569/default.aspx#ancor

FAO. (2007). 'FAO sounds alarm on loss of livestock breeds.' FAO Newsroom, Rome, Sept. 4, 2007, Rome. Retrieved from: http://www.fao.org/newsroom/en/news/2007/1000650/index.html

FAO. (2006). 'Water Monitoring: Mapping Existing Global Systems and Initiatives.' *UN Water Task Force on Monitoring*. Rome: FAO.

FAO. (2005). 'Pollution from industrialized livestock production.' *Livestock Policy Brief #2*. Rome: FAO.

FAO. (2003). *World Agriculture Towards 2030-2050*. Rome: FAO.

Federal, Provincial and Territorial Governments of Canada (FPTGC). (2010). *Canadian Biodiversity: Ecosystem Status and Trends 2010*. Ottawa: Canadian Councils of Resource Ministers. Retrieved from: www.biodivcanada.ca/ecosystems

Flannery, T. (2009). *Now or Never: Why We Need to Act Now to Achieve a Sustainable Future*. Toronto: HarperCollins Publishers.

Garnett, T. (2009). Livestock-related greenhouse gas emissions: impacts and options for policy-makers. *Environmental Science and Policy* 12, pp. 491-503.

Garvey, J. (2008).*The Ethics of Climate Change: Right and Wrong in a Warming World*. New York: Continuum Publishing.

Germanwatch (2011). *Climate change performance index 2012*. Germanwatch. Retrieved from: www.germanwatch.org/ccpi.htm

Gilland, B. (2002). World Population and food supply: Can food production keep pace with population growth in the next half-century? *Food Policy* 27(1), 47-63.

Gleick, P.H. (Ed.) (2011). *The World's Water, Vol. 7: The Biennial Report on Freshwater Resource*s. Washington: Island Press.

Godfray, H.C.J, Beddington, J.R., Crute, I.R., Haddad, L, Lawrence, D., Muir, J.F.,…Toulmin, C. (2010). Food Security: The Challenge of Feeding Nine Billion People. Science, 327, 812-18.

Goodland, R. & Anhang, J. (2009). Livestock and Climate Change: What if the key actors in climate change are cows, pigs, and chickens? *World Watch Magazine* 22(6). Retrieved from: www.worldwatch.org/node/6294

Hall, A. (1998). Sustainable agriculture and conservation tillage: managing the contradictions. *Canadian Review of Sociology and Anthropology* 35(2).

Halweil, B. & Nierenberg, D. (2008). Meat and Seafood: The Global Diet's Most Costly Ingredients. In L. Starke (Ed.) *Worldwatch Institute. State of the World 2008: Innovations for a Sustainable Economy*. New York: W.W. Norton & Co.

Hansen, J. (2009). *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity*. New York: Bloomsbury.

Hooda, P.S, Edwards, A.C., Anderson, H.A. & Miller, A. (2000). A review of water quality concerns in livestock farming areas. *Science of the Total Environment* 250(1-3),143-87.

Intergovernmental Panel on Climate Change (IPCC) (2007). *Climate Change 2007. The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Jarosz, L. (2009). Energy, Climate Change, Meat and Markets: Mapping the Coordinates of the Current World Food Crisis. *Geography Compass*, 3(6): 2065-2083.

Joshi, M., Hawkins, E., Sutton, R., Lowe, J. & Frame, D. (2011). Projections of when temperature change will exceed 2°C above pre-industrial levels. *Nature Climate Change*, 1, 407-412.

Leiztmann, C. (2003). Nutrition ecology: the contribution of vegetarian diets. *American Journal of Clinical Nutrition*, 78(3), 657-59.

MacMillan, W.R. & Llewellyn, P. (2000). A Survey of the Environmental Security of Earthen Hog Manure Storage Ponds in Alberta. Technical Services Division, Alberta Agriculture, Food, and Rural Development, Red Deer, Alberta. Submitted to Alberta Pork, Edmonton, AB.

Mallin, M. & Cahoon, L.B. (2003). Industrialized Animal Production – A Major Source of Nutrient and Microbial Pollution to Aquatic Ecosystems. *Population and Environment* 24(5), 369-385.

Marks, R. (2001). Cesspools of Shame: How Factory Farm Lagoons and Sprayfields Threaten Environmental and Public Health. Natural Resources Defense Council and Clean Water Network. Retrieved from: www.nrdc.org/water/pollution/cesspools/cesspools.pdf

Mason, J. & Singer, P. (1990). *Animal Factories*, 2nd ed. New York: Harmony Books.

McCully, P. (1996). *Silenced Rivers: The Ecology and Politics of Large Dam*s. London: Zed Books.

McIntyre, B.D., Herren, H.R., Wakhungu, J., & Watson, R.T. (Eds.) (2009). *International Assessment of Agricultural Knowledge, Science and Technology for Development: Synthesis Report*. Washington: Island Press.

McKenney, J. (2002): 'Artificial Fertility: The Environmental Costs of Industrial Fertilizers.' In: Andrew Kimbrell (ed.): *The Fatal Harvest Reader: The Tragedy of Industrial Agriculture*. (pp. 121-29). Washington: Island Press.

McKinney, R.A., Lake, J.L., Charpentier, M.A., & Ryba, S. (2002). Using Mussel Isotope Ratios to Assess Anthropogenic Nitrogen Inputs to Freshwater Ecosystems. *Environmental Monitoring and Assessment* 74(2),167-92.

McMahon, J. (2007). Streamlining Wastewater Treatment in Poultry Processing. *Food Quality Magazine*. December/January. Retrieved from: www.foodquality.com/details/article/817077/Streamlining_Wastewater_Treatment_in_Poultry_Processing.html

McMichael, A.J., Powles, J.W., Butler, C.D. & Uauy, R. (2007). Food, livestock production, energy, climate change, and health. *The Lancet*, 370, 1253-63.

Millennium Ecosystem Assessment (MEA). (2005). *Millennium Ecosystem Assessment Report. Ecosystems and Human Well-being: Biodiversity Synthesis*. Washington: Island Press.

Mitchell, A. (2009). *Sea Sick: The Global Ocean in Crisis*. Toronto: McClelland & Stewart.

Montgomery, D.R. (2007). *Dirt: The Erosion of Civilizations*. Berkeley: University of California Press.

Moore, M. (2002). Hidden Dimensions of Damage: Pesticides and Health." In A. Kimbrell (Ed.) The Fatal Harvest Reader: *The Tragedy of Industrial Agriculture*. Washington: Island Press,130-147.

Myers, N. & Kent, J. (2003). New consumers: The influence of affluence on the environment. *Proceedings of the National Academy of Sciences of the United States of America* 100(8), 4963-68.

National Farmers Union (NFU) (2005). *The Farm Crisis and Corporate Profits. A Report by the National Farmers Union*. Saskatoon: NFU.

Nierenberg, D. (2005). *Happier Meals: Rethinking the Global Meat Industr*y. Washington: WorldWatch Paper #171.

Nowlan, L. (2005). Buried Treasure: Groundwater Permitting and Pricing in Canada. Walter and Duncan Gordon Foundation. March. Retrieved from: www.gordonfn.org/resfiles/Buried_Treasure.pdf

Paton, W.H.N. (2010). Water Supply is Putting Canadian's Health and Economy at Risk. *CSEB Newsletter/Bulletin* 67(2), 9-10.

Paton, W.H.N. (2007). The Sustainability of the Hog Production Industry in Manitoba. *Canadian Society of Environmental Biologists Newsletter*, 64(2),11.

Paton, W.H.N. (2003).The Smell of Intensive Pig Production on the Canadian Prairies. In A.M. Ervin, C. Holtslander & R. Sawa (Eds.), *Beyond Factory Farming: Corporate Hog Barns and the Threat to Public Health, the Environment, and Rural Communities*. Ottawa: Canadian Centre for Policy Alternatives, 79-109.

Paton, W.H.N. (1998). Irrigating Downstream: Water Quality and Health Issues of Importance to Users of the Assiniboine River. In J. Welsted (Ed.), *Proceedings of the Symposium: Irrigation in Manitoba: Past, Present and Future*. Conference of the Canadian Water Resources Association,118-29.

Pew Commission on Industrial Farm Animal Production (PCIFAP) (2008): *Putting Meat on the Table: Industrial Farm Animal Production in America*. Washington: The Pew Charitable Trusts and The John Hopkins Bloomberg School of Public Health.

Pimentel, D. (2006). Soil erosion: a food and environmental threat. *Environment, Development and Sustainability* 8(1), 119-137.

Pimentel, D. (2004). Ethical Issues of Global Corporatization: Agriculture and Beyond. *Poultry Science* 83, 321-29.

Pimentel, D. & Pimentel, M. (2003). Sustainability of meat-based and plant-based diets and the environment. *American Journal of Clinical Nutrition* 78(3), 6605-35.

Pimentel, D., Houser, J., Preiss, E., White, O., Fang, H., Mesnick, L.,… Alpert, S. (1997). Water Resources: Agriculture, the Environment, and Society, *BioScience* 47(2), 97-106.

Rifkin, J. (1992). *Beyond Beef: The Rise and Fall of the Cattle Culture*. New York: Penguin.

Rogelj, J., Hare, W., Lowe, J., van Vuuren, D.P., Riahi, K., Matthews, B.,… Meinshausen, M. (2011). Emission pathways consistent with a 2°C global temperature limit. *Nature Climate Change*, 1, 413-418.

Sainz, R.D. (2003). Framework for calculating fossil fuel use in livestock systems. Livestock-Environment Initiative: Fossil Fuels Component. Rome: FAO.

Sampson, F. & Knopf, F. (1994). Prairie Conservation in North America. *Bioscience*, 44(6), 418-21.

Schindler, D.W. & Vallentyne, J.R. (2008). *The algal bowl: overfertilization of the world's freshwaters and estuaries*. Edmonton: The University of Alberta Press.

Schmidhuber, J. & Tubiello, F.N. (2007). Global Food Security Under Climate Change. *Proceedings of the National Academy of Sciences of the United States*, 104(50), 19703-08.

Schneider, M. (2011). Feeding China's Pigs: Implications for the Environment, China's Smallholder Farmers and Food Security. Minneapolis: Institute for Agriculture and Trade Policy.

Shepherd, M.W., Singh, R., Kim, J. & Jiang, X. (2010). Effect of heat-shock treatment on the survival of *Escherichia coli* and SalmonellaentericaTyphimurium in dairy manure co-composted with vegetable wastes under field conditions. *Bioresource Technology* 101(14), 5407-13.

Senate Standing Committee on Agriculture, Fisheries and Forestry (SSCAFF). (1984). *Soil At Risk: Canada's Eroding Future*. Ottawa: Government of Canada.

Statistics Canada (StatsCan). (2007). Selected Historical Data from the Census of Agriculture: Data tables. *2006 Census of Agriculture*. Ottawa: Government of Canada.
Retrieved from: www.statscan.gc.ca/pub/95-632-x/2007000/4129762-eng.htm#i

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. (2006). *Livestock's Long Shadow: Environmental Issues and Options*. Rome: FAO.

Tilman, D., Cassman, K., Matson, P., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and the costs and benefits of intensive production practices. *Nature*, 418, 671-77.

Wackernagel, M. & Rees, W.E., (1996). *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island BC: New Society Publishers.

Warshall, P. (2002). Tilth and Technology: the Industrial Redesign of our Nation's Soils.' In A. Kimbrell (Ed.), *The Fatal Harvest Reader: The Tragedy of Industrial Agriculture*. Washington: Island Press.

Weis, T. (2012). A Political Ecology Approach to Food Production. In M. Koc, J. Sumner & T. Winson (Eds.): *Critical Perspectives in Food Studies*. Toronto: Oxford University Press.

Weis, T. (2010a). The Ecological Hoofprint and the Population Bomb of Reverse Protein Factories. *Review* 33(2/3).

Weis, T. (2010b). The Accelerating Biophysical Contradictions of Industrial Capitalist Agriculture. *The Journal of Agrarian Change*, 10(3), 315-41.

Weis, T. (2010c). Breadbasket Contradictions: The Unstable Bounty of Industrial Agriculture in the United States and Canada. In G. Lawrence, K. Lyons & T. Wallington (Eds.), *Food Security, Nutrition and Sustainability: New Challenges, Future Options*. London: Earthscan.

Weis, T. (2007). *The Global Food Economy: The Battle for the Future of Farming*. London: Zed Books.

WorldWatch. (2009). *State of the World 2009: Into a Warming World*. New York: W.W. Norton and Company.

WorldWatch. (2004). Meat: Now, It's Not Personal! But like it or not, meat-eating is becoming a problem for everyone on the planet. WorldWatch Magazine, 17(4), 12-20.

Animal Welfare

Farm Animal Welfare in Canada: Major Problems and Prospects

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Introduction

The most dramatic and momentous changes in the 10,000 year history of animal agriculture took place during the 20th century, with the replacement of many traditional extensive agricultural systems by intensive and industrialized confinement agriculture. Traditional agriculture, of necessity, was rooted in animal husbandry; placing the animals into an optimal environment for which they were biologically suited, and then augmenting their ability to survive and thrive by provision of food during famine, water during drought, medical attention, protection from predators, help in birthing, and in general attention to their needs. The overarching incentive for providing good husbandry was self-interest – the producer did well if and only if the animals did well. To hurt the animals or violate their natures thus entailed harming oneself. So powerful was this 'ancient contract', that when the psalmist sought a metaphor for God's ideal relationship to humans, he could do no better in the 23rd Psalm than invoke the Good Shepherd. Husbandry can be schematized as placing square pegs in square holes, round pegs in round holes, and creating as little friction as possible in doing so.

In the 20th century, the "application of industrial methods to the production of animals," as textbooks of animal science describe intensive agriculture, broke the ancient rule that militated in favour of good welfare for farm animals. No longer was it necessary to respect animal nature, to put square pegs in square holes; what we may call 'technological sanders' allowed modern agriculture to put animals into environments for which they were ill-suited, yet still assure production and profitability.

Whereas, in traditional agriculture, failing to respect animal nature would have led to ruination, this is forestalled in modern agriculture by technology such as antibiotics, vaccines, air-handling systems, and the like to deal with increased disease risks and poor air quality that can be associated with confinement at high stocking density. One could now assure productivity and produce increased quantities of cheap food without concomitantly assuring animal welfare. In traditional agriculture, such sustained infringement on welfare would inevitably ramify in loss of productivity and, in many if not most cases, the sickness and death of the animals. In modern systems, the loss of welfare does not always entail a loss in economic productivity.

When modern intensive production practices were first criticized on animal welfare grounds in the 1960s (e.g. Harrison, 1964; Command Paper 2836, 1965), it was their intensiveness and degree

> "[i]n Europe there has been a concerted attempt to rectify the welfare short-comings of intensive animal production…progress in North America has been slow."

of confinement that were targeted. Research in the subsequent 50 years has shown that these criticisms were well-founded; intensive production systems and severe confinement can indeed lead to greatly reduced welfare (Wood-Gush et al., 1975; Dawkins, 1980; Rollin, 1995; Ewing et al., 1999; Benson and Rollin, 2004). Research has also shown that there are many additional factors that have a deleterious effect on welfare. These include, painful invasive procedures (Duncan and Molony, 1986; Benson, 2004), transportation and pre-slaughter management (Grandin, 2007) and genetic selection for production characteristics (Grandin and Deesing, 1998).

Whereas in Europe there has been a concerted attempt to rectify the welfare short-comings of intensive animal production (e.g. battery cages will be banned in the European Union from January 2012), progress in North America has been slow. However, there are signs of an awakening social concern for farm animal welfare. For example, in 2008 California passed a ballot initiative to phase out veal crates, battery cages and gestation crates with overwhelming support and a statute has thus been enacted, the Prevention of Farm Animal Cruelty Act, which will outlaw these forms of production from January 2015. Several other states have enacted similar laws. To date, no such legislation has been passed in Canada. However, the Manitoba Egg Producers launched a policy in 2010 stating that husbandry systems for hens should provide for the Five Freedoms (Farm Animal Welfare Council, 2009) and that after 2018, all new housing facilities for laying hens in Manitoba will be required to meet this policy. Since conventional battery cages cannot provide the Five Freedoms, this signals the phasing out of this type of battery cage in Manitoba.

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Another sign of public concern for farm animal welfare has been the rise of animal welfare assurance schemes such as Certified Humane in the US, Animal Welfare Approved and Global Animal Partnership in the US and Canada and SPCA Certified run by the British Columbia SPCA in Canada. The fact that all of these welfare assurance schemes are expanding suggests that there is increasing public concern in this area.

This report will concentrate on three aspects of modern intensive animal production that reduce welfare. These are 1) environments that restrict and frustrate animals, 2) procedures that cause pain to animals, and 3) suffering in animals caused by inappropriate genetic selection.

Environments that Restrict and Frustrate Animals

The three worst examples of environments that severely frustrate animals have already been mentioned, viz. crates for veal calves, battery cages for laying hens, and gestation stalls for sows. The welfare problems associated with these systems will be described in detail; other features of intensive animal production that reduce welfare will be mentioned briefly.

Crates for Veal Calves

In Canada, about one-third of veal calves are 'milk-fed' and two-thirds 'grain-fed'. The vast majority of the calves are males of the Holstein breed and are a by-product of the dairy industry. Calves destined for veal are removed from their mother hours after birth. Sixty-five percent of 'milk-fed' calves are raised in wooden crates and 35 percent in groups. 'Grain-fed' calves are raised on a milk, or milk substitute, diet for the first 6-8 weeks of their lives and this period is also spent in crates. Thereafter, the grain-fed calves are generally kept in group housing. A considerable proportion of veal produced in Canada therefore, comes from calves that have been housed in crates for at least part of their lives. Crates frustrate calves by severely restricting movement. Calves are prevented from walking and running, and the recommended width of a crate of 90 cm (Canadian Agri-Food Research Council, 1998) prevents them from even turning round except when they are very young. The narrowness of the crate also prevents the calf from lying laterally with the legs extended – a normal resting posture. Crating also prevents normal social contact with other calves including all the play behaviour that a group of calves will normally engage in (Sato et al., 1987; Bouissou et al., 2001). Crates do not have bedding, and so discomfort is added to the frustration that calves experience.

The milk or milk-substitute diet that milk-fed calves are raised on is deficient in iron. Although the veal industry argues strenuously that milk-fed calves are not clinically anaemic, the fact that their flesh is much lighter coloured than calves on a more natural diet and is sold in restaurants as 'white veal' would suggest that they are at least marginally anaemic. Since this physiological state is likely to lead to a specific appetite and search for iron, these calves are probably frustrated further. Veal calves generally do not have access to forage. This impedes normal rumen development (Coverdale et al., 2004) and can also lead to frustration as the calf seeks the missing long fibres. The combination of all these stressors can lead to behavioural abnormalities and pathological lesions in crated veal calves (Wiepkema et al., 1987). There can be no doubt that veal crates severely reduce welfare.

Battery Cages for Laying Hens

In 2010, 96 percent of egg-laying hens in Canada were housed in battery cages (International Egg Commission, 2011). A battery cage is a wire cage with a sloping floor holding 5-7 laying hens. The cages are usually in long 'batteries' of 3-5 tiers with many thousands of hens housed in a barn with a completely controlled environment. There are a few welfare advantages to battery cages. They are hygienic, the birds are kept in small social groups (compared with alternative husbandry systems in which group sizes of hundreds or thousands are common), and the air quality in a battery cage operation is generally better than that in a barn holding an equal number of hens in a free-run system.

> "…a modern hen [lays] 320 eggs in a year which means she will be severely frustrated seven days out of eight."

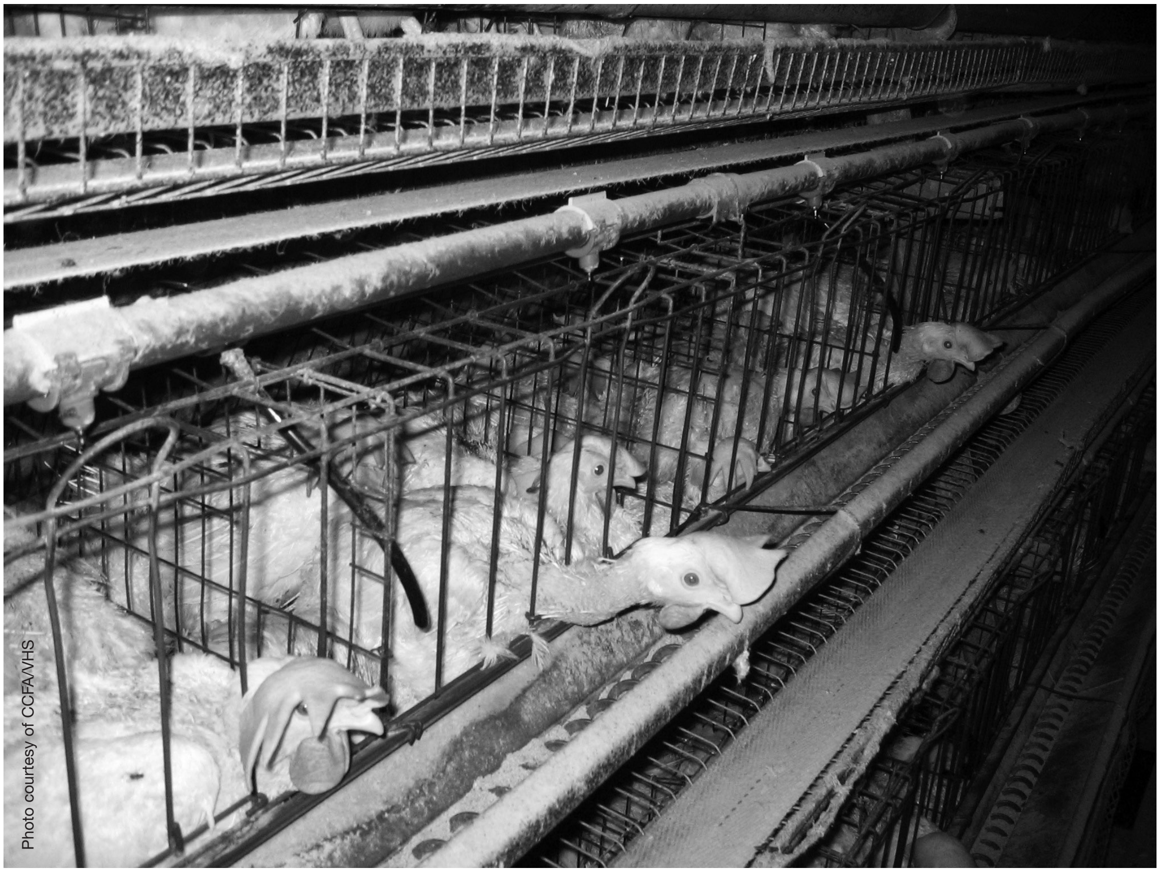
However, there are many welfare disadvantages to cages. Normal nesting behaviour is prevented and most hens (80 percent of white egg layers and 60 percent of brown egg layers) show signs of severe frustration for 1½ hours before an egg is laid (Wood-Gush and Gilbert, 1969; Duncan, 1970). It should be remembered that a modern hen is laying 320 eggs in a year (e.g. Hy-Line International Red Book, 2009) which means she will be severely frustrated seven days out of eight. In addition, it has been shown that hens are very highly motivated to find a suitable nesting site before laying, and will work very hard to find one by pushing open a weighted swing door (Duncan and Kite, 1987). In fact, hens will work as hard to get to a nest site as they will to reach food when they have been deprived of food for 28-30 hours (Follensbee et al., 1992).

Standards for the care and handling of farm animals in Canada are laid out in the "Recommended Codes of Practice" (NFACC, 2011). When a code for a particular species is planned, NFACC forms a committee with representatives from industry, animal protection societies and welfare scientists represented. The resultant code is therefore a compromise between trying to protect the welfare of the animals and allowing industry to exploit the animals sufficiently to make a profit.

The recommended space allowance for caged hens in Canada is 432 cm^2 for hens up to 1700 g (white-egg layers) and 483 cm^2 for hens up to 1900 g (brown-egg layers) (Canadian Agri-Food Research Council, 2003). However, using overhead cameras it has been shown that hens kept at the usual cage space allowance try to space themselves out as much as possible (Keeling and Duncan, 1989), suggesting that the recommended stocking densities are far too tight. In addition to crowding hens too close together, the small dimensions of the battery cage also compromise welfare by restricting the behavioural repertoire of the birds (Dawkins, 1985; Nicol, 1987a, b). It is possible to 'ask' animals about features of their environment using preference and motivation tests (see Fraser and Matthews, 1997). When hens have been 'asked' how much space they prefer, they have chosen more space than that available in conventional battery cages (Hughes, 1975; Dawkins, 1981).

If given the opportunity, hens prefer to roost high off the ground at night in a posture that involves gripping a perch with the feet (Blokhuis, 1984). A battery cage prevents hens from changing level at night and from adopting this posture. When hens have been used to roosting on perches high off the ground and are then denied access, they show signs of frustration (Olsson and Keeling, 2000). They will also work hard, by pushing open a weighted door, to reach perches (Olsson and Keeling, 2002).

Hens kept in extensive conditions spend the major part of their day foraging for food. Although hens in cages have food continuously available to them, they cannot perform the normal activities associated with foraging such as ground-scratching and pecking while walking, and probing and flicking at items on the ground with the beak. Hens kept outside also tear leafy material from growing plants (Savory et al., 1978). Research has shown that the performance of foraging behaviour benefits welfare in addition to allowing the consumption of food (Moffat and Duncan, 1999).



■ **Hens are confined 5-7 into one cage in a typical Canadian egg barn.**

Hens keep their feathers in good order by dust-bathing in a dry dusty substrate about every second day. Occasionally hens are seen to attempt to dust-bathe on the floor of the cage, although there is no dusty substrate present, and the performance of the behaviour does not have the correct functional results. It appears that hens are not frustrated, but there is evidence that hens find complete dust-bathing pleasurable and so husbandry systems that promote dust-bathing have a welfare advantage (Widowski and Duncan, 2000).

Finally, cages prevent hens from getting sufficient exercise to maintain bone strength. It is not known whether this causes frustration or not, but there is a price to pay. Each day, a hen uses some bone reserves of calcium for the shell of the next egg to be laid. The bone reserves are then replenished from dietary sources. However, over the course of a laying year, there is gradual calcium loss from the skeleton and this is exacerbated by lack of exercise. This means that at the end of a laying year, caged hens are suffering from osteoporosis and bone weakness (Leeson et al., 1995). When the hens are removed from the cages at the end of a laying year, many of them end up with broken bones (Gregory and Wilkins, 1989).

Gestation Stalls for Sows

The vast majority of sows in Canada are kept in gestation stalls for most of their pregnancy. The swine industry argues that the stalls (typically 62 cm wide, 210 cm long and 110 cm high) help ensure each sow gets exactly the right amount of food, individual veterinary attention and eliminates fighting, which they sometimes do when housed socially. However, a gestation stall is not much bigger than the sow herself and therefore imposes extreme confinement. It is known that pigs kept in extensive environments engage in a rich repertoire of behavioural activities (Stolba and Wood-Gush, 1989). Compared to this, a sow in a gestation stall is denied locomotion (and thus exercise), foraging behaviour, wallowing opportunities, exploration, and social interactions. The only postures possible for sows are standing and lying, and gestation stalls are so restrictive that many sows have difficulty switching from one to the other without causing themselves injury (Anil et al., 2002). There is no doubt that sows confined to gestation stalls for most of their pregnancy are subjected to extreme frustration. Superimposed on this frustration is a fairly strict level of food restriction imposed to keep the sow in good reproductive condition. This practice results in very hungry sows (Appleby and Lawrence, 1987; Lawrence et al., 1988). Moreover, the combination of hunger and physical restriction results in the vast majority of sows in stalls developing stereotyped behaviour (Terlouw et al., 1991). These prolonged, obsessive, repetitive and apparently purposeless activities (such as bar biting and vacuum chewing) do not occur naturally and are generally accepted as a sign of reduced welfare (Duncan et al., 1993). This is a huge and widespread problem – 91.5 percent of stalled sows perform stereotypies which amounts to 15.4 million animals in Europe and North and Central America alone (Mason and Latham, 2004).

> "…society has expressed extreme repugnance at the use of gestation crates…and these systems have been banned in several states across the US by citizen-initiated referenda."

■ **Sows stalls are one of the worst confinement systems.**

It has been shown that the lack of exercise sows get when kept in stalls leads to decreased bone density (Marchant and Broom, 1996), but whether or not this causes suffering is unknown. However, as with spent laying hens, this condition will increase the risk of bone fracture when the sows are transported for slaughter.

Of late, European and North American society has begun to reject the very severe confinement systems under which pork is produced.

■ **Dairy cows chained in stall in Canadian barn.**

Notably, society has expressed extreme repugnance at the use of gestation crates that provide the living environment for the productive life of breeding sows in confinement, and these systems have been banned in several states across the US by citizen-initiated referenda. The major pork producers in North America, Smithfield in the United States, and Maple Leaf in Canada, have announced their intentions to phase out sow stalls in their production systems. Time will tell whether or not these intentions are acted upon.

Some other Causes of Frustration

In addition to these three egregious examples, there are many other sources of frustration in intensive animal production, and a few examples are given below.

All systems that crowd animals closer than they would normally space themselves will lead to social frustrations. For example, in intensive animal production, pigs, meat chickens and turkeys are all raised at very high stocking densities – far higher than these species would choose to space themselves in more extensive environments (McBride et al., 1969; Watts and Stokes, 1971; Wood-Gush et al., 1978; Jensen, 1986; Stolba and Wood-Gush, 1989).

The traditional method of housing dairy cows is tethering each one in her own stall to which all feedstuffs are brought. In the second half of the 20th century the 'free stall' system was developed whereby cows are free to move about the barn, choose their own stall for resting, and eat from one or several feeding stations. This system appears to give cows more freedom. However, it is common for dairy cows under this system to be stocked at a rate of more than 110 cows per 100 stalls. In a completely free and comfortable environment, dairy cows prefer to spend 12-14 hours/day lying down resting, and this behaviour seems to be very highly motivated (Jensen et al., 2005; Munksgaard et al., 2005). Even with small groups of cows, overstocking leads to a reduction in lying time (Fregonesi et al., 2007). Under commercial conditions with hundreds of cows competing for stalls, this effect is exacerbated. In addition to cows being frustrated, cows that are standing for longer periods are at a higher risk of developing painful types of lameness (Galindo and Broom, 2000; Nordlund et al., 2004).

The usual method of housing lactating sows with litters of piglets is to keep each sow in a farrowing crate measuring 2.4 x 0.75 x 1.0 m (l x w x h) with a creep area on each side for the piglets. The crate is designed to protect piglets from crushing when the sow lies down. However, farrowing crates cause frustration by preventing sows from engaging in the strongly-motivated behaviour pattern of nest-building before farrowing (Arey et al., 1991). Farrowing crates also prevent the sow from having a full social relationship with her piglets and, like gestation stalls, deprive her from expressing many natural behaviour patterns. While a farrowing crate can protect piglets from crushing, fairly low levels of piglet mortality can also be achieved in free-farrowing systems (Pedersen et al., 2006). Since the sow only lives in the crate for 3-4 weeks, it could be argued that this is a short period of restriction compared to the benefit accruing to the piglets. Having said all that, there is no doubt that farrowing crates impose severe restriction on the behaviour of lactating sows.

Dairy calves, separated from their mothers shortly after birth, are highly motivated to suck, and they perform non-nutritive sucking on objects in their environment even when they are provided with milk in a bucket. Calves being raised commercially as replacements for the dairy herd are seldom given teats to suck. However, the performance of sucking triggers release of the digestive hormones insulin and cholecystokinin and improves digestion (de Passillé et al., 1993), so not only are calves frustrated in sucking behaviour, but their digestive systems are compromised as well.

A final example of frustration being caused in intensive animal production is the case of weaning. In many cases, young animals are weaned earlier than they would choose to wean themselves and this leads to frustration and separation anxiety. This is always worse when a bond between mother and offspring has formed. Weaning in the beef industry is well-known to be very distressing and various strategies have been devised to minimize these effects (Haley et al., 2005). Similarly in the pig sector, weaning is known to cause much distress. Weaning in the intensive sector of the Canadian pig industry takes place between 18 and 21 days, which is still much younger than that which would occur if the sow and piglets were allowed to wean naturally (Stolba and Wood-Gush, 1989).

Procedures that Cause Pain to Animals

One welfare issue common to both traditional and modern agriculture are animal mutilations used to deal with animal management problems. 'Mutilation' is the infliction of an injury, wound, or trauma in the absence of any pain control and for non-therapeutic purposes. Such acutely painful procedures as hot iron branding and castration of unanaesthetized animals have persisted through the long history of animal agriculture and have endured unchanged in the transition to industrialized agriculture.

Mutilations in the Beef Industry

Cattle ranching for beef production has resisted industrialization the most. Devoted to pursuing a way of life as to making a living, Western ranchers strongly adhere to an ethic of animal husbandry. For example, of the approximately 20,000 ranchers all over the US and Canadian West who Rollin has addressed on ethics and animal welfare, well over 90 percent, in fact, closer to 100 percent, have spent more money and time on saving a marginal, sick calf than the calf is worth in strictly economic terms. When asked to explain this putatively economically irrational decision, ranchers will invoke their moral obligations to the animals under their aegis. Yet shortly after the birth of a calf, the same ranchers will brand, dehorn, castrate, and vaccinate these animals with no pain control.

Branding of cattle by the use of a hot iron to create an indelible mark on the skin by infliction of a third degree-burn is extremely painful, and work by destroying melanocytes or pigmentation cells. The purpose is to provide proof of ownership, with each ranch employing a unique, centrally registered mark and to allow for easy recognition of one's cows under mixed range conditions, where many different animals with numerous different owners may graze together. In addition, ranchers claim that brands help to prevent rustling (e.g. theft of cattle). With periodic change in cattle ownership, an animal may be branded more than once.

■ **Modern technologies have eliminated the need and justification for the hot branding of cattle.**

Historically, there were not many alternatives for permanently identifying cattle, nor were there methods for controlling the pain of the burn. Over the past 30 years, attempts have been made to persuade Western ranchers that, in today's world, where industrial agriculture has become increasingly less acceptable to society, and a return to husbandry agriculture is sought, they would do well to underscore their commitment to animal welfare by eliminating painful management practices, and marketing beef as the humane meat product. A group at Colorado State University created digitized retinal images of cow retinas, which has more data points than human fingerprints (Golden and Shadduck, 2000). Similarly, cattlemen could employ other biometric identifiers or electronic forms of identification such as microchips. All such methods provide permanent, unalterable forms of identification and provide the additional advantage of facilitating trace-back in the event of disease outbreak. Conservative ranchers have resisted moving to alternative methods of identification in spite of the overwhelming evidence that hot-iron branding is extremely painful (Schwartzkopf et al., 1997). If asked to justify the infliction of a third-degree burn morally, cattlemen will cite the trade-off involved in living extensively in exchange for a short-term burn pain. However, in addition to the cost to the animal in terms of pain, there is an actual monetary cost to the industry. Branding has been estimated to cost the Canadian beef industry $3.57 per head or $9.5 million per year due to hide damage (Schwartzkopf-Genswein, 2000).

Knife castration of beef cattle is another painful management practice originating in antiquity. Typically, neither anaesthesia nor analgesia is utilized to control the attendant pain, which has been well documented (Zobell et al., 1993; Molony et al., 1995). Castration is done to reduce aggressiveness in male animals, thereby minimizing aggressive interactions and danger to humans, as well as to prevent unplanned impregnation of female animals, and to improve the perceived quality of the meat. Sometimes castration is accomplished by placing elastic or rubber bands around the testicles, creating ischemia so that the testicles eventually die and shrivel. As a prolonged insult, banding appears to be more painful than knife castration, although bloodless. Ways of mitigating knife castration include raising and marketing young bulls, which has been done successfully; use of local anaesthetics and subsequent analgesics to mitigate pain; chemical castration (where injections of toxic chemicals or sclerosing agents destroy spermatogenic capability); and immunological castration, which involves using the immune system to interfere with the spermatogenic cascade. Castration is particularly irrational economically, as the anabolic growth promotion of the testicles is often replaced by hormonal implants (growth-promoting hormones), which do not work as well as endogenous testosterone and which tend to be viewed with suspicion by consumers.

■ **'Disbudding' procedures done on calves with electric irons, cutting or caustic paste are extremely traumatic and painful.**

Dehorning is utilized to prevent injury by horned cattle to each other and to humans. When done to adult animals by cutting or gouging out the horns, the procedure is extremely painful. When done on young calves, so-called 'disbudding' of the horn buttons can be accomplished less traumatically but still painfully by use of caustic paste, electric irons, or cutting. Anaesthetics and analgesics are virtually never used in the beef industry but are beginning to be used in the dairy sector in Canada where pain-relieving protocols are well documented (Faulkner and Weary, 2000). Of course, a simple alternative to dehorning is to genetically introduce the poll or hornlessness gene into one's herd.

Castration and tail amputation, again without anaesthesia or analgesia, are routinely performed on sheep and goats. There is also ample evidence that these are painful procedures no matter how they are performed (Kent et al., 1995, 1998). All of the mutilations discussed above are regularly performed across North America. Although well-established by tradition, most ranchers will admit that these procedures could be eliminated or replaced without any significant structural effect on their industry. In a real sense, technological innovation is quite capable of rendering these mutilations irrelevant.

Mutilations in the Dairy Industry

Over the past four decades, tail amputation, performed without anaesthesia or analgesia, has been increasingly practiced in the dairy industry across the world, including Canada. Although it has been claimed that docking reduces mastitis because the tail acts as a 'brush' to spread manure, this has been refuted by scientific research (Tucker et al., 2001). Such benefit as it might provide could be accomplished by trimming the tail-switch, a painless procedure. Tail-docking can cause infection, chronic pain, and immunosuppression. It is therefore good to see that the most recent voluntary Dairy Codes of Practice (NFACC, 2009) state that dairy cattle should not be tail docked unless medically necessary.

Mutilations in the Poultry Industry

On the other hand, the rise of intensive, industrial, high-technology agriculture has created a demand for many more animal mutilations, making it easier for such agriculture to violate animal nature and force square pegs into round holes. Whereas the mutilations rec ounted above are not essential to raising cattle and other animals under extensive conditions, and could theoretically be eliminated, this is far less the case with mutilations called forth by industrial conditions.

Consider modern egg production. Cannibalism can lead to high rates of mortality in battery chickens, and feather-pecking causes injury and loss of thermo-regulatory ability. Ironically, the industry

■ **The front upper beak of this hen was removed with a hot blade. This procedure, done without anaesthesia, was painful and can cause chronic health problems.**

> "It is essential to emphasize that none of these mutilations would be necessary if the animals were raised under the sorts of conditions they were evolved to cope with..."

labels cannibalism and feather-pecking as 'vices,' as if chickens are morally blameworthy for engaging in such behaviour, whereas inappropriate breeding and intensified production has caused that aberrant behaviour. The 'solution' to this set of problems is a mutilation known as 'debeaking' or 'beak trimming', wherein the frontal portion of the upper beak is cut off with a hot blade with no anaesthesia or analgesia. Although beak-trimming, as practiced by the industry does not decrease the incidence of these behaviour patterns, it does render the beak significantly less effective in producing injury (Blokhuis and van der Haar, 1989).

For many years, industry argued that beak-trimming was a benign procedure, no more invasive or hurtful than cutting nails in humans. However, it is now clear that this is not the case and that trimming causes behavioural (Duncan et al., 1989) and neurophysiological changes (Breward and Gentle, 1985) betokening both acute and chronic pain. After hot-blade trimming, damaged nerves in the innervated beak grow randomly and develop into extensive neuromas, known to be painful in both humans and animals. Furthermore, these neuromas show abnormal discharge and neural response patterns known to be indicative of acute and chronic pain syndromes in mammals (Breward and Gentle, 1985). Behavioural and white-cell responses to beak-trimming further evidence this conclusion. There is also evidence that the pain of debeaking may ramify and cause pain during eating, resulting in weight loss.

The meat sector of the poultry industry also engages in mutilations. Male chicks (destined to become broiler breeders) and turkeys (of both sexes) often have a toe amputated in the hatchery to prevent them from injuring other birds. There is evidence that de-toeing, again performed without any anaesthesia or analgesia, causes acute pain (Gentle and Hunter, 1988).

Another mutilation commonly performed in poultry is called 'dubbing' which involves removing the comb on top of a male chicken's head. Again, this is done without anaesthesia in order to prevent later injury to the comb and potential infection. In turkeys, surgical removal of the fleshy protuberance above the beak is known as 'desnooding,' and is again performed without pain control of any kind.

It is essential to emphasize that none of these mutilations would be necessary if the animals were raised under the sorts of conditions they were evolved to cope with (e.g. under extensive circumstances animals can flee more aggressive conspecifics and therefore a practice like debeaking is rendered unnecessary). Humans have raised poultry for thousands of years without resorting to the procedures allegedly necessitated by confinement agriculture.

Mutilations in the Swine Industry

Another area of confined animal production heavily dependent upon mutilation is the swine industry. Young piglets between 1 to 10 days after birth are subjected to a battery of invasive procedures: vaccination, ear-notching for identification (in some cases), teeth-clipping, tail-docking, and castration (if male). As usual, pain control is almost never utilized for these procedures in North America, though parts of Europe are now making it mandatory. Producers often argue that these manipulations are minimally invasive, but common sense tells us otherwise, particularly when all of these procedures are performed at once. There is also abundant evidence that these mutilations are acutely painful (White et al., 1995; Weary et al., 1998; Taylor and Weary, 2000).

"Surgical solutions to human-caused animal problems are not morally acceptable."

Teeth-clipping and tail-docking are management procedures carried out to solve problems brought about by a combination of severe confinement and intensive genetic selection for fast growth. Piglets' deciduous teeth, otherwise known as 'needle teeth,' are clipped in order to prevent the laceration of the sows' udders and abrasion of the faces of other piglets during competition for teats (Fraser, 1975). Tail-docking was virtually unknown before the development of intensive production but is now routinely done without pain control, to prevent tail-biting, a behaviour pattern which generally increases once begun and spreads to biting other parts of the body. A victim of tail-biting gradually ceases to be reactive to being bitten, in something analogous to learned helplessness. Infection often ensues, and can become systemic.

Pigs are very highly motivated to root and forage for food. When they are kept in confinement systems with a lack of substrate to forage in, this behaviour seems to be redirected towards other pigs' tails. Once the chewing of tails causes a bleeding wound, then an attraction to blood causes the behaviour to escalate (Fraser, 1987). Under extensive conditions they have the space to get away from one another. It is only in confinement that tail-biting became a serious problem. The response of producers has been to amputate the distal half of the tail, a surgical solution to a humanly-induced problem arising from keeping the animals in a pathogenic environment. Once again, as mentioned earlier, tail-biting is referred to as a 'vice', as if the pig is bad for tail-biting. Surgical solutions to human-caused animal problems are not morally acceptable. One ought to change the environment to a less pathogenic one, not mutilate the animal. Better husbandry, provision of straw, and alleviating boredom can all reduce tail-biting.

Time to Stop Cruel Mutilations

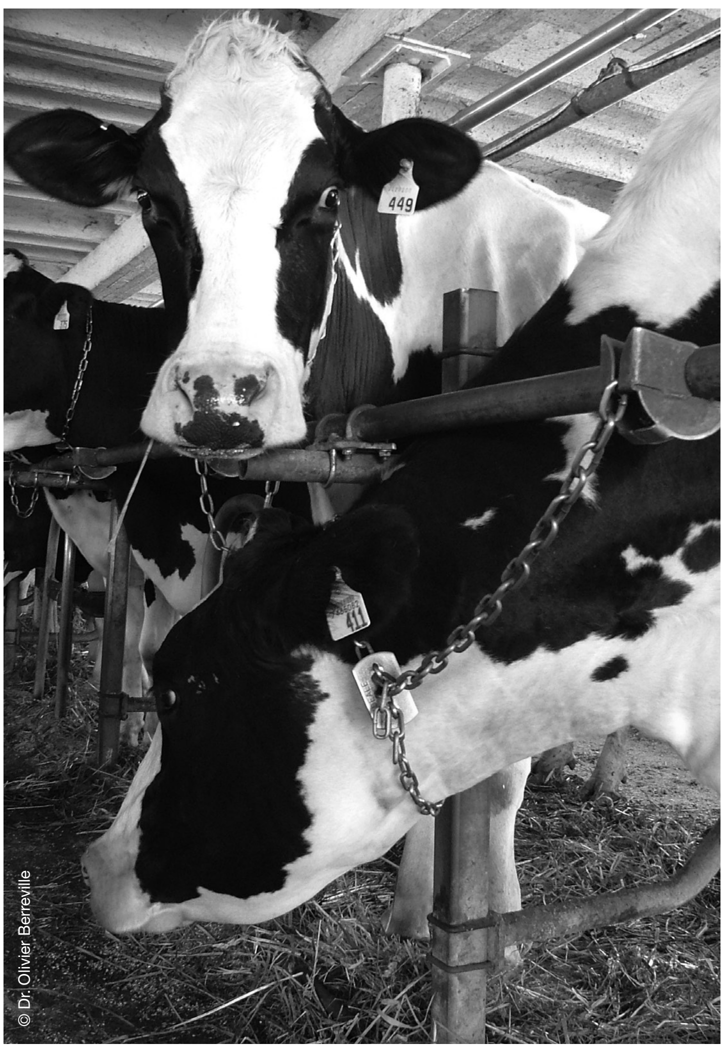
There is solid evidence that all these mutilations cause acute pain. At least one of them (beak trimming) has been shown to cause chronic pain. And yet they are all generally accepted practices in animal production that are not prohibited. If similar practices were carried out on companion animals without appropriate anesthesia, cruelty charges would be laid immediately. It is time for animal agriculture to stop these invasive practices altogether or, when they are considered necessary, then adequate pain cover must be given.

Suffering in Animals Caused by Inappropriate Genetic Selection

In recent years, some farm livestock has been showing signs of genetic problems that reduce welfare. There are a variety of ways in which this can occur, but all of them lead to suffering. They are usually the result of blinkered genetic selection, in which the goal of fast growth, or food conversion efficiency, or high milk production or some other commercial gain has been pursued without considering the total effects on the animal's well-being. These problems will be considered according to the livestock affected.

Beef Cattle

In recent years there have been an increasing number of reports from the beef sector of animals that are unmanageable during handling and transportation. This phenomenon is not well documented but seems to be connected with selection for muscle growth and leanness. In the early 1990s, Temple Grandin noticed an increasing incidence of cattle that were more difficult to contain in her well-designed systems (Grandin, 1994). These animals became extremely agitated while passing through chute systems, often showed blind panic, and sometimes crashed into gates, which gave them the name of 'gate-crashers'. The increase in the incidence of gate-crashers coincided with genetic selection for rapid growth and high lean yield and with the use of bulls of certain European breeds (Grandin and Deesing, 1998). Gate-crashers were also more likely to yield tough meat when slaughtered and be classified as 'dark cutters' (Voisinet et al., 1997). It should be remembered that one or two gate-crashers in a group can adversely affect the welfare of the whole group by creating fear and panic amongst them. Also, one or two gate-crashers can adversely affect the mood of the handlers and this can add to the problem.



■ **Dairy cows chained in a stall in Canadian barn.**

Dairy Cattle

There is evidence that very high-producing dairy cows are at some welfare risk. Webster (1994 pp. 171-178) thinks one of the main risks to welfare is that there may be metabolic hunger due to an imbalance between nutrient supply and demand. There is also an increased incidence of pain due to lameness (Wierenga and Peterse, 1987; Blowey, 1993; Kempson and Logue, 1993) and there is an increased rate of metabolic diseases such as milk fever, ketosis and fatty liver syndrome as well as exhaustion in very high producing dairy cows. Webster (1994) concludes that these animals are 'worn out' by sustained hard work. This syndrome obviously has a profound and very deleterious effect on welfare and greatly shortens the cows' lives. For example, the average life-span of a dairy cow in Ontario is about 3½ lactations (as opposed to 8-10 lactations in a more natural system) and the reasons for this early culling are usually infertility and chronic lameness.

Of course all the decrements to dairy cow welfare described above cannot be laid entirely at the door of the breeders; these problems are a result of complex genotype-environment interactions. However, the fact that they exist and the fact that their incidence seems to be increasing, even with the excellent knowledge we have of management techniques, suggests that genetic selection for even higher production should be curtailed, at least until we develop the skills to manage these cows humanely.

Swine

There have also been reports of an increasing incidence of highly excitable pigs which are very prone to panic and become extremely agitated when subjected to novel stimulation (Grandin and Deesing, 1998). To a large extent, this problem is associated with the Porcine Stress Syndrome trait (PSS) and the Pietrain breed. Unfortunately, PSS is linked with a high lean percentage and large loin eyes (a valuable cut of meat) and was introduced to the North American herd when efforts were being made to increase leanness. The PSS trait is inherited in a simple Mendelian manner; homozygous recessive animals are very excitable and if stressed shortly before slaughter, they yield very low quality meat called Pale Soft Exudative pork (PSE) and, some of them die during transportation. A test for PSS has been available for many years and the gene could be eliminated if desired. For example, it has been estimated that the incidence of PSE in pork in Denmark even as long ago as 1984 was less than five percent (Barton-Gade, 1984). This came about through putting emphasis on meat quality and instituting a program to eliminate the PSS gene. On the other hand, the incidence of PSE is around 16 percent in the United States, where more emphasis is placed on meat quantity (Kauffman et al., 1992).

Another welfare problem in the swine sector that has come about through intense genetic selection, is the extreme hunger that is experienced by breeding sows for a large proportion of their lives. Modern commercial pigs going for slaughter have been selected for huge appetites. This means that the breeding sows also have huge appetites. If they were allowed to feed to satiation, these sows would become obese and reproductively unfit. They are therefore kept very severely food-restricted, to the extent that they are extremely hungry for most of the day throughout the gestation period. It has been shown that it is the combination of this hunger with the impoverished environment of the gestation stall that is largely responsible for the

- **When egg production wanes, 'spent hens' are culled or sent to slaughter. Many suffer feather loss and abrasions from being pecked.**

sows performing stereotyped oral behaviour such as bar-chewing (Appleby and Lawrence, 1987). The conclusion is obvious: we cannot continue to select animals having bigger and bigger appetites when this necessitates keeping the breeding stock severely food restricted. We need to change the genetics.

Laying Hens

A long-standing welfare problem in laying strains of domestic fowl is feather pecking and cannibalism. This has been described above, and is another behavioural problem that has a complex aetiology but with an obvious genetic component (see, for example, Hughes and Duncan, 1972). The evidence suggests that it has hereditary characteristics (Richter, 1954) and that its incidence may have been increased by unintentional genetic selection (Cuthbertson, 1980). The long-term solution to this problem will undoubtedly be a genetic one. Muir and Craig (1998) have shown that it is possible to select against feather pecking using a kin selection method and they have produced a line of birds that shows a very low level of feather pecking when not beak trimmed. The challenge will be to persuade the primary breeding companies to adopt such a procedure.

Meat Poultry

Metabolic diseases associated with fast growth are now a greater problem in the meat poultry sector than are infectious diseases (in that they cause bigger economic losses) (Leeson et al., 1995). The main problems are skeletal disorders in broiler stock and turkeys, ascites in broilers and turkeys, and round heart and aortic rupture in turkeys (Leeson et al., 1995; Julian, 1998). The skeletal disorders cover a whole range of diseases of which tibial dyschondroplasia and chondrodystrophy are probably the most important (Leeson et al., 1995). These are welfare problems as well as production problems because they cause the birds to suffer. For example, broilers with leg problems and gait abnormalities, when given a choice between two feeds one of which contained an analgesic, consumed more of the drugged feed than did broilers with no lameness. Moreover, the walking ability of lame birds was improved by this self-administered treatment (Danbury et al., 2000). In another experiment, the amount of spontaneous movement shown by male turkeys was greatly increased by the administration of a drug that reduces pain and inflammation in arthritic joints. These turkeys were later shown to have degenerative lesions of the hip joints (Duncan et al., 1991). The increasing incidence of fast growth problems such as these, indicates that we are reaching, or have reached, the biological limit of growth in meat strains of poultry. Moreover, there is no evidence that there is an environmental or nutritional solution to these problems. The long-term solution will be a genetic one.

Without doubt, ascites and its related conditions are distressing for the bird, if not actually painful. The cardio-pulmonary class of metabolic disease also suggests that we are reaching the biological limit of growth in meat poultry and that we will not be able to continue selecting for growth without imposing huge costs in terms of suffering on the bird.

The selection for fast growth in broilers has resulted in birds with huge appetites. This large appetite is not a problem for broilers themselves, since they have *ad libitum* access to food. However, broiler breeders, the parent stock that produce broilers, have the same huge appetites as their offspring and have to be maintained on very severe food restriction so that they are able to reproduce. If allowed free access to food, they soon become obese and suffer from all the problems of obesity including low fertility and reduced life expectation (Leeson and Summers, 2000; Renema, 2000). Food restriction is carried out for a very good reason, to keep the birds in good reproductive condition and prevent them becoming obese, a condition which would itself reduce welfare. However, these birds exhibit physiological (Mench, 1991) and behavioral signs (Savory, 1989; Savory and Maros, 1993; Mench and Falcone, 2000) that indicate greatly reduced welfare. It may be possible to alleviate the problem in the short-term by diluting the diet with non-nutritive substances such as cellulose (Zuidhof et al., 1995; Savory et al., 1996). However, in the long-term, parent stock with smaller appetites is the answer. Perhaps when the primary breeding companies realize that they have reached the biological limit and stop selecting for growth rate, then this problem will be resolved.

In conclusion, it can be said that some welfare problems have a substantial genetic component. They are often the result of intensive selection for one trait such as fast growth or lean meat yield. Sometimes they have a more obscure link with breeding practices. When welfare problems are caused by breeding practices, then environmental solutions are likely to be limited.

Conclusion

This section has detailed major and patent sources of suffering for farm animals. Mutilations of the sort we have described are very obviously morally problematic, as they cause patent, significant and sometimes prolonged pain to farm animals. As we have outlined, however, that there are many other ways in which farm animals are harmed that do not involve physical pain. Any violation of the animals’ needs and interests represent other significant sources of harm, sometimes worse than physical pain. It has been suggested that each animal species has an inherent biological and psychological nature which, following Aristotle, has been called telos (Rollin, 1993). This telos should be nurtured and fulfilled in order to protect welfare.

Others have drawn a similar conclusion but, rather than describing an animal’s needs in terms of its nature, they have done so in terms of individual motivational systems (Hughes and Duncan, 1988).

Stud boars and bulls are often socially isolated. Animals are often kept in groupings that make it difficult for a stable social order to exist, [e.g. very large group size (broiler chickens), very crowded (growing pigs), all of one sex (dairy cows), all exactly the same age (growing turkeys)]. Animals are often prevented from engaging in highly-motivated behaviour patterns (hens nesting). They are often stopped from eating what they are naturally built to consume (beef cattle fed concentrates in feed-lots; veal calves fed milk substitute until they reach market weight). The appetitive elements of feeding such as grazing and browsing (dairy cows) and foraging (sows) are often prevented completely. Animals are often denied the opportunity to choose their own micro-climate; they are stuck with what is provided. They are often not allowed normal levels of exercise. Young animals are removed from mothers at unnatural time-points (after a few hours with dairy cows; after a strong bond has formed in the case of beef cattle; much earlier than would occur naturally in the case of sows and piglets). Normal parental ministrations are often grossly interfered with (farrowing crates in the swine industry). Opportunities for play behaviour are destroyed. In addition to all these insults to their welfare on the farm, animals have to endure the frightening and stressful events that take place in the 24 hours before they are killed.

Raising animals for food is a morally-laden activity. Wherein lies the human entitlement to kill animals to satisfy our gustatory predilections? This moral question was historically answered by the ancient contract represented in animal husbandry. The loss of husbandry and its replacement by modern, industrial agriculture has destroyed the fairness implicit in traditional animal agriculture, wherein animals benefited from their relationships with humans. Contemporary intensive agriculture is far closer to patent exploitation than to a fair contract.

A reasonable place to begin restoring common decency to animal agriculture is to end the painful mutilations we have described above. The ancient mutilations we enumerated can, as we indicated, largely be replaced with emerging technological modalities. More problematic are the mutilations upon which confinement agriculture in its current form depends.

As with other industrialized countries, Canada has developed and expanded its animal production sector. Within a North American free market, the methods used to maximise returns are similar to those of other industries (i.e. economies of scale, mechanisation and efficiency savings to reduce overheads and the costs of production). This has resulted in a large industry that provides a secure and cheap source of food. Even though the industry has largely changed from small pastoral farming communities with a traditional and pleasing image (Smithers et al., 2005), there need not be anything inherently wrong, from an animal welfare perspective, with a large-scale agricultural sector. That said, animal welfare research has increased our knowledge and understanding of how food producing animals respond to modern animal production systems. This increased understanding can be valuable in many circumstances, in that it can provide recommendations of best practice that are often synergistic with outcomes such as good economic returns, food safety and food quality. However, animal welfare research has also identified issues that are present in intensive production systems and are not currently addressed in an appropriate manner. These issues are different in nature from the traditional animal welfare concerns, such as cruelty and neglect that are mainly associated with inefficient management and a reduction in performance.

Animal welfare research has shown that some housing systems do not provide an environment for the animals that avoids certain types of suffering and some of the procedures performed upon animals as part of normal management can cause pain and suffering. The Canadian Food and Beverage Industry reassure consumers that they care for animals. They state that (a) “Farmers and food producers regardless of size or production methods, care about the well-being of animals entrusted to their care – their livelihoods depend on it.” and (b) “A combination of government regulations, industry Codes of Practice and On-Farm assessments, ensure best practices are followed.” (Canadian Food and Beverage Industry, 2010). The purpose in writing this report is not to attack the legitimate business of industrial animal production or to suggest that farmers are cruel, but to inform relevant stakeholders (producers, processors, industry bodies, government and consumers) that there are some major concerns over the way in which animals are managed in modern animal production systems. Encouragement of discussion of these issues with industry can be beneficial and provide ways of reconciling economic and societal requirements (Reynnells, 2004; Frewer et al., 2005).

In Europe, animal welfare concerns have been addressed in ways that have not caused economic damage to the agricultural sector. They have largely been addressed by the introduction of industry-based and third party quality assurance schemes that provide consumers with the reassurance that the food that they purchase is from animals that have been managed in a humane manner that avoids unnecessary suffering. There are several examples of the successful development of this type of scheme in North America (Grandin 2006). For example, the Global Animal Partnership (GAP) operates a stepped welfare standards scheme that encourages producers to make continuous improvements to welfare standards (GAP, 2011). Within Canada, the BC SPCA runs an excellent welfare labelling program that now extends well beyond British Columbia. In addition, the National Farm Animal Care Council (NFACC) process of updating the Codes of Practice for the welfare of each type of farmed animal will further assist in the development of these schemes but remains voluntary (National Farm Animal Care Council, 2011). Within an international context, the World Organization for Animal Health (OIE) is developing international standards for on-farm animal welfare and there is the potential for animal welfare issues to increasingly affect international trade.

Some have suggested that we can avoid some of the suffering attendant on intensive agriculture's placing square pegs in round holes by changing animals through the vehicle of biotechnology. It seems to us far more reasonable, based on 10,000 years of husbandry-based agriculture, to raise the bridge, not lower the river. As the Pew Commission Report on Industrial Farm Animal Production (2008) argued, the development of confinement agriculture was largely driven by the values of efficiency, productivity, and cheap food. It is now urgent to reconfigure modern agriculture so as to include those values that were forgotten in the rush to industrialization—preservation of the environment; minimization of agricultural pollution; protection of air and water; preservation of rural communities; prevention of zoonotic disease; assurance of animal health; and, not least, assuring good welfare for the animals we consume.

Policy Recommendations

- Mutilations to farm livestock should be phased out. Alternative solutions are available for many of them. For example, incorporating the poll gene in breeding programs could replace dis-budding and de-horning calves; selecting strains that do not feather peck could replace beak trimming in poultry; marketing male pigs at an earlier age could avoid boar taint and the need to castrate; selecting for short-tailed or bare-tailed sheep could avoid the need to tail-dock; electronic identification methods could replace branding. In cases where there is currently no alternative to surgical intervention, then farm animals should receive similar pain relief as is expected (and required) for companion animals. Agricultural practices involving deliberate infliction of pain should not be exempt from animal welfare legislation.

- The most restrictive of production systems should be phased out. These include battery cages for laying hens, crates for veal calves and gestation crates for sows. All other systems should ensure that animals can live free from intense frustration, fear, discomfort, deprivation, maternal separation, social stress and boredom. In other words, farm animals should be able to live their lives without suffering.

- We must take a long hard look at where our breeding practices are taking us. Too often in the past the focus has been on production factors alone, without considering the wider implications of blinkered selection. The control of breeding strategies is often not in the hands of the producer. In the poultry sector, breeding is controlled by a handful of primary breeding companies who, to date, have selected heavily on production traits and less on general fitness, absence of damaging behaviour, low incidence of metabolic diseases and so on. Pressure must be put on these companies to produce birds that, if given a good environment, can live lives free from suffering. This would mean having breeding stock in the meat sector that did not have to be so severely food-restricted. In the dairy sector, breeding is largely controlled by a few pedigree breeders. Once again, a longer-term view must be taken that goes further than selection for kilograms of milk. The current state of affairs whereby milking cows commonly suffer from a variety of metabolic and infectious diseases such as laminitis, sub-acute rumen acidosis, ketosis, mastitis, and various reproductive disorders which together severely reduce their welfare and curtail their life-spans leading to the average number of lactations in Canada being 2.7. A milking cow should be easily capable of 8-10 lactations, and this should be the aim of the breeders – cows living long happy lives. For all the other sectors of animal production, where breeding policy may be more in the hands of the producers themselves, a strong effort must be made to produce animals that can live their lives in a good environment free from suffering.

References

Anil, L., Anil, S.S. & Deen, J. (2002). Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *J. Am. Vet. Med. Assoc.*, 221, 834-836.

Appleby, M.C. & Lawrence, A.B. (1987). Food restriction as a cause of stereotypic behaviour in tethered gilts. *Anim. Prod.*, 45, 103-111.

Arey, D.S., Petchey, A.M. & Fowler, V.R. (1991). The preparturient behaviour of sows in enriched pens and the effect of pre-formed nests. *Appl. Anim. Behav. Sci.*, 31, 61-68.

Barton-Gade, P. (1984). Influence of Halothane genotype on meat quality in pigs subjected to various pre-slaughter treatments. *Proceedings of the 30th International Congress on Meat Science Technology*, pp. 8-9. Bristol, England.

BC SPCA. (2011). *SPCA Certified*. Retrieved from: www.spca.ca/welfare/farm-animal-welfare/spca-certified/

Benson, G.J. (2004). Pain in farm animals: Nature, recognition and management. In: *The Well-Being of Farm Animals: Challenges and Solutions*. Benson, G.J. and Rollin, B.E. (Eds.), pp. 61-84. Ames, IA: Blackwell Publishing.

Benson, G.J. & Rollin, B.E. (Eds.). (2004). *The Well-Being of Farm Animals: Challenges and Solutions*. Ames, IA: Blackwell Publishing.

Blokhuis, H.J. (1984). Rest in poultry. *Appl. Anim. Behav. Sci.*, 12, 289-303.

Blokhuis, H.J. & van der Haar, J.W. (1989). Effects of floor type during rearing and of beak trimming on ground pecking and feather pecking in laying hens. *Appl. Anim. Behav. Sci.*, 22, 359-369.

Bouissou, M.F., Boissy, A., Le Neindre, P. & Veissier, I. (2001). The social behaviour of cattle. In: *Social Behaviour in Farm Animals*. Keeling, L.J. & Gonyou, H.W.(Eds.) pp. 113-145. Wallingford, Oxon, UK: CAB International

Breward, J. & Gentle, M.J. (1985). Neuroma formation and abnormal afferent nerve discharges after partial beak amputation (beak trimming) in poultry. *Experientia*, 41, 1132-1134.

Brown, J.A., Dewey, C., Delange, C.F.M., Mandell, I.B., Purslow, P.P., Robinson, J.A., ... Widowski, T.M. (2009). Reliability of temperament tests on finishing pigs in group-housing and comparison to social tests. *Appl. Anim. Behav. Sci.*, 118, 28-35.

Canadian Agri-Food Research Council (CARC). (1998). *Recommended Code of Practice for the Care and Handling of Farm Animals: Veal Calves*. CARC, Ottawa, Canada.

Canadian Agri-Food Research Council (CARC). (2003). *Recommended Code of Practice for the Care and Handling of Pullets, Layers and Spent Fowl*. CARC, Ottawa, Canada.

Canadian Food and Beverage Industry. (2010). What we bring to the table. Retrieved from: www.cpepc.ca/documents/FBIndBrochureE.pdf

Canadian Pork Council. (2011). Retrieved from: www.cpc-ccp.com

Command Paper 2836. (1965). *Report of the Technical Committee to Enquire into the Welfare of Animal Kept under Intensive Livestock Husbandry Systems*. Her Majesty's Stationery Office, London.

Coverdale, J.A., Tyler, H.D., Quigley, J.D. & Brumm, J.A. (2004). Effect of various levels of forage and form of diet on rumen development and growth in calves. *J. Dairy Sci.*, 87, 2554-2562.

Cuthbertson, G.J. (1980). Genetic variation in feather-pecking behaviour. *Br. Poult. Sci.*, 21, 447-450.

Danbury, T.C., Weeks, C.A., Chambers, J.P., Waterman-Pearson, A.E. & Kestin, S.C. (2000). Self-selection of the analgesic drug carprofen by lame broiler chickens. *Vet. Rec.*, 146, 307-311.

Dawkins, M.S. (1980). *Animal Suffering*. London, U.K.: Chapman and Hall.

Dawkins, M.S. (1981). Priorities on the cage size and flooring preferences of domestic hens. *Br. Poult. Sci.*, 22: 255-263.

Dawkins, M.S. (1985). Cage height preference and use in battery-kept hens. Vet. Rec., 116, 345-347.

de Passillé, A.M.B., Christopherson, R.J. & Rushen, J. (1993). Nonnutritive sucking and postprandial secretion of insulin, CCK and gastrin by the calf. *Physiol. Behav.*, 54, 1069-1073.

Duncan, I.J.H. (1970). Frustration in the fowl. In B. Freeman & R.F. Gordon (Eds.). *Aspects of Poultry Behaviour*. (pp. 15-31). Edinburgh, U.K.: British Poultry Science.

Duncan, I.J.H. & Kite, V.G. (1987). Some investigations into motivation in the domestic fowl. *Appl. Anim. Behav. Sci.*, 18, 387-388.

Duncan, I.J.H. & Molony, V. (Eds). (1986). *Assessing Pain in Farm Animals*. Commission of the European Communities, Luxembourg.

Duncan, I.J.H., Beatty, E.R., Hocking, P.M. & Duff, S.R.I. (1991). An assessment of pain associated with degenerative hip disorders in adult male turkeys. *Res. Vet. Sci.*, 50, 200-203.

Duncan, I.J.H., Hocking, P.M. & Seawright, E. (1990). Sexual behaviour and fertility in broiler breeder domestic fowl. *Appl. Anim. Behav. Sci.*, 26, 201-213.

Duncan, I.J.H., Rushen, J. & Lawrence, A.B. (1993). Conclusions and implications for animal welfare. In: Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare. A.B. Lawrence and J. Rushen (Eds.) pp. 193-206. Wallingford, U.K.: CAB International.

Duncan, I.J.H., Slee, G.S., Seawright, E. & Breward, J. (1989). Behavioural consequences of partial beak amputation (beak trimming) in poultry. *Br. Poult. Sci.*, 30, 479-488.

Ewing, E.A., Lay, D.C. & von Borell, E. (1999). *Farm Animal Well-Being: Stress Physiology, Animal Behavior, and Environmental Design*. Upper Saddle River, NJ: Prentice Hall.

Faulkner, P. & Weary, D.M. (2000). Reducing pain after dehorning in dairy calves. *J. Dairy Sci.*, 83, 2037-2041.

Fraser, D. (1975). The ‘teat order’ of suckling pigs: II. Fighting during suckling and the effects of clipping the eye teeth. *J. Agric. Sci.* (Camb.), 84, 393-399.

Fraser, D. (1987). Attraction to blood as a factor in tail-biting by pigs. *Appl. Anim. Behav. Sci.*, 17, 61-68.

Fraser, D. & Matthews, L. (1997). Preference and motivation testing. In M.C. Appleby & B.O. Hughes (Eds.) *Animal Welfare* (pp. 159-173). Wallingford, UK: CAB International.

Fregonesi, J.A., Tucker, C.B. & Weary, D.M. (2007). Overstocking reduces lying time in dairy cows. *J. Dairy Sci.*, 90, 3349-3354.

Frewer, L.J., Kole, A., Van De Kroon, S.M.A., & De Lauwere, C. (2005). Consumer attitudes towards the development of animal-friendly husbandry systems. *J. Agric. Environ. Ethics*, 18, 345-367.

Follensbee, M.E., Duncan, I.J.H. & Widowski, T.M. (1992). Quantifying nesting motivation of domestic hens. *J. Anim. Sci.*, 70 (Suppl. 1) p. 50.

Galindo, F. & Broom, D.M. (2000). The relationships between social behaviour of dairy cows and the occurrence of lameness in three herds. *Res. Vet. Sci.*, 69, 75-79.

Gentle, M.J. & Hunter, L.N. (1988). Neural consequences of partial toe amputation in chickens. *Res. Vet. Sci.*, 45, 374-376.

Global Animal Partnership (GAP). (2011). *The 5-Step Program*. Retrieved from: www.globalanimalpartnership.org

Grandin, T. (1994). Solving livestock handling problems. *Vet. Med.*, 89, 989-998.

Grandin, T. (1999). Canadian Animal Welfare Audit of Stunning and Handling in Federal and Provincial Inspected Slaughter Plants. Retrieved from: www.grandin.com/survey/canada.audit.html

Grandin, T. (2003). *Canadian Welfare Audits. 2002 and 2003 Audits of Stunning and Handling in Canadian Federally Inspected Beef, Pork and Chicken Slaughter Plants*. Retrieved from: www.grandin.com/survey/canadian.welfare.audits.html

Grandin, T. (2006). Progress and challenges in animal handling and slaughter in the US. *Appl. Anim. Behav. Sci.*, 100, 129-139.

Grandin, T. (Ed.) (2007a). *Livestock Handling and Transport*. Wallingford, UK: CAB International.

Grandin, T. (2007b). *Interpretation of the American Meat Institute (AMI) Animal Handling Guidelines for auditing the welfare of cattle, pigs, and sheep at slaughter plants*. Retrieved from: www.grandin.com/interpreting.ami.guidelines.html

Grandin, T. (2010). Auditing animal welfare at slaughter plants. *Meat Sci.*, 86, 56-65.

Grandin, T. (2011). *2010 Restaurant Animal Welfare and Humane Slaughter Audits in US Federally Inspected Beef and Pork Slaughter Plants*. Retrieved from: www.grandin.com/survey/2010.restaurant.audits.html

Grandin, T. & Deesing, M.J. (1998). Genetics and animal welfare. In: *Genetics and the Behavior of Domestic Animals*. Grandin, T. (Ed.), pp. 319-346. San Diego, CA: Academic Press.

Gregory, N.G. & Wilkins, L.J. (1989). Broken bones in domestic fowl: Handling and processing damage in end-of-lay battery hens. *Br. Poult. Sci.*, 30, 555-562.

Harrison, R. (1964). *Animal Machines*. London, UK: Vincent Stuart.

Haley, D.B., Bailey, D.W. & Stookey, J.M. (2005). The effects of weaning beef calves in two stages on their behaviour and growth rate. *J. Anim. Sci.*, 83, 2205-2214.

Hughes, B.O. (1975). Spatial preference in the domestic hen. *Br. Vet. J.*, 131, 560-564.

Hughes, B.O. & Duncan, I.J.H. (1972). The influence of strain and environmental factors upon feather pecking and cannibalism in fowls. *Br. Poult. Sci.*, 13, 525-547.

Hughes, B.O. & Duncan, I.J.H. (1988). The notion of ethological 'need', models of motivation, and animal welfare. *Anim. Behav.*, 36, 1696-1707.

Hy-Line International Red Book. (2009). Hy-Line Gray Performance Standards. Retrieved from: www.hyline.com/Redbook/Performance/Gray_All.pdf

International Egg Commission. (2011). *Annual Review 2011*. IEC, London, UK.

Jensen, M.B., Pedersen, L.J. & Munksgaard, L. (2005). The effect of reward duration on demand functions for rest in dairy heifers and lying requirements as measured by demand functions. *Appl. Anim. Behav. Sci.*, 90, 207-217.

Jensen, P. (1986). Observation on the maternal behaviour of free-ranging domestic pigs. *Appl. Anim. Behav. Sci.*, 16, 131-142.

Julian, R.J. (1998). Rapid growth problems: ascites and skeletal deformities in broilers. *Poult. Sci.*, 77, 1773-1780.

Kauffman, R.G., Cassens, R.G., Scherer, A. & Meeker, D.L. (1992). *Variations in Pork Quality*. Des Moines, Iowa: National Pork Producers Council.

Keeling, L.J. & Duncan, I.J.H. (1989). Inter-individual distances and orientation in laying hens housed in groups of three in two different-sized enclosures. *Appl. Anim. Behav. Sci.*, 24, 325-342.

Kempson, S.A. & Logue, D.N. (1993). Ultrastructural observations on hoof horn from dairy cows: changes in the white line during the first lactation. *Vet. Rec.*, 132, 524-527.

Kent, J.E., Molony, V. & Robertson, I.S. (1995). Comparison of the Burdizzo and rubber ring methods for castrating and tail docking lambs. *Vet. Rec.*, 136,192-196.

Kent, J. E., Molony, V. & Graham, M. J. (1998). Comparison of methods for the reduction of acute pain produced by rubber ring castration or tail docking of week old lambs. *Vet. J.*, 155, 39-51.

Lawrence, A.B., Appleby, M.C. & Illius, A.W. (1988). Measuring hunger in the pig using operant conditioning: the effect of food restriction. *Anim. Prod.*, 47, 131-137.

Leeson, S., Diaz, G.J. & Summers, J.D. (1995). *Poultry Metabolic Disorders and Mycotoxins*. Guelph, ON: University Books.

Marchant, J.N. & Broom, D.M. (1996). Effects of dry sow housing conditions on muscle weight and bone strength. *J. Anim. Sci.*, 62,105-113.

Mason, G.J. & Latham, N.R. (2004). Can't stop, won't stop: is stereotypy a reliable animal welfare indicator? *Anim. Welf.*, 13 (Supplement): S57-S69.

McBride, G., Parer, I.P. & Foenander, F. (1969). The social organization and behaviour of the feral domestic fowl. *Anim. Behav. Monographs*, 2, 125-181.

Mench, J.A. (1991). Feed restriction in broiler breeders causes a persistent elevation incorticosterone secretion that is modulated by dietary tryptophan. *Poult. Sci.*, 70, 2547-2550.

Mench, J.A. (1993). Problems associated with broiler breeder management. In C.J. Savory & B.O. Hughes (Eds.) *Proceedings of the Fourth European Symposium on Poultry Welfare*. (pp. 195-207). Universities Federation for Animal Welfare, Potters Bar, UK.

Mench, J.A. & Falcone, C. (2000). Welfare concerns in feed-restricted meat-type poultry parent stocks. In *Proceedings of the 21st World's Poultry Congress* (Paper S3.3.03). World's Poultry Science Association, Montreal, Canada.

Millman, S.T. & Duncan, I.J.H. (2000a). Strain differences in aggressiveness of male domestic fowl in response to a male model. *Appl. Anim. Behav. Sci.*, 66, 217-233.

Millman, S.T. & Duncan, I.J.H. (2000b). Effect of male-to-male aggressiveness and feed-restriction during rearing on sexual behaviour and aggressiveness towards females by male domestic fowl. *Appl. Anim. Behav. Sci.*, 70, 63-82.

Millman, S.T. & Duncan, I.J.H. (2000c). Do female broiler breeder fowl display a preference for broiler breeder or laying strain males in a Y-maze test? *Appl. Anim. Behav. Sci.*, 69, 275-290.

Millman, S.T., Duncan, I.J.H. & Widowski, T.M. (2000). Male broiler breeder fowl display high levels of aggression towards females. *Poult. Sci.*, 79, 1233-1241.

Moffat, L.A. & Duncan, I.J.H. (1999). Effects of food and substrate deprivation on foraging behaviour in laying hens. *Can. J. Anim. Sci.*, 78, 586.

Molony, V., Kent, J.E. & Robertson, I.S. (1995). Assessment of acute and chronic pain after three different methods of castration of calves. *Appl. Anim. Behav. Sci.*, 46, 33-48.

Muir, W.M. & Craig, J.V. (1998). Improving animal well-being through genetic selection. *Poult. Sci.*, 77, 1781-1788.

Munksgaard, L., Jensen, M.B., Pedersen, L.J., Hansen, S.W. & Matthews, L. (2005). Quantifying behavioural priorities – effects of time constraints on behaviour of dairy cows, Bos taurus. *Appl. Anim. Behav. Sci.*, 92, 3-14.

National Farm Animal Care Council (NFACC). (2009). *Code of Practice for the Care and Handling of Dairy Cattle*. NFACC, Ottawa, Canada.

National Farm Animal Care Council (NFACC). (2011). Retrieved from: www.nfacc.ca

Nicol, C.J. (1987a). Effect of cage height and area on the behaviour of hens housed in battery cages. *Br. Poult. Sci.*, 28, 327-335.

Nicol, C.J. (1987b). Behavioural responses of laying hens following a period of spatial restriction. *Anim. Behav.*, 35, 1709-1719.

Nordlund, K.V., Cook, N.B. & Oetzel, G.R. (2004). Investigation strategies for laminitis problem herds. *J. Dairy Sci.*, 87 (E. Suppl.): E27-E35.

Olsson, I.A.S. & Keeling, L.J. (2000). Night-time roosting in laying hens and the effect of thwarting access to perches. *Appl. Anim. Behav. Sci.*, 68, 243-256.

Olsson, I.A.S. & Keeling, L.J. (2002). The push-door for measuring motivation in hens: Laying hens are motivated to perch at night. *Anim. Welfare*, 11, 11-19.

Pedersen, L.J., Jørgensen, E., Heiskanen, T. & Damm, B.I. (2006). Early piglet mortality in loose-housed sows related to sow and piglet behaviour and to the progress of parturition. *Appl. Anim. Behav. Sci.*, 96, 215-232.

Pew Commission on Industrial Farm Animal Production. (2008). Putting Meat on the Table: Industrial Farm Animal Production in America. Pew Commission, Washington, D.C.

Van Putten, G & Elshof, W.Y. (1982). The lying behaviour of veal calves up to 220 kg. In Signoret, J.P. (Eds.), *Welfare and Husbandry of Calves*. (pp. 83-98). Martinus Nijhoff, The Hague.

Reynnells, R.D. (2004). United States Department of Agriculture: building bridges through innovative animal well-being initiatives. *Anim. Welfare*, 13, S175-S180.

Richter, F. (1954). Experiments to ascertain the causes of feather-eating in the domestic fowl. *Proceedings of the 10th World's Poultry Congress*, pp. 258-262. World's Poultry Science Association, Edinburgh, UK.

Rollin, B.E. (1995). *Farm Animal Welfare: Social, Bioethical and Research Issues*. Iowa State Ames, IA: University Press.

Rollin, B.E. (2007). An ethicist's commentary on increased cost of proper shipping. *Can. Vet. J.*, 48, 126.

Sato, S., Wood-Gush, D.G.M. & Wetherill, G. (1984).Observations on crèche behaviour in suckler calves. *Behav. Processes*, 15, 333-343.

Savory, C.J. (1989). Stereotyped behaviour as a coping strategy in restricted-fed broiler breeder stock. In J.M. Faure & A.D. Mills (Eds.), *Proceedings of the Third European Symposium on Poultry Welfare*. (pp. 261-264). French Branch of the World Poultry Science Association, Tours, France.

Savory, C.J. & Maros, K. (1993). Influence of degree of food restriction, age and time of day on behaviour of broiler breeder chickens. *Behav. Proc.*, 29, 179-190.

Savory, C.J., Hocking, P.M., Mann, J.S. & Maxwell, M.H. (1996). Is broiler breeder welfare improved by using qualitative rather than quantitative food restriction to limit growth. Anim. Welfare, 5, 105-127.

Savory, C.J., Wood-Gush, D.G.M. & Duncan, I.J.H. (1978). Feeding behaviour in a population of domestic fowl in the wild. Appl. Anim. Ethol., 4, 1327.

Schwartzkopf, K.S., Stookey, J.M. & Welford, T. (1997). Behavior of cattle during hot-iron and freeze branding and the effects on subsequent handling ease. *J. Anim. Sci.*, 75, 2064-2072.

Schwartzkopf-Genswein, K. (2000). Quality Assurance Practices – Branding. Retrieved from: www.agric.gov.ab.ca/livestock/beef/qa/branding.html

Smithers, J., Joseph, A.E., & Armstrong, M. (2005). Across the divide (?): Reconciling farm and town views of agriculture-community linkages. *J. Rural Stud.* 21, 281-295.

Stolba, A. & Wood-Gush, D.G.M. (1989). The behaviour of pigs in a semi-natural environment. A*nim. Prod.*, 48, 419-425.

Taylor, A.A. & Weary, D.M. (2000). Vocal responses of piglets to castration: identifying procedural sources of pain. *Appl. Anim. Behav. Sci.*, 70, 17-26.

Terlouw, E.M.C., Lawrence, A.B. & Illius, A.W. (1991). Influences of feeding level and physical restriction on development of stereotypies in sows. *Anim. Behav.*, 42, 981-991.

Tucker, C.B., Fraser, D. & Weary, D.M. (2001). Tail docking dairy cattle: effects on cow cleanliness and udder health. *J. Dairy Sci.*, 84, 84-87.

Voisinet, B.D., Grandin, T., O'Connor, S.F., Tatum, J.D. & Deesing, M.J. (1997). Bos indicus cross feedlot cattle with excitable temperaments have tougher meat and a higher incidence of borderline dark cutters. *Meat Sci.*, 46, 367-377.

Watts, C.R. & Stokes, A.W. (1971). The social order of turkeys. *Scientific American*, 224, 112-118.

Weary, D.M., Braithwaite, L.A. & Fraser, D. (1998). Vocal response to pain in piglets. *Appl. Anim. Behav. Sci.*, 56, 161-172.

Webster, J. (1994). *Animal Welfare: A Cool Eye Towards Eden*. Oxford, UK: Blackwell Science.

White, R.G., DeShazer, J.A., Tressler, C.J., Borcher, G.M., Davey, S., Waninge, S., & ...Clemens, E.T. (1995). Vocalization and physiological response of pigs during castration with or without a local anesthetic. *J. Anim. Sci.*, 73, 381-386.

Widowski, T.M. & Duncan, I.J.H. (2000). Working for a dust-bath: Are hens increasing pleasure rather than reducing suffering? *Appl. Anim. Behav. Sci.*, 68, 39-53.

Wiepkema, P.R., van Hellemond, K.K., Roessingh, P. & Romberg, H. (1987). Behaviour and abomasal damage in individual veal calves. *Appl. Anim. Behav. Sci.*, 18, 257-268.

Wierenga. H.K. & Peterse, J. (1987). *Cattle Housing Systems, Lameness and Behaviour*. Martinus Nijhoff, Dordrecht, The Netherlands.

Wood-Gush, D.G.M. (1956). The agonistic and courtship behaviour of the Brown Leghorn cock. *Br. J. Anim. Behav.*, 4, 133-142.

Wood-Gush, D.G.M., Duncan, I.J.H. & Fraser, D. (1975). Social stress and welfare problems in agricultural animals. In Hafez, E.S.E. (Eds.): *The Behaviour of Domestic Animals* (3rd edit.) (pp. 182-200). Baillière Tindall, London.

Wood-Gush, D.G.M., Duncan, I.J.H. & Savory, C.J. (1978). Observations on the social behaviour of domestic fowl in the wild. *Biol. Behav.*, 3, 193-205.

Wood-Gush, D.G.M. & Gilbert, A.B. (1969). Observations on the laying behaviour of hens in battery cages. *Br. Poult. Sci.*, 10, 29-36.

World Organisation for Animal Health (OIE). Retrieved from: http://www.oie.int

Worobec, E.K., Duncan, I.J.H. & Widowski, T.M. (1999). The effects of weaning at 7, 14 and 28 days on piglet behaviour. *Appl. Anim. Behav. Sci.*, 62, 173-182.

Zobell, D.R., Goonewardene, L.A. & Ziegler, K. (1993). Evaluation of the bloodless castration procedure for feedlot bulls. *Can. J. Anim. Sci.*, 73, 967-970.

Zuidhof, M.J., Robinson, F.E., Feddes, J.J.R., Hardin, R.T., Wilson, J.L., McKay, R.I. & Newcombe, M. (1995). The effects of nutrient dilution on the well-being and performance of female broiler breeders. *Poult. Sci.*, 74, 441-456.

Consumer Support for Healthy, Humane and Sustainable Food

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Consumers are increasingly interested in foods that are healthy for them and their communities, and that are produced sustainably and compassionately. These trends are being reflected in consumer surveys, in purchasing decisions, and in support of programs that certify foods as good for health, the environment, and animals. Canadian consumers choose meals partly for price, convenience, availability, and familiarity, but increasingly say they want to consider additional factors of personal and social well-being.

Health is a major concern, including community health issues linked to the environment. The vast majority of Canadians (92 percent) believe their food decisions can reduce their risk of disease and improve long-term health, according to a study for Agriculture and Agri-Food Canada (Decima Research, 2006). Almost three-quarters of Canadians (72 percent) said they'd made recent changes, including dietary ones, to improve their health. Other research shows that consumers are worried about excessive pesticides and antibiotics, and about the health effects of genetically modified (GM) foods including meat from animals raised on GM soy, corn, and other feeds (Serecon, 2005). Such factors are often perceived as affecting both personal and environmental health.

Animal welfare in food production is another rising priority. One 2010 poll commissioned for WSPA showed that almost every Canadian (95 percent) agrees that animal pain and suffering should be reduced as much as possible, even for livestock and farm animals being raised to be slaughtered (Harris/Decima, 2010a). The poll demonstrated that compassionate treatment of animals is important to most Canadians in all demographic groups, both rural and urban, women and men, all ages, in all regions, and across the political spectrum. Though animal welfare is a slightly higher priority for some groups including women, non-hunters and -fishers, and supporters of centre-left political parties, the data showed "a remarkable and consistently high level of concern for animal well-being across all Canadian demographics" (WSPA, 2011). The poll showed that a full 93 percent of Canadians would support laws ensuring that all farm animals are able to lie down, turn around, stretch their limbs and spread their wings. A separate Harris/Decima poll conducted in 2010 for the Vancouver Humane Society showed that the large majority of Canadians are concerned about the treatment of farm animals raised for food, and that almost three-quarters (72 percent) would be willing to pay more for farm animal products certified to humane standards of care by a third party organization (Harris/Decima, 2010b).

The growing popularity of certification programs is also evidence of the trends. Local Food Plus (LFP) is an example. Based in Ontario and now expanding across the country, LFP identifies and rewards producers who meet ethical and environmental standards to reduce pesticides, adhere to animal welfare standards, lower greenhouse gas emissions, add to biodiversity, use fair labour practices, and more. Positive response to LFP reflects a broadening public understanding of the ripple effects of societal food systems and personal consumption habits, according to LFP president Lori Stahlbrand. Having started with 15 certified farmers in 2006, LFP now has about 200 farmers and processors certified across Canada (LFP officials, personal communication, January 2011 and 2012). Also growing in reach and public support is the SPCA Certified program run by the British Columbia Society for the Prevention of Cruelty to Animals (BC SPCA). Their red barn label identifies producers who raise animals humanely for eggs, dairy products, or meat. When launched nine years ago, the program had three farmers certified. Today it has 24. According to program supervisor Alyssa Bell Stoneman, farmers and BC SPCA officials have witnessed a change in public attitudes in a decade. “Consumers now think not just about taste and price, but also about the animals”(A. Bell Stoneman and other BC SPCA staff, personal communication, January 2011 and 2012).

These attitudes are beginning to affect Canadians’ buying habits. Over the past few years consumers have been purchasing more locally-made foods, cage-free eggs, and organic meats and other food products (AAFC, 2010; Guelph Food Panel, 2008; Decima Research, 2006). They continue the trend to eat less red meat, in line with perceptions that it is not as healthy as other meats (Statistics Canada, 2010). Consumers are eating more fruits and vegetables and more meatless meals (Statistics Canada, 2010; Serecon, 2005).

Despite the emerging good intentions, however, Canadians are not always motivated to follow through. Consumers continue to eat large amounts of intensively-farmed meat, and spend much of their dining dollar on conventional meals high in fats, sugar, and salt. These foods tend to have large footprints both ecological and ethical, and contribute to our most pressing health and environmental challenges (Statistics Canada, 2010; FAO, 2006; FAO, 2011).

There are numerous barriers to change, both bottom-up from citizens and top-down from food and agricultural policy. Barriers at the personal level include price and habit. Some consumers resist paying more for better food, and sacrificing what they expect in taste and convenience. Shoppers can be confused by labels, definitions, and seemingly conflicting reports on what are good food choices for personal and social well-being. At the policy level, national and international support for large-scale, export-oriented food systems, including industrial animal agriculture, means grocery shelves and restaurant menus are dominated by processed, factory foods. There are increasing calls from researchers and citizens for a visionary food policy (MacRae, 2011; People’s Food Policy Project, 2011). But for now, small-scale sustainable producers find themselves outside mainstream marketing and distribution systems, making it difficult to deliver good foods to people who want them (Baker et al. 2010). Consumers hoping to eat ethically and ecologically often need to seek out specialty stores, go directly to farmers, and pay more. Consumers today need commitment to find satisfying sustenance.

References

Agriculture and Agri-Food Canada (AAFC). (2010, July). Comparative Consumer Profile, Canada and the United States. Retrieved from: www.ats.agr.gc.ca/info/5645-eng.htm

Baker, L., Campsie, P., & Rabinowicz, K. (2010, June). Menu 2020: Ten Good Food Ideas for Ontario. Metcalf Foundation. Retrieved from: http://metcalffoundation.com/wp-content/uploads/2011/05/menu-2020.pdf

Decima Research. (2006). Demand for Food Products Supporting Health and Wellness 2006. Agriculture and Agri-Food Canada.

FAO. (2011). *World Livestock 2011: Livestock in Food Security*. Rome.

FAO. (2006). *Livestock's Long Shadow: Environmental Issues and Options*. Rome.

Guelph Food Panel. (2008). *Local Food Products: Who Buys Them and Why?* University of Guelph Dept of Food, Agricultural and Resource Economics.

Harris/Decima. (2010a). *WSPA – Humane Treatment of Animals*. This study was commissioned by the World Society for the Protection of Animals (WSPA) and conducted by Harris/Decima from October 26 to November 7, 2010. A total of 1,007 Canadians were surveyed, and the corresponding margin of error is +/-3.1 percent, 19 times out of 20.

Harris/Decima. (2010b). *VHS – Battery Cages*. This study was commissioned by the Vancouver Humane Society (VHS) and conducted by Harris/Decima from November 18 to November 21, 2010. A total of 1,009 Canadians were surveyed, and the corresponding margin of error is +/- 3.1%, 19 times out of 20.

Komirenko, Z., Veeman, M., & Unterschultz, J. (2010). "Do Canadian Consumers Have Concerns about Genetically Modified Animal Feeds?" *AgBioForum*, 13(3): 242-250.

MacRae, R. (2011). A Joined-Up Food Policy for Canada. *J Hunger and Environmental Nutrition*, 6, 424-457.

People's Food Policy Project. (2011) *Resetting the Table: A People's Food Policy for Canada*. Retrieved from: http://foodsecurecanada.org/the-peoples-food-policy-project

Serecon. (2005). *Canadian Food Trends to 2020: A Long Range Consumer Outlook*. Agriculture and Agri-Food Canada.

Statistics Canada. (2010). Food Statistics 2009. (Catalogue no. 21-020-X). Ministry of Industry. Retrieved from: www.statcan.gc.ca/pub/21-020-x/21-020-x2009001-eng.pdf

World Society for the Protection of Animals (WSPA). (2011). *Will Canadians Vote With Their Hearts? A new study commissioned by WSPA reveals Canadians have strong views on animal welfare*. Retrieved from: www.wspa.ca/latestnews/2011/will_canadians_vote_with_their_hearts.aspx

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